

DEPARTMENT OF THE INTERIOR

U.S. GEOLOGICAL SURVEY

United States Earthquakes, 1957

By

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and

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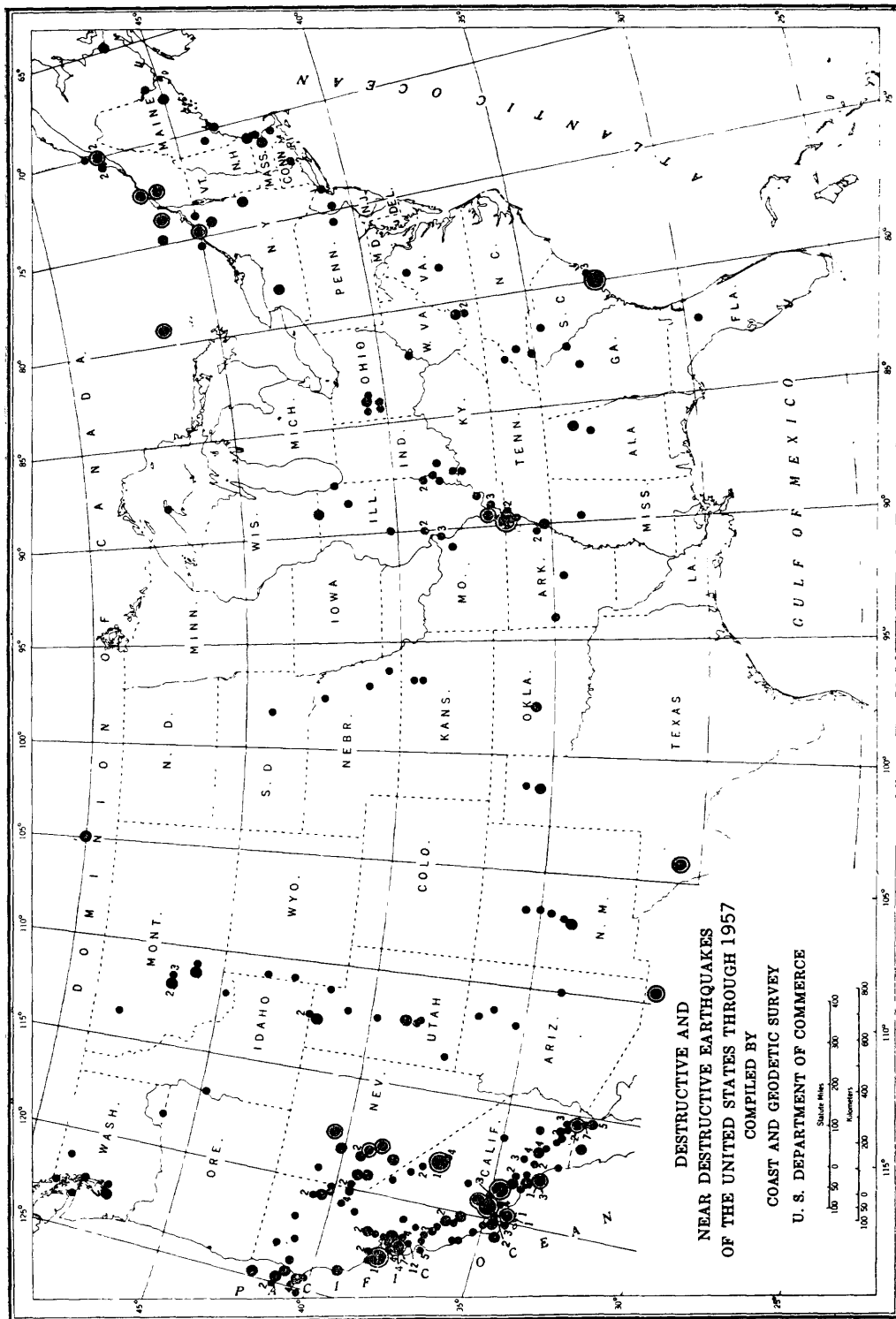


FIGURE 1.—Destructive and near destructive earthquakes in the United States through 1957.

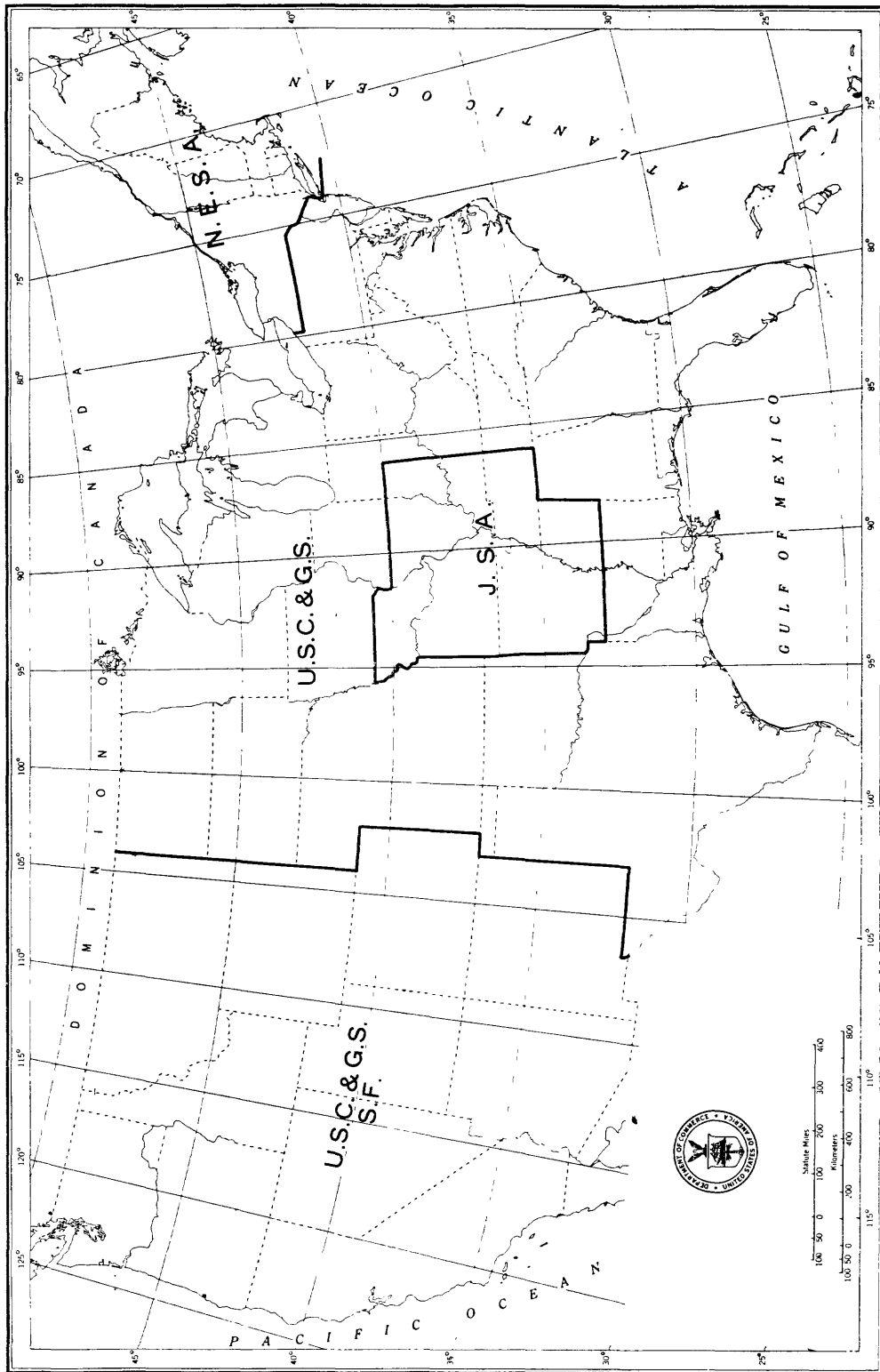


FIGURE 2.—Areas canvassed for earthquake information by various organizations; the United States Coast and Geodetic Survey, the Jesuit Seismological Association, and the Northeastern Seismological Association. The western area is covered by the San Francisco office of the Survey.

UNITED STATES EARTHQUAKES, 1957

INTRODUCTION

This publication is a summary of earthquake activity in the United States and regions under its jurisdiction for the calendar year 1957. The sources of non-instrumental 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 Observatory Summary*; 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 61 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 map the seismic areas of the country adequately 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 1957:

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

Colorado.—Prof. W. Warren Longley, University of Colorado, Boulder.

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 (see fig. 2), the Jesuit Seismological Association with central office at St. Louis University collects information in the central Mississippi Valley area (Rev. Dr. Victor J. Blum, 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. Additional information is furnished regularly by Mr. Berlen C. Moneymaker, Chief Geologist, Tennessee Valley Authority, Knoxville, Tenn., for earthquakes in the State of Tennessee, and Dr. Gerald R. McCarthy, Department of Geology, University of North Carolina, Chapel Hill, N. C., for earthquakes in the State of North Carolina.

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 MERCALI INTENSITY SCALE OF 1931

(ABRIDGED)

- I. Not felt except by a very few under specially 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 structure; **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

¹ Modified Mercalli Intensity Scale of 1931. Harry O. Wood and Frank Neumann, *Bulletin of the Seismological Society of America*, vol. 12, No. 4, December 1931.

- 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 riverbanks 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 1957. The smallest dots indicate 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 dots may be associated with damage ranging from several thousand dollars to one hundred thousand dollars, or to shocks usually perceptible over more than 150,000 square miles (intensity VIII to IX); the smaller encircled dots represent damage ranging from approximately one hundred thousand to one million dollars, or an affected area greater than 500,000 square miles (intensity IX to X); the larger encircled dots represent damage of a million dollars or more, or an affected area usually greater than 1,000,000 square miles (intensity X to XII).

Figure 3 shows earthquake distribution in the United States during 1957. 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 3, 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. 4–13) 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 61 is a list of Survey and cooperating teleseismic stations for which the Survey publishes results. During the year the locations of 1335 epicenters were announced promptly on *Preliminary Determination of Epicenter* 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 1957, MSI-193 through 204 for the monthly bulletins of 1957 were published.

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 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 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 7.

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 1958 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 1958. 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.

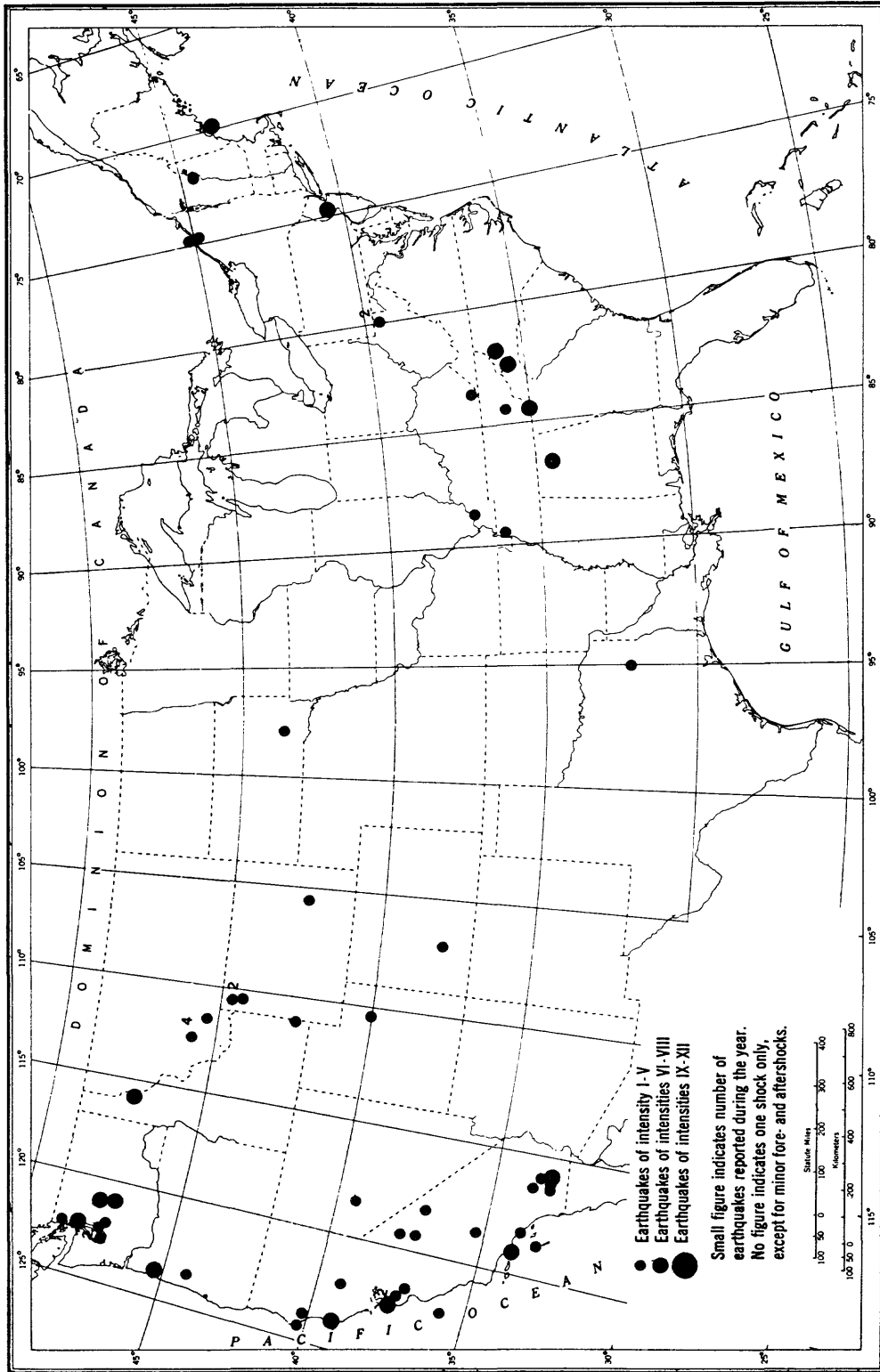


FIGURE 3.—United States earthquake epicenters, 1957.

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; NESAs, 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 Western Mountain Region, MSA series, issued on mailing list CGS-3 by the Coast and Geodetic Survey, Washington 25, D.C.

EARTHQUAKE ACTIVITY IN THE VARIOUS STATES

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

Alabama: April 23, VI.
Arizona: April 25, IV; May 26.
Arkansas: March 19, V.
California: (Intensity V and above) January 24, V; 29, V; 31, V; February 1, V; 6, V; 23, V; March 14, V; 18, V, VI; 22, VII, V (5); 23, VI; 26, V; 27, V; April 7, V; 25, VII; 29, V; May 26, V; June 20, V; 28, V; July 1, V; August 16, V; October 30, VI; 31, V; November 1, V; 20, V.
Colorado: May 3.
Connecticut: April 26, IV.
Georgia: April 23, V.
Idaho: November 3, IV; December 18, VI.
Kentucky: January 25; March 26, V.
Louisiana: March 19, IV.
Maine: April 26, VI.
Massachusetts: April 26, V.
Montana: May 17, V; 18, 25 (2); June 2, IV; 2.
Nevada: March 27, IV; April 25, IV; 26; June 10; October 17, IV.
New Hampshire: April 26, V.
New Jersey: March 23, VI.
New York: February 20, IV; November 30, IV.
North Carolina: May 13, VI; July 2, VI; November 24, V.
Oregon: March 22; November 16, VI.
South Carolina: May 13; November 24.
South Dakota: December 3, IV.
Tennessee: June 23, V; July 2, IV; August 17, IV; November 24, VI.
Texas: March 19, V.
Utah: July 18, IV.
Vermont: April 23, V; 26, IV.
Washington: January 25, VI; February 11, VI; March 14, IV; May 4, V; 29, IV; July 7, IV; October 29, IV; November 1, V; 16.
West Virginia: March 7, 13.
Wyoming: January 5, III; July 7, IV; August 21, IV; September 1, IV.

EARTHQUAKE ACTIVITY OUTSIDE THE UNITED STATES

NOTE.—The intensity of the earthquakes when completely defined are given.

Alaska: March 9, V; 9 (10), 10 (12), 11 (8), 12 (8), 13 (6), 14 (5), 15 (6), 16 (2), 17 (2), 18 (2), 19 (4), 20 (3), 21 (2), 23 (3), 24 (2), 25, 26, 27, 29 (3), 31; April 3 (2), 4, 5, 7, 22, 24, 25 (2), 25 IV; 26, IV; June 1 (2), 6, 12, 18, 22; July 16, 25; August 13, 18, 27; October 4 (2), 11; November 6, IV; 22; December 3, 9, 20.

Hawaii: January 3, 6, 7, 22; February 11, 23; March 13; April 5, 6; May 14, 16, 18, 21; June 5, 9, 20; July 4 (2), 19, 26, 27; August 18, 23 (3), 26; September 5, 14, 29; October 25, 28, 31; November 16, 23, 30.

Panama Canal Zone: February 4; April 8; 28, III; May 10, I; July 10; August 15, IV; October 31, III.

Puerto Rico: October 23; December 27, IV.

NORTHEASTERN REGION

(75TH MERIDIAN OR EASTERN STANDARD TIME)

February 20: 10:45 (about). Massena, N. Y. IV. Felt by many. Houses shook; windows and dishes rattled; overhead light swayed. Rumbling sounds and a rattling bump were reported.

April 23: 19:41:59*. St. Johnsbury, Vt. V. Felt by and alarmed many within a radius of 15 miles. Police switchboards in the area were swamped with calls from residents. Buildings shook; windows and dishes rattled. Many thought there had been an explosion or a plane crash. Felt at Danville, East Barnet, Lyndonville, Passumpsic, Waterford, and West Barnet. Recorded by Weston seismograph.

April 26: 06:40:06*. Epicenter 43.6° north, 69.8° west, near coast of Maine, NESA. Felt over an area of 31,500 square miles of Maine, Massachusetts, New Hampshire, Connecticut, and

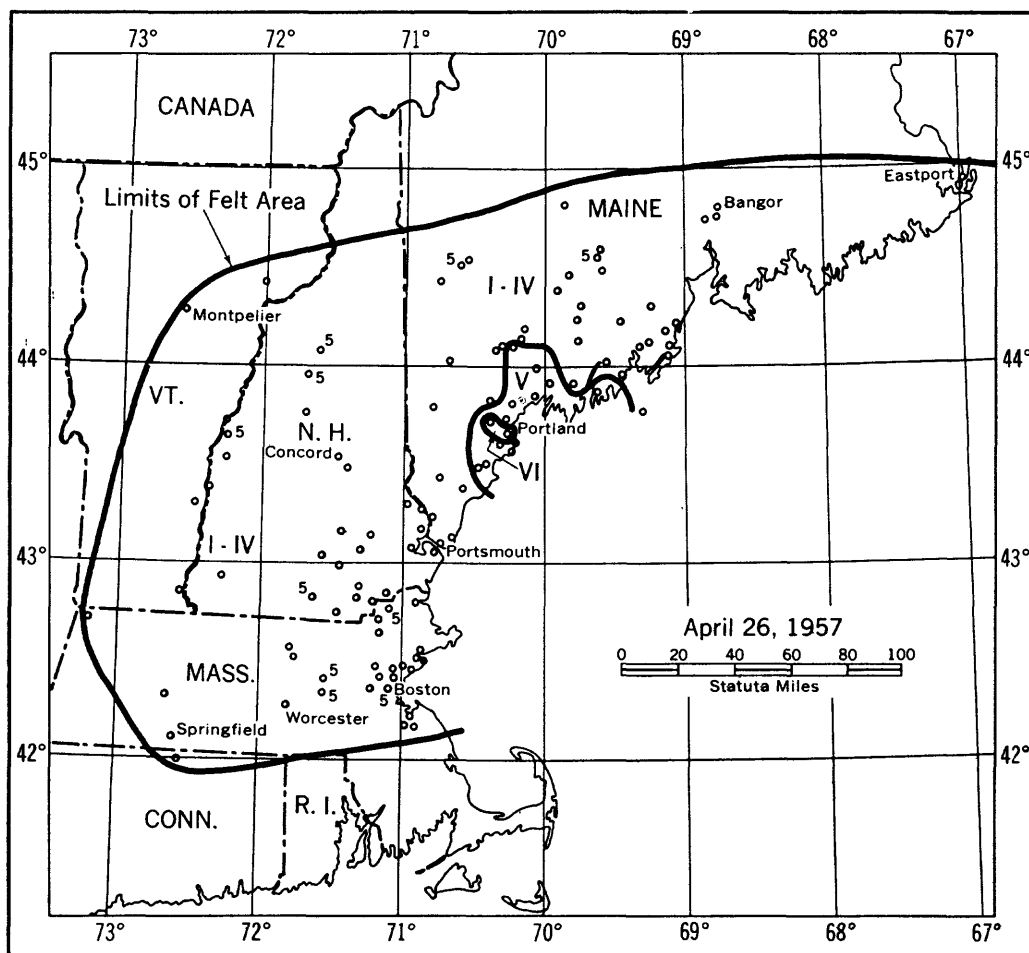


FIGURE 4.—Area affected by earthquake of April 26.

Vermont. (See map, p. 8.) Maximum intensity (damage) VI. Minor damage at Portland and Westbrook, Maine.

INTENSITY (DAMAGE) VI IN MAINE:

Portland.—Felt by all; awakened and frightened many. Few walls cracked; plaster cracked. Canned goods in grocery stores fell to floor; gardening supplies and equipment tumbled from shelves; kitchen utensil fell. Visible swaying of taller buildings reported. Hundreds of calls flooded the switchboards of the police and fire departments, the newspaper offices, radio and television stations, and the office of the U.S. Weather Bureau. The Weather Bureau reported a ¼-inch jog on the station's barogram. A single vertical chop was reported to the Coast Guard by ships at sea to at least 20 miles offshore, with some minor damage to bulkheads, windshields, etc. At Radio Station WJAN the record arm of the turntable was knocked off. The earthquake sent many householders to check on furnaces; others on chimneys. Many more jumped to the conclusion their houses had been hit by a truck.

Westbrook.—Felt by all; many awakened and alarmed. Damage consisted of split chimneys, broken windows and dishes. Merchandise in stores shaken from shelves. Police and radio stations deluged with calls from alarmed residents. Telephone poles and wires swayed. Custodian of church thought the steeple would topple over.

INTENSITY (DAMAGE) V IN MAINE:

Biddeford.—Felt by and awakened many. Houses shook; doors, windows, and dishes rattled. Police switchboards swamped with calls of inquiry from alarmed residents. Thunderous sounds heard.

Boothbay Harbor.—Felt by nearly all; many awakened. Beds shook; windows and dishes rattled. Rumbling like distant thunder or distant train. Many thought the furnace had exploded.

Brunswick.—Felt by and awakened many. Houses vibrated; dishes rattled; coffee spilled from cup. Police switchboards received many calls from householders who had been jolted awake by the vibration and faint rumbling sound accompanying it.

Cumberland Center.—Felt by many. Several grocermen reported canned goods fell from shelves. Houses shook; windows rattled. Figurines in home rattled on mantle.

Falmouth.—Felt by many. Phone shaken from desk.

Freeport.—Felt by nearly all; awakened many. One observer reported the shock nearly shook her out of bed. Furniture shook; dishes and windows rattled; suspended objects swung. The earthquake was accompanied by roaring noise like that of a low flying airplane.

Jefferson.—Felt by nearly all. Books fell from shelves. Buildings creaked; loose objects rattled.

Lewiston.—Felt by and awakened many. Newspaper offices swamped with calls of inquiry from alarmed residents. Windows and pipes rattled; beds shook.

Lisbon Falls.—Felt by nearly all; awakened many; few alarmed. Beds and furniture shook; dishes and windows rattled; bottles on shelves clinked. Rumbling noise like heavy truck or distant thunder.

Rumford Center.—Felt by many; few alarmed. Pictures displaced; water in dish spilled. Buildings creaked; loose objects rattled. Visible swaying of power lines. Moderately, loud roaring sounds heard. Rocking motion.

Saco.—Felt by and awakened many. Police switchboards swamped with calls of inquiry from alarmed residents. Houses shook; doors, windows, and dishes rattled. Thunderous sounds heard.

Scarboro.—Felt by many. Crack in foundation of new home under construction reported.

Waterville.—Felt by and awakened many. Dishes tossed from cupboard in one home. Houses shook; windows and dishes rattled. One observer reported two shocks, one longer than the other. Some thought it was a heavy truck passing, others their furnaces backfiring.

INTENSITY (DAMAGE) V IN MASSACHUSETTS:

Boston.—Felt by, awakened, and alarmed many. Newspaper offices and police station switchboards swamped with calls from frightened residents. Houses rocked; windows and dishes rattled; pictures swayed on walls. Many persons reported they were nearly tossed out of bed. One observer reported the temblor spilled coffee into his lap. The earthquake was accompanied by rumbling, thuds, and growling noises.

Haverhill.—Felt by all; awakened many. Houses shook; windows and doors vibrated; dishes rattled. Two distinct shocks reported.

Hudson.—Felt by and awakened many. Slight damage reported in a garage in the east part of town. A second tremor reported (slight) at 9:30.

Marlboro.—Felt by and awakened many. Houses shook; windows and dishes rattled; pictures swayed.

INTENSITY (DAMAGE) V IN NEW HAMPSHIRE:

Lebanon.—Felt by and awakened many.

Lincoln.—Felt by several. Visible swaying of trees in east to west direction. Buildings creaked; loose objects rattled; furniture moved.

Milford.—Felt by nearly all. Dishes displaced on shelves. Buildings shook. Sounded like heavy train or truck.

Woodstock.—Felt by several. Visible swaying of trees. Buildings creaked; loose objects rattled.

INTENSITY (DAMAGE) IV IN CONNECTICUT: Thompsonville.

INTENSITY (DAMAGE) IV IN MAINE: Appleton, Auburn, Augusta, Bangor, Bath, Belgrade, Brewer, Bridgton, Camden, Cape Cottage, Cornish, Dresden, Eastport, Greene, Hampden, Hampden Highlands, Kennebunk, Minor, Readfield, Rockland, Rockport, Round Pond, Rumford, Sanford, South Thomaston, Thomaston, Waldoboro, Warren, and West Rockport.

INTENSITY (DAMAGE) IV IN MASSACHUSETTS: Andover, Arlington, Braintree, Fitchburg, Lawrence, Leominster, Lexington, Lynn, Lynnfield, Marblehead, Nahant, Newburyport, Newtonville, Northampton, Quincy, Salem, Saugus, Sixteen Acres, Swampscott, Townsend, Wenham, Westminster, Weymouth, and Williamsburg.

INTENSITY (DAMAGE) IV IN NEW HAMPSHIRE: Allentown, Canaan, Candia, Chester, Claremont Junction, Deerfield, Derry, Dover, Gilmanton, Goffstown, Hanover, Keene, Laconia, Manchester, Nashua, Newmarket, North Stratford, Pembroke, Plaistow, Plymouth, Portsmouth, Rochester, Salem, South Cornish, Walpole, and Windham Depot.

INTENSITY (DAMAGE) IV IN VERMONT: Brattleboro and Montpelier.

INTENSITY (DAMAGE) I TO III IN MAINE: Bethel, Cape Elizabeth, Damariscotta, Fairfield, Gardiner, Kittery, Mechanic Falls, Mohegan Island (9 miles off Pemaquid Beach), North Anson, North Vassalboro, Skowhegan, South Berwick, Windham, Yarmouth, and York.

INTENSITY (DAMAGE) I TO III IN MASSACHUSETTS: Allston, Attleboro, Ballardvale, Beverly, Chelsea, Concord, Dedham, Ipswich, Lowell, Malden, Melrose, Needham, Newton, North Andover, Norton, Oxford, Springfield, Tewksbury, Tyngsboro, Williamstown, Wilmington, Winchester, Woburn, and Worcester.

INTENSITY (DAMAGE) I TO III IN NEW HAMPSHIRE: Claremont, Concord, Meriden, Peterboro, and Somersworth.

INTENSITY (DAMAGE) I TO III IN VERMONT: Bloomfield, St. Johnsbury, and Springfield.

November 30: 01:27:52*. Epicenter 45°49' north, 74°44' west, near Cornwall, Ontario, Canada, (Dominion Observatory, Ottawa). Massena, N.Y. IV. Felt by many at Massena where houses creaked; floors trembled. Several observers reported rumbling noise followed by a bump which jarred house. Also felt at Brasher Falls, N.Y.

EASTERN REGION

(75TH MERIDIAN OR EASTERN STANDARD TIME)

January 25: 13:15. Noetown, Ky. Press reported a light earthquake felt generally over Noetown, a suburb of Middlesboro. The shock was not felt in Middlesboro proper.

March 7: 16:05:09*. Morgantown, W. Va. Felt. Recorded by the Morgantown seismograph.

March 13: 16:00:41*. Morgantown, W. Va. Felt. Recorded by the Morgantown seismograph.

March 23: 14:02:31*. West central New Jersey, NESA. VI. Felt by and frightened many at Lebanon, where chimneys cracked; windows and dishes broke; pictures fell. Houses shook; windows and dishes rattled; walls creaked. Trees, bushes shaken slightly. In the vicinity of Hamden one observer reported well curb broken and chimney cracked. At Long Valley felt by and frightened many. Walls and plaster cracked; plaster fell. Windows, doors, and dishes rattled; walls creaked. Trees, bushes shaken slightly.

INTENSITY (DAMAGE) V:

Bedminster.—Felt by and frightened all. Windows, doors, and dishes rattled.

Califon.—Felt by and frightened many. Knickknacks fell; small objects moved; windows rattled.

Hampton.—Felt by and frightened many. Windows, doors, and dishes rattled.
High Bridge.—Felt by and frightened all. Windows, doors, and dishes rattled.
Neshanic Station.—Felt by several. Trees, bushes shaken slightly. Windows rattled.
Pattensburg.—Felt by and awakened one. Knickknacks fell; small objects overturned; windows and dishes rattled.

Pottersville.—Felt by many. Trees, bushes shaken moderately. Windows rattled.

INTENSITY (DAMAGE) IV: Bernardsville, Chester, Clinton, Pittstown, and Whitehouse.

INTENSITY (DAMAGE) I TO III: Branchburg (near Somerville) and Milford.

April 23: 04:23:39*. Epicenter $34\frac{1}{2}^{\circ}$ north, $86\frac{3}{4}^{\circ}$ west, northern Alabama, W. Felt over an area of approximately 11,500 square miles of Alabama and Georgia. (See map, p. 11.) Maximum intensity (damage) VI at Birmingham.

INTENSITY (DAMAGE) VI IN ALABAMA:

Birmingham.—Felt by, awakened, and alarmed many. Minor damage to several chimneys; one report of cement steps cracked in two; and several small cracks in walls. Table-top items tumbled to the floor. Telephone calls jammed switchboards at newspaper offices, police and fire

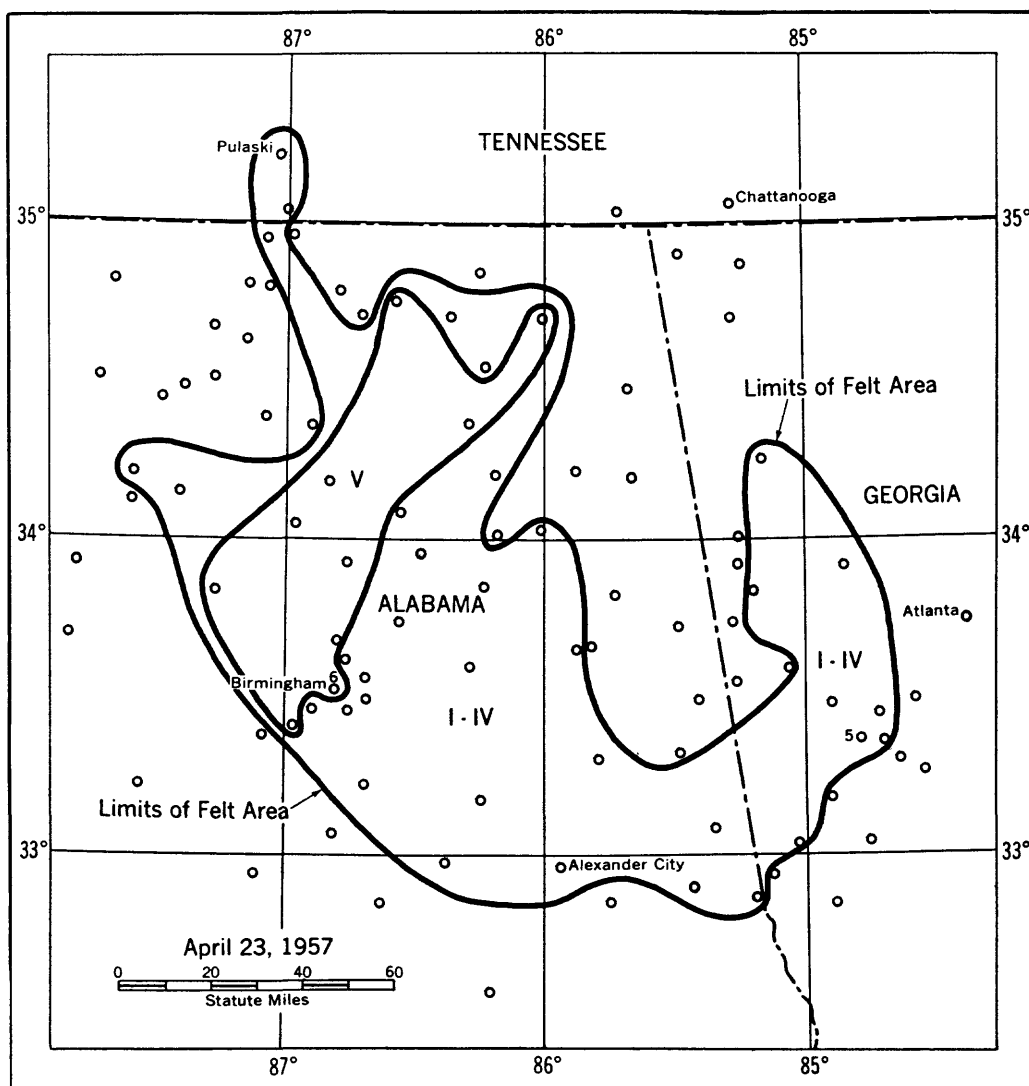


FIGURE 5.—Area affected by earthquake of April 23

stations, and the U.S. Weather Bureau. In a mine 2 miles underground an observer said "It was like something taking hold of you, shaking you hard. It seemed like a mine explosion. The air reversed itself like a rock fall or explosion."

INTENSITY (DAMAGE) V IN ALABAMA:

Bessemer.—Felt by and awakened nearly all; many alarmed. Police switchboards swamped with calls from frightened residents. Buildings shook; loose objects rattled.

Bremen.—Felt by nearly all; many awakened. "From the talk in general, it had the effect of a barrel or something rolling across the house." Buildings creaked; loose objects rattled. Thunderous rolling sounds heard.

Cullman.—Felt by and awakened many. Creaking of buildings and rattling of loose objects heard by many.

Fultondale.—Felt by, awakened, and alarmed many. Buildings creaked; loose objects rattled. Thunderous sounds heard by many.

Garden City.—Felt by, awakened, and alarmed many. Buildings creaked; loose objects rattled. Thunderous sounds heard by many.

Guntersville.—Felt by, awakened, and frightened many. Houses shook. Some people thought it was a tornado.

Hayden.—Felt by and awakened several. Slight crack in plaster wall of one building. Disturbed objects observed by several. Buildings creaked; loose objects rattled. Subterranean (rattling, roaring) sounds heard at beginning of earthquake.

Huntsville.—Felt by and awakened many. Police switchboards swamped with calls from alarmed residents. Many feared there had been an explosion at Redstone Arsenal. Houses shook. Trembling motion.

Jasper.—Felt by, awakened, and alarmed many. Buildings creaked; loose objects rattled. Police switchboards swamped with calls from frightened residents.

Scottsboro.—Felt by and alarmed many. Houses shook; people ran into the streets.

INTENSITY (DAMAGE) V IN GEORGIA:

Newnan.—Felt by, awakened, and alarmed many. Venetian blinds and pictures swayed. Buildings creaked; loose objects rattled. Disturbed objects observed by several.

INTENSITY (DAMAGE) IV IN ALABAMA: Alexander City, Ashville, Athens, Blountsville, Boaz, Clay, Columbiana, Decatur, Double Springs, Gadsden, Gorgas, Grant, Graham, Gurley, Haleyville, Homewood, Hopewell (8 miles east of Heflin), Irondale, LaFayette, Mountain Brook, New Market, Oneonta, Oxford, Pell City, Pinson, Plevna, Roanoke, Sayre, and Tarrant.

INTENSITY (DAMAGE) IV IN GEORGIA: Buchanan, Dallas, Franklin, LaGrange, Rome, and Whitesburg.

INTENSITY (DAMAGE) I TO III IN ALABAMA: Anderson, Ashland, Fairfield, and Lanett.

INTENSITY (DAMAGE) I TO III IN GEORGIA: Forkville, Madras, Raymond, Roscoe, and Rose.

May 13: 09:24:58*. Western North Carolina, W. Felt over an area of 8,100 square miles of western North Carolina. (See map, p. 13.) Maximum intensity (damage) VI.

INTENSITY (DAMAGE) VI IN NORTH CAROLINA:

Micaville.—Felt by nearly all. Plaster cracked. Windows and dishes rattled. Low rumbling sounds heard just before the vibration.

Nebo.—Felt by all and frightened many. One report of cracked plaster. Suspended objects in store rattled and swayed. Loose screen shaken from window. Loud roaring noises; sensation like truck striking building.

Sevier (2 miles north of Woodlawn).—Felt by and frightened all. Loose objects shaken from shelves; dust fell from ceiling. Loud roaring noise heard.

Woodlawn.—Sudden heavy jar like explosion in basement felt at Thread City Service Station. Books fell from school library shelves 5 miles north of village. Sprinkler pipe shaken loose at factory; painters on ladder came down for fear of being shaken off. Loud rumbling noises heard.

INTENSITY (DAMAGE) V IN NORTH CAROLINA:

Ashford.—Felt by and alarmed many. Windows, doors, and dishes rattled; explosive sounds heard.

Bakersville.—Felt by all. Objects swung; windows and dishes rattled. Rumbling sounds heard just before and during earthquake.

Boiling Springs (2 miles south of).—Felt. House quivered and small cracks appeared in the plaster.

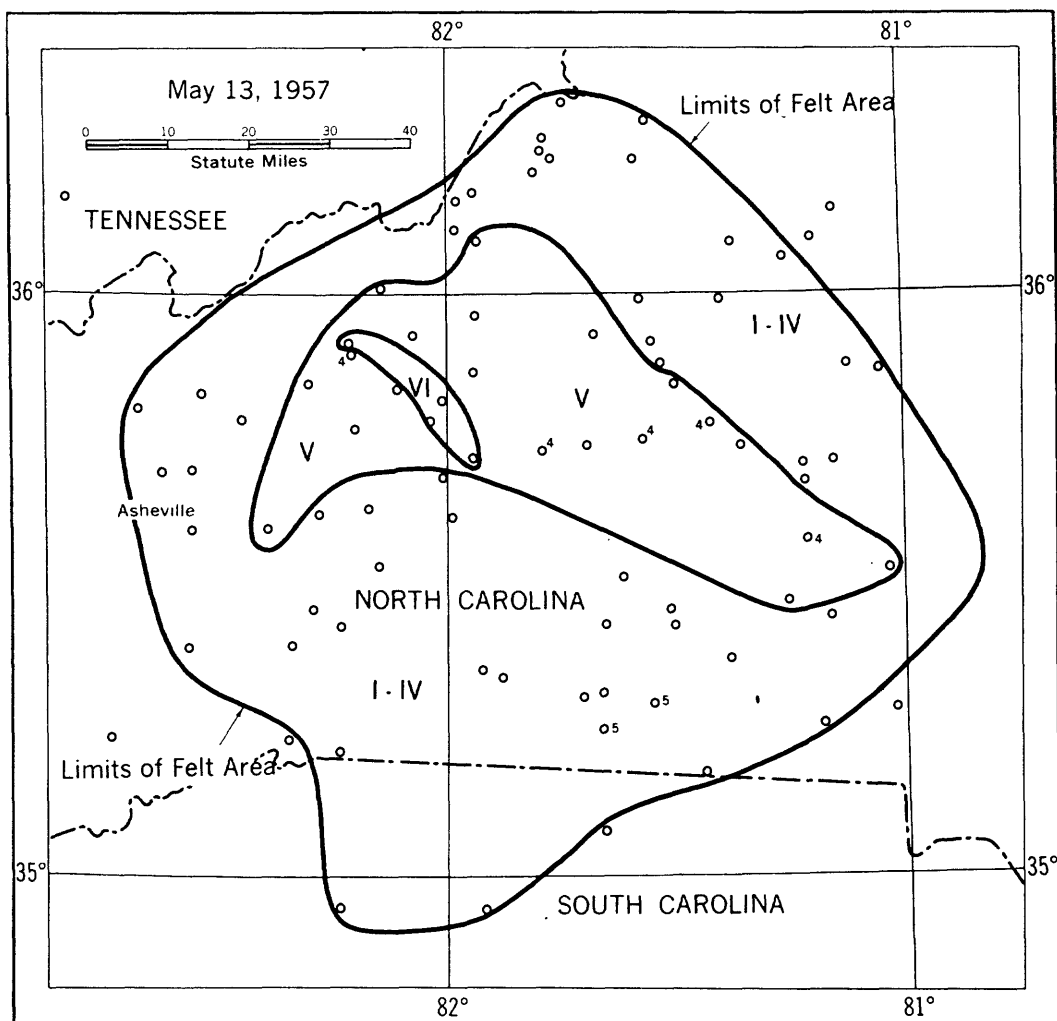


FIGURE 6.—Area affected by earthquake of May 13.

Busick.—Felt by nearly all. Old cracks in wall enlarged. Dishes and windows rattled; scales in grocery store “danced around.”

Collettsville.—Felt by nearly all. Houses creaked; windows and small objects rattled. It sounded as if “some one was rolling a heavy object over the floor.”

Denver.—Felt by nearly all. Windows rattled.

Hickory.—Felt by and frightened many. Windows shook; chinaware “danced” on shelves; and in some instances there was a rumbling sound. Police stations and newspaper office switchboards swamped with calls.

Hudson.—Felt by many; few alarmed. At the new Hudson High School crack noticed in cinder block wall and on the concrete bleachers of football stadium. (The cracks may have existed prior to the earthquake.)

Lincolnton.—Felt by and frightened many. Newspaper offices and police and radio station switchboards swamped with calls. Houses shook; windows and venetian blinds rattled; floors trembled.

Linville Falls.—Felt by and frightened many. House shook.

Little Switzerland.—Felt by all. Houses shook; windows rattled; cans moved on grocery shelves. A deep rumble was heard just prior to the tremor.

Morgantown.—Felt by and frightened many. Houses shook; lamp was knocked from its stand. At the North Carolina School for the Deaf the earthquake was evident by the expression on the students' faces.

Pensacola.—Felt by nearly all; some alarmed. Rumbling noises heard.

Shelby.—Felt by and alarmed many. Houses shook violently. Doors, windows, and dishes rattled; floors vibrated. Doors shaken open and utility cabinet set to rocking.

Spruce Pine.—Felt by and frightened many. People ran from homes and business buildings. A driver abandoned his truck believing "the whole mountain was coming down."

Swannanoa.—Felt by all. Creaking of buildings and rattling of loose objects heard by all. Roaring sounds heard during earthquake.

INTENSITY (DAMAGE) IV IN NORTH CAROLINA: Asheville, Barnardsville, Banner Elk, Bat Cave, Belwood, Boomer, Burnsville, Casar, Cherryville, Claremont, Conover, Deep Gap, Elk Park, Fallston, Ferguson, Forest City, Glen Alpine, Grover, Henry River, Kings Creek, Lake Lure, Lattimore, Lenoir, Maiden, Marion, Marshall, Mars Hill, Minneapolis, Mooresboro, Newland, Newton, Old Fort, Patterson, Plumptree, Polkville, Rhodhiss, Ridgecrest, Stony Point (2 miles west of), Sugar Grove, Sunshine, Taylorsville (3 miles southeast of), Tryon, Valdese, Valle Crucis, Vilas, Weaverville, and Zionville.

INTENSITY (DAMAGE) I TO III IN NORTH CAROLINA: Alexander, Bald Creek (near Burnsville), Baton, Bill's Creek (8 miles northeast of Chimney Rock), Edneyville, Gastonia, Glenwood, Golden Valley, Iron Station, Mountain Home, Sherwood, Spindale, Todd, Whitel, and Woodland (3 to 4 miles north of).

INTENSITY (DAMAGE) I TO III IN SOUTH CAROLINA: Greer and Spartanburg.

June 23: 01:34:18*. Epicenter $36\frac{1}{2}^{\circ}$ north, $84\frac{1}{2}^{\circ}$ west, east central Tennessee, W. V. Felt by and awakened many in the Hardin Valley and Clinch River Valley. Houses shook; windows rattled. Press reported children were almost thrown from beds. Intensity (damage) IV at Concord, Dixie Lee Junction, and Oak Ridge, where windows rattled and few were awakened.

July 2: 04:33:01*. Western North Carolina, W. VI. Felt strongly in Buncombe and Madison counties where minor damage consisting of a few cracked chimneys, cracked walls, and cracked plaster was reported.

INTENSITY (DAMAGE) VI IN NORTH CAROLINA:

Asheville.—Felt by, awakened, and alarmed many. Walls cracked; plaster cracked. Newspapers, radio stations, and police department reported hundreds of calls from frightened residents. Buildings shook; loose objects rattled. Rumbling, rolling sounds ending in a thump.

Marshall.—Felt by, awakened, and alarmed many. Few people ran from homes. One retaining wall cracked. Houses shook; windows and dishes rattled. Extremely loud, thunderous, roaring sounds heard before the earthquake. Disturbed objects observed.

Swannanoa.—Felt by and awakened many; few alarmed. A few chimneys damaged; plaster cracked. Visible swaying of buildings and trees. Buildings creaked; loose objects rattled. Moderately loud, thunderous sounds heard.

Weaverville.—Felt by all; awakened and alarmed many. Plaster cracked. Pictures and mirrors swayed on walls. Dishes, doors, and windows rattled. Thunderous sounds heard by many.

INTENSITY (DAMAGE) V IN NORTH CAROLINA:

Alexander.—Felt by, awakened, and alarmed many. Numerous calls to police and radio stations. Buildings creaked; loose objects rattled. Bed shook. Sounded like heavy dynamite explosion followed by a series of diminishing rumbles.

Barnardsville.—Felt by all; awakened and alarmed many. Houses shook; windows and dishes rattled; walls creaked. Sounded like one big explosion and continuous rumbling roar for about 30 seconds.

Biltmore.—Felt by and awakened many. House and bed vibrated. Sharp, thunderlike clap before earthquake. Vibrations like those of a passing truck.

Canton.—Felt by, awakened, and alarmed many. Buildings shook; loose objects rattled. Roaring sounds heard.

Clyde.—Felt by and awakened nearly all; many alarmed. Trembling motion.

Enka.—Felt by many; several awakened; few alarmed. Slight damage to buildings. Disturbed objects observed by several. Thunderous sounds heard at beginning of the earthquake.

Leicester.—Felt by all; awakened and alarmed many. Buildings shook; loose objects rattled.

Walls creaked; dishes, windows, and doors rattled. Felt like heavy truck striking the house. Thunderous sounds heard.

Montreat.—Felt by and awakened many. Houses creaked; loose objects rattled. Many thought it was thunder—some dynamite.

Mars Hill.—Felt by and awakened many. Windows rattled; sounded like distant explosion.

Morganton.—Felt by and awakened many. Rumbling sounds heard.

Murphy.—Felt by and awakened many. Rumbling sounds heard.

Stocksville.—Felt by and awakened nearly all. Windows rattled. Sounded like sharp clap of thunder or an explosion.

Waterville.—Felt by and awakened nearly all. Dishes and windows rattled. A roaring sound like a high wind was heard and lasted for one or two minutes.

Waynesville.—Felt by and awakened many. Buildings creaked; loose objects rattled.

INTENSITY (DAMAGE) IV IN NORTH CAROLINA: Andrews, Arden, Black Mountain, Candler, Cove Creek (about 6–8 miles from Dellwood, Haywood County), Hendersonville, Ridgecrest, and Skyland.

INTENSITY (DAMAGE) IV IN TENNESSEE: Flag Pond.

INTENSITY (DAMAGE) I TO III IN NORTH CAROLINA: Bat Cave, Brevard, and Lenoir.

November 24: 15:06:17*. Epicenter 35° north, 83½° west, North Carolina-Tennessee border, W. Felt over an area of approximately 4,100 square miles of North Carolina and Tennessee. (See map, p. 15.) Maximum intensity (damage) IV occurred at Hartford, Tenn.

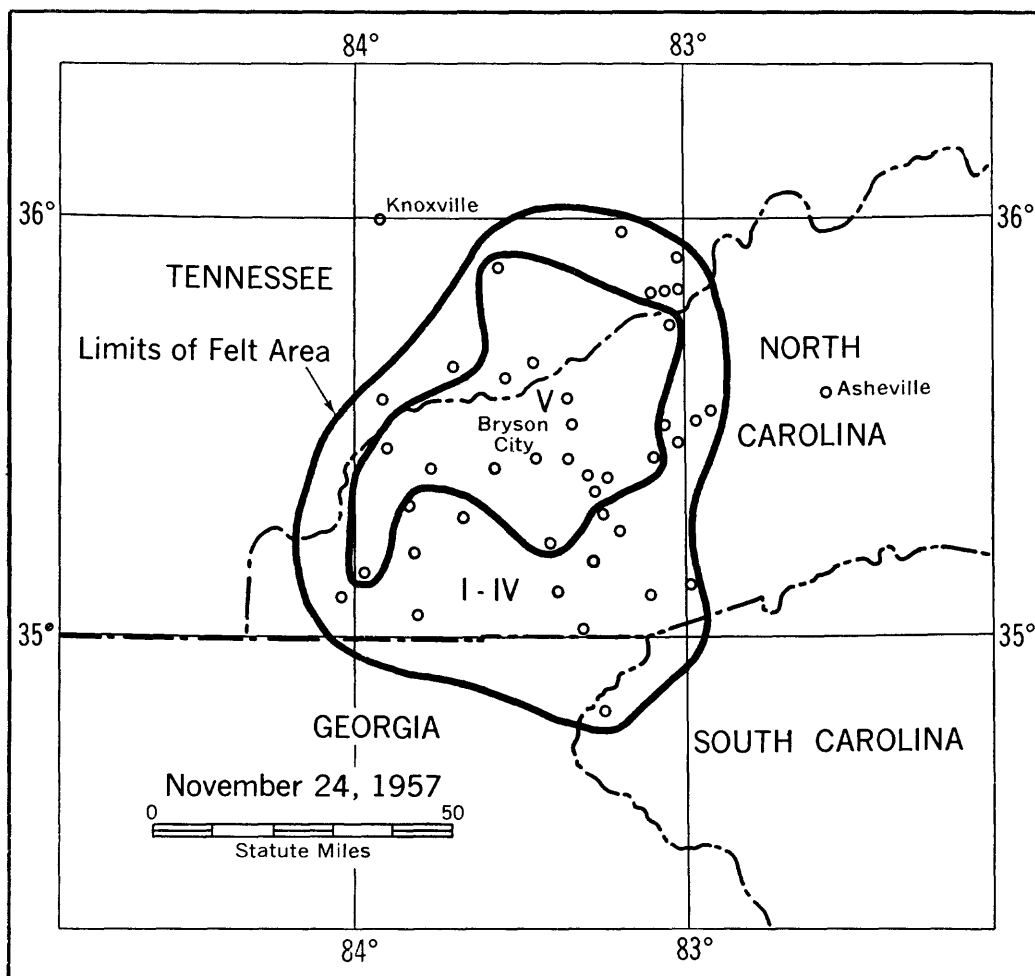


FIGURE 7.—Area affected by earthquake of November 24.

INTENSITY (DAMAGE) VI IN TENNESSEE:

Hartford.—Felt by nearly all; several alarmed. Press reported slight damage to buildings; one report of wall cracked in NE-SW direction. Kitchen separated from rest of house, subsequently flooded by rain. Bottles overturned in showcase. Windows and dishes rattled. Disturbed objects observed by several. Roaring sounds heard.

INTENSITY (DAMAGE) V IN NORTH CAROLINA:

Almond.—Felt by nearly all. Buildings creaked; loose objects rattled. Disturbed objects observed by one. Windows and doors rattled. Whistling sounds heard by several before earthquake. Trembling motion.

Balsam.—Felt by nearly all; many alarmed. Buildings creaked; loose objects rattled. Disturbed objects observed by several. Felt like truck striking building. Roaring sounds heard.

Bryson City.—Felt by and alarmed many. Buildings shook; loose objects rattled. Dishes displaced. Lights and chandeliers swung from ceilings; trees and wires to houses swayed. Sensation of a heavy truck striking house. Sounds like thunder.

Cherokee.—Felt by all; some alarmed. Dishes and pans rattled; furniture moved. Heavy rumbling like thunder.

Dillsboro.—Felt by nearly all. Houses shook; dishes rattled. Low rumbling sounds heard during earthquake.

Fontana Dam.—Felt by nearly all. Houses vibrated; dishes and windows rattled. Noise like distant thunder or dynamite at a distance.

Franklin.—Felt by all. Disturbed objects observed by many. Buildings shook; loose objects rattled. Sounded like rolling thunder. Some reported two shocks.

Marble.—Felt by nearly all. Loose objects rattled; beds moved. Disturbed objects observed by several. Thunderous sounds heard by several. Trembling motion.

Stecoah.—Felt by nearly all; few alarmed. Buildings shook; dishes, pans, and bottles rattled.

Sylva.—Felt by many. Heavy furniture moved; buildings shook; dishes, windows, and doors rattled.

Waterville.—Felt by all. Houses creaked; windows and dishes rattled; venetian blinds beat against window casing. Following the jar there was a noise like rushing wind.

Waynesville.—Felt by nearly all. Windows and dishes rattled. A dull roar and jarring effect, like truck striking building.

Webster.—Felt by nearly all; few alarmed. Dish fell from shelf. Disturbed objects observed by several. Houses creaked; windows and dishes rattled. Sounded as if a plane had passed through the sound barrier. Some reported a sharp cracking noise preceded the rumble.

INTENSITY (DAMAGE) V IN TENNESSEE:

Gatlinburg.—Felt by half the population; few alarmed. One report of cracked window. Houses shook; doors and dishes rattled. Trembling motion. Two shocks felt.

Pittman Center (Sevierville).—Felt by nearly all. Floor of pulpit in church distinctly shaken. Two shocks felt.

INTENSITY (DAMAGE) IV IN NORTH CAROLINA: Andrews, Clyde, Cullowhee, Gneiss, Greens Creek, Hayesville (6 miles from), Hazlewood, Lake Junaluska, Maggie, Murphy, Nantahala, Otto, Qualla (southeast of Cherokee), Robbinsville, Sapphire, Tuckasegee, and Whittier.

INTENSITY (DAMAGE) IV IN TENNESSEE: Cosby and Denton (near Bluffton).

INTENSITY (DAMAGE) I TO III IN NORTH CAROLINA: Bluff Creek, Cashiers, Hayesville, Hayesville (Shooting Creek Section), and Scaly. *Great Smoky Mountains National Park*: Big Creek Ranger Station, Cataloochee, and Smokemont.

INTENSITY (DAMAGE) I TO III IN SOUTH CAROLINA: Longcreek.

INTENSITY (DAMAGE) I TO III IN TENNESSEE: Del Rio, Del Rio (15 miles south of), and Newport. *Great Smoky Mountains National Park*: Alum Cave area, Cades Cove, Cosby Ranger Station, Deconaluttee Ranger Station, Townsend, and Tremont.

CENTRAL REGION

(90TH MERIDIAN OR CENTRAL STANDARD TIME)

March 19: 10:37:38*, 11:41:17*, 16:36, and 16:45. Northeastern Texas. These shocks were felt over an area of approximately 10,100 square miles of northeastern Texas and the bordering States of Arkansas and Louisiana. (See map, p. 17.) Maximum intensity (damage) V. The press reported a few objects upset and at least one or two windows broken. Newspaper:

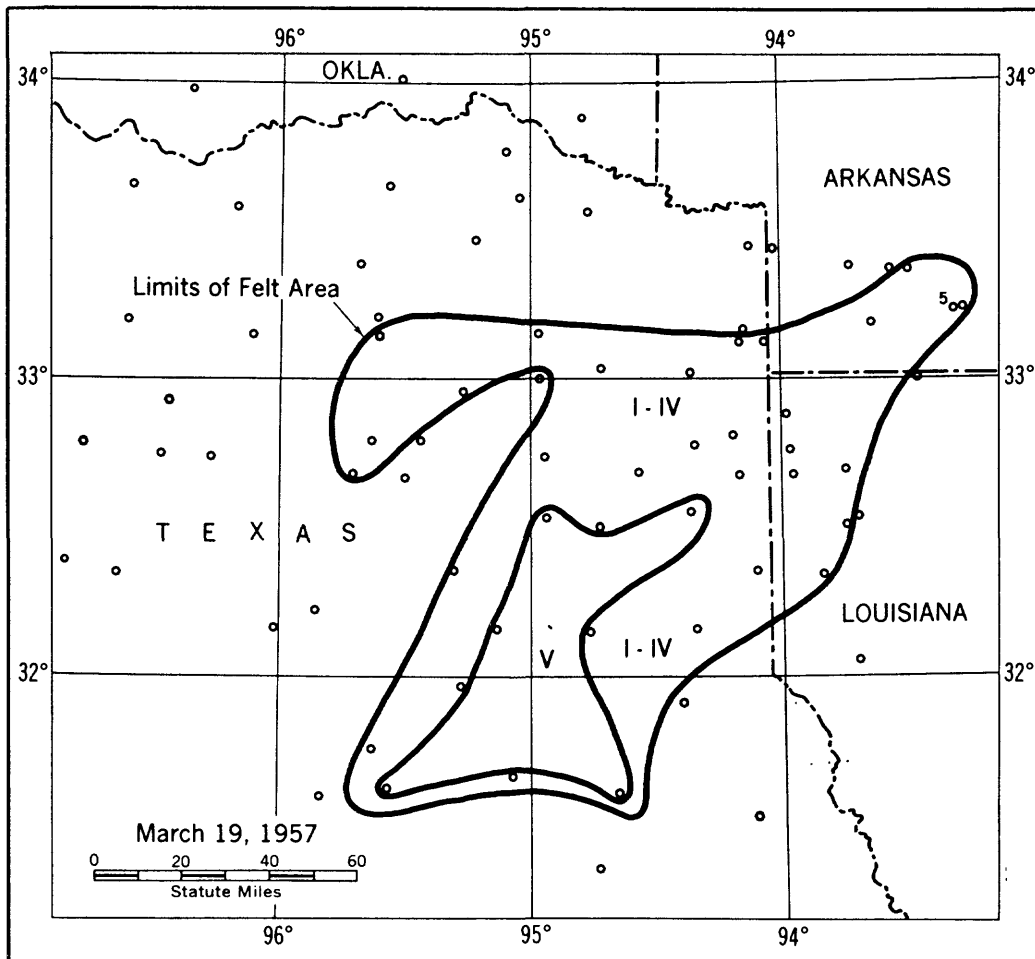


FIGURE 8.—Area affected by earthquake of March 19.

office and police station switchboards were swamped with calls from alarmed residents. The first two shocks were recorded by the Dallas seismograph station.

INTENSITY (DAMAGE) V IN TEXAS:

Diana.—Felt by all; many alarmed. Three shocks. Many calls to newspaper offices. Trees swayed. Disturbed objects observed by many. Creaking of buildings and rattling of loose objects heard by all. Several residents reported the ground trembled.

Elkhart.—Felt by all. One shock. Slight jar.

Gladewater.—Felt by many; few alarmed. Electric clock knocked from wall. Buildings creaked; venetian blinds rattled. Disturbed objects observed by one. Many thought it was an explosion; others, a jet plane breaking the sound barrier. One shock felt.

Marshall.—Felt by many; few alarmed. Four shocks felt. Telephone jolted off cradle; plants fell from ledges. Reports of overturned vases and glasses in a number of homes. Closed door popped open. Houses shook; windows and dishes rattled.

Nacogdoches.—Felt by all. Buildings creaked; loose objects rattled. "Quick tremble like that following a heavy ground explosion."

Troup.—Felt by many. One shock. Small articles jarred from shelves. Buildings creaked; loose objects rattled. Many thought a jet plane had broken the sound barrier.

INTENSITY (DAMAGE) V IN ARKANSAS:

Magnolia.—Felt by several. Figurines shaken from table and smashed on floor. Houses shook. Trembling motion.

Magnolia (2 miles east of).—Felt. Pots and pans fell from kitchen stove. House shook.

INTENSITY (DAMAGE) IV IN ARKANSAS: Canfield and Stamps.

INTENSITY (DAMAGE) IV IN LOUISIANA: Benton, Keithville, Mooringsport, Shreveport, and Vivian.

INTENSITY (DAMAGE) IV IN TEXAS: Atlanta, Bloomburg, Carthage, Gilmer, Grand Saline (3 miles southwest of), Jefferson, Karnack, Linden, Longview, Mount Pleasant, Palestine, and Sulphur Springs.

INTENSITY (DAMAGE) I TO III IN TEXAS: Alba, Alto, Daingerfield, Harleton, Kilgore, Panola, Tyler, and Winnsboro.

March 26: 02:27:06*. Paducah, Ky. V. Felt by and awakened many. Buildings creaked; loose objects rattled. Newspaper and radio switchboards were swamped with calls of inquiry. Most people thought a big explosion had occurred somewhere in the area. Disturbed objects observed by several. Trembling motion. Felt by and awakened several at Smithland, where buildings creaked and loose object rattled. Thunderous sounds heard by several. Recorded by the Saint Louis seismograph.

August 17: (late p.m.). Bogota, Tenn. IV. Felt by many. Buildings shook; windows and dishes rattled; canned goods in stores jolted. Duration several seconds.

December 3: 01:30. Mount Vernon and Mitchell (8 miles northwest of), S. Dak. IV. Felt by and awakened several at Mount Vernon, where buildings creaked and loose objects rattled. At Mitchell (8 miles northwest of), house shook; windows and doors rattled; stock "alarmed and all bunched up."

WESTERN MOUNTAIN REGION

(105TH MERIDIAN OR MOUNTAIN STANDARD TIME)

January 5: 19:00 Esterbrook, Wyo. (about 6 miles north of). III. Felt by several within an area of 36 square miles. Abrupt trembling from southeast. Loud roaring heard by all.

May 3: 01:30. Creede, Colo. Felt at Hermit.

May 17: 10:41:13*. Southwestern Montana, W. V. At Divide, stoves and iceboxes "danced"; objects and chair moved east-west. Children frightened at school. Felt by many and frightened few at Twin Bridges where small objects shifted. Woman sitting in heavy chair said it moved 2 inches. Also felt on many of the ranches in the Twin Bridges area and in Silver Star. Two shocks reported at Iron Rod Bridge; only the one shock reported felt at Twin Bridges. Felt by many at Melrose; felt like house dropped 2 inches and like truck hit north side of house; objects rattled; lamps swung. Felt by several at Glen; windows, doors, and dishes rattled; small objects and furnishings vibrated. Rumbling and explosive noises. Recorded on Butte seismograph.

May 18: 14:58:50*. Melrose, Mont. Described as stronger than shock felt on the 17th. Recorded on Butte seismograph.

May 25: 00:31:04* and 05:57:49*. Melrose, Mont. Sharp, brief shock at 00:31:04. Roaring earth noises accompanied the shocks. Recorded on Butte seismograph.

June 2: 02:00. Melrose, Mont. (1½ miles southwest of). IV. Awakened persons at ranch.

June 2: 04:57:20*. Ennis, Mont. Slight shock felt at Ennis and at Ennis Lake (about 5 miles north of). Shock was stronger north of Ennis. Recorded on Butte seismograph.

July 7: 09:30. Yellowstone National Park, Wyo. (Shoshone Lake Patrol Station). IV. Numerous slight shakes, lasting a few seconds each, accompanied by rumblings, felt during the day and evening. Cabin creaked; stovepipe in cabin rattled during the shocks at 09:30.

July 18: 08:24:20*. Epicenter 40° north, 110½° west, northern Utah, W. Castle. IV. "A slight earthquake broke seals in a coal mine, releasing methane gas that killed three men."—(BSSA, October 1957.)

August 21: 23:40. Yellowstone National Park, Wyo. (Lake Station). IV. Felt by observer indoors and by others outdoors (quiet). Windows, doors, and dishes rattled.

September 1: 03:30. Yellowstone National Park, Wyo. (Norris section). IV. Felt by two sleeping in log house. House creaked; objects rattled.

November 3: 10:38:22*. Epicenter 42½° north, 111° west, southeastern Idaho, W. IV. Felt by several at Geneva. Windows rattled. Felt by three persons at a compressor station about 4 miles west of Georgetown.

December 18: 23:25. Wallace, Idaho. VI. At the Galena Silver Mine (1 mile west of Wallace) timbers fell and some mine walls caved in, but no one was injured. Damage was

"extensive but not heavy." Frightened miners working 3,400 feet underground. A mine official said he believed the disturbance was caused by a slippage of the deep west silver belt that runs through the mine. Awakened all and frightened many at Wallace where small objects shifted and overturned; knickknacks fell. Also felt at Osburn (about 4 miles northwest of Wallace) and Mullan (about 5 miles east of Wallace).

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: 1:25 (a.m. or p.m. not given). Atascadero. "A light rolling earthquake was felt . . ."—(BSSA, April 1957.)

January 12: 15:05:11*, 15:14:30*. Epicenter 36°32' north, 121°27' west, near Gonzales, B. IV. Felt by many 7 miles south of Hollister. Windows rattled during the shock at 15:14:30. Motion slow, lasting a few seconds; direction northeast-southwest.

January 17: 08:53:18*. Epicenter 34°11' north, 116°44' west, southeast of Baldwin Lake, P. IV. Felt by several in home at Fawnskin where doors rattled.

January 19: 03:36. Canyon. IV. Awakened several in home. House creaked.

January 21: 20:15:46*. Epicenter 39.1° north, 122.9° west, Clear Lake, B. IV. Felt over a small area of the Clear Lake region in Lake County. Felt by all at Finley. Awakened and frightened few at Glenhaven. One sharp shock "like a loud thump" felt at Kelseyville. Felt by all at Lucerne; felt like something hit house. At Lakeport felt by many; awakened and frightened few. To observer at Nice it felt like the two-story house would be uprooted and "like we were on top of something about to erupt." Long, rolling, deep motion; loud earth noises from northeast. Reported as severe and of long duration at Scotts Valley. Slight jar felt at Upper Lake and 5 miles east of Lower Lake. Rolling motion felt about 4 minutes after first shock.

January 22: 11:03:10*. Epicenter 39.1° north, 122.9° west, Clear Lake, B. Felt in the Clear Lake area.

January 24: 12:54:49*. Epicenter 33°08' north, 116°23' west, southeast of Palomar, P. V. Felt over an area of approximately 6,000 square miles of Riverside and San Diego counties. Magnitude 4.5. Felt by all at Campo; windows and doors rattled; walls creaked. Small objects overturned at Guatay; loud earth noises from north heard by many. Felt by many or all and frightened few at Pine Valley; dishes rattled; frame creaked. Small objects shifted and loud earth noises heard by many at Ranchita. At San Diego, felt by all and frightened few; windows rattled; walls creaked. Few cans fell from shelves at Warner Springs; roof beams creaked; moderate earth noises from northwest heard 3-4 seconds before shock. Intensity (damage) IV at Alpine, Dulzura, El Cajon, Fallsville, Hemet, Highland, Jamul, Julian, Lakeside, Moreno, Mount Laguna, Palm Springs, Pauma Valley, Potrero, Ramona, San Marcos, Santa Ysabel, and Santee. Also felt at Bostonia, Coronado, Imperial Beach, Laguna Beach, La Quinta, Miramar, Mountain Center, Nuevo, San Clemente, San Jacinto, San Ysidro, and Sorrento.

January 25: 07:07:18*. Epicenter 37.8° north, 118.8° west, northern Owens Valley, P. Long Valley Dam (about 20 miles northwest of Bishop). IV. Rapid motion, lasting about 2 seconds, felt by all in home lying down. Walls creaked.

January 26: 09:37:27*. Epicenter 40°24' north, 124°01' west, near Scotia, B. II. Quiver, lasting about 1 second, felt at Petrolia.

January 29: 13:19:53*. Epicenter 35°52' north, 122°07' west, off coast southwest of Big Sur, B. V. Felt over a land area of approximately 5,000 square miles of the coast region of west-central California. Magnitude 4.9. Felt by many and frightened few at Big Sur. Windows and doors rattled; house creaked. Trees, bushes shaken strongly. Merchandise fell from shelves at Cambria. Felt by all and frightened few at Carmel Valley where observer reported: "One rafter cracked." Felt by all at Harmony, King City, Lucia Lodge (Lucia), and Seaside, where windows, doors, and dishes rattled. At Seaside, some persons thought a large gun had been fired at near-by Fort Ord. Felt by many at Marina where small objects shifted. Intensity (damage) IV at Capitola, Carmel, Cayucos, Chualar, Creston, Greenfield, Jolon, Lone Pine Inn (20 miles west of Coalinga), Moss Landing, Paicines, Paloma Station, Parkfield, Salinas, San Ardo, San Lucas, San Luis Obispo, San Miguel, Tassajara Hot Springs, and Templeton. Also felt

at Aptos, Boulder Creek, Castroville, Cholame, Freedom, Hollister, Morro Bay, Paso Robles, San Francisco, Santa Margarita, and Santa Maria.

January 31: 23:52:15*. Epicenter 33°58' north, 116°20' west, Little San Bernardino Mountains, P. V. Felt over an area of about 3,000 square miles of southern California, principally in Riverside County. Magnitude 4.5. Awakened many and frightened few at Desert Hot Springs. Awakened many at Indio; windows and doors rattled; house creaked. At Joshua Tree, frightened many; pendulum clock stopped. "I was awakened by a sharp jerk which swung my bed like a hammock." Awakened many and frightened few at Thousand Palms where thudding earth noises were heard. Awakened many and frightened few at Twentynine Palms; windows rattled; walls creaked; loud earth noises heard. Intensity (damage) IV at Hemet, Palm Springs, Thermal, and Yucca Valley. Also felt at San Jacinto, Warner Springs, and White Water.

February 1: 03:00. V. Awakened many and frightened all at Twentynine Palms. Hanging objects swung northeast.

February 4: 02:00 (about). Modesto. IV. "A series of earthquakes rattled windows..."—(BSSA, April 1957.)

February 4: 07:15:30*. Epicenter 38°00' north, 122°13' west, north of Berkeley, B. III. Slight shock felt by few in the Berkeley-Oakland area.

February 6: 01:04:32*. Epicenter 34°01' north, 117°17' west, northeast of Riverside, P. V. Many persons in the Fontana area were awakened by a light shock.

February 8: 13:20. "A sharp earthquake was felt on the Monterey Peninsula..."—(BSSA, April 1957.)

February 9: 00:10: Atascadero. IV. Felt by and awakened many; frightened few in home.

February 10: 11:54:47*. Epicenter 33°43' north, 116°30' west, east of Hemet, P. IV. Felt by several in home at Hemet; windows rattled. Moderate north-south motion.

February 14: 05:03:48*. Epicenter 37°25' north, 121°46' west, northeast of San Jose, B. IV. House creaked and bed shook at San Jose.

February 18: 11:05:03*. Epicenter 41.0° north, 124.2° west, off coast west of Crannell, B. Described as slight, sharp, and jolting in the Eureka area.

February 19: 08:30:48*, 08:43:38*. Epicenter 35°16' north, 118°37' west, southeast of Caliente, P. IV. Reported felt in the Bakersfield-Arvin-Tehachapi area. Sharply felt at Tehachapi; motion seemed to rise, twist, then drop with a jar. Buildings creaked. Motion jerking at 08:43:38. Both shocks felt at Woodford. Shock at 08:30:48 felt at Cliff.

February 23: 12:44:45*. Epicenter 32.8° north, 115.7° west, west of El Centro, P. V. "An earthquake . . . rattled windows, broke dishes, and did other minor damage in El Centro and Brawley."—(BSSA, July 1957.)

March 3: 16:07:40*. Epicenter 37°22' north, 121°46' west, east of San Jose, B. Slightly felt in the San Jose area.

March 8: 05:24:27*. Epicenter 35°43' north, 117°30' west, southeast of China Lake, P. IV. People awakened at China Lake. Abrupt, twisting motion felt by many at Trona.

March 13: 13:50:57*. Epicenter 40.7° north, 123.9° west, east of Falk, B. Slightly felt at Eureka.

March 14: 11:27:42*. Epicenter 40°16' north, 123°50' west, north of Miranda, B. V. Merchandise fell from store shelves in Rio Dell. Felt by all and frightened few in office building at Fortuna; doors rattled; partitions and ceiling creaked. Rapid, heavy settling motion. Felt by many at Eureka where buildings creaked; loose objects rattled. At Petrolia, felt by some outdoors (active); windows, doors, and dishes rattled.

March 18: 01:55:28*. Epicenter 33°46' north, 118°04' west, east of Long Beach, P. V. Felt by and awakened many at Long Beach. One rapid, blastlike jolt. Particularly noticeable in the Belmont Shore District. Awakened few at Bellflower; windows rattled. People awakened at Midway City. Also felt at Huntington Beach.

March 18: 10:56:28*. Epicenter 34°06' north, 119°10' west, south of Oxnard, P. VI. Felt over a land area of approximately 3,000 square miles of southern California, principally in Ventura County. (See map, page 21.) Magnitude 5. Minor damage occurred at Oxnard, Port Hueneme, and Ventura.

INTENSITY (DAMAGE) VI:

Montalvo.—Felt by and frightened many or all. Damage slight. Dishes broken. Small objects shifted; vases overturned.

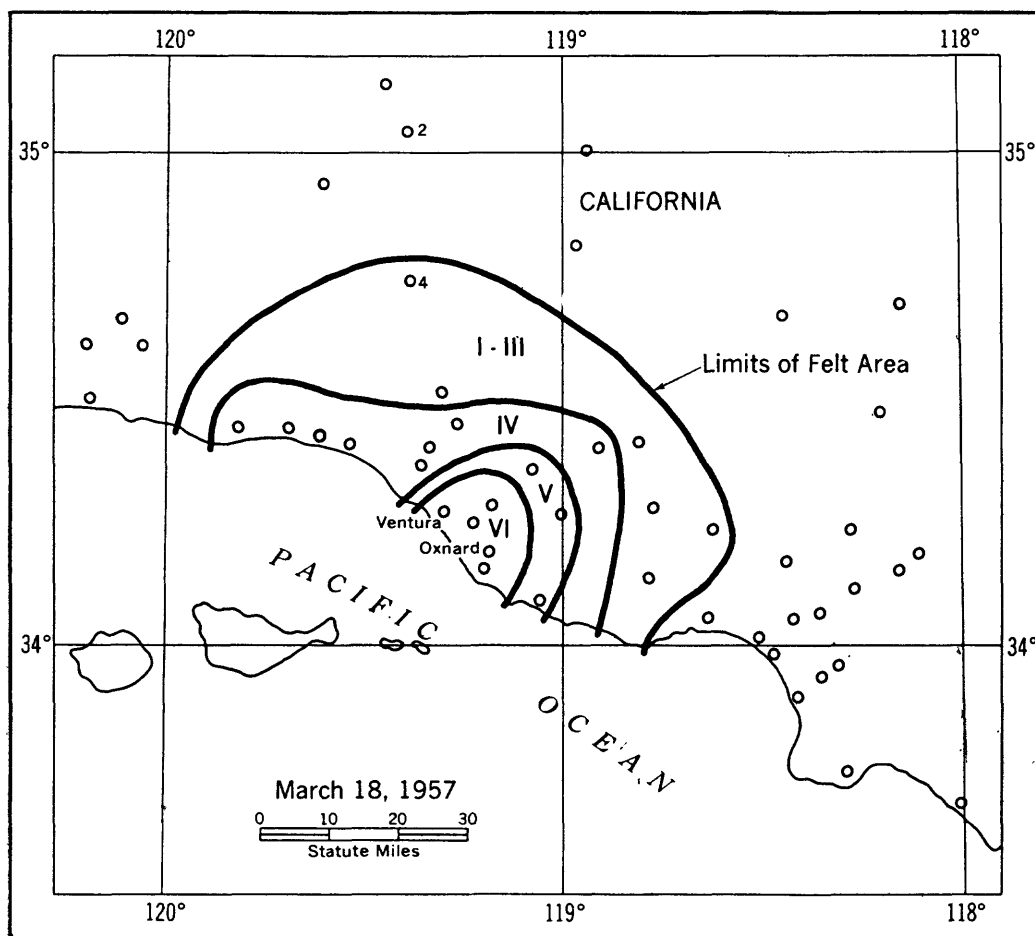


FIGURE 9.—Area affected by earthquake of March 18.

Oxnard.—Heaviest damage occurred in Oxnard. Damage extensive to old Masonic Temple. Building attached to the Temple (on south side) was broken loose by snapping of steel ties. Interior and exterior walls were cracked and bricks fell at the church. Plaster cracked, bricks fell, and windows broke at several other locations. Several pipes broke at the American Crystal Sugar Co. and two steel I-beams (portion of roof truss) pulled away from brick wall and fell to floor. Large quantity of merchandise fell in stores; some loss from breakage. Dishes broke; knickknacks, books, pictures fell.

Port Hueneme.—Felt by all; frightened many; some ran from homes. Full-length crack in exterior wall at First National Bank Building. Fluorescent light fixtures fell in furniture store. Food markets had heavy damage from breakage. Felt by and frightened all at the Navy Base; slight damage to tilt-up concrete wall.

Saticoy.—Wall cracked. Small objects and furnishings shifted.

Ventura.—Felt by all and frightened few in community. Cracks reported in three school buildings. Brick chimney damaged on old building. Some plaster fell; windows and dishes broke. Groceries and books fell from shelves at many places.

INTENSITY (DAMAGE) v: Point Mugu (Naval Air Missile Test Center), Santa Paula, and Somis.

INTENSITY (DAMAGE) IV: Carpinteria, Fillmore, Goleta, Oak View, Ojai, Santa Barbara, Summerland, and Wheatley Ranch (about 15 miles southeast of Ventucopa).

INTENSITY (DAMAGE) I TO III: Chatsworth, Maricopa, Moorpark, and Piru.

March 21: 00:34. San Diego. Rapid motion felt by observer in home.

March 21: 06:15. Oxnard. II. Abrupt, rocking motion felt by several at American Crystal Sugar Company.

March 22: 08:38:01*. Epicenter 37°41' north, 122°29' west, west of Colma, B. Foreshock of the March 22 earthquake at 11:44:21*. San Francisco-Daly City areas. IV. Sharp jolting, of alarming intensity and accompanied by loud, explosive earth noises, in southwest San Francisco area. Awakened person on 6th floor of building in the downtown area. Also felt in Daly City and San Bruno.

March 22: 10:18. San Bruno. IV. Sharp jolt. Felt like house was hit by heavy object.

March 22: 10:48:23*. Epicenter 37°40' north, 122°28' west, southwest of Colma, B. Fore-shock of the March 22 earthquake at 11:44:21*. Magnitude 3.8. V. Strong twisting and jolting motion, accompanied by loud earth noises, alarmed many in the San Francisco-Daly City areas. In downtown San Francisco ceiling plaster cracked in hotel. Small objects shifted. Frightened few at Oakland; windows, doors, and dishes rattled. Also felt in Berkeley, Hollister (7 miles south of), Kentfield (Marin County), and Santa Cruz.

March 22: 11:44:21*. Epicenter 37°40' north, 122°29' west, east of Mussel Rock, B. Main shock of the March 22d series. Magnitude 5.3. Strongest shock felt in the San Francisco Bay area since 1906. Felt over an area of approximately 12,000 square miles. (See map, page 23.) Maximum intensity (damage) VII. About 40 minor injuries reported. Overall damage was estimated at about one million dollars. State Highway No. 1, near Mussel Rock, was blocked by one of several landslides, and highway pavement extensively cracked. Structural damage in several dwellings occurred in the Westlake Palisades tract west of Daly City and a large reinforced concrete water reservoir cracked. Minor building and dwelling damage occurred in San Francisco, consisting mainly of cracked plaster and broken windows. Road pavement along the edge of Lake Merced sloughed off into the lake and a 200-foot-long pedestrian bridge collapsed. Hundreds of plumbing installations were damaged, many requiring replacement. Many gas supply lines damaged. Numerous brick chimneys damaged at Daly City; about 40 pulled down by Fire Department. At the Colma cemeteries some headstones fell and many were twisted. All strong-motion seismographs in San Francisco, San Jose, Martinez and Oakland were operated by this shock.

INTENSITY (DAMAGE) VII:

Colma.—Felt by all; many very frightened. At the cemeteries headstones fell and many were twisted. The movement of monuments in some sections of this cemetery reflect the possibility that there was more than one type of earth motion. Some monuments were turned as much as 45° on a vertical axis on their stone base but were not dislodged, while others were moved on their base as much as 6 inches in a westerly direction. Other monuments were toppled from the base. Retaining wall shifted 3 inches toward east. Walls and plaster cracked. Furniture and dishes broke; heavy furniture moved 1–2 inches.

Daly City, Westlake, and Westlake Palisades areas.—Estimates of damage were: personal belongings, \$400,000; homes in Westlake Palisades, \$62,500; Westlake Shopping Center, \$69,000. Of the 4,000 homes in the Westlake and Westlake Palisades areas, 200 were damaged, 20 seriously. Minor damage to several schools. The Westlake Reservoir, 1,600,000-gallon, 175 feet long, 108 feet wide, 23 feet deep (half submerged in the ground) had a 4-foot-long crack on one side extending upward from the ground. Forty-four brick chimneys were pulled down by the Fire Department in the Daly City areas and many more were probably damaged.

Mussel Rock, near (on State Highway No. 1).—Landslides (loosely consolidated sandstone and sand) completely blocked the road at Thornton Bluffs and highway was extensively cracked along shoulder. Two automobiles were partially buried by the slide. This was reported to be the worst of ten slides between Edgemar and Westlake. Estimated cost of removing dirt and repairing road was \$100,000.

San Bruno area.—At the San Francisco International Airport there were underground pipe leaks and breaks in at least six locations; damage to concrete walls and roof bracing of one hangar. Gas main broke in Rollingwood tract. House twisted and moved about ½ inch on foundation. Some ground breakage reported. Sidewalks and exterior stucco wall cracked; chimneys damaged; windows and plumbing broken. Minor damage to several schools; marked damage to plaster walls at the Parkside School, with considerable movement of precast concrete units indicated. Heavy furniture moved and overturned. Much merchandise fell in store.

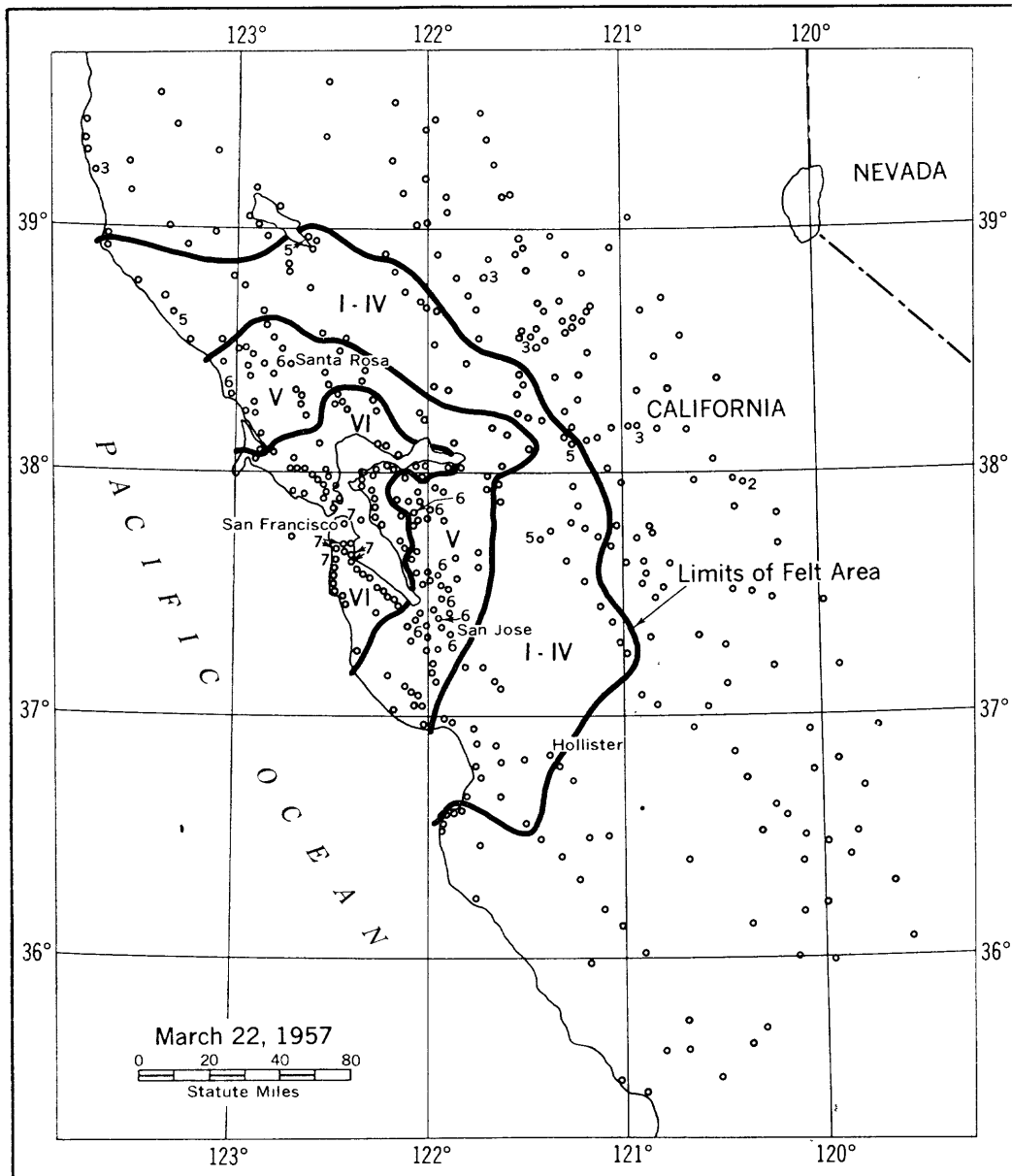


FIGURE 10.—Area affected by earthquake of March 22.

San Francisco.—Very strongly felt; many very frightened; many left downtown office buildings. In the southwest section of San Francisco the highway (on unconsolidated soil and fill) skirting the south edge of Lake Merced cracked and sloughed off into the lake. Harding Park access road damaged and sewer and gas lines to the Harding Park Golf Course broken. Both ends of a 200-foot-long pedestrian bridge collapsed. Extensive plumbing damage. Glass broke in more than 400 street lights. Approximately 1,100 reports were received from all sections of San Francisco, with about 650 reporting some type of damage, principally cracked plaster, broken windows, and damage to fallen objects. The State Division of Architecture reported: "With the exception of two schools, Presidio Junior High and Sheridan, where the chimneys suffered some damage, and the San Francisco City College, where some ceramic facing tiles fell off, all damage

observed consisted of cracked plaster on furred walls and fallen portions of plastered ceilings, particularly in buildings having wood lath. It can be generally stated that schools built prior to the Field Act suffered greater damage than those built after 1933. Most of the modern schools went through the earthquake practically unscathed." Many heavy objects such as stoves, refrigerators, pianos, bookcases, etc., shifted. Motorists on the Bayshore Highway said cars were shaken with a shuddering, sidewise motion.

Sharp Park area.—Felt by and frightened all. Plaster, windows, walls, chimneys, and ground cracked. Objects and furnishings shifted and broke.

INTENSITY (DAMAGE) VI:

Agnew.—Felt by all and frightened many in community. Damage slight. Plaster cracked. Small objects shifted.

Alameda.—Generally felt. Damage slight. Front and flooring of brick fireplace cracked and moved $\frac{1}{2}$ inch from wall. Plaster cracked; windows broke. Trees, bushes shaken strongly. Small objects and furnishings shifted.

Albany.—Felt by many (some outdoors; active); frightened few in community. Damage slight. Plaster cracked. Separation crack between chimney and house. Cracks widened. Small objects shifted; knickknacks and pictures fell.

Associated.—Felt by all at Tidewater Associated Oil Refinery; frightened many in community. Small objects shifted and overturned; knickknacks fell.

Atherton.—Felt by and frightened many in community. Water in some swimming pools splashed like large waves. Very decided sidewise motion.

Bayshore City (about 4 miles east of Daly City).—Felt by many or all. Few dishes broken.

Belmont.—Felt by all in community. Small objects and furnishings shifted and overturned.

Belvedere.—Felt by all and frightened many in community. Slight plaster cracking and slight cracks in concrete patio. Small objects shifted. Trees, bushes shaken strongly.

Benicia.—Frightened all in community. Water bottle rocked north-south. House rocked.

Berkeley.—Generally felt over the Berkeley area; frightened many. Principal damage reported was cracked plaster. Some tile and windows cracked. Slight damage to brick and masonry of garden wall. Small objects and furnishings shifted; 2-ton press jumped. Fisherman knocked down on pier $1\frac{1}{2}$ miles out in bay. No damage was found in the Berkeley schools.

Bodega Bay.—Felt by all; frightened many in community. Small objects shifted; books fell.

Bolinas.—Frightened all in community. Severely felt. Food market in shambles from fallen merchandise. Glass knickknacks and antiques broken in home.

Boyes Hot Springs.—Felt by many in post office; frightened few in community. Few plaster cracks. Pendulum clock stopped.

Brisbane.—Felt by all and frightened many in community. Plaster, windows, and walls cracked. Dishes and windows broke. Knickknacks, pictures, and plaster fell. Large pieces of furniture shifted. Trees, bushes shaken strongly.

Burlingame.—Felt by all and frightened many in community. Damage slight. Ledge broke loose from house. Two gas mains broke in the Hillsdale Industrial Park. Plaster, walls, chimneys, and ground cracked. People left stores. Dishes broken; furnishings shifted.

Canyon.—Felt by and frightened all in community. Plaster, windows, walls, and chimneys cracked; windows broke. Damage slight to brick, masonry, and concrete. Pendulum clock stopped. Trees, bushes shaken strongly.

Concord.—Felt by and frightened many. Ninety square feet of composition subceiling fell at the year-old Mayfair Market. Canned goods fell from shelves. Cracks in drying-out soil slightly lengthened. Bench built around and attached to a center post shifted about $\frac{1}{8}$ inch in a northeast direction and remained in the new position, making the bench wobbly. Small objects shifted.

Corte Madera.—Felt by all and frightened few in community. Damage slight. North-south walls of one apartment severely shaken but undamaged, while on opposite sides tongue-and-groove boards broke apart $\frac{1}{16}$ to $\frac{1}{8}$ inch. Plaster cracked; very fine stucco cracks.

Crockett.—Felt by some outdoors (active); frightened many in community. Damage slight. Small objects and furnishings shifted.

Danville.—Felt by and frightened many in community. Ground cracked. Damage none or slight to brick and concrete. Visible swaying of counters in kitchen. House creaked strongly.

El Sobrante.—Felt by all and frightened few in community. Damage slight. Hairline cracks in stucco. Bird cage rocked.

Fairfax.—Frightened many in community. Damage slight. Plaster cracked. Small objects and furnishings shifted; vases and small objects overturned; knickknacks fell. Felt like house was hit at southeast corner.

Fremont.—Felt by many (some outdoors; active); frightened many in community. Plaster cracked. Small objects shifted; vases, etc., overturned; knickknacks and pictures fell.

Glen Ellen.—Felt by all and frightened many in community. Damage slight. Pendulum clocks stopped. Trees, bushes shaken moderately. Hanging objects swung northeast.

Gulf of the Farallones.—Lightship on the bar, about 9 miles off shore of San Francisco, reported: "Heavy shock; violent flapping of anchor chains."

Half Moon Bay.—Felt by and frightened all in community. Damage slight. Fuse shaken loose in substation, causing temporary power failure. Plaster and walls cracked; plaster fell. Small objects shifted and overturned; knickknacks and books fell.

Hillsborough.—Damage slight. Small water line broken. Plaster, walls, and ground cracked; some retaining walls cracked; outdoor brick and masonry planter slightly damaged. Small objects and furnishings shifted; dishes broke. "Three doors on north-south axis seem to stick less than usual."

Kentfield.—Felt by and frightened all. Damage slight. Plaster cracked. Visible swaying of buildings and trees. Trunks and small objects shifted.

Marin City.—Felt by all and frightened many in community. Furnishings shifted.

Menlo Park.—Generally felt. Plaster cracked. Observer first noticed small north-south waves in swimming pool, then large east-west waves, causing water to nearly splash over coping. Pool 36 feet long in east-west direction. Full, 5-gallon water container swayed violently north-west-southeast and long tubes on doorbell chimes swung northwest-southeast for 5 minutes after shock. Small objects and furnishings shifted.

Millbrae.—Felt by and frightened all in community; six injuries reported. Front of City Hall severely cracked and market damaged. Retaining wall cracked; chimney cracked and twisted; several water heaters broken. Plaster, walls, and ground cracked. Plate glass windows and dishes broken. Heavy acoustical tile fell at school. Small objects and furniture overturned. Brick chimney on side of house dislodged about $\frac{1}{4}$ inch. Plaster between brick in patio cracked. House seemed to rise up as if on the crest of a wave, tilted north, shuddered violently, then jolted down into place, then quivered and rattled for about a minute.

Mill Valley.—Felt outdoors by some (active); frightened many in community. Damage considerable to concrete foundations and retaining walls. Plaster cracked; windows broke. Closed crack between outside wall and chimney. Sheetrock wall of stairway cracked. Small objects fell; furnishings shifted. Strong visible movement of house.

Napa.—Felt by many (some outdoors; active); frightened few. Damage slight. Plaster cracked; slight crack in wood molding. Small objects and furnishings shifted. Floor swayed "like ocean waves." Car in carport rolled up and back.

Niles.—Felt by all and frightened many in community. Small objects shifted. Trees, bushes shaken slightly.

Novato.—Felt by (some outdoors; active) and frightened many in community. Walls cracked. Damage slight to brick and masonry. Dishes broke. Small objects shifted and overturned; knickknacks and pictures fell. Large picture swung out 6 inches from wall; all pictures and mirrors in house tilted. Ground undulated violently west-east.

Oakland.—Felt generally; frightened many; people rushed to the streets. Very minor cracking in State approved schools; extensive cracking occurred in a few unapproved schools. Concrete and plaster cracked; windows broken. Iron tie rods in hollow brick building snapped. Light fixture swung violently. Large quantity of canned goods toppled in stores. Five-foot antenna on truck whipped almost due east-west. Small objects shifted at many places.

Palo Alto.—Frightened many in community. Damage slight. Plaster, walls, and ceiling cracked. Eaves and drainpipe pulled loose from one side of house. Caused toilet to flush. Chandelier swung from side-to-side, then in complete circles. Small objects shifted at many places.

Pedro Valley.—Frightened many. Damage slight. Linda Mar market closed due to damage. Settlement caused 6-inch pipe separation at the Linda Mar sewage plant. Cement porch and driveway cracked; plaster, walls, and ground cracked. Water heater broken. Dishes broken; dishes and articles fell from shelves at liquor and hardware stores; furnishings shifted.

Pescadero.—Frightened all in community. Minor plaster cracks and a few minor exterior stucco cracks at school.

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

Pittsburg.—Frightened many in community. Damage slight. Plaster cracked. Hairline cracks in exterior stucco.

Point Reyes Station.—Felt by all; frightened few. Damage slight. Chimneys cracked. Small objects shifted. Trees, bushes shaken moderately.

Port Chicago.—Felt by many (some outdoors; active); frightened many in community. Damage slight. Trees, bushes shaken strongly.

Port Costa.—Felt by and frightened all in community. Plaster, windows, and walls cracked slightly; knickknacks, books, pictures, and plaster fell. "Had to dismiss school. Damage to school building. Many small aftershocks felt."

Redwood City.—Felt by all and frightened many in community. Cement garage floor cracked; small crack in one wall. Overhead electric wires and telephone cables alternately sagged very low then snapped taut, others swayed from side-to-side. Fire trucks in station (with hand brakes on) moved back and forth at least a foot. Small objects shifted.

Richmond.—Felt by many or all. Damage slight. Huge steel beams shaken off storage racks. Plaster cracked. Small objects and furnishings shifted. Observer reported motion was not nearly as strong as that caused by bridge blasting.

Rockaway Beach.—Felt by all and frightened many in community. Considerable damage to some houses. Plaster, windows, walls cracked; acoustical ceiling cracked. Dishes, windows, and mirror broken. Small objects shifted and overturned; knickknacks and books fell. Electric clock facing northeast stopped.

Rodeo.—Felt by all and frightened few in community. Damage slight. Plaster cracked. Small objects shifted; vases overturned; knickknacks fell.

Ross.—Felt by all and frightened many in community. Damage slight. Plaster cracked; basement cement cracked; ceiling fixtures broke loose. Small objects shifted and overturned. Clock stopped.

Saint Mary's College (Moraga).—Felt by most persons. Ground cracked. Slight damage to water pipes. Visible swaying of walls, chapel, and tower; chandeliers in chapel swung slightly. Trees made swishing sound. Motion gentle, large amplitude, and sort of circular.

San Anselmo.—Frightened all in community. Ammonia line broke in market and large quantity of merchandise fell. Plaster cracked; wall cracks enlarged. Small objects and pictures shifted; furnishings rocked; brick chimney and antenna rocked. Observer on ladder felt ladder hop upward and at same time heard composition roofing make flapping noise against sheathing.

San Carlos.—Felt by all; frightened few. Damage slight. Factory building cracked; plaster cracked. Large plate glass window shifted $\frac{1}{4}$ inch to one side out of frame. Objects and furnishings shifted; beds, rocking horse, and other objects moved; garage door moved.

San Geronimo.—Frightened many in community. Damage slight. Small objects shifted; vases, etc., small objects overturned; knickknacks and pictures fell. Trees, bushes shaken moderately. Observer ran from house.

San Jose.—Generally felt. Plaster fell from second-story walls of the old Santa Clara County Courthouse. Overhead pipes and floors swayed; light fixtures swayed; wall pictures shifted. Motion described as "like sitting on flowing mud" also up and down and north-south.

San Leandro.—Generally felt. Damage slight to concrete. Plaster cracked. Small objects and furnishings shifted. Birds greatly alarmed. Feeling of imbalance experienced while outdoors.

San Lorenzo.—Damage slight. Plaster and ground cracked. Small objects and furnishings shifted. Feeling of imbalance; person very frightened.

San Mateo.—A number of dwellings and stores reported broken windows, fallen plaster, and minor wall cracks. Overpass lighting electroliers loosened. Ground cracked; cement in garage cracked. Damage generally reported as slight. Bookcase broken; refrigerator shifted. Objects fell.

San Rafael.—Generally felt. Damage slight. Garage floor, chimney, and concrete wall in yard cracked. Plaster cracked; windows broke. Two large transport trucks (in gear) rocked back and forth 2 feet and moved northeast about 8 inches. Visible trembling of house. Small objects and furnishings shifted.

Santa Rosa.—Felt by all in community. Frightened and excited persons jammed telephone switchboards with calls; many ran to the streets in downtown and residential areas. Damage slight. Plaster and chimneys cracked; plasterboard cracked. Liquor display fell; knickknacks and books fell. Pendulum clock facing east stopped. Large lighting fixture swung for 5 minutes after shock; doors swung; visible swaying of buildings; bells rang.

Sausalito.—Felt by all and frightened many. Damage in general was slight. Plaster, walls, and windows cracked; plaster fell. Dishes, windows, mirrors, and furniture broke. Two foundation posts shifted several inches. Heavy bureau moved about 2 feet; small objects and furnishings shifted and fell. "Knocked my daughter out of bed and me to the floor."

Sonoma.—Frightened all in community. Damage slight. Plaster, walls, and shelves in grocery store cracked. Huge wine casks rolled and dirt crumbled down in the limestone caves at winery. Small objects shifted; knickknacks and pictures fell.

South San Francisco.—Felt by all; frightened many. Damage in general reported as slight. Many minor fires, gas leaks, and broken water pipes. Ground cracked. Cornice atop hotel loosened. Concrete and chimneys cracked; numerous reports of plaster cracking. Considerable window and dish breakage; some furniture broken. Heavy furnishings shifted; many objects fell; groceries and liquor fell from shelves in supermarkets.

Sunnyvale.—Generally felt; many frightened. Plaster and walls cracked. Damage slight to concrete in seams of house. Small objects and furnishings shifted; file cabinets swayed; light fixtures swung for 10 minutes after shock.

Tiburon.—Damage slight to plaster. Small objects shifted. Hanging lamp swung north-south.

Vallejo.—Frightened many in community. Small objects and furnishings shifted; vases, etc., overturned; pictures fell. Windowpanes shook. Light fixtures swayed northwest-southeast. At location on U.S. Highway 40 the motion was easily noticed above traffic vibrations.

Vineburg.—Felt by all in community; frightened few. Small objects and furnishings shifted. Hanging objects swung.

Warm Springs.—Felt by all in community; frightened few. Small objects shifted; knickknacks fell.

INTENSITY (DAMAGE) V: Antioch, Alamo, Alvarado, Alviso, Bethel Island, Big Basin, Birds Landing, Boulder Creek and vicinity, Campbell, Camp Meeker, Castro Valley, Centerville, Clayton, Clearlake Highlands, Cotati, Cowell, Decoto, Dillon Beach, Duncan Mills, El Cerrito, El Granada, El Verano, Emeryville, Fairfield, Fallon, Felton, Forest Knolls, Forestville, Gilroy; Guerneville, Hamilton Air Force Base, Hayward, Healdsburg, Hercules, Holy City, Imola, Inverness, Isleton, Jenner, Kenwood, Lafayette, Lagunitas, Larkspur, Livermore area, Lodi, Los Altos, Mare Island, Marshall, Martinez, Milpitas, Moffett Field, Montara, Moraga, Moss Beach, Mountain View, Newark, Nicasio, Oakley, Occidental, Olema, Orinda, Parks Air Force Base, Penn-grove, Petaluma, Pleasant Hills, Redwood Estates, Rio Nido, Rio Vista, Saint Helena, San Martin, Santa Clara, Santa Cruz, San Quentin, Saratoga, Sebastopol, Selby, Stewarts Point, (4 miles east of), Stinson Beach, Suisun City and Grizzly Island, Tomales, Tracy, Valley Ford, Veterans Home, Walnut Creek, Woodacre, and Woodside.

INTENSITY (DAMAGE) IV: Angwin, Annapolis, Aptos, Ben Lomond, Brooks, Byron, Calistoga, Capitola, Cazadero, Clarksburg, Courtland, Coyote, Cupertino, Davenport, Diablo, Dixon, Eldridge, Elmira, Fort Ross and 2 miles northeast of, Fulton, Graton, Guinda, Hobergs, Hollister, Holt, Hood, Irvington, Knightsen, Lathrop, Los Gatos, Lower Lake, Lytton, Madrone, Manteca, Middletown, Mission San Jose, Morgan Hill, Mount Hamilton, Mount Hermon, New Almaden, Permanente, Pleasanton, Prunedale (10 miles north of Salinas), Ripon, Ryde, Soquel, Stockton and Rough and Ready Island, Sunol, Thornton, Vacaville, Vernalis, Villa Grande, Walnut Grove, Watsonville, Windsor, and Winters.

INTENSITY (DAMAGE) I TO III: Albion, Banta, Brentwood, Brookdale, Camanche, Capay, Chualar, Cloverdale, Cobb, Esparto, Gustine, Knights Landing, Marina, Moss Landing, Newman, Pacific Grove, Patterson, Point Arena, Princeton Beach (Half Moon Bay), Sacramento, Salinas, Sonoma, Travis Air Force Base (Fairfield), West Sacramento, and Wilton.

March 22: 11:50:16*, 11:52:30*, B. Aftershocks of 11:44:21*. San Francisco (Federal Office Building, Civic Center). Felt slightly.

March 22: 11:57:36*, B. Aftershock of 11:44:21*. Slightly felt at two locations in downtown San Francisco.

March 22: 12:00:26*, B. Aftershock of 11:44:21*. Felt in San Francisco (southwest section). "Many aftershocks felt."

March 22: 12:27.1*, 12:29:01*, B. Aftershocks of 11:44:21*. Two light shocks felt at San Francisco in the Sunset District near the ocean.

March 22: 12:32:16*, 12:35:35*, B. Aftershocks of 11:44:21*. Both shocks slightly felt in downtown San Francisco. Shock at 12:32:16* reported felt in Sonoma.

March 22: 13:07:47*. Aftershock of 11:44:21*. Epicenter 37°41' north, 122°29' west, southwest of Daly City, B. San Francisco (downtown area). III. Magnitude 3.6. Motion described by one observer as vertical, lasting 2 seconds; by another, as moderate, circular.

March 22: 13:18:29*. Aftershock of 11:44:21*. Epicenter 37°40' north, 122°29' west, east of Mussel Rock, B. Magnitude 3.8. Reported felt at Martinez, Oakland, San Anselmo, and San Francisco. At the Federal Office Building in San Francisco observer reported: "Light shock but could hear shock wave approach from south."

March 22: 15:14:35*. Aftershock of 11:44:21*. Epicenter 37°39' north, 122°27' west, south of Colma, B. V. Magnitude 4.4. At Millbrae the City Hall was closed when file cabinets rolled 6 inches from walls. Windows rattled and walls shook at Burlingame. Frightened few at the Chabot Observatory in Oakland where windows, doors, and dishes rattled; house creaked. Sharply felt by many in various sections of San Francisco, frightening few. Overhead lights swung back and forth; windows rattled. Also felt at Alameda, Benicia, Canyon, Castro Valley, Los Gatos, San Anselmo, San Carlos, San Leandro, San Mateo, and Vallejo.

March 22: 16:26:55*. Aftershock of 11:44:21*. Epicenter 37°39' north, 122°29' west, southeast of Edgemar, B. San Francisco. V. Magnitude 4.0. Small objects shifted; picture swung. Heavy, shaking jolt felt at San Mateo. Also felt at Benicia, Canyon, Oakland (just a bump), and San Jose.

March 22: 17:45:30*. Aftershock of 11:44:21*. Epicenter 37°39' north, 122°30' west, off coast, west of Edgemar, B. Felt at San Francisco near Fort Mason.

March 22: 18:15. Aftershock of 11:44:21*. San Francisco (south Market Street area). IV. Everything in room shook.

March 22: 18:48:08*. Aftershock of 11:44:21*. Epicenter 37°42' north, 122°30' west, off coast, west of Daly City, B. San Francisco. V. Fairly rapid, vertical motion. Small objects shifted. Also felt at Oakland and San Leandro.

March 22: 19:00:15*. Aftershock of 11:44:21*. Daly City, B. Very loud cracking sound preceded loud rumble of short duration.

March 22: 19:28:53*. Aftershock of 11:44:21*. Epicenter 37°40' north, 122°27' west, southeast of Colma, B. San Francisco (west Twin Peaks area). IV. Felt by all in home. House rattled and shook. Felt like an extremely strong gust of wind swept through the house.

March 22: 21:42:13*. Aftershock of 11:44:21*. Epicenter 37°42' north, 122°30' west, off coast, west of Daly City, B. San Francisco. V. Sharply felt in several widely separated sections of the city. Fairly rapid, vertical motion shifted small objects in the Presidio district. "Lighter than shock at 18:48:08."

March 22: 22:14:23*. Aftershock of 11:44:21*. Epicenter 37°41' north, 122°31' west, off coast, northwest of Mussel Rock, B. San Francisco (west Twin Peaks area). III. Rapid, jerking, east-west motion felt by several sitting in home. Lasted 2 seconds.

March 22: 23:54:00*. Aftershock of 11:44:21*, B. Felt at Canyon in store.

March 23: 00:13:48*. Aftershock of 11:44:21*. Epicenter 37°42' north, 122°31' west, off coast, west of Daly City, B. Felt over a land area of approximately 3,500 square miles. Maximum intensity (damage) VI. Magnitude 4.2. Damage slight.

INTENSITY (DAMAGE) VI:

Menlo Park.—Damage slight. Plaster, walls, and ceiling cracked. Small objects shifted and fell to floor.

San Francisco.—Generally felt; many awakened. Concrete retaining wall cracked. Fire at hotel was believed to have been caused by a broken gas main in the basement. Plaster cracked. Small objects shifted and overturned. Houses severely shaken. Loud cracking earth noises heard.

INTENSITY (DAMAGE) V: Benicia, Millbrae, Oakland, and Port Costa.

INTENSITY (DAMAGE) IV: Boyes Hot Springs, Burlingame, Canyon, Palo Alto, Ryde, Saint Mary's College (Moraga), Stinson Beach, and Sunol.

INTENSITY (DAMAGE) I TO III: Orinda, Saint Helena, Santa Rosa, and Vallejo.

Other places reporting the shock as felt (no details): Alameda, Alamo, Centerville, Fallon, Hamilton Air Force Base, Mill Valley, San Bruno, San Leandro, San Mateo, and Walnut Creek.

March 23: 00:48:07*. Aftershock of 11:44:21*, B. IV. Observer at Burlingame awakened.

March 23: 02:57:3*. Aftershock of 11:44:21*, B. Felt in San Francisco at east edge of Golden Gate Park.

March 23: 04:54:33*. Aftershock of 11:44:21*. Epicenter 37°40' north, 122°29' west, north of Edgemar, B. Magnitude 3.8. Reported as hard shock in the southwest section of San Francisco. Also felt at Fallon (Marin County).

March 23: 05:56:11*. Aftershock of 11:44:21*, B. Very brief shock felt in southwest section of San Francisco.

March 23: Between 6 and 7 (a.m. or p.m. not given). Aftershocks of 11:44:21*. San Francisco (Downtown Center Garage). "Felt rumblings sometime between 6 and 7."

March 23: 08:56:32*. Aftershock of 11:44:21*. Epicenter 37°41' north, 122°30' west, coastline north of Mussel Rock, B. Very brief shock felt in southwest section of San Francisco.

March 23: 14:48:00*. Aftershock of 11:44:21*. Epicenter 37°39' north, 122°28' west, east of Edgemar, B. IV. Felt as sharp jolt in the Presidio area of San Francisco.

March 23: 14:55:16*. Aftershock of 11:44:21*, B. Very brief shock felt in southwest San Francisco area.

March 23: 16:35:28*. Aftershock of 11:44:21*. Epicenter 37°40' north, 122°30' west, east of Mussel Rock, B. IV. In the San Francisco Presidio area observer reported that small objects shifted.

March 23: 16:47. San Diego. III. Hanging objects swung. Motion rapid; direction north. Felt as a rolling motion at Suncrest.

March 23: 19:36:00*. Aftershock of 11:44:21*. Epicenter 37°41' north, 122°30' west, coastline southwest of Daly City, B. IV. Sharp jolt felt in the San Francisco Presidio area; in the Sunset District, near the ocean, potted plants rocked and floor shook.

March 23: 22:26:51*. Aftershock of 11:44:21*. Epicenter 37°41' north, 122°29' west, near coast, southwest of Daly City, B. IV. In the San Francisco Sunset District, near the ocean, dishes rattled. Also felt in the Richmond District.

March 24: 07:34:12*, 09:43:13*, 11:11:16*, 11:52:33*, B. Aftershocks of 11:44:21*. All four shocks felt in the San Francisco Richmond District; shock at 11:52:33 also felt in the southwest section of the city.

March 25: 04:36:09*. Aftershock of 11:44:21*. In the San Francisco Westwood Park area, south of Mt. Davidson, observer reported a decided east-west lurch was the only effect noticed.

March 25: 06:45 (about). Felt at San Bruno.

March 25: 07:28. Felt in the San Francisco Richmond District.

March 25: 08:58. In the San Francisco Westwood Park area, south of Mount Davidson, motion seemed to be from south-north. Continuous shaking for several minutes.

March 25: Night and morning, and 15:00. San Francisco (east Richmond District). Night and morning shocks slightly felt; awakened observers. Prolonged shock felt at 15:00.

March 25: 23:13:32*. Aftershock of 11:44:21*, B. Southwest San Francisco area. "Noise last heard about 23:12 on March 25."

March 26: 06:51:29*. Aftershock of 11:44:21*. Epicenter 37°40' north, 122°31' west, off coast, northwest of Mussel Rock, B. V. Shocks jolted the northern San Francisco Peninsula areas. Many awakened at 06:51:29*. Objects rattled. Four shocks in the early morning were reported felt in the southwest San Francisco area.

March 26: 07:20:53*. Aftershock of 11:44:21*. Epicenter 37°41' north, 122°31' west, off coast, west-southwest of Daly City, B. Reported felt in Daly City and in the Sunset District of San Francisco.

March 26: 15:45, 15:50. Reported felt in the Sunset District of San Francisco.

March 26: 18:13:25*. Aftershock of 11:44:21*. Epicenter 37°40' north, 122°30' west, off coast, west of Mussel Rock, B. Reported felt in the Richmond District of San Francisco. Also felt shock at 23:04:49*.

March 27: 02:41:53*. Aftershock of 11:44:21*. Epicenter 37°42' north, 122°31' west, off coast, west of Daly City, B. V. Many awakened in the San Francisco area.

March 27: 05:22:12*. Epicenter 39°19' north, 118°32' west, southeast of Fallon, Nev., B. Salt Wells, Nev. IV. "Residents were awakened by three mild earthquakes . . . Magnitude 3. No damage was reported."—(BSSA, July 1957.)

March 27: (during night). Rumbblings during the night in the Suncrest District of San Diego.

March 28: 01:09. San Diego. III. Rapid north-south motion felt by observer in home where hanging objects swung.

March 29: (a.m.) Aftershocks of 11:44:21*. Southwest San Francisco. Several shocks felt during morning hours. Also many shocks felt during week.

March 30: 13:34:49*. Epicenter 33°08' north, 116°28' west, northeast of Julian, P. San Diego. III. Rapid north-south motion. Felt by several in community. Also reported felt in Alpine, Mount Helix, and Spring Valley.

March 31: 08:43:26*. Aftershock of 11:44:21*, B. Reported felt in the Daly City-Westlake areas.

April 1: 00:36. San Diego. III. Rapid motion felt by several.

April 1: 20:22:47*, 20:25:27*. Epicenter 33°42' north, 115°56' west, east of Indio, P. IV. Magnitudes 4.1 and 3.5 respectively. Felt by several at the Hayfield Pumping Plant near Desert Center. Buildings creaked; loose objects rattled. North-south rocking motion. Slight shock felt by many and frightened few at Thermal. Windows, doors, and dishes rattled; walls creaked; hanging objects swung. Also felt at San Diego.

April 4: 16:40. IV. Explosivelike bump felt by many at Los Alamos.

April 6: 05:24. Hemet-San Jacinto Valley. IV. "A sharp jolt rattled windows . . . but no damage reported."—(BSSA, July 1957.)

April 7: 08:20:30*. Aftershock of 11:44:21*. Epicenter 37°41' north, 122°31' west, B. Magnitude 3.3. San Francisco Peninsula area. V. Reported as the strongest aftershock felt since March 27. Water main breakage at San Mateo may have been caused by the shock. Felt by many and frightened few at San Francisco.

April 7: 16:18:24*. Aftershock of 11:44:21*. Epicenter 37°38' north, 122°28' west, B. Magnitude 2.9. San Francisco area. Felt principally in the southwest part of San Francisco and the Westlake area. Doors rattled.

April 10: 22:25:10*. Aftershock of 11:44:21*. Epicenter 37°42' north, 122°32' west, B. IV. Magnitude 2.8. Brief shock awakened observer in the Presidio area of San Francisco.

April 13: 12:23:35*. Aftershock of 11:44:21*. Epicenter 37°39' north, 122°30' west, B. III. Magnitude 2.9. Very brief, rapid shock felt by several in home in the Presidio area of San Francisco.

April 19: 20:52. Felt at Salinas.

April 21: 10:55:24*, 13:38:09*. Aftershocks of 11:44:21*. Magnitudes 2.8 and 2.9, respectively, B. III. Felt in the southwestern part of San Francisco. Shock at 10:55:24* awakened one in home.

April 25: 13:57. Epicenter 33.1° north, 115.9° west, southwest end of Salton Sea, P. Fore-shock of the main shock at 13:57:39*. Magnitude 2.9. Two minor tremors reported felt at Niland.

April 25: 13:57:39*. Main shock of the series occurring on the 25th. Epicenter 33°11' north, 115°51' west, southwest end of the Salton Sea, P. Magnitude 5.2. Felt over an area of approximately 12,000 square miles of southern California and western Arizona. (See map, p. 31.) Maximum intensity (damage) VII. Water flowed from blowholes and ground cracks near Calipatria. Slight damage at few other places. A number of aftershocks, ranging in magnitudes from 2.9 to 5.1, were recorded during the afternoon of the 25th. Those definitely reported as felt occurred at 14:05 (magnitude 4.2); 14:24:12* (magnitude 5.1); 16:01:25* (magnitude 4.1).

INTENSITY (DAMAGE) VII:

Calipatria area.—Felt by and frightened all. Greatest damage occurred about 1½ miles north of Vail Canal where a strip of land about a half-mile wide and a mile and a half long was broken and cracked, with water seeping from hundreds of blowholes. In some places water seeped from fissures as wide as 2 feet. Cotton fields were considerably damaged by flooding. Plaster cracked. Small objects shifted; trees, bushes shaken strongly.

INTENSITY (DAMAGE) VI:

Boulevard.—Felt by many in community; frightened few. Damage slight. Plaster cracked.

Brawley.—Felt by many in community (some outdoors; active). Plaster fell. Supermarkets suffered considerable loss from stock breakage. Both east-west and north-south direction. Few items fell from shelves during the later shocks.

Niland.—Sharp jolt. Groceries fell from store shelves. Two small aftershocks felt.

Westmorland.—Felt by all and frightened few in community. Water main broke. Exterior

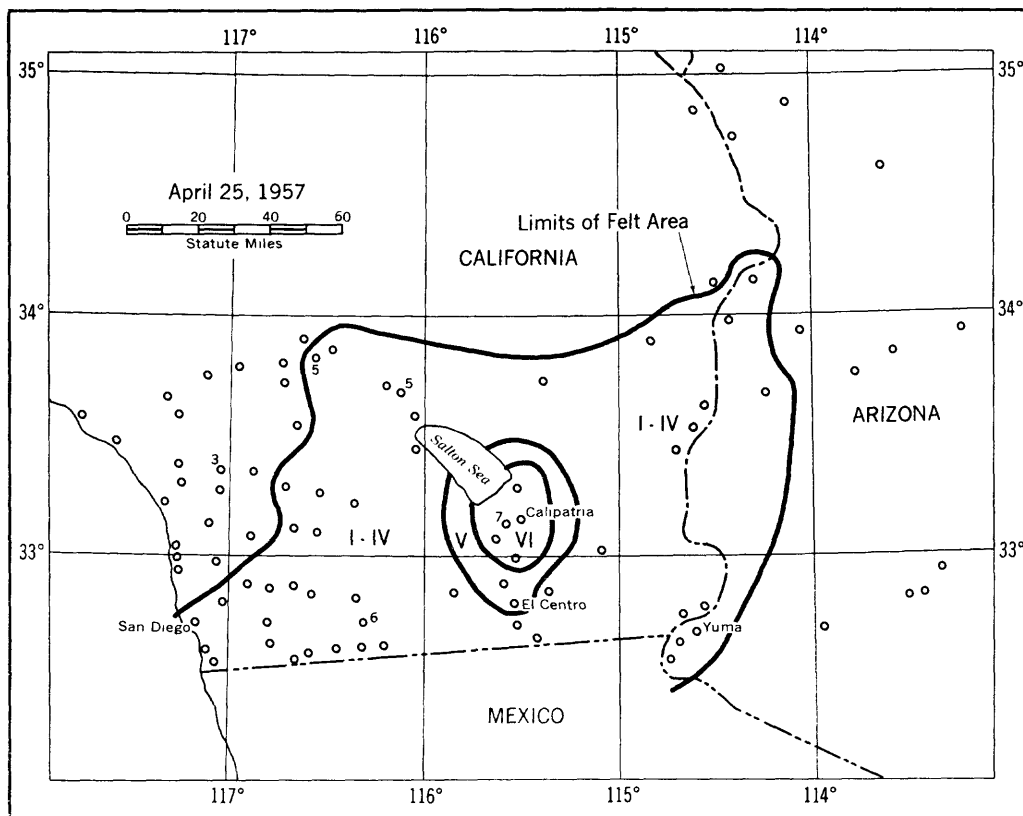


FIGURE 11.—Area affected by earthquake of April 25.

wall cracks and a section of plaster fell in store. Vases overturned; knickknacks and books fell. Pendulum clock facing west stopped. Strong shock at 14:24:12* knocked clock off wall in office.

INTENSITY (DAMAGE) V: Cathedral City, Coachella, El Centro (also fairly strong at 14:24:12*; minor at 16:01:25*), and Imperial.

INTENSITY (DAMAGE) IV: Borrego Springs, Calexico (also 14:24:12* felt), Campo, Heber, Holtville (also 14:24:12* felt), Jacumba (shock at 14:24:12* reported as strongest), Lakeside, Mecca, Palo Verde, Pine Valley, Plaster City (also 14:24:12* felt), Potrero, San Diego (also 14:24:12* felt), Santa Ysabel, and Winterhaven.

INTENSITY (DAMAGE) IV IN ARIZONA: Poston (also 14:05 felt), Quartzsite, and Yuma.

INTENSITY (DAMAGE) I TO III: Alpine, Bard, Blythe (also 14:24:12* felt), Desert Center, Glamis, Indio, Jamul, Midland, Oasis, Pala, Ripley, San Ysidro, Thousand Palms, and Warner Springs.

INTENSITY (DAMAGE) I TO III IN ARIZONA: Gadsden (several slight shocks felt) and Parker.

April 25: 19:08:09*. Epicenter 37°07' north, 118°05' west, southeast of Big Pine, P. IV. Magnitude 3.8. Felt by many in community at Laws. Rapid, northeast to east motion. "Not very strong nor long." Two brief shocks felt at Tinemaha Reservoir (Independence) where chandelier swung. Direction west-east. At Dyer, Nev. (3.6 miles southeast of) sharp shock felt by several. Pendulum on Anniversary clock swayed north-south. Dishes rattled. Motion rapid, then slow, north-south swaying.

April 26: 09:54. San Francisco. III. Three-second shock felt by observer. Small crystals on candle-type lamp swung about ½ inch.

April 26: 16:15:04*. Aftershock of 11:44:21*. Epicenter 37°43' north, 122°33' west, B. Felt in the Daly City-Westlake area.

April 26: 21:39:27*. Epicenter 39.4° north, 118.5° west, east of Fallon, Nev., B. Minor shock, preceded by roar, felt at Fallon.

April 28: 03:12:07*. Aftershock of 11:44:21*. Epicenter 37°39' north, 122°30' west, B. Lightly felt in the San Francisco Bay area.

April 28: 15:05:11*. Epicenter 37°22' north, 121°44' west, northwest of Mount Hamilton, B. IV. In the San Francisco Sunset District, near the ocean, windows, doors, and dishes rattled; house creaked. Reported as light shock in the San Francisco Bay area.

April 29: 00:07:38*. Epicenter 37°57' north, 122°00' west, southeast of Concord, B. IV. House creaked and bed shook at Canyon. Motion rapid, lasted 2-3 seconds. Also felt at Concord and Ygnacio Valley.

April 29: 22:27:46*. Aftershock of 11:44:21*. Epicenter 37°39' north, 122°31' west, B. V. Magnitude 3.4. Damage reported from one place: In the San Francisco Bernal Heights area, plaster cracked; fireplace moved $\frac{1}{8}$ inch; molding opened; and collars loosened on bathtub faucets. Sounded like truck backed into garage. Reported strongest in the Daly City-Westlake area and the southwestern part of San Francisco where people were awakened by creaking of buildings; chandeliers swayed. At Canyon, house rocked and floor moved; slight shock. Windows rattled and house creaked at San Mateo.

May 1: 11:36:22*. Aftershock of 11:44:21*. Epicenter 37°39' north, 122°30' west, B. San Francisco Bay area. Magnitude 3.3. Slightly felt by several in the Castro Valley District and the Westlake area of Daly City.

May 8: 10:34. Fortuna. IV. Two rapid back-and-forth swings from north-northeast to south-southwest, lasting 2-3 seconds, felt by all (6) in building.

May 8: 11:36:04*. Aftershock of 11:44:21*. Epicenter 37°40' north, 122°31' west, B. Felt slightly in some parts of San Francisco.

May 12: 17:08:28*. Aftershock of 11:44:21*. Epicenter 37°44' north, 122°34' west, B. Felt slightly in the Daly City-Westlake area.

May 14: 17:50:27*. Epicenter 37°59' north, 122°30' west, north of San Pablo, B. East San Francisco Bay area. IV. Police switchboards flooded with calls from Albany, Berkeley, El Cerrito, and Richmond. Two slight rapid shakes of momentary duration felt by one of three in home at Canyon.

May 18: 19:22:35*. Aftershock of 11:44:21*. Epicenter 37°44' north, 122°34' west, B. Felt slightly in San Francisco.

May 19: 07:03:14*. Aftershock of 11:44:21*. Epicenter 37°44' north, 122°34' west, B. IV. Windows and dishes rattled in the Sunset District of San Francisco.

May 26: 07:59:33*. Epicenter 33°12' north, 116°01' west, southwest of Salton Sea, P. Magnitude 5.0. Felt over an area of approximately 7,000 square miles of southern California. No damage reported. Maximum reported intensity (damage) V at Calipatria, where the shock was felt by all; windows and doors rattled; walls creaked. Rapid motion, lasting 10 seconds; faint earth noises from north heard. Intensity (damage) IV at Alpine, Decanso, Holtville, Jacumba, Julian, La Mesa, Palm Springs, Warner Springs, and Westmorland. Also felt at Borrego Springs, Boulevard, Brawley, Campo, Desert Center (15 miles northwest of), El Cajon, El Centro, Heber, Hemet, Lakeside, Miramar, Niland, San Diego, Santa Ysabel, San Ysidro, and Valley Center. Felt slightly at Wellton, Ariz.

May 26: 14:00 (about). Felt at Imperial Beach.

May 27: 09:04:41*. Epicenter 33°52' north, 116°58' west, south of Beaumont, P. Barely noticeable at Hemet.

June 3: 10:14:47*. Aftershock of 11:44:21*. Epicenter 37°39' north, 122°31' west, B. IV. Magnitude 2.7. Windows rattled at Daly City. Also felt at San Bruno and San Francisco.

June 5: 07:02:52*. Epicenter 36°18' north, 119°02' west, north of Haiwee, P. Olancho. IV. Magnitude 3.5. Felt by many (some outdoors; active); frightened few in community. Windows, doors, and dishes rattled; house creaked.

June 5: 10:32:55*. Epicenter 40°30' north, 124°00' west, near Scotia, B. Petrolia. IV. Small, sharp jolt felt by few; windows and dishes rattled.

June 7: 14:50. Olancho. IV. Felt by many (some outdoors); frightened few in community; windows, doors, and dishes rattled; house creaked.

June 10: 09:59:22*. Epicenter 39.5° north 118.6° west, east of Fallon, Nev., B. Stillwater, Nev. Reported as the strongest shock felt in some time.

June 11: 23:39:00*. Aftershock of 11:44:21*. Epicenter 37°44' north, 122°33' west, B. IV. Light shock awakened few in San Francisco.

June 12: 01:04:47*. Aftershock of 11:44:21*. Epicenter 37°42' north, 122°33' west, B. Felt at Daly City and in the Sunset District of San Francisco.

June 13: 02:40:55*. Aftershock of 11:44:21*. Epicenter 37°42' north, 122°31' west, B. IV. Felt in downtown San Francisco and in the Sunset District. Some awakened; small objects rattled.

June 18: 22:16:17*. Epicenter 36°54' north, 121°43' west, east of Watsonville, B. "Felt at Watsonville and Freedom."—(*BSSA, October 1957.*)

June 20: 16:41:25*. Epicenter 37°42' north, 119°17' west, east of Yosemite, B. V. Very noticeable and heavy in the central section of Yosemite Valley where many were alarmed; disturbed objects observed by many; lamps in houses swayed; thunderous earth noises, like a rock slide, heard at time of shock. Motion trembling, bumping, abrupt, brief. Very brief and rapid at Camp Curry; felt by many; many heard loud earth noises one second before shock. At Wawona Station, felt by several (some outdoors; active); windows, doors, and dishes rattled. Brief shock felt by several at June Lake; house creaked. At El Portal, few heard a loud blast-like noise. House seemed to jump straight up.

June 21: 12:46:42*. Epicenter 35.1° north, 120.9° west, off the coast, San Luis Obispo County, P. IV. Magnitude 3.7. Described as light in the San Luis Obispo area. Radio Station KATY went off the air temporarily when circuit breakers were activated. Felt by some outdoors (active) at Morro Bay.

June 26: 20:38:02*. Aftershock of 11:44:21*. Epicenter 37°39' north, 122°29' west, B. IV. Felt principally in Daly City and the southwest sections of San Francisco. Windows rattled. Motion jerking; seemed in north-south direction.

June 27: 18:43:10*. Epicenter 35°26' north, 118°44' west, north of Bena, P. Magnitude 3.7. Very light at the Kern Canyon Powerhouse, about 10 miles east of Bakersfield.

June 28: 03:32:03*. Epicenter 35°10' north, 118°40' west, west of Tehachapi, P. V. Magnitude 4.1. Felt by nearly all at Tehachapi where buildings creaked; loose objects rattled. Heavy 3-second jar, seemed to twist upward and then drop.

July 1: 22:56:41*. Epicenter 33°02' north, 116°38' west, south of Julian, P. V. Magnitude 4.1. Felt by and awakened many at Ranchita. Loud creaking of all buildings. Rapid, brief, east-west motion. Also felt at San Diego.

July 2: 01:18:22*. Epicenter 34°22' north, 119°53' west, west of Santa Barbara, P. Magnitude 3.4. Felt by few at Santa Barbara.

July 2: 22:29:09*, 23:05:48*. Epicenter 38°16' north, 122°02' west, near Fairfield, B. Magnitude 3.1 and 3.3, respectively. First shock reported felt at the Cordelia PG&E Substation, about 5 miles southwest of Fairfield; lasted about 30 seconds.

July 4: 14:25:13* (magnitude 4.8), 15:27:12* (magnitude 4.6), 16:58:00* (magnitude 4.7). Epicenter of first shock 32° north, 113° west; of second, 31° north, 114° west; of third, 32° north, 114° west, W. IV. Three shocks were reported felt in San Diego, the first rattling dishes and shaking light fixtures.

July 29: 06:24, 09:00. Light shocks reported felt at Brawley.

August 5: 19:35:26*, 21:40:43*. Epicenter 33°15' north, 118°38' west, Santa Monica Bay, P. Magnitude 3.3 and 2.9, respectively. Light shocks felt at Santa Monica and West Los Angeles. In northwest Los Angeles, observer lying down felt bumping motion from east with gradual onset.

August 13: 15:14:06*. Epicenter 36°45' north, 121°38' west, southwest of San Juan Bautista, B. Magnitude 3.5. Brief, but sharply felt at San Juan Bautista.

August 16: 10:02. San Juan Bautista. V. "An earthquake . . . was reported to have cracked a window or two in San Juan Bautista. The tremor was also felt in Watsonville and Aromas."—(*BSSA, January 1958.*)

August 16: 21:24:11*. Aftershock of 11:44:21*. Epicenter 37°39' north, 122°28' west, B. IV. Magnitude 2.9. Felt sharply in northern San Mateo County and southwest San Francisco. Dishes rattled.

August 18: 03:05:25*. Epicenter 34°28' north, 120°08' west, east of Gaviota. Felt at Cachuma reservoir.

August 21: 11:39 (about). Hollister (7½ miles south of). IV. Rapid, brief motion felt by observer walking in home; windows and doors rattled; walls creaked.

September 2: 21:19:21*. Epicenter 37°03' north, 121°30' west, near Gilroy, B. Magnitude 3.9. Felt over a land area of approximately 1,500 square miles of the coastal region of west-central California. Maximum intensity (damage) IV at Aromas, Coyote, Gilroy, Morgan Hill,

Mount Hermon, San Francisco, San Jose, San Martin, and Watsonville. Principal effects of the shock were the rattling of windows, doors, and dishes and the creaking of buildings. Also felt at Big Sur, Montara, and Warm Springs.

September 4: 11:26 and 12:35. San Diego area. IV. Rapid motion felt by several. Series of sharp tremors. Observer reports that on September 3 and 4 there were quite a number of calls from Del Mar, Descanso, and El Cajon.

September 10: 20:59:20*. Aftershock of 11:44:21*. Epicenter 37°42' north, 122°32' west, B. Magnitude 2.0. Reported as mild shock in the Sunset District of San Francisco.

September 12: 13:36. II. Slight shock felt by few at the PG&E Morro Bay Power Plant.

September 21: 07:32. Very mild shock felt at the PG&E Morro Bay Power Plant.

September 28: 13:04:39*. Epicenter 36°36' north, 121°14' west, southeast of Hollister, B. IV. Magnitude 4.5. Rolling motion, lasting 3 seconds, felt by several at Big Sur where windows and doors rattled; frame creaked. At Hollister (7½ miles south of) slow, northeast motion felt by many in community; windows, doors, and dishes rattled; trees, bushes shaken slightly.

October 1: 09:29:42*. Epicenter 37°52' north, 122°12' west, near Berkeley, B. III. Felt slightly by several in the East Bay area.

October 5: 06:42. Los Alamos. IV. Felt by many in the west section of Los Alamos. Bumping motion, lasting several seconds.

October 8: 22:18:28*. Epicenter 34°07' north, 117°30' west, near Etiwanda, P. IV. Felt by all in Fontana where windows rattled. Light shock in the Riverside and Pomona Valley areas.

October 17: 02:14:09*. Epicenter 39°17' north, 118°26' west, southeast of Fallon, Nev., B. IV. Magnitude 4.6. Dishes rattled at Fallon.

October 27: 18:38:12*. Aftershock of 11:44:21*. Epicenter 37°40' north, 122°31' west, B. Felt as mild shock in the Outer Mission District of San Francisco.

October 30: 18:47:46*. Epicenter 39°11' north, 123°41' west, near Comptche, B. Magnitude 4.7. Felt over a land area of approximately 4,000 square miles, principally in Mendocino County of northwestern California. Maximum intensity (damage) VI. Damage slight.

INTENSITY (DAMAGE) VI:

Comptche.—Felt by and frightened all in community; felt by all in neighboring towns. Damage slight. Knickknacks fell and broke.

Willits.—Felt by all; frightened few. Damage slight. Plaster cracked. Small objects shifted; knickknacks fell.

INTENSITY (DAMAGE) V: Boonville, Calpella, Elk, Mendocino, Nashmead, Navarro, Philo, and Talmage.

INTENSITY (DAMAGE) IV: Albion, Caspar, Covelo, Cummings, Dos Rios, Fort Bragg, Gualala, Laytonville, Littleriver, Longvale, Orrs Hot Springs, Point Arena, Potter Valley, Redwood Valley and 5 miles north of, Spyrock, Ukiah and 4 miles west of, Westport, Witter Springs, and Yorkville.

INTENSITY (DAMAGE) I TO III: Branscomb (3 miles east of), Finley, Hopland, Leggett, Manchester, Petrolia, and Rohnerville.

October 31: 06:38:00*. Epicenter 39.2° north, 123.7° west, west of Ukiah, B. Minor shock felt at Philo.

October 31: 11:47:06*. Epicenter 37°21' north, 122°13' west, southwest of Palo Alto, B. Magnitude 4.1. Felt over a land area of approximately 2,500 square miles of the coastal area of west-central California. Maximum intensity (damage) V at Ben Lomond where the shock was felt by all; frightened few; small objects and furnishings shifted. Sharp motion of momentary duration. Intensity (damage) IV at Alvarado, Aptos, Boulder Creek, El Granada, Los Gatos, Pescadero, and Soquel; also felt at Berkeley, Colma, Los Altos, Menlo Park, Palo Alto, Redwood City, San Francisco, and Santa Cruz.

November 1: 12:50:57*. Epicenter 39°15' north, 123°47' west, northwest of Ukiah, B. V. Felt by all at Comptche; windows and doors rattled; frame creaked; trees, bushes shaken slightly. Rapid motion, lasting 2 seconds; seemed to hit southwest corner of building. Light rumble, then heavy west-east shock at Philo. Also felt at Mendocino.

November 5: 15:50:52*. Epicenter 34°43' north, 120°20' west, near Los Alamos, P. Magnitude 3.4. IV. Felt by most everyone at Los Alamos. Big bump, like an underground explosion. Earth noises heard by most everyone just before shock.

November 9: 09:33:16*. Epicenter 37°43' north, 122°07' west, east of San Leandro, B. Light shock felt in the Castro Valley, Hayward, and San Leandro areas.

November 19: 23:47:53*. Aftershock of 11:44:21*. Epicenter 37°39' north, 122°30' west, B. Felt in the Westlake Palisades District west of Daly City.

November 20: 10:41:28*. Epicenter 40°14' north, 124°17' west, near Petrolia, B. Magnitude 3.4. Felt over a land area of approximately 500 square miles of southwestern Humboldt County. Maximum intensity (damage) V at Petrolia where the shock was felt by and frightened all; windows and doors rattled; house creaked. At Honeydew, felt by many (some outdoors; active); frightened few; house creaked; trees, bushes shaken slightly. Also felt at Brice-land, Holmes, Kneeland, and Weott.

December 2: 07:58:31*. Epicenter 34°32' north, 118°36' west, near Castaic, P. Magnitude 3.2. III. Felt by few at Saugus Power Plant No. 2. Trolley wires on crane, approximately 35-foot span, swung east-west. Abrupt onset.

December 3: 18:51:43*. Epicenter 34°08' north, 116°21' west, west of Twentynine Palms, P. Magnitude 4.3. Reported felt in the Morongo Valley area; slight at Desert Hot Springs.

December 6: 19:45. Tehachapi. IV. Building creaked; loose objects rattled. Moderately loud earth noises like a dull thump heard at time of shock. Sharp jar, abrupt onset, lasted 2 seconds.

December 10: 15:05:51*. Epicenter 36°50' north, 121°28' west, near San Juan Bautista, B. Hollister (7½ miles south of). IV. Felt by many; frightened few. Windows, doors, and dishes rattled; house creaked; weak shocks also felt at 14:45 and 15:08.

December 10: 17:41:18*. Epicenter 36°50' north, 121°28' west, near San Juan Bautista, B. Hollister (7½ miles south of). IV. Felt by several in home; windows, doors, and dishes rattled; house creaked.

December 12: 10:25. Weak shock felt 7½ miles south of Hollister.

December 19: 23:30. San Francisco (Sunset District). Observer thought vibration of house was caused by slight shock.

December 25: 07:26:19*. Epicenter 34°10' north, 118°05' west, near Sierra Madre, P. Magnitude 2.9. Felt at Pasadena.

December 30: 16:02:25*. Epicenter 34°00' north, 118°10' west, near Bell, P. Magnitude 3.2. Felt from Long Beach to Los Angeles. Felt most strongly in North Long Beach and Paramount.

WASHINGTON AND OREGON

(120TH MERIDIAN OR PACIFIC STANDARD TIME)

January 25: 17:16:06*. Epicenter 48°20' north, 122°26' west, near mouth of Skagit River, S. Felt over an area of approximately 15,000 square miles of northwestern Washington. (See map, p. 36.) Maximum intensity (damage) VI was reported from one location, Clearlake, where plaster cracked and fell on second floor of school; knickknack shelf shifted; felt by many and frightened few. Lights swayed in barber shop and barber was forced to stop cutting hair until vibrations ceased.

INTENSITY (DAMAGE) V: Acme, Anacortes, Arlington, Bothell, Bow, Burlington, Chimacum, Clinton, Clipper, Deming, Friday Harbor, Granite Falls, Greenbank (Sec. 8, T30N, R2E), Hadlock, Index, Langley, Lowell, Lummi Island, Port Gamble, Port Ludlow, Seabold, Seattle, Sedro Woolley, Silvana, Snohomish, Stanwood and 5 miles east of, Startup, Sultan, and Wickersham.

INTENSITY (DAMAGE) IV: Alderton, Alderwood Manor, Allyn (Sherwood Creek), Baring, Bellingham, Blanchard, Bremerton, Carlsborg, Carnation, Centralia, Concrete, Coupeville, Darrington, Decatur Island, Deer Harbor, Duvall, Eastsound, Edison, Everett, Everson, Fall City, Fortson, Freeland, Glacier, Gold Bar, Hamilton, Hansville, Harper, Hoodspport, Kenmore, Kitsap, La Conner, Lakewood, Leland, Lopez, Lynwood, Marblemount, Marietta, Marysville, Mount Vernon, Mukilteo, Nordland, North Bend and North Bend Ranger Station, Oak Harbor, Orcas, Oso, Port Angeles and North Olympic Peninsula, Port Orchard, Port Townsend, Preston, Quilcene, Richmond Beach, Seattle Heights, Selleck, Skykomish, Snoqualmie and Meadowbrook, Sumas, Suquamish, Tacoma, Waldron, and Woodinville.

INTENSITY (DAMAGE) I TO III: Aberdeen, Blaine, Brinnon, Cedar Falls, Cushman Dam (Hoodspport), Custer, Edmonds, Elbe, Ferndale, Graham (Davis Road), Hyak, Joyce, Kennydale, Kent, Keyport, La Grande, Lilliwaup, Longbranch, Lost Lake (10 miles west of Shelton), Lynden, Maltby, Mercer Island, Monroe, Nisqually, Nooksack, Nooksack Falls Powerhouse, Olalla, Olga, Orillia, Orting, Pacific, Portage, Puyallup, Redmond, Retsil, Rockport, Rollingbay, Seabeck, Shaw Island, Shelton, Van Zandt, and Wauna. Also felt at Ladner, B. C.

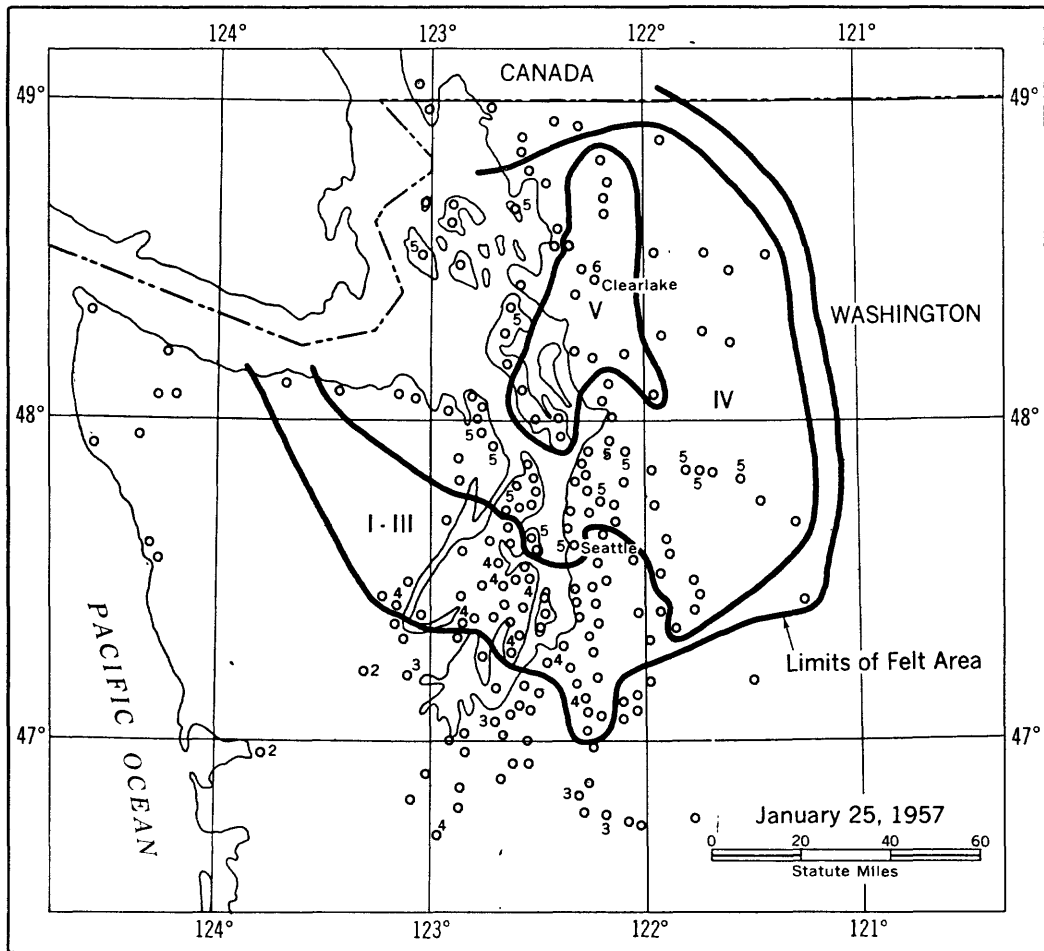


FIGURE 12.—Area affected by earthquake of January 25.

February 11: 09:04:57*. Epicenter 47°32' north, 121°04' west, near North Bend, S. Felt over an area of approximately 4,000 square miles of northwestern Washington. Maximum intensity (damage) VI.

INTENSITY (DAMAGE) VI:

Fall City.—Felt by all; frightened few. Chimney cracked. Small objects and furnishings shifted; knickknacks fell.

North Bend Ranger, Station (North Bend).—Felt by several. Eight-inch plasterboard crack. Windows, doors, and dishes rattled slightly; house creaked. Felt by many at North Bend (some outdoors; active); awakened and frightened few.

Snoqualmie.—Felt by many (by observer; active). Plaster cracked. Dishes rattled; walls creaked.

INTENSITY (DAMAGE) V: Issaquah, Preston, Redmond, Snoqualmie Falls, and Snoqualmie Falls Tree Farm (near Black Lake).

INTENSITY (DAMAGE) IV: Bothell, Carnation, Cedar Falls and Cedar Falls Power Station Camp, Gold Bar, Kenmore, Kenndale, Orillia, Port Gamble, Renton, Seahurst, Seattle and Seattle-Tacoma Airport (15 miles south of Seattle), and Sellick.

INTENSITY (DAMAGE) I TO III: Bellevue, Cumberland, Dash Point, Dockton, Eatonville, Gorst, Houghton, Longley, Maltby, Mercer Island, Mukilteo, Pacific, Port Blakely, Poulsbo, Redondo, Seabeck, Skykomish, Sultan, Summer, Tracyton (2 miles north of), Vashon, and Woodinville.

March 14: 03:16. Bellingham, Washington area, S. IV. Distinctly felt by many in the Lake Sammish, Lake Whatcomb, and southern suburban areas of Bellingham.

March 22: 16:00. Alsea, Oreg. Two light tremors felt.

May 4: 13:09:25*. Epicenter 47°21' north, 122°23' west, Puget Sound, near Dash Point, S. Felt over an area of approximately 2,000 square miles of western Washington. Maximum intensity (damage) V.

INTENSITY (DAMAGE) V:

Alcona.—Felt by and frightened many in community; awakened few. Small objects shifted.

Auburn.—Chair moved back and forth about 2 inches. Motion reported as quite violent. Observer immediately left modern concrete building. Felt like a sharp, up-and-down movement to another person, who became slightly nauseated. Windows rattled; walls creaked.

Buckley.—Felt by all. Windows, doors, and dishes rattled.

Des Moines.—Felt by all.

Redondo.—Felt by several. Small objects shifted. Windows rattled.

Sumner.—Felt by and frightened many. Trees, bushes shaken moderately.

Zenith.—Felt by all.

INTENSITY (DAMAGE) IV: Alderton, Bremerton, Burien, Burley, Burton, Cove, Dash Point, Dockton, Fox Island, Gorst, Manchester, McMillin, Milton, Oakville, Olalla, Olympia, Orting, Port Orchard, Puyallup, Roy, South Colby, Southworth, Spanaway, Tacoma, Tracyton, Tumwater, Wauna, and Yoman.

INTENSITY (DAMAGE) I TO III: Belfair, Carbonado, Cedar Falls, Dieringer, Eatonville, Fort Steilacoom, Gig Harbor, Harper, Kennydale, Lakebay, Lakeview, North Bend, Orillia, Portage, Seabeck, Seahurst, and Seattle.

May 29: 02:46 and 03:15. Hoodsport, Wash. (Lake Cushman, Cushman Power Plant No. 1), S. IV. Felt by several at power plant; awakened few in home and community.

July 7: 09:23. North Bend, Wash., S. IV. Felt by several. Walls creaked. Lasted 10 seconds; direction northeast-southwest.

October 29: 07:30. Eatonville and Selby, Wash., S. IV. At Eatonville some persons left their beds and went outdoors to find out what had happened. Reported as having about the same intensity as the shock of November 1 at 02:12:00*. At Elbe, many felt the shock, which was accompanied by a rumbling noise.

November 1: 02:12:00*. Epicenter 47° north, 121° west, near Mount Rainier, W. Felt over an area of approximately 1,500 square miles of southwestern Washington, principally in Pierce and Lewis counties. Maximum intensity (damage) V.

INTENSITY (DAMAGE) V:

Longmire.—Felt by and awakened many in community. Windows rattled; walls creaked.

Packwood.—Awakened all and frightened few in community. Windows rattled; houses shaken. Regarded as strong shock by everyone. Two slight shocks felt about 10–15 minutes after the first; one moderately heavy shock felt about 30–40 minutes after first shock.

Randle.—Strong shock. Felt by and awakened many in community; frightened few. Windows, doors, and dishes rattled; trees, bushes shaken slightly. Two light aftershocks felt.

INTENSITY (DAMAGE) IV: Ashford, Eatonville, Elbe, Enumclaw, and Morton.

INTENSITY (DAMAGE) I TO III: Baldi (8 miles east of Palmer), Granite Falls and 2 miles south of, Riffe (25 miles east of), and Seattle.

November 16: 22:00:29*. Epicenter 45.3° north, 123.8° west, northwest of Salem, B. Felt over a land area of approximately 4,500 square miles of northwestern Oregon. (See map, p. 38.) Maximum intensity (damage) VI at Salem. Damage slight.

INTENSITY (DAMAGE) VI:

Salem.—Frightened all. Plaster and walls cracked in West Salem. Furnishings shifted. In the northeast section, pictures and lamps rattled; whole house rumbled. Woman lying on sofa said sofa "began to move across room." TV temporarily blacked out and other momentary outages reported. Some persons reported the motion seemed like a single, sharp, blastlike jolt, while others said the vibrations lasted for several seconds.

INTENSITY (DAMAGE) V: Dallas, Newberg, Otis, Willamina, and Yamhill.

INTENSITY (DAMAGE) IV: Aloha, Aumsville, Beaver, Boring, Brooks, Cherry Grove, Cloverdale, Corvallis, Dundee, Falls City, Grande Ronde, Harlan, Kernville (7 miles up river), McMinville, Molalla, Pacific City, Portland, Sherwood, Siletz, Tillamook, Toledo (4 miles east of), and Valsetz.

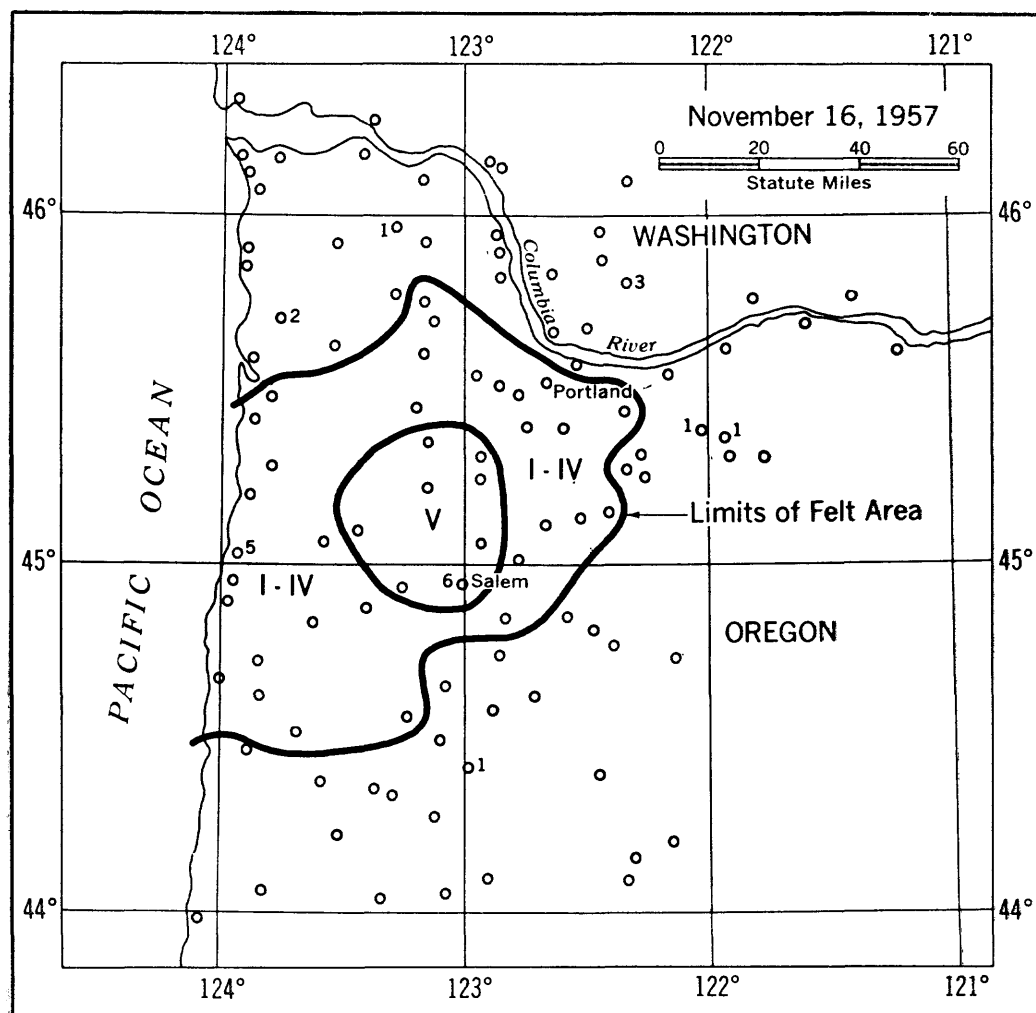


FIGURE 13.—Area affected by earthquake of November 16.

INTENSITY (DAMAGE) I TO III: Birkenfeld, Brightwood, Brownsville, Buxton, Colton, Gales Creek, Hood River, Monmouth, Nehalem, Oceanside, Silverton, Taft, Woodburn, and Zigzag.

INTENSITY (DAMAGE) I TO III IN WASHINGTON: Yacolt (about 7 miles southeast of, Dole Valley).

ALASKA

(150TH MERIDIAN OR ALASKA STANDARD TIME)

March 9: 04:06:52*. Epicenter 65° north, 149° west, central Alaska, W. V. Felt by and alarmed many at Fairbanks, where buildings rocked; ceiling lights swayed; and windows rattled. Deep subterranean sounds heard by many. At the International Airport outer marker at end of runway knocked out. Disturbed objects observed by several. Also felt at College and Ladd Air Force Base. Aftershocks felt at 04:45.

March 9: 04:22:27.5*. Epicenter 51.3° north, 175.8° west, Andreanof Islands, Aleutian Islands, W. Magnitude 8.3. This great earthquake initiated a series of shocks extending more than 700 miles along the southern edge of the Aleutian Islands from Unimak Island to Amchitka Pass, which separates the Andreanof Islands from the Rat Islands. More than three hundred aftershocks occurred. It was reported a 40-foot wall of water smashed against the coastline at Scotch Cap. At Sand Bay a 26-foot wave washed away many buildings and did extensive damage

to oil lines. On Adak, 15-foot-wide cracks appeared in road. Also two bridges were destroyed and some damage to housing was reported. At Umnak the earthquake destroyed part of the dock, flipping the piling on the road like matches. A cement mixer was turned upside down and other equipment scattered about. Mount Vsevidof, on Umnak, dormant for 200 years, erupted. Other volcanic activity was reported on the Alaska Peninsula where Mount Trident was observed sending up smoke and steam.

Seismic sea wave caused destruction of two villages and \$3,000,000 damage on Oahu and Kauai, T.H. Waves up to 10 feet flooded fishing hamlets on the eastern shore of Hokkaido, Japan. The wave caused minor damage in San Diego Bay, Calif., and Acajutla, El Salvador. The wave was also noted at many points in the Pacific. Details regarding the effects of this seismic sea wave are given in references listed in the section on Tidal Disturbances of Seismic Origin, page 46.

March 9: 05:41:50*. Epicenter $50\frac{1}{2}^{\circ}$ north, 177° west, Andreanof Islands, Aleutian Islands, W. Felt on Adak.

March 9: 06:32:30*. Epicenter 51° north, 176° west, Andreanof Islands, Aleutian Islands, W. Felt on Adak.

March 9: 06:45:26*. Epicenter 51.5° north, 174° west, Andreanof Islands, Aleutian Islands, W. Felt on Adak.

March 9: 07:10:13*. Epicenter $51\frac{1}{2}^{\circ}$ north, $172\frac{1}{2}^{\circ}$ west, Andreanof Islands, Aleutian Islands, W. Felt on Adak.

March 9: 09:37:31*. Epicenter 51° north, 173° west, Andreanof Islands, Aleutian Islands, W. Felt on Adak.

March 9: 17:06:10.5*. Epicenter 51.6° north, 174.4° west, Andreanof Islands, Aleutian Islands, W. Magnitude $6\frac{1}{2}$ - $6\frac{3}{4}$. Felt on Adak.

March 9: 17:08:55*. Epicenter $51\frac{1}{2}^{\circ}$ north, 174° west, Andreanof Islands, Aleutian Islands, W. Felt on Adak.

March 9: 19:33:27*. Epicenter 52° north, 174° west, Andreanof Islands, Aleutian Islands, W. Felt on Adak.

March 9: 21:23:18*. Epicenter 52° north, 176° west, Andreanof Islands, Aleutian Islands, W. Felt on Adak.

March 10: 02:45:31*. Epicenter 51° north, 177° west, Andreanof Islands, Aleutian Islands, W. Felt on Adak.

March 10: 05:26:23.5*. Epicenter 51.5° north, 173.6° west, Andreanof Islands, Aleutian Islands, W. Magnitude $6\frac{3}{4}$ (Berk). Felt on Adak.

March 10: 06:37:45*. Epicenter $51\frac{1}{2}^{\circ}$ north, $173\frac{1}{2}^{\circ}$ west, Andreanof Islands, Aleutian Islands, W. Felt on Adak.

March 10: 09:18:30*. Epicenter 51° north, 177° west, Andreanof Islands, Aleutian Islands, W. Felt on Adak.

March 10: 09:40:55*. Epicenter 52° north, 173° west, Andreanof Islands, Aleutian Islands, W. Felt on Adak.

March 10: 17:12:41.5*. Epicenter 50.9° north, 176° west, Andreanof Islands, Aleutian Islands, W. Magnitude $6\frac{3}{4}$ -7. Felt on Adak.

March 10: 17:35:00*. Epicenter $51\frac{1}{2}^{\circ}$ north, 177° west, Andreanof Islands, Aleutian Islands, W. Felt on Adak.

March 10: 17:55:27*. Epicenter $50\frac{1}{2}^{\circ}$ north, 177° west, Andreanof Islands, Aleutian Islands, W. Felt on Adak.

March 10: 18:05:09*. Epicenter 51° north, 177° west, Andreanof Islands, Aleutian Islands, W. Felt on Adak.

March 10: 21:08:00*. Epicenter 51° north, 177° west, Andreanof Islands, Aleutian Islands, W. Felt on Adak.

March 10: 21:39:05*. Epicenter $51\frac{1}{2}^{\circ}$ north, $178\frac{1}{2}^{\circ}$ west, Andreanof Islands, Aleutian Islands, W. Felt on Adak.

March 10: 22:42:48*. Epicenter $50\frac{1}{2}^{\circ}$ north, 178° west, Andreanof Islands, Aleutian Islands, W. Felt on Adak.

March 11: 04:55:20*. Epicenter 51.5° north, 178.4° west, Andreanof Islands, Aleutian Islands, W. Magnitude $6\frac{3}{4}$. Felt on Adak and Umnak.

March 11: 05:35:53*. Epicenter 51.1° north, 179.0° west, Andreanof Islands, Aleutian Islands, W. Magnitude $6\frac{1}{2}$. Felt on Adak and Umnak.

- March 11:** 13:32:03*. Epicenter 52° north, 173° west, Andreanof Islands, Aleutian Islands, W. Felt on Adak.
- March 11:** 15:02:33*. Epicenter 52° north, 174½° west, Andreanof Islands, Aleutian Islands, W. Felt on Adak.
- March 11:** 15:46:35*. Epicenter 52° north, 173° west, Andreanof Islands, Aleutian Islands, W. Felt on Adak.
- March 11:** 21:28:48*. Epicenter 51.7° north, 174.1° west, Andreanof Islands, Aleutian Islands, W. Magnitude 6¼-6½. Felt on Adak.
- March 11:** 21:39:17.5*. Epicenter 51.0° north, 178.2° west, Andreanof Islands, Aleutian Islands, W. Magnitude 6¼-6½. Felt on Adak.
- March 11:** 22:03:14*. Epicenter 51.2° north, 177.2° west, Andreanof Islands, Aleutian Islands, W. Felt on Adak and Umnak.
- March 12:** 00:38:30*. Epicenter 51½° north, 174½° west, Andreanof Islands, Aleutian Islands, W. Felt on Adak.
- March 12:** 01:44:50.5*. Epicenter 51.4° north, 177.7° west, Andreanof Islands, Aleutian Islands, W. Magnitude 7.3. Felt on Adak and Umnak.
- March 12:** 07:00:21*. Epicenter 51½° north, 175° west, Andreanof Islands, Aleutian Islands, W. Felt on Adak.
- March 12:** 08:25:18*. Epicenter 51° north, 178° west, Andreanof Islands, Aleutian Islands, W. Felt on Adak.
- March 12:** 13:45:25*. Epicenter 52° north, 174° west, Andreanof Islands, Aleutian Islands, W. Felt on Adak.
- March 12:** 16:48:22*. Epicenter 51.7° north, 171.2° west, Andreanof Islands, Aleutian Islands, W. Felt on Adak.
- March 12:** 17:32:58*. Epicenter 51.4° north, 175.3° west, Andreanof Islands, Aleutian Islands, W. Felt on Adak.
- March 12:** 21:21:53*. Epicenter 51.4° north, 178.4° west, Andreanof Islands, Aleutian Islands, W. Felt on Adak.
- March 13:** 01:37:49*. Epicenter 51° north, 177° west, Andreanof Islands, Aleutian Islands, W. Felt on Adak.
- March 13:** 01:57:58*. Epicenter 52° north, 173° west, Andreanof Islands, Aleutian Islands, W. Felt on Adak.
- March 13:** 02:42:35*. Epicenter 51½° north, 177° west, Andreanof Islands, Aleutian Islands, W. Felt on Adak.
- March 13:** 05:42:04*. Epicenter 51.3° north, 178.5° west, Andreanof Islands, Aleutian Islands, W. Magnitude 6¾. Felt on Adak.
- March 13:** 07:43:40*. Epicenter 51° north, 175° west, Andreanof Islands, Aleutian Islands, W. Felt on Adak.
- March 13:** 14:35:38*. Epicenter 51° north, 178° west, Andreanof Islands, Aleutian Islands, W. Felt on Adak.
- March 14:** 04:47:45.5*. Epicenter 51.2° north, 177.4° west, Andreanof Islands, Aleutian Islands, W. Magnitude 7.2. Felt on Adak.
- March 14:** 05:51:00*. Epicenter 51½° north, 177½° west, Andreanof Islands, Aleutian Islands, W. Felt on Adak.
- March 14:** 07:06:21*. Epicenter 51° north, 178° west, Andreanof Islands, Aleutian Islands, W. Felt on Adak.
- March 14:** 12:18:23*. Epicenter 51½° north, 176° west, Andreanof Islands, Aleutian Islands, W. Felt on Adak.
- March 14:** 18:12:56*. Epicenter 51° north, 176° west, Andreanof Islands, Aleutian Islands, W. Felt on Adak.
- March 15:** 01:57:28*. Epicenter 51° north, 173° west, Andreanof Islands, Aleutian Islands, W. Felt on Adak.
- March 15:** 12:13:25*. Epicenter 51½° north, 177° west, Andreanof Islands, Aleutian Islands, W. Felt on Adak.
- March 15:** 16:13:23*. Epicenter 51½° north, 175° west, Andreanof Islands, Aleutian Islands, W. Felt on Adak.
- March 15:** 16:34:12*. Epicenter 52° north, 179° west, Andreanof Islands, Aleutian Islands, W. Magnitude 6¾. Felt on Adak.

- March 15:** 17:33:57*. Epicenter 52° north, 174° west, Andreanof Islands, Aleutian Islands, W. Felt on Adak.
- March 15:** 23:30:36*. Epicenter 51° north, 177° west, Andreanof Islands, Aleutian Islands, W. Felt on Adak.
- March 16:** 16:48:36*. Epicenter 51° north, 178½° west, Andreanof Islands, Aleutian Islands, W. Felt on Adak.
- March 16:** 21:53:51*. Epicenter 51° north, 179° west, Andreanof Islands, Aleutian Islands, W. Felt on Adak.
- March 17:** 14:12:10*. Epicenter 51° north, 179½° west, Andreanof Islands, Aleutian Islands, W. Felt on Adak.
- March 17:** 19:08:34*. Epicenter 51½° north, 179° west, Andreanof Islands, Aleutian Islands, W. Felt on Adak.
- March 18:** 14:40. Valdez. Slight shock. Duration 2 seconds.
- March 18:** 17:39:35*. Epicenter 52° north, 175½° west, Andreanof Islands, Aleutian Islands, W. Felt on Adak.
- March 19:** 01:28:50*. Epicenter 51½° north, 176½° west, Andreanof Islands, Aleutian Islands, W. Felt on Adak.
- March 19:** 02:50:51*. Epicenter 51½° north, 175° west, Andreanof Islands, Aleutian Islands, W. Magnitude 6¼. Felt on Adak.
- March 19:** 14:00:51*. Epicenter 52° north, 173° west, Andreanof Islands, Aleutian Islands, W. Felt on Adak.
- March 19:** 17:25:00*. Epicenter 51½° north, 175½° west, Andreanof Islands, Aleutian Islands, W. Felt on Adak.
- March 20:** 01:01:42*. Epicenter 52° north, 172° west, Andreanof Islands, Aleutian Islands, W. Felt on Adak.
- March 20:** 10:28:03*. Epicenter 51½° north, 174½° west, Andreanof Islands, Aleutian Islands, W. Felt on Adak.
- March 20:** 18:29:02*. Epicenter 52° north, 173° west, Andreanof Islands, Aleutian Islands, W. Felt on Adak.
- March 21:** 05:46:16*. Epicenter 51° north, 175° west, Andreanof Islands, Aleutian Islands, W. Felt on Adak.
- March 21:** 07:39:12*. Epicenter 51½° north, 177° west, Andreanof Islands, Aleutian Islands, W. Felt on Adak.
- March 23:** 03:24:33*. Epicenter 51½° north, 179° west, Andreanof Islands, Aleutian Islands, W. Felt on Adak.
- March 23:** 03:39:53*. Epicenter 51° north, 179½° west, Andreanof Islands, Aleutian Islands, W. Felt on Adak.
- March 23:** 21:29:15*. Epicenter 51° north, 179½° west, Andreanof Islands, Aleutian Islands, W. Felt on Adak.
- March 24:** 03:53:53*. Epicenter 51° north, 179½° west, Andreanof Islands, Aleutian Islands, W. Felt on Adak.
- March 24:** 15:03:59*. Epicenter 52° north, 176° west, Andreanof Islands, Aleutian Islands, W. Felt on Adak.
- March 25:** 16:47:50*. Epicenter 51° north, 177½° west, Andreanof Islands, Aleutian Islands, W. Felt on Adak.
- March 26:** 08:16:47*. Epicenter 51° north, 179½° west, Andreanof Islands, Aleutian Islands, W. Felt on Adak.
- March 27:** 15:15:20*. Epicenter 51½° north, 174½° west, Andreanof Islands, Aleutian Islands, W. Felt on Adak.
- March 29:** 14:42:40*. Epicenter 51½° north, 179½° west, Andreanof Islands, Aleutian Islands, W. Felt on Adak.
- March 29:** 15:50:39*. Epicenter 51½° north, 178° west, Andreanof Islands, Aleutian Islands, W. Felt on Adak.
- March 29:** 23:17:00*. Epicenter 52° north, 175° west, Andreanof Islands, Aleutian Islands, W. Felt on Adak.
- March 31:** 00:08:28*. Epicenter 51½° north, 178° west, Andreanof Islands, Aleutian Islands, W. Felt on Adak.

April 3: 13:09:15*. Epicenter $51\frac{1}{2}^{\circ}$ north, 177° west, Andreanof Islands, Aleutian Islands, W. Felt on Adak.

April 3: 14:13:08*. Epicenter 58° north, $155\frac{1}{2}^{\circ}$ west, near coast of Alaska Peninsula, W. Depth about 150 km. Felt on Kodiak. Intensity (damage) IV at Kitoi Bay, where house shook and rumbling sounds heard. Duration 30 seconds.

April 4: 04:00. Valdez. Felt. Duration 3 seconds.

April 5: 06:36:20*. Epicenter $51\frac{1}{2}^{\circ}$ north, $178\frac{1}{2}^{\circ}$ west, Andreanof Islands, Aleutian Islands, W. Felt on Adak.

April 7: 17:30. Kitoi Bay. Slight tremor.

April 22: (no time given). Wild Lake. Three tremors. Duration 1-2 seconds.

April 24: 04:00. Cordova. Slight tremor.

April 25: 00:25. Cordova. Slight tremor.

April 25: 03:22:42*. Cordova. IV. Felt by and awakened several. Disturbed objects observed by several. Trees and buildings swayed.

April 25: 04:07:58*. Epicenter $60\frac{1}{2}^{\circ}$ north, 145° west, near south coast of Alaska, W. Felt at Valdez.

April 26: 00:23:17*. Epicenter 60° north, 147° west, near south coast of Alaska, W. Cordova. IV. Felt by and awakened several. Disturbed objects observed by several. Trees and buildings swayed. Lights swayed in east-west direction. Also felt at Valdez.

June 1: 03:39. Kenai. Light tremor.

June 1: 06:03:52*. Epicenter $59\frac{1}{2}^{\circ}$ north, $150\frac{1}{2}^{\circ}$ west, Kenai Peninsula, W. Felt at Kenai where 3 heavy tremors were reported. Also felt 5 miles northwest of Homer.

June 6: (no time given). Valdez. Slight tremor.

June 12: 18:08:08*. Felt at College and Fairbanks.

June 18: 13:30. Big Lake. Light tremor.

June 22: 17:27:02*. Epicenter $58\frac{1}{2}^{\circ}$ north, 137° west, near coast of southeastern Alaska, W. Magnitude $5\frac{1}{2}$ - $5\frac{3}{4}$ (Berk). Felt at Sitka.

July 16: 07:57. Caswell. Felt.

July 25: 08:00. Caswell. Felt.

August 13: 02:00:03*. Epicenter 61° north, 148° west, southern Alaska, W. Felt at Valdez. Duration 5 seconds. Two shocks, early a.m., reported 4 miles southeast of Palmer.

August 18: 08:30. Moose Valley. Felt.

August 27: 08:15. Homer (5 miles northwest of). Felt.

October 4: 01:19. Homer (5 miles northwest of). Felt. Slight tremor.

October 4: 13:03. Valdez. Slight tremor. Duration 2 seconds.

October 11: 11:20. Homer (5 miles northwest of). Felt. Slight tremor.

November 6: 21:39:07*. Fairbanks and College. IV. Felt by many. Also felt at Nenana and McKinley Park.

November 22: 01:09. Valdez. Felt. Duration 3 seconds.

December 3: 10:40. Seward. Felt. Slight tremor.

December 9: 15:31. Moose Valley. Felt. Slight tremor.

December 20: 10:17. Eklutna. Felt. Slight tremor.

HAWAIIAN ISLANDS

(150TH MERIDIAN OR HAWAIIAN STANDARD TIME)

NOTE.—Data on the following local disturbances were determined from seismograph stations operated on the islands of Hawaii and Maui by the Hawaiian Volcano Observatory of the Geological Survey. For additional information, see the Hawaiian Volcano Observatory Summary 5 through 8.

January 3: 21:25:42*. Moderate. Felt by few at Hawaii National Park. Origin northeast rim of Kilauea caldera.

January 6: 08:45. Feeble. Felt by many in central Kona. Origin Kealakekua.

January 7: 12:54:15*. Moderate. Felt from Kilauea caldera to Kona. Origin east of Anipeahi on the southeast flank of Mauna Loa.

January 22: 18:35:24*. Slight. Felt by several in central Kona. Origin Kealakekua.

February 11: 14:03:24*. Moderate. Felt in the vicinity of Kilauea caldera and in central Kona. Origin west of Apua Point.

February 23: 17:34:32*. Moderate. Felt by many in central Kona. Origin Kona.

- March 13: 07:57:26*. Feeble. Felt near Kilauea caldera. Origin southeast of Apua Point.
- April 5: 22:28:40*. Moderate. Felt northwest of Honokaa. Origin near Kamuela.
- April 6: 09:57:38*. Slight. Felt in the vicinity of Kilauea caldera. Origin south of Uwekahuna.
- May 14: 16:51:47*. Feeble. Felt at Kapapala. Origin southwest of Pahala.
- May 16: 03:38:27*. Moderate. Felt from Hilo to Kapapala. Origin south of the Mauna Loa seismograph station.
- May 18: 10:52:56*. Very feeble. Felt at Captain Cook. Origin Kealakekua fault.
- May 21: 06:46:44*. Feeble. Felt from Kilauea caldera to Hilo. Origin southeast of Uwekahuna.
- June 5: 06:41:19*. Moderate. Felt along the northeast rim of Kilauea caldera. Origin north of the Whitney station.
- June 9: 00:35:52*. Feeble. Felt at Captain Cook. Origin Kealakekua fault.
- June 20: 22:37:15*. Very feeble. Felt at Captain Cook. Origin Kealakekua fault.
- July 4: 00:53:59*. Strong. Felt generally over the island of Hawaii. Origin southwest of Waikii.
- July 4: 01:03:28*. Feeble. Felt at Kealakekua and Hawaii National Park. Origin southwest of Ohaieka.
- July 19: 09:31:51*. Felt at Kealakekua. Origin Kealakekua.
- July 26: 01:40:30*. Strong. Felt at Kealakekua. Origin west of Hawi.
- July 27: 02:16:57*. Feeble. Felt at Kealakekua. Origin near Kealakekua.
- August 18: 00:41:54*. Epicenter 21° north, 156° west, Hawaiian Islands, W. Felt widely on the islands of Hawaii and Maui. Origin east of Hana, Maui.
- August 23: 08:38. Feeble. Felt at Hawaii National Park Headquarters.
- August 23: 08:41:14*. Moderate. Felt at Hawaii National Park Headquarters.
- August 23: 08:46:44*. Very feeble. Felt at Hawaii National Park Headquarters.
- August 26: 16:58:52*. Strong. Felt at Kukuihaele and Pohakuloa. Origin beneath the summit of Kohala mountain.
- September 5: 09:31:24*. Slight. Felt at Hilo. Origin north of Keeau.
- September 14: 05:22:48*. Very feeble. Felt at Hilo. Origin east of Apua Point.
- September 29: 03:37:02*. Slight. Felt at the Slope Observatory and Captain Cook. Origin south of Ohaieka.
- October 25: 01:02:38*. Very feeble. Felt at Captain Cook. Origin near Keahole Point.
- October 28: 19:23:57*. Feeble. Felt at Hawaii National Park Headquarters. Origin east rim of Kilauea caldera.
- October 31: 05:48:24*. Feeble. Felt at Captain Cook. Origin Kealakekua fault.
- November 16: 02:30:32*. Very feeble. Felt at Kealakekua and Captain Cook. Origin west of Kailua.
- November 23: 20:21:28*. Moderate. Felt at Hawaii National Park, Kealakekua, and Kamuela. Origin southwest of the Mauna Loa Seismograph Station.
- November 30: 17:15:45*. Felt at Captain Cook. Origin Kealakekua fault.

PANAMA CANAL ZONE

(60TH MERIDIAN TIME)

- February 4: 05:01:52*. Epicenter 10° north, 84° west, Costa Rica, W. Felt strongly at Puerto Armuelles, Panama.
- April 8: 16:18:09*. Epicenter 8½° north, 83° west, Panama-Costa Rica border, W. Magnitude 6½. Felt at San Jose, Costa Rica; Balboa Heights, Canal Zone; and strongly at Puerto Armuelles, Panama.
- April 28: 02:40:29*. Balboa Heights. III. Felt.
- May 10: 07:22:08*. Balboa Heights. I. Felt.
- July 10: 05:04:08*. Epicenter 8° north, 82½° west, near coast of Panama, W. Magnitude 6½-6¾. Felt on board ship at 7°22' north, 82°48' west—vibrations lasted 5 seconds. Also felt at Balboa Heights.
- August 15: 04:32:56*. Epicenter 10° north, 80° west, near north coast of Panama, W. Balboa Heights. IV. Felt in the Canal Zone and Panama.

October 31: 06:07:54*. Epicenter $6\frac{1}{2}^{\circ}$ north, 83° west, off coast of Panama, W. Magnitude $6\frac{1}{2}$ - $6\frac{3}{4}$. Balboa Heights. III. Felt on board the SS Hai Huang at $7^{\circ}30'$ north, $83^{\circ}16'$ west—vessel vibrated heavily twice at intervals of 10 seconds.

PUERTO RICO

(60TH MERIDIAN TIME)

October 23: 00:38:30*. Epicenter 19° north, 64° west, Puerto Rico, W. Felt strongly in eastern Puerto Rico and St. Thomas, Virgin Islands.

December 27: 07:22:25*. San Juan. IV. Felt. Windows rattled.

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 1957.

After the San Francisco earthquake of March 22, 1957 (page —), the network of triangulation points originally observed in 1951 was reobserved. This system is composed of points 6 to 8 miles apart, almost filling the area between Mount Tamalpais, Sierra Morena, Mount Diablo, and Mocho.

Figure 14 shows the shift in position as indicated by a comparison of two independent adjustments, using the line between Mount Oso and Vaca as a fixed base. The vectors show the same systematic movement as disclosed by previous resurveys. The faults shown are taken from the Geomorphic Map of California (1938) by Olaf P. Jenkins, Chief Geologist, California Department of Natural Resources. There does not appear to be any sharp break or discontinuity in the

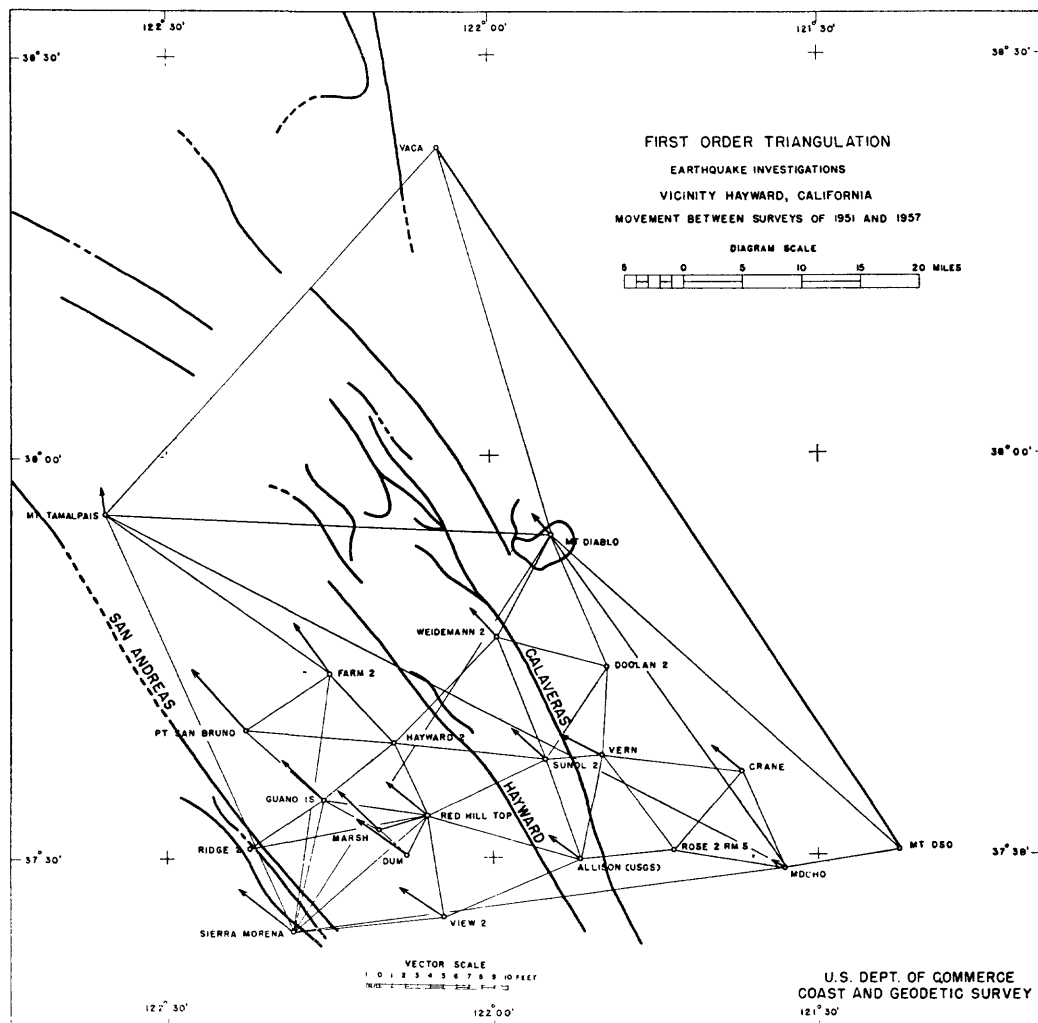


FIGURE 14.—Horizontal movements indicated by comparative surveys made in 1951 and 1957.

field of vectors such as would be expected if there had been any large horizontal displacement along any of these faults.

A word of caution needs to be given concerning the interpretation of these vectors. The pattern suggests the possibility of clockwise rotation about the base line. Adverse atmospheric conditions during either survey could produce as much as a two second change of azimuth on the base line, which would show a false shift of three feet at Sierra Morena. However, the check angles that were measured at each end of the base line indicated that the error due to atmospheric conditions was probably much less than this so it can be concluded that a major portion of the indicated displacement is real.

The two small check figures, one at Olema and the other at Crystal Springs, were reobserved. One of the four marks at Olema had been destroyed. This was replaced by a new monument. The checks on the other three indicated some slight disturbance, less than one centimeter, between them. The checks at Crystal Springs gave no evidence of any shift.

Two new sets of check points were established near Hollister at the Taylor Winery. One set consists of 4 points in a quad and the other of 4 points on line perpendicular to the fault. Both sets straddle the fault line. There had been evidence of slippage along this portion of the fault line and these two sets of check points will be resurveyed periodically.

In 1957, about 2,000 miles of releveled was undertaken in California over a net of lines covering a region from the vicinity of Los Banos south to Wheeler Ridge. Although this releveled is of particular interest to those studying subsidence in the San Joaquin Valley, it also covers areas of earthquake investigation. Anchors were secured in bedrock in the Sierra Nevada and Coast Ranges and also a tie was made to tidal observations at San Luis Obispo Bay.

TIDAL DISTURBANCES OF SEISMIC ORIGIN

There were two seismic sea waves recorded on tide gages during 1957. The Aleutian Islands earthquake of March 9 with epicenter at 51.3° north, 175.8° west, generated a seismic sea wave recorded by 52 tide stations throughout the Pacific. Three- to nine-foot waves battered the northern fringes of the Hawaiian Islands, 10-foot waves smashed the Japanese coast, and 6-foot waves reached as far as the shores of Chile. Timely warnings disseminated by the Seismic Sea Wave Warning System materially minimized property damage and prevented any loss of life. A study of the tidal records has provided the Coast and Geodetic Survey with much additional data on wave velocity, period, and height. Observed travel times to tide gages were:

	<i>h</i>	<i>m</i>		<i>h</i>	<i>m</i>
Honolulu	4	28	San Francisco	5	56
Wake Island	4	45	Port Hueneme	6	32
Guam	6	40	La Jolla	6	36
Pago Pago	9	07	Acapulco	10	51
Sitka	4	54	Talara	15	03
Neah Bay	4	58	Valparaiso	18	26
Crescent City	5	11			

The Mexican shock of July 28 at $16\frac{1}{2}^{\circ}$ north, 99° west, was accompanied by a seismic sea wave that was recorded on Mexican gages at Acapulco and Salina Cruz. At Acapulco the maximum amplitude was about $8\frac{1}{2}$ feet; at Salina Cruz it was about one foot.

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 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 United States Earthquakes, 1943, and those for subsequent years through 1949 appeared in United States Earthquakes, 1949, and United States Earthquakes, 1950, 1951, 1952, 1953, 1954, 1955, and 1956, respectively. Descriptions of wells given here include only those that have not appeared in previous editions.

WELL DESCRIPTIONS

ALABAMA

Well No. Mag-2, artesian, Thomaston, SE $\frac{1}{4}$ NE $\frac{1}{4}$ Sec. 24, T. 15 N., R. 4 E. Owner, Thomaston Prison. Depth, 1,224 feet; diameter, 4 inches; depth of casing, 20 feet; screen, 1,202 to 1,222 feet. Aquifer, sand; Eutaw formation, late Cretaceous.

Well No. Mon-3, artesian, Monroeville, NE $\frac{1}{4}$ NW $\frac{1}{4}$ Sec. 2, T. 6 N., R. 7 E. Owner, U.S. Geological Survey. Depth, 128.3 feet; diameter, 6 inches; depth of casing, 88 feet; finish, open hole. Aquifer, sand, gravel and limestone; Eocene, Oligocene, Miocene, and Pliocene.

Well No. Tus-1, nonartesian, Tuscaloosa, NE $\frac{1}{4}$ NE $\frac{1}{4}$ Sec. 23, T. 21 S., R. 10 W. Owner, U.S. Geological Survey. Depth, 56 feet; diameter, 4 inches; depth of casing, 56 feet; screen, from 50 to 56 feet. Aquifer, sand and gravel; Tuscaloosa group of Late Cretaceous age.

CALIFORNIA

Well No. 32/36-35R2, nonartesian, 3.5 miles east of Mojave Marine Corps Auxiliary Air Station, SE $\frac{1}{4}$ SE $\frac{1}{4}$ Sec. 35, T. 32 S., R. 36 E. Owner, U.S. Navy. Depth, 720 feet; diameter, 8 $\frac{5}{8}$ inches; depth of casing, 720 feet; finish, perforated casing from 200 to 720 feet. Aquifer, gravel, sand, and clay lenses; Late Tertiary (?) to Quaternary alluvial deposits.

Well No. 15/16-20R1, nonartesian, Fresno County, SE, SE, Sec. 20, T. 15 S., R. 13 E., MDB and M. Owner, Tranquillity Irrigation District. Depth, 1,250 feet; diameter, 16 inches; finish, perforated casing from 490 to 1,203 feet. Aquifer, gravel and sand; Recent and Pleistocene undifferentiated.

Well No. 14/13-28P1, artesian, Fresno County, SE, SW, Sec. 28, T. 14 S., R. 13 E., MDB and M. Owner, Emp. Enterprises. Depth, 1,780 feet; diameter, 16 inches; finish, perforated casing from 601 to 1,789 feet, gravel packed. Aquifer, Recent and Pleistocene (?) undifferentiated.

IDAHO

Well No. 7N-36E-20cal, nonartesian, North Lake Game Refuge, Jefferson County, 43°55' N., 112°22' W. Owner, Idaho Department of Fish and Game. Depth, 65 feet; diameter, 20 inches; depth of casing 45 feet; finish, open end black iron casing. Aquifer, lava and cinders; some sand, gravel and clay, Snake River Lava, Quaternary.

NEW YORK

Well No. Q64, artesian, 83d St., and 45th Ave., Elmhurst, 40°44'30" N., 73°52'50" W. Owner, American Ice Company. Depth, 560 feet; diameter, 10 to 8 inches; screen in Lloyd sand member and also open hole in underlying metamorphic bedrock. Aquifer, Lloyd sand member, Raritan formation (Upper Cretaceous) and underlying schist and gneiss (Pre-Cambrian to Ordovician).

TABLE 1.—*Fluctuations in well-water levels, January 1 through December 1957.*

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

ALABAMA

Well No.	Date	Time G.C.T.	Depth to water				Amplitude of fluctuation
			Before disturb- ance	After disturb- ance	At highest point	At lowest point	
Jef-1.....	Mar. 9, 1957	13:30	46.64	46.68	46.55	46.73	0.18
Tus-1.....	Mar. 21, 1957	18:00	25.64	25.65	25.52	25.76	.24
Mon-3.....	June 10, 1957	21:00	59.55	59.53	59.40	59.58	.18
Mag-2.....	June 20, 1957	22:00	10.79	10.79	10.77	10.81	.04
Jef-1.....	July 28, 1957	06:30	49.70	49.70	49.58	49.82	.24

CALIFORNIA

18/18-31P1.....	Jan. 9, 1957	08:00	176.54	176.54	176.52	176.57	0.05
18/18-31P1.....	Jan. 19, 1957	02:00	176.64	176.64	176.62	176.67	.05
18/18-31P1.....	Jan. 23, 1957	12:00	175.55	175.55	175.53	175.58	.05
18/18-31P1.....	Feb. 1, 1957	02:00	176.14	175.85	175.82	176.15	.33
11/5-2N4.....	Feb. 3, 1957	23:00	10.15	10.15	10.14	10.22	.08
15/16-34E1.....	Feb. 8, 1957	13:00	154.70	154.70	154.67	154.74	.07
18/18-31P1.....	Feb. 17, 1957	16:00	176.00	176.00	175.97	176.00	.03
18/18-31P1.....	Feb. 21, 1957	00:00	175.53	175.59	175.53	175.59	.06
15/16-34E1.....	Feb. 26, 1957	21:00	155.90	155.90	155.87	155.93	.06
15/16-20R1.....	Mar. 9, 1957	22:00	66.25	66.21	66.16	66.33	.17
15/16-20R1.....	Mar. 14, 1957	19:00	68.37	68.37	68.41	68.36	.05
15/16-34E1.....	Mar. 18, 1957	19:00	159.17	159.20	159.17	159.25	.08
4/28-5K3.....	do.....	18:56	9.26	9.26	9.24	9.28	.04
5/28-34N1.....	do.....	18:56	8.84	8.84	8.84	8.85	.01
15/16-20R1.....	Mar. 22, 1957	18:00	71.53	71.53	71.50	71.55	.05
15/16-20R1.....	Apr. 14, 1957	19:00	66.20	66.20	66.19	66.23	.04
26/40-22P1.....	May 14, 1957	22:00	66.14	66.14	66.14	66.15	.01
20/15-32A1.....	May 26, 1957	20:00	190.93	190.93	190.77	191.37	.60
20/15-32A1.....	July 4, 1957	15:00	191.37	191.37	191.35	191.39	.04
20/15-32A1.....	July 7, 1957	16:00	191.43	191.43	191.31	191.49	.18
18/18-31P1.....	July 8, 1957	11:00	177.17	177.18	177.16	177.20	.04
18/18-31P1.....	July 21, 1957	19:00	179.35	179.33	179.24	179.52	.28
5/28-34N1.....	July 28, 1957	08:45	9.48	9.47	9.44	9.50	.13
18/18-31P1.....	July 29, 1957	07:00	180.22	180.24	180.19	180.24	.05
18/18-31P1.....	do.....	13:00	180.30	180.32	180.27	180.32	.05
11/5-2N4.....	Aug. 13, 1957	12:00	11.50	11.54	11.50	11.56	.06
14/13-28P1.....	Aug. 15, 1957	02:00	399.55	399.59	399.55	399.64	.09
14/13-28P1.....	do.....	06:00	399.60	399.61	399.58	399.62	.04
14/13-28P1.....	Aug. 20, 1957	10:00	400.00	400.00	399.98	400.05	.07
14/13-28P1.....	Aug. 25, 1957	12:00	400.93	400.93	400.89	400.99	.10
2/7-4H1.....	Sept. 5, 1957	08:00	190.56	190.56	190.52	190.56	.04
18/18-31P1.....	Sept. 11, 1957	20:00	182.92	182.91	182.91	182.94	.03
18/18-31P1.....	Sept. 19, 1957	11:00	183.39	183.41	183.38	183.42	.04
13/13-15R1.....	do.....	16:00	244.6	244.6	244.58	244.62	.04
18/18-31P1.....	Sept. 20, 1957	21:00	183.48	183.57	183.48	183.61	.13
18/18-31P1.....	Oct. 12, 1957	16:00	184.95	184.94	184.93	184.97	.04
15/16-34E1.....	Oct. 14, 1957	09:00	167.29	167.29	167.28	167.32	.04
32/36-35E2.....	Oct. 24, 1957	22:00	209.04	209.04	209.03	209.04	.01
15/16-34E1.....	Oct. 26, 1957	05:00	167.15	167.17	167.12	167.20	.08
20/15-32A1.....	Nov. 5, 1957	20:00	190.20	190.21	190.04	190.34	.30
14/13-28P1.....	do.....	23:00	386.08	386.08	386.06	386.12	.06
18/18-31P1.....	Nov. 14, 1957	03:00	183.26	183.24	183.23	183.27	.04
15/16-34E1.....	Nov. 29, 1957	24:00	164.84	164.82	164.80	164.89	.09
15/16-34E1.....	Dec. 11, 1957	06:00	163.28	163.28	163.25	163.31	.06
14/13-28P1.....	Dec. 15, 1957	10:00	390.89	390.89	390.85	390.96	.11
18/18-31P1.....	do.....	16:00	178.21	178.21	178.15	178.21	.06
18/18-31P1.....	Dec. 16, 1957	03:00	178.13	178.12	178.06	178.20	.14
15/16-20R1.....	Dec. 17, 1957	10:00	55.91	55.91	55.89	55.92	.03

Footnotes at end of table.

TABLE 1.—*Fluctuations in well-water levels, January 1 through December 1957—Continued*

NORTHERN FLORIDA

Well No.	Date	Time G.C.T.	Depth to water				Amplitude of fluctuation
			Before disturb- ance	After disturb- ance	At highest point	At lowest point	
M46.....	Feb. 22, 1957	19:00	+10.47	+10.48	+10.94	+10.71	0.23
H500.....	Mar. 2, 1957	00:30	-55.25	-55.25	-55.23	-55.25	.02
L7.....	do.....	00:15	-169.34	-169.34	-169.32	-169.40	.08
M92.....	do.....	00:15	-45.29	-45.29	-45.29	-45.30	.01
P16.....	do.....	01:30	-73.44	-73.45	-73.44	-73.45	.01
T35.....	do.....	00:30	-28.38	-28.40	-28.35	-28.45	.10
M46.....	Mar. 3, 1957	19:00	+13.53	+13.56	+13.67	+13.34	.33
H30.....	Mar. 9, 1957	15:30	+7.17	+7.12	+7.19	+7.07	.12
H500.....	do.....	15:00	-54.30	-54.31	-54.23	-54.36	.13
L7.....	do.....	14:15	-169.40	-169.37	-169.21	-169.62	.41
M92.....	do.....	15:10	-44.50	-44.49	-44.43	-44.55	.12
M450.....	do.....	15:05	-2.30	-2.30	-2.20	-2.38	.18
O47.....	do.....	15:30	-9.85	-9.85	-9.83	-9.88	.05
P16.....	do.....	16:00	-73.60	-73.58	-73.57	-73.60	.03
P13.....	do.....	15:00	-9.60	-9.57	-9.56	-9.60	.04
P246.....	do.....	15:00	-26.37	-26.40	-26.35	-26.43	.08
S9.....	do.....	15:30	-2.76	-2.76	-2.73	-2.77	.04
T35.....	do.....	15:00	-28.15	-28.15	-27.96	-28.45	.49
L7.....	Mar. 12, 1957	13:45	-169.46	-169.49	-169.41	-169.53	.12
T35.....	do.....	14:00	-28.10	-28.15	-28.03	-28.20	.17
L7.....	Mar. 14, 1957	15:45	-169.53	-169.53	-169.48	-169.57	.09
T35.....	do.....	17:00	-28.00	-28.03	-27.95	-28.05	.10
D206.....	Mar. 22, 1957	15:05	-13.96	-13.97	-13.93	-14.00	.07
L7.....	Apr. 21, 1957	21:30	-168.04	-168.02	-167.99	-168.04	.05
D206.....	do.....	22:00	-14.32	-14.31	-14.30	-14.33	.03
M92.....	do.....	22:00	-43.20	-43.19	-43.17	-43.21	.04
T35.....	do.....	22:00	-28.20	-28.20	-28.18	-28.22	.04
D206.....	June 27, 1957	01:00	-14.48	-14.49	-14.44	-14.52	.08
L7.....	do.....	01:00	-162.69	-162.70	-162.65	-162.75	.10
P45.....	do.....	01:00	-66.92	-66.92	-66.90	-66.94	.04
T35.....	do.....	01:00	-19.28	-19.28	-19.20	-19.38	.18
D206.....	July 28, 1957	09:35	-13.41	-13.39	-13.19	-13.61	.42
H30.....	do.....	09:30	-8.39	-8.44	-8.56	-8.29	.27
H500.....	do.....	09:30	-50.72	-50.68	-50.58	-50.78	.20
L7.....	do.....	08:45	-163.15	-163.12	-162.90	-163.36	.46
M46.....	do.....	09:15	-15.04	-15.10	-15.04	-15.14	.10
M92.....	do.....	09:00	-41.65	-41.62	-41.46	-41.81	.35
O47.....	do.....	09:05	-6.92	-6.91	-6.85	-6.98	.13
P16.....	do.....	09:05	-69.85	69.85	-69.77	-69.90	.13
P13.....	do.....	09:30	-8.57	-8.59	-8.50	-8.67	.17
P246.....	do.....	09:30	-25.40	-25.42	-25.33	-25.50	.17
P45.....	do.....	09:10	-66.23	-66.21	-65.90	-66.51	.61
S9.....	do.....	09:00	-1.45	-1.44	-1.37	-1.51	.14
T35.....	do.....	09:30	-16.05	-16.10	-15.75	-16.40	.65
D206.....	Sept. 9, 1957	22:45	-12.60	-12.62	-12.58	-12.70	.12
D206.....	Sept. 24, 1957	09:30	-12.81	-12.80	-12.78	-12.84	.06
P45.....	do.....	09:30	-62.45	-62.45	-62.43	-62.47	.05
L7.....	Oct. 4, 1957	06:00	-155.67	-155.62	-155.60	-155.65	.05
M92.....	do.....	06:00	-40.40	-40.39	-40.38	-40.40	.02
P45.....	do.....	05:45	-62.27	-62.27	-62.21	-62.30	.09
T35.....	do.....	06:00	-14.65	-14.65	-14.60	-14.71	.11
L7.....	Oct. 31, 1957	10:00	-155.41	-155.43	-155.40	-155.43	.03
T35.....	do.....	09:30	-17.55	-17.55	-17.50	-17.58	.08
H30.....	Nov. 9, 1957	21:50	+6.78	+6.79	+6.80	+6.77	.03
L7.....	Nov. 29, 1957	22:30	-157.49	-157.50	-157.48	-157.52	.04
T35.....	Dec. 2, 1957	18:15	-18.40	-18.40	-18.33	-18.47	.14
D206.....	Dec. 4, 1957	06:00	-12.58	-12.55	-12.42	-12.71	.29
H30.....	do.....	05:10	+7.29	+7.34	+7.41	+7.23	.18
H500.....	do.....	05:15	-51.77	-51.76	-51.67	-51.83	.16
L7.....	do.....	05:00	-157.46	-157.40	-157.25	-157.65	.40

Footnotes at end of table.

TABLE 1.—*Fluctuations in well-water levels, January 1 through December 1957—Continued*

NORTHERN FLORIDA—Continued

Well No.	Date	Time G.C.T.	Depth to water				Amplitude of fluctuation
			Before disturb- ance	After disturb- ance	At highest point	At lowest point	
M46.....	Dec. 4, 1957	05:10	+13.74	+13.74	+13.71	+13.76	.05
M92.....	do.....	05:10	-42.75	-42.73	-42.65	-42.79	.14
O47.....	do.....	05:00	-5.78	-5.78	-5.76	-5.80	.04
P16.....	do.....	05:00	-66.50	-66.50	-66.49	-66.52	.03
P13.....	do.....	04:45	-9.42	-9.47	-9.40	-9.47	.07
P246.....	do.....	05:10	-25.53	-25.55	-25.48	-25.60	.12
P45.....	do.....	04:50	-66.87	-66.85	-66.71	-67.02	.31
S9.....	do.....	05:20	-2.50	-2.45	-2.42	-2.51	.09
T35.....	do.....	04:20	-18.40	-18.38	-18.03	-18.78	.75
T36.....	do.....	04:00	-13.63	-13.61	-13.59	-13.67	.08
D206.....	Dec. 17, 1957	14:45	-12.87	-12.87	-12.86	-12.89	.03

SOUTHERN FLORIDA

F210.....	Mar. 1, 1957	24:00	2.24	2.24	2.26	2.19	0.07
F291.....	do.....	24:30	2.94	2.94	2.03	1.86	.17
G580.....	do.....	24:10	3.38	3.38	3.41	3.35	.06
S19.....	do.....	24:00	1.76	1.76	1.81	1.69	.12
S68.....	do.....	24:00	.86	.86	.94	.75	.19
S329.....	do.....	24:30	2.81	2.81	2.83	2.80	.03
F210.....	Mar. 9, 1957	15:00	2.24	2.24	2.26	2.19	.07
F291.....	do.....	15:30	2.04	2.04	2.07	1.97	.10
G580.....	do.....	15:20	3.33	3.33	3.37	3.23	.14
S68.....	do.....	15:00	.97	.97	.98	.93	.05
S329.....	do.....	15:30	2.75	2.75	2.77	2.71	.06
C130.....	July 28, 1957	08:15	3.45	3.45	3.50	3.40	.10
F210.....	do.....	08:15	1.72	1.72	2.00	1.42	.58
F291.....	do.....	08:15	2.02	2.02	2.35	1.63	.72
G518.....	do.....	08:15	2.31	2.31	2.48	2.18	.30
G553.....	do.....	08:15	4.60	4.60	4.72	4.52	.20
G580.....	do.....	08:15	2.37	2.37	2.72	2.08	.64
L414.....	do.....	08:15	19.05	19.05	19.12	19.04	.08
S19.....	do.....	08:15	.80	.80	1.03	.53	.50
S68.....	do.....	08:15	-.07	-.07	.11	-.20	.31
S329.....	do.....	08:15	3.60	3.60	3.74	3.43	.31
C130.....	Dec. 4, 1957	04:15	2.40	2.40	2.42	2.38	.04
F210.....	do.....	04:00	2.46	2.46	2.54	2.38	.16
F291.....	do.....	04:00	2.17	2.17	2.22	2.11	.11
G518.....	do.....	04:15	1.95	1.95	1.99	1.90	.09
G553.....	do.....	04:15	4.35	4.35	4.37	4.30	.07
G580.....	do.....	04:00	2.74	2.74	2.78	2.66	.12
L414.....	do.....	04:15	16.40	16.40	16.41	16.38	.03
S19.....	do.....	04:00	1.33	1.33	1.42	1.23	.19
S68.....	do.....	04:15	.33	.33	.37	.28	.09
S329.....	do.....	04:15	2.35	2.35	2.40	2.30	.10

GEORGIA

12-3.....	Mar. 9, 1957	14:30	26.67	26.67	26.59	26.75	0.16
12-3.....	do.....	21:00	26.79	26.79	26.78	26.80	.02
12-4.....	do.....	14:00	16.61	16.61	16.60	16.63	.03
15-6.....	do.....	14:30	20.02	20.02	20.01	20.02	.01
12-3.....	Mar. 10, 1957	03:30	26.75	26.75	26.74	26.75	.01
12-3.....	Mar. 11, 1957	03:45	26.82	26.82	26.81	26.83	.02
12-3.....	do.....	10:30	26.82	26.82	26.81	26.83	.02
12-3.....	do.....	15:00	26.84	26.84	26.83	26.85	.02

Footnotes at end of table.

TABLE 1.—*Fluctuations in well-water levels, January 1 through December 1957—Continued*

GEORGIA—Continued

Well No.	Date	Time G.C.T.	Depth to water				
			Before disturb- ance	After disturb- ance	At highest point	At lowest point	Amplitude of fluctuation
12-3.....	Mar. 12, 1957	12:45	26.88	26.88	26.86	26.90	.04
12-3.....	Mar. 14, 1957	15:00	27.08	27.08	27.05	27.10	.05
12-3.....	Mar. 19, 1957	13:00	26.87	26.87	26.86	26.88	.02
12-3.....	Mar. 22, 1957	14:00	26.92	26.92	26.91	26.94	.03
5-4.....	Apr. 22, 1957	15:00	52.37	52.37	52.36	52.38	.02
		17:00					
14-2.....	.....do.....	18:00	45.27	45.27	45.26	45.27	.01
		19:00					
12-1.....	June 13, 1957	15:00	19.93	19.93	19.92	19.94	.02
		17:00					
12-3.....	June 21, 1957	22:00	26.12	26.12	26.11	26.14	.03
		24:00					
12-1.....	June 28, 1957	16:00	20.65	20.65	20.63	20.66	.03
		18:00					
12-3.....	July 4, 1957	14:00	28.28	28.28	28.23	28.32	.09
		16:00					
12-3.....	July 28, 1957	06:00	28.70	28.70	28.63	28.76	.13
		07:00					
119.....	.....do.....	08:00	47.53	47.53	47.37	47.71	.34
120.....	.....do.....	08:00	41.36	41.36	41.23	41.50	.27
11-4.....	Sept. 19, 1957	18:00	36.22	36.22	36.21	36.23	.02
12-3.....	Dec. 3, 1957	23:00	27.83	27.83	27.78	27.89	.11
		24:00					
12-4.....	.....do.....	23:00	22.40	22.40	22.39	22.41	.02
		24:00					
15-6.....	.....do.....	23:00	16.44	16.45	16.44	16.48	.04
		24:00					
291.....	Dec. 4, 1957	03:00	25.85	25.85	25.72	25.94	.22
		04:00					

IDAHO

8S-27E-31DD1.....	Feb. 9, 1957	14:00	23.34	23.34	23.28	23.40	0.12
3N-29E-14ad1.....	Feb. 13, 1957	16:00					
		22:00	455.05	455.05	455.01	455.09	.08
3N-29E-14ad1.....	Feb. 14, 1957	24:00					
		14:00	453.96	453.96	453.92	453.99	.07
3N-29E-14ad1.....	Feb. 15, 1957	16:00					
		21:00	455.13	455.13	455.10	455.14	.04
7N-35E-20cal.....	.....do.....	23:00					
		14:00	38.37	38.37	38.26	38.56	.30
3N-29E-14ad1.....	Feb. 16, 1957	16:00					
		13:00	455.11	455.11	455.06	455.13	.07
3N-29E-14ad1.....	Feb. 17, 1957	15:00					
		14:00	455.06	455.06	455.02	455.09	.07
3N-29E-14ad1.....	Feb. 18, 1957	16:00					
		13:00	455.00	455.00	454.97	455.02	.05
3N-29E-14ad1.....	Feb. 19, 1957	15:00					
		12:00	454.89	454.89	454.86	454.90	.04
3N-29E-14ad1.....	.....do.....	14:00					
		19:00	454.89	454.89	454.85	454.91	.06
3N-29E-14ad1.....	Feb. 20, 1957	21:00					
		19:00	454.84	454.84	454.81	454.87	.06
3N-29E-14ad1.....	Feb. 21, 1957	21:00					
		12:00	454.95	454.95	454.92	454.98	.06
3N-29E-14ad1.....	.....do.....	14:00					
		19:00	454.94	454.94	454.92	454.96	.04
3N-29E-14ad1.....	Feb. 22, 1957	21:00					
		16:00	454.92	454.92	454.89	454.95	.06
		18:00					

Footnotes at end of table.

TABLE 1.—*Fluctuations in well-water levels, January 1 through December 1957—Continued*

IDAHO—Continued

Well No.	Date	Time G.C.T.	Depth to water				
			Before disturb- ance	After disturb- ance	At highest point	At lowest point	Amplitude of fluctuation
7S-31E-13dc1.....	Feb. 23, 1957	{ 04:00	61.49	61.50	61.43	61.65	.12
		{ 16:00					
8S-27E-31dd1.....	Mar. 2, 1957	{ 02:00	23.35	23.35	23.31	23.38	.07
		{ 04:00					
8S-27E-31dd1.....	Mar. 8, 1957	{ 14:00	23.22	23.22	23.21	23.23	.02
		{ 16:00					
8S-26E-33bc1.....	do.....	{ 15:00	103.78	103.79	103.55	103.88	.33
		{ 15:00	455.08	455.08	455.01	455.13	.12
3N-29E-14ad1.....	do.....	{ 17:00					
8S-25E-36da1.....	do.....	{ 18:00	103.62	103.62	103.61	103.65	.04
		{ 13:00	216.38	216.36	216.34	216.40	.06
6N-31E-13db1.....	Mar. 9, 1957	{ 15:00					
		{ 11:00	454.90	454.90	454.84	454.95	.11
		{ 13:00					
8S-25E-36da1.....	do.....	{ 15:30	103.55	103.55	103.54	103.60	.06
		{ 10:00	34.08	34.08	34.05	34.11	.06
6S-33E-20ab1.....	do.....	{ 12:00					
		{ 15:00	455.05	455.05	454.98	455.09	.11
3N-29E-14ad1.....	Mar. 11, 1957	{ 17:00					
		{ 14:00	455.07	455.07	455.01	455.12	.11
3N-29E-14ad1.....	Mar. 13, 1957	{ 16:00					
		{ 15:00	455.22	455.22	455.17	455.27	.10
		{ 17:00					
8S-25E-36da1.....	Mar. 15, 1957	{ 16:00	103.72	103.72	103.71	103.73	.02
8S-25E-36da1.....	Mar. 16, 1957	{ 14:30	103.70	103.71	103.69	103.72	.03
		{ 17:00	455.01	455.01	454.97	455.06	.09
3N-29E-14ad1.....	do.....	{ 19:00					
		{ 17:00	455.13	455.13	455.08	455.17	.09
3N-29E-14ad1.....	Mar. 17, 1957	{ 19:00					
		{ 15:00	103.78	103.78	103.76	103.79	.03
8S-25E-36da1.....	do.....	{ 17:00	455.11	455.11	455.10	455.13	.03
3N-29E-14ad1.....	Mar. 18, 1957	{ 19:00					
		{ 15:00	103.94	103.94	103.77	104.02	.25
8S-26E-33bc1.....	do.....	{ 13:00	144.94	144.94	144.92	144.95	.03
2S-20E-1ac2.....	Mar. 21, 1957	{ 15:00					
		{ 15:30	104.15	104.14	103.92	104.23	.31
8S-26E-33bc1.....	Mar. 27, 1957	{ 13:30	103.86	103.87	103.84	103.88	.04
8S-25E-36da1.....	Mar. 30, 1957	{ 15:00	103.84	103.84	103.82	103.85	.03
8S-25E-36da1.....	Mar. 31, 1957	{ 20:00	127.71	127.71	127.69	127.74	.05
7S-25E-23db1.....	Apr. 4, 1957	{ 16:00	104.07	104.08	103.99	104.43	.44
8S-26E-33bc1.....	Apr. 6, 1957	{ 13:00	104.14	104.14	104.12	104.15	.03
8S-26E-33bc1.....	Apr. 10, 1957	{ 11:00	23.48	23.47	23.42	23.53	.11
8S-27E-31dd1.....	do.....	{ 13:00					
		{ 17:00	23.49	23.49	23.42	23.56	.14
8S-27E-31dd1.....	do.....	{ 19:00					
		{ 14:00	104.26	104.26	104.00	104.47	.47
8S-26E-33bc1.....	Apr. 15, 1957	{ 15:00	104.27	104.27	104.09	104.36	.27
8S-26E-33bc1.....	Apr. 17, 1957	{ 16:00	104.24	104.24	104.02	104.33	.31
8S-26E-33bc1.....	Apr. 19, 1957	{ 18:00	104.25	104.25	104.02	104.36	.34
8S-26E-33bc1.....	do.....	{ 18:00	22.39	22.39	22.34	22.44	.10
8S-27E-31dd1.....	do.....	{ 20:00					
		{ 14:00	104.16	104.16	103.90	104.26	.36
8S-26E-33bc1.....	Apr. 20, 1957	{ 17:30	104.14	104.14	103.90	104.22	.32
8S-26E-33bc1.....	do.....	{ 19:30	104.17	104.17	104.05	104.42	.37
8S-26E-33bc1.....	Apr. 23, 1957	{ 19:00	22.41	22.41	22.39	22.43	.04
8S-27E-31dd1.....	Apr. 28, 1957	{ 21:00					
		{ 23:30	104.11	104.11	104.02	104.24	.22
8S-26E-33bc1.....	Apr. 30, 1957	{ 14:00	104.18	104.18	103.96	104.26	.30
8S-26E-33bc1.....	May 1, 1957	{ 10:00	22.39	22.40	22.37	22.41	.02
8S-27E-31dd1.....	do.....	{ 12:00					
8S-26E-33bc1.....	May 2, 1957	{ 13:00	104.15	104.16	103.93	104.27	.34

Footnotes at end of table.

TABLE 1.—*Fluctuations in well-water levels, January 1 through December 1957—Continued*

IDAHO—Continued

Well No.	Date	Time G.C.T.	Depth to water				
			Before disturb- ance	After disturb- ance	At highest point	At lowest point	Amplitude of fluctuation
9S-22E-33ab1.....	May 5, 1957	13:00	226.92	226.92	226.85	227.17	.32
8S-26E-27ab1.....	May 7, 1957	11:00	130.64	130.64	130.62	130.66	.04
		13:00					
8S-26E-33bc1.....	May 9, 1957	13:00	104.16	104.17	104.04	104.26	.22
8S-26E-33bc1.....	May 13, 1957	24:00	103.99	103.99	103.81	104.10	.29
8S-26E-33bc1.....	May 14, 1957	14:00	104.03	104.04	103.77	104.39	.62
8S-26E-33bc1.....	May 16, 1957	14:30	104.07	104.08	103.96	104.37	.41
8S-25E-36da1.....	May 17, 1957	22:30	103.51	103.49	103.26	104.01	.75
8S-25E-36da1.....	do.....	05:30	103.57	103.56	103.33	104.02	.69
8S-26E-33bc1.....	May 19, 1957	14:00	103.84	103.85	103.71	103.96	.25
8S-26E-33bc1.....	May 20, 1957	14:00	103.97	103.97	103.81	104.09	.28
8S-26E-33bc1.....	May 22, 1957	21:00	103.84	103.83	103.58	103.96	.38
8S-26E-33bc1.....	May 24, 1957	15:00	103.85	103.85	103.64	103.93	.29
9S-20E-1da1.....	May 28, 1957	18:00	354.06	354.06	354.02	354.13	.11
		20:00					
1S-19E-3cc2.....	June 2, 1957	12:00	13.60	13.60	13.51	13.70	.19
		14:00					
8S-26E-33bc1.....	June 8, 1957	15:30	103.54	103.54	103.46	103.68	.22
8S-26E-33bc1.....	June 12, 1957	22:30	103.37	103.35	103.33	103.42	.09
		13:00					
2S-20E-lac2.....	June 13, 1957	15:00	145.59	145.58	145.56	145.60	.04
8S-25E-36da1.....	June 24, 1957	02:00	102.91	102.92	102.77	103.06	.29
8S-27E-31dd1.....	June 26, 1957	23:01	22.46	22.45	22.41	22.49	.08
5N-29E-23ed1.....	June 28, 1957	00:00	275.65	275.65	275.58	275.67	.09
		00:02					
7S-24E-2ad1.....	June 30, 1957	11:00	207.17	207.17	207.15	207.19	.04
		15:00					
8S-26E-33bc1.....	July 1, 1957	01:00	103.15	103.15	103.12	103.17	.05
8S-27E-31dd1.....	July 7, 1957	19:00	22.34	22.33	22.32	22.36	.04
		21:00					
3N-29E-14ad1.....	July 9, 1957	08:00	454.92	454.93	454.90	454.99	.09
		10:00					
8S-26E-33bc1.....	July 11, 1957	11:30	102.95	102.95	102.77	103.03	.26
8S-26E-33bc1.....	do.....	13:00	102.95	102.96	102.81	103.04	.23
8S-26E-33bc1.....	July 12, 1957	12:30	102.89	102.90	102.79	102.97	.18
8S-25E-36da1.....	do.....	14:30	102.15	102.15	102.13	102.17	.04
8S-27E-31dd1.....	July 13, 1957	18:00	22.30	22.30	22.28	22.31	.03
		20:00					
8S-26E-33bc1.....	July 14, 1957	12:30	102.86	102.86	102.65	103.15	.50
8S-26E-33bc1.....	July 18, 1957	14:00	102.75	102.75	102.60	102.79	.19
8S-27E-31dd1.....	do.....	22:00	22.40	22.40	22.37	22.43	.06
		24:00					
8S-27E-31dd1.....	July 20, 1957	03:00	22.38	22.38	22.35	22.43	.08
		05:00					
1S-19E-3cc2.....	July 28, 1957	05:00	6.98	6.98	6.91	7.07	.16
		07:00					
2S-20E-lac2.....	do.....	05:00	142.20	142.20	142.14	142.27	.13
		07:00					
8S-26E-33bc1.....	do.....	14:00	102.59	102.59	102.35	102.80	.45
6N-31E-13db1.....	do.....	03:00	217.20	217.20	217.09	217.32	.23
		05:00					
9S-25E-23db1.....	do.....	09:00	123.17	123.17	123.15	123.21	.06
7N-34E-4cd1.....	do.....	10:00	20.66	20.66	20.54	20.79	.25
6S-33E-20ab1.....	do.....	05:00	35.11	35.20	35.10	35.32	.22
		07:00					
8S-25E-24bd1.....	July 29, 1957	03:00	139.91	139.91	139.89	139.92	.03
2S-20E-lac2.....	Aug. 11, 1957	15:00	141.24	141.24	141.20	141.26	.06
		17:00					
8S-27E-31dd1.....	Oct. 24, 1957	19:00	23.10	23.10	23.08	23.12	.04
		21:00					
8S-27E-31dd1.....	Dec. 4, 1957	02:00	23.76	23.76	23.61	23.89	.28
		04:00					

Footnotes at end of table.

TABLE 1.—*Fluctuations in well-water levels, January 1 through December 1957—Continued*

IDAHO—Continued

Well No.	Date	Time G.C.T.	Depth to water				Amplitude of fluctuation
			Before disturb- ance	After disturb- ance	At highest point	At lowest point	
2S-20E-1ac2.....	Dec. 26, 1957	{ 02:00 04:00	146.64	146.64	146.60	146.67	.07

INDIANA

Pu6.(29/4W-4L1).....	Jan. 1, 1957	21:55	19.05	19.05	19.04	19.06	0.01
Pu6.(29/4W-4L1).....	Mar. 9, 1957	08:30	17.70	17.71	17.57	17.84	.27
Pu6.(29/4W-4L1).....	do.....	14:45	17.77	17.77	17.75	17.79	.04
Pu6.(29/4W-4L1).....	Mar. 10, 1957	09:30	17.74	17.74	17.73	17.74	.01
Pu6.(29/4W-4L1).....	do.....	21:15	17.66	17.66	17.65	17.67	.02
Pu6.(29/4W-4L1).....	Mar. 11, 1957	04:15	17.49	17.49	17.48	17.51	.03
Pu6.(29/4W-4L1).....	do.....	09:30	17.50	17.50	17.49	17.51	.02
Pu6.(29/4W-4L1).....	Mar. 14, 1957	09:15	17.74	17.75	17.71	17.76	.05
Pu6.(29/4W-4L1).....	Mar. 15, 1957	20:45	17.90	17.90	17.90	17.92	.02
Pu6.(29/4W-4L1).....	Apr. 14, 1957	13:15	11.28	11.26	11.25	11.29	.04
Pu6.(29/4W-4L1).....	Apr. 21, 1957	15:10	9.19	9.19	9.17	9.21	.04
Pu6.(29/4W-4L1).....	Nov. 29, 1957	16:30	10.26	10.26	10.26	10.27	.01
Pu6.(29/4W-4L1).....	Dec. 3, 1957	21:30	10.55	10.54	10.46	10.73	.27
Pu6.(29/4W-4L1).....	Dec. 17, 1957	19:55	10.01	10.02	10.01	10.03	.02

ILLINOIS

ANL-10.....	Jan. 2, 1957	05:00	75.20	75.20	.....	.....	0.03
ANL-10.....	Jan. 20, 1957	05:45	75.25	75.24	75.23	75.28	.05
ANL-10.....	Feb. 13, 1957	23:45	77.22	77.24	77.20	77.24	.04
ANL-10.....	Mar. 9, 1957	14:30	74.91	74.93	74.77	75.08	.21
ANL-10.....	do.....	21:00	75.02	75.02	75.00	75.04	.04
ANL-9.....	do.....	14:30	94.17	94.21	94.06	94.32	.26
ANL-11.....	do.....	14:30	80.46	80.46	80.42	80.50	.08
ANL-20.....	do.....	14:30	39.63	39.65	39.61	39.70	.08
ANL-10.....	Mar. 11, 1957	11:00	74.84	74.86	74.82	74.85	.03
ANL-10.....	do.....	15:00	74.86	74.86	74.85	74.88	.03
ANL-10.....	Mar. 12, 1957	12:15	75.31	75.35	75.29	75.35	.06
ANL-20.....	do.....	14:00	40.00	39.82	39.86	40.05	.19
ANL-10.....	Mar. 14, 1957	15:30	76.82	76.81	76.78	76.84	.06
ANL-9.....	Mar. 18, 1957	07:00	94.33	94.33	94.27	94.33	.06
ANL-10.....	Apr. 10, 1957	11:30	76.96	76.98	76.95	77.02	.07
ANL-10.....	July 2, 1957	12:30	77.08	77.06	77.03	77.08	.05
ANL-9.....	July 28, 1957	08:30	93.92	93.92	93.88	93.94	.06
ANL-10.....	do.....	08:15	77.44	77.43	77.35	77.50	.15
ANL-11.....	do.....	08:00	83.68	83.62	83.61	83.69	.08

MICHIGAN

GeFL491.....	Jan. 10, 1957	09:00	28.16	28.16	28.15	28.18	0.03
GeFL491.....	Mar. 9, 1957	16:00	27.29	27.29	27.05	27.53	.48
GeFL491.....	do.....	22:30	27.30	27.30	27.26	27.34	.08
GeFL491.....	Mar. 11, 1957	04:30	27.38	27.38	27.36	27.39	.04
GeFL491.....	do.....	11:00	27.29	27.29	27.27	27.31	.04
GeFL491.....	do.....	16:00	27.26	27.26	27.24	27.29	.05
GeFL491.....	Mar. 12, 1957	13:00	27.18	27.18	27.12	27.23	.11
GeFL491.....	Mar. 13, 1957	02:00	27.28	27.28	27.27	27.30	.03
GeFL491.....	Mar. 14, 1957	15:30	27.33	27.33	27.27	27.39	.12
7N.7E.17-1*.....	Apr. 10, 1957	12:30	26.87	26.87	26.83	26.91	.08

Footnotes at end of table.

TABLE 1.—*Fluctuations in well-water levels, January 1 through December 1957—Continued*

MICHIGAN—Continued

Well No.	Date	Time G.C.T.	Depth to water				Amplitude of fluctuation
			Before disturb- ance	After disturb- ance	At highest point	At lowest point	
7N.7E.17-1.....	Apr. 14, 1957	20:00	27.51	27.51	27.49	27.52	.03
7N.7E.17-1.....	July 21, 1957	22:00	27.50	27.50	27.48	27.52	.04
7N.7E.17-1.....	Apr. 24, 1957	19:45	27.39	27.39	27.38	27.40	.02
7N.7E.17-1.....	June 13, 1957	11:30	28.43	28.43	28.40	28.45	.05
7N.7E.17-1.....	June 27, 1957	01:30	31.93	31.93	31.89	31.97	.08
7N.7E.17-1.....	Aug. 4, 1957	16:00	31.11	31.11	31.10	31.12	.02
7N.7E.17-1.....	Sept. 23, 1957	12:30	29.60	29.60	29.58	29.61	.03
7N.7E.17-1.....	Dec. 4, 1957	04:30	28.11	28.11	27.93	28.29	.36
7N.7E.17-1.....	Dec. 17, 1957	14:45	27.93	27.93	27.89	27.96	.07

NEVADA

S21/61-29dda1.....	Feb. 4, 1957	21:20	16.86	16.86	16.83	16.91	0.08
S20/61-35ddc2.....	Feb. 8, 1957	22:15	+20.20	+20.20	+23.90	+15.50	8.40
S20/60-25adb1.....	Feb. 10, 1957	19:50	55.92	55.92	55.82	56.08	.26
S19/60-9bec1.....	Mar. 9, 1957	15:00	90.93	90.97	90.67	91.18	.51
S19/60-9bec1.....	Mar. 9, 1957	20:40	90.96	90.96	90.93	90.99	.06
S19/60-9bec1.....	Mar. 11, 1957	03:50	91.21	91.21	91.20	91.22	.02
S19/60-9bec1.....	do.....	10:15	91.19	91.19	91.14	91.23	.09
S19/60-9bec1.....	do.....	15:40	91.27	91.27	91.25	91.28	.03
S19/60-9bec1.....	Mar. 12, 1957	12:00	91.16	.....	91.60	91.71	.11
S19/60-9bec1.....	Mar. 14, 1957	16:00	91.41	91.41	91.38	91.43	.05
S19/60-9bec1.....	Mar. 22, 1957	14:15	91.34	91.34	91.27	91.40	.13
S19/60-9bec1.....	Mar. 29, 1957	05:45	91.38	91.38	91.37	91.90	.53
S19/60-9bec1.....	Apr. 10, 1957	05:30	93.13	93.13	93.12	93.14	.02
S19/60-9bec1.....	do.....	11:30	93.16	93.16	93.12	93.19	.07
S19/60-9bec1.....	Apr. 14, 1957	20:00	93.01	93.01	92.96	93.06	.10
S19/60-9bec1.....	Apr. 19, 1957	23:15	94.63	94.62	94.61	94.64	.03
S20/61-35ddc2.....	do.....	20:45	+18.30	+18.30	+18.60	+18.00	.60
S19/60-9bec1.....	Apr. 21, 1957	17:55	94.88	94.88	94.87	94.89	.02
S20/61-35ddc2.....	Apr. 26, 1957	03:50	+18.60	+18.60	+18.90	+18.10	.80
S20/61-35ddc2.....	May 3, 1957	22:30	+19.00	+19.00	+20.36	+17.80	2.50
S21/54-10adc1.....	May 6, 1957	08:00	44.04	44.04	44.00	44.07	.07
11/24-22dc1.....	May 14, 1957	04:00	58.98	58.98	58.95	59.00	.05
S20/61-35ddc2.....	May 24, 1957	01:00	+17.50	+17.50	+18.00	+17.00	1.00
S19/60-9bec1.....	May 26, 1957	08:00	95.20	95.20	95.19	95.21	.02
11/24-22dc1.....	June 1, 1957	16:00	58.95	58.95	58.90	59.13	.23
S20/61-35ddc2.....	June 12, 1957	19:50	+15.60	+15.80	+16.80	+15.30	1.50
S19/20-9bec1.....	June 13, 1957	10:30	96.75	96.75	96.73	96.77	.04
S20/61-35ddc2.....	June 14, 1957	17:35	+15.90	+15.90	+16.30	+14.80	1.50
S19/60-9bec1.....	June 18, 1957	15:10	97.06	97.06	97.03	97.09	.06
S19/60-9bec1.....	June 27, 1957	01:00	97.15	97.15	97.13	97.17	.04
S19/60-9bec1.....	July 21, 1957	06:30	97.70	97.70	97.70	97.80	.10
S20/60-25adb1.....	July 28, 1957	11:00	63.56	63.62	63.45	63.74	.29
S19/60-9bec1.....	do.....	08:50	96.56	96.56	96.30	96.76	.40
S19/60-9bec1.....	Aug. 4, 1957	06:30	96.98	96.98	96.96	96.99	.03
S19/60-9bec1.....	Aug. 15, 1957	04:45	97.18	97.18	97.12	97.30	.18
S19/60-9bec1.....	Sept. 24, 1957	07:50	98.85	98.85	98.84	98.86	.02
S19/60-9bec1.....	Oct. 4, 1957	06:00	98.21	98.21	98.19	98.21	.02
S19/60-9bec1.....	Oct. 24, 1957	22:00	98.31	98.31	98.30	98.32	.02
S19/60-9bec1.....	Nov. 20, 1957	12:20	93.33	93.33	93.32	93.33	.01
S19/60-9bec1.....	Nov. 29, 1957	22:50	92.93	92.93	92.91	92.95	.04
S19/60-9bec1.....	Dec. 4, 1957	04:15	92.74	92.74	92.62	92.85	.23
S19/60-9bec1.....	Dec. 17, 1957	13:15	92.03	92.03	92.00	92.06	.06

Footnotes at end of table.

TABLE 1.—*Fluctuations in well-water levels, January 1 through December 1957—Continued*

NEW JERSEY

Well No.	Date	Time G.C.T.	Depth to water				Amplitude of fluctuation
			Before disturb- ance	After disturb- ance	At highest point	At lowest point	
26.22.4.4.4.	Jan. 2, 1957	04:00	+ .70	+ .70	+ .72	+ .69	0.03
26.22.4.4.4.	do.	04:15	+ .70	+ .70	+ .72	+ .69	.03
37.31.9.4.9.	Mar. 9, 1957	14:30	+17.26	+17.25	+17.19	+17.35	.16
26.21.5.9.2.	do.	14:30	+54.74	+54.76	+54.81	+54.69	.12
27.42.6.4.8.	Mar. 14, 1957	15:00	+ .43	+ .44	+ .48	+ .41	.07
27.42.6.4.8.	Apr. 14, 1957	20:00	+ .99	+ .99	+1.14	+ .89	.25
26.22.4.4.4.	May 26, 1957	02:00	+28.02	+28.02	+28.04	+28.01	.03
26.22.4.4.4.	June 13, 1957	11:15	+25.67	+25.67	+25.69	+25.65	.04
26.22.4.4.4.	June 22, 1957	19:45	+23.43	+23.43	+23.45	+23.41	.04
26.22.4.4.4.	June 26, 1957	18:45	+18.88	+18.88	+18.92	+18.83	.09
37.31.9.4.9.	July 28, 1957	09:00	-9.58	-9.57	-9.53	-9.60	.07
26.22.4.5.8.	do.	09:00	+22.30	+22.30	+22.32	+22.28	.04
26.22.4.4.4.	do.	09:00	+24.22	+24.23	+24.28	+24.12	.16
26.21.5.4.6.	do.	09:00	+60.12	+60.12	+60.13	+60.12	.01
26.22.4.4.4.	Nov. 29, 1957	22:30	+26.73	+26.73	+26.76	+26.71	.05
31.1.6.4.8.	Dec. 3, 1957	23:35	-8.58	-8.57	-8.59	-8.66	.07
26.22.4.4.4.	do.	23:30	+28.97	+28.99	+29.15	+28.84	.31

NEW YORK

Q64.	Feb. 18, 1957	14:50	-1.14	-1.14	-1.12	-1.15	0.03
Q64.	Mar. 9, 1957	14:22	-.27	-.27	-.06	-.56	.62
Q64.	do.	20:22	-.36	-.36	-.30	-.42	.12
Q64.	Mar. 11, 1957	03:13	-.58	-.58	-.52	-.63	.11
Q64.	do.	09:59	-.58	-.58	-.55	-.62	.07
Q64.	Mar. 12, 1957	06:03	-.47	-.47	-.41	-.52	.11
Q64.	Mar. 14, 1957	10:35	-.70	-.70	-.65	-.75	.10
Q64.	Mar. 15, 1957	21:13	-.63	-.63	-.61	-.67	.06
Q64.	Mar. 22, 1957	19:44	-.45	-.45	-.37	-.53	.17
Q64.	Apr. 10, 1957	11:29	-.61	-.61	-.57	-.64	.07
Q64.	Apr. 14, 1957	20:59	-.67	-.67	-.59	-.76	.16
Sa529.	Apr. 15, 1957	20:00	-43.38	-43.38	-43.36	-43.39	.03
Q64.	Apr. 20, 1957	17:54	-.70	-.70	-.69	-.71	.02
Q64.	Apr. 21, 1957	21:12	-.63	-.63	-.59	-.66	.06
Q64.	May 26, 1957	15:59	-.44	-.44	-.41	-.48	.07
Q64.	June 13, 1957	10:40	-.50	-.50	-.48	-.51	.03
Sa529.	do.	11:15	-45.64	-45.64	-45.63	-45.65	.02
Sa529.	June 14, 1957	11:30	-45.14	-45.14	-45.13	-45.15	.02
Q64.	June 19, 1957	01:29	-.51	-.51	-.49	-.52	.03
Q64.	June 26, 1957	16:48	-.70	-.70	-.63	-.76	.13
Sa529.	Sept. 24, 1957	09:45	-46.85	-46.84	-46.83	-46.85	.02
Q64.	do.	09:10	-1.53	-1.53	-1.47	-1.60	.13
Sa529.	Oct. 4, 1957	05:15	-46.83	-46.82	-46.82	-46.83	.01
Sa529.	Dec. 4, 1957	04:15	-45.03	-44.93	-44.91	-45.06	.15
Q64.	Dec. 17, 1957	13:50	-.23	-.23	-.16	-.30	.14

TENNESSEE

7:1-6.	Jan. 13, 1957	19:30	74.75	74.75	74.72	74.75	0.03
7:1-6.	Jan. 26, 1957	19:00	75.03	75.03	75.02	75.04	.02
7:1-6.	Feb. 3, 1957	10:30	71.84	71.84	71.84	71.85	.01
7:1-6.	Mar. 1, 1957	00:30	74.60	74.60	74.60	74.61	.01
7:1-6.	Mar. 9, 1957	16:30	74.54	74.55	74.47	74.62	.15
79:7-26.	do.	14:00	72.76	72.77	72.74	72.77	.03
79-148-1D.	do.	14:20	49.04	49.09	49.04	49.05	.01
7:1-6.	Mar. 12, 1957	04:45	74.51	74.52	74.51	74.53	.02

Footnotes at end of table.

TABLE 1.—*Fluctuations in well-water levels, January 1 through December 1957—Continued*

TENNESSEE—Continued

Well No.	Date	Time G.C.T.	Depth to water				
			Before disturb- ance	After disturb- ance	At highest point	At lowest point	Amplitude of fluctuation
7:1-6.....	do.....	06:10	74.52	74.52	74.52	74.53	.01
79:8-73.....	June 1, 1957	16:00	124.77	124.77	124.74	124.90	.16
1-6.....	July 10, 1957	09:00	75.51	75.51	75.51	75.52	.01
7:1-6.....	July 28, 1957	09:00	75.82	75.81	75.77	75.86	.09
148-S.....	do.....	09:00	45.63	45.63	45.61	45.64	.03
148-D.....	do.....	09:00	48.18	48.17	48.16	48.19	.03
79:1-2.....	do.....	08:40	87.29	87.28	87.27	87.29	.02
2-1.....	Aug. 2, 1957	19:55	97.34	97.36	97.32	97.44	.12
3-A.....	Aug. 10, 1957	03:30	68.43	68.44	68.41	68.46	.05
3-A.....	Aug. 16, 1957	12:00	68.88	68.89	68.87	68.90	.03
7:1-6.....	Dec. 4, 1957	03:30	74.35	74.35	74.31	74.39	.08
79:148-1S.....	do.....	04:30	45.28	45.28	45.27	45.29	.02

WISCONSIN

LF-57.....	Jan. 12, 1957	03:00	94.20	94.19	94.14	94.26	0.12
LF-148.....	Feb. 15, 1957	21:00	65.03	65.03	64.64	65.12	.46
LF-57.....	Mar. 2, 1957	00:30	95.21	95.22	95.20	95.24	.05
LF-57.....	Mar. 9, 1957	19:30	95.34	95.32	95.24	95.43	.19
LF-95.....	do.....	15:00	83.88	83.88	83.88	83.89	.01
LF-121.....	do.....	14:30	78.97	79.07	78.86	79.21	.35
LF-121.....	do.....	21:00	79.05	79.04	79.02	79.06	.04
MI-121.....	do.....	16:00	67.27	67.29	67.24	67.32	.08
LF-57.....	Mar. 10, 1957	04:00	95.34	95.35	95.29	95.39	.10
LF-57.....	do.....	16:30	95.27	95.24	95.21	95.30	.09
LF-57.....	Mar. 11, 1957	04:00	95.20	95.20	95.14	95.27	.13
LF-57.....	do.....	11:00	95.23	95.20	95.15	95.30	.15
IF-57.....	do.....	16:00	95.25	95.26	95.20	95.33	.13
LF-57.....	Mar. 12, 1957	08:30	95.47	95.47	95.46	95.50	.04
LF-57.....	do.....	12:30	95.45	95.48	95.31	95.64	.33
LF-57.....	Mar. 13, 1957	16:30	95.41	95.41	95.39	95.43	.04
LF-57.....	Mar. 14, 1957	15:00	95.40	95.36	95.28	95.53	.25
LF-121.....	do.....	14:30	78.85	78.82	78.82	78.85	.03
LF-57.....	Mar. 15, 1957	03:30	95.43	95.41	95.40	95.43	.03
LF-57.....	Mar. 16, 1957	03:30	95.58	95.57	95.54	95.60	.06
LF-36.....	Mar. 18, 1957	19:00	319.90	319.90	319.89	319.91	.25
LF-57.....	Mar. 19, 1957	13:00	95.52	95.54	95.51	95.57	.06
LF-57.....	Mar. 22, 1957	14:15	95.53	95.54	95.51	95.58	.07
LF-57.....	Mar. 24, 1957	08:30	95.60	95.59	95.58	95.61	.03
LF-148.....	Mar. 25, 1957	22:00	65.12	65.11	65.03	65.75	.72
LF-57.....	Mar. 29, 1957	05:30	95.64	95.64	95.62	95.65	.02
LF-57.....	Apr. 10, 1957	11:30	95.81	95.86	95.63	96.02	.39
LF-57.....	Apr. 14, 1957	20:30	95.91	95.89	95.80	95.99	.19
LF-57.....	Apr. 19, 1957	23:00	95.91	95.91	95.84	95.98	.14
LF-57.....	Apr. 20, 1957	13:00	95.99	96.00	95.93	96.13	.19
LF-57.....	Apr. 21, 1957	20:00	96.02	96.00	95.88	96.11	.23
LF-57.....	May 2, 1957	03:00	96.13	96.13	96.11	96.14	.03
LF-57.....	June 13, 1957	12:00	97.04	97.07	96.99	97.10	.11
LF-57.....	June 27, 1957	01:00	97.23	97.27	97.18	97.28	.10
LF-95.....	July 28, 1957	08:00	82.66	82.65	82.65	82.66	.01
LF-121.....	do.....	08:45	76.13	76.17	76.02	76.29	.27
MI-5.....	do.....	09:00	26.06	26.10	26.05	26.11	.06
MI-148.....	do.....	03:00	33.76	33.78	33.73	33.77	.04
LF-36.....	Sept. 14, 1957	18:30	320.82	320.81	320.57	321.32	.75
LF-57.....	Sept. 28, 1957	08:00	97.40	97.43	97.20	97.50	.30
LF-121.....	Dec. 14, 1957	05:30	74.95	74.98	74.83	75.06	.23

Footnotes at end of table.

TABLE 1.—*Fluctuations in well-water levels, January 1 through December 1957—Continued*

HAWAIIAN ISLANDS

Well No.	Date	Time G.C.T.	Depth to water				Amplitude of fluctuation
			Before disturb- ance	After disturb- ance	At highest point	At lowest point	
36A.....	Jan. 2, 1957	04:00	12.17	12.17	12.16	12.18	0.02
36A.....	do.....	05:00	12.18	12.18	12.17	12.19	.02
132.....	do.....	02:00	14.13	14.12	14.11	14.14	.03
132.....	do.....	02:40	14.12	14.12	14.10	14.13	.03
132.....	do.....	03:40	14.12	14.13	14.11	14.14	.03
T-52.....	do.....	01:30	144.46	144.46	144.45	144.47	.02
T-52.....	do.....	03:20	144.47	144.48	144.47	144.50	.03
T-52.....	do.....	04:20	144.50	144.50	144.47	144.52	.05
T-52.....	do.....	04:50	144.50	144.51	144.49	144.53	.04
132.....	Feb. 23, 1957	23:00	13.31	13.30	13.27	13.33	.06
T-52.....	do.....	21:20	143.70	143.69	143.69	143.70	.01
36A.....	do.....	21:45	11.11	11.10	11.10	11.12	.02
1A.....	Mar. 9, 1957	13:40	9.55	9.55	9.40	9.75	.35
1A.....	do.....	18:20	9.63	9.63	9.57	9.73	.16
2.....	do.....	14:50	8.31	8.30	8.28	8.31	.03
2.....	do.....	20:30	8.32	8.32	8.31	8.33	.02
36A.....	do.....	15:45	11.43	11.43	11.05	11.91	.86
36A.....	do.....	17:00	11.43	11.44	11.38	11.49	.11
36A.....	do.....	20:20	11.49	11.49	11.41	11.60	.19
83.....	do.....	14:00	+4.49	+4.50	+4.53	+4.48	.05
83.....	do.....	19:00	+4.38	+4.38	+4.42	+4.30	.12
132.....	do.....	13:00	13.65	13.65	12.91	.....	1.50
132.....	do.....	14:30	13.65	13.65	13.54	13.75	.21
132.....	do.....	19:15	13.67	13.67	13.62	13.73	.11
T-24.....	do.....	15:00	32.55	32.55	32.52	32.56	.04
T-41.....	do.....	14:30	61.70	61.68	61.62	61.72	.10
T-41.....	do.....	15:00	61.65	61.63	61.61	61.70	.09
T-45.....	do.....	14:45	34.19	34.18	34.18	34.19	.01
T-45.....	do.....	15:20	34.18	34.18	34.18	34.19	.01
T-52.....	do.....	14:40	144.50	144.50	144.07	144.90	.83
T-52.....	do.....	21:00	144.49	144.48	144.44	144.52	.08
132.....	Mar. 10, 1957	14:00	13.58	13.58	13.57	13.59	.02
1A.....	Mar. 11, 1957	02:00	9.58	9.59	9.58	9.60	.02
1A.....	do.....	14:00	9.56	9.56	9.56	9.58	.02
36A.....	do.....	16:30	11.41	11.42	11.35	11.50	.15
132.....	do.....	01:40	13.60	13.61	13.57	13.63	.06
132.....	do.....	08:20	13.57	13.56	13.49	13.64	.15
132.....	do.....	13:15	13.53	13.53	13.45	13.62	.17
T-52.....	do.....	04:00	144.39	144.41	144.37	144.44	.07
T-52.....	do.....	11:00	144.47	144.16	144.41	144.50	.09
T-52.....	do.....	15:50	144.45	144.46	144.42	144.51	.09
1A.....	Mar. 12, 1957	10:30	9.51	9.50	9.48	9.52	.04
36A.....	do.....	13:30	11.42	11.42	11.36	11.48	.12
132.....	do.....	12:00	13.57	13.56	13.47	13.65	.18
T-52.....	do.....	13:00	144.58	144.57	144.50	144.62	.12
1A.....	Mar. 14, 1957	14:40	9.53	9.54	9.53	9.57	.04
36A.....	do.....	15:40	11.50	11.51	11.49	11.54	.05
132.....	do.....	14:40	13.67	13.68	13.61	13.71	.07
T-52.....	do.....	16:50	144.74	144.75	144.71	144.80	.09
T-52.....	do.....	17:20	144.76	144.77	144.74	144.78	.04
36A.....	Mar. 16, 1957	03:40	11.65	11.65	11.60	11.69	.09
132.....	do.....	02:00	13.95	13.96	13.91	14.01	.10
T-52.....	do.....	02:50	144.80	144.81	144.79	144.84	.05
T-52.....	Mar. 19, 1957	13:30	144.74	144.74	144.72	144.75	.03
T-52.....	Mar. 22, 1957	14:50	144.87	144.87	144.85	144.89	.04
36A.....	do.....	15:30	11.68	11.68	11.63	11.73	.10
132.....	do.....	13:00	13.83	13.82	13.78	13.87	.09
36A.....	Mar. 29, 1957	05:20	12.06	12.06	12.03	12.09	.06
132.....	do.....	04:40	14.28	14.27	14.24	14.30	.06
1A.....	Apr. 10, 1957	10:00	9.69	9.69	9.68	9.70	.02
132.....	do.....	10:40	14.29	14.28	14.24	14.32	.08

Footnotes at end of table.

COAST AND GEODETIC SURVEY

TABLE 1.—*Fluctuations in well-water levels, January 1 through December 1957—Continued*

HAWAIIAN ISLANDS—Continued

Well No.	Date	Time G.C.T.	Depth to water				
			Before disturb- ance	After disturb- ance	At highest point	At lowest point	Amplitude of fluctuation
T-52.....	...do.....	12:30	145.38	145.38	145.37	145.42	.05
36A.....	Apr. 14, 1957	20:00	12.40	12.39	12.26	12.55	.29
132.....	...do.....	17:40	14.47	14.46	14.31	14.63	.32
T-52.....	...do.....	20:00	145.42	145.43	145.39	145.49	.10
T-52.....	Apr. 19, 1957	22:30	145.20	145.18	145.14	145.22	.08
36A.....	...do.....	23:00	12.40	12.39	12.39	12.41	.02
132.....	...do.....	21:50	14.76	14.77	14.76	14.77	.01
36A.....	June 13, 1957	10:30	13.94	13.92	13.90	13.97	.07
132.....	...do.....	10:10	15.95	15.92	15.88	15.97	.09
T-52.....	June 14, 1957	00:10	146.33	146.32	146.29	146.34	.05
36A.....	June 23, 1957	00:40	14.30	14.30	14.28	14.31	.03
132.....	June 27, 1957	01:30	16.48	16.49	16.44	16.51	.07
T-52.....	...do.....	01:10	146.71	146.70	146.69	146.71	.02
36A.....	July 28, 1957	09:30	15.46	15.45	15.41	15.49	.08
132.....	...do.....	09:30	17.59	17.58	17.50	17.66	.16
T-52.....	...do.....	10:00	147.22	147.22	147.21	147.23	.02
36A.....	Sept. 28, 1957	15:00	15.73	15.72	15.70	15.73	.03
132.....	...do.....	13:30	17.67	17.67	17.66	17.68	.02
T-52.....	...do.....	14:20	148.01	148.00	147.98	148.01	.03
36A.....	Dec. 4, 1957	05:00	15.05	15.05	14.99	15.12	.13
132.....	...do.....	04:00	16.92	16.94	16.75	17.12	.37
T-24.....	...do.....	03:45	34.98	34.99	34.97	34.99	.02
T-52.....	...do.....	03:30	147.10	147.10	146.97	147.21	.24
36A.....	Dec. 17, 1957	06:30	14.21	14.21	14.20	14.22	.02
36A.....	...do.....	15:15	14.11	14.12	14.09	14.14	.05
132.....	...do.....	05:15	16.25	16.26	16.24	16.28	.04
132.....	...do.....	14:00	16.16	16.16	16.11	16.21	.10
T-52.....	...do.....	14:00	146.61	146.61	146.59	146.62	.03

* Formerly GeFL491.

+ 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.)	Kipapa, T.H. Lincoln, Nebr. (Nebraska Wesleyan University)
Boulder City, Nev. Bozeman, Mont. (Montana State College)	Philadelphia, Pa. (The Franklin Institute)
Butte, Mont. (Montana School of Mines)	Rapid City, S. Dak. (South Dakota State School of Mines and Technology)
Chicago, Ill. (University of Chicago and U.S. Weather Bureau)	Salt Lake City, Utah (University of Utah)
College, Alaska	San Juan, Puerto Rico
Columbia, S.C. (University of South Carolina)	Sitka, Alaska
Eureka, Nev. (Eureka Corporation Limited)	Tucson, Ariz.
Honolulu, T.H.	Ukiah, Calif. (International Latitude Observatory)
Hungry Horse, Mont.	Washington, D.C.

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

Boulder City and Hungry Horse are cooperating stations of the Bureau of Reclamation. Eureka is operated by personnel of the Eureka Corporation Limited.

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

Balboa Heights 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, which may be obtained on loan by addressing the Seismograph Station Director, Meteorological and Hydrographic Office, Panama Canal Company, Balboa Heights, C.Z.

For detailed instrumental data regarding these stations, including instrumentation, constants, and other information, see *Seismological Bulletin*, MSI-205, January 1958. 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.

TABLE 2.—Summary of instrumental epicenters for 1957.

1957	Origin time G. C. T.	Region, focal depth, and remarks	Coordinates of provisional epicenter			
			Latitude		Longitude	
	<i>h</i> <i>m</i> <i>s</i>		°	'	°	'
Jan. 1.....	00 56 40*	Kamchatka. Depth about 150 km.....	53½	N.	159	E.
1.....	03 25 05*	Unimak Island, Aleutian Islands.....	54½	N.	164	W.
2.....	00 39 22*	Fox Islands foreshock. Mag. 6½-6¾.....	53	N.	168½	W.
2.....	02 17 35*	Fox Islands foreshock. Mag. 6¾.....	52½	N.	168	W.
2.....	03 12 52*	Fox Islands foreshock. Mag. 6½-6¾.....	53	N.	168	W.
2.....	03 30 34*	Fox Islands foreshock.....	52½	N.	168½	W.
2.....	03 41 08*	do.....	52½	N.	168½	W.
2.....	03 48 44*	Fox Islands, Aleutian Islands. Mag. 7.0.....	53	N.	168	W.
2.....	04 03 26*	Fox Islands aftershock.....	52½	N.	169	W.
2.....	10 49 32*	Fox Islands aftershock. Mag. 6½.....	52½	N.	168	W.
2.....	12 47 07*	Fox Islands aftershock.....	53	N.	168	W.
2.....	14 16 32*	do.....	52½	N.	168½	W.
2.....	17 51 56*	do.....	53	N.	168	W.
3.....	00 41 02*	do.....	53	N.	168	W.
3.....	02 18 03**	Fiji Islands.....				
3.....	02 42 00*	Northern Chile. Depth about 100 km.....	20	S.	69	W.
3.....	08 53 28**	Northern Honshu, Japan.....				
3.....	12 48 27*	Southern Manchuria. Felt. Depth about 600 km. Mag. 7.0.	44	N.	130	E.
3.....	13 43 29*	Manchuria aftershock. Depth about 600 km.....	44	N.	130	E.
4.....	12 36 10*	Near coast of Colombia.....	7	N.	78	W.
4.....	13 38 00**	Solomon Islands. Depth about 100 km.....				
4.....	15 51 25**	Solomon Islands.....				
5.....	01 12 16*	Kurile Islands.....	44½	N.	149½	E.
5.....	12 36 14**	Andreanof Islands, Aleutian Islands.....				
5.....	17 15 15*	South of Unimak Island, Aleutian Islands.....	54	N.	165	W.
6.....	00 18 23*	Mid-Atlantic Ocean.....	½	S.	20	W.
6.....	01 36 58*	Ryukyu Islands.....	26	N.	126	E.
6.....	05 15 06*	Near south coast of Hokkaido, Japan. Depth about 100 km.	42	N.	142	E.
6.....	20 23 37**	Near north coast of Mindanao, Philippine Islands.....				
7.....	16 45 02*	Near east coast of Mindanao, Philippine Islands. Depth about 250 km.	8½	N.	126	E.
8.....	01 20 15**	Sumatra foreshock.....				
8.....	05 22 26*	Off west coast of Sumatra.....	2	S.	99	E.
8.....	17 29 36*	Fox Islands aftershock.....	52½	N.	168	W.
9.....	01 38 50*	Komandorskie Islands.....	54	N.	169	E.
9.....	06 15 37**	New Britain region.....				
9.....	07 52 56*	Fox Islands aftershock. Mag. 6½.....	53	N.	167½	W.
9.....	09 23 40*	Off south coast of Panama.....	5	N.	83	W.
9.....	09 56 23*	Venezuela.....	7½	N.	69½	W.
9.....	10 27 45*	Off east coast of Honshu, Japan. Felt.....	34½	N.	141	E.
10.....	04 14 44*	Northern Sumatra.....	6	N.	95½	E.
10.....	06 02 33*	Samoa Islands region.....	14	S.	175½	W.
10.....	13 47 26*	Central Chile. Felt. Depth about 100 km.....	29	S.	70½	W.
11.....	23 31 50*	Ryukyu Islands.....	27	N.	127½	E.
12.....	12 09 00**	South of Honshu, Japan.....				
12.....	23 14 30	Near Gonzales, California. Felt.....	36 32	N.	121 27	W.
13.....	11 38 15*	Tadshik S.S.R.....	38½	N.	71	E.
13.....	12 12 37*	Mariana Islands.....	16½	N.	146½	E.
13.....	12 20 00*	About 200 miles off east coast of Honshu, Japan.....	32½	N.	142½	E.
13.....	19 35 33*	Fallon, Nevada. Mag. 4 (Berk).....	39½	N.	118	W.
14.....	00 28 38*	Solomon Islands.....	11	S.	163	E.
14.....	05 36 03*	Tarapaca Providence, Chile. Felt. Depth about 200 km.	20	S.	69	W.
14.....	09 49 10*	Fiji Islands. Depth about 600 km.....	18½	S.	178	W.
14.....	14 20 17*	Fiji Islands region. Depth about 600 km.....	22	S.	179	W.
15.....	04 09 15*	Ecuador. Depth about 100 km.....	2	S.	76½	W.
15.....	11 58 40**	Michoacan, Mexico.....				
15.....	20 21 45*	About 100 miles off east coast of Mindanao, Philippine Islands. Depth about 100 km.	6½	N.	127	E.
15.....	21 40 26*	Near coast of Nicaragua.....	11	N.	86½	W.

Footnotes at end of table.

TABLE 2.—Summary of instrumental epicenters for 1957—Continued

1957	Origin time G. C. T.	Region, focal depth, and remarks	Coordinates of provisional epicenter	
			Latitude	Longitude
	<i>h m s</i>		<i>° ' "</i>	<i>° ' "</i>
Jan. 15	22 54 05**	Southern Catamarca Providence, Argentina.		
16	11 43 30**	Chagos Islands region.		
16	20 36 07**	Tonga Islands.		
17	07 23 43*	Banda Sea. Depth about 100 km.	7½ S.	129½ E.
17	11 26 17**	Flores Islands.		
17	16 21 08*	Batan Islands region.	21 N.	121 E.
17	16 53 18*	Southeast of Baldwin Lake, Calif. Felt.	34 11 N.	116 44 W.
17	22 26 46*	Off south coast of Honshu, Japan. Felt in central Honshu. Depth about 350 km.	33 N.	137½ E.
18	13 12 42**	Near coast of Guerrero, Mexico.		
19	05 16 37*	Fiji Islands region. Depth about 650 km. Mag. 6½.	21½ S.	179 W.
20	10 59 35**	About 300 miles off south coast of Honshu, Japan.		
20	13 52 40*	Northern Ryukyu Islands.	29 N.	129½ E.
20	18 12 47*	Hindu Kush. Depth about 150 km.	36½ N.	71½ E.
21	10 01 46*	Chile. Felt at Antofagasta and Pedro de Valdivia. Depth about 100 km.	23 S.	70½ W.
21	12 59 20*	Chile. Felt at Antofagasta and Pedro de Valdivia. Depth about 150 km.	23½ S.	70½ W.
22	11 18 23*	Belgian Congo. Two killed at Kigoma.	4½ S.	28½ E.
22	12 31 54*	Santa Cruz Islands.	11 S.	166½ E.
23	17 26 51*	Near west coast of Greece.	37 N.	22½ E.
23	17 40 19*	Tonga Islands.	22 S.	175 W.
23	22 04 39**	Georgia foreshock.		
24	01 11 11*	Near east coast of New Guinea. Depth about 100 km.	6 S.	147 E.
24	02 04 40**	Mariana Islands.		
24	07 16 29*	Near coast of Peru. Mag. 6¼.	12½ S.	78 W.
24	14 59 37*	Southern Gulf of California.	25½ N.	109½ W.
24	15 49 23**	About 100 miles off west coast of Sumatra.		
24	16 30 45*	Gulf of California aftershock.	25½ N.	110 W.
24	16 59 50*	do.	25½ N.	109½ W.
24	19 25 16*	Tonga Islands.	20 S.	176½ W.
24	20 54 49	Southeast of Palomar, California. Felt in Riverside and San Diego counties. Mag. 4.5.	33 08 N.	116 23 W.
25	03 36 47*	Andreanof Islands, Aleutian Islands. Mag. 6½.	51½ N.	177 W.
25	16 59 48*	Northern Kurile Islands.	49½ N.	156 E.
25	23 26 08**	About 100 miles off northeast coast of Greenland.		
26	01 16 06	Northwestern Washington. Felt in the Puget Sound area.	48 20 N.	122 26 W.
26	09 57 50*	Near east coast of Samar, Philippine Islands.	11½ N.	125½ E.
26	16 30 48*	Georgia S.S.R.	42½ N.	42 E.
27	14 03 22*	Mindanao, Philippine Islands. Felt at Surigao.	10 N.	126½ E.
28	05 23 25*	Ryukyu Islands.	27 N.	130½ E.
28	08 16 19*	Samoa Islands region. Mag. 6½.	15½ S.	173 W.
28	18 25 27*	Near coast of northern Chile. Felt at Pedro de Valdivia.	22½ S.	71½ W.
28	21 01 42*	Tadzhik S.S.R.	38½ N.	69½ E.
28	23 18 51*	Northern Kurile Islands.	49 N.	156 E.
28	23 59 46*	Near coast of Nicaragua.	12 N.	86½ W.
29	15 17 30*	Georgia aftershock.	43 N.	43 E.
29	15 46 35*	Fiji Islands region.	16 S.	176 W.
29	21 19 53	Off coast of west-central California. Slight damage at Cambria. Mag. 4.9 (Berk).	35 52 N.	122 07 W.
30	09 46 05*	Samoa Islands region.	15 S.	173 W.
30	12 08 27*	Yukon, Canada.	65 N.	134 W.
30	15 29 00*	Tonga Islands. Mag. 6-6¼.	20½ S.	174 W.
30	16 54 40**	Samoa Islands.		
31	00 47 00*	Southern Bolivia. Felt in northern Chile. Depth about 150 km.	22 S.	66 W.
31	15 34 40**	Kurile Islands.		
Feb. 1	07 52 15	Little San Bernardino Mts., California. Felt in Riverside County. Mag. 4.5.	33 58 N.	116 20 W.
1	11 40 33**	About 150 miles off coast of El Salvador. Felt in western El Salvador.		
1	22 32 53*	Kurile Islands.	48½ N.	155 E.

Footnotes at end of table.

COAST AND GEODETIC SURVEY

TABLE 2.—Summary of instrumental epicenters for 1957—Continued

1957	Origin time G. C. T.			Region, focal depth, and remarks	Coordinates of provisional epicenter			
					Latitude		Longitude	
	<i>h</i>	<i>m</i>	<i>s</i>		°	'	°	'
Feb. 2.....	11	45	35*	Loyalty Islands region.....	21½	S.	170	E.
2.....	11	55	32*	Near east coast of Honshu, Japan. Felt.....	37	N.	141½	E.
3.....	10	33	09**	Kamchatka foreshock.....				
3.....	17	01	47*	.....do.....	53½	N.	159	E.
3.....	17	24	50*	Kamchatka. Mag. 6½-6¾.....	53½	N.	159	E.
3.....	21	11	53*	Kamchatka aftershock.....	53½	N.	159	E.
3.....	21	17	35*	.....do.....	53½	N.	159	E.
3.....	22	58	24*	.....do.....	53½	N.	159	E.
4.....	09	01	52*	Costa Rica. Felt at Puerto Armuelles, Panama.....	10	N.	84	W.
4.....	10	28	27*	Off south coast of Kamchatka.....	51	N.	160½	E.
5.....	04	02	05*	Fiji Islands region. Depth about 300 km.....	18	S.	176½	W.
5.....	04	51	20*	Mid-Atlantic Ocean. Mag. 6.....	25½	N.	45½	W.
5.....	15	57	27*	Santa Cruz Islands.....	11	S.	166	E.
5.....	16	28	36*	New Hebrides Islands. Depth about 100 km.....	18	S.	168	E.
5.....	17	20	24*	Near south coast of Turkey. Felt on Rhodes.....	36½	N.	29	E.
6.....	12	41	16**	Galapagos Islands foreshock.....				
6.....	13	06	13*	Galapagos Islands region. Mag. 6.....	2	N.	91	W.
6.....	13	07	30**	Galapagos Island aftershock. May. 6.....				
6.....	20	34	55*	Lake Baikal region, U.S.S.R.....	50	N.	105½	E.
7.....	09	02	23**	Cordoba Province, Argentina.....				
7.....	16	17	09*	Andreanof Islands, Aleutian Islands. Depth about 60 km.....	52½	N.	175	W.
7.....	18	14	19*	Off coast of Vancouver Island, British Columbia.....	50	N.	130	W.
9.....	01	53	05*	Near north coast of New Guinea.....	1½	S.	137½	E.
9.....	05	59	04*	Near east coast of Samar, Philippine Islands. Felt at Surigao. Depth about 60 km.....	10½	N.	126½	E.
9.....	07	23	18*	Off south coast of Panama.....	7½	N.	83	W.
9.....	08	07	15*	Caroline Islands.....	11½	N.	138½	E.
9.....	13	29	18*	Off coast of North Island, New Zealand. Depth about 150 km. Mag. 6¼.....	34	S.	180	
9.....	16	38	07	Near coast of northern California. Mag. 5.4 (Berk)....	41 10	N.	126 18	W.
9.....	17	38	25	Northern California aftershock. Mag. 4.7 (Berk)....	41 12	N.	126 17	W.
9.....	17	56	00*	Tonga Islands.....	19	S.	174	W.
10.....	05	47	59*	Azores Islands region. Mag. 5¼.....	35½	N.	35	W.
10.....	22	32	15*	Mindanao foreshock. Felt at Borongan, Catbalogan, Hinatuan, Mambajao, and Surigao. Mag. 6½-6¾....	10	N.	126	E.
10.....	22	50	52*	Mindanao, Philippine Islands. Felt at Borongan and Surigao. Mag. 6¾.....	10½	N.	126½	E.
11.....	01	14	44*	Mindanao aftershock. Felt at Borongan, Hinatuan, Mambajao, and Surigao. Mag. 6½.....	10	N.	126	E.
11.....	03	36	11*	Mindanao aftershock.....	10	N.	126½	E.
11.....	03	44	33*	Mindanao aftershock. Felt at Surigao.....	10	N.	126	E.
11.....	04	04	08*	Mindanao aftershock.....	10	N.	126	E.
11.....	04	47	52**	Mindanao aftershock. Felt at Surigao.....				
11.....	06	47	37*	.....do.....	10	N.	126	E.
11.....	11	57	16*	.....do.....	10	N.	126½	E.
11.....	12	20	09**	.....do.....				
11.....	14	25	38*	Mindanao aftershock. Felt at Mambajao and Surigao. Mag. 6¼.....	10	N.	126	E.
11.....	15	42	57*	England. Slight property damage at Nottinghamshire...	53	N.	1	W.
11.....	18	56	50*	Mindanao aftershock. Felt at Surigao.....	10	N.	126½	E.
12.....	08	52	48*	Northern Kurile Islands.....	48½	N.	155	E.
12.....	17	14	10**	Mindanao aftershock. Felt at Surigao.....				
12.....	21	06	56**	Mindanao aftershock.....				
13.....	00	29	48*	Mindanao aftershock. Felt at Surigao.....	10	N.	126½	E.
13.....	12	37	14*	New Hebrides Islands. Depth about 200 km.....	18	S.	169	E.
13.....	14	41	34*	Northern Kurile Islands.....	48½	N.	157½	E.
14.....	10	16	13**	Mindanao aftershock.....				
14.....	23	01	19*	Near south coast of Formosa.....	20	N.	120	E.
15.....	07	33	10*	Southeastern Peru. Depth about 100 km.....	14	S.	71	W.
15.....	18	49	43*	Mariana Islands region.....	13½	N.	141½	E.
16.....	14	12	30*	Java Sea. Depth about 550 km.....	5½	S.	110	E.
16.....	22	49	28**	Near Islands, Aleutian Islands. Depth about 100 km...				

Footnotes at end of table.

TABLE 2.—Summary of instrumental epicenters for 1957—Continued

1957	Origin time G. C. T.	Region, focal depth, and remarks	Coordinates of provisional epicenter			
			Latitude		Longitude	
	<i>h</i> <i>m</i> <i>s</i>		°	'	°	'
Feb. 17.....	04 36 20**	Near east coast of Kamchatka.....				
17.....	09 51 10*	Near east coast of Samar, Philippine Islands.....	13	N.	126	E.
17.....	15 46 45*	Oaxaca, Mexico. Felt in the Federal District and Oaxaca. Depth about 60 km. Mag. 5¼-6.	16	N.	96½	W.
17.....	16 04 02*	Banda Sea.....	4½	S.	125½	E.
18.....	00 18 34*	Kurile Islands. Depth about 60 km.....	45	N.	152	E.
18.....	14 49 30*	Mid-Atlantic Ocean. Mag. 6¼-6½.....	25½	N.	45½	W.
18.....	23 49 52*	Near coast of Peru. Felt at Lima. Depth about 100 km. Mag. 6½-6¾.	11½	S.	78	W.
19.....	07 43 54*	Near south coast of Greece. Felt in Messinia.....	36½	N.	22	E.
19.....	16 30 48	Southeast of Caliente, California. Felt at Arvin, Bakersfield, and Tehachapi.	35 16	N.	118 37	W.
19.....	19 58 55*	Near east coast of Kamchatka.....	56	N.	164	E.
20.....	04 41 00*	Northern Tunisia. Thirteen killed, many injured, and extensive property damage in Souk-el-Khemis area. Also felt in Algeria.	36½	N.	9	E.
20.....	05 17 18*	Near coast of southern Peru. Felt in northern Chile. Depth about 100 km.	16	S.	72	W.
20.....	12 59 44*	Near east coast of Kamchatka. Depth about 60 km....	53½	N.	160	E.
20.....	20 10 57**	Near south coast of Mindanao, Philippine Islands.....				
20.....	21 58 23*	Near coast of Sumatra.....	2	N.	97	E.
21.....	14 30 06*	Fox Islands, Aleutian Islands. Depth about 100 km. Mag. 6¾.	53	N.	171	W.
21.....	19 36 05*	Kermadec Islands.....	31	S.	178	W.
22.....	04 58 00*	Southeastern Kazakh S.S.R.....	43	N.	76½	E.
22.....	17 12 49*	Kurile Islands foreshock.....	49	N.	156	E.
23.....	03 34 46**	do.....				
23.....	04 57 46*	Northern Kurile Islands.....	49	N.	156	E.
23.....	05 01 27**	Kurile Islands aftershock.....				
23.....	13 16 51*	Off coast of Vancouver Island, British Columbia.....	49	N.	129	W.
23.....	18 54 37*	Caroline Islands region.....	12	N.	141	E.
23.....	20 26 12*	Formosa. Eleven killed, many injured, and extensive property damage at Hualien and Taipei. Mag. 7.3.	24	N.	122	E.
23.....	22 13 28**	Albania.....				
24.....	17 06 02**	Mindanao aftershock.....				
24.....	21 47 26*	Formosa aftershock.....	26	N.	121½	E.
25.....	02 04 08*	Sumbawa Island.....	8½	S.	118	E.
25.....	13 21 17*	Banda Sea.....	6	S.	130	E.
26.....	02 54 43*	Near north coast of Mindanao, Philippine Islands. Depth about 100 km.	9½	N.	126	E.
26.....	06 10 22*	Near east coast of Kamchatka.....	52½	N.	161	E.
27.....	15 01 22*	Formosa aftershock.....	24	N.	121½	E.
27.....	16 07 58*	Santa Cruz Islands.....	11½	S.	167	E.
28.....	11 01 45*	Andreanof Islands, Aleutian Islands.....	51½	N.	180	
28.....	23 31 25**	Western Indian Ocean. About 800 miles off coast of Madagascar.				
Mar. 1.....	02 15 12**	Near coast of Oaxaca, Mexico.....				
2.....	00 27 33*	Jamaica. Three killed and five injured. Moderate property damage at Kingston and Montego Bay. Mag. 6¾.	18½	N.	78	W.
2.....	07 12 10*	Southern Iran.....	27½	N.	53½	E.
2.....	08 10 24*	Near south coast of New Britain. Felt at Pomio and Rabaul.	6	S.	151	E.
3.....	03 18 23*	Off coast of Mexico. Mag. 5¼.....	8	N.	103	W.
3.....	20 49 30*	Off east coast of New Guinea. Depth about 100 km....	9½	S.	154	E.
4.....	05 47 30**	South Central Alaska.....				
5.....	12 24 35*	North Atlantic Ocean. Mag. 6½-6¾.....	33	N.	39½	W.
5.....	19 03 30*	New Hebrides Islands.....	14	S.	167½	E.
6.....	03 39 45**	Off coast of Chiapas, Mexico.....				
6.....	11 26 44*	Kurile Islands.....	49	N.	155	E.
7.....	10 47 25*	Fiji Islands. Depth about 550 km.....	19	S.	178½	W.
7.....	21 55 42**	Arctic Ocean, north of Svalbard.....				

Footnotes at end of table.

TABLE 2.—Summary of instrumental epicenters for 1957—Continued

1957	Origin time G. C. T.	Region, focal depth, and remarks	Coordinates of provisional epicenter			
			Latitude		Longitude	
	<i>h m s</i>		°	'	°	'
Mar. 8.....	12 14 12*	Eastern Greece foreshock. Moderate property damage in Larisa and Magnisia Provinces.	39½	N.	23	E.
8.....	12 21 08*	Eastern Greece. Two dead, many injured, and moderate property damage in Larisa and Magnisia Provinces.	39½	N.	23	E.
8.....	13 24 27	Southeast of China Lake, California. Felt.....	35 43	N.	117 30	W.
8.....	16 35 11*	South of Fiji Islands. Depth about 600 km.....	23	S.	179	E.
8.....	20 37 54*	Eastern Greece aftershock. Felt.....	39½	N.	23	E.
8.....	23 35 08*	.....do.....	39½	N.	23	E.
9.....	14 06 52*	Central Alaska. Felt at College and Fairbanks.....	65	N.	149	W.
9.....	14 22 27.5	Andreanof Islands, Aleutian Islands. Seismic sea wave caused destruction of two villages and \$3 million damage on Oahu and Kauai, T. H. Mag. 8.3.	51.3	N.	175.8	W.
9.....	15 41 50*	Andreanof Islands, Aleutian Islands. Felt on Adak.....	50½	N.	177	W.
9.....	16 32 30*	.....do.....	51	N.	176	W.
9.....	16 45 26	.....do.....	51.5	N.	174	W.
9.....	17 10 13*	.....do.....	51½	N.	172½	W.
9.....	19 37 31*	.....do.....	51	N.	173	W.
9.....	20 00 56*	Fox Islands, Aleutian Islands.....	51½	N.	170½	W.
9.....	20 22 02*	.....do.....	52	N.	169½	W.
9.....	20 39 16	Fox Islands, Aleutian Islands. Mag. 7.1.....	52.3	N.	169.0	W.
9.....	21 56 24*	Fox Islands, Aleutian Islands.....	53	N.	168	W.
9.....	22 19 15**	Southern Bolivia. Felt at Santa Cruz.....				
9.....	22 59 26*	Fox Islands, Aleutian Islands.....	51½	N.	171	W.
10.....	03 06 10.5	Andreanof Islands, Aleutian Islands. Felt on Adak. Mag. 6½-6¾.	51.6	N.	174.4	W.
10.....	03 08 55*	Andreanof Islands, Aleutian Islands. Felt on Adak.....	51½	N.	174	W.
10.....	04 41 04*	Fox Islands, Aleutian Islands.....	52	N.	170	W.
10.....	05 33 27*	Andreanof Islands, Aleutian Islands. Felt on Adak.....	52	N.	174	W.
10.....	07 23 18*	.....do.....	52	N.	176	W.
10.....	07 31 35	Fox Islands, Aleutian Islands.....	53.1	N.	168.0	W.
10.....	11 20 49.5	.....do.....	52.2	N.	170.5	W.
10.....	12 12 18½*	Andreanof Islands, Aleutian Islands.....				
10.....	12 36 04*	Fox Islands, Aleutian Islands.....	51	N.	171	W.
10.....	12 45 31*	Andreanof Islands, Aleutian Islands. Felt on Adak.....	51	N.	177	W.
10.....	13 10 13	Andreanof Islands, Aleutian Islands.....	50.9	N.	179.9	E.
10.....	13 28 31	.....do.....	51.1	N.	178.5	W.
10.....	15 26 23.5	Andreanof Islands, Aleutian Islands. Felt on Adak. Mag. 6¾ (Berk).	51.5	N.	173.6	W.
10.....	16 37 45*	Andreanof Islands, Aleutian Islands. Felt on Adak.....	51½	N.	173½	W.
10.....	19 18 30*	.....do.....	51	N.	177	W.
10.....	19 40 55*	.....do.....	52	N.	173	W.
10.....	23 56 50*	Fox Islands, Aleutian Islands.....	53	N.	169	W.
11.....	00 08 07*	.....do.....	52	N.	169	W.
11.....	01 50 55*	.....do.....	50½	N.	170	W.
11.....	03 12 41.5	Andreanof Islands, Aleutian Islands. Felt on Adak. Mag. 6¾-7	50.9	N.	176	W.
11.....	03 35 00*	Andreanof Islands, Aleutian Islands. Felt on Adak.....	51½	N.	177	W.
11.....	03 55 27*	.....do.....	50½	N.	177	W.
11.....	04 05 09*	.....do.....	51	N.	177	W.
11.....	06 42 49*	Fox Islands, Aleutian Islands.....	51½	N.	168	W.
11.....	06 51 56*	.....do.....	51½	N.	170½	W.
11.....	07 08 00*	Andreanof Islands, Aleutian Islands. Felt on Adak.....	51	N.	177	W.
11.....	07 39 05*	.....do.....	51½	N.	178½	W.
11.....	08 37 15*	Fox Islands, Aleutian Islands.....	53	N.	168	W.
11.....	08 42 48*	Andreanof Islands, Aleutian Islands. Felt on Adak.....	50½	N.	178	W.
11.....	09 58 45	Fox Islands, Aleutian Islands. Mag. 7.0.....	52.5	N.	169.2	W.
11.....	12 09 10*	Off coast of Sumatra. Felt at Tapanouli.....	2	N.	97	W.
11.....	14 55 20	Andreanof Islands, Aleutian Islands. Felt on Adak. Mag. 6¾.	51.5	N.	178.4	W.
11.....	15 35 53	Andreanof Islands, Aleutian Islands. Felt on Adak. Mag. 6½.	51.1	N.	179.0	W.
11.....	18 58 16**	Andreanof Islands, Aleutian Islands.....				

Footnotes at end of table.

TABLE 2.—Summary of instrumental epicenters for 1957—Continued

1957	Origin time G. C. T.	Region, focal depth, and remarks	Coordinates of provisional epicenter			
			Latitude		Longitude	
	<i>h</i> <i>m</i> <i>s</i>		°	'	°	'
Mar. 11.....	23 32 03*	Andreanof Islands, Aleutian Islands. Felt on Adak.....	52	N.	173	W.
12.....	00 18 00*	Fox Islands, Aleutian Islands.....	53	N.	168	W.
12.....	00 39 50*	Tonga Islands. Depth about 100 km.....	19	S.	175½	W.
12.....	01 02 33*	Andreanof Islands, Aleutian Islands. Felt on Adak.....	52	N.	174½	W.
12.....	01 46 35*	.....do.....	52	N.	173	W.
12.....	02 22 59.5	Fox Islands, Aleutian Islands.....	52.4	N.	170.7	W.
12.....	05 12 08*	.....do.....	52½	N.	169	W.
12.....	06 02 47**	.....do.....				
12.....	07 28 48	Andreanof Islands, Aleutian Islands. Felt on Adak. Mag. 6¼-6½.	51.7	N.	174.1	W.
12.....	07 39 17.5	.....do.....	51.0	N.	178.2	W.
12.....	08 03 14	Andreanof Islands, Aleutian Islands. Felt on Adak and Umnak.	51.2	N.	177.2	W.
12.....	10 38 30*	Andreanof Islands, Aleutian Islands. Felt on Adak.....	51½	N.	174½	W.
12.....	11 44 50.5	Andreanof Islands, Aleutian Islands. Felt on Adak and Umnak. Mag. 7.3.	51.4	N.	177.7	W.
12.....	12 46 13	Fox Islands, Aleutian Islands.....	52.6	N.	168.7	W.
12.....	16 32 05*	New Hebrides Islands.....	14½	S.	168	E.
12.....	17 00 21*	Andreanof Islands, Aleutian Islands. Felt on Adak.....	51½	N.	175	W.
12.....	17 21 47*	Fiji Islands. Depth about 700 km.....	21½	S.	179	W.
12.....	18 25 18*	Andreanof Islands, Aleutian Islands. Felt on Adak.....	51	N.	178	W.
12.....	18 28 50*	Fiji Islands. Depth about 650 km.....	18	S.	178½	W.
12.....	19 11 16*	Fiji Islands region. Depth about 400 km.....	16	S.	176½	W.
12.....	20 00 30*	Near Unimak Island.....	54	N.	165	W.
12.....	20 07 31*	Unimak Island aftershock.....	54	N.	165	W.
12.....	21 23 04*	Ecuador. Depth about 150 km.....	1½	S.	79½	W.
12.....	23 45 25*	Andreanof Islands, Aleutian Islands. Felt on Adak.....	52	N.	174	W.
13.....	02 48 22	.....do.....	51.7	N.	171.2	W.
13.....	03 32 58	.....do.....	51.4	N.	175.3	W.
13.....	07 21 53	.....do.....	51.4	N.	178.4	W.
13.....	09 09 35.5	Fox Islands, Aleutian Islands.....	52.3	N.	170.0	W.
13.....	09 11 15**	Near west coast of North Island, New Zealand. Felt on North Island and northern South Island.				
13.....	11 37 49*	Andreanof Islands, Aleutian Islands. Felt on Adak.....	51	N.	177	W.
13.....	11 57 58*	.....do.....	52	N.	173	W.
13.....	12 42 35*	.....do.....	51½	N.	177	W.
13.....	15 42 04	Andreanof Islands, Aleutian Islands. Felt on Adak. Mag. 6¾.	51.3	N.	178.5	W.
13.....	17 43 40*	Andreanof Islands, Aleutian Islands. Felt on Adak.....	51	N.	175	W.
13.....	18 56 33*	Fox Islands, Aleutian Islands.....	52½	N.	168	W.
13.....	19 59 24.5	.....do.....	53.9	N.	165.6	W.
14.....	00 35 38*	Andreanof Islands, Aleutian Islands. Felt on Adak.....	51	N.	178	W.
14.....	01 52 16*	Fox Islands, Aleutian Islands.....	52½	N.	169	W.
14.....	02 46 55*	Off south coast of Unimak Island.....	53½	N.	163½	W.
14.....	10 34 33*	Fox Islands, Aleutian Islands.....				
14.....	12 29 32*	.....do.....	53	N.	166½	W.
14.....	14 47 45.5	Andreanof Islands, Aleutian Islands. Felt on Adak. Mag. 7.2.	51.2	N.	177.4	W.
14.....	15 51 00*	Andreanof Islands, Aleutian Islands. Felt on Adak.....	51½	N.	177½	W.
14.....	17 06 21*	.....do.....	51	N.	178	W.
14.....	22 18 23*	.....do.....	51½	N.	176	W.
15.....	02 52 08*	Fox Islands, Aleutian Islands. Mag. 6¾.	53	N.	167	W.
15.....	04 12 56*	Andreanof Islands, Aleutian Islands. Felt on Adak.....	51	N.	176	W.
15.....	11 57 28*	.....do.....	51	N.	173	W.
15.....	16 38 02*	Fox Islands, Aleutian Islands.....	53	N.	167	W.
15.....	22 13 25*	Andreanof Islands, Aleutian Islands. Felt on Adak.....	51½	N.	177	W.
16.....	00 43 41*	Northern Iran.....	35	N.	53	E.
16.....	02 13 23*	Andreanof Islands, Aleutian Islands. Felt on Adak.....	51½	N.	175	W.
16.....	02 34 12*	Andreanof Islands, Aleutian Islands. Felt on Adak. Mag. 6¾.	52	N.	179	W.
16.....	03 33 57*	Andreanof Islands, Aleutian Islands. Felt on Adak.....	52	N.	174	W.
16.....	09 30 36*	.....do.....	51	N.	177	W.
16.....	23 55 08*	Ryukyu Islands.....	27	N.	127½	E.

Footnotes at end of table.

TABLE 2.—Summary of instrumental epicenters for 1957—Continued

1957	Origin time G. C. T.	Region, focal depth, and remarks	Coordinates of provisional epicenter	
			Latitude	Longitude
	<i>h m s</i>		° ' "	° ' "
Mar. 17.....	01 46 56*	Andreanof Islands, Aleutian Islands. Felt on Adak.....	51 N.	180
17.....	02 48 36*	.....do.....	51 N.	178½ W.
17.....	07 04 40*	Fox Islands, Aleutian Islands.....	52½ N.	169 W.
17.....	07 53 51*	Andreanof Islands, Aleutian Islands. Felt on Adak.....	51 N.	179 W.
17.....	11 30 33*	Fox Islands, Aleutian Islands.....	53½ N.	167 W.
17.....	15 11 42*	.....do.....	53 N.	167½ W.
17.....	16 17 13*	.....do.....	52½ N.	166 W.
17.....	22 44 44*	Fox Islands, Aleutian Islands. Mag. 6½.....	54 N.	166 W.
18.....	00 12 10*	Andreanof Islands, Aleutian Islands. Felt on Adak.....	51 N.	179½ W.
18.....	02 24 39*	Fox Islands, Aleutian Islands.....	52½ N.	171 W.
18.....	02 25 56*	.....do.....	52½ N.	171 W.
18.....	05 08 34*	Andreanof Islands, Aleutian Islands. Felt on Adak.....	51½ N.	179 W.
18.....	18 56 28	Near coast of southern California. Minor damage at Oxnard and Ventura. Mag. 4.7.	34 06 N.	119 10 W.
18.....	19 30 16*	Fiji Islands. Depth about 450 km.....	20 S.	178 W.
18.....	20 03 47*	Andreanof Islands, Aleutian Islands. Felt on Adak.....	52 N.	180
18.....	21 14 12*	New Britain. Felt at Karoola, Rabaul, and Warangoi.....	6 S.	152 E.
18.....	23 17 22*	Near coast of Crimean Peninsula.....	45 N.	33 E.
19.....	03 39 35*	Andreanof Islands, Aleutian Islands. Felt on Adak.....	52 N.	175½ W.
19.....	08 12 40*	Fox Islands, Aleutian Islands.....	52 N.	169 W.
19.....	08 14 10*	.....do.....	53 N.	168 W.
19.....	11 28 50*	Andreanof Islands, Aleutian Islands. Felt on Adak.....	51½ N.	176½ W.
19.....	12 50 51*	Andreanof Islands, Aleutian Islands. Felt on Adak. Mag. 6¾.	51½ N.	175 W.
19.....	15 47 24*	Fox Islands, Aleutian Islands.....	52 N.	172½ W.
19.....	17 04 25*	.....do.....	52½ N.	171 W.
20.....	00 00 51*	Andreanof Islands, Aleutian Islands. Felt on Adak.....	52 N.	173 W.
20.....	00 22 25*	Fox Islands, Aleutian Islands.....	53 N.	169 W.
20.....	03 25 00*	Andreanof Islands, Aleutian Islands. Felt on Adak.....	51½ N.	175½ W.
20.....	06 10 27*	Near north coast of Mindanao, Philippine Islands.....	10½ N.	127 E.
20.....	11 01 42*	Andreanof Islands, Aleutian Islands. Felt on Adak.....	52 N.	172 W.
20.....	20 28 03*	.....do.....	51½ N.	174½ W.
21.....	04 29 02*	.....do.....	52 N.	173 W.
21.....	08 44 46*	Near coast of Chiapas, Mexico.....	14½ N.	93 W.
21.....	12 31 30*	Fox Islands, Aleutian Islands.....	52 N.	171 W.
21.....	15 46 16*	Andreanof Islands, Aleutian Islands. Felt on Adak.....	51 N.	175 W.
21.....	16 35 28*	Near north coast of New Guinea.....	3 S.	144½ E.
21.....	17 39 12*	Andreanof Islands, Aleutian Islands. Felt on Adak.....	51½ N.	177 W.
22.....	14 21 06*	Fox Islands, Aleutian Islands. Mag. 7.0.....	54 N.	166 W.
22.....	14 33 13*	Fox Islands, Aleutian Islands.....	54 N.	165½ W.
22.....	17 09 51*	.....do.....	52½ N.	171 W.
22.....	19 44 21	Northern California. Minor damage at Daly City and San Francisco. Mag. 5.3 (Berk).	37 40 N.	122 29 W.
22.....	23 14 35	Northern California aftershock. Felt. Mag. 4.4 (Berk).	37 39 N.	122 27 W.
23.....	00 26 55	Northern California aftershock. Felt. Mag. 4.0 (Berk).	37 39 N.	122 29 W.
23.....	03 53 55**	Near coast of Chiapas, Mexico.....	5½ S.	131 E.
23.....	05 12 31*	Banda Sea. Felt on board the "SS Changte" at 6°13' S., 131°25' E. Depth about 100 km. Mag. 7.3.	5½ S.	131 E.
23.....	13 24 33*	Andreanof Islands, Aleutian Islands. Felt on Adak.....	51½ N.	179 W.
23.....	13 39 53*	.....do.....	51 N.	179½ W.
24.....	04 36 22*	Rat Islands region, Aleutian Islands.....	51½ N.	175½ E.
24.....	06 37 40**	Antarctic Ocean, north of Balleny Islands.....		
24.....	07 29 15*	Andreanof Islands, Aleutian Islands. Felt on Adak.....	51 N.	179½ W.
24.....	08 22 23*	Near north coast of Vancouver Island, British Columbia. Mag. 6-6¼ (Berk).	51 N.	130 W.
24.....	11 06 10*	Fox Islands, Aleutian Islands.....	52½ N.	169½ W.
24.....	11 36 50*	.....do.....	52½ N.	171½ W.
24.....	12 05 10*	Hindu Kush. Depth about 200 km.....	37 N.	71 E.
24.....	13 53 53*	Andreanof Islands, Aleutian Islands. Felt on Adak.....	51 N.	179½ W.
24.....	13 56 35**	Gulf of California.....		
24.....	16 32 28*	Fox Islands, Aleutian Islands.....	52½ N.	169½ W.
25.....	00 39 29*	.....do.....	53 N.	167 W.
25.....	01 03 59*	Andreanof Islands, Aleutian Islands. Felt on Adak.....	52 N.	176 W.

Footnotes at end of table.

TABLE 2.—Summary of instrumental epicenters for 1957—Continued

1957	Origin time G. C. T.	Region, focal depth, and remarks	Coordinates of provisional epicenter			
			Latitude		Longitude	
	<i>h m s</i>		<i>° ' "</i>	<i>N. S.</i>	<i>° ' "</i>	<i>W. E.</i>
Mar. 25.....	02 28 36*	Near coast of Guatemala. Felt at San Salvador, El Salvador.	13½	N.	91	W.
25.....	05 37 25*	Unimak Island region, Alaska.....	54	N.	163½	W.
25.....	14 13 33*	Fox Islands, Aleutian Islands.....	54	N.	165½	W.
25.....	18 25 48*	Revilla Gigedo Islands region.....	20	N.	109	W.
26.....	02 10 15*	Fox Islands, Aleutian Islands.....	54	N.	165½	W.
26.....	02 47 50*	Andreanof Islands, Aleutian Islands. Felt on Adak..	51	N.	177½	W.
26.....	03 04 55*	Fox Islands, Aleutian Islands.....	51½	N.	170	W.
26.....	04 49 20*	Near south coast of Iran.....	28	N.	52½	E.
26.....	16 01 53*	Andreanof Islands, Aleutian Islands.....	50½	N.	180	
26.....	18 16 47*	Andreanof Islands, Aleutian Islands. Felt on Adak....	51	N.	179½	W.
27.....	04 13 52*	Fox Islands, Aleutian Islands.....	52½	N.	170	W.
27.....	07 31 56*	Tonga Islands region. Depth about 150 km.....	22	S.	177	W.
27.....	13 00 27*	Off coast of New Britain. Felt at Karoola and Rabaul. Depth about 100 km.	5	S.	153½	E.
28.....	01 15 20*	Andreanof Islands, Aleutian Islands. Felt on Adak.....	51½	N.	174½	W.
28.....	19 55 31**	Andreanof Islands, Aleutian Islands.....				
28.....	20 08 20*	Fox Islands, Aleutian Islands.....	51	N.	171½	W.
28.....	22 25 58*	Central Greece.....	39½	N.	22½	E.
29.....	05 10 28*	Fox Islands, Aleutian Islands. Mag. 6½.....	53½	N.	167	W.
29.....	05 37 50*	Talaud Islands.....	4	N.	127	E.
29.....	07 25 58*	Fox Islands, Aleutian Islands.....	53½	N.	167	W.
29.....	08 16 03*	.....do.....	53	N.	167	W.
29.....	22 49 51*	Fox Islands, Aleutian Islands. Mag. 6-6¼.....	53	N.	169	W.
30.....	00 42 40*	Andreanof Islands, Aleutian Islands. Felt on Adak.....	51½	N.	179½	W.
30.....	01 50 39*	.....do.....	51½	N.	178	W.
30.....	06 37 00*	Andreanof Islands, Aleutian Islands.....	51	N.	180	
30.....	09 17 00*	Andreanof Islands, Aleutian Islands. Felt on Adak....	52	N.	175	W.
31.....	02 22 40**	Near coast of northern Chile. Depth about 100 km.....				
31.....	02 23 05*	Off coast of Oregon.....	43½	N.	127½	W.
31.....	10 08 28*	Andreanof Islands, Aleutian Islands. Felt on Adak.....	51½	N.	178	W.
31.....	17 22 55*	Kamchatka.....	54	N.	158	E.
Apr. 1.....	07 30 27*	Near coast of Samar, Philippine Islands. Depth about 60 km.	11½	N.	126	E.
1.....	07 54 20*	Molucca Passage. Depth about 100 km.....	4½	N.	129	E.
1.....	11 35 30*	Andreanof Islands, Aleutian Islands.....	51	N.	173	W.
1.....	19 04 41*	.....do.....	51½	N.	178½	W.
2.....	00 39 42*	.....do.....	51	N.	173	W.
2.....	04 22 47	East of Indio, California. Felt. Mag. 4.1.....	33 42	N.	115 56	W.
2.....	08 33 10*	Off south coast of Honshu, Japan. Depth about 550 km.	30	N.	137	E.
2.....	11 51 42*	Andreanof Islands, Aleutian Islands.....	51	N.	173	W.
2.....	20 16 57*	.....do.....	51½	N.	173	W.
2.....	20 39 04*	.....do.....	51	N.	173½	W.
2.....	21 27 54*	.....do.....	51	N.	173	W.
3.....	20 28 45**	Near west coast of Cyprus.....				
3.....	23 09 15*	Andreanof Islands, Aleutian Islands.....	51½	N.	177	W.
4.....	00 13 08*	Near coast of Alaska Peninsula. Felt on Kodiak. Depth about 150 km.	58	N.	155½	W.
4.....	00 50 47*	Fox Islands, Aleutian Islands.....	53	N.	168	W.
4.....	01 29 42*	.....do.....	53	N.	166	W.
4.....	06 52 18*	Northern Kurile Islands.....	48	N.	155	E.
4.....	11 00 20**	Southern Mendoza Province, Argentina. Felt in central Chile.				
4.....	11 36 17*	Hindu Kush.....	36	N.	70	E.
4.....	14 43 49*	Fox Islands, Aleutian Islands.....	52½	N.	170½	W.
5.....	02 49 39*	Fox Islands, Aleutian Islands. Mag. 6½.....	52	N.	172½	W.
5.....	07 30 22*	Kermadec Islands region. Depth about 100 km. Mag. 6¼.	26½	S.	177	W.
5.....	15 04 09*	Kurile Islands.....	45	N.	148	E.
5.....	16 12 20*	Near coast of Nicaragua. Felt in El Salvador. Depth about 100 km.	12½	N.	88	W.
5.....	16 36 20*	Andreanof Islands, Aleutian Islands. Felt on Adak.....	51½	N.	178½	W.

Footnotes at end of table.

COAST AND GEODETIC SURVEY

TABLE 2.—Summary of instrumental epicenters for 1957—Continued

1957	Origin time G. C. T.			Region, focal depth, and remarks	Coordinates of provisional epicenter			
					Latitude		Longitude	
	<i>h</i>	<i>m</i>	<i>s</i>		°	'	°	'
Apr 7.....	04	23	16**	Near east coast of Kamchatka.....				
7.....	07	33	47*	Andreanof Islands, Aleutian Islands.....	51½	N.	175½	W.
7.....	08	03	46*	Fox Islands, Aleutian Islands.....	53	N.	167	W.
7.....	10	14	08*	Near north coast of New Guinea. Mag. 6-6¼.....	1	S.	137½	E.
7.....	13	13	10**	Andreanof Islands, Aleutian Islands.....				
8.....	00	06	37*	do.....	52	N.	175½	W.
8.....	01	12	10*	do.....	50½	N.	179	E.
8.....	20	18	09*	Panama-Costa Rica border. Felt at San Jose, Costa Rica, and Balboa Heights, Canal Zone. Mag. 6½.....	8½	N.	83	W.
8.....	20	43	10**	Andreanof Islands, Aleutian Islands.....				
9.....	00	24	39*	Off south coast of Honshu, Japan. Felt. Depth about 450 km. Mag. 6¾.....	30½	N.	138½	E.
9.....	02	17	06*	Mariana Islands region.....	22½	N.	144½	E.
9.....	07	39	40*	Fox Islands, Aleutian Islands.....	53	N.	167	W.
9.....	09	59	27*	Andreanof Islands, Aleutian Islands.....	51	N.	178½	W.
9.....	10	35	34*	South of Honshu, Japan. Depth about 500 km.....	30½	N.	138	E.
9.....	11	02	09*	Andreanof Islands, Aleutian Islands.....	51½	N.	178½	W.
9.....	17	40	13*	do.....	51½	N.	179½	W.
9.....	20	23	56*	Fox Islands, Aleutian Islands.....	52½	N.	169	W.
9.....	22	33	54*	Andreanof Islands, Aleutian Islands.....	51	N.	177½	W.
9.....	22	49	47*	do.....	51½	N.	177	W.
10.....	03	25	21.5	Fox Islands, Aleutian Islands.....	53.2	N.	168.0	W.
10.....	05	12	08*	Near coast of Oaxaca, Mexico. Mag. 6½.....	15½	N.	98	W.
10.....	07	28	03*	Guatemala.....	14	N.	91½	W.
10.....	09	09	18*	Andreanof Islands, Aleutian Islands.....	51	N.	177	W.
10.....	11	29	58*	Kodiak Island region. Mag. 7.1.....	56	N.	154	W.
10.....	13	20	14*	Andreanof Islands, Aleutian Islands.....	51½	N.	176½	W.
10.....	13	43	43*	Samoa Islands. Felt at Apia.....	15	S.	173	W.
11.....	06	44	33**	Samoa Islands.....				
11.....	16	12	08*	Fox Islands, Aleutian Islands.....	52½	N.	169½	W.
11.....	17	40	37*	do.....	52	N.	168½	W.
12.....	04	17	45*	Andreanof Islands, Aleutian Islands.....	51½	N.	178½	W.
12.....	06	49	11*	do.....	51½	N.	176	W.
12.....	13	03	45**	do.....				
13.....	03	44	00*	Off coast of Vancouver Island, British Columbia.....	48½	N.	128	W.
13.....	05	13	32*	Fox Islands, Aleutian Islands.....	52½	N.	168½	W.
13.....	06	30	08*	Near Coast of Mindanao, Philippine Islands.....	6½	N.	126½	E.
13.....	07	59	23*	Fox Islands, Aleutian Islands.....	52½	N.	168½	W.
13.....	10	10	48*	Near south coast of Mindanao, Philippine Islands.....	5	N.	126½	E.
13.....	15	39	43*	Northern Chile. Felt. Depth about 150 km.....	19	S.	69½	W.
14.....	07	11	50*	Southern Tibet. Mag. 6¼.....	31	N.	84½	E.
14.....	08	24	51*	Windward Passage.....	20	N.	73	W.
14.....	12	32	39*	Bismarck Sea. Depth about 550 km.....	4½	S.	150	E.
14.....	19	17	57*	Samoa Islands. Felt at Apia. Mag. 7.5.....	15½	S.	173	W.
14.....	20	59	00*	Andreanof Islands, Aleutian Islands.....	50½	N.	179	W.
15.....	10	38	37*	do.....	51½	N.	179	W.
15.....	18	21	33*	do.....	51½	N.	179	W.
15.....	19	53	39*	do.....	51½	N.	176	W.
15.....	21	33	05*	Fox Islands, Aleutian Islands.....	52½	N.	167	W.
16.....	04	04	04*	Western Java Sea. Depth about 600 km. Mag. 7.5.....	4½	S.	107½	E.
16.....	18	17	12*	Southern Bolivia. Felt in northern Chile.....	9½	S.	67	W.
17.....	04	35	47*	Kodiak Island region.....	56	N.	154	W.
17.....	08	07	58*	Tonga Islands. Depth about 200 km.....	20	S.	176	W.
17.....	09	27	54*	Fox Islands, Aleutian Islands.....	52½	N.	171	W.
17.....	13	24	58*	do.....	52½	N.	169	W.
17.....	15	07	24*	South of Unimak Island.....	54	N.	164	W.
17.....	18	09	26*	Mexico-Guatemala border.....	14½	N.	92	W.
18.....	00	16	17*	Fox Islands, Aleutian Islands.....	52	N.	171	W.
18.....	07	00	03*	Andreanof Islands, Aleutian Islands.....	52	N.	176½	W.
18.....	22	13	10*	South of Honshu, Japan.....	31	N.	142	E.
19.....	08	39	37*	Solomon Islands. Felt at Buin.....	6½	S.	155½	E.
19.....	15	44	53*	Fox Islands, Aleutian Islands.....	51½	N.	168½	W.
19.....	22	19	26*	Fox Islands, Aleutian Islands. Mag. 7.3.....	52	N.	166½	W.

Footnotes at end of table.

TABLE 2.—Summary of instrumental epicenters for 1957—Continued

1957	Origin time G. C. T.	Region, focal depth, and remarks	Coordinates of provisional epicenter	
			Latitude	Longitude
	<i>h m s</i>		<i>° /</i>	<i>° /</i>
Apr. 20.....	00 09 10**	Solomon Islands.....		
20.....	06 48 04*	South Pacific Ocean.....	54½ S.	131½ W.
20.....	12 30 37*	Near coast of New Guinea.....	6 S.	147½ E.
20.....	17 54 20*	Fox Islands, Aleutian Islands.....	52 N.	168 W.
20.....	19 54 24*	Andreanof Islands, Aleutian Islands.....	51 N.	177 W.
21.....	21 12 26*	Colombia-Venezuela border. Minor property damage at Arboletes, Colombia. Mag. 6½-6¾.	7 N.	72 W.
21.....	23 17 52*	Andreanof Islands, Aleutian Islands.....	52 N.	176 W.
22.....	00 18 16*	Tibet.....	30½ N.	84½ E.
22.....	01 42 15*	.....do.....	30½ N.	84½ E.
22.....	05 29 01*	.....do.....	31 N.	91 E.
22.....	13 43 14*	Colombia-Venezuela aftershock. 180 houses destroyed at Tachiro, Venezuela.	7 N.	72 W.
22.....	15 37 20*	Colombia-Venezuela aftershock. Felt at Caracas and Tachiro, Venezuela, and in northern Colombia.	7 N.	72 W.
23.....	09 23 39*	Northern Alabama. Minor damage at Birmingham. Felt in Georgia.	34½ N.	86¾ W.
23.....	17 57 18**	Colombia-Venezuela aftershock.....		
23.....	21 58 35*	Northern Chile-Argentina border. Felt in northern Chile.	27 S.	68 W.
24.....	19 10 05*	Turkey foreshock. Minor property damage at Fethiye, Turkey and on Rhodes. Mag. 6¾-7.	36 N.	28½ E.
25.....	02 25 36*	Near south coast of Turkey. 15 killed at Fethiye, Turkey. Many injured and extensive property damage throughout southeastern Turkey and the Island of Rhodes. Also felt on Cyprus, Dodecanese Islands, and in Egypt, Israel, and Lebanon. Mag. 7.1.	36½ N.	29 E.
25.....	07 09 20*	Outer Mongolia.....	45 N.	100 E.
25.....	07 15 15*	Andreanof Islands, Aleutian Islands.....	52 N.	173½ W.
25.....	07 52 03**	Turkey aftershock. Felt on Rhodes and Samos.....		
25.....	10 16 18*	Off coast of New Guinea.....	4½ S.	134 E.
25.....	11 06 02*	Molucca Passage.....	1½ N.	126 E.
25.....	14 07 58*	Near south coast of Alaska. Felt at Valdez.....	60½ N.	145 W.
25.....	17 45 14*	Andreanof Islands, Aleutian Islands.....	51½ N.	180
25.....	21 57 39	Southwest end of Salton Sea. Felt. Mag. 5.2.....	33 11 N.	115 51 W.
25.....	22 24 12	Southwest end of Salton Sea. Felt. Mag. 5.1.....	33 11 N.	115 51 W.
26.....	02 11 52*	Hindu Kush. Depth about 200 km.....	37 N.	70½ E.
26.....	06 33 32*	Turkey aftershock. Felt in the Dodecanese Islands.....	36½ N.	29 E.
26.....	10 23 17*	Near south coast of Alaska. Felt at Cordova and Valdez.	60 N.	147 W.
26.....	11 40 06*	Near coast of Maine. Minor damage at Portland and Westbrook, Maine. Also felt in Connecticut, Massa- chusetts, New Hampshire, and Vermont.	43.6 N.	69.8 W.
26.....	15 08 22*	Kurile Islands.....	45 N.	148 E.
27.....	00 09 47*	Near coast of Celebes. Depth about 60 km.....	0	121½ E.
27.....	02 39 24*	Fox Islands, Aleutian Islands.....	53 N.	166 W.
27.....	04 19 20**	Near coast of central Chile. Felt at Santiago.....		
27.....	11 30 33*	Loyalty Islands. Depth about 100 km.....	20 S.	170 E.
27.....	12 48 45**	Andreanof Islands, Aleutian Islands.....		
28.....	00 00 15**	New Britain region. Felt at Karoola, Rabaul, and Warramung.		
28.....	01 23 40*	Off coast of Mindanao, Philippine Islands. Mag. 5¾-6..	7 N.	127 E.
28.....	10 36 41*	Solomon Islands. Felt at Karoola, Sohano, Tol, and Warramung. Depth about 60 km.	6 S.	155 E.
28.....	14 48 52*	Fox Islands, Aleutian Islands.....	52½ N.	168½ W.
28.....	18 55 04**	Northern Sumatra.....		
28.....	20 03 42*	Andreanof Islands, Aleutian Islands.....	50½ N.	178 W.
28.....	23 39 14*	Fox Islands, Aleutian Islands.....	52 N.	166 W.
29.....	04 30 04*	.....do.....	52½ N.	168½ W.
29.....	04 37 12*	.....do.....	52½ N.	169 W.
29.....	09 22 14*	Kurile Islands.....	44 N.	147 E.
29.....	10 11 53*	Argentina-Bolivia border. Felt at Antofagasta, Chile. Depth about 200 km.	22 S.	66 W.

Footnotes at end of table.

TABLE 2.—Summary of instrumental epicenters for 1957—Continued

1957	Origin time G. C. T.			Region, focal depth, and remarks	Coordinates of provisional epicenter			
					Latitude		Longitude	
	<i>h</i>	<i>m</i>	<i>s</i>		°	'	°	'
Apr. 29.....	19	22	58*	Near south coast of Mindanao, Philippine Islands. Depth about 400 km.	5½	N.	126	E.
29.....	20	55	57*	Off south coast of Java.....	9	S.	107	E.
30.....	03	32	49*	Off coast of Samar Island, Philippine Islands.....	10½	N.	127	E.
May 1.....	00	45	00*	Kirghiz-China border.....	41½	N.	78½	E.
1.....	23	28	09*	Fox Islands, Aleutian Islands.....	52½	N.	171	W.
2.....	01	50	09*	Near New Britain. Felt at Rabaul and Namatanai. Depth about 60 km.	4½	S.	153	E.
2.....	02	22	18*	Fox Islands, Aleutian Islands.....	54	N.	166	W.
2.....	03	55	34*	Baffin Bay. Mag. 6¼-6½.....	72	N.	67½	W.
2.....	10	34	14*	South Pacific Ocean.....	56½	S.	123	W.
2.....	11	29	13*	Fox Islands, Aleutian Islands.....	52½	N.	169	W.
2.....	11	38	52*	.....do.....	52½	N.	169	W.
2.....	13	53	27*	Andreanof Islands, Aleutian Islands.....	51	N.	176½	W.
2.....	21	36	25*	Flores Sea. Depth about 600 km.....	7½	S.	120	E.
3.....	06	15	01**	Andreanof Islands, Aleutian Islands.....				
3.....	07	10	25*	.....do.....	51	N.	179½	E.
3.....	14	43	03*	Near east coast of Samar Island, Philippine Islands.....	12½	N.	125½	E.
4.....	10	05	45*	Western New Guinea.....	3½	S.	137	E.
4.....	11	22	53*	Fox Islands, Aleutian Islands.....	52½	N.	166½	W.
4.....	14	52	20*	Chinghai Province, China.....	37	N.	96½	E.
6.....	11	18	15*	Andreanof Islands, Aleutian Islands.....	52	N.	173	W.
6.....	11	19	47*	.....do.....	52	N.	173	W.
6.....	11	37	33*	Tonga Islands region. Depth about 250 km.....	17½	S.	176	W.
6.....	15	06	47*	Northern Iran.....	36	N.	51	E.
6.....	21	41	30*	Off coast of Mindanao, Philippine Islands.....	10½	N.	127	E.
7.....	01	18	28*	Off coast of Ecuador.....	1	N.	85½	W.
7.....	05	36	32*	Andreanof Islands, Aleutian Islands.....	51½	N.	179½	E.
7.....	09	09	53*	Fox Islands, Aleutian Islands.....	51½	N.	170	W.
7.....	22	19	03*	South of Honshu, Japan.....	30	N.	137½	E.
8.....	14	24	30*	Kirghiz S. S. R.....	41½	N.	75	E.
8.....	20	09	53*	Fiji Islands. Depth about 400 km.....	15½	S.	179	E.
11.....	07	30	22*	Andreanof Islands, Aleutian Islands.....	51½	N.	178½	W.
11.....	14	56	30*	Near east coast of Kamchatka.....	52½	N.	160	E.
12.....	04	47	44*	Sandwich Islands region.....	60½	S.	26	W.
12.....	06	48	27*	Northern Sakhalin.....	53	N.	142	E.
12.....	11	29	07*	Near south coast of Java.....	8½	S.	107½	E.
13.....	02	20	55*	Sikhota Alin, Siberia. Depth about 300 km.....	44	N.	135½	E.
13.....	14	24	58**	Western North Carolina. Minor damage.....				
13.....	15	19	35*	South of Honshu, Japan. Felt. Depth about 400 km.....	32½	N.	137	E.
14.....	02	58	57*	Near east coast of Japan. Felt. Depth about 60 km.....	36½	N.	141	E.
14.....	18	43	28**	Andreanof Islands, Aleutian Islands.....				
15.....	01	19	59*	Northern Afghanistan.....	35	N.	70	E.
15.....	01	43	05*	Andreanof Islands, Aleutian Islands.....	51½	N.	175	W.
15.....	02	11	05*	Chapala, Mexico. Depth about 100 km.....	17½	N.	93½	W.
16.....	14	54	33*	Catamarca Province, Argentina. Depth about 100 km.	28	S.	66	W.
17.....	02	42	02*	Fiji Islands region. Depth about 60 km.....	18	S.	176½	W.
17.....	17	41	13**	Southwestern Montana. Felt.....				
17.....	20	42	40**	Revilla Gigedo Islands region.....				
18.....	05	24	01*	Fox Islands, Aleutian Islands.....	51	N.	171	W.
19.....	05	19	40**	Near coast of central Peru.....				
19.....	07	17	20**	About 800 miles west of Galapagos Islands.....				
19.....	20	45	03*	Ryukyu Islands.....	25	N.	125½	E.
19.....	21	00	36*	Near coast of Nicaragua. Depth about 100 km.....	12	N.	87	W.
19.....	22	41	03*	Peru. Depth about 200 km.....	8	S.	74	W.
20.....	01	50	54*	Andreanof Islands, Aleutian Islands.....	51	N.	180	
20.....	03	42	26*	Fox Islands, Aleutian Islands.....	53½	N.	167	W.
20.....	06	38	30**	Off coast of Costa Rica.....				
20.....	19	57	35*	Sicily foreshock. Felt.....	38½	N.	14	E.
21.....	01	11	58*	Mariana Islands region. Depth about 100 km. Mag. 7.0.	21½	N.	144	E.
21.....	11	36	06*	Near east coast of Honshu, Japan. Felt at Tokyo.....	36½	N.	141½	E.

Footnotes at end of table.

TABLE 2.—Summary of instrumental epicenters for 1957—Continued

1957	Origin time G. C. T.			Region, focal depth, and remarks	Coordinates of provisional epicenter			
					Latitude		Longitude	
	h	m	s		°	'	°	'
May 21.....	11	44	04*	Near north coast of Sicily. Felt.....	38½	N.	14	E.
21.....	13	24	16*	Near east coast of Greece. Felt.....	39½	N.	23	E.
22.....	13	29	44*	Andreanof Islands, Aleutian Islands.....	50	N.	177	W.
22.....	18	32	35*	Svalbard Islands region.....	77	N.	5	E.
24.....	02	37	37*	Colombia. Two killed, many injured, and moderate property damage. Mag. 6¼.	3	N.	76½	W.
24.....	03	36	33*	Fox Islands, Aleutian Islands. Mag. 6-6¼ (Berk).....	53	N.	167½	W.
24.....	10	07	40*	Mariana Islands. Depth about 100 km.....	17	N.	146	E.
24.....	12	49	14*	Samoa Islands region.....	15	S.	173½	W.
25.....	14	23	37*	Salta Province, Argentina.....	25½	S.	65	W.
26.....	04	16	44**	Fox Islands, Aleutian Islands.....				
26.....	06	33	31*	Bolu Province, Turkey. 66 killed, many injured, and major property damage. Mag. 7.1.	41	N.	31	E.
26.....	08	54	45*	Turkey aftershock.....	40½	N.	31	E.
26.....	09	13	43*	Turkey aftershock. Felt.....	41	N.	31	E.
26.....	09	36	33*	.....do.....	41	N.	31	E.
26.....	15	53	30*	Ceram Islands region.....	3	S.	131	E.
26.....	15	59	33	Southwest of the Salton Sea. Felt. Mag. 5.0.....	33 12	N.	116 01	W.
27.....	07	05	11*	Turkey aftershock.....	41	N.	31	E.
27.....	10	55	16*	Off coast of Colombia.....	4	N.	83	W.
27.....	11	01	26*	Turkey aftershock. Felt.....	40½	N.	31	E.
27.....	13	17	37*	Andreanof Islands, Aleutian Islands.....	51½	N.	177½	W.
27.....	19	57	56*	Fox Islands, Aleutian Islands.....	52	N.	170½	W.
28.....	00	09	45*	Turkey aftershock.....	40½	N.	31	E.
28.....	00	19	10**	Samoa Islands.....				
28.....	01	19	26*	Fox Islands, Aleutian Islands.....	53	N.	169	W.
28.....	05	51	30*	Pakistan-Burma border.....	25½	N.	95	E.
28.....	23	19	39*	New Hebrides Islands. Depth about 300 km.....	15	S.	168	E.
28.....	23	46	20**	Near coast of Formosa.....				
29.....	10	08	27*	South of Honshu, Japan.....	31	N.	142	E.
29.....	10	17	43*	Turkey aftershock.....	40½	N.	31	E.
29.....	18	39	09**	Southern Greece. Felt at Argohide.....				
30.....	00	18	52*	Tonga Islands.....	20	S.	175	W.
30.....	19	49	25*	Near south coast of Hokkaido, Japan.....	41½	N.	143	E.
30.....	20	58	15*	Fiji Islands region. Depth about 600 km.....	22	S.	179	W.
31.....	02	16	27*	Santiago del Estero Province, Argentina. Felt. Depth about 600 km. Mag. 6¼-6½.	27½	S.	63	W.
31.....	03	10	18*	Unimak Island region.....	54	N.	163½	W.
31.....	16	19	39*	Fox Islands, Aleutian Islands.....	55	N.	169	W.
31.....	21	57	46*	Near coast of Colombia. Depth about 100 km.....	3½	N.	77	W.
31.....	22	17	10*	Andreanof Islands, Aleutian Islands.....	51	N.	179½	W.
June 1.....	05	26	50*	Northern Turkey aftershock.....	40½	N.	31	E.
1.....	16	03	52*	Kenai Peninsula, Alaska. Felt at Kenai.....	59½	N.	150½	W.
1.....	19	35	08*	Galapagos Islands.....	1	N.	91	W.
1.....	21	08	12**	Turkey aftershock.....				
2.....	01	11	56**	.....do.....				
2.....	11	57	20**	Southwestern Montana. Felt.....				
2.....	21	21	45*	Near east coast of Kamchatka.....	52½	N.	160	E.
2.....	23	00	29**	Eastern Java. Felt at Kediri, Madian, and Surakarta.....				
3.....	14	52	15*	South of Honshu, Japan.....	31	N.	142	E.
4.....	00	40	35*	Unimak Island region.....	54	N.	165	W.
4.....	11	14	50*	Santa Cruz Islands.....	10½	S.	166½	E.
4.....	17	05	02*	Fiji Islands. Depth about 550 km. Mag. 6¼-6½.....	17½	S.	178	W.
4.....	19	59	10*	Tonga Islands. Depth about 250 km.....	18½	S.	176	W.
4.....	20	18	05**	Central Sumatra.....				
5.....	07	16	17*	North Atlantic Ocean.....	52½	N.	35	W.
5.....	08	26	53**	Southern Alaska.....				
5.....	09	09	40*	Fox Islands, Aleutian Islands.....	53	N.	167	W.
5.....	13	57	42*	Off east coast of Kamchatka.....	53	N.	162½	E.
6.....	03	30	22*	Andreanof Islands, Aleutian Islands.....	52	N.	178	W.
6.....	05	38	27*	Fox Islands, Aleutian Islands.....	52	N.	171½	W.
6.....	19	49	47*	Molucca Passage.....	3	N.	126½	E.
7.....	00	03	17*	Sinkiang Province, China.....	44½	N.	81	E.

Footnotes at end of table.

TABLE 2.—Summary of instrumental epicenters for 1957—Continued

1957	Origin time G. C. T.	Region, focal depth, and remarks	Coordinates of provisional epicenter			
			Latitude		Longitude	
	<i>h m s</i>		°	'	°	'
June 7.....	02 46 40*	Andreanof Islands, Aleutian Islands.....	51½	N.	179	W.
7.....	20 52 25**	Fiji Islands.....				
8.....	03 23 33*	Bismarck Sea.....	3	S.	147½	E.
8.....	06 07 47*	New Ireland.....	2½	S.	150	E.
8.....	09 01 28**	Near east coast of Kamchatka.....				
8.....	17 12 03*	Tonga Islands. Felt at Apia.....	16½	S.	173½	W.
8.....	21 19 42*	Off south coast of Sumatra.....	7	S.	102½	E.
8.....	22 26 17*	Loyalty Islands.....	19½	S.	168	E.
10.....	00 59 54*	Sumbawa Island. Felt on Bali, Lombok, and Sumbawa. Mag. 6¾.	9	S.	117	E.
10.....	02 31 00**	Andreanof Islands, Aleutian Islands.....				
10.....	03 13 11*	Mariana Islands. Felt on Guam. Depth about 150 km. Mag. 6¾.	13½	N.	143½	E.
10.....	04 46 12*	Central Baluchistan, Pakistan.....	30	N.	68	E.
11.....	04 04 33*	Unimak Island region.....	54	N.	165	W.
11.....	04 57 24*	Hindu Kush. Depth about 200 km.....	36½	N.	70	E.
11.....	07 01 39**	Near southeast coast of Kamchatka.....				
11.....	14 49 47*	Kermadec Islands. Felt on Raoul Island. Depth about 100 km. Mag. 6.8.	30	S.	178	W.
11.....	18 49 24*	Near coast of Luzon, Philippine Islands. Moderate property damage at Vigan. Felt throughout northern and central Luzon.	18	N.	120½	E.
11.....	23 53 57*	Andreanof Islands, Aleutian Islands.....	52	N.	176	W.
11.....	23 59 09*	.....do.....	51	N.	177	W.
12.....	01 30 36*	.....do.....	52½	N.	173½	W.
12.....	08 28 34*	Near south coast of Hokkaido, Japan. Felt southern Hokkaido and northern Honshu.	41½	N.	142½	E.
12.....	10 02 37*	Near coast of Peru.....	11	S.	78	W.
13.....	10 40 38*	Andreanof Islands, Aleutian Islands. Mag. 6¾.....	51½	N.	175	W.
13.....	20 21 42*	Near east of Sumatra. Depth about 150 km.....	3	S.	101	E.
13.....	21 27 18*	Northern Celebes.....	½	N.	123½	E.
14.....	06 24 20*	Andreanof Islands, Aleutian Islands. Mag. 6¼ (Berk) ..	52	N.	173½	W.
14.....	11 36 49*	Southern Afghanistan. Several killed and heavy property damage at Kandahar, Khalakhund, and Mohammed Qila.	32	N.	67	E.
15.....	00 44 15*	Indian Ocean. Mag. 6-6¼.....	34	S.	56	E.
15.....	18 18 20*	Fox Islands, Aleutian Islands. Mag. 6 (Berk).....	52	N.	171	W.
16.....	02 17 23*	Fox Islands, Aleutian Islands.....	53	N.	169	W.
17.....	06 16 44*	Samoa Islands region. Felt at Apia. Mag. 5¾.....	15	S.	173½	W.
17.....	07 32 25*	Andreanof Islands, Aleutian Islands.....	52	N.	174½	W.
18.....	02 12 12*	Gulf of Martaban, Burma.....	14½	N.	96	E.
18.....	05 45 19**	Near south coast of Hokkaido, Japan.....				
18.....	11 18 53*	Northern Luzon, Philippine Islands. Felt at Aparri and Tuguegarao. Depth about 60 km.	18	N.	120½	E.
18.....	11 45 03*	Southern Nevada.....	37	N.	116	W.
18.....	14 48 17*	Burma aftershock.....	14	N.	96	E.
18.....	17 56 03*	Loyalty Islands region. Mag. 6.....	25	S.	170	E.
19.....	01 29 48*	Tonga Islands. Mag. 6¼-6½.....	24	S.	175½	W.
19.....	02 55 03**	Fiji Islands. Depth about 600 km.....				
19.....	05 21 37*	Rat Islands, Aleutian Islands.....	51	N.	179	E.
19.....	08 01 30*	Fiji Islands. Mag. 6½.....	16½	S.	176½	E.
20.....	01 06 25*	Mariana Islands.....	20	N.	145½	E.
21.....	00 41 25	East of Yosemite, California. Felt in Yosemite Valley. Mag. 4½ (Berk).	37 42	N.	119 17	W.
21.....	18 38 08*	Kurile Islands region.....	49	N.	156	E.
22.....	06 19 06*	Near coast of Chiapas, Mexico. Felt at Tehuantepec and San Salvador, El Salvador. Mag. 6½.	16	N.	94	W.
22.....	19 22 22*	Mid-Atlantic Ocean.....	16	N.	45½	W.
22.....	23 50 23*	Near north coast of New Guinea. Extensive damage in the Geelvink Bay area. Mag. 7.5.	1½	S.	137	E.
23.....	03 27 02*	Near coast of southeastern Alaska. Felt at Sitka. Mag. 5½-5¾ (Berk).	58½	N.	137	W.
23.....	03 38 25*	Samoa Islands. Felt at Apia.....	14	S.	173½	W.

Footnotes at end of table.

TABLE 2.—Summary of instrumental epicenters for 1957—Continued

1957	Origin time G. C. T.	Region, focal depth, and remarks	Coordinates of provisional epicenter			
			Latitude		Longitude	
	<i>h</i> <i>m</i> <i>s</i>		°	'	°	'
June 23.....	06 34 18*	East central Tennessee. Felt in Anderson, Knox, and Loudon counties.	36½	N.	84½	W.
24.....	09 49 47*	Mexico aftershock. Felt at Tehuantepec.....	16	N.	94	W.
24.....	11 21 11**	About 150 miles southeast of Java.....				
24.....	13 30 03*	Southern Nevada.....	37	N.	116	W.
25.....	10 11 17*	Andaman Islands region.....	10	N.	94	E.
26.....	02 47 36*	Indian Ocean, east of Chagos Archipelago.....	7½	S.	85½	E.
26.....	16 48 12**	Andreanof Islands, Aleutian Islands.....				
27.....	00 09 28*	Northeast of Lake Baikal, U.S.S.R. Damage at Chita. Mag. 7.9.	56½	N.	116	E.
27.....	12 49 51*	Loyalty Islands region.....	22	S.	171	E.
28.....	04 58 03**	Fox Islands, Aleutian Islands.....				
28.....	21 23 22*	Near coast of Algeria. Minor damage at Bougainville and Orleansville.	36	N.	1	E.
29.....	03 58 06*	Near coast of central Chile. Felt.....	32½	S.	72½	W.
29.....	07 48 18*	Fox Islands region, Aleutian Islands.....	51½	N.	166	W.
29.....	10 49 42*	Andreanof Islands, Aleutian Islands.....	51½	N.	178	W.
29.....	22 33 52*	Lake Baikal aftershock.....	56	N.	116½	E.
July 1.....	02 22 26*	Tonga Islands. Depth about 60 km.....	22	S.	176	W.
1.....	06 23 57**	Near east coast of Sumatra.....				
1.....	13 04 48**	Atlantic Ocean foreshock.....				
1.....	13 17 45**	Mid-Atlantic Ocean, near Ascension Island.....				
1.....	19 30 16*	India-Burma border. Felt in India and East Pakistan.....	25	N.	94	E.
2.....	00 42 23*	Iran. About 2,000 dead, many injured, and extensive property damage throughout northern Iran. Mag. 7.1.	36	N.	53	E.
2.....	06 56 41	South of Julian, California. Felt. Mag. 4.1.....	33 02	N.	116 38	W.
2.....	09 33 01**	Western North Carolina.....				
2.....	21 52 20*	Near coast of northern Chile. Felt at Antofagasta.....	24½	S.	70½	W.
3.....	01 47 40*	Near south coast of Kamchatka.....	52	N.	159	E.
3.....	06 02 37*	Fiji Islands region. Depth about 550 km.....	24	S.	180	
3.....	09 09 14*	Near coast of southeastern Alaska.....	58	N.	137	W.
3.....	12 24 37*	Andreanof Islands, Aleutian Islands. Mag. 6-6¼.....	50½	N.	179	W.
3.....	15 11 30*	Andreanof Islands, Aleutian Islands.....	50	N.	179½	W.
3.....	17 04 26*	Fox Islands, Aleutian Islands.....	54	N.	165	W.
4.....	08 29 01*	Near south coast of Sumatra. Depth about 100 km.....	4	S.	102	E.
4.....	12 31 15*	Near south coast of Honshu, Japan. Felt.....	33	N.	137	E.
4.....	14 11 36*	New Britain. Felt at Pomio and Rabaul.....	5	S.	152	E.
4.....	19 19 45*	Mariana Islands. Depth about 150 km.....	20	N.	146	E.
4.....	22 25 13*	Arizona-Mexico border. Felt at San Diego, California. Mag. 4.8.	32	N.	113	W.
4.....	23 27 12*	Arizona-Mexico aftershock. Felt at San Diego, California. Mag. 4.6.	31	N.	114	W.
5.....	00 58 09*	Arizona-Mexico aftershock. Felt at San Diego, California. Mag. 4.7.	32	N.	114	W.
5.....	12 33 56*	Kermadec Islands.....	28½	S.	179	W.
5.....	15 32 00**	Eastern Belgian Congo.....				
7.....	05 58 48*	Turkey. Seven injured and minor damage in Bingol Province.	38½	N.	40	E.
7.....	16 11 15*	Solomon Islands. Slight damage at Buin. Felt at Aropa, Karoola, Kieta, and Rabaul. Mag. 6¾.	6½	S.	156	E.
8.....	15 30 33*	Guatemala. Moderate damage in western Guatemala and Chiapas, Mexico. Felt in Western El Salvador. Depth about 150 km. Mag. 6 (Berk).	14½	N.	91	W.
9.....	09 59 09*	Near south coast of Sumatra. Depth about 60 km.....	6	S.	104	E.
9.....	20 35 06**	About 150 miles north of Iceland.....				
10.....	04 42 48*	Fox Islands, Aleutian Islands.....	52½	N.	170	W.
10.....	09 04 08*	Near coast of Panama. Felt on board ship at Lat. 7°22' N., Long. 82°48' W., and at Balboa Heights, Canal Zone. Mag. 6½-6¾.	8	N.	82½	W.
10.....	13 15 28*	Batan Islands.....	20½	N.	123	E.
11.....	08 11 05*	Kurile Islands. Felt at Kushiro, Japan.....	44	N.	147	E.
11.....	17 14 27*	Hindu Kush.....	37	N.	71½	E.

Footnotes at end of table.

TABLE 2.—Summary of instrumental epicenters for 1957—Continued

1957	Origin time G. C. T.	Region, focal depth, and remarks	Coordinates of provisional epicenter			
			Latitude		Longitude	
	<i>h m s</i>		°	'	°	'
July 12.....	20 56 18*	Bismarck Sea.....	3	S.	148½	E.
12.....	21 58 45*	Bismarck Sea aftershock.....	3	S.	148½	E.
12.....	22 12 52*	Off east coast of Formosa.....	22½	N.	122½	E.
13.....	00 59 28*	Fox Islands, Aleutian Islands.....	52	N.	169½	W.
13.....	01 48 18*	.....do.....	52½	N.	169½	W.
13.....	09 32 05*	Samoa Islands region.....	15	S.	173	W.
13.....	13 58 45*	Samoa Islands aftershock.....	14½	S.	173½	W.
14.....	02 26 54*	Kurile Islands.....	46	N.	151½	E.
14.....	06 23 52*	Kermadec Islands region. Depth about 150 km. Mag. 7.1.	27	S.	178	W.
14.....	08 10 45*	Kermadec Islands. Mag. 6¼.....	30	S.	177	W.
14.....	09 16 12*	Mariana Islands.....	12½	N.	144	E.
14.....	09 42 27*	Tonga Islands.....	20	S.	174½	W.
15.....	09 36 30*	West of Gibraltar. Felt at Ayamonte, Cartaya, Huelva, and Lepe, Spain.	36	N.	7½	W.
15.....	23 08 08*	West Pakistan.....	29	N.	70	E.
16.....	16 57 03**	Near east coast of Borneo.....				
16.....	19 23 42*	Unimak Island, Aleutian Islands.....	54½	N.	164	W.
17.....	05 12 53*	Northern Chile. Felt.....	24½	S.	69	W.
17.....	08 54 13*	Fox Islands, Aleutian Islands.....	53	N.	170	W.
17.....	11 10 17*	Santa Cruz Islands. Depth about 100 km. Mag. 6¼-6½.	11½	S.	166½	E.
17.....	12 26 06*	New Guinea.....	2	S.	137	E.
17.....	18 39 57*	Mid-Atlantic Ocean.....	1	S.	13	W.
18.....	01 14 52*	Fox Islands, Aleutian Islands.....	53	N.	169	W.
18.....	01 19 52*	.....do.....	53	N.	170	W.
18.....	11 10 58*	Near north coast of New Guinea. Felt at Karkar, Kumbung, and Madang.	5	S.	146	E.
18.....	12 06 39*	South of Honshu, Japan. Felt on Honshu. Depth about 400 km.	30	N.	139	E.
18.....	15 24 20*	Northern Utah. Felt at Castle.....	40	N.	110½	W.
19.....	03 24 24*	Hindu Kush.....	36	N.	71	E.
19.....	11 58 39*	Fox Islands, Aleutian Islands.....	54	N.	166	W.
19.....	13 02 05*	Near north coast of Formosa. Felt at Taipei.....	25	N.	122½	E.
19.....	20 26 03*	New Guinea foreshock. Felt at Lumi.....	3	S.	142	E.
19.....	21 36 46*	Northern New Guinea. Felt at Aitape and Lumi.....	3½	S.	142	E.
20.....	09 55 33*	Southern Mozambique.....	22	S.	34	E.
20.....	11 12 53*	Off south coast of Kamchatka. Depth about 60 km.....	50½	N.	156	E.
20.....	14 08 14*	Near east coast of Hokkaido, Japan. Felt.....	43	N.	145	E.
20.....	15 38 47*	Tonga Islands.....	19½	S.	174	W.
20.....	19 34 40*	Fox Islands, Aleutian Islands.....	52	N.	170½	W.
21.....	00 23 05**	Northern Chile-Argentina border.....				
21.....	05 59 13*	Balleny Islands region.....	62½	S.	156	E.
21.....	06 04 11*	Near coast of Guatemala. Felt at San Salvador, El Salvador. Depth about 100 km. Mag. 5¼-6.	14½	N.	92	W.
21.....	06 36 58*	New Hebrides Islands.....	18	S.	169½	E.
21.....	07 00 10*	New Ireland. Felt at Karoola, Namatanai, Rabaul, Tol, and Warangoi.	4½	S.	153	E.
21.....	17 30 02*	Blast near Lakeside, Utah.....	41½	N.	113	W.
21.....	19 37 10*	Kermadec Islands region. Depth about 150 km.....	28	S.	175	W.
22.....	06 16 52*	Kermadec Islands region.....	33½	S.	178	W.
22.....	06 21 50*	Kermadec Islands aftershock.....	34	S.	177½	W.
22.....	10 16 31*	Southern Honshu, Japan. Felt. Depth about 350 km..	34½	N.	136	E.
22.....	13 57 41*	Fox Islands, Aleutian Islands.....	53	N.	167	W.
23.....	00 45 12*	Andersnof Islands, Aleutian Islands.....	52	N.	177	W.
23.....	04 03 57**	Fox Islands, Aleutian Islands.....				
23.....	06 20 43*	Loyalty Islands.....	20½	S.	170	E.
23.....	13 30 17**	Kermadec Islands region. Depth about 600 km.....				
24.....	01 57 25*	Central Chile-Argentina border. Felt at Copiapo, La Serena, Santiago, and Valparaiso, Chile. Slightly deeper than normal. Mag. 6½.	30	S.	70½	W.
24.....	09 56 57*	New Hebrides Islands.....	18	S.	169½	E.

Footnotes at end of table.

TABLE 2.—Summary of instrumental epicenters for 1957—Continued

1957	Origin time G. C. T.	Region, focal depth, and remarks	Coordinates of provisional epicenter			
			Latitude		Longitude	
	<i>h m s</i>		<i>°</i>	<i>'</i>	<i>°</i>	<i>'</i>
July 24.....	10 47 44*	Catamarca Province, Argentina. Felt at Antofagasta, Chile. Depth about 150 km.	27	S.	66	W.
24.....	11 02 30*	New Hebrides Islands. Mag. 6½.	20	S.	169	E.
24.....	14 40 45*	Western New Guinea.	3	S.	134½	E.
25.....	03 24 40*	Andreanof Islands, Aleutian Islands.	52	N.	177	W.
25.....	07 42 25*	Andreanof Islands, Aleutian Islands. Mag. 6¼.	51	N.	177	W.
25.....	18 31 36*	Near south coast of Hokkaido, Japan. Felt in southern Hokkaido and northern Honshu.	42	N.	142	E.
26.....	00 40 02*	Fox Islands, Aleutian Islands.	53	N.	171½	W.
26.....	06 49 42*	Off north coast of North Island, New Zealand.	35	S.	180	
27.....	06 49 00*	Guatemala.	14½	N.	91½	W.
27.....	14 45 28*	Tonga Islands.	20	S.	174½	W.
27.....	15 37 30*	Off east coast of Mindanao, Philippine Islands.	5½	N.	127½	E.
27.....	18 43 01*	New Britain region.	6½	S.	151½	E.
27.....	20 59 21*	Andreanof Islands, Aleutian Islands.	51½	N.	180	
28.....	01 30 52*	New Hebrides Islands.	15	S.	167½	E.
28.....	08 40 01*	Guerrero, Mexico. Sixty-eight dead, many injured, and extensive property damage at Acapulco and Mexico City. Seismic sea wave with maximum amplitude about 8½ ft. reported at Acapulco. Mag. 7.9.	16½	N.	99	W.
28.....	09 58 30*	Mexico aftershock.	17	N.	99	W.
28.....	13 34 20*	.....do.	17½	N.	99	W.
29.....	00 11 20*	.....do.	17	N.	99	W.
29.....	09 11 49**	Fiji Islands region.	51½	N.	178	W.
29.....	13 00 29*	Andreanof Islands, Aleutian Islands.	23½	S.	71½	W.
29.....	17 15 14*	Near coast of Chile. Felt at Antofagasta. Mag. 7.0.	6½	S.	105	E.
31.....	07 32 39*	Sunda Strait. Depth about 100 km.	17	N.	99	W.
Aug. 1.....	01 12 53*	Mexico aftershock.	52	N.	170	W.
1.....	16 18 48*	Fox Islands, Aleutian Islands.	30	S.	177½	W.
1.....	16 57 30*	Kermadec Islands.	16	N.	97	W.
1.....	22 13 40*	Near coast of Mexico.	38	S.	178	E.
2.....	02 12 35*	New Zealand. Minor damage in Gisborne District.	5	N.	126½	E.
2.....	09 40 00*	Near south coast of Mindanao, Philippine Islands. Depth about 150 km.	52	N.	175	W.
2.....	12 21 37*	Andreanof Islands, Aleutian Islands.	7	S.	103	E.
3.....	06 43 40*	Off south coast of Sumatra.	28	S.	176½	W.
3.....	08 15 45*	Kermadec Islands region.	50	N.	157	E.
3.....	10 21 10*	Northern Kurile Islands.	21	N.	145	E.
3.....	11 41 41*	Mariana Islands foreshock.	21	N.	145	E.
3.....	11 44 55*	Mariana Islands region.	3½	S.	145	E.
4.....	00 39 12*	Near north coast of New Guinea. Felt at Angoram, Bogia, and on Karkar and Manam Islands.	17	N.	100	W.
4.....	06 06 36*	Mexico aftershock. Felt. Mag. 6¼.	17	N.	99½	W.
4.....	11 28 24*	Mexico aftershock. Felt.	17	N.	99½	W.
4.....	14 16 18*	Mexico aftershock. Felt. Mag. 6½.	45	S.	35	E.
4.....	21 08 51*	Prince Edward Islands region.	5	S.	154	E.
5.....	08 12 46*	New Britain region. Felt at Aropa and Namatanai.	52½	N.	158½	E.
5.....	10 04 38*	Kamchatka.	52	N.	159	E.
5.....	13 51 14**	Near east coast of Kamchatka.	16	N.	96	W.
5.....	14 12 04*	Kamchatka.	30½	N.	130	E.
5.....	17 34 54*	Near coast of Oaxaca, Mexico. Depth about 100 km.	52½	N.	160½	E.
5.....	21 30 39**	Kermadec Islands region.	19	N.	109	W.
5.....	23 04 00*	Northern Ryukyu Islands. Felt on Yaku-Shima.	30	N.	103	E.
6.....	00 03 54*	Kamchatka.	7½	S.	13	W.
6.....	23 47 30**	Andreanof Islands, Aleutian Islands.	2	S.	137	E.
7.....	05 49 43**	Near coast of Kamchatka.	19½	S.	178	W.
7.....	15 44 47**	Northern Peru. Minor damage at Talara.	32½	N.	25½	E.
7.....	19 40 46*	Fiji Islands. Depth about 550 km.	19	N.	109	W.
8.....	01 12 15*	Near coast of Egypt.	30	N.	103	E.
8.....	04 44 20*	Revilla Gigedo Islands.	7½	S.	13	W.
8.....	19 42 39*	Sinkiang Province, China.	2	S.	137	E.
8.....	22 33 02*	Ascension Island region.				
9.....	02 29 20*	New Guinea.				

Footnotes at end of table.

TABLE 2.—*Summary of instrumental epicenters for 1957—Continued*

1957	Origin time G. C. T.	Region, focal depth, and remarks	Coordinates of provisional epicenter			
			Latitude		Longitude	
	<i>h</i> <i>m</i> <i>s</i>		°	'	°	'
Aug. 9	07 42 50**	Andreanof Islands, Aleutian Islands				
9	10 59 46*	Kurile Islands. Depth about 100 km.	46	N.	151	E.
10	00 01 34*	Kurile Islands. Depth about 60 km.	46	N.	150½	E.
10	02 18 38*	Fiji Islands region. Depth about 600 km.	21½	S.	179½	W.
10	03 55 46*	Tonga Islands	17	S.	172	W.
10	09 43 40**	Samoa Islands				
10	19 12 47*	Celebes Sea. Depth about 300 km.	3½	N.	124½	E.
11	05 12 40*	North Island, New Zealand	38½	S.	177	E.
11	13 40 18*	Kermadec Islands	31½	S.	177½	W.
11	21 38 03*	New Hebrides Islands. Mag. 6¼	17½	S.	169	E.
12	07 08 38*	Mindanao, Philippine Islands	6	N.	124½	E.
12	07 58 05*	Near east coast of Kamchatka	52½	N.	160½	E.
12	10 24 40*	Samoa Islands region	16½	S.	176	W.
12	11 19 20*	Off south coast of Honshu, Japan. Felt. Depth about 200 km.	33	N.	140	E.
13	12 00 03*	Southern Alaska. Felt at Valdez	61	N.	148	W.
13	14 36 15*	Near coast of Oregon	43	N.	125	W.
13	14 42 30*	Northern Mindanao, Philippine Islands	9½	N.	126	E.
13	15 50 58*	Near east coast of Formosa	23½	N.	121½	E.
14	02 44 24*	Dodecanese Islands	35½	N.	28	E.
14	09 19 54**	Rat Islands, Aleutian Islands				
14	18 26 52*	Tonga Islands region. Depth about 200 km.	21	S.	176½	W.
15	08 32 56*	Near north coast of Panama. Felt in the Canal Zone and Panama.	10	N.	80	W.
15	20 45 20*	Solomon Islands region. Depth about 500 km.	4½	S.	155	E.
16	03 26 05*	Solomon Islands. Felt at Karoola, Londolovit, Namatanai; and Rabaul, New Britain.	5	S.	154	E.
16	11 57 16*	Solomon Islands. Felt at Karoola, Londolovit, Namatanai; and Rabaul, New Britain.	5	S.	155	E.
16	14 48 19**	Solomon Islands aftershock. Felt at Karoola, Namatanai; and Rabaul, New Britain.				
16	20 54 20*	Volcano Islands	24½	N.	143	E.
16	23 31 55*	Pacific Ocean. Mag. 6½-6¾	10½	N.	104	W.
17	02 21 47*	New Britain. Felt at Rabaul; and Karoola, Solomon Islands.	4	S.	151	E.
17	12 07 04*	Solomon Islands. Felt at Karoola; and Rabaul, New Britain.	5	S.	155	E.
17	12 39 23*	Bonin Islands region. Felt on Tori-Shima	29	N.	141	E.
18	06 34 16*	South Pacific Ocean	57	S.	142½	W.
18	08 36 57*	Philippine Islands. Felt at Catarman, Masbate, and Roxas City.	12	N.	124	E.
18	10 41 54*	Hawaiian Islands. Felt on Hawaii and Maui	21	N.	156	W.
18	21 10 42*	Mexico aftershock. Felt	16½	N.	99	W.
18	21 42 30*	Northern Kurile Islands. Mag. 6½	50	N.	157	E.
19	00 11 13*	New Britain aftershock. Felt at Rabaul and Warangoi	4½	S.	153	E.
19	02 41 14**	do.				
19	06 10 28*	Fox Islands, Aleutian Islands	52½	N.	169	W.
19	07 22 26*	Caspian Sea	38½	N.	50	E.
19	11 34 36*	Solomon Islands foreshock. Mag. 6½	10	S.	161	E.
19	21 31 55*	Fox Islands, Aleutian Islands	51½	N.	171	W.
20	06 27 07*	Solomon Islands foreshock. Mag. 6-6¼	10	S.	161	E.
20	12 01 54*	Solomon Islands. Mag. 6½	10	S.	161	E.
20	15 21 06*	Hindu Kush. Felt at Peshawar, Pakistan. Depth about 200 km.	37	N.	71½	E.
20	22 17 05*	Andreanof Islands, Aleutian Islands	52	N.	173	W.
20	22 32 06*	Outer Mongolia	50½	N.	96½	E.
21	11 51 12*	Fox Islands, Aleutian Islands	52½	N.	168	W.
21	15 34 04*	Kurile Islands. Felt in northern Hokkaido. Depth about 100 km.	44½	N.	146½	E.
21	17 38 38*	Samoa Islands region	15	S.	173½	W.
21	19 31 08*	Fox Islands, Aleutian Islands	51½	N.	171	W.
22	03 37 57*	Near south coast of Hokkaido, Japan. Felt in southern Hokkaido and northern Honshu.	41½	N.	142½	E.

Footnotes at end of table.

TABLE 2.—Summary of instrumental epicenters for 1957—Continued

1957	Origin time G. C. T.	Region, focal depth, and remarks	Coordinates of provisional epicenter			
			Latitude		Longitude	
	<i>h</i> <i>m</i> <i>s</i>		°	'	°	'
Aug. 22.....	07 55 06*	Molucca Passage.....	1	N.	126	E.
22.....	15 27 10*	.....do.....	3	N.	126½	E.
22.....	16 43 35*	New Hebrides Islands.....	15	S.	168	E.
23.....	02 00 09*	Solomon Islands. Felt at Arope, Kokopo, Londolovit, Namatanai, Rabaul, and Sobano, New Britain. Depth about 60 km. Mag. 6½.	6	S.	154½	E.
23.....	11 42 34*	Off east coast of Formosa. Moderate damage at Taipei..	24	N.	122	E.
23.....	13 33 51*	Solomon Islands. Felt at Rabaul and Warangoi, New Britain. Depth about 100 km.	6	S.	154	E.
23.....	15 12 24**	Revilla Gigedo Islands.....				
23.....	17 24 20**	Near coast of Kamchatka.....				
23.....	22 51 10*	Java. Depth about 100 km.....	7	S.	112	E.
25.....	21 11 45*	Off south coast of Java.....	10	S.	111	E.
26.....	06 53 43*	Andreanof Islands, Aleutian Islands.....	51	N.	177	W.
26.....	11 28 50*	Southern Bolivia. Felt at Potosi, Santa Cruz, Sucre, and Valle Grande. Mag. 6¼-6½.	19	S.	63	W.
26.....	13 58 48*	Near coast of Ecuador. Felt in western Ecuador. Mag. 6.	2	S.	81	W.
26.....	18 22 18*	Southern Bolivia aftershock.....	19	S.	63	W.
26.....	19 53 33*	Solomon Islands region. Felt at Londolovit and Ra- baul, New Britain. Depth about 100 km.	5½	S.	154	E.
27.....	20 56 29*	South of Fiji Islands. Depth about 650 km.....	25½	S.	178	E.
28.....	08 19 10*	Kermadec Islands region.....	28½	S.	175	W.
28.....	23 22 21*	Mariana Islands.....	21	N.	145	E.
28.....	23 22 22*	Northern Chile. Felt. Depth slightly greater than normal.	21½	S.	69	W.
28.....	23 50 15*	Mariana Islands.....	21	N.	145	E.
29.....	00 57 45*	Mariana Islands aftershock.....	21	N.	145	E.
29.....	12 47 06**	San Juan Province, Argentina. Felt in central Chile. Depth about 150 km.				
29.....	16 40 22**	Mariana Islands aftershock.....				
30.....	03 50 36**	Kermadec Islands region.....				
30.....	16 17 56*	Tadzhik S.S.R.....	39	N.	73	E.
30.....	16 53 47*	Near east coast of Honshu, Japan. Felt. Depth about 60 km.	37½	N.	141	E.
30.....	20 04 01*	Batan Islands region.....	20½	N.	121½	E.
30.....	20 45 18**	Mariana Islands aftershock.....				
31.....	12 01 06*	Outer Mongolia.....	49	N.	100	E.
Sept. 1.....	12 49 55*	Western Sinkiang Province, China.....	39	N.	75	E.
1.....	23 59 54*	Mariana Islands.....	18	N.	147½	E.
2.....	00 27 26*	Mariana Islands. Depth about 100 km.....	18	N.	147	E.
2.....	03 36 00**	India-Burma border region.....				
2.....	09 46 30*	Samoa Islands. Felt at Apia. Mag. 6-6¼ (Berk).....	15	S.	173½	W.
2.....	14 20 13*	Fox Islands, Aleutian Islands.....	51½	N.	168	W.
2.....	21 27 36*	Hindu Kush. Felt at Peshawar, Warsak and Muzaf- farabad. Depth about 200 km.	37	N.	71	E.
3.....	06 06 42*	Santa Cruz Islands.....	12	S.	167	E.
3.....	07 49 52*	Fox Islands, Aleutian Islands.....	53	N.	167	W.
3.....	14 28 12**	Mariana Islands region.....				
3.....	14 40 24*	Fiji Islands region. Depth about 600 km.....	21½	S.	179½	E.
4.....	01 31 23*	Santa Cruz Islands.....	12	S.	167½	E.
4.....	04 25 05**	Fox Islands, Aleutian Islands.....				
4.....	04 33 51**	South Indian Ocean, about 1000 miles northeast of Kerguelen Islands.				
4.....	08 07 15*	Pakistan.....	28	N.	65½	E.
4.....	12 26 35*	New Britain. Felt at Rabaul.....	4	S.	151½	E.
5.....	04 01 49*	Alaska Peninsula.....	55½	N.	159	W.
5.....	07 25 19*	Near east coast of Kamchatka.....	53½	N.	160½	E.
5.....	11 36 07**	Southern Iran. 1 killed, many injured in Jahrom. Moderate property damage in Jahrom and Kerman.				
5.....	13 50 33**	Java. Felt in southern Priangan.....				
5.....	18 58 42*	Southern Bolivia. Felt in northern Chile. Depth about 150 km.	20	S.	67	W.

Footnotes at end of table.

TABLE 2.—Summary of instrumental epicenters for 1957—Continued

1957	Origin time G. C. T.			Region, focal depth, and remarks	Coordinates of provisional epicenter			
					Latitude		Longitude	
	<i>h</i>	<i>m</i>	<i>s</i>		°	'	°	'
Sept. 6.....	00	17	55*	Chile-Bolivia border. Felt in northern Chile. Depth about 100 km.	20	S.	68	W.
6.....	04	54	37*	Andreanof Islands, Aleutian Islands.....	51	N.	177	W.
6.....	20	22	03*	Albania.....	41	N.	20	E.
7.....	01	10	32*	Western Venezuela. Felt at Cucuta, Colombia.....	8½	N.	72	W.
7.....	06	48	36*	Northern Kurile Islands.....	50	N.	156	E.
7.....	10	06	47*	Andreanof Islands, Aleutian Islands.....	51½	N.	178½	W.
8.....	08	41	26*	Off north coast of New Guinea.....	2	S.	141	E.
8.....	10	19	48*	Fox Islands, Aleutian Islands.....	52	N.	171	W.
8.....	13	18	55*	New Britain. Felt at Kokopo and Rabaul. Depth about 60 km.	5	S.	152	E.
9.....	00	13	30*	South Indian Ocean.....	48	S.	100	E.
9.....	09	00	33*	Fiji Islands region.....	15	S.	176½	W.
10.....	00	13	55**	Ascension Island region.....				
10.....	06	13	40*	India-Burma border.....	27	N.	96½	E.
10.....	14	43	05*	Near coast of Ecuador. Depth about 400 km.....	1½	S.	80	W.
10.....	15	27	40*	Davao Gulf.....	5	N.	125½	E.
11.....	13	41	44*	Fiji Islands region. Depth about 500 km.....	19	S.	178	W.
11.....	14	26	45**	New Ireland region.....				
11.....	23	22	09*	Samoa Islands region. Felt at Apia.....	16	S.	172	W.
12.....	00	28	02*	About 100 miles north of Honduras. Felt at Havana, Cuba.	17½	N.	85	W.
12.....	01	21	06*	Mariana Islands.....	21	N.	145	E.
12.....	04	01	24*	Off coast of Guerrero, Mexico. Depth about 60 km.....	15½	N.	98½	W.
12.....	17	26	05*	Kirghiz-Tadzhik S.S.R. border.....	40	N.	73½	E.
14.....	06	13	20*	Ceram Island.....	4	S.	130	E.
14.....	13	56	25*	Near north coast of New Guinea. Felt at Lae.....	5½	S.	147	E.
14.....	17	06	49*	Near coast of Ecuador.....	1½	S.	80½	W.
14.....	21	26	18**	Samar Island, Philippine Islands. Felt at Catarman, Catbalogan, and Masbate.				
15.....	04	22	34*	Near north coast of Java. Felt in southern Priangan. Depth about 300 km.	5½	S.	108	E.
15.....	18	42	20*	Solomon Islands. Felt at Karoola and Rabaul. Depth about 150 km.	6	S.	153½	E.
15.....	22	07	21*	Andreanof Islands, Aleutian Islands.....	51	N.	174½	W.
16.....	00	07	37*	Near south coast of Honshu, Japan. Felt. Depth about 60 km.	35	N.	140	E.
16.....	01	34	36*	Arctic Ocean.....	82	N.	120	E.
16.....	09	04	23*	Kamchatka.....	54	N.	158½	E.
17.....	14	24	01*	Indian Ocean.....	36	S.	53½	E.
17.....	18	44	44*	South of Honshu, Japan. Depth about 450 km.....	29½	N.	139	E.
18.....	00	59	20*	Near east coast of Kamchatka.....	53	N.	160	E.
18.....	18	15	10*	Fox Islands, Aleutian Islands.....	52½	N.	168	W.
19.....	13	42	06*	.....do.....	52	N.	168	W.
19.....	17	00	00	Nevada (Nuclear Explosion).....	37.2	N.	116.2	W.
19.....	17	02	02*	Tonga Islands. Depth about 200 km.....	19	S.	176	W.
19.....	17	29	02*	Svalbard region.....	79½	N.	3	E.
20.....	08	25	19*	Kurile Islands.....	46	N.	151½	E.
20.....	10	01	58*	Hindu Kush. Destructive in Kandahar, Afghanistan. Depth about 200 km.	36½	N.	71	E.
20.....	23	07	22*	Fox Islands, Aleutian Islands.....	52	N.	170½	W.
21.....	20	16	53*	Northern Turkey.....	40½	N.	34½	E.
23.....	09	12	55*	Rat Islands, Aleutian Islands.....	52	N.	177½	E.
23.....	09	22	36*	Banda Sea.....	6	S.	131	E.
23.....	18	44	10*	Samoa Islands region.....	16	S.	173	W.
24.....	08	21	05*	Near south coast of Mindanao, Philippine Islands. Felt on Mindanao and on Koror Island, West Caroline Islands. Mag. 7.6.	5½	N.	127½	E.
24.....	09	10	30*	Mindanao aftershock.....	6	N.	127	E.
25.....	05	50	56*	Near Azores. Mag. 6¼-6½.....	34	N.	38½	W.
25.....	16	36	37**	Mindanao aftershock.....				
25.....	22	17	00*	.....do.....	6	N.	127½	E.
25.....	23	33	30*	.....do.....	5½	N.	127½	E.

Footnotes at end of table.

TABLE 2.—Summary of instrumental epicenters for 1957—Continued

1957	Origin time G. C. T.	Region, focal depth, and remarks	Coordinates of provisional epicenter			
			Latitude		Longitude	
	<i>h</i> <i>m</i> <i>s</i>		°	'	°	'
Sept. 26.....	02 32 01*	.....do.....	5	N.	127	E.
26.....	08 03 50**	Near coast of Chiapas, Mexico.....				
26.....	10 07 42**	About 150 miles south of Mindanao, Philippine Islands.....				
26.....	12 03 01*	North Island, New Zealand. Depth about 150 km.....	39½	S.	174½	E.
26.....	13 35 22*	Guatemala-Mexico border. Depth about 150 km.....	15	N.	92½	W.
26.....	18 46 41*	Mindanao aftershock.....	6	N.	126½	E.
27.....	04 08 23*	Spice Islands.....	1	S.	127	E.
27.....	04 18 49*	Spice Islands aftershock.....	1	S.	127½	E.
27.....	04 58 52*	Eastern Siberia.....	64	N.	178	E.
27.....	05 48 15*	Fox Islands, Aleutian Islands.....	53	N.	168	W.
27.....	05 56 50*	Spice Islands aftershock.....	1	S.	127	E.
27.....	11 16 52*	Fox Islands, Aleutian Islands.....	52½	N.	169	W.
27.....	11 45 24*	.....do.....	52½	N.	169½	W.
27.....	14 21 43*	Luzon, Philippine Islands. Felt at Aparri, Laoag, and Tuguegarao.	18	N.	121	E.
28.....	00 27 31*	Off south coast of Honshu, Japan. Depth about 500 Mag. 6¼.	30½	N.	137½	E.
28.....	04 11 23*	Near north coast of New Guinea.....	3	S.	135½	E.
28.....	14 20 00*	Fiji Islands. Depth about 650 km. Mag. 7.5.....	20½	S.	178	W.
28.....	14 44 02*	Fiji Islands aftershock. Depth about 600 km.....	20½	S.	178½	W.
28.....	21 03 18*	Mariana Islands. Depth about 200 km.....	17½	N.	146	E.
28.....	21 04 39	Southeast of Hollister, California. Mag. 4.5.....	36 36	N.	121 14	W.
29.....	02 08 55*	South Pacific Ocean.....	64½	S.	172½	W.
29.....	06 37 33*	Celebes. Depth about 200 km.....	0		124	E.
29.....	07 06 11*	Fiji Islands. Depth about 650 km.....	20	S.	178	W.
29.....	08 13 22*	South of Fiji Islands. Depth about 600 km. Mag. 6¼ (Berk).	25	S.	178½	E.
29.....	13 30 42*	Near east coast of Kamchatka.....	53½	N.	160	E.
29.....	19 53 30*	Near coast of Peru.....	13	S.	77	W.
30.....	11 02 36*	South of Honshu, Japan.....	29½	N.	140	E.
30.....	12 06 43*	Spice Islands aftershock.....	1½	S.	126½	E.
30.....	20 21 30*	Volcano Islands.....	24½	N.	143	E.
Oct. 1.....	07 12 26*	Solomon Islands. Felt at Rabaul. Depth about 100 km.	5½	S.	155	E.
1.....	23 20 50*	Peru-Brazil border.....	7	S.	74	W.
1.....	11 25 02*	Mindanao aftershock.....	5½	N.	127	E.
2.....	12 27 55*	Venezuela foreshock. Felt at Trinidad, B.W.I. Mag. 6¼-6½.	11	N.	63	W.
2.....	20 42 52**	Bouvet Island region.....				
2.....	20 58 39*	Chagos Islands.....	6½	S.	69½	E.
3.....	01 34 39*	Near south coast of Hokkaido, Japan. Felt. Depth about 60 km.	42½	N.	145	E.
3.....	05 58 12*	New Guinea.....	4	S.	134	E.
3.....	06 39 08*	Venezuela foreshock.....	10½	N.	62½	W.
4.....	00 21 07*	Mid-Atlantic Ocean.....	30½	N.	42	W.
4.....	01 01 00*	Fiji Islands region. Depth about 400 km.....	21½	S.	178	W.
4.....	05 26 09*	Near coast of Venezuela. Depth about 60 km. Mag. 6¼.	11	N.	63	W.
4.....	06 05 50*	Venezuela aftershock.....	11	N.	62½	W.
4.....	06 17 45*	.....do.....	11	N.	62½	W.
4.....	23 55 45*	Rat Islands, Aleutian Islands.....	53	N.	178	E.
5.....	11 36 46*	Near Crete.....	34½	N.	26½	E.
5.....	15 51 48*	Crete aftershock.....	34½	N.	27	E.
5.....	16 05 38*	Timor Island region.....	10½	S.	122½	E.
5.....	22 40 44*	Afghanistan-Tadzhik border.....	38	N.	69½	E.
6.....	00 54 05*	Venezuela aftershock.....	11	N.	62½	W.
6.....	21 27 51*	Northern Kurile Islands. Depth about 60 km.....	49½	N.	155	E.
6.....	23 27 00*	Andreanof Islands, Aleutian Islands.....	52	N.	174	W.
7.....	03 53 53*	Tonga Islands.....	21	S.	174½	W.
7.....	05 10 17*	Unimak Island region.....	53½	N.	165	W.
7.....	07 31 14*	Solomon Islands. Depth about 150 km.....	7	S.	155	E.
7.....	13 19 45*	Off southeast coast of Kamchatka.....	51	N.	159	E.
7.....	16 48 47*	Fiji Islands. Depth about 650 km.....	20	S.	179	W.

Footnotes at end of table.

COAST AND GEODETIC SURVEY

TABLE 2.—Summary of instrumental epicenters for 1957—Continued

1957	Origin time G. C. T.	Region, focal depth, and remarks	Coordinates of provisional epicenter			
			Latitude		Longitude	
	<i>h m s</i>		<i>°</i>	<i>'</i>	<i>°</i>	<i>'</i>
Oct. 8.....	01 27 28**	Off southeast coast of Mindanao, Philippine Islands.....				
8.....	05 31 53*	Kurile Islands.....	46	N.	153	E.
8.....	06 53 31*	Northern Chile. Felt at Antofagasta. Depth about 150 km.	23½	S.	68	W.
9.....	01 25 35*	South Pacific Ocean.....	53½	S.	134½	W.
10.....	01 43 00*	Fox Islands, Aleutian Islands.....	52½	N.	169½	W.
10.....	03 39 11*	do.....	52½	N.	166½	W.
10.....	03 46 59*	South of Fiji Islands. Depth about 700 km.....	22	S.	178½	E.
10.....	05 44 32*	Andreanof Islands, Aleutian Islands.....	52	N.	174½	W.
10.....	06 54 44*	Novaya Zemlya.....	71	N.	52½	E.
10.....	07 38 18*	Andreanof Islands, Aleutian Islands.....	52	N.	174	W.
10.....	18 44 30*	Fiji Islands region. Depth about 400 km.....	23	S.	179	W.
10.....	18 53 59*	Fox Islands, Aleutian Islands. Mag. 5¼ (Berk).....	54	N.	166	W.
11.....	00 21 50*	Fox Islands, Aleutian Islands.....	52½	N.	170	W.
12.....	16 46 30*	Sandwich Islands region.....	59	S.	16	W.
12.....	17 35 26*	Mariana Islands. Depth about 100 km.....	14	N.	145	E.
12.....	18 57 02*	Near south coast of Java.....	8	S.	111	E.
12.....	22 03 00*	Bismarck Sea.....	3	S.	146½	E.
13.....	04 19 17*	Off southeast coast of Kamchatka.....	52½	N.	160	E.
13.....	20 33 01*	Antarctic Ocean, southwest of Macquarie Island.....	60	S.	151	E.
14.....	08 17 36*	Near coast of Venezuela.....	11	N.	63	W.
14.....	13 27 42*	Andreanof Islands, Aleutian Islands.....	51½	N.	173	W.
15.....	04 02 07*	Near south coast of Costa Rica.....	9	N.	84	W.
15.....	05 55 21*	Kermadec Islands. Depth about 150 km.....	30	S.	179	W.
15.....	09 11 04**	Central Bolivia.....				
16.....	21 37 19**	Andreanof Islands, Aleutian Islands.....				
17.....	10 14 09	Nevada. Felt at Fallon. Mag. 4.6 (Berk).....	39 17	N.	118 26	W.
17.....	14 21 44*	South of Honshu, Japan.....	31	N.	141½	E.
17.....	14 29 18*	North Atlantic foreshock.....	46	N.	27	W.
17.....	14 37 36*	North Atlantic Ocean.....	47	N.	27½	W.
17.....	15 20 26*	Near north coast of Mindanao, Philippine Islands.....	10	N.	126	E.
17.....	17 36 25*	North Atlantic aftershock.....	46	N.	27½	W.
18.....	01 50 48*	Central Greece. Felt.....	38½	N.	21½	E.
18.....	07 41 02**	New Britain region. Felt at Rabaul.....				
18.....	19 08 53*	Loyalty Islands region.....	22	S.	172	E.
18.....	21 43 58*	Oaxaca, Mexico. Felt. Depth about 150 km.....	17	N.	95	W.
19.....	06 13 58**	Guerrero, Mexico. Felt.....				
19.....	18 28 50*	Near east coast of Formosa. Several killed at Hotal and slight damage at Taipei. Mag. 6½-6¾.	23½	N.	122	E.
19.....	21 41 59*	Off northeast coast of Hokkaido, Japan. Felt in east- ern Hokkaido, and southern Honshu. Depth about 150 km. Mag. 6½-6¾.	44½	N.	146	E.
20.....	02 54 48*	Near coast of Peru.....	14½	S.	76	W.
20.....	12 04 22*	Atlantic Ocean.....	11½	N.	42	W.
21.....	00 17 25*	Santa Cruz Islands. Depth about 100 km.....	11	S.	167	E.
21.....	07 04 39*	Fiji Islands region. Depth about 600 km.....	22	S.	179½	W.
21.....	14 25 46*	North Atlantic Ocean.....	34	N.	38	W.
22.....	20 44 38*	Near northeast coast of Hokkaido, Japan. Felt.....	43½	N.	146	E.
23.....	04 38 30*	Puerto Rico. Felt in Puerto Rico and on St. Thomas, Virgin Islands.	19	N.	64	W.
23.....	05 56 52*	Fox Islands, Aleutian Islands. Mag. 6¼.....	52½	N.	169½	W.
23.....	12 13 36**	Kermadec Islands.....				
23.....	23 51 33*	San Luis Province, Argentina.....	32	S.	67	W.
24.....	00 17 37*	New Hebrides Islands. Mag. 6½.....	14½	S.	168	E.
24.....	02 33 13*	Northwestern Turkey. Felt.....	40	N.	29½	E.
24.....	09 07 30*	Fiji Islands. Depth about 550 km.....	20½	S.	179	W.
24.....	20 07 15*	La Rioja Province, Argentina. Moderate damage at Jague, Vinchina, and Villa Castelli.	29	S.	68	W.
24.....	21 44 28*	Gulf of California. Mag. 6.....	25	N.	109½	W.
25.....	01 42 52*	Formosa foreshock.....	21½	N.	121½	E.
25.....	02 18 18*	Greece. Felt.....	38	N.	22½	E.
25.....	03 16 03*	Batan Islands.....	22	N.	121½	E.
25.....	04 37 35*	Fox Islands, Aleutian Islands.....	52½	N.	169½	W.

Footnotes at end of table.

TABLE 2.—Summary of instrumental epicenters for 1957—Continued

1957	Origin time G. C. T.	Region, focal depth, and remarks	Coordinates of provisional epicenter			
			Latitude		Longitude	
	<i>h m s</i>		°	'	°	'
Oct. 25.....	06 19 06*	Off coast of Formosa.....	21½	N.	121½	E.
25.....	10 03 32*	Near south coast of Kamchatka. Mag. 6¾.....	50½	N.	156½	E.
25.....	11 39 52*	Fox Islands, Aleutian Islands.....	51½	N.	171	W.
25.....	16 26 47*	Northeastern Utah.....	40	N.	111	W.
25.....	22 44 51*	Luzon, Philippine Islands. Depth about 200 km.....	14	N.	120½	E.
26.....	01 46 41*	Northeastern Utah.....	40	N.	111	W.
26.....	04 31 03*	Molucca Passage.....	0		125	E.
26.....	08 26 12*	Fiji Islands. Depth about 600 km. Mag. 6-6¼.....	20½	S.	178	W.
26.....	14 16 57*	Borneo.....	2	S.	116	E.
27.....	05 40 56*	New Hebrides Islands. Depth about 150 km.....	13½	S.	167½	E.
27.....	18 29 04*	Near north coast of Honduras.....	16	N.	88	W.
27.....	22 32 39*	Kamchatka. Depth about 150 km. Mag. 6½-6¾.....	55½	N.	161	E.
27.....	22 56 55*	Santa Cruz Islands.....	11½	S.	166½	E.
28.....	05 55 35**	Panama foreshock.....				
28.....	14 18 20**	Off coast of Oaxaca, Mexico.....				
29.....	00 09 07*	Near east coast of Kamchatka.....	53½	N.	160	E.
29.....	02 21 30*	Borneo aftershock.....	2	S.	116	E.
29.....	08 02 05*	Andreanof Islands, Aleutian Islands.....	50	N.	179	W.
30.....	01 43 03*	Dodecanese Islands. Felt on Karpathos, Rhodes, and Crete.....	36	N.	27½	E.
30.....	02 13 08*	Fox Islands, Aleutian Islands.....	53	N.	167	W.
30.....	02 50 26*	Andreanof Islands, Aleutian Islands.....	50½	N.	179	W.
30.....	07 30 20*	Dodecanese Islands. Felt on Karpathos.....	36	N.	27½	E.
30.....	23 24 40*	Colombia-Venezuela border. Depth about 100 km.....	7	N.	72	W.
31.....	02 36 58*	Honshu, Japan. Felt. Depth about 60 km.....	38	N.	140½	E.
31.....	02 47 46	Mendocino County, California. Felt in Mendocino and Humboldt counties. Slight damage. Mag. 4.7 (Berk). Solomon Islands region.....	39 11	N.	123 41	W.
31.....	04 24 04*	Off coast of Panama. Felt at Balboa Heights, Canal Zone and on board the "S. S. Hai Huang." Mag. 6½-6¾.....	8	S.	161	E.
31.....	10 07 54*	Off coast of Panama. Felt at Balboa Heights, Canal Zone and on board the "S. S. Hai Huang." Mag. 6½-6¾.....	6½	N.	83	W.
31.....	15 29 10*	South of Tasmania.....	55	S.	148	E.
31.....	16 24 17*	Galapagos Islands region.....	1½	N.	86	W.
31.....	19 47 06	West-central California. Felt. Mag. 4.1.....	37 21	N.	122 13	W.
Nov. 1.....	10 12 00*	Near Mount Rainier, Washington. Felt in southwestern Washington.....	47	N.	121	W.
1.....	14 54 12**	Guatemala.....				
2.....	01 18 18*	Fox Islands, Aleutian Islands.....	52½	N.	169	W.
2.....	07 20 58*	Near coast of Chiapas, Mexico. Depth about 100 km.....	15	N.	93½	W.
2.....	16 16 52*	Off southeast coast of Mindanao, Philippine Islands.....	6	N.	127½	E.
2.....	18 30 24*	New Hebrides Islands.....	13	S.	166½	E.
3.....	10 24 51*	Near northeast coast of New Guinea. Felt at Camp Diddy and Lae.....	6	S.	147	E.
3.....	11 14 30*	do.....	6½	S.	147	E.
3.....	16 58 00*	Southeastern Idaho.....	42½	N.	111½	W.
3.....	17 38 22*	Southeastern Idaho. Felt at Geneva.....	42½	N.	111	W.
4.....	02 30 30*	Andreanof Islands, Aleutian Islands.....	52	N.	175½	W.
5.....	09 54 29*	New Hebrides Islands region. Depth about 650 km.....	13	S.	169	E.
5.....	11 18 43*	New Britain.....	6	S.	150	E.
5.....	19 51 15*	Andreanof Islands, Aleutian Islands.....	51	N.	178½	W.
6.....	04 59 01*	Salta Province, Argentina.....	24½	S.	65	W.
6.....	13 12 53*	Kurile Islands. Felt at Nemuro and Urakawa, Japan.....	45	N.	149½	E.
7.....	02 58 53*	South Pacific Ocean.....	24	S.	112½	W.
7.....	04 15 35*	Rat Islands, Aleutian Islands. Depth about 150 km.....	52	N.	179	E.
7.....	06 21 56*	South Pacific Ocean.....	57½	S.	143½	W.
8.....	02 46 22*	Solomon Islands. Felt at Karoola and Rabaul.....	5½	S.	155	E.
8.....	09 03 34*	Near east coast of Hokkaido, Japan. Felt.....	43	N.	144½	E.
9.....	06 16 59*	Unimak Island region.....	53½	N.	164	W.
9.....	19 10 39**	Solomon Islands. Depth about 150 km.....				
9.....	23 55 50*	Greece. Felt.....	38½	N.	22	E.
10.....	02 36 21*	Solomon Islands. Felt at Aropa and Buin.....	7	S.	155½	E.
10.....	03 43 49*	do.....	7½	S.	155½	E.
10.....	05 28 10*	Tonga Islands region.....	24½	S.	175½	W.

Footnotes at end of table.

TABLE 2.—Summary of instrumental epicenters for 1957—Continued

1957	Origin time G. C. T.	Region, focal depth, and remarks	Coordinates of provisional epicenter			
			Latitude		Longitude	
	<i>h</i> <i>m</i> <i>s</i>		°	'	°	'
Nov. 10.....	05 48 57*	Near northeast coast of New Guinea. Felt at Camp Diddy and Lae.	6½	S.	147	E.
10.....	08 26 06*	Near south coast of Honshu, Japan. Felt.....	34½	N.	139	E.
10.....	08 42 50*	Solomon Islands. Felt at Aropa.....	7½	S.	156½	E.
10.....	09 40 30**	About 100 miles south of Honshu, Japan.....				
10.....	10 21 14*	Northern Colombia.....	8	N.	74½	W.
10.....	18 01 37*	Near east coast of Borneo.....	2	S.	116	E.
10.....	19 20 05*	Near east coast of Honshu, Japan. Felt.....	34	N.	139½	E.
10.....	22 13 55*	Kenai Peninsula.....	60	N.	152	W.
11.....	06 24 00*	Kermadec Islands.....	30½	S.	177½	W.
11.....	07 49 54*	Montana.....	46½	N.	112	W.
11.....	14 12 26**	Andreanof Islands, Aleutian Islands.....				
11.....	18 20 38**	Near coast of Guerrero, Mexico. Felt at Acapulco and Federal District.				
12.....	00 03 02*	Cayman Islands.....	19	N.	81½	W.
12.....	00 20 03*	Tongo Islands region.....	24	S.	177	W.
12.....	01 31 40*	New Britain Island. Felt at Kandrian and Walindi.....	6	S.	149½	E.
12.....	05 30 28**	Andreanof Islands, Aleutian Islands.....				
12.....	09 33 51*	Banda Sea.....	7½	S.	128½	E.
13.....	08 44 36**	Near south coast of Hokkaido, Japan. Felt.....				
13.....	17 22 41*	Kermadec Islands region. Mag. 6½-6¾.....	33	S.	179	W.
14.....	04 34 41*	Andreanof Islands, Aleutian Islands.....	51	N.	179	W.
14.....	05 20 17**	do.....				
15.....	06 06 55*	Fox Islands, Aleutian Islands.....	52	N.	171½	W.
15.....	07 52 25*	Mindanao, Philippine Islands. Felt at Dipolog, Dumaguete, and Mambajao.	8½	N.	124	E.
15.....	12 01 46*	South of Honshu, Japan. Felt. Depth about 60 km....	34½	N.	141	E.
15.....	16 30 29*	Near east coast of Kamchatka.....	51½	N.	158	E.
16.....	01 48 48*	Andreanof Islands, Aleutian Islands.....	51½	N.	177	W.
16.....	05 06 46*	Off north coast of Honduras.....	17	N.	85	W.
17.....	05 57 48*	Sea of Okhotsk. Felt in eastern Hokkaido and northern Honshu. Depth about 350 km.	49	N.	148½	E.
17.....	06 32 17*	Off coast of northern California.....	40½	N.	125½	W.
17.....	06 43 00**	Baja California. Mag. 5.....				
17.....	15 41 22**	Southern Chile-Argentina border.....				
17.....	17 55 04*	South of Honshu, Japan. Depth about 450 km.....	30½	N.	138	E.
18.....	10 12 00*	Andreanof Islands, Aleutian Islands.....	51½	N.	179½	W.
18.....	14 53 56*	do.....	51	N.	179½	W.
18.....	15 12 58*	Kurile Islands. Felt in eastern Hokkaido, Japan. Depth about 60 km.	44	N.	148	E.
19.....	01 44 36*	Ryukyu Islands. Felt.....	27½	N.	129	E.
19.....	02 34 15**	Antarctic Ocean, about 350 miles northwest of Balleny Islands.				
19.....	11 21 39*	Bonin Islands region.....	28½	N.	140½	E.
19.....	16 13 29*	Kurile Islands. Depth about 100 km.....	47	N.	152½	E.
19.....	23 14 45*	Off south coast of Honshu, Japan.....	31½	N.	140	E.
20.....	02 35 29*	Volcano Islands.....	23½	N.	143½	E.
20.....	12 40 23*	Unimak Island. Mag. 6¼-6½ (Berk).....	54	N.	165	W.
21.....	05 11 33*	Halmahera Island region.....	½	S.	127½	E.
21.....	14 34 15*	Kermadec Islands region.....	33½	S.	180	
21.....	17 57 21*	Ceram Island region.....	3	S.	130	E.
22.....	16 05 35*	Loyalty Islands region.....	22½	S.	172½	E.
22.....	18 03 02*	Bonin Islands region. Depth about 400 km.....	29	N.	139½	E.
22.....	21 51 04*	Spice Islands.....	1	S.	127	E.
23.....	00 55 00*	Near Islands, Aleutian Islands.....	52	N.	172	E.
23.....	00 58 36*	Fox Islands, Aleutian Islands. Depth slightly greater than normal.	53	N.	167½	W.
23.....	22 04 13*	Loyalty Islands region.....	23	S.	173	E.
24.....	01 25 35*	Andreanof Islands, Aleutian Islands.....	51	N.	177½	W.
24.....	04 44 52**	Near east coast of New Guinea.....				
24.....	09 43 36*	Near northeast coast of Greenland.....	78	N.	20	W.
24.....	20 06 17*	North Carolina-Tennessee border. Minor damage at Hartford, Tenn.	35	N.	83½	W.

Footnotes at end of table.

TABLE 2.—Summary of instrumental epicenters for 1957—Continued

1957	Origin time G. C. T.	Region, focal depth, and remarks	Coordinates of provisional epicenter			
			Latitude		Longitude	
	<i>h m s</i>		°	'	°	'
Nov. 25.....	00 01 48**	Loyalty Islands region.....				
25.....	00 26 32*	Halmahera Island.....	3	N.	128	E.
25.....	04 11 09*	Alaska. Depth about 150 km.....	62½	N.	151	W.
25.....	07 36 08*	Andreanof Islands, Aleutian Islands.....	50½	N.	175½	W.
25.....	18 55 12*	Off coast of Oregon.....	44	N.	130	W.
25.....	19 04 40*	Oregon aftershock.....	44	N.	129	W.
25.....	20 32 25*	.....do.....	44½	N.	129½	W.
25.....	22 16 44*	.....do.....	45	N.	130	W.
25.....	22 35 00*	Near east coast of Borneo.....	1½	S.	116½	E.
26.....	05 10 00*	.....do.....	2	S.	116	E.
26.....	08 15 27*	Greece foreshock. Felt.....	40	N.	23	E.
26.....	11 35 44*	Andreanof Islands, Aleutian Islands.....	51½	N.	176	W.
26.....	11 50 07*	Greece foreshock. Felt.....	40	N.	23	E.
26.....	19 07 02*	Near north coast of Luzon, Philippine Islands.....	19	N.	121	E.
26.....	23 24 03*	Near coast of Nicaragua. Depth about 100 km.....	11½	N.	86½	W.
27.....	03 08 06*	Near east coast of Greece. Felt.....	39½	N.	22½	E.
27.....	03 22 19*	Northern Colombia. Depth about 200 km.....	7	N.	73	W.
27.....	13 56 30*	Southern Bolivia.....	20	S.	67½	W.
28.....	03 07 55*	Brazil-Peru border. Depth about 600 km.....	10	S.	75½	W.
28.....	05 09 35*	Near east coast of Mindanao, Philippine Islands.....	8½	N.	126½	E.
28.....	20 50 10*	New Hebrides Islands.....	15	S.	168½	E.
29.....	17 43 38*	South Indian Ocean.....	48½	S.	124½	E.
29.....	22 19 38*	Southern Bolivia. Slight damage in northern Chile. Depth about 200 km. Mag. 7.8.	21	S.	66	W.
30.....	06 27 52	Near Cornwall, Ont., Canada. Felt at Brasher Falls and Massena, N. Y.	45 49	N.	74 44	W.
30.....	17 41 15*	Arctic Ocean.....	83½	N.	112½	E.
30.....	20 28 18*	Kurile Islands.....	49	N.	154	E.
30.....	21 37 11*	.....do.....	47	N.	154½	E.
30.....	21 54 10*	.....do.....	47	N.	154	E.
Dec. 1.....	01 00 26*	.....do.....	47½	N.	153½	E.
1.....	01 09 00*	.....do.....	47½	N.	154	E.
1.....	01 38 14*	Fox Islands, Aleutian Islands.....	52½	N.	170	W.
1.....	02 12 34*	Kurile Islands.....	47½	N.	153½	E.
1.....	10 00 05*	.....do.....	47	N.	154	E.
1.....	19 05 35*	Fox Islands, Aleutian Islands.....	52½	N.	170	W.
2.....	12 48 54*	Near coast of Algeria. Slight damage at Tenes.....	37	N.	2	E.
2.....	17 41 10*	Near coast of El Salvador. Felt in Southeastern El Salvador. Depth about 100 km.	13	N.	88½	W.
2.....	23 58 58*	Near northeast coast of Greenland. Depth about 100 km.	83	N.	25	W.
3.....	01 46 05*	Andreanof Islands, Aleutian Islands.....	51½	N.	178	W.
3.....	21 46 18*	Fox Islands, Aleutian Islands.....	52	N.	169	W.
3.....	23 31 16*	Andreanof Islands, Aleutian Islands.....	51	N.	178½	W.
4.....	00 27 01*	Molucca Passage.....	0		125	E.
4.....	02 51 43	West of Twentynine Palms, California. Felt. Mag. 4.3.	34 08	N.	116 21	W.
4.....	03 37 45*	Outer Mongolia. Twenty injured, 13 missing, and damage in Bayankhongor, Ara Khangai, and Uber Khangai District. Mag. 8.3.	45½	N.	99½	E.
4.....	05 00 48**	Outer Mongolia aftershock.....				
4.....	07 17 28**	Tonga Islands region.....				
4.....	09 09 10*	Outer Mongolia aftershock.....	45½	N.	99	E.
4.....	11 19 30*	.....do.....	45½	N.	100½	E.
4.....	13 20 08*	.....do.....	45	N.	101½	E.
4.....	22 16 50*	.....do.....	45	N.	99½	E.
4.....	23 41 57*	.....do.....	45	N.	99	E.
5.....	07 40 09*	Near east coast of Hokkaido, Japan. Felt. Depth about 100 km.	41	N.	142½	E.
5.....	14 04 30*	Jan Mayen Island region.....	72	N.	6	E.
5.....	18 09 32*	Outer Mongolia aftershock.....	45	N.	100	E.
6.....	03 49 33*	Kurile Islands. Depth about 60 km.....	45	N.	150½	E.
6.....	08 36 21*	Kurile Islands.....	44½	N.	150½	E.

Footnotes at end of table.

COAST AND GEODETIC SURVEY

TABLE 2.—Summary of instrumental epicenters for 1957—Continued

1957	Origin time G. C. T.			Region, focal depth, and remarks	Coordinates of provisional epicenter			
					Latitude		Longitude	
	<i>h</i>	<i>m</i>	<i>s</i>		°	'	°	'
Dec. 7.....	03	16	43*	Flores Sea. Depth about 550 km.....	6½	S.	123½	E.
7.....	08	24	03*	Guatemala.....	15½	N.	92	W.
7.....	14	11	15*	Outer Mongolia aftershock.....	43½	N.	100	E.
7.....	22	05	00*	Kurile Islands.....	45	N.	150½	E.
7.....	22	18	49*	Off east coast of Nicaragua.....	13½	N.	82	W.
8.....	01	34	40*	New Hebrides Islands.....	13	S.	167	E.
8.....	06	13	02*	Outer Mongolia aftershock.....	45	N.	100½	E.
8.....	12	16	30*	Off east coast of Honshu, Japan.....	35	N.	142	E.
8.....	14	41	34*	do.....	34½	N.	142	E.
8.....	15	29	15*	Outer Mongolia aftershock.....	45	N.	99	E.
8.....	16	26	33**	do.....				
8.....	21	28	45*	do.....	44½	N.	100	E.
9.....	01	16	00*	Near north coast of Luzon, Philippine Islands.....	18	N.	122½	E.
9.....	08	02	19*	Iceland.....	64½	N.	17½	W.
9.....	15	49	34**	New Hebrides Islands.....				
9.....	22	07	43*	Yukon, Canada.....	65½	N.	133	W.
10.....	14	35	57*	Solomon Islands. Felt at Arope, Buin, and Rabaul. Max. 6¼.	6	S.	154½	E.
10.....	15	53	02*	Solomon Islands aftershock. Felt at Rabaul.....	5½	S.	155	E.
11.....	03	28	44*	Solomon Islands aftershock.....	6½	S.	155	E.
11.....	18	11	14*	South of Honshu, Japan. Depth about 100 km.....	30½	N.	143	E.
11.....	21	55	10*	Outer Mongolia aftershock.....	44½	N.	101	E.
12.....	09	47	02*	New Hebrides Islands.....	14½	S.	167½	E.
12.....	18	38	19*	do.....	13½	S.	167	E.
13.....	01	31	57*	Colombia. Felt throughout western Colombia. Depth about 100 km. Mag. 6¼.	7	N.	76	W.
13.....	01	44	59*	Iran. More than 2,000 killed, many injured. Farsinaj destroyed. Mag. 7.2.	34½	N.	48	E.
13.....	02	27	45*	Solomon Islands aftershock.....	6	S.	154½	E.
13.....	17	30	19*	Samoa Islands region.....	15	S.	173½	W.
13.....	20	03	58*	Solomon Islands aftershock.....	6½	S.	155½	E.
13.....	20	26	22*	Fox Islands, Aleutian Islands.....	52½	N.	170	W.
13.....	23	37	45**	About 150 miles off south coast of Nicaragua.....				
15.....	22	18	25*	Peru.....	14½	S.	73	W.
16.....	17	27	47*	Vancouver Island, British Columbia.....	50	N.	127	W.
16.....	23	05	28*	Iran aftershock.....	34	N.	48	E.
17.....	05	10	11*	Near east coast of Kamchatka. Max. 6¼.	53½	N.	162	E.
17.....	13	50	12*	Santa Cruz Islands. Depth about 100 km. Mag. about 7.8.	12½	S.	166½	E.
18.....	02	11	40*	Venezuela.....	11	N.	63½	W.
18.....	20	44	53*	Sandwich Islands.....	60	S.	28	W.
19.....	04	11	13**	Nicaragua.....				
19.....	12	03	55**	Kamchatka.....				
19.....	19	01	08*	South of Honshu, Japan.....	30½	N.	142	E.
20.....	10	16	20**	Andreanof Islands, Aleutian Islands.....				
20.....	11	18	42*	Central Chile. Felt.....	30½	S.	71	W.
21.....	16	04	35*	Algeria. Felt.....	36	N.	2	E.
21.....	18	53	27*	do.....	36	N.	2	E.
23.....	12	34	03*	Atlantic Ocean.....	35	N.	36½	W.
23.....	13	19	28*	Nicaragua. Depth about 150 km.....	12½	N.	86½	W.
24.....	15	40	04**	Northern Chile.....				
25.....	02	09	20*	Near east coast of Kamchatka.....	53½	N.	162	E.
25.....	13	42	12*	do.....	55	N.	161	E.
25.....	16	26	01*	Venezuela. Felt at Point Fortin, Port of Spain, and St. Augustine, Trinidad, B. W. I.	10½	N.	62½	W.
26.....	06	42	03*	Near east coast of Kamchatka.....	53½	N.	162	E.
26.....	12	09	11*	Kermadec Islands.....	32½	S.	178	W.
26.....	12	20	35*	Off coast of California.....	41½	N.	127	W.
26.....	18	48	17*	Near east coast of Kamchatka.....	54	N.	162	E.
27.....	01	28	02*	Near east coast of Honshu, Japan. Felt.....	36½	N.	131	E.
27.....	15	00	45*	Off east coast of Kamchatka.....	53½	N.	162	E.
28.....	14	36	40*	Bolivia.....	18	S.	64½	W.
28.....	15	29	27**	Southern Bolivia.....				

Footnotes at end of table.

TABLE 2.—Summary of instrumental epicenters for 1957—Continued

1957	Origin time G. C. T.	Region, focal depth, and remarks	Coordinates of provisional epicenter			
			Latitude		Longitude	
	<i>h</i> <i>m</i> <i>s</i>		°	'	°	'
Dec. 28.....	19 01 22*	Tonga Islands region.....	16	S.	172	W.
29.....	14 11 40*	Mariana Islands.....	13	N.	144	E.
29.....	15 12 08*	Coquimbo Province, Chile. Felt.....	29	S.	70½	W.
29.....	19 09 55*	Central Chile. Felt. Depth about 100 km.....	34	S.	70½	W.
30.....	12 46 04*	Fox Islands, Aleutian Islands.....	53½	N.	166	W.
30.....	13 28 51*	Near coast of Venezuela. Felt at Port of Spain, Trini- dad, B. W. I.	10½	N.	62	W.
30.....	13 58 26*	Near north coast of Luzon, Philippine Islands. Felt at Aparri, Bangued, Laoag, Tagudin, and Vigan.	19	N.	120½	E.
30.....	18 38 00*	South of Unimak Island.....	53	N.	164	W.
31.....	10 21 35*	North Atlantic Ocean.....	58	N.	32	W.
31.....	13 02 20*	.....do.....	25	N.	46	W.
31.....	14 28 15*	Off coast of South Island, New Zealand.....	45	S.	165½	E.
31.....	21 16 03*	South Indian Ocean.....	45	S.	96½	E.

*Indicates probable error of 1/10 minute.

**Indicates probable error of 1/4 minute.

TABLE 3.—Principal earthquakes of the world from January through December 1957.

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

1957	Origin Time G.C.T.	Region	Coordinates of provisional epicenter		Remarks
			Latitude	Longitude	
	<i>h m s</i>		<i>° ' ° ' ° ' ° ' ° '</i>		
Jan. 2.....	03 48 44*	Fox Islands, Aleutian Islands.	53 N.	168 W.	Mag. 7.0.
3.....	12 48 27*	Southern Manchuria.....	44 N.	130 E.	Felt. Depth about 600 km. Mag. 7.0.
Feb. 23.....	20 26 12*	Formosa.....	24 N.	122 E.	11 killed, many injured, and extensive property damage at Hualien and Taipei. Mag. 7.3.
Mar. 9.....	14 22 27.5	Andreanof Islands, Aleutian Islands.	51.3 N.	175.8 W.	Seismic sea wave caused destruction of two villages and \$3 million damage on Oahu and Kauai, T.H. Mag. 8.3.
9.....	20 39 16	Fox Islands, Aleutian Islands.	52.3 N.	169.0 W.	Mag. 7.1.
11.....	09 58 45	.....do.....	52.5 N.	169.2 W.	Mag. 7.0.
12.....	11 44 50.5	Andreanof Islands, Aleutian Islands.	51.4 N.	177.7 W.	Felt on Adak and Unnak. Mag. 7.3.
14.....	14 47 45.5	.....do.....	51 2 N.	177.4 W.	Felt on Adak. Mag. 7.2.
22.....	14 21 06*	Fox Islands, Aleutian Islands.	54 N.	166 W.	Mag. 7.0.
23.....	05 12 31*	Banda Sea.....	5½ S.	131 E.	Felt on board the "S. S. Chengte" at 6°13' S., 131°25' E. Depth about 100 km. Mag. 7.3.
Apr. 10.....	11 29 58*	Kodiak Island region....	56 N.	154 W.	Mag. 7.1.
14.....	19 17 57*	Samoa Islands.....	15½ S.	173 W.	Felt at Apia. Mag. 7.5.
16.....	04 04 04*	Western Java Sea.....	4½ S.	107½ E.	Depth about 600 km. Mag. 7.5.
19.....	22 19 26*	Fox Islands, Aleutian Islands.	52 N.	166½ W.	Mag. 7.3.
25.....	02 25 36*	Near south coast of Turkey.	36½ N.	29 E.	15 killed at Fethiye. Many injured and extensive property damage throughout southeastern Turkey and the Island of Rhodes. Also felt on Cyprus, Dodecanese Islands, and in Egypt, Israel, and Lebanon Mag. 7.1.
May 21.....	01 11 58*	Mariana Islands region...	21½ N.	144 E.	Depth about 100 km. Mag. 7.0.
26.....	06 33 31*	Bolu Province, Turkey...	41 N.	31 E.	66 killed, many injured, and major property damage. Also felt in the Dodecanese Islands. Mag. 7.1.
June 14.....	11 36 49*	Southern Afghanistan....	32 N.	67 E.	Several killed and heavy property damage at Kandahar, Khalakhund, and Mohammed Qila.
22.....	23 50 23*	Near north coast of New Guinea.	1½ S.	137 E.	Extensive damage in the Geelvink Bay area. Mag. 7.5.
27.....	00 09 28*	Northeast of Lake Baikal, U.S.S.R.	56½ N.	116 E.	Damage at Chita. Mag. 7.9.
July 2.....	00 42 23*	Iran.....	36 N.	53 E.	About 2,000 dead, many injured and extensive property damage throughout northern Iran. Mag. 7.1.
14.....	06 23 52*	Kermadec Islands region.	27 S.	178 W.	Depth about 150 km. Mag. 7.1.
28.....	08 40 01*	Guerrero, Mexico.....	16½ N.	99 W.	68 dead, many injured and extensive property damage in Acapulco and Mexico City. Seismic sea wave, with maximum amplitude about 8½ feet was reported at Acapulco. Mag. 7.9.
29.....	17 15 14*	Near coast of Chile.....	23½ S.	71½ W.	Felt at Antofagasta. Mag. 7.0.
Sept. 24.....	08 21 05*	Near south coast of Mindanao, Philippine Islands.	5½ N.	127½ E.	Felt on Mindanao and Koror Island, West Caroline Islands. Mag. 7.6.
28.....	14 20 00*	Fiji Islands.....	20½ S.	178 W.	Depth about 650 km. Mag. 7.5.

Footnotes at end of table.

TABLE 3.—Principal earthquakes of the world from January through December 1957—Continued

1957	Origin Time G.C.T.	Region	Coordinates of provisional epicenter		Remarks
			Latitude	Longitude	
	<i>h m s</i>		<i>°</i>	<i>°</i>	
Oct. 10.....	03 46 59*	South of Fiji Islands.....	22 S.	178½ E.	Depth about 700 km.
Nov. 29.....	22 19 38*	Southern Bolivia.....	21 S.	66 W.	Slight damage in northern Chile. Depth about 200 km. Mag. 7.8.
Dec. 4.....	03 37 45*	Outer Mongolia.....	45½ N.	99½ E.	Subsidence of a length of 15 km and a width of 8 km in the Bakhar massif. Great destruction with fissures and faults in the Bogdo mountains; the greatest fissure extending from 250 km. Total destruction in Dzum Bogd, Bayan Gobi and surrounding localities. Mag. 8.3.
13.....	01 44 59*	Iran.....	34½ N.	48 E.	More than 2,000 killed and many in- jured. Several villages destroyed in region of Hamadan and Ker- manchah. Mag. 7.2.
17.....	13 50 12*	Santa Cruz Islands.....	12½ S.	166½ E.	Depth about 100 km. Mag. about 7.8.

*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 Earthquake* 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 super-position 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/sec² 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 0.1g.

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 criti-

cal 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 Dec. 31, 1957.*

NORTHERN CALIFORNIA

Station	Accelerograph	Displacement 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		
San Francisco, Southern Pacific Bldg., 14th floor.....	1		
San Francisco, State Bldg., basement.....	1	2	
San Jose, Bank of America, basement.....	1	1	
San Jose, Bank of America, 13th floor.....	1		
Suisun Bay Bridge.....	1		

SOUTHERN CALIFORNIA

Bakersfield.....	1	1	
Bishop.....	1		
Cachuma Dam, Crest.....	1	1	
Cachuma Dam, Valve House.....	1	1	
Colton.....	1	1	
El Centro.....	1	2	
Hollywood Storage Co., basement.....	1		
Hollywood Storage Co., penthouse.....	1		
Hollywood Storage Co., adjoining P. E. Lot.....	1		
Long Beach, Public Utilities Building.....	1	1	
Long Beach, Terminal Island.....	1		
Los Angeles, Edison Bldg., basement.....	1		
Los Angeles, Occidental Life Bldg., basement.....	1		
Los Angeles, Occidental Life Bldg., 11th floor.....	1		
Los Angeles, Subway Terminal, subbasement.....	1	1	
Los Angeles, Subway Terminal, 13th floor.....	1		
Los Angeles, Vernon, C. M. D.....	1		
Pasadena, California Institute of Technology.....	1		1
Port Hueneme.....	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	1	

TABLE 4.—*Coast and Geodetic Survey strong-motion stations in operation as of Dec. 31, 1957.*

Continued

OUTSIDE CALIFORNIA

Station	Accelerograph	Displacement 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	1	.....
Hoover Dam, Nev., intake tower.....	1	1	.....
Hoover Dam, Nev., oilhouse.....	1	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., Federal Office Building.....	1	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.....	62	19	11

TABLE 5.—*List of shocks recorded and records obtained on strong-motion seismographs in 1957.*

Date	Region and Recording Station	Records			
		Accelerograph	Survey displacement meter	Carder displacement meter	Weed
Jan. 24.....	Peru, South America, Lima.....	1			
Feb. 18.....	do.....	1			
Mar. 14.....	Northern California, Ferndale.....	1	1		
Mar. 18.....	Southern California, Cachuma Dam, Crest.....	1		1	
	Cachuma Dam, Valve House.....	1		1	
	Port Hueneme.....	1		1	
	Santa Barbara.....	1			
	Taft.....	1			
Mar. 22.....	Central California, San Francisco, Southern Pacific Building.....	2			
Mar. 22.....	Central California, Oakland, Chabot Observatory.....				1
	Oakland, City Hall.....	2			
	San Francisco, Alexander Building.....	3			
	San Francisco, Golden Gate Park.....	1			
	San Francisco, Shell Building.....				2
	San Francisco, Southern Pacific Building.....	2			
	San Francisco, State Building.....	1	1	1	
	San Francisco, 450 Sutter Building.....				1
	San Jose, Bank of America Building.....	2		1	
	Suisun Bay Bridge.....	1			
Mar. 22.....	Central California, San Francisco, Southern Pacific Building.....	2			
	San Francisco, State Building.....	1		1	
Mar. 22.....	Central California, Oakland, City Hall.....	2			
	San Francisco, Alexander Building.....	3			
	San Francisco, Golden Gate Park.....	1			
	San Francisco, Shell Building.....				3
	San Francisco, Southern Pacific Building.....	2			
	San Francisco, State Building.....	1		1	
	San Francisco, 450 Sutter Building.....				1
Mar. 22.....	Central California, San Francisco, Southern Pacific Building.....	2			
Mar. 23.....	Central California, Oakland, City Hall.....	2			
	San Francisco, Golden Gate Park.....	1			
	San Francisco, Southern Pacific Building.....	2			
Apr. 25.....	Imperial Valley, El Centro.....	1	1	1	
Apr. 25.....	do.....	1	1	1	
Apr. 25.....	do.....	1	1	1	
Apr. 25.....	do.....		1		
May 26.....	do.....	1	1	1	
Sept. 28.....	Central California, Hollister.....	1		1	
	Total.....	46	7	12	8

TABLE 6.—Summary of outstanding instrumental and noninstrumental data for 1957.

PERU EARTHQUAKE OF FEBRUARY 18

Epicenter	Recording station and distance	Location of instrument	Intensity ¹	Acceleration	Displacement ²
Peru.....	Lima.....	1st floor.....		cm./sec. ² 32	cm. 0.004

SOUTHERN CALIFORNIA EARTHQUAKE OF MARCH 18

34°06' N., 119°10' W., offshore south of Oxnard, VI.* Mag. 5.	Port Hueneme, 4 miles.....	basement.....	VI	167	1.4
--	----------------------------	---------------	----	-----	-----

SAN FRANCISCO EARTHQUAKE OF MARCH 22, 11:44

37°40' N., 122°29' W., east of Mussel Rock. VII.* Mag. 5.3.	San Francisco, Southern Pacific Building, 10 miles.	14th floor.....	VI	168	1.3
--	---	-----------------	----	-----	-----

SAN FRANCISCO AFTERSHOCK OF MARCH 22, 15:15

37°39' N., 122°27' W., south of Colma. V.* Mag. 4.4.	San Francisco, Southern Pacific Building, 10 miles.	14th floor.....	100	0.6
--	---	-----------------	-------	-----	-----

SAN FRANCISCO AFTERSHOCK OF MARCH 23

37°42' N., 122°31' W., offshore west of Daly City. VI.* Mag. 4.2.	San Francisco, Golden Gate Park, 5 miles.	1st floor.....	.....	19	0.005
	San Francisco, Southern Pacific Building, 9 miles.	14th floor.....	.....	15	0.09

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 1957.

PERU EARTHQUAKE OF JANUARY 24

Station and component	Instrument No.	T ₀	V	Sensitivity	ε	Acceleration		Displacement		Remarks
						Period	Amplitude	Period	Amplitude*	
		sec.		cm./g		sec.	cm./sec. ²	sec.	cm.	
Lima:										
Vertical.....	286.....	0.0641	123	12.5	6	0.1	5	.....	0.001	
N. 8° E.....	288.....	.0634	122	12.2	9	.2	9	.....	.009	
N. 82° W.....	287.....	.0635	125	12.5	7	.2	8	.....	.008	

PERU EARTHQUAKE OF FEBRUARY 18

Lima:										
Vertical.....	286.....	0.0641	123	12.5	6	0.06	12	.....	0.001	
N. 8° E.....	288.....	.0634	122	12.2	9	.07	32	.....	.004	
N. 82° W.....	287.....	.0635	125	12.5	7	.08	27	.....	.004	

SOUTHERN CALIFORNIA EARTHQUAKE OF MARCH 18

Cachuma Dam Crest Station:										
Vertical.....	361.....	0.0608	118	10.8	12	.....	.....	.....	.....	Negligible trace motion.
N.-S.....	362.....	.0616	118	11.1	14	.....	.....	.....	.....	Do.
E.-W.....	363.....	.0604	118	10.7	11	.....	.....	.....	.....	Do.
N.-S.....	CDM-14..	2.24	.8	.....	10	.....	.....	0.09	0.04	
E.-W.....	CDM-15..	2.50	.9	.....	10	.....	.....	.7	.02	
Valve House Station:										
Vertical.....	364.....	.0618	116	11.0	10	.....	.....	.....	.....	Negligible trace motion.
N.-S.....	365.....	.0622	121	11.6	10	.....	.....	.....	.....	Do.
E.-W.....	366.....	.0641	122	12.4	11	.....	.....	.....	.....	Do.
Vertical.....	CDM-2..	2.09	1.1	.....	10	.....	.....	1.0	.01	
N.-S.....	CDM-30..	5.28	1.0	.....	10	.....	.....	1.2	.02	
E.-W.....	CDM-9..	5.44	1.0	.....	10	.....	.....	1.5	.02	
Port Hueneme:										
Vertical.....	1001.....	.0774	118	17.6	11	0.6	26	.....	.2	
N.-S.....	1002.....	.0753	120	17.2	8	.5	167	.....	.....
E.-W.....	1003.....	.0774	119	17.7	20	.5	92	.....	.....
N.-S.....	CDM-33..	2.50	1.1	.....	10	.....	.....	1.3	1.1	
E.-W.....	CDM-32..	2.48	1.1	.....	10	.....	.....	1.1	1.4	
Santa Barbara:										
Vertical.....	259.....	.0650	125	13.1	.....	.6	1	.....	.009	
N. 42° E.....	260.....	.0640	127	12.9	.....	.6	3	.....	.03	
N. 48° W.....	261.....	.0652	126	13.3	.....	.6	3	.....	.03	
Taft:										
Vertical.....	298.....	.0797	115	18.2	10	.....	.....	.....	.....	Negligible trace motion.
N. 7° E.....	299.....	.0817	123	20.4	9	.....	.....	.....	.....	Do.
N. 83° W.....	300.....	.0817	121	20.0	8	.....	.....	.....	.....	Do.

Footnotes at end of table.

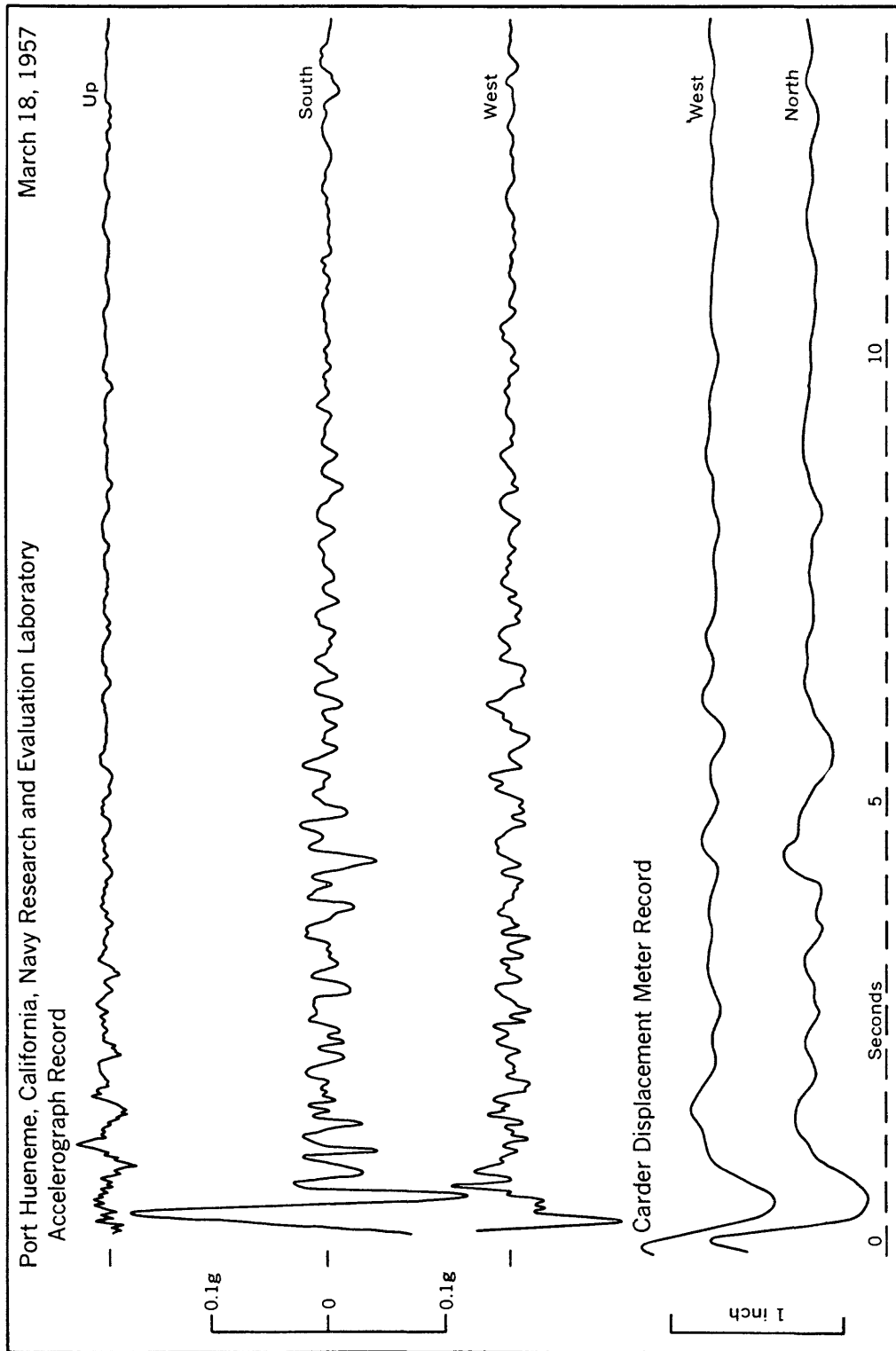


FIGURE 15.—Tracings of accelerograph and displacement meter records obtained at Port Hueneme on March 18.

TABLE 7.—Composite of strong-motion instrumental data for 1957—Continued

SAN FRANCISCO EARTHQUAKE OF MARCH 22, 11:44

Station and component	Instrument No.	T ₀	V	Sensitivity	ε	Acceleration		Displacement‡		Remarks
						Period	Amplitude	Period	Amplitude*	
		sec.		cm./g		sec.	cm./sec. ²	sec.	cm.	
Oakland, Chabot Observatory (Weed):										
N. 56° E.	8.	0.200	7	7	4	0.2	74	.....	0.07	Probable resonance. Do.
N. 34° W.	8. ....	.182	7	6	4	.2	100	.....	.1	
Oakland, City Hall, 16th floor:										
Vertical.	226. ....	.0450	117	5.8	8	.2	125	.....	.13	
N. 26° E.	227. ....	.0455	116	5.1	10	.2	125	.....	.13	
N. 64° W.	228. ....	.0458	118	5.9	15	.2	70	.....	.07	
Basement:										
Vertical.	235. ....	.0668	117	13.0	11	.07	21	.....	.003	
N. 26° E.	236. ....	.0662	115	12.5	9	.2	45	.....	.05	
N. 64° W.	237. ....	.0673	118	13.2	10	.2	28	.....	.03	
San Francisco, Alexander Building, 16th floor:										
Vertical.	181. ....	.0466	121	6.5	12	.2	118	.....	.12	
N. 9° W.	180. ....	.0460	121	6.4	14	.3	83	.....	.19	
N. 81° E.	179. ....	.0457	120	6.2	8	.3	131	.....	.3	
11th floor:										
Vertical.	178. ....	.0455	121	6.2	15	.2	103	.....	.10	
N. 9° W.	176. ....	.0462	119	6.3	12	.3	58	.....	.13	
N. 81° E.	177. ....	.0456	122	6.3	8	.2	45	.....	.05	
Basement:										
Vertical.	199. ....	.0635	120	12.0	7	.2	34	.....	.03	
N. 9° W.	198. ....	.0650	121	12.7	10	.1	49	.....	.01	
N. 81° E.	197. ....	.0639	124	12.6	8	.3	52	.....	.12	
San Francisco, Golden Gate Park:										
Vertical.	304. ....	.0764	119	17.2	8	.09	53	.....	.01	
N. 10° E.	305. ....	.0754	121	17.1	8	.1	103	.....	.03	
N. 80° W.	306. ....	.0779	120	18.1	10	.1	124	.....	.03	
San Francisco, Shell Building										
29th floor (Weed):										
N. 9° W.	2. ....	.187	7	6	4	.4	95	.....	.4	
N. 81° E.	2. ....	.185	7	6	3	.4	65	.....	.3	
21st floor (Weed) :										
N. 9° W.	3. ....	.201	7	7	2	.4	83	.....	.3	
N. 81° E.	3. ....	.210	7	8	2	.3	59	.....	.1	
San Francisco, Southern Pacific Building, 14th floor:										
Vertical.	184. ....	.0473	119	6.6	13	.1	168	.....	.04	
N. 45° E.	183. ....	.0466	120	6.4	9	.6	96	.....	.9	
N. 45° W.	182. ....	.0458	122	6.4	10	.6	147	.....	1.3	
Basement:										
Vertical.	196. ....	.0669	118	13.1	10	.2	33	.....	.03	
N. 45° E.	194. ....	.0668	117	13.0	10	.2	48	.....	.05	
N. 45° W.	195. ....	.0665	119	13.1	10	.4	45	.....	.2	
San Francisco, State Building:										
Vertical.	232. ....	.0648	121	12.6	9	.3	48	.....	.11	
N. 9° W.	233. ....	.0658	123	13.2	10	.3	101	.....	
N. 81° E.	234. ....	.0650	122	12.8	9	.2	61	.....	
N. 9° W.	CDM-3.	2.38	.8		10					
N. 81° E.	CDM-4.	2.32	.8		10					
N. 9° W.	SDM-14.	9.91	1		10			3	1.1	
N. 81° E.	SDM-14.	9.90	1		10			4	.7	

Footnotes at end of table.

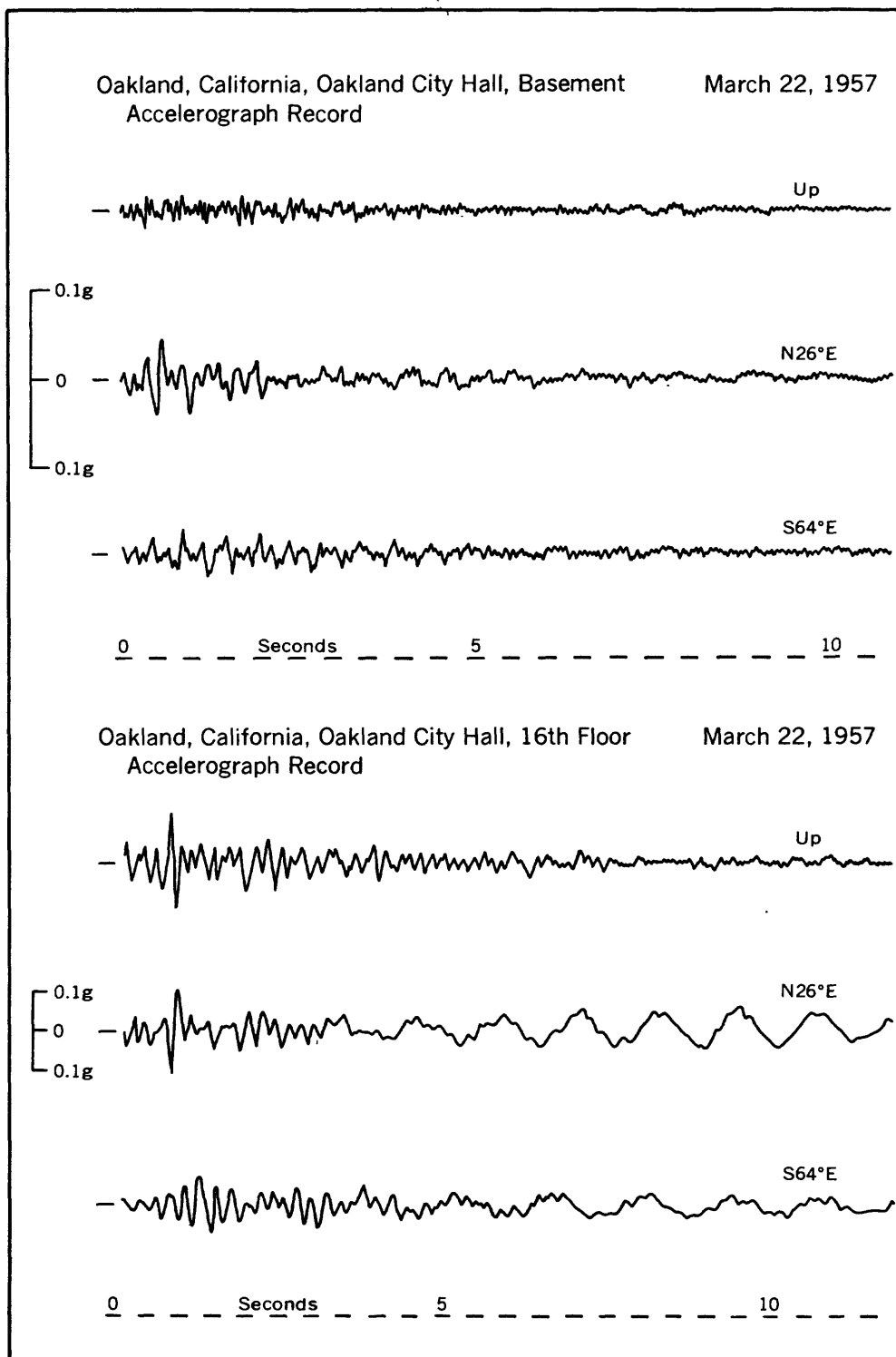


FIGURE 16.—Tracings of accelerograph records obtained at Oakland City Hall, basement and 16th floor, on March 22.

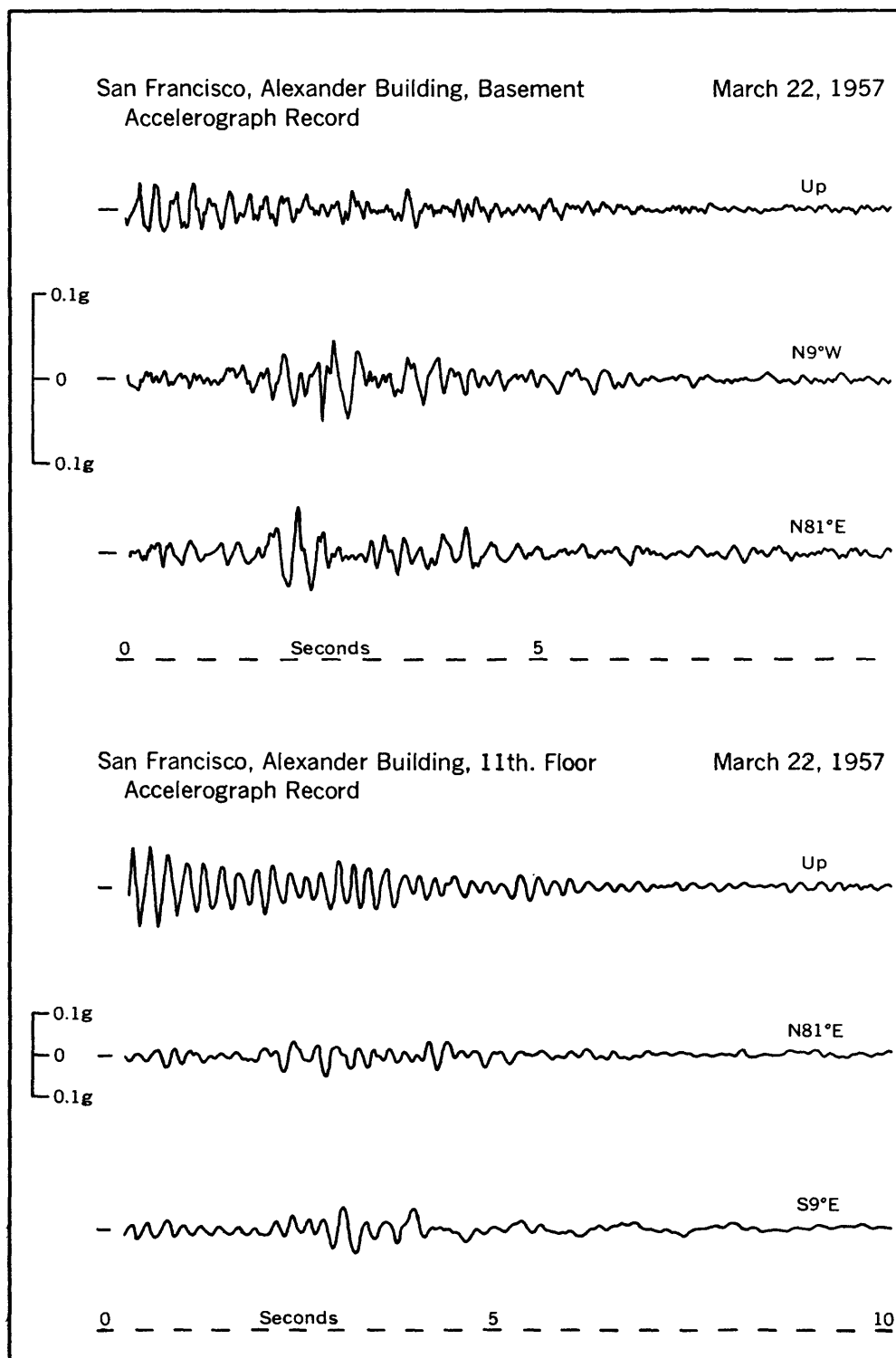


FIGURE 17.—Tracings of accelerograph records obtained at San Francisco, Alexander Building, basement and 11th floor, on March 22.

TABLE 7.—Composite of strong-motion instrumental data for 1957—Continued

SAN FRANCISCO EARTHQUAKE OF MARCH 22, 11:44—Continued

Station and component	Instrument No.	T ₀	V	Sensitivity	ε	Acceleration		Displacement		Remark
						Period	Amplitude	Period	Amplitude*	
		sec.		cm./g		sec.	cm./sec. ²	sec.	cm.	
San Francisco, 450 Sutter Building, Basement (Weed):										Negligible trace motion.
N. 9° W.....	6.....	.177	7	6	2	.6	5	.....	.05
N. 81° E.....	6.....	.181	7	6	2	.....	.....	.....	.....
San Jose, Bank of America, 13th floor:										
Vertical.....	175.....	.0458	120	6.2	10	.2	9	.....	.009
N. 59° E.....	174.....	.0458	122	6.4	10	.4	12	.....	.05
N. 31° W.....	173.....	.0474	120	6.7	8	.3	9	.....	.02
Basement:										
Vertical.....	202.....	.0666	118	13.0	9	.2	5	.....	.005
N. 59° E.....	201.....	.0656	119	12.7	8	.3	7	.....	.....
N. 31° W.....	200.....	.0662	116	12.6	11	.3	6	.....	.....
N. 59° E.....	CDM-8.....	2.27	.8	.....	11	.....	.....	1.2	.08
N. 31° W.....	CDM-7.....	2.28	.8	.....	8	.....	.....	1.3	.09
Suisun Bay Bridge:										
Vertical.....	223.....	.0456	120	6.2	10	.1	3	.....	.001
N. 59° E.....	224.....	.0462	117	6.2	9	.3	30	.....	.07
N. 31° W.....	225.....	.0465	118	6.3	9	.1	54	.....	.01

SAN FRANCISCO EARTHQUAKE OF MARCH 22, 15:15

Oakland, City Hall, 16th floor:										
Vertical.....	226.....	0.0450	117	5.8	8	0.5	5	.....	0.03	
N. 26° E.....	227.....	.0455	116	5.1	10	.2	8	.....	.008	
N. 64° W.....	228.....	.0458	118	5.9	15	1.2	15	.....	.5	
Basement:										
Vertical.....	235.....	.0668	117	13.0	11	.2	2	.....	.002	
N. 26° E.....	236.....	.0662	115	12.5	9	.4	2	.....	.008	
N. 64° W.....	237.....	.0673	118	13.2	10	.2	4	.....	.004	
San Francisco, Alexander Building, 16th floor:										
Vertical.....	181.....	.0466	121	6.5	12	.2	21	.....	.02	
N. 9° W.....	180.....	.0460	121	6.4	14	.4	38	.....	.15	
N. 81° E.....	179.....	.0457	120	6.2	8	.3	44	.....	.10	
11th floor:										
Vertical.....	178.....	.0455	121	6.2	15	.2	14	.....	.01	
N. 9° W.....	176.....	.0462	119	6.3	12	.3	16	.....	.04	
N. 81° E.....	177.....	.0456	122	6.3	8	.3	12	.....	.03	
Basement:										
Vertical.....	199.....	.0635	120	12.0	7	.2	6	.....	.006	
N. 9° W.....	198.....	.0650	121	12.7	10	.4	18	.....	.07	
N. 81° E.....	197.....	.0639	124	12.6	8	.2	18	.....	.02	
San Francisco, Golden Gate Park:										
Vertical.....	304.....	.0764	119	17.2	8	.1	6	.....	.002	
N. 10° E.....	305.....	.0754	121	17.1	8	.1	10	.....	.003	
N. 80° W.....	306.....	.0779	120	18.1	10	.1	10	.....	.003	
San Francisco, Shell Building, 29th floor (Weed):										
N. 9° W.....	2.....	.187	7	6	4	.8	40	.....	.6	
N. 81° E.....	2.....	.185	7	6	3	.7	30	.....	.4	
21st floor (Weed):										
N. 9° W.....	3.....	.201	7	7	2	.4	37	.....	.1	
N. 81° E.....	3.....	.210	7	8	2	.4	12	.....	.05	

Footnotes at end of table.

TABLE 7.—Composite of strong-motion instrumental data for 1957—Continued

SAN FRANCISCO EARTHQUAKE OF MARCH 22, 15:15—Continued

Station and component	Instrument No.	T ₀	V	Sensitivity	ε	Acceleration		Displacement		Remarks
						Period	Amplitude	Period	Amplitude*	
		<i>sec.</i>		<i>cm./g</i>		<i>sec.</i>	<i>cm./sec.²</i>	<i>sec.</i>	<i>cm.</i>	
Subbasement (Weed):										
N. 9° W.....	4.....	.191	7	6	3	.5	8	.....	.05	
N. 81° E.....	4.....	.195	7	7	4	.6	6	.....	.05	
San Francisco Southern Pacific Building, 14th floor:										
Vertical.....	184.....	.0473	119	6.6	13	.5	24	.....	.15	
N. 45° E.....	183.....	.0466	120	6.6	9	.5	43	.....	.3	
N. 45° W.....	182.....	.0458	122	6.4	10	.5	100	.....	.6	
Basement:										
Vertical.....	196.....	.0669	118	13.1	10	.6	7	.....	.06	
N. 45° E.....	194.....	.0668	117	13.0	10	.7	9	.....	.11	
N. 45° W.....	195.....	.0665	119	13.1	10	.4	26	.....	.11	
San Francisco, State Building:										
Vertical.....	232.....	.0648	121	12.6	9	.4	15	.....	.06	
N. 9° W.....	233.....	.0658	123	13.2	10	.3	25	.....	
N. 81° E.....	234.....	.0650	122	12.8	9	.2	35	.....	
N. 9° W.....	CDM-3.....	2.38	.8		10			.....	
N. 81° E.....	CDM-4.....	2.32	.8		10			.....	
N. 9° W.....	SDM-14.....	9.91	1		10			.8	.12	
N. 81° E.....	SDM-14.....	9.90	1		10			.5	.12	
San Francisco, 450 Sutter Building, 29th floor (Weed):										
N. 9° W.....	1.....	.196	7	7	2	.4	54	.....	.2	
N. 81° E.....	1.....	.196	7	7	3	.4	40	.....	.2	

SAN FRANCISCO EARTHQUAKE OF MARCH 22, 16:27

San Francisco, Southern Pacific Building, 14th floor:										
Vertical.....	184.....	.0473	119	6.6	13	0.2	7	.....	0.007	
N. 45° E.....	183.....	.0466	120	6.4	9	.4	17	.....	.07	
N. 45° W.....	182.....	.0458	122	6.4	10	.5	28	.....	.18	
Basement:										
Vertical.....	196.....	.0669	118	13.1	10	.5	3	.....	.02	
N. 45° E.....	194.....	.0668	117	13.0	10	.2	2	.....	.002	
N. 45° W.....	195.....	.0665	119	13.1	10	.5	8	.....	.05	

SAN FRANCISCO EARTHQUAKE OF MARCH 23

Oakland, City Hall, 16th floor:										
Vertical.....	226.....	.0450	117	5.8	8	0.2	17	.....	0.02	
N. 26° E.....	227.....	.0455	116	5.1	10	.2	10	.....	.01	
N. 64° W.....	228.....	.0458	118	5.9	15	.2	12	.....	.01	
Basement:										
Vertical.....	235.....	.0668	117	13.0	11	.1	5	.....	.001	
N. 26° E.....	236.....	.0662	115	12.5	9	.1	5	.....	.001	
N. 64° W.....	237.....	.0673	118	13.2	10	.2	5	.....	.005	
San Francisco, Golden Gate Park:										
Vertical.....	304.....	.0764	119	17.2	8	.1	9	.....	.002	
N. 10° E.....	305.....	.0754	121	17.1	8	.2	15	.....	.02	
N. 80° W.....	306.....	.0779	120	18.1	10	.1	19	.....	.005	

Footnotes at end of table.

TABLE 7.—Composite of strong-motion instrumental data for 1957—Continued

SAN FRANCISCO EARTHQUAKE OF MARCH 23—Continued

Station and component	Instrument No.	T ₀	V	Sensitivity	ε	Acceleration		Displacement		Remarks
						Period	Amplitude	Period	Amplitude*	
		sec.		cm./g		sec.	cm./sec. ²	sec.	cm.	
San Francisco, Southern Pacific Building, 14th floor:										
Vertical.....	184.....	.0473	119	6.6	13	.2	12	.....	.01	
N. 45° E.....	183.....	.0466	120	6.4	9	.5	8	.....	.05	
N. 45° W.....	182.....	.0458	122	6.4	10	.5	15	.....	.09	
Basement:										
Vertical.....	196.....	.0669	118	13.1	10	.1	4	.....	.001	
N. 45° E.....	194.....	.0668	117	13.0	10	.2	6	.....	.006	
N. 45° W.....	195.....	.0665	119	13.1	10	.1	5	.....	.001	

CENTRAL CALIFORNIA EARTHQUAKE OF SEPTEMBER 28

Hollister:										
Vertical.....	238.....	0.0621	122	11.7	10	0.2	7	.....	0.007	
N. 1° E.....	239.....	.0602	124	11.2	8	.2	12	.....	.....
N. 89° W.....	240.....	.0598	122	10.8	9	.2	27	.....	.....
N. 1° E.....	CDM-6..	2.12	1.0	.....	10	.....	.....	0.8	.07	
N. 89° W.....	CDM-5..	2.30	1.0	.....	10	.....	.....	.9	.06	

*Estimated from acceleration if no entry in displacement period column.

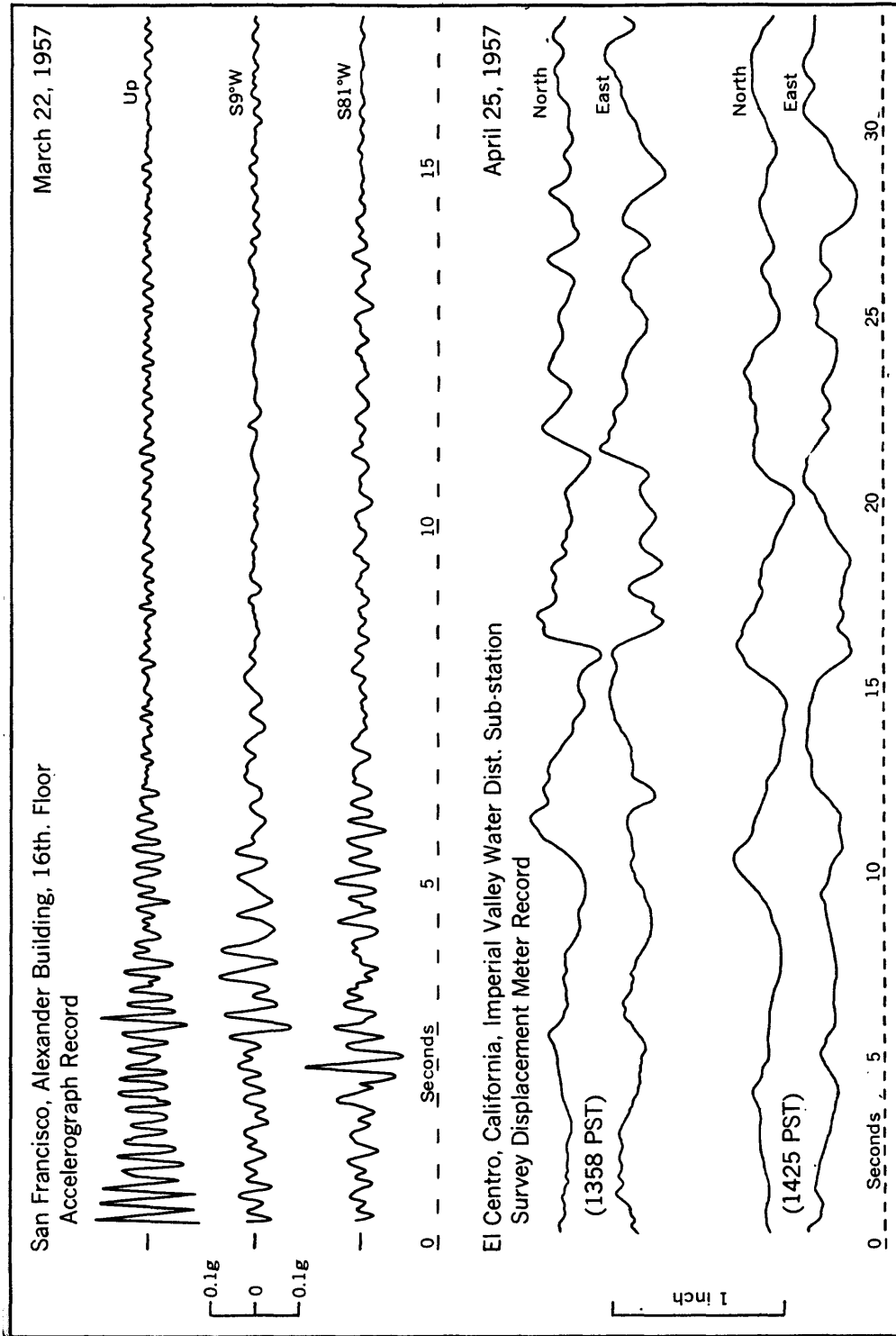


FIGURE 18.—Tracings of accelerograph record at San Francisco, Alexander Buildings, 16th floor, on March 22; and Survey displacement meter records at El Centro on April 25.

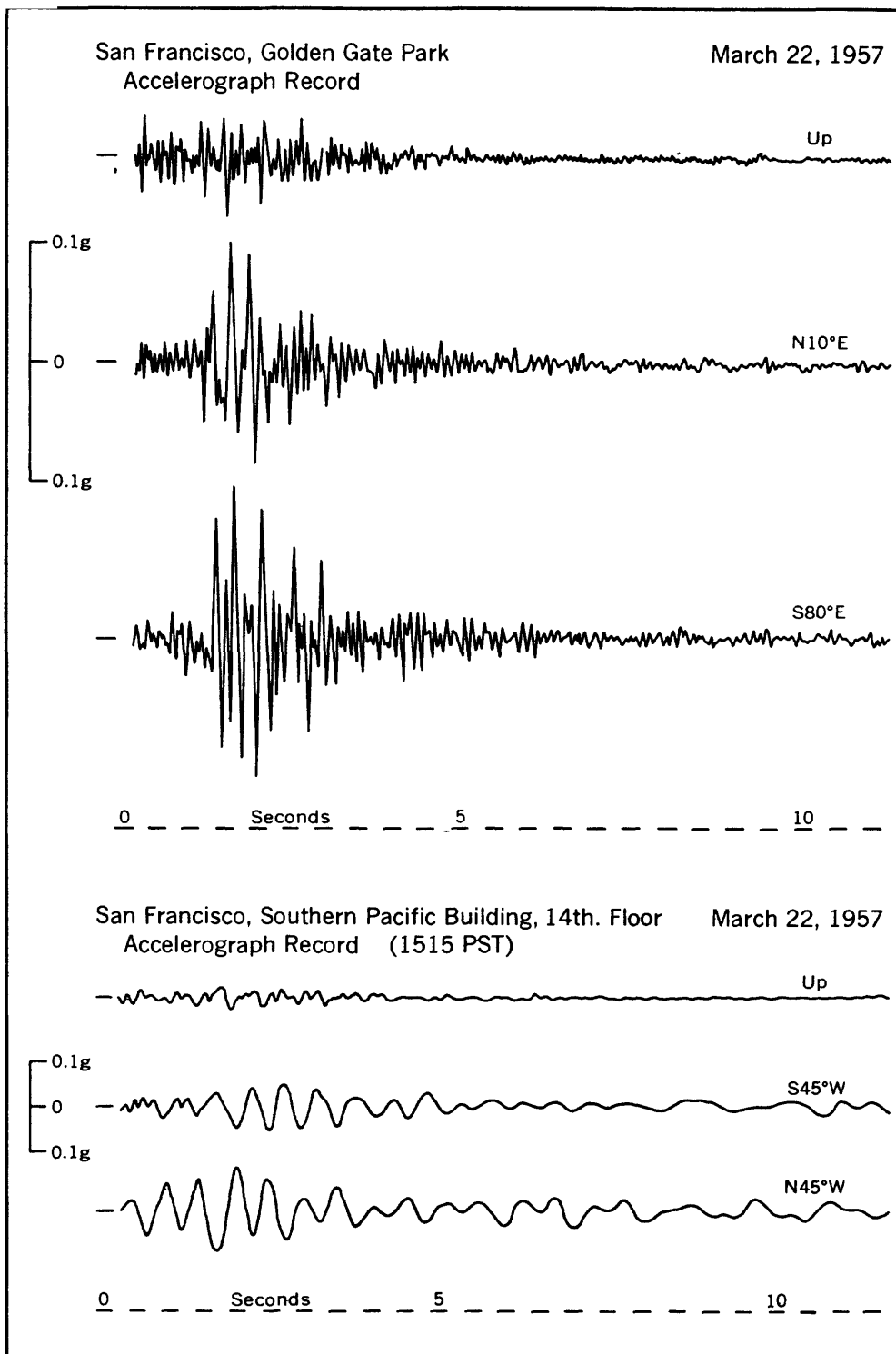


FIGURE 19.—Tracings of accelerograph records obtained at San Francisco, Golden Gate Park and Southern Pacific Building, 14th floor, on March 22.

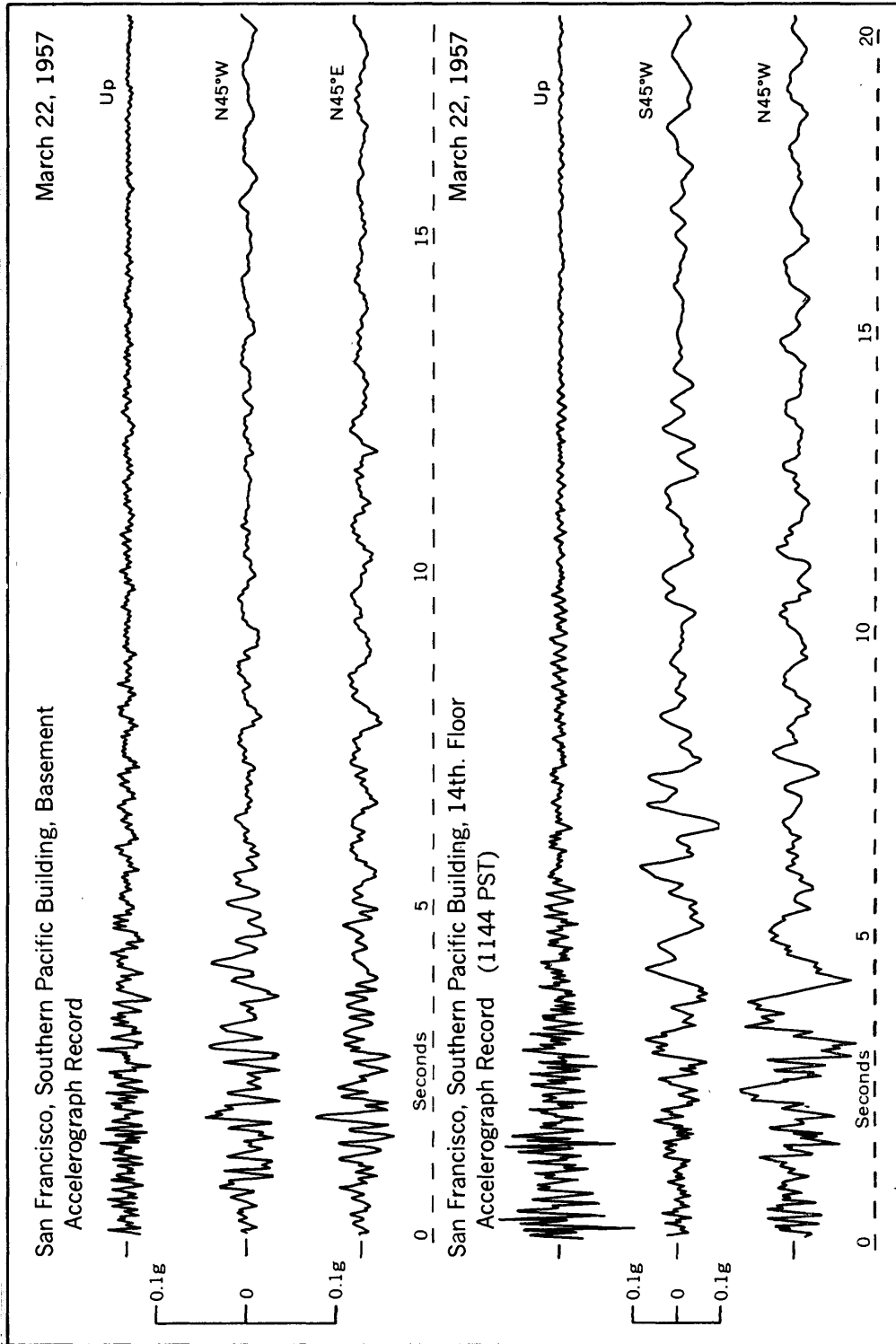


FIGURE 20.—Tracings of accelerograph records obtained at San Francisco, Southern Pacific Building, basement and 14th floor, on March 22.

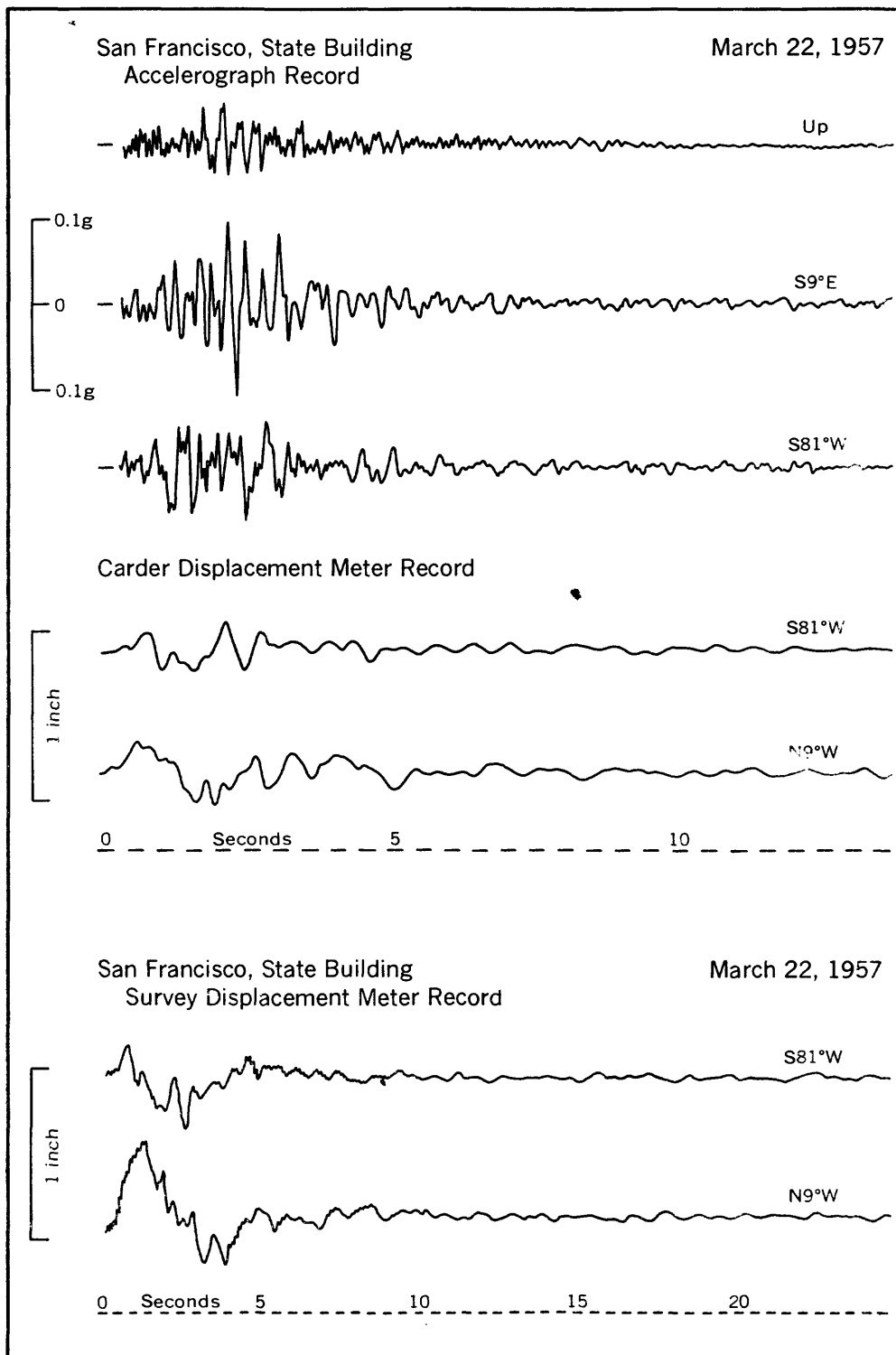


FIGURE 21.—Tracings of accelerograph and displacement meter records obtained at San Francisco, State Building, on March 22.

TILT OBSERVATIONS

The tiltmeter in the Astronomy Building on the University of California campus at Berkeley, Calif., was removed from service 18 December 1957. Three Merritt tiltmeter stations continued in routine operation.

CORRECTIONS TO PREVIOUS EDITIONS

Serial 785, United States Earthquakes, 1953. Page 26. Change date of Alaska earthquake from 17 to 18 July.

PUBLICATION NOTICES

The Coast and Geodetic Survey maintains mailing lists for notices of issuance of its publications. Should you desire to receive notices of seismological publications, address your request to the Director, Coast and Geodetic Survey, Washington 25, D.C.