DEPARTMENT OF THE INTERIOR

U.S. GEOLOGICAL SURVEY

United States Earthquakes, 1973

By

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Preface

In 1973, most seismological activities of the National Oceanic and Atmospheric Administration (NOAA) were absorbed by the U.S. Geological Survey (USGS). These operations included the Seismological Research Group, National Earthquake Information Center, and Geomagnetic Research Group, Boulder, Colo.; Seismological Field Survey, San Francisco, Calif.; and Special Projects Party, Las Vegas, Nev. Although the seismology functions of the NOAA/Environmental Data Service remained intact, it was decided that the 1973 and subsequent issues of *United States Earthquakes* would be published jointly by NOAA/USGS. Except for minor changes, the format for this first joint report is essentially the same as that in past issues of *United States Earthquakes.*

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Introduction

United States Earthquakes, prepared annually since 1928, describes all earthquakes that were felt in the United States and nearby territories during the year. Earthquakes are listed chronologically in 11 regions: Northeastern Region, Eastern Region, Central Region, Western Mountain Region, California and Western Nevada, Washington and Oregon, Alaska, Hawaii, Panama Canal Zone, Puerto Rico, and Virgin Islands. In addition, table 1 contains instrumental epicenters of U.S. earthquakes and lists those that were not felt by residents; table 2 lists principal earthquakes of the world for the year with brief accounts of their effects.

This report also includes sections on horizontal and vertical control surveys for crustal movement studies, tsunamis, well-water fluctuations, and strong-motion seismograph data.

Sources of noninstrumental information used in this compilation include reports received from questionnaire canvasses conducted by the U.S. Geological Survey National Earthquake Information Service (NEIS); reports from seismology collaborators; newspaper clippings; bulletins of the Seismological Society of America; special reports of other organizations; and felt data from NOAA's National Weather Service.

Instrumental data utilized in computing earthquake epicenters, depths, magnitudes, and times of occurrence are obtained by NEIS from NOAA, USGS, and cooperating seismological observatories, both domestic and foreign.

NATIONAL GEOPHYSICAL AND SOLAR-TERRESTRIAL DATA CENTER

The National Geophysical and Solar-Terrestrial Data Center (NGSDC) is one of the five major facilities of NOAA's Environmental Data Service. NGSDC's Solid Earth Data Services Division is responsible for data activities in the field of seismology.

Its services include preparing local and regional seismic histories for engineers, actuaries, and other scientists, and answering direct inquiries from the public on all aspects of historical earthquakes. Additional services and products include publishing annual earthquake summaries and revised historical earthquake reports; and making available in several formats (at a nominal fee) copies of seismograms, accelerograms, displacement meter records, digitized strong-motion seismograms, and epicenter lists. Many of these products and services are based on seismic records or other data that have originated with USGS recording networks or with USGS data-reduction facilities. Information concerning services and products of NGSDC may be obtained from the National Geophysical and Solar-Terrestrial Data Center, NOAA/EDS, Boulder, Colo. 80302. Some of these seismological services and products are described in the following paragraphs.

Earthquake Data File

The earthquake hypocenter data file lists hypocenters geographically and chronologically from 1900–1974. It is available on magnetic tape and 16-mm microfilm. Monthly updates on punched cards also may be purchased. The file gives date, origin time, geographic location, focal depth, magnitude, and intensity (Modified Mercalli) for each event when available. Searches for one, or combination, of the parameters above can be made. Additional information is available on request.

Strong-Motion Earthquake Data

All records in the strong-motion file, dating from the initial accelerograms recorded in 1933, are available in full-size paper copies or as 70-mm film chips. A chronological listing (1933–1971) may be purchased on seven reels of 35-mm microfilm. Digitized accelerograms may be obtained on magnetic tape or punched cards. The same information is described in geographic arrangement in

Key to Geophysical Records Documentation No. 2 (see description on p. 2).

Other Data

The *Preliminary Determination of Epicenters Monthly Listing,* a chronological listing of earthquakes located throughout the world, may be purchased on 16-mm microfilm for the period 1969–December 1973. It contains for each earthquake the time of occurrence, geographic coordinates, region, felt and damage data, depth, magnitude, and other useful data.

The *Earthquake Data Report,* a twice-weekly compilation of data used in the computation of the report described above, is now available on 16-mm microfilm for the years 1969–1973. It contains station arrival times, individual distances, azimuths, and traveltime residuals.

The *Reid Earthquake Catalog,* compiled by the late Professor Harry F. Reid, is a comprehensive collection of earthquake and volcano data recorded on cards (3 × 5 in.) and augmented by newspaper clippings of principal earthquakes. The catalog, which is in chronological sequence and cross-indexed by geographical regions, covers the time from before Christ to 1931. It is available on five reels of 16-mm microfilm.

Seismograms from Worldwide Network

Seismograms are available from all stations in the Worldwide Network of Standard Seismograph Stations, which operates with identical instruments. Each station produces six seismograms daily. In addition, records from ten high-gain, long-period stations are available beginning with January 1971. Seismograms from other selected stations—foreign, Canadian, and U.S. Geological Survey networks—may also be obtained. Requests for these records should include time, date, station, components, and type of copies desired. A list of available formats and prices will be supplied upon request.

Publications

NGSDC issued the following publications in 1973:

Publication 41-1, Earthquake History of the United States, Revised Edition (Through 1970). This report describes prominent earthquakes (generally of intensity V and above) in the United States and Puerto Rico from historical times. It contains regional tables that list earthquake epicenters or probable locations, intensity, and extent of felt area.

Seismological Publications and Services. This pamphlet describes earthquake data and services available from several sources within the Federal Government.

Key to Geophysical Records Documentation No. 2, Catalog of Strong-Motion Seismograph Stations and Records. This catalog lists all strong-motion seismographs which either have produced records or are presently operational. Also given are dates and times of all strong-motion records written and the formats in which copies are available. Several maps show locations of strong-motion stations in the United States and Central and South America.

NATIONAL EARTHQUAKE INFORMATION SERVICE

The U.S. Geological Survey National Earthquake Information Service (NEIS) maintains an earthquake reporting system that provides accurate and rapid epicenter locations and magnitude values to the press and other interested groups. These results are available within 2–3 hours for earthquakes of magnitude 6½ or larger. Locations and magnitudes of smaller events are computed on request or on receipt of a press report.

USGS, NOAA, and cooperating seismic observatories throughout the world also furnish data for the epicenter program of the National Earthquake Information Service. Figure 1 shows locations of primary USGS and NOAA seismograph stations. Basic data from these and approximately 200 additional seismic stations are routinely telegraphed to NEIS for use in epicenter computation. Some 250 other seismic stations are canvassed for data that are critical in the location of particular earthquakes.

During 1973, the locations of 5,211 epicenters were announced in the twice-weekly *Preliminary Determination of Epicenters* (PDE) list. Epicenters are published when sufficient information has accumulated to insure a reasonable degree of accuracy. The results are preliminary and do not always agree with later epicenters determined from additional seismic readings or from new data with critical azimuths and distances. For special studies, an inquiry should be made to the NEIS office (Denver Federal Center, D2, Bldg. 25, Denver, Colo. 80225) for possible recomputation of epicenters of interest.

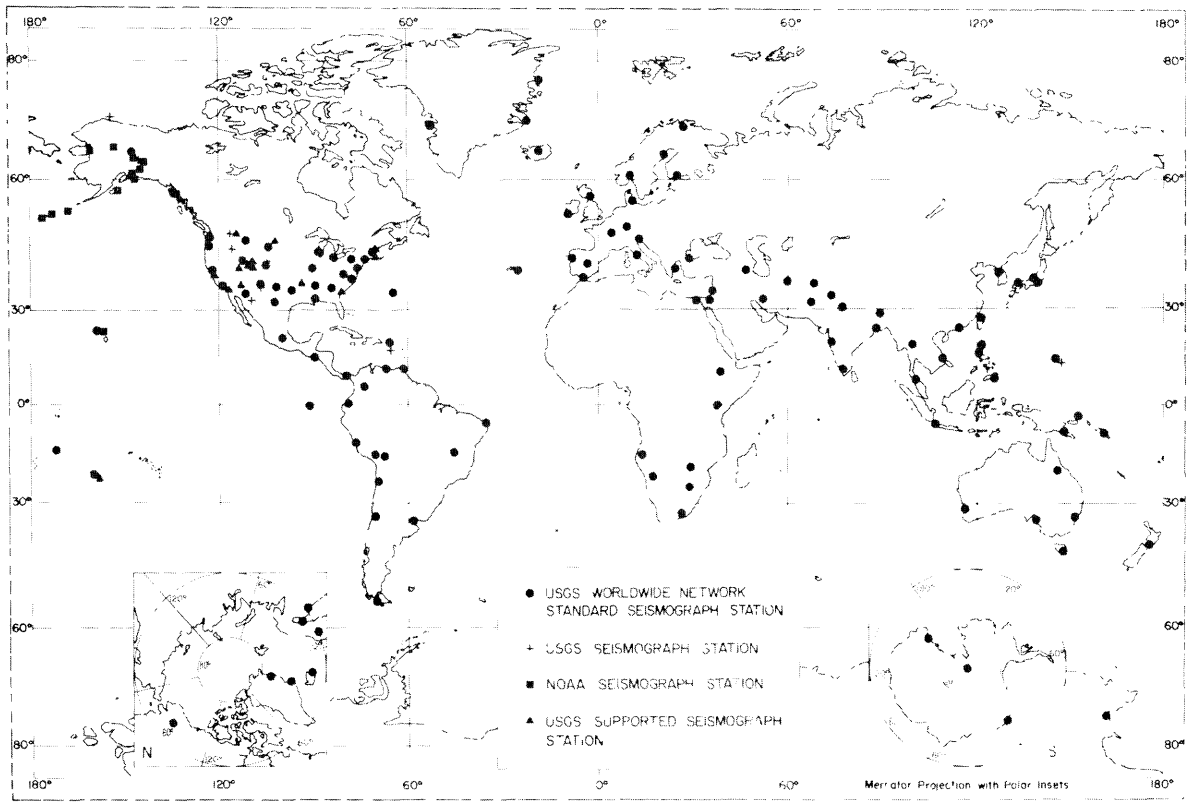

FIGURE 1.—USGS and NOAA seismograph stations that routinely report basic seismological data to NEIS.

NEIS coordinates the collection of all types of earthquake information, with the special objective of correlating instrumentally determined earthquake locations with noninstrumental locations indicated by intensity data. This correlation is achieved through intensive regional investigations of earthquakes by local organizations and NEIS. Primary data are gathered by a canvass of the epicentral area using questionnaire cards. Cities that receive questionnaire cards are selected by computer, based upon an analysis of the earthquake magnitude and projected felt area. When returned and analyzed, this information is used to map the seismic areas of the country in order to promote public safety through a better understanding of earthquake phenomena. Because the success of this data collection program depends largely on the cooperation of local officials and citizens, all who receive earthquake questionnaire cards are urged to complete and return them to the office indicated.

NEIS issued the following technical reports in 1973:

Preliminary Determination of Epicenters. These twice-weekly reports list the approximate hypocentral locations of all earthquakes recorded throughout the world. They contain origin time, geographic coordinates, region of occurrence, felt and damage data, depth, magnitude, and other related information on each earthquake. *The Preliminary Determination of Epicenters Monthly Listing,* a chronological listing of the twice-weekly data, is available to the general public by subscription from the Government Printing Office.

Earthquake Data Report. This twice-weekly report contains data used in the computation of the report above. It lists station arrival times, individual distances, azimuths, and traveltime residuals.

World Seismicity Map. This is a five-color map, 48 by 36 inches, that depicts patterns of global earthquake activity for the period July 1, 1963, through December 31, 1972. Dots show earthquake epicenters with body-wave magnitude $\geqslant 4.5$ and whose locations were determined using 10 or more observations. The map shows the Earth on a Mercator projection. Three colors distinguish the principal depth-of-focus classes (0–70 km, 71–300 km, and 301–700 km).

In addition to these publications, the USGS publishes a bimonthly *Earthquake Information*

Bulletin, which contains information on past and continuing studies in seismology and describes techniques used in the investigation of earthquakes and related phenomena. This two-color magazine has regular departments for new publications, meetings, and current earthquake descriptions.

SEISMOLOGY COLLABORATORS

Active cooperation in earthquake investigations in the Pacific Coast and Western Mountain States is provided by the University of California Seismographic Station at Berkeley, the California Institute of Technology Seismological Laboratory at Pasadena, and by several seismology collaborators. The following served as collaborators to NOAA and USGS during 1973.

Arizona.—Richard T. Moore, Arizona Bureau of Mines, University of Arizona, Tucson.

Colorado.—Warren L. Longley, University of Colorado, Boulder.

Idaho.—Melvin W. Jackson, Argonne National Laboratory, Idaho Falls.

Montana.—Stephen W. Nile, 320 Ranch, Gallatin Gateway.

Nevada.—David B. Slemmons, University of Nevada, Reno.

New Mexico.—Stuart A. Northrop, University of New Mexico, Albuquerque.

Utah.—J. Stewart Williams, Utah State University, Logan.

Washington.—Howard A. Coombs, University of Washington, Seattle.

Commercial agencies on the West Coast that provide valuable services to NOAA include telephone, power, oil, railroad, and insurance companies. Agencies interested in the manufacture of earthquake-resistive building materials also give active support as do several organizations of structural engineers and architects.

Earthquake information was collected in other parts of the country by the following:

Northeastern Region.—Daniel J. Linehan, S.J., Weston College, Weston, Mass.

Eastern Region.—Gilbert A. Bollinger, Virginia Polytechnic Institute and State University, Blacksburg (for earthquakes in Virginia).

Central Region.—William J. Stauder, S.J., Saint Louis University (for earthquakes in the central Mississippi Valley area); E. J. Walter, John Carroll University, Cleveland (for earthquakes in Ohio); and Berlen C. Moneymaker, Tennessee Valley Authority, Knoxville (for earthquakes in Tennessee).

Hawaii.—Hawaiian Volcano Observatory, U.S. Geological Survey, Hawaii National Park.

EPICENTER MAPS

Figure 2 shows the locations of damaging earthquakes (intensity VII and above) known to have occurred in the United States from historical times through 1973. Small numerals beside a plotted point indicate the number of shocks that have occurred at that location. Some of the principal earthquakes are listed on page 6.

Figure 3 is a plot of 1973 earthquakes by intensity. In some instances where instrumental control was not satisfactory or where results of investigations were inadequate, the plotted epicenters show the occurrence, rather than the precise locations, of the earthquakes. Earthquakes in the California and western Nevada region are plotted on figure 3 when felt reports are received from several towns. Feeble earthquakes and minor aftershocks of large earthquakes usually are not shown on this map. A numeral beside a dot indicates the number of shocks reported at that location. Bulletins of the University of California Seismographic Station at Berkeley and the California Institute of Technology Seismological Laboratory at Pasadena should be consulted for additional details on epicenters in California.

The selection of intensity or "felt-area" maps (figs. 4–7, 11, and 14) is governed largely by the size of the area affected, the minimum radius generally being about 80 km (50 miles). This means that sharp, localized shocks of intensity VI (which occur mostly in California) may not be shown on such maps, whereas others of intensity V and VI (that occur largely in the Eastern and Central States) often will be illustrated. Numerals on these computer-plotted maps represent the locations of the Mercalli intensities at each town.

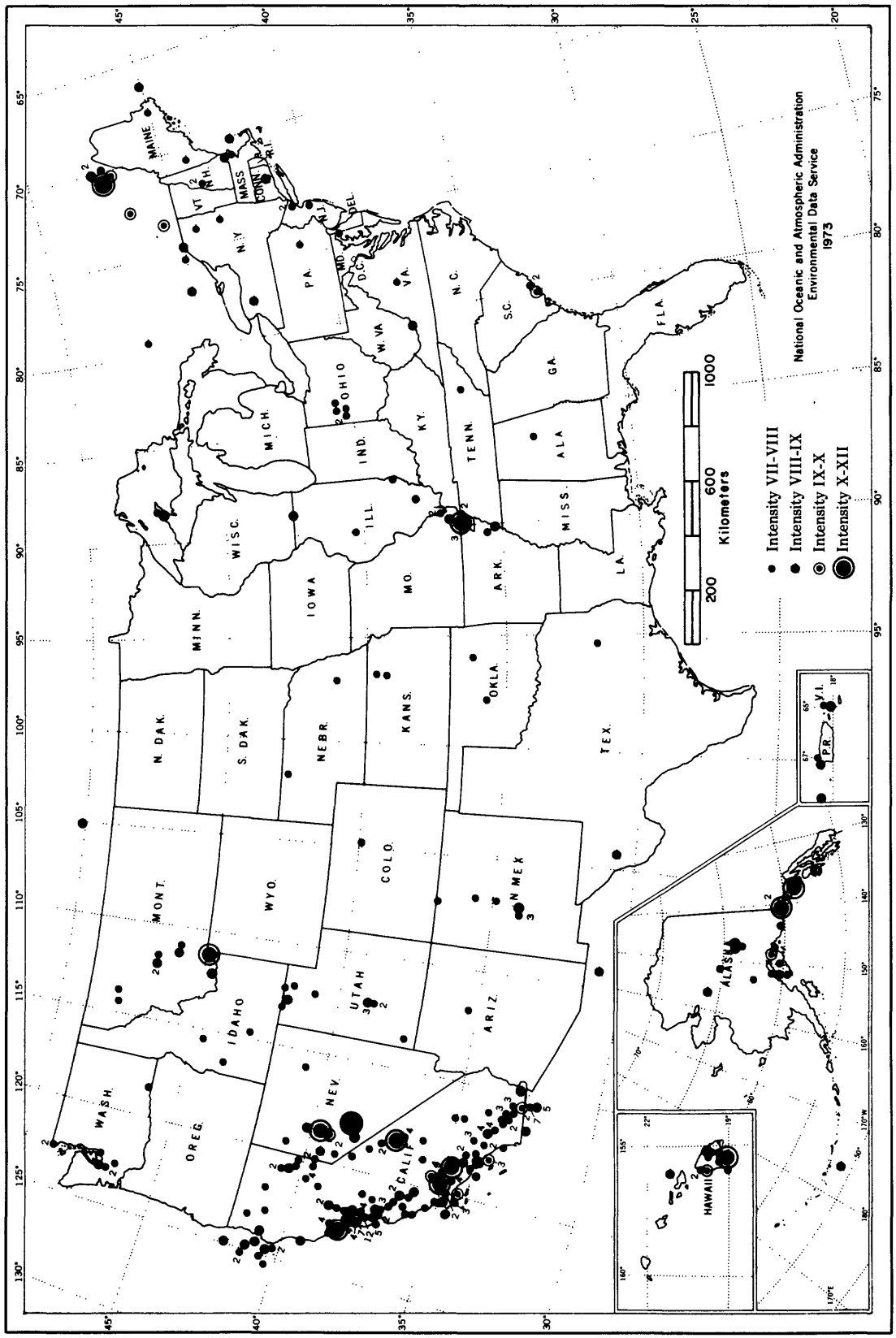

FIGURE 2.—Damaging earthquakes in the United States from earliest history through 1973.

List of Principal Earthquakes in the United States Through 1973 (see fig. 2)

Date	Locality	N. Lat.	W. Long.	Area	Modified Mercalli Intensity
		°	°	*sq. mi.*	
1663 Feb. 5	St. Lawrence River region	47.6	70.1	750,000	X
1755 Nov. 18	East of Cape Ann, Mass.	42.5	70.0	300,000	VIII
1811 Dec. 16	Near New Madrid, Mo.	36.6	89.6	2,000,000	XII
1812 Jan. 23	Near New Madrid, Mo.	36.6	89.6	2,000,000	XII
1812 Feb. 7	Near New Madrid, Mo.	36.6	89.6	2,000,000	XII
1812 Dec. 21	Off coast of southern California	34	120	.....	X
1836 June 10	San Francisco Bay	38	122	.....	IX-X
1838 June	San Francisco region	37½	122½	.....	X
1852 Nov. 9	Near Fort Yuma, Ariz.	33	114½	.....	VIII-IX
1857 Jan. 9	Near Fort Tejon, Calif.	35	119	.....	X-XI
1865 Oct. 1	Fort Humboldt and Eureka, Calif.	41	124½	.....	VIII-IX
1865 Oct. 8	Santa Cruz Mountains, Calif.	37	122	.....	VIII-IX
1868 Apr. 2	Near south coast of Hawaii	19	155½	.....	X
1868 Oct. 21	Hayward, Calif.	37½	122	.....	IX-X
1872 Mar. 26	Owens Valley, Calif.	36½	118	125,000	X-XI
1886 Aug. 31	Northwest of Charleston, S.C.	32.9	80.0	2,000,000	IX-X
1892 Feb. 23	Northern Baja California	31½	116½	.....	VIII-IX (U.S.)
1892 Apr. 19	Vacaville, Calif.	38½	122½	.....	IX
1892 Apr. 21	Winters, Calif.	38½	122	.....	IX
1893 Apr. 4	Northwest of Los Angeles, Calif.	34½	118½	.....	VIII-IX
1895 Oct. 31	Charleston, Mo.	37.0	89.4	1,000,000	VIII
1898 Apr. 14	Mendocino County, Calif.	39	124	.....	VIII-IX
1899 Sept. 3	Yaktutat Bay, Alaska	60	142	.....	XI
1899 Sept. 10	.....do.....	60	140	.....	XI
1899 Dec. 25	San Jacinto and Hemet, Calif.	33½	116½	100,000	IX
1906 Apr. 18	Northwest of San Francisco, Calif.	38	123	375,000	XI
1915 Oct. 2	Pleasant Valley, Nev.	40½	117½	500,000	X
1918 Apr. 21	Riverside County, Calif.	33¾	117	150,000	IX
1921 Sept. 29	Elsinore, Utah	38.8	112.2	.....	VIII
1921 Oct. 1	Elsinore, Utah	38.8	112.2	.....	VIII
1922 Mar. 10	Cholame Valley, Calif.	35¾	120¼	100,000	IX
1925 Feb. 28	St. Lawrence River region	47.6	70.1	2,000,000	VIII
1925 June 27	Helena, Mont.	46.0	111.2	310,000	VIII
1925 June 29	Santa Barbara, Calif.	34.3	119.8	.....	VIII-IX
1927 Nov. 4	West of Point Arguello, Calif.	34½	121½	.....	IX-X
1931 Aug. 16	Western Texas	30.6	104.1	450,000	VIII
1932 Dec. 20	Western Nevada	38.7	117.8	500,000	X
1933 Mar. 10	Long Beach, Calif.	33.6	118.0	100,000	IX
1934 Jan. 30	Southeast of Hawthorne, Nev.	38.3	118.4	110,000	VIII-IX
1934 Mar. 12	Near Kosmo, Utah	41.7	112.8	170,000	VIII
1935 Oct. 18	Northeast of Helena, Mont.	46.6	112.0	230,000	VIII
1935 Oct. 31	.....do.....	46.6	112.0	140,000	VIII
1940 May 18	Southeast of El Centro, Calif.	32.7	115.5	60,000	X
1949 Apr. 13	Western Washington	47.1	122.7	150,000	VIII
1952 July 21	Kern County, Calif.	35.0	119.0	160,000	XI
1954 July 6	East of Fallon, Nev.	39.4	118.5	130,000	IX
1954 Aug. 23	.....do.....	39.6	118.5	150,000	IX
1954 Dec. 16	Dixie Valley, Nev.	39.3	118.2	200,000	X
1958 July 9	Southeastern Alaska	58.6	137.1	100,000	XI
1959 Aug. 17	Near Hebgen Lake, Mont.	44.8	111.1	600,000	X
1964 Mar. 27	Southern Alaska	61.0	147.8	700,000	IX-X
1965 Apr. 29	Northwestern Washington	47.4	122.3	130,000	VIII
1971 Feb. 9	San Fernando, Calif.	34.4	118.4	80,000	XI
1973 Apr. 26	Hilo, Hawaii	19.9	155.1	.....	VIII

MAGNITUDE AND INTENSITY RATINGS

Magnitude is a measure of the "size" of an earthquake and is roughly related to the energy release at its focus. Although the magnitude scale has neither "top" nor "bottom" values, the highest ever recorded was magnitude 8.9 and the lowest about —3. On this logarithmic scale, a magnitude 6 shallow-focus earthquake represents elastic-wave energy approximately 30 times greater than that generated by a magnitude 5 earthquake, 900 times greater than that of a magnitude 4 shock, etc. Many factors enter into the determination of earthquake magnitude, including earthquake focal depth, frequency content of the sampled energy, and the earthquake radiation pattern.

Intensity, expressed on the Modified Mercalli Intensity Scale of 1931 (see next section), is a measure of the effects of an earthquake on people and objects, as determined by experienced observers. It is a result of many factors, including magnitude of the earthquake, distance from its epicenter, local geological conditions, and structural properties of buildings. An earthquake in a populated city thus will have different intensities in different parts of the city, depending on these local factors.

MODIFIED MERCALLI INTENSITY SCALE OF 1931

NOAA's National Geophysical and Solar-Terrestrial Data Center and the USGS National Earthquake Information Service report all intensities on the Modified Mercalli Intensity Scale of 1931.[1] The abridged version of this scale is given below. Values in parentheses are equivalent intensities on the Rossi-Forel Scale, which is still used in some countries to evaluate earthquake effects.

ABRIDGED

I. Not felt except by a very few under specially favorable circumstances. (I)

II. Felt only by a few persons at rest, especially on upper floors of buildings. Delicately suspended objects may swing. (I to II)

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)

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)

V. Felt by nearly everyone, many awakened. Some dishes, windows, etc., broken; a few instances of cracked plaster; unstable objects overturned. Disurbances of trees, poles, and other tall objects sometimes noticed. Pendulum clocks may stop. (V to VI)

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)

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–)

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

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+)

[1] Harry O. Wood and Frank Neumann, Modified Mercalli Intensity Scale of 1931, *Bulletin of the Seismological Society of America*, Vol. 21, No. 4, pp. 277–283, December 1931.

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

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.

(page 11 follows)

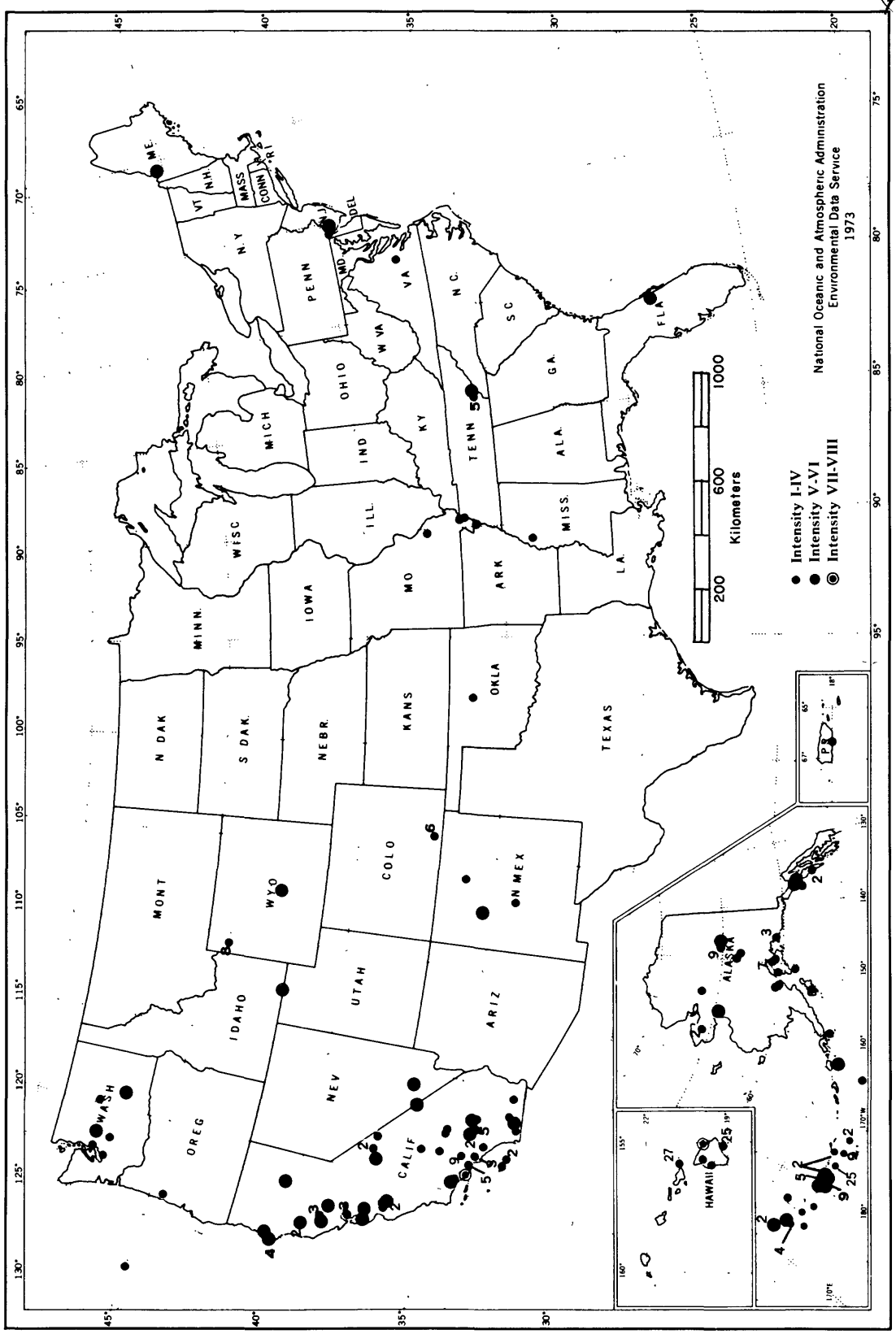

FIGURE 3.—Locations of earthquakes that were felt or caused damage in the United States during 1973.

Earthquake Descriptions

INTRODUCTION

The times of earthquake occurrences in the regions that follow are given in standard time. Times are expressed continuously from midnight to midnight, or 0 to 24 hours. Greenwich mean times are given in parentheses, following standard (local) times, for earthquakes with instrumental epicenters. The following symbols are used to indicate authority for arrival or origin times, epicenters, and/or magnitudes.

ADK—NOAA, Adak Observatory, Adak, Alaska.

B—Seismographic Station, University of California, Berkeley.

BLA—Virginia Polytechnic Institute and State University, Blacksburg.

COL—U.S. Geological Survey, College Observatory, College, Alaska.

ERL—NOAA, Environmental Research Laboratories, Boulder, Colo.

JSA—Department of Earth and Atmospheric Sciences, Saint Louis University.

NED—Delaware Geological Survey, University of Delaware, Newark.

P—Seismological Laboratory, California Institute of Technology, Pasadena.

PMR—NOAA, Palmer Observatory, Palmer, Alaska.

S—University of Washington, Seattle.

SIT—U.S. Geological Survey, Sitka Observatory, Sitka, Alaska.

SNM—New Mexico Institute of Mining and Technology, Socorro.

TDC—U.S. Geological Survey temporary station, Trinidad, Colo.

USGS—U.S. Geological Survey, National Earthquake Information Service, Boulder, Colo.

Magnitude values in the descriptions that follow are either local (M_L), surface wave (M_S), or body wave (m_b). All magnitudes are M_L (local) unless otherwise noted. Magnitude M_L is the original magnitude scale based on the variation of maximum recorded amplitudes as a function of distance. Magnitude M_S is based on the average of surface-wave amplitudes recorded by standard long-period horizontal seismometers. Magnitude m_b is computed from the P (primary) phase only, in the manner defined by Gutenberg and Richter. It is an average value determined from data forwarded by cooperating standard stations and other observatories. Magnitude values are preceded by the abbreviation mag. in the descriptions.

Roman numerals in the earthquake descriptions refer to the Modified Mercalli Intensity Scale of 1931 (see page 7), which gives about equal weight to the disturbance of inanimate objects and to personal reactions. When more than one degree of intensity is reported from a town, the town is assigned the highest intensity reported. Omission of an intensity rating indicates insufficient data. For brevity, intensity is abbreviated int. in the descriptions that follow. Intensity descriptions are generally direct quotes from the questionnaire cards received from each town.

SUMMARY OF EARTHQUAKE ACTIVITY

This is a summary of earthquake intensity data by region. If no intensity is cited, data were insufficient to rate the effects on the Modified Mercalli Intensity Scale. Numbers in parentheses indicate the number of earthquakes occurring on that date.

NORTHEASTERN REGION

Connecticut: Felt New Jersey earthquake of Feb. 28, V. Felt Maine earthquake of June 14, IV.

Maine: June 14, VI.

Massachusetts: Feb. 3, V. Felt Maine earthquake of June 14, V.

New Hampshire: Felt Maine earthquake of

June 14, V.

New York: Felt Maine earthquake of June 14, V.

Rhode Island: Feb. 3, V. Felt Maine earthquake of June 14, IV.

Vermont: Felt Maine earthquake of June 14, VI.

Eastern Region

Delaware: Felt New Jersey earthquake of Feb. 28, V. July 9, IV.

Florida: Oct. 27, V.

Georgia: Felt Tennessee earthquake of Nov. 30, V.

Kentucky (eastern): Felt Tennessee earthquakes of Oct. 30, V and Nov. 30, V.

Maryland: Felt New Jersey earthquake of Feb. 28, V.

New Jersey: Feb. 28, V. July 9, IV.

North Carolina: Felt Tennessee earthquakes of Oct. 30, II and Nov. 30, V.

Pennsylvania: Felt New Jersey earthquake of Feb. 28, V.

South Carolina: Felt Tennessee earthquake of Nov. 30, V. Dec. 19.

Tennessee (eastern): Oct. 30, V; 30. Nov. 30, VI; 30, II. Dec. 13; 14; 21 (2).

Virginia: Felt New Jersey earthquakes of Feb. 28, IV and Nov. 30, IV. Apr. 9, IV.

West Virginia: Felt Tennessee earthquake of Nov. 30, IV.

Central Region

Arkansas: Oct. 2, IV.

Kentucky (western): Felt Missouri earthquake of Oct. 9.

Mississippi: May 25.

Missouri: Jan. 12, IV. Felt Arkansas earthquake of Oct. 2, IV. Oct. 9, IV. Dec. 20.

Oklahoma: Jan. 10.

Tennessee (western): Felt Arkansas earthquake of Oct. 2, IV. Felt Missouri earthquake of Oct. 9.

Western Mountain Region

Colorado (western): Sept. 19, 22 (4); 23.

Idaho: Apr. 13, V.

Nevada (eastern): Feb. 9, V; 15, III (2); 19, IV. Dec. 25.

New Mexico: Mar. 17. Sept. 10; 22. Dec. 23, VI.

Utah: Felt Idaho earthquake of Apr. 13.

Wyoming: Mar. 27; 29; 30 (2); 31. Apr. 21 (2); 21, V. Aug. 20.

California and Western Nevada

[INTENSITY V AND ABOVE]

Jan. 15, V. Feb. 21, VII; 27, V. Mar. 12, V; 28, V. Apr. 11, V. May 13, V. June 21, V. July 14, V; 24, V. Aug. 6, V; 8, VI. Sept. 13, V; 14, V; 16, V; 18, V. Oct. 3, V. Nov. 11, V; 12, V; 24, V; 28, V. Dec. 21, V.

Washington and Oregon

Jan. 31, III. Feb. 21, IV. Mar. 17, IV; 18. June 9, V; 16, IV. July 18, IV. Nov. 3. Dec. 19, V.

Alaska

[INTENSITY V AND ABOVE]

Andreanof Islands: Jan. 12, V. May 26, V. June 22, V. Dec. 14, V.

Central Alaska: Apr. 10, V. May 31, V.

Fox Islands: May 28, V.

Near Islands: Mar. 19, V; 27, V. July 11, V.

Southeastern Alaska: July 1, V; 3, V.

Hawaii

Jan. 2; 13; 14 (2); 22 (2). Feb. 9; 12; 23. Mar. 6; 7; 13. Apr. 15; 22; 24; 26, VIII; 26; 27. May 5 (2); 7; 19; 29; 30. June 10; 20; 21; 24; 29. July 1 (2); 4; 14; 20; 27. Aug. 11. Sept. 3; 14; 15; 19 (2). Oct. 1; 2 (2); 9 (2); 13; 18; 26. Nov. 3; 10; 28 (2). Dec. 13; 14.

Puerto Rico

Dec. 4.

NORTHEASTERN REGION

[The time in this region is given in eastern standard. If an epicenter is quoted, Greenwich mean time is given in parentheses. This region includes earthquake descriptions for Connecticut, Maine, Massachusetts, New Hampshire, New York, Rhode Island, and Vermont.]

Feb. 3. Between 12:15 and 13:00. Rhode Island and eastern Massachusetts. Int. V. The press reported that a disturbance, possibly an earthquake, shook houses and rattled windows at Block Island, Bristol, East Providence, Jamestown, Narrangansett, Newport, South Kingstown, Westerly, and West Warwick, R.I., and at Acushnet, Bridgewater, Cape Cod, Dartmouth, Marion, Middleboro, New Bed-

ford (2 shocks), and Wareham, Mass. A crack opened in the living room ceiling at one Dartmouth, Mass., home (in Seabury Heights). At Marion, two shocks about 10 to 20 minutes apart shook houses and rattled windows; a wreath was knocked off a door. A Bristol, R.I., observer said, "The whole house shook and we ran to the street." Noises like an explosion or sonic boom were heard in many areas. Police stations were inundated with telephone calls, according to press accounts. The disturbance was not reported by seismograph stations in the area.

June 14. 20:09:04.2 (June 15, 01:09). Epicenter 45.32° N., 70.91° W., western Maine, at a depth of 12 km, mag. 5.2 (m_b), USGS. Felt over about 250,000 km^2 (96,000 mi^2) of all or parts of Maine, New Hampshire, Vermont, New York, Massachusetts, Connecticut, Rhode Island, and eastern Canada (Quebec Province) (fig. 4). Int. VI. Chimneys (one was downed) and grocery stock sustained minor damage at Woburn, Quebec. Chimneys moved away from walls at Canaan, Vt. Road surface cracks were reported in the Montpelier, Vt., area. Light damage (int. V), generally in the form of cracked plaster and windows and broken dishes, occurred at Freedom and Sebec

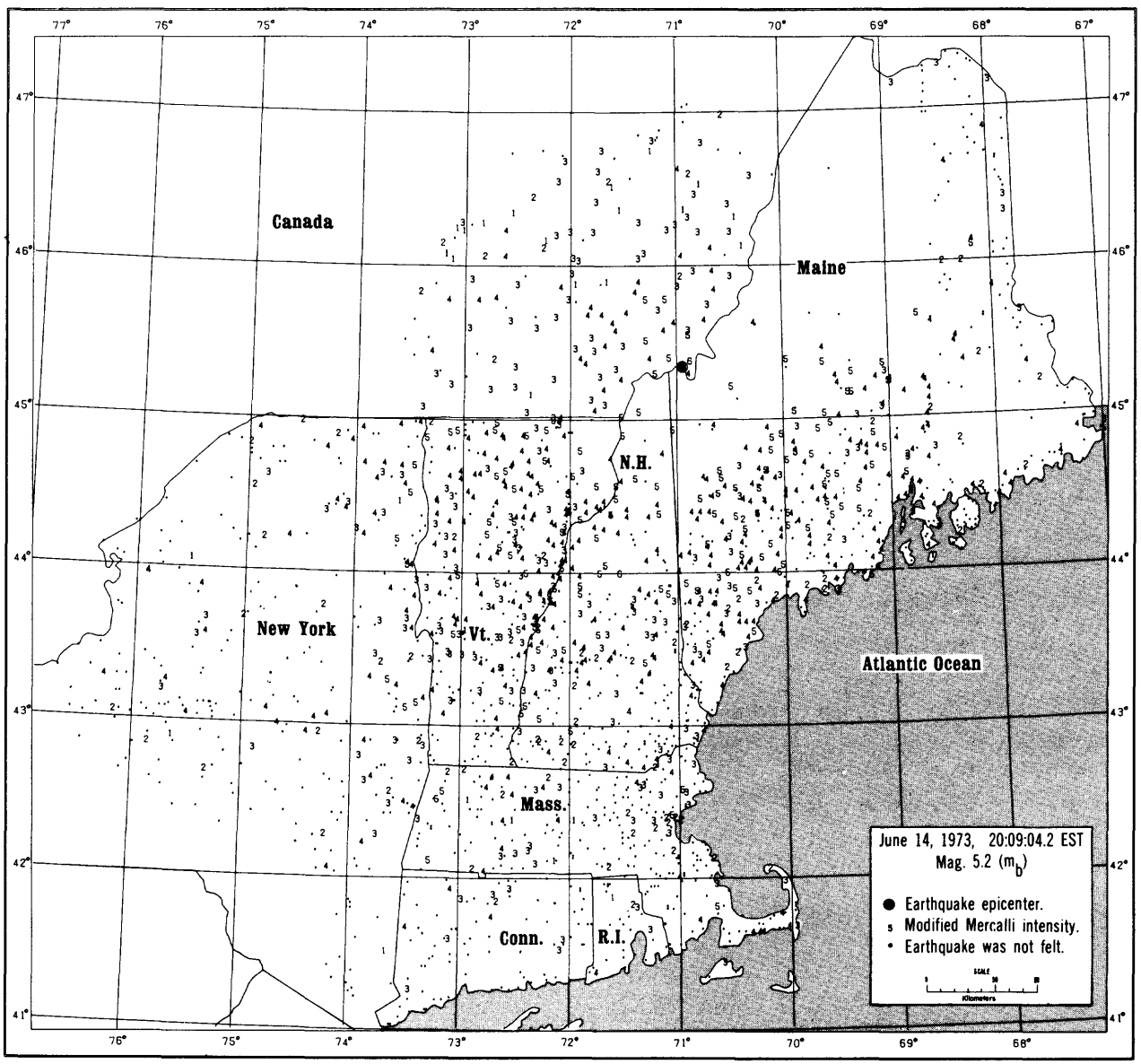

FIGURE 4.—Area affected by western Maine earthquake of June 14.

Lake, Maine; Malden and Mill River, Mass.; East Madison, Madison, Percy, and Rye, N.H.; and Elizabethtown, N.Y. The NEIS questionnaire canvass was supplemented with felt data from Reverend D. Linehan, S.J., Weston Observatory, Weston, Mass., and R. Wetmiller, Department of Energy, Mines and Resources, Ottawa, Ontario, Canada.

INTENSITY VI IN CANADA

Woburn.—"The town of Woburn, Quebec, appears to have experienced the maximum intensity (VI) and we have confirmed instances of minor damage only from the Woburn area. The town appears to be generally on solid ground. . . . In Woburn everyone was frightened, many small objects were overturned (falling consistently to the north), and the stock of the two general stores was thrown on the floor with much breakage. There are several reports of fallen plaster and two and possibly more confirmed reports of damaged chimneys. One chimney was brought down completely; the others appear to have lost only a few bricks. . . ." (Letter from R. Wetmiller, Department of Energy, Mines and Resources, Ottawa, Canada, to J. F. Lander, NOAA/EDS, Boulder, Colo., dated Aug. 29, 1973)

INTENSITY VI IN VERMONT

Canaan.—Felt by all in community; frightened many. Moderate, rumbling earth noises. Trees and bushes shook. Chimneys moved away from wall. Plaster cracked. Furniture shifted. Damage slight.

Montpelier area.—Felt by and frightened many; awakened few. Trees and bushes shook. Small objects fell. The press reported some road surface cracks near Montpelier. A Burlington resident noted that police also reported road surface cracks in the Montpelier area.

INTENSITY V IN CANADA

Chartierville, Notre Dame des Bois (about 4.8 km west of Woburn), Saint Romain, Scotstown, Stratford Centre, and Valracine.

INTENSITY V IN MAINE

Athens, Augusta, Bingham, Brownfield, Brownville Junction, Bryant Pond, Buckfield, Caratunk, Carmel, Casco, Clinton, Dixfield, Dixmont, East New Portland, East Vassalboro, Etna, Eustis, Freedom (few dishes broke), Frye, Gray, Greene, Greenville, Harmony, Hiram, Lewiston, Liberty, Lisbon, Lisbon Falls, Livermore, Madison, Mechanic Falls, Millinocket (damage slight), New Portland, Newry, New Vineyard, North Jay, Oakfield, Palermo, Raymond, Readfield, Roxbury, Rumford Center, Sangerville, Sebec Lake (plaster cracked), Shawmut, Shirley Mills, Skowhegan, South Portland, Starks, Stetson, Tenants Harbor, Troy, Waterboro, Waterford, Waterville, Weeks Mills, Wellington, West Bowdoin, West Farmington, West Forks, West Sumner, Wilsons Mills, Winterport, and Winthrop.

INTENSITY V IN MASSACHUSETTS

Berkshire, Cheshire, Danvers, Malden (two cracks in bathroom tile—press), Mill River (chimneys damaged and windows cracked), and Onset.

INTENSITY V IN NEW HAMPSHIRE

Alton, Bristol, Colebrook, Cornish Flat, Drewsville, East Madison (plaster cracked), Franconia, Gilmanton Iron Works, Gilsum, Gorham, Hancock, Haverhill, Lancaster, Lincoln, Lyme, Madison (plaster cracked), Milan, Orford, Percy (roofing paper split), Pittsburg, Rye ("a couple of water mains cracked"—reported by East Barrington resident), Walpole, Warren, Wentworth, West Lebanon, West Springfield, West Stewartstown, and Whitefield.

INTENSITY V IN NEW YORK

East Greenwich, Elizabethtown (slight window cracks), Greenwich, Keeseville, Moriah, Plattsburgh, and South Glens Falls.

INTENSITY V IN VERMONT

Adamant, Averill, Beebe Plain, Beecher Falls, East Berkshire, Grafton, Granby, Greensboro Bend, Guildhall, Highgate Center, Island Pond, Isle La Motte, Johnson, Lake Elmore, Lower Waterford, Lyndon, McIndoe Falls, Moretown, Newport, Northfield Falls, North Hyde Park, North Thetford, North Troy, Proctorsville, Randolph, Richford, Richmond, Ripton, Swanton, Taftsville, Troy, Waterbury Center, West Burke, West Glover, West Rutland, White River Junction, and Williamstown.

INTENSITY IV IN CANADA

Arnold Bog, Audet, Bernieres (Levis), Bishopton, Bolduc, Chambly, Disraëli, Dixville, East Angus, Garthby Station, Kingsey Falls, La Patrie, Lennoxville, Milan, Nicolet, Saint Adelphe de Dudswell, Saint Anselme, Saint Camille, Saint Denis de Brompton, Sainte Edwidge, Saint Ephrem, Saint Eugene de Grantham, Saint Gedeon de Beauce, Saint Georges, Saint Georges de Windsor, Saint Hugues, Saint Isidore d'Auckland, Saint Zephirin, Sherbrooke, Springhill (Nantes), Stanstead, Weedon, and Wotton.

INTENSITY IV IN CONNECTICUT

Hartford, New Hartford, South Kent, and Winsted.

INTENSITY IV IN MAINE

Albion, Alfred, Alna, Andover, Anson, Auburn, Bangor, Bar Mills, Belgrade, Belgrade Lakes, Bethel, Blue Hill, Bridgton, Brooklyn, Brunswick, Bucksport, Cambridge, Canton, Caribou, Castine, Charleston, Cherryfield, China, Cornish, Costigan, Damariscotta Mills, Danville, Denmark, Dennysville, Derby, Douglas Hill, Dover Foxcroft, Dryden, East Andover, East Baldwin, East Dixfield, East Holden, East Lebanon, East Livermore, East Machias, East Newport, East Peru, East Poland, East Stoneham, East Wilton, Enfield, Farmington, Farmington Falls, Frankfort, Fryeburg, Gardiner, Glen Cove, Gorham, Greenville Junction, Guilford, Hancock, Harrison, Haynesville, Hebron, Hinckley, Hollis Center, Hope, Howland, Jackman, Kezar Falls, Kingfield, La Grange, Lee, Levant, Limington, Lincolnville, Lisbon Center, Livermore Falls, Locke Mills, Lovell, Manchester, Mattawamkeag, Medway, Mexico, Milbridge, Milo, Minot, Monmouth, Monroe, Monson, Moody, Mount Vernon, New Harbor, Newport, Norridgewock, North Anson, North Fryeburg, North Monmouth, North Sebago, North Vassalboro, Norway, Oakland, Olamon, Old Town, Orland, Orrs Island, Palmyra, Passadumkeag, Penobscot, Phillips, Phippsburg, Plymouth, Poland, Poland Spring, Portland, Pownal, Rangeley, Readfield Depot, Rumford Point, Sabattus, Sanford, Scarborough, Searsport, Sebec, Sheridan, Smyrna Mills, South Freeport, South Gardiner, South Hiram, South Waterford, South Windham, Spruce Head, Steep Falls, Stillwater, Stockton Springs, Stonington, Strong, Temple, Thomaston, Thorndike, Turner, Unity, Vassalboro, Vienna, Waite, Walpole, West Bethel, Westbrook, West Buxton, West Enfield, West Paris, West Poland, West Rockport, West Sullivan, Wilton, Windsor, and Winn.

INTENSITY IV IN MASSACHUSETTS

Athol, Bernardston, Brewster, Centerville, Colrain, Forestdale, Hatfield, Holyoke, Hyannis, Lake Pleasant, North Chelmsford, Rochester, Shelburne Falls, South Barre, Southwick, West Boxford, West Bridgewater, West Falmouth, and West Yarmouth.

INTENSITY IV IN NEW HAMPSHIRE

Acworth, Alton Bay, Bartlett, Bath, Berlin, Bethlehem, Center Barnstead, Center Conway, Danbury, Dover, East Barrington, East Hebron, Enfield, Errol, Etna, Franklin, Georges Mills, Glencliff, Grafton, Groveton, Hanover, Hooksett, Jackson, Jefferson, Lisbon, Littleton, Lyme Center, Meadows, Melvin Village, Meredith, Meriden, Milford, Monroe, Nashua, New Durham, Newport, North Conway, North Haverhill, North Stratford, North Sutton, Pelham, Piermont, Pike, Pittsfield, Plainfield, Plymouth, Potter Place, Randolph, Salem, Sanbornton, Sandwich, Tamworth, Tilton, Troy, Twin Mountain, Warner, West Ossipee, Wilmot Flat, Wolfeboro Falls, Wonalancet, and Woodsville.

INTENSITY IV IN NEW YORK

Albany, Ballston Lake, Bloomingdale, Brainardsville, Broadalbin, Catskill, Childwold, Churubusco, Clemons, Croghan, Dannemora, Delmar, Dolgeville, East Nassau, Fonda, Fort Edward, Glens Falls, Gloversville, Hague, Keene Valley, Lake Hill, Lake Luzerne, Lyon Mountain, Massena, McConnellsville, Mooers, Moriah Center, Morrisonville, New Lebanon Center, Paradox, Pennellville, Peru, Port Henry, Port Leyden, Rainbow Lake, Redford, Rouses Point, Saint Johnsville, Salem, Stockport, Ticonderoga, Vernon Center, Watertown, Whippleville, and Wilmington.

INTENSITY IV IN RHODE ISLAND

Charlestown.

INTENSITY IV IN VERMONT

Albany, Arlington, Bakersfield, Barton, Belmont, Belvidere Center, Bolton, Bradford, Bristol, Brownsville, Burlington; Cabot, Calais, Cambridge, Cavendish, Chester Depot, Chittenden, Concord, Corinth, Craftsbury Common, Danville, Derby Line, East Calais, East Charleston, East Concord, East Middlebury, East Ryegate, Eden, Eden Mills, Ely, Enosburg Falls, Fairfax, Fair Haven, Florence, Gaysville, Gilman, Greensboro, Groton, Hancock, Hardwick, Hinesburg, Huntington, Hyde Park, Jeffersonville, Lowell, Ludlow, Lunenburg, Lyndon Center, Marshfield, Milton, Montgomery, Montgomery Center, Morristown, Morrisville, Newbury, Newfane, North Concord, Northfield, North Hartland, Norwich, Orleans, Passumpsic, Peacham, Pittsford, Post Mills, Proctor, Quechee, Randolph Center, Rochester, Roxbury, Saint Albans Bay, Saint Johnsbury, Sharon, Shelburne, Sheldon, South Barre, South Newbury, South Royalton, South Ryegate, Stowe, Strafford, Thetford, Townshend, Underhill, Underhill Center, Vergennes, Warren, Washington, West Barnet, West Charleston, West

Fairlee, Westfield, Westford, West Rupert, Whiting, Windsor, Winooski, Wolcott, and Woodbury.

INTENSITY I-III IN CANADA

Acton Vale, Arthabaska, Ascot Corner, Aston Jonction, Beauceville (Quest), Beebe, Berthierville, Black Lake, Bromptonville, Brossard (Montreal), Bury, Champlain, Coaticook, Courcelles, Cowansville, Danville, Daveluyville, Deschaillons, Deschambault, Drummondville, East Broughton, Granby, Ham Nord, Knowlton, Lac Etchemin, Lac Megantic, Lacolle, L'Assumption, Laurier (Saint Flavien), Leeds Village, Limoilou (Quebec City), Longueuil, Lyster, Magog, Manseau, Mansonville, Martinville, Maskinongé, Montmagny, Pierreville, Plessisville, Pont Rouge, Quebec, Richmond, Rock Island, Saint Alexander d'Iberville, Saint Croix, Saint Cuthbert (Co. Berthier), Sainte Aime, Sainte Claire, Saint Edouard, Sainte Eulalie, Sainte Rose de Watford, Sainte Ursule, Saint Evariste de Forsyth, Saint Flavien, Saint Hermenegilde, Saint Honore, Saint Hyacinthe, Saint Johns, Saint Joseph de Beauce, Saint Justin, Saint Ludger, Saint Magloire, Saint Malachie, Saint Marc Sur Richelieu, Saint Prosper, Saint Raphaël, Saint Romuald (Levis), Saint Theophile, Saint Zacharie, Sawyerville, Sorel, South Bolton, Stoke Center, Stornoway, Thetford Mines, Tingwick, Tring Jonction, Trois-Rivieres, Val Alain, Valcourt, Valee Jonction, Victoriaville, Warwick, Waterloo, Windsor (near Sherbrooke), and Yamachiche.

INTENSITY I-III IN CONNECTICUT

Georgetown, Melrose, Norwich, Oakville, Pine Meadow, Poquonock, Versailles, and Windsor.

INTENSITY I-III IN MAINE

Aurora, Bernard, Berwick, Biddeford, Boothbay, Bremen, Bradford, Bridgewater, Brownville, Cardville, Columbia Falls, Cumberland Center, Detroit, Dexter, East Eddington, Eastport, East Sumner, Edgecomb, Emery Mills, Exeter, Forest City, Franklin, Freeport, Hampden, Island Falls, Jefferson, Kennebunk, Maplewood, Monticello, Naples, New Gloucester, New Sharon, North Bridgton, North Brooklin, North Whitefield, North Windham, Old Orchard Beach, Orrington, Oxford, Patten, Pemaquid Harbor, Peru, Pittsfield, Princeton, Saint Francis, Sandy Point, Searsmont, Sebago Lake, Solon, South Casco, South Paris, Springfield, Springvale, Standish, Upper Frenchville, Van Buren, Weld, West Baldwin, West Newfield, and Woolwich.

INTENSITY I-III IN MASSACHUSETTS

Allston (press), Amherst, Baldwinville, Beverly, Bondsville, Brant Rock, Brookline (press), Cambridge (press) Chatham, Chelmsford, Chelsea (press), Chicopee, Deerfield, Dracut, Framingham (press), Granville, Haverhill, Humarock, Ludlow, Maynard, Methuen (press), Monroe Bridge, Monson, Newton (press), North Adams, Orange, Orleans, Plainfield, Plymouth, Provincetown, Randolph (press), Richmond, Rowley, Royalston, Rutland, Somerville (press), Sterling Junction, Sudbury, Swampscott, Three Rivers, Truro, Uxbridge, Vineyard Haven, Waltham (press), Westover Air Force Base, Wilmington, and Winthrop.

INTENSITY I-III IN NEW HAMPSHIRE

Antrim, Atkinson, Bradford, Brookline, Center Tuftonboro, Charlestown, Claremont, Concord, Dorchester, Dublin, East Andover, Exeter, Freedom, Gilmanton, Goffstown, Goshen, Grantham, Guild, Hampton, Hill, Jaffrey, Keene, Lebanon (press), Mirror Lake, Moultonboro, Newbury, New Hampton, North Sandwich, Ossipee, Peterborough, Rindge, Rumney, Rye Beach, Sanbornville, South Danbury, Swanzey (press), Westmoreland, and Wolfeboro.

INTENSITY I-III IN NEW YORK

Brantingham, Brant Lake, Burke, Clintonville, Colton, Comstock, Constableville, Cranberry Lake, Crown Point, East Schodack, Fort Covington, Grafton, Greig, Hensonville, Holmes, Hoosick, Hoosick Falls, Huletts Landing, Indian Lake, Jay, Lake George (press), Lake Placid, Malden Bridge, Maplecrest, Middle Granville, Morrisville, Natural Bridge, New Woodstock, North Chatham, Parishville, Raymondville, Saranac, Schaghticoke, Schenectady, Schuyler Falls, Silver Bay, Slingerlands, South Edmeston, Springfield Center, Stottville, Thendara, Tribes Hill, Upper Saint Regis, Syracuse, Utica (press), Vermontville, Verona Beach, Warrensburg, and Watertown.

INTENSITY I-III IN RHODE ISLAND

Bristol, East Providence, Harmony, and Providence.

INTENSITY I-III IN VERMONT

Alburg, Barnet, Barre, Bartonsville, Bethel, Bomoseen, Bridgewater, Bridgewater Corners, Castleton, Center Rutland, Charlotte, Chelsea, Col-

chester, East Corinth, East Haven, East Montpelier, East Saint Johnsbury, East Thetford, East Wallingford, Essex Junction, Fairlee, Granville, Hartland Four Corners, Holland, Irasburg, Londonderry, Manchester, Mendon (press), Middletown, Monkton, New Haven, Newport Center, Shaftsbury, Shoreham, South Strafford, South Woodstock, Starksboro, Stockbridge, Tinmouth, Topsham, Vernon, Waits River, Wallingford, Waterville, Websterville, Wells River, West Danville, West Dover, West Hartford, Wilder, Williston, Woodstock, and Worchester.

Dec. 6. Between 15:40 and 16:00. Eastern Connecticut. State police reported to the press that residents in Andover, Bolton, Columbia, Coventry, Hebron, Manchester, and Vernon noted houses shaking and ground trembling. The event was not recorded by seismograph stations in the area. Probably a sonic boom.

EASTERN REGION

[The time in this region is given in eastern standard. If an epicenter is quoted, Greenwich mean time is given in parentheses. This region includes earthquake descriptions for Alabama, Delaware, Florida, Georgia, Kentucky (eastern), Maryland, Mississippi (southeastern), New Jersey, North Carolina, Pennsylvania, South Carolina, Tennessee (eastern), Virginia, Washington, D.C., and West Virginia.]

Feb. 28. 03:21:32.3 (08:21). Epicenter 39.72° N., 75.44° W., New Jersey, at a depth of 14 km, mag. 3.8, ERL. Felt over approximately 40,000 km^2 (15,440 mi^2), including southern Connecticut (one town), northern Delaware, northern Maryland, New Jersey, eastern Pennsylvania, and eastern Virginia (one town) (fig. 5). Int. V. Observers reported cracked plaster at North East and Perryville, Md., and Laurel Springs and Penns Grove, N.J. At Harrisonville, N.J., cinder block basements reportedly cracked. An observer at Palmyra, N.J., reported damage (not described) and that a driveway "dropped 3 inches." At New London, Pa., patio, walls, and plaster cracked. "Slight cracks where concrete meets house," loosened rain spouts, and cracked plaster were observed by Norristown, Pa., residents. At Thornton, Pa., pipe connections to a well broke. Two mirrors fell from a wall and shattered at Wallingford, Pa. Small objects shifted and fell in several towns in Delaware, New Jersey, and Pennsylvania.

INTENSITY V IN DELAWARE

Claymont, Delaware City, Hockessin, Middletown, Montchanin, Newark, New Castle, Rockland, Saint Georges, and Yorklyn.

INTENSITY V IN MARYLAND

Centreville, Chesapeake City, Elkton, North East (plaster cracked and fell), and Perryville (cracked plaster).

INTENSITY V IN NEW JERSEY

Audubon, Barrington, Bellmawr, Berlin, Beverly, Blackwood, Camden, Cedar Knolls, Cherry Hill, Clarksboro, Collingswood, Deepwater, Deerfield Street, Ewan, Florence, Franklinville, Gibbstown, Glassboro, Gloucester City, Grenloch, Haddon Heights, Hancocks Bridge, Harrisonville (cinder block basements cracked), Juliustown, Kirkwood, Laurel Springs (hairline plaster cracks), Lawnside, Magnolia, Mantua, Medford Lakes, Mickleton, Mount Ephraim, Mount Royal, Mullica Hill, New Egypt, Oxford, Palmyra ("driveway dropped 3 in."), Paulsboro, Pedricktown, Pemberton, Penns Grove (damaged plaster), Pennsville, Quinton, Richwood, Riverton, Runnemede, Salem, Spotswood, Stratford, Swedesboro, Thorofare, Wenonah, West Berlin, Woodbury, and Woodbury Heights.

INTENSITY V IN PENNSYLVANIA

Abington, Ardmore, Avondale, Bala-Cynwyd, Berwyn, Birchrunville, Boothwyn, Brandamore, Bristol, Broomall, Bryn Athyn, Bryn Mawr, Chadds Ford, Chatham, Cheltenham, Chester, Chester Heights, Cheyney, Clifton Heights, Coatesville, Cochranville, Concordville, Conshohocken, Crum Lynne, Darby, Downingtown, Doylestown, Drexel Hill, Exton, Flourtown, Folcroft, Folsom, Fort Washington, Gap, Gladwyne, Glenmoore, Glenolden, Green Lane, Holmes, Immaculata, Jenkintown, Kelton, Kemblesville, Kennett Square, Langhorne, Lansdowne, Lewisville, Lionville, Malvern, Media, Mendenhall, Merion Station, Miquon, Modena, Mont Clare, Narberth, New Britain, New London (plaster cracked), Niantic, Norristown (slight crack in house; rain spouts shook loose; plaster cracked), Norwood, Oxford, Penns Park, Plymouth Meeting, Pocopson, Port Kennedy, Prospect Park, Ridley Park, Rushland, Sadsburyville, Southampton, Springfield, Spring Mount, Thornton (pipes connected to well broke), Unionville, Upper Darby, Valley Forge, Wagontown, Wallingford (two mirrors fell from wall and shattered), War-

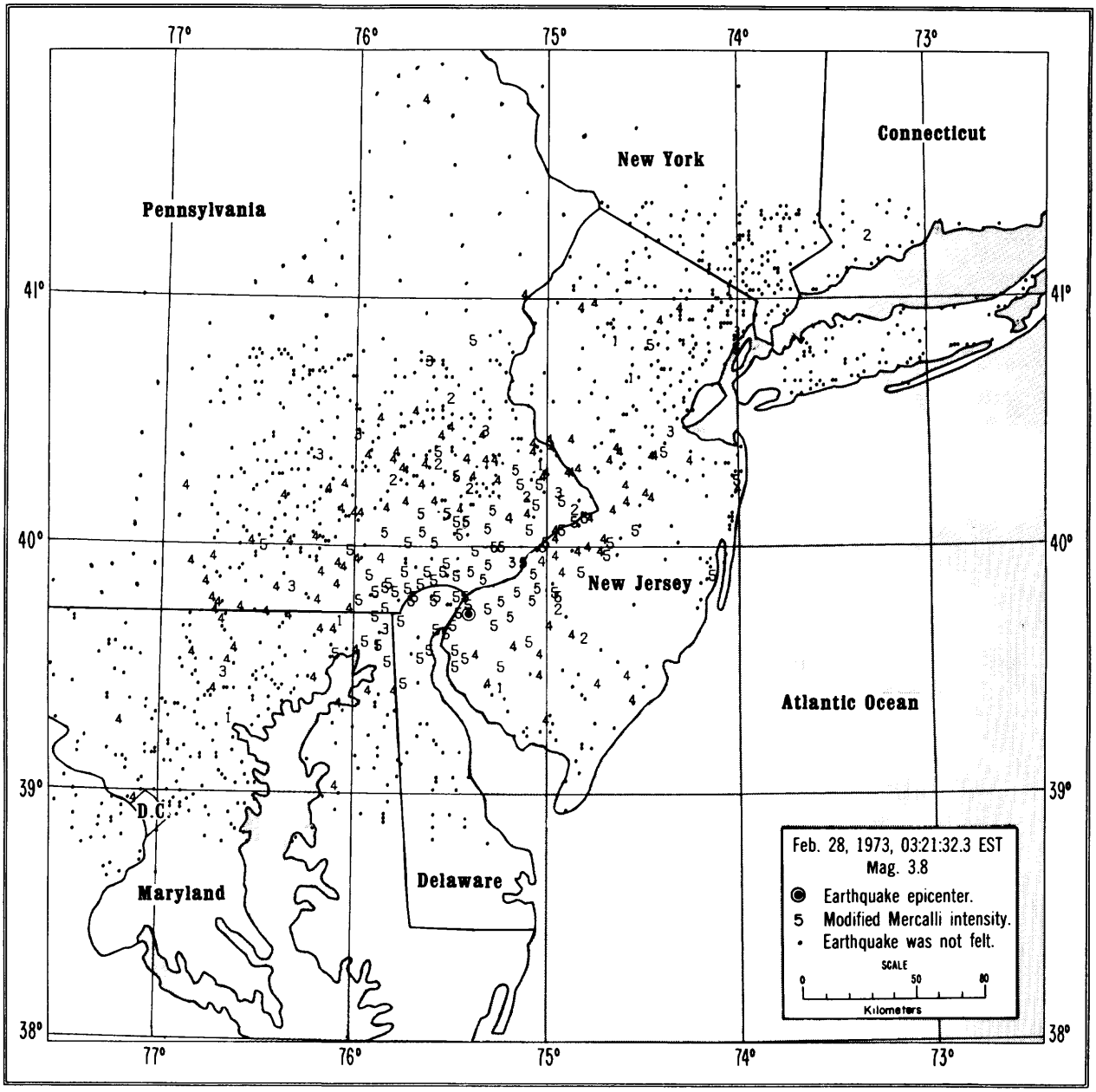

FIGURE 5.—Area affected by New Jersey earthquake of February 28.

rington, Washington Boro, West Grove, Woodlyn, Wyncote, and Yeadon.

INTENSITY I-IV IN MARYLAND

Baltimore (press), Betterton, Cardiff, Charlestown, Cockeysville, Colora, Conowingo, Damascus, Earleville, Elk Mills, Elkton (press), Freeland, Glen Echo, Kennedyville, Monkton, Perryman, Rising Sun, Sparks, Stevenson, Upperco, and Warwick.

INTENSITY I-IV IN NEW JERSEY

Allentown, Alloway, Andover, Asbury Park, Birmingham, Boonton, Bridgeton, Clarksburg, Clayton, Crosswicks, Elmer, Greendell, Haddonfield, Hainesport, Hammonton, Helmetta, Ironia, Jamesburg, Jobstown, Kingston, Lambertville, Lumberton, Lyons, Malaga, Maple Shade, Marlton, Mays Landing, Monroeville, Moorestown, Mount Holly, Palisades Park, Park Ridge, Pitman, Pleasantville, Pomona, Pompton Plains, Princeton.

Ringoes, Riverside, Rocky Hill, Roebling, Roosevelt, Rosemont, Sayreville, Shiloh, Stockton, Titusville, Vineland, Washington, Wickatunk, Williamstown, Windsor, and Winslow.

INTENSITY I-IV IN PENNSYLVANIA

Adamstown, Airville, Allentown, Arcola, Bart, Bausman, Berwick, Birdsboro, Boyertown, Carversville, Chalfont, Christiana, Churchtown, Colmar, Cornwells Heights, Darling, Dauberville, Denver, Elverson, Essington, Fawn Grove, Fountainville, Gibson, Glen Rock, Goodville, Harleysville, Haverford, Hereford, Holicong, Holtwood, Honey Brook, Kirkwood, Lafayette Hill, Levittown, Limekiln, Maxatawny, Milford Square, New Cumberland, New Freedom, Newtown, Ninepoints, Nottingham, Oley, Oreland, Paradise, Parker Ford, Peach Bottom, Penryn, Philadelphia, Pineville, Point Pleasant, Pomeroy, Pottstown, Quakertown, Quarryville, Railroad, Reading, Richlandtown, Saint Peters, Sassamansville, Sellersville, Seven Valleys, Shawnee on Delaware, Silverdale, Skippack, Slatington, Smoketown, Stewartstown, Sumneytown, Terre Hill, Thomasville, Tylersport, Virginville, Warminster, Washington Crossing, Willow Grove, Womelsdorf, Woxall, Wrightsville, Wycombe, Wynnewood, Yardley, Yellow House, York, and Zionsville.

INTENSITY IV IN VIRGINIA

Withams.

INTENSITY II IN CONNECTICUT

Easton.

Apr. 9. 18:11:02.7, BLA. Richmond, Va., area. This light tremor shook houses and rattled windows in 11 counties of central Virginia. Int. IV at Amelia, Bon Air, Charles City, Chesterfield, Dinwiddie, Disputanta, Ford, Hopewell, Mannboro, Manquin, Matoaca, Midlothian, Moseley, Petersburg, Prince George, Richmond, Ruther Glen, South Richmond, Stony Creek, Sutherland, and Winterpark; int. I-III at Ashland, Bon Air (4 km southeast of), Carson, Chester, McKenney, North Richmond, Sandston, Stony Creek (4 km east of), West Point, and West Richmond. The questionnaire canvass was conducted by G. A. Bollinger, Virginia Polytechnic Institute and State University, Blacksburg, Va.

July 9. 23:38:02, NED. Northern Delaware–western New Jersey area. The press reported a light earthquake was felt by residents in the Penns Grove, N.J.–Wilmington, Del., area. Int. IV. Several telephone calls were received by police officials in Penns Grove and Carneys Point, N.J. Windows rattled at Carneys Point. City police at Wilmington, Del., received telephone calls also.

Oct. 27. 01:21:07.5 (06:21). Macroseismic location 28.7° N., 81.0° W., Florida Peninsula, USGS. Felt over a small area of central Florida, from Hollister in the north to Lake Placid in the south, and from Cape Canaveral in the east to Tampa (fig. 6). Int. V. The earthquake generally awakened residents, shook houses, and displaced small objects, but little damage occurred. Windows cracked at Cocoa Beach, Dundee (about 40 km southwest of Orlando), and Osteen, and sheetrock cracked at Winter Springs (Orlando area). A Merritt Island resident reported: "Stepladder in carport overturned. New cracks above the front door and below window sills on the outside. I noted fresh paint and concrete chips on the ground below cracks. More minor cracks were noted in interior plaster." An interesting phenomenon was reported in a letter to Reverend L. J. Eisele, S.J., Spring Hill College, Mobile, Ala., from a Melbourne resident. Following is a partial quote: "We were awake at the time [of the earthquake] and looking out the window. The noise was like a cannon going off nearby, and the whole outdoors flashed in bright orange like the color of the sunset. The houses were so bright orange that it hurt our eyes to look at them. The bright color stayed a few seconds. The bed shook where we were sitting and the windows (panes) rattled as if they might break, and of course the house shook. . . ." Reverend Eisele also noted: "While in Tampa I learned that many people along the coast (East) of Florida saw a light such as described in the enclosed letter, *then* heard the explosive sound and felt the shaking. . . ."

INTENSITY V

Cape Canaveral, Chuluota, Cocoa Beach (windows broke), Debary, Deland, Dundee (windows cracked), Eagle Lake, Eau Gallie, Grant, Lakeland, Merritt Island (cracks above door and window sills outside; minor cracks in interior plaster), Mims, Osteen (windows cracked), Rockledge, Scottsmoor, Tampa (press), Titusville, Windermere, and Winter Springs (small cracks in sheetrock joints).

INTENSITY IV

Altamonte Springs, Auburndale, Avon Park, Babson Park, Cassadaga, Christmas, Cocoa, Eaton

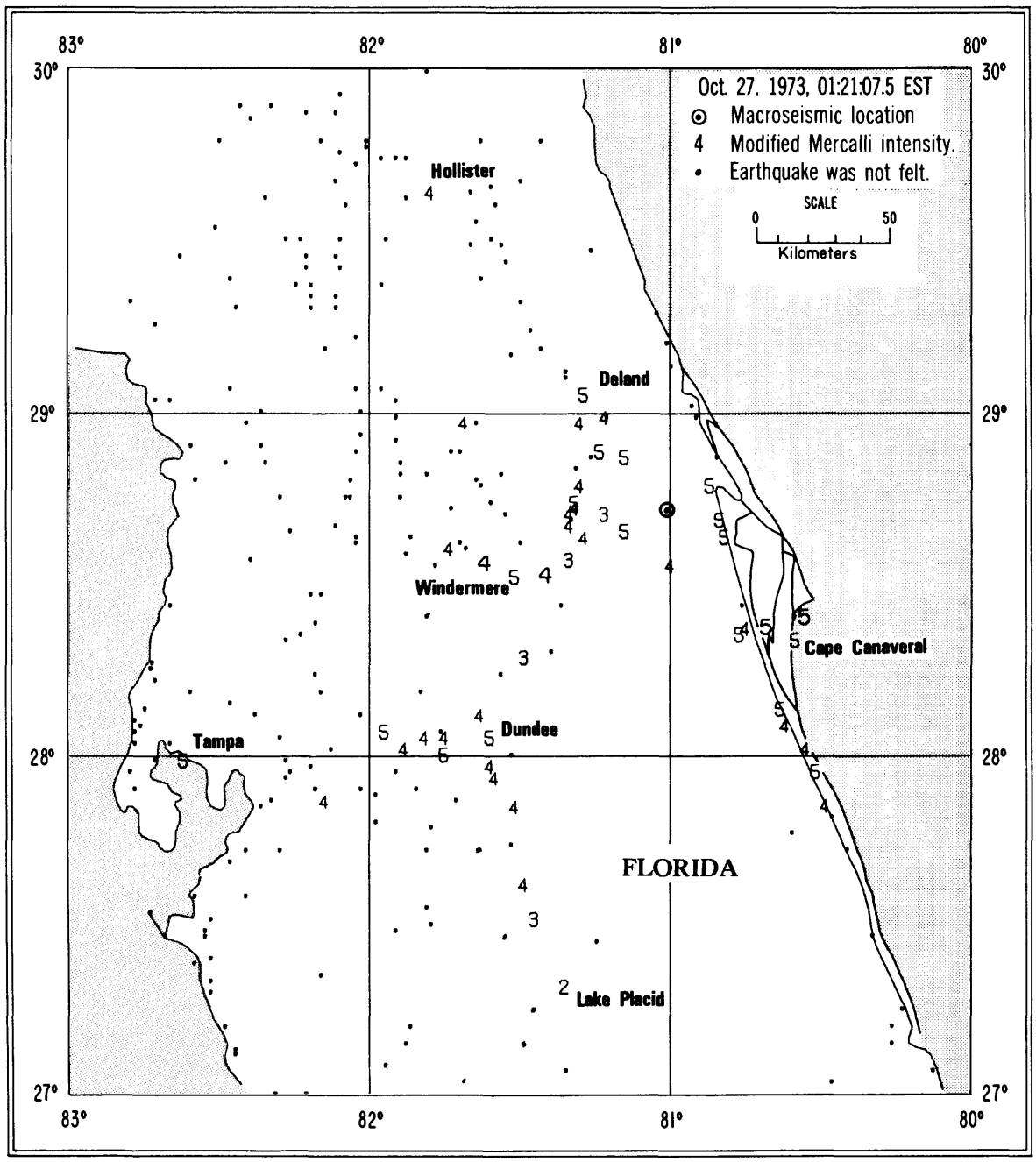

FIGURE 6.—Area affected by Florida earthquake of October 27.

Park, Goldenrod, Haines City, Hollister, Lake Mary, Lake Wales, Lithia, Longwood, Maitland, Malabar, Melbourne, Minneola, Orange City, Roseland, Umatilla, Waverly, Winter Haven, and Winter Park.

INTENSITY I-III

Clarmont, Intercession City, Lake Placid, Orlando, Oviedo, and Sebring.

Oct. 30. 17:58:39.0 (22:58), 18:09. Foreshock of November 30 earthquake. Macroseismic location 35.75° N., 84.00° W., eastern Tennessee, at a depth of about 33 km, mag. 3.4 (m_b), USGS. Felt over about 6,300 km^2 (2,400 mi^2) of Blount, Greene, Knox, and Loudon Counties, Tenn.; also felt in three towns in southeastern Kentucky and eastern North Carolina. Int. V. Small objects shifted at

Alcoa, Tenn. The press reported dishes were shaken from a cupboard in Knoxville, but no damage occurred.

INTENSITY V IN TENNESSEE

Alcoa, Friendsville, Knoxville (press; aftershock at 6:09 p.m.), and Maryville.

INTENSITY IV IN TENNESSEE

Greenback, Lenoir City, Louisville, Midway, Rockford, Townsend, and Walland.

INTENSITY I-III IN KENTUCKY

Hill Top and Pathfork.

INTENSITY II IN NORTH CAROLINA

Almond.

INTENSITY I-III IN TENNESSEE

Concord (press), Lake City, and Tallassee.

Nov. 30. 02:48:41.2 (07:48), 03:51. Epicenter 35.799° N., 83.962° W., eastern Tennessee, at a depth of 3 km, mag. 4.6–4.7 (M_S), USGS. Felt over approximately 150,000 km^2 (54,300 mi^2) in seven states, including all or parts of Georgia, Kentucky, North Carolina, South Carolina, Tennessee, Virginia, and West Virginia (fig. 7). Int. VI. Minor damage occurred in several towns of eastern Tennessee, Georgia, Kentucky, and North Carolina. The press reported minor cracks in walls at the University of Tennessee Hospital at Knoxville. Minor damage to walls, windows, and chimneys was reported from the Maryville–Alcoa area (figs. 8 and 9). The shock disrupted relay contacts at the Alcoa Switching Station, causing a loss of 300,000 kw of electricity for 11 minutes.

A team of U.S. Geological Survey seismologists was dispatched to the epicentral area to survey the damage and to set up aftershock equipment (fig. 10). According to a preliminary report by the USGS [1], 12 aftershocks (between magnitude −0.6–1.0) were located from December 3 to 6. Additional aftershocks were reported on November 30 at 03:51 and 04:27 (Cumberland Plateau Observatory, USGS); December 1 at 16:20 and 16:30 and December 2 at 01:25, 01:32, and 02:36 (Georgia Tech and Virginia Polytechnic Institute and State University portable seismic equipment). The aftershock on November 30 at 03:51 was felt by few at Alcoa, Knoxville, Louisville, and Maryville, Tenn. Additional aftershocks were reported felt on December 13 (about 10:00), December 14, and two on December 21 (03:00 and 13:30).

[1] G. A. Bollinger, Charley J. Langer, and S. T. Harding, "The Eastern Tennessee Sequence of October Through December 1973," *Bulletin of the Seismological Society of America*, Vol. 65 (in press).

The largest historical seismic event in eastern Tennessee occurred on March 28, 1913 (epicenter 36.2° N., 83.7° W., near Knoxville, int. VII). The small felt area of that shock (7,000 km^2) may be attributed, in part, to the less dense population at that time.

INTENSITY VI IN TENNESSEE

Alcoa.—Felt by several, awakened and frightened all in home. Windows, doors, and dishes rattled. Building creaked. Moderate earth noises. Few cracks. Damage slight. (See Maryville–Alcoa description below.)

Knoxville.—Felt by all in community; awakened and frightened many. Windows vibrated. Small trees shook. Loud earth noises "like loud thunder." Hanging objects swung violently. Small objects fell; furniture shifted (shook and moved back and forth). According to the press, the earthquake cracked a wall in the emergency room of the University of Tennessee Hospital. There were several other minor cracks in walls. Two injuries were reported.

Louisville.—Felt by and awakened all in community; frightened many. Severe shaking of windows, doors, and dishes. House shook. Loud earth noises, like thunder. Small objects shifted. "No damage in my home. Damage to houses in this area: Windows cracked. Plaster fell. Objects fell off shelves and window sills. Chimneys damaged."

Maryville–Alcoa.—According to the *Daily Times,* the Tennessee Valley Authority said the shock disrupted relay contacts at the Alcoa Switching Station, located on Big Spring Road near the Maryville–Alcoa By-pass. TVA reported the facility lost some 300,000 kw of electricity for 11 minutes. The plate glass window was broken at a radio and television shop on West Broadway. Walls cracked and windows broke at Blount Memorial Hospital. A window broke at the Medical Arts Building. Part of a chimney was knocked down at a residence on Wilson Avenue. Windows broke at a home in the White's Mill area. The shock lasted about 5 to 8 seconds. Earth noise resembled extremely heavy thunder, but was heavier and lasted longer than even heavy thunder. Awakened all but the soundest sleepers.

A report by B. J. Morrill (USGS, Seismic Engineering, San Francisco, Calif.) stated: "In the area of Maryville, Alcoa, and Knoxville, it broke windows, cracked some plaster, knocked some stock

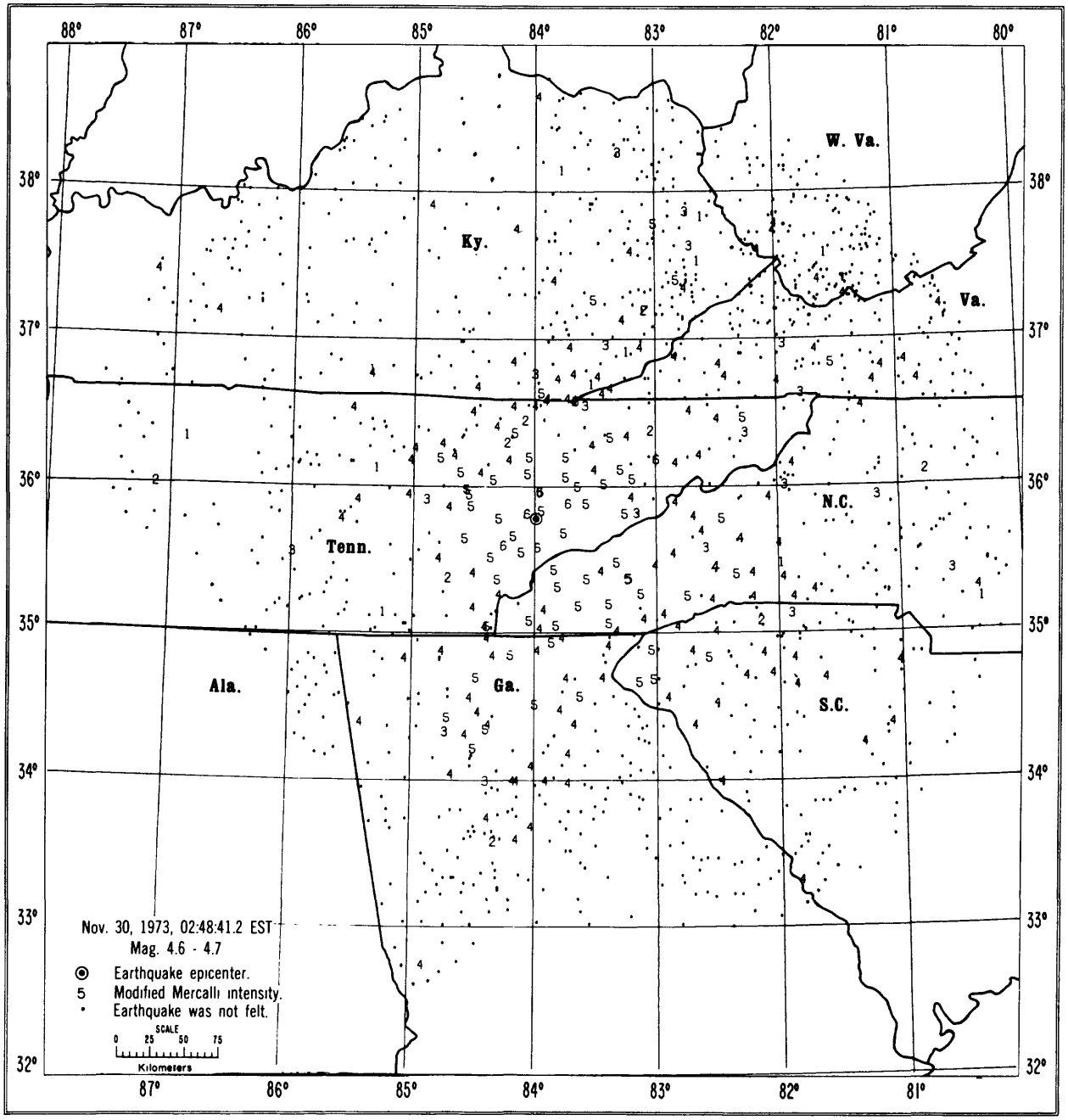

FIGURE 7.—Area affected by eastern Tennessee earthquake of November 30.

from shelves, and caused other minor damage. No structural damage was reported. Most of the damage occurred at Maryville. At Old Piney Church, very near the epicenter, there was no evidence that a quake had occurred, even though the buildings are constructed of unreinforced brick. At Alcoa, bottles did not fall from shelves."

Midway.—Felt by and awakened many; frightened few. Building creaked "like pulling nails." Hanging objects swung. Small objects shifted. Plaster cracked, broke, and fell. Stone fireplace cracked. Cracking around chimneys. Damage moderate.

Seymour.—Felt by, awakened, and frightened all in community. Whole house shook. Loud earth noises. Hanging objects swung moderately. Small

FIGURE 8.—Chimney damage caused by eastern Tennessee earthquake of November 30. (Photo—S. Harding, USGS)

FIGURE 9.—November 30 earthquake cracked concrete porch in Maryville, Tenn. (Photo—S. Harding, USGS)

objects overturned. Furniture shifted. Plaster cracked. "The closer the earthquake the louder the noise. The shaking of the earth was tremendous. Small articles were turned over and larger articles shaken. The worst earthquake ever in this area."

Vonore.—Felt by, awakened, and frightened many. Loud earth noises. Trees and bushes shook; vehicles rocked. Hanging objects swung violently. Small objects fell. Few windows cracked. Some plaster cracked, broke, and fell. Damage slight.

FIGURE 10.—USGS team sets up aftershock equipment in Maryville–Alcoa, Tenn., area following November 30 earthquake. (Photo—S. Harding, USGS)

INTENSITY V IN GEORGIA

Ball Ground, Cannon, Dahlonega, DeMorest (one instance of fallen plaster), Ellijay, Fairmount, Hurst, and Young Harris.

INTENSITY V IN KENTUCKY

Falcon (blocks broke?), Frakes, Saul (windows cracked), and Raven.

INTENSITY V IN NORTH CAROLINA

Almond, Aquone, Barnardsville, Cherokee, Edneyville, Fontana Dam (plaster cracked), Franklin (plaster cracked), Hayesville, Murphy, Otto, Pisgah Forest (windows broke), Robbinsville, Tuckasegee, and Webster.

INTENSITY V IN SOUTH CAROLINA

Easley, Richland, Tamassee, and Westminster.

INTENSITY V IN TENNESSEE

Andersonville, Bean Station, Blaine, Bluff City, Bybee, Clinton (plaster cracked), Corryton, Cosby, Dandridge, Deer Lodge, Ducktown, Emory Gap, Erie (plaster cracked), Friendsville (windows, walls, and ceiling cracked in some homes), Greenback, Harriman, Harrogate, Heiskell, Kimberlin Heights, Kingston, Kodak, LaFollette, Lenoir City (few wall cracks), Loudon, Luttrell, Madisonville, Mascot, Oakdale, Oliver Springs, Rafter, Rockford (some walls cracked), Sevierville, Shooks, Tallassee, Tellico Plains, Townsend, Walland, Wartburg, and White Pine.

INTENSITY V IN VIRGINIA

Marion.

INTENSITY IV IN GEORGIA

Acworth, Alto, Atlanta, Blairsville, Blue Ridge, Buckhead, Buford, Cisco, Clermont, Conyers, Cran-

dall, Duluth, Epworth, Habersham, Hamilton (press), Helen, Hiawassee, Jasper, Lula, Lyerly, McCaysville Morganton, Mountain City, Nelson, Oxford, Talking Rock, Talmo, Tunnel Hill, Turnerville, Waleska, Whitestone, and Winder.

INTENSITY IV IN KENTUCKY

Bondville, Bow, Fonde, Germantown, Green Hall, Greenup, Guage, Ingram, Island, Middlesboro, Pathfork, Revelo, Salt Gum, Straight Creek, Strunk, Tinsley, Totz, Waco, Walden, Wendover, Wheelwright, Winston, and Woodbury.

INTENSITY IV IN NORTH CAROLINA

Alexander, Andrews, Banner Elk, Brasstown, Bryson City, Canton, Cashiers, Chimney Rock, Columbus, Culberson, Cullowhee, Dana, Dillsboro, Ellenboro, Enka, Etowah, Flat Rock, Fletcher, Gerton, Glenwood, Harris, Hazelwood, Hendersonville, Highlands, Hot Springs, Kannapolis, Lake Lure, Lake Toxaway, Marble, Mars Hill, Marshall, Mill Spring, Montreat, Mooresboro, Mountain Home, Naples, Old Fort, Piney Creek, Ridgecrest, Rosman, Rutherfordton, Saluda, Sapphire, Scaly Mountain, Skyland, Spruce Pine, Sylva, Tuxedo, Warne, Waynesville, and Whittier.

INTENSITY IV IN SOUTH CAROLINA

Belton, Cross Anchor, Duncan, Edgemoor, Jackson, Marietta, Pauline, Peak, Pickens, Reidville, Simpsonville, Slater, Starr, Startex, Townville, Union, Winnsboro, and Woodruff.

INTENSITY IV IN TENNESSEE

Athens, Bone Cave, Briceville, Burrville, Celina, Charleston, Chuckey, Church Hill, Clarkrange, Coalfield, Coke Creek, Crossville, Decatur, Delano, Eagan, Englewood, Etowah, Greeneville, Grimsley, Jefferson City, Jonesboro, Kingsport, Lake City, Lancing, Limestone, Mooresburg, Newcomb, New Market, Newport, Niota, Norris, Oak Ridge, Oneida, Petros, Philadelphia, Pioneer, Postelle, Pruden, Reliance, Rockwood, Russellville, Rutledge, Sparta, and Sweetwater.

INTENSITY IV IN VIRGINIA

Abingdon, Austinville, Big Stone Gap, Broadford, Cripple Creek, Dungannon, Elk Creek, Ewing, Inman, McCoy, Nickelsville, Rose Hill, and Woodlawn.

INTENSITY IV IN WEST VIRGINIA

Algoma, Jenkinjones, Stirrat, Switzer, Thacker, and Welch.

INTENSITY I-III IN GEORGIA

Rydal and Stockbridge.

INTENSITY I-III IN KENTUCKY

Burkesville, Cubage, Davisport, Emma, Gausdale, Harold, Helton, Owingsville, Pine Knot, Putney, River, Scuddy, and Soldier.

INTENSITY I-III IN NORTH CAROLINA

Arden, Asheville, Clyde, Concord, Crossnore, Hamptonville, Henrietta, Horse Shoe, Oakboro, Penland, Taylorsville, and Union Mills.

INTENSITY I-III IN SOUTH CAROLINA

Chesnee, Gramling, Greenville, and Walhalla.

INTENSITY I-III IN TENNESSEE

Arthur, Caryville, Copperhill, Crab Orchard, Cumberland Gap, Duff, Elizabethton, Fairview, Hartford, Hixson, Joelton, Monterey, Riceville, Rogersville, Summitville, and Tazewell.

INTENSITY I-III IN VIRGINIA

Damascus, Rosedale, and Pineville.

Dec. 5. 06:30. Eglin Air Force Base, Fla. Felt by many. Faint earth noises. "Low-frequency rumbling, like distant series of explosions, was felt and heard." Not recorded on seismographs in the area. Probably not of seismic origin.

Dec. 13. 10:00 (about). An aftershock of the November 30 earthquake was felt in the Maryville–Alcoa area of Blount County, Tenn.

Dec. 14. No time given. Maryville–Alcoa, Tenn., area. Unconfirmed felt report. (S. Harding, USGS).

Dec. 19. 05:16:08.7 (10:16). Epicenter 32.98° N., 80.26° W., South Carolina, at a depth of 8 km, USGS. Felt west of Summerville.

Dec. 21. 03:00, 13:30. Maryville–Alcoa, Tenn., area. Unconfirmed felt reports. (S. Harding, USGS).

CENTRAL REGION

[The time in this region is given in central standard. If an epicenter is quoted, Greenwich mean time is given in parentheses. This region includes earthquake descriptions for Arkansas, Colorado (eastern), Illinois, Indiana, Iowa, Kansas, Kentucky (western), Louisiana, Michigan, Minnesota, Mississippi (western), Missouri, Nebraska, North Dakota, Ohio, Oklahoma, South Dakota, Tennessee (western), Texas (eastern), and Wisconsin.]

Jan. 10. 10:38:17.7, USGS. Felt at Enid, Okla.

Jan. 12. 05:56:56.0 (11:56). Epicenter 37.93° N., 90.52° W., eastern Missouri, at a depth of 20 km, mag. 3.2, JSA. Int. IV. The press reported "things shook for a little bit and glass rattled in windows at Farmington." Also felt at Bonne Terre, Festus,

Flat River, Hillsboro, Ironton, Kirkwood, and Sullivan.

May 25. 08:40:13.9 (14:40). Epicenter 33.92° N., 90.78° W., Mississippi, at a depth of 6 km, ERL. Felt at Bolivar, Cleveland, and Merigold.

Oct. 2. 21:50:20.4 (Oct. 3, 03:50). Epicenter 35.91° N., 90.00° W., Arkansas, at a depth of 10 km, mag. 3.4 (m_b), JSA. Int. IV in the Bootheel section of Missouri and in northwestern Tennessee–Arkansas area.

Oct. 9. 14:15:26.8 (20:15). Epicenter 36.51° N., 89.61° W., New Madrid, Mo., region, at a depth of 1 km, mag. 3.8 (m_b), JSA. Int. IV in the New Madrid area. "The shock affected a small area in Lake County, Tenn., and Fulton County, Ky., but full extent of area was not determined." (B. C. Moneymaker, Engineering Geologist, Knoxville, Tenn.)

Dec. 20. 04:45:00.1 (10:45). Epicenter 36.157° N., 89.580° W., New Madrid, Mo., region, at a depth of 10 km, mag. 3.4 (m_b), JSA. Felt in Caruthersville, Hayti, and Gobler.

Dec. 24. 20:46. Southeast of San Antonio, Tex. Int. IV at Jend Rusell Ranch, about 27 km west of Falls City. Int. III at Port Arkansas, about 100 km southeast of Falls City on the Gulf coast. All other reports from towns in the region were negative.

WESTERN MOUNTAIN REGION[2]

[The time in this region is given in mountain standard. If an epicenter is quoted, Greenwich mean time is given in parentheses. This region includes earthquake descriptions for Arizona, Colorado (western), Idaho, Montana, Nevada (eastern), New Mexico, Texas (western), Utah, and Wyoming. Authority for all epicenters and magnitudes, unless otherwise indicated, is the U.S. Geological Survey, National Earthquake Information Service.]

Feb. 9. 16:10:34.4 (23:10). Epicenter 36.8° N., 115.9° W., southern Nevada, at a depth of 5 km, mag. 4.2, ERL. Int. V. At the Beatty post office, a 13.5-kg steel cash drawer fell to the floor and was damaged. Also felt in the Nevada Test Site area.

Feb. 15. 16:06:08.9 (23:06), 16:14:57.1 (23:14). Epicenter 36.8° N., 115.9° W., southern Nevada, both at a depth of 4 km, ERL. Int. III in the Nevada Test Site area.

Feb. 19. 04:15:21.7 (11:15). Epicenter 36.8° N., 115.9° W., southern Nevada, at a depth of 6 km, mag. 4.0, B. Int. IV at Beatty. The press reported that a moderate earthquake and several aftershocks jarred the southern Nevada desert area on February 19, but caused no damage; also, several small shocks occurred in the same area on February 18.

Mar. 17. 00:43:05.5 (07:43). Epicenter 36.1° N., 106.2° W., New Mexico, at a depth of 6 km, mag. 4.5 (m_b), ERL. Felt in the Los Alamos area.

Mar. 27. 19:39:58.3 (Mar. 28, 02:39). Epicenter 44.4° N., 110.4° W., Yellowstone National Park, Wyo., at a depth of 8 km, mag. 5.0 (m_b), ERL. Felt in Yellowstone National Park. One of a swarm occurring during the last week of March with epicenters near Yellowstone Lake in the central section of the park. No damage was reported from any of the tremors.

Mar. 29. 17:32:57.6 (Mar. 30, 00:32). Epicenter 44.4° N., 110.4° W., Yellowstone National Park, Wyo., at a depth of 11 km, mag. 4.6 (m_b), ERL. The press reported a minor earthquake was felt by park employees near the south entrance of the park.

Mar. 30. 07:36:25.2 (14:36), 13:18:59.0 (20:18). Epicenter (1) 44.1° N., 110.3° W.; (2) 44.4° N., 110.5° W., Yellowstone National Park, Wyo., both at a depth of 10 km, ERL. The press reported two small tremors were felt on both the east and west sides of the park.

Mar. 31. 13:33:33.6 (20:33). Epicenter 44.5° N., 110.5° W., Yellowstone National Park, Wyo., at a depth of 10 km, mag. 5.1 (m_b), ERL. The press reported the shock was felt on the shore of Yellowstone Lake. The Chief Park Naturalist said the shock was small and similar to others that have been felt in the park recently.

Apr. 13. 23:45:49.2 (Apr. 14, 06:45). Epicenter 42.1° N., 112.5° W., southeastern Idaho, at a depth of 24 km, mag. 4.7, ERL. Int. V. The press reported that the shock awakened people in Franklin and Oneida Counties, Idaho, and also was felt in northern Box Elder and Cache Counties, Utah. In the Samaria area of Oneida County (about 13 km southwest of Malad City) where the strongest effects were reported, canned goods toppled from shelves and food spilled in a storage locker. A man driving a car thought he had a flat tire. Very loud earth noises were heard. Int. IV at Malad City and Preston. Also felt in the Cub River and Mink Creek areas.

[2] Prepared by Nina H. Scott, U.S. Geological Survey, San Francisco, Calif.

Apr. 21. 00:26:10.7 (07:26). Epicenter 44.5° N., 110.1° W., Yellowstone National Park, Wyo., at a depth of 10 km, mag. 4.4 (m_b), ERL. Felt.

Apr. 21. 00:45:09.7 (07:45). Epicenter 44.4° N., 110.5° W., Yellowstone National Park, Wyo., at a depth of 10 km, ERL. Felt at Old Faithful.

Apr. 21. 23:07:12.4 (Apr. 22, 06:07). Epicenter 42.6° N., 107.8° W., Wyoming, mag. 4.8 (m_b), ERL. The epicenter is in a sparsely settled area of southeast Fremont County, about 19 km northwest of Jeffrey City. Int. V. The press reported the shock was felt through a 96-km area between Jeffrey City and Lander. Residents in the area reported being awakened, hearing glass and furniture rattle, and feeling the earth tremble. In Jeffrey City, a mining community, the shock was described as a rumbling, then a heave, like the rolling motion of a boat; others described it as a sharp shock. Glasses "jumped" off a coffee table. At a ranch house between Jeffrey City and Lander, one person said there were two sharp shocks, then a roll. Int. IV at Shoshoni (about 96 km north-northwest of Jeffrey City). A questionable felt report was received from Morton (about 121 km northwest of Jeffrey City).

Aug. 20. 03:35:12.5 (10:35). Epicenter 44.5° N., 110.4° W., Yellowstone National Park, Wyo. Felt in northwest Yellowstone Lake area.

Sept. 10. 12:29:30.5. Mag. 2.6, SNM. Felt at Boys Ranch, N. Mex., 45 km north of Socorro.

Sept. 19. 06:28:20.5 (13:28). Epicenter 37.2° N., 104.6° W., Colorado, at a depth of 5 km. Felt at Segundo.

Sept. 22. 14:47:38.1, TDC. Felt in Boncarbo and Segundo areas, Colo.

Sept. 22. 16:38:35.8 (23:38). Epicenter 34.5° N., 107.0° W., New Mexico, at a depth of 5 km, mag. 3.1. Felt at Bernardo.

Sept. 22. 20:58:54.9 (Sept. 23, 03:58). Epicenter 37.1° N., 104.6° W., Colorado, at a depth of 5 km, mag. 4.2 (m_b). Felt in Boncarbo and Segundo areas, Colo.

Sept. 22. 20:58:57.1, 21:41:14.8, TDC. Felt in Boncarbo and Segundo areas, Colo.

Sept. 23. 02:51:27.2, TDC. Felt in Boncarbo and Segundo areas, Colo.

Dec. 23. 19:20:14.9 (Dec. 24, 02:20). Epicenter 35.3° N., 107.7° W., New Mexico, at a depth of 18 km, mag. 4.1. Int. VI. Felt in McKinley and Valencia Counties. Minor damage occurred at Grants, Laguna, Bluewater, and Fort Wingate. Press reported that police at Grants said the only damage was some broken windows at a gas station on the east side of town. Two people called police and said they were knocked out of bed. Police dispatcher said it shook so much he thought the roof would collapse. Grants police reported they received more than 50 calls from an area between San Rafael (about 8 km south of Grants) and San Mateo (about 48 km north of Grants). State police reported several residents said pictures fell from walls.

INTENSITY VI

Grants.—Felt by all and frightened some in community. "Everything in house shook. Concrete floor felt like it was waving up and down." Deep rumbling earth sound. Several cracks appeared on outer wall of addition. Paneling on walls pulled apart at two corners. Some plaster cracked, broke, and fell. "I believe the cracks existed as hairline cracks and the tremor opened them up." Damage slight.

Laguna.—Felt by all in community; frightened all in home. Windows and dishes rattled. Building shook. Three walls cracked. Chimneys cracked. Plaster cracked. Damage moderate.

INTENSITY V

Bluewater (slight chunk of wall fell out), Casa Blanca, Fort Wingate (plaster cracked), New Laguna, Prewitt, and Thoreau.

INTENSITY I-IV

Ambrosia Lake (press), Ramah (press), San Fidel, San Mateo, and San Rafael.

Dec. 25. 23:18:16.6 (Dec. 26, 06:18). Epicenter 36.1° N., 114.6° W., southern Nevada, at a depth of 5 km, mag. 3.3. The press reported that a mild, rolling motion was felt at Boulder City.

CALIFORNIA AND WESTERN NEVADA[3]

[The time is given in Pacific standard. If an epicenter is quoted, Greenwich mean time is given in parentheses. All towns are in California unless otherwise noted.]

Jan. 15. 01:43:29.8 (09:43; main shock), 01:58, 02:23:43.4 (10:23), 06:41:22.3 (14:41). Epicenter 36.7° N., 121.3° W., central California, all at a depth of 8 km, mag. 4.0, 3.7, and 3.7, respectively, B. Int. V. Felt principally in the Cienega Road–Paicines area south of Hollister where people were

[3] Prepared by Nina H. Scott, U.S. Geological Survey, San Francisco, Calif.

generally awakened by the main shock at 01:43. No damage was reported. Int. V at Almaden Winery (about 14 km south of Hollister), Chualar, Contival Ranch (about 21 km south of Hollister), Libby Ranch (about 2.3 km southwest of Paicines), Paicines (at Robert Law Ranch where four more small shocks were felt during the night and several were felt during the next morning), Paicines (about 10 km south of), and Pinnacles National Monument (about 24 km south of Paicines; shock also felt at 01:58). Int. IV at Gonzales (about 14 km northeast of; shock at 02:23 also was felt at about the same intensity as the main shock), Harris Ranch (about 11 km south of Hollister), Hollister (three shocks felt), Moss Landing, Salinas, and Saling Ranch (about 19 km south of Hollister). Int. I-III at Hernandez Dam (San Benito River, 116 km south of Hollister) and San Juan Bautista.

Jan. 16. 05:35. Int. IV at Etiwanda.

Jan. 16. 11:00 (about). Slight shock was felt about 14 km northeast of Gonzales.

Jan. 22. 14:00 (about). Slight shock felt about 14 km northeast of Gonzales.

Jan. 27. 05:48:51.4 (13:48). Epicenter 34.4° N., 118.5° W., southern California, at a depth of 8 km, mag. 3.7, P. Felt in the Newhall and Saugus areas.

Feb. 1. 03:55. Int. IV at Etiwanda.

Feb. 4. 17:37:45.6 (Feb. 5, 01:37). Epicenter 34.4° N., 118.4° W., southern California, at a depth of 8 km, mag. 3.5, P. Felt in Saugus area.

Feb. 8. 08:38:15.8 (16:38). Epicenter 34.0° N., 118.7° W., southern California, at a depth of 8 km, mag. 3.3, P. Felt at Malibu.

Feb. 15. 22:35:21.3 (Feb. 16, 06:35). Epicenter 37°42.6′ N., 122°03.5′ W., central California, mag. 2.4, B. Felt in Hayward and San Leandro. Police received reports of a loud, booming noise.

Feb. 16. 23:45:17.5 (Feb. 17, 07:45). Epicenter 37°25.0′ N., 121°48.2′ W., central California, at a depth of 8 km, mag. 3.1, B. Int. II in Centerville district of Fremont.

Feb. 21. 06:45:57.3 (14:45; main shock), 06:55:08.0 (14:55), 06:56:45.0 (14:56), 07:59:26.8 (15:59), 15:55:03.1 (23:55), 16:14:41.8 (Feb. 22, 00:14), 20:16:47.0 (Feb. 22, 04:16). Epicenter 34.1° N., 119.0° W., on coast of southern California, near Point Mugu (all shocks had essentially the same epicenter), at depths of 8, 18, 16, 15, 12, 12, and 12 km, respectively, mag. 5.9, 3.8, 4.1, 3.8, 3.4, 3.4, and 3.0, respectively, P. Numerous aftershocks were recorded. The press reported at least nine aftershocks were felt in the Ventura–Oxnard area during the day of the 21st.

The main shock generally was felt over about 59,800 km^2 (23,000 mi^2), extending from Lompoc near the coast of Santa Barbara County, northeast through the Taft and Bakersfield area to Onyx in northeast Kern County, southeast to Barstow to the Palm Springs area, thence southwest to the coastal area north of San Diego (fig. 11). Int. VII. The press indicated that the shock also was felt at San Luis Obispo and San Diego. There were no fatalities, but several injuries were reported by the press. The most serious injury was a broken leg suffered by a man in a fall when running from a church. Damage in the Oxnard area was estimated at approximately $1 million. There were no reports of serious ground disturbances, highway damage, or utilities damage. Along the Pacific Coast Highway in the Point Mugu area, some large boulders fell onto the highway, blocking the highway for a brief time, and at other places in the area there were numerous small rockslides which partially covered the highway (fig. 12). In the Solromar area, near Tonga Street, a long narrow crack, reportedly caused by slip failure, was observed in the highway. Morton and Campbell reported[4]: "All of the onshore surface effects of the earthquake centered near Point Mugu . . . can probably be attributed to ground shaking rather than to fault rupture at the surface. Surface effects were minor except for damage caused by seismic shaking of structures in nearby communities, notably Oxnard. The most striking features visible from the helicopter reconnaissance were numerous sand craters in Mugu Lagoon and adjacent drainage channels. Other notable effects were landslides (rockfalls) from steep cuts along the Pacific Coast Highway, and lurch cracks, chiefly in fill along the shoreward side of the beach as well as in and adjacent to wet sediments of Mugu Lagoon, Calleguas Creek, and the Santa Ana River.

"Small sand flows occurred in areas of local relief along the bottom of Calleguas Creek, forming numerous small sand fans. No large slumps could be clearly attributed to the earthquake. One large

[4] D. M. Morton and R. H. Campbell, "Some Features Produced by the Earthquake of 21 February 1973, Near Point Mugu, California," *California Geology*, California Division of Mines and Geology, December 1973, pp. 287–290.

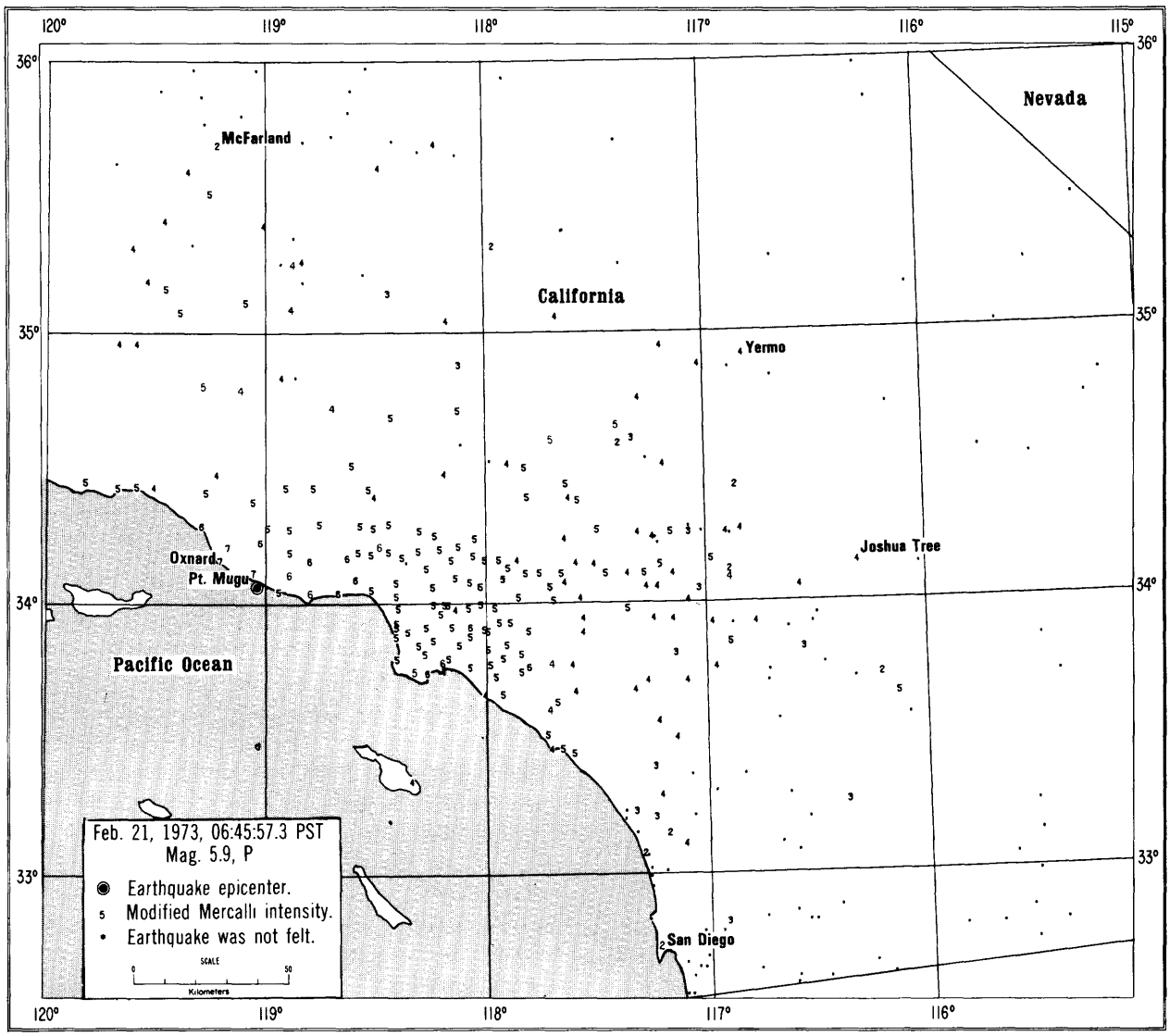

FIGURE 11.—Area affected by Point Mugu, Calif., earthquake of February 21.

slump about 12 miles (19 km) east of Point Mugu had encroached onto Encinal Road before the earthquake, and workmen did not report any increase in its rate of movement. All of the ground cracks observed appeared to be related to displacement by spreading of unconsolidated surficial material toward lower areas nearby (lurch cracks); evidence of tectonic origin was looked for but not found. Several hundred sand craters, ranging in diameter from less than 1 foot (0.3 m) to about 6 feet (2 m), developed in Mugu Lagoon, mostly in the central and eastern parts. A few were observed to be spouting water as high as 1 foot (0.3 m) (as estimated from a hovering helicopter) 7 hours after the main shock had occurred. In Mugu Lagoon, the sand craters did not appear to be intimately associated with lurch cracks as were some clusters of craters in saturated alluvium in the channel of Calleguas Creek. Lurch cracks associated with clusters of craters occurred as much as 5 miles (8 km) inland from the lagoon. A few craters and lurch cracks also were seen along the lower 3 miles (5 km) of the channel of the Santa Clara River. The sand craters, sand fans, and lurch cracks (produced by spreading) indicate liquefaction during the earthquake and were apparently restricted to saturated sediments in the lagoon and stream channels. None were observed in adjacent

FIGURE 12.—Landslide in Point Mugu, Calif., area resulting from February 21 tremor. (Photo—Dames & Moore)

cultivated fields where, had shaking been more severe, such effects might well have been widespread and could have resulted in significant crop losses."

It was also reported [5] that craters were found on the sea floor of Point Mugu canyon (fig. 13). The craters were about 0.9 to 1.5 m in diameter and 0.3 to 0.6 m deep with very steep sides. Fresh, loose soil in the center indicated that they were of recent origin and probably related to the earthquake. The press reported that there was some power outage, principally at Oxnard, owing to high-tension wires snapping or wrapping together. The most extensive building damage occurred to business establishments in downtown Oxnard. There were some wall failures in a few old, unreinforced brick buildings. Numerous chimneys were damaged, principally in the older part of Oxnard. Exterior and interior building cracks were reported. False ceilings, light fixtures, and acoustical tiling fell. Much plaster cracked. Numerous plate glass windows broke. Water sprinkler systems in stores were broken or activated, causing extensive water damage to merchandise. Much merchandise fell in stores. Observers at the Point Mugu Naval Air Station and Pacific Missile Range and at Port Hueneme reported only slight to moderate damage. At Camarillo State Hospital (about 8 km north-northeast of Point Mugu), damage was estimated at about $20,000.

INTENSITY VII

Camarillo State Hospital (about 8 km north-

[5] California Division of Mines and Geology, "Sea Floor Craters at Point Mugu Quake Site," *California Geology*, May 1973, pp. 116–117.

FIGURE 13.—Underwater craters in Point Mugu, Calif., submarine canyon, possibly caused by February 21 earthquake. (Photo—Dames & Moore)

northeast of Point Mugu).—Felt by many in community; awakened and frightened few. Two waterlines broke. Boiler breaks; boiler shut down. Concrete cracked. Chimneys cracked, twisted, and overturned. Plaster cracked, broke, and fell. Windows broke. Expansion joints moved. Water disturbed. Furniture shifted and overturned. Small objects shifted, overturned, and fell. "The State Hospital has about 120 buildings (maximum height two stories), with water, electrical, sewage, and heating systems. Water storage tanks have capacity of about 14,000 m^3. Movement appeared to be about 2.5 to 3.8 cm north-south. Damage should not exceed $20,000." (Report from Administrator, Camarillo State Hospital)

Oxnard.—Felt by and awakened all in community; frightened many. The following was excerpted from a memorandum report received from Dames & Moore, Consultants in Applied Earth Sciences, Los Angeles: "In Oxnard there was suprisingly little visible structural damage. There were some broken windows, numerous damaged chimneys, a couple of wall failures in old, lime mortared unreinforced brick buildings. One fallen cornice was seen on Fifth Street. An old brick school on F Street appeared to have suffered no serious damage and was occupied on the day of the earthquake. The Esplanade Shopping Center at the north end of Oxnard suffered the most damage to a single structure. It is a large, covered shopping center and many of the shops had stock knocked off shelves and false ceilings fall in. Cracking of arches in the central plaza was common and cracking of the facing on pillars was common. Wooden beams crossing the structure were severely cracked. . . . Numerous windows were broken in the shopping

center. The Disco Fair, adjacent to the Esplanade, suffered much stock damage and the false ceiling collapsed in some parts of the store. The sprinkler system also went off and caused water damage. The only noticeable structural damage was vertical cracks, generally about 20 feet (6 m) apart all around the building, in the masonry walls."

The following was excerpted from press reports: Thirteen electrical circuits were knocked out, 12 of them in Oxnard, when high-tension wires were snapped and others were wrapped together. Traffic signals were out at several intersections. No damage was reported to underground gaslines. Oil companies with facilities in the Santa Barbara Channel reported no problems or damage. Ventura County's major oil field operators reported there were no earthquake-connected incidents. The only evidence of damage to Oxnard School District structures was to the Administration Building where a few ceiling tiles fell. The 3-block-long Esplanade Shopping Center Mall was the hardest hit. Arches in the enclosed shopping center were damaged; tiling cracked; acoustical ceilings dislodged. Merchandise was damaged extensively. Automatic sprinkler pipes broke. Many large sections of overhead fluorescent lights fell. Television and stereo sets fell from counters and were damaged. At a market on Ventura Road and Fifth Street, cement walls buckled, sending ceiling tiles crashing to the floor. Damage was minor at the City Hall—stairwells cracked, acoustical ceiling tiles fell, and a light fixture fell. At the city library, some books were unshelved and ceiling tiles fell. At Oxnard's Community Center, a small amount of plaster fell in the auditorium. Police reported 69 houses, many of them in a 6-block area of older dwellings near the downtown area, had suffered visible damage, mostly to windows or chimneys. Fires were reported in at least two homes, but were quickly extinguished. Windows in 28 downtown business places were broken. Bricks fell from side walls of two old brick buildings, and the owner of one building said it was damaged so badly that it will be torn down. Plaster and dirt fell at one church and the cross and steeple were damaged at another. An observer at the Coast Guard Station at Channel Islands Harbor reported the retaining wall cracked at the base and slipped 18 cm, and that a lamp stanchion bent. A 2-m ^{3} water tank ruptured and was shaken from its foundation at Saint John's Hospital.

Point Mugu and vicinity.—As previously stated, sand boils were observed in the Mugu Lagoon and adjacent drainage channels, and craters were found on the sea floor of Point Mugu canyon. Dames & Moore, Consultants in Applied Earth Sciences, Los Angeles, reported in a memorandum report: "There was little or no visible sliding or rock-fall material along the Pacific Coast Highway until we came to the Solromar area, near Tonga Street. A slip failure caused a crack in the highway about 1.5 inches (3.8 cm) wide with about a 1.5-inch downdrop on the ocean side. In the Point Mugu area there were numerous small rock and debris slides which partially covered the highway. There was much debris along the road throughout the Mugu Rocks area. There was no visible ground breakage." The press reported that large boulders tumbled onto California Highway 1, near Point Mugu State Park, partially blocking the highway. Other observers in the Point Mugu area reported: At the Point Mugu Pacific Missile Range, moderate damage was sustained—ceilings damaged; plaster fell; walls and floors cracked; plate glass broke; waterpipes broke; groceries and other items fell. The Laguna Peak Road was passable but hazardous. At the Point Mugu Naval Air Station, an observer reported that ground cracked; supports for waterline moved off alinement; plaster and windows cracked; suspended ceilings sustained moderate damage.

Port Hueneme.—Felt by all in community; awakened and frightened many. The press reported that business places and homes sustained only slight damage. A few windows were broken. A ceramic shop sustained between $3,000 to $4,000 damage to stock. A market sustained minor damage. In the Hueneme School District, damage amounted to only a few broken windows. At a home, water cooler in kitchen broke; headboard fell on sleeping child; block wall fell. Woman said she could "see the sidewalk buckling." Power was out for a short time. "There was a big rumble before the shock. It sounded as if a big engine were going to crash through the window. Thought the building would fall apart." Other observers reported: Hanging objects swung violently north-south; ceramic tile fell off wall; plaster cracked moderately.

INTENSITY VI

Calabasas.—Felt by and awakened all; frightened many. Small objects shifted. "I was driving uphill, less than 1 mile (1.6 km) north of 24466 Mulhol-

land Highway, when the car swerved westward across the centerline."

Camarillo (about 13 km east by north of Oxnard).—Felt by and awakened all in community. The press reported that damage was slight to businesses and homes. Some windows and waterpipes broke. Two industrial buildings were flooded when sprinkler systems broke. Tiles fell from the roof of a store. Other observers reported: Plaster cracked, broke, and fell. Water service line was damaged. At a church, the bell tower was cracked where it joins the main part of building; people ran from the church. "Several old unreinforced brick buildings (within 90 m of the church) suffered moderate damage to parapets when bricks fell and were loosened in the walls." Furniture shifted. Small objects in homes shifted and fell. Hanging objects swung violently southwest-northeast. Trees and bushes shook; vehicles rocked. One observer commented: "Was not in the building long enough to know whether it creaked or not."

Malibu.—Felt by many; frightened all in post office. Landslides. Vehicles rocked. The press reported that windows and plaster were damaged.

Malibu Lake (about 2.6 km southeast of Cornell).—Felt by all; awakened and frightened many. Chimneys cracked, twisted, and overturned. Plaster cracked. Landslides. Small objects shifted. Loud earth noises. (This observer also reported no damage.)

Norwalk.—Felt by all and awakened many in community; frightened few. The press reported that a 61-m section of ceiling tile fell at the courthouse. "Water began seeping through concrete floor a few days after the shock. A waterpipe encased in the concrete had sprung a leak at a rusted joint, but not positive if this was caused by the earthquake."

San Pedro.—Felt by all, awakened many, and frightened few in community. The press reported that marble walls were cracked at the courthouse. Plaster cracked very slightly.

Sylmar.—Felt by all in home. Large pine tree toppled on powerline and shorted wires; all electricity off for 18 minutes. Repaired stucco was again damaged. Small objects on shelves shifted slightly.

Terminal Island.—The press reported that Harbor Department officials said a water main broke and spouted a geyser about 6-m-high at Berth 228 shortly after the main shock.

Topanga.—Felt by all in community; awakened many; frightened few. Rockslides. Small objects shifted. Strong shaking.

Tustin.—Felt by all in home and post office. Plaster cracked. Mortar holding structural beam cracked and fell. Opened up new cracks and enlarged existing cracks in concrete floors and walls. Swimming pool water splashed.

Ventura.—Felt by and awakened all in community; frightened many. The press reported that slight damage was sustained at business establishments and homes, mostly broken windows and dishes. Plate glass windows broke and merchandise fell in stores. Acoustical tile fell. Other observers reported: Chimneys cracked. Plaster cracked slightly. Small objects overturned north-south. Water splashed in toilet tank, activating valve. "Earth movements were sharp and strong but of fairly short duration and amplitude."

Westlake Village area (about 7 km southeast of Thousand Oaks).—The press reported that the shock caused several thousand dollars in damage (probably merchandise damage) to a liquor store on Lake Lindero Canyon Road.

Zuma District (in area of Pacific Coast Highway, west of Malibu and north of Point Dume).—The press reported that bricks were knocked off chimneys.

INTENSITY V

Agoura (plaster cracked), Alhambra (plaster cracked slightly), Altadena, Anaheim, Angelus Oaks, Arcadia, Artesia, Azusa, Baldwin Park, Bell, Bellflower (plaster cracked), Beverly Hills, Brea, Buena Park, Burbank (hairline plaster cracks), Canoga Park, Capistrano Beach, Castaic (near Castaic Dam), Chatsworth, Chino, Claremont (press), Coachella, Compton, Costa Mesa, Culver City, Downey, Duarte, El Monte, El Segundo, El Toro, Encino, Fillmore, Florence, Fontana, Fountain Valley, Frazier Park area (Cuddy Valley, about 8 km west of Frazier Park), Fullerton (very little plaster damage), Gardena, Garden Grove, George Air Force Base (near Victorville), Gilman Hot Springs, Glendale, Goleta, Granada Hills, Hacienda Heights, Harbor City, Hawthorne, Hermosa Beach, Hollywood (press), Huntington Park (very little plaster cracking), Inglewood (plaster cracked; damage slight), Kagel Canyon (about 6 km east of San Fernando), La Habra, Lake Hughes, Lakeview, Lakewood, La Mirada, Lancaster, La Puente, La

Verne, Lawndale, Llano, Lomita, Long Beach (plaster cracked), Los Angeles (plaster cracked; press), Lynwood (very little plaster damage), Lytle Creek, Manhattan Beach, Maricopa, Maywood, Midway City, Mission Hills, Mission Viejo (about 3 km southeast of El Toro), Monrovia, Montclair, Monterey Park, Montrose, Moorpark, Mount Wilson, Newbury Park (minor window damage; press), North Hollywood, Northridge (slight plaster cracking), Oak View, Orange, Pacific Palisades, Palos Verdes Estates, Panorama City, Paramount (plaster cracked), Pasadena, Patton (plaster cracked), Phelan, Pico Rivera, Pinon Hills, Piru, Placentia, Pomona, Redondo Beach, Reseda, Riverside (press reported numerous windows were broken, but questionnaire canvass did not substantiate this report), Rosemead, San Bernardino, San Clemente, San Dimas, San Fernando, San Gabriel, San Marino, Santa Ana, Santa Barbara, Santa Fe Springs, Santa Monica, Santa Paula, Santa Ynez, Saugus, Seal Beach (slight plaster cracks), Shafter, Sherman Oaks (old chimney crack and old plaster crack slightly reopened), Sierra Madre, Signal Hill, Simi Valley (stucco fell from wall of house; press), Skyforest, Somis (damage slight; no details), South Gate, South Laguna, Stanton, Studio City, Summerland, Sunland, Sunset Beach, Sun Valley, Taft, Tarzana, Temple City, Thermal, Thousand Oaks (minor window damage; press), Torrance, Tujunga, Upland (plaster cracked in one room), Valyermo, Van Nuys, Venice, Verdugo City (plaster cracked slightly; floor covering damaged slightly), Vernon, Walnut, West Covina, Whittier, Wilmington, Woodland Hills, and Yorba Linda.

INTENSITY IV

Acton, Alta Loma, Apple Valley, Arleta (south of Pacoima), Avalon (Santa Catalina Island), Bakersfield and vicinity, Barstow, Beaumont, Bell Gardens, Big Bear City, Big Bear Lake, Bodfish, Bonsall, Boron, Bryn Mawr, Buellton, Buttonwillow, Cabazon, Calimesa, Carpinteria, Cedarpines Park, Chuchupate Ranger Station (about 8 km southwest of Frazier Park), Corona Del Mar, Covina, Crestline, Crest Park, Cucamonga, Cuyama, Dana Point, Di Giorgio, East Highlands, Elsinore, Escondido, Etiwanda, Fellows, Frazier Park, Glendora, Helendale, Hemet, Highland, Hinkley, Huntington Beach, Joshua Tree, La Canada, La Crescenta, Laguna Hills, Lake Arrowhead, Loma Linda, Los Alamos, Los Olivos, Marine Corps Air Station (El Toro), Marine Corps Air Station (Santa Ana), McKittrick, Mettler (about 5 km north of Wheeler Ridge), Mojave, Moreno, Morongo Valley, Mount Baldy, Murrieta, New Cuyama, Newhall, Norco, Norton Air Force Base (near San Bernardino), Ojai, Ontario, Onyx, Ozena Guard Station (about 24 km north of Wheeler Springs), Pearblossom, Redlands, Rialto, Rimforest, Sandberg Ranch (Sandberg), San Jacinto, Silverado, Solvang, South El Monte, South Pasadena, Sun City, Sunnymead, Surfside, Temecula, Trabuco Canyon, Wasco, Wildomar, Winchester, Wrightwood, and Yermo.

INTENSITY I-III

Adelanto, Borrego Springs, Cantil, Fairmont Reservoir (about 3 km north by east of Lake Hughes), Fallbrook, Forest Falls, Green Valley Lake, Homeland, Indio, Leucadia, Lompoc, Lucerne Valley, McFarland, Nuevo, Oro Grande, Palm Springs, Rancho Santiago (in Lockwood Valley, about 19 km southwest of Frazier Park), Rosamond, San Diego (press), San Luis Obispo (press), San Luis Rey, San Marcos, Santee, Tehachapi, Vista, and Yucaipa.

Feb. 22. 01:30:19.4 (09:30), 07:36. Epicenter 34.0° N., 119.0° W., southern California, at a depth of 17 km, mag. 4.0, P. Aftershock of February 21. The press reported that the shocks "jiggled" the Oxnard area.

Feb. 27. 02:38. Mag. 3.5, B. Int. V (no damage) at Ferndale, Rio Dell, and Scotia; IV at Carlotta (about 3 km east of) and Fortuna; I-III at Petrolia. Also reported felt in the Capetown area and at King Salmon (press).

Mar. 2. 10:31:15.1 (18:31). Epicenter 35.7° N., 118.4° W., central California, at a depth of 8 km, mag. 3.1, P. Felt in Lake Isabella area.

Mar. 3. 10:14:49.5 (18:14). Epicenter 35.2° N., 118.5° W., central California, at a depth of 8 km, mag. 4.0, P. Int. IV at Arvin, Bakersfield, Di Giorgio, and Tehachapi (southwest of, at Cummings Ranch and the State Institution for Women); I-III at Greenfield, Keene, Kern City, and Lebec.

Mar. 5. 04:55:59.7 (12:55). Epicenter 34.0° N., 119.0° W., southern California, at a depth of 8 km, mag. 3.5, P. Aftershock of February 21. Felt at Camarillo.

Mar. 12. 04:50:00.8 (12:50), 04:50:11.5 (12:50). Epicenter (both shocks) 40.3° N., 124.2° W., near coast of northern California, mag. of second shock

4.3, B. Int. V. Some reports indicated the shocks were felt as one event. The press reported that Ferndale residents felt two smaller shocks—one several minutes after the main shock and one about 30 minutes later. Felt over about 6,500 km^2 (2,500 mi^2), principally in Humboldt County. Reported felt "as far as Redding" by the press. Other than some broken dishes at Eureka (press) and Rio Dell, no damage was reported. Merchandise fell in two stores at Rio Dell. Int. V at Bayside, Blue Lake, Bridgeville and about 9 km north of, Carlotta (3 km east of), Eureka (dishes broke; press), Ferndale, Fields Landing, Fortuna, Honeydew, Howe Creek (about 16 km southeast of Ferndale), Kneeland, Loleta, Maple Creek area (Dollar Ranch, about 11 km east of Kneeland), Petrolia (and about 13 km east of, at Hough Ranch), Redcrest, Rio Dell (dishes broke), Scotia, Upper Mattole, and Weott. Int. IV at Arcata, Blocksburg, Bridgeville (about 13 km north of, on Kneeland Rd.), Burnt Ranch, Hackett Ranch (about 5 km west of Scotia), Hyampom, Petrolia (about 5 km south of), Phillipsville, Piercy (about 6 km northwest of), and Salyer. Int. I-III at Miranda and Whitethorn.

Mar. 16. 14:38:20.9 (22:38), 16:54:35.8 (Mar. 17, 00:54). Epicenter 34.0° N., 119.0° W., southern California, at a depth of 8 km, mag. 3.5 and 3.7, respectively, P. Aftershocks of February 21. Press reported the two shocks jarred residents of Oxnard.

Mar. 20. 20:11:49.7 (Mar. 21, 04:11). Epicenter 33.8° N., 118.3° W., southern California, at a depth of 9 km, mag. 3.5, P. Int. IV at Gardena (central business district), Hawthorne (east of, in Athens district), and Wilmington; III at Torrance.

Mar. 25. During the night. Int. III at Etiwanda.

Mar. 26. 01:57:52.2 (09:57). Epicenter 34.1° N., 117.4° W., southern California, at a depth of 8 km, mag. 2.9, P. Int. IV at Etiwanda and Fontana.

Mar. 26. 07:13:28.2 (15:13). Epicenter 34.1° N., 118.8° W., southern California, at a depth of 8 km, mag. 3.0, P. Felt at Camarillo.

Mar. 28. 09:52:25.8 (17:52). Epicenter 34.1° N., 117.3° W., southern California, at a depth of 8 km, mag. 3.5, P. Int. V at San Bernardino where the press reported the shock was strong enough to shake pictures off walls and overturn lamps. Int. IV at Etiwanda. Also felt at Crestline, Fontana, Grand Terrace, and Riverside.

Mar. 29. 13:35:34.7 (21:35). Epicenter 34.0° N., 118.5° W., southern California, at a depth of 8 km, mag. 3.3, P. Int. IV at Santa Monica; III at Westwood (west Los Angeles area).

Mar. 30. 07:50:21.9 (15:50). Epicenter 34.0° N., 117.3° W., southern California, at a depth of 8 km, mag. 3.3, P. Int. III at San Bernardino.

Apr. 11. 00:00:48.9 (08:00). Epicenter 34.1° N., 117.4° W., southern California, at a depth of 8 km, mag. 3.5, P. Int. V at Etiwanda where many were awakened. Also felt at Rialto and San Bernardino.

Apr. 17. 13:34:22.6 (21:34). Epicenter 34.4° N., 118.4° W., southern California, at a depth of 8 km, mag. 3.2, P. Felt in Sylmar area.

May 8. 12:37:26.9 (20:37). Epicenter 34.4° N., 118.4° W., southern California, at a depth of 8 km, mag. 3.1, P. Felt at Newhall.

May 10. No time given. Int. III at Santa Monica.

May 12. 17:45 (about). Int. III in west Los Angeles area.

May 13. 03:20:19 (11:20). Epicenter 40.3° N., 121.4° W., northern California, mag. 3.4, B. Int. V at Mineral where many were awakened; IV at Mill Creek (about 6 km east of Mineral).

May 14. 18:21. Small shock "jostled" sections of Hollywood (press).

May 15. 09:18:50.7 (17:18). Epicenter 35.1° N., 117.5° W., central California, at a depth of 8 km, mag. 3.3, P. Int. II at Victorville. Faint earth noises were heard at Barstow.

May 17. 22:35:19.6 (May 18, 06:35). Epicenter 34.0° N., 117.1° W., southern California, at a depth of 12 km, mag. 3.2, P. Felt in Riverside area.

May 20. 19:38:40.4 (May 21, 03:38). Epicenter 40.3° N., 124.5° W., near coast of northern California, mag. 4.0, B. Int. IV at Bridgeville, Eureka (Humboldt Hill), Fortuna, Miranda, and Rio Dell.

May 23. 23:35. Int. II at Grass Valley.

June 9. 19:45. Int. IV about 10 km northeast of Avenal (at the Kettleman Compressor Station, Pacific Gas & Electric Company).

June 10. 19:51. Int. IV at Harris Ranch (about 11 km south of Hollister).

June 19. 02:26:28.6 (10:26), 03:50:09.9 (11:50). Epicenter (1) 32.8° N., 117.8° W., (2) 32.8° N., 117.7° W., off coast of San Diego County, at a depth of 10 and 8 km, respectively, mag. 4.0 and 3.2, respectively, P. Int. IV. The press reported that two small earthquakes shook San Diego County, awakening some people. Police said they heard from people throughout the county who felt the shocks.

June 21. 05:11:06.0 (13:11). Epicenter 33.0° N.,

115.5° W., southern California, at a depth of 8 km, mag. 4.0, P. Felt in Imperial County.

June 21. 17:29:12.4 (June 22, 01:29). Epicenter 36.6° N., 121.2° W., central California, at a depth of 9 km, mag. 4.2, B. Int. V at Bear Valley Fire Control Station (36.54° N., 121.18° W.), Gonzales, and in Pinnacles National Monument area (about 16 km northeast of Soledad). Int. IV at Fort Ord, Harris Ranch (about 11 km south of Hollister), Paicines, Salinas, and Soledad. Int. I-III at Contival Ranch (about 21 km south of Hollister, on Cienega Rd.) and San Juan Bautista.

June 25. 04:39:50.1 (12:39). Epicenter 33.8° N., 116.8° W., southern California, at a depth of 8 km, P. Felt in Palm Springs area.

June 29. 05:38:12.7 (13:38). Epicenter 34.4° N., 118.4° W., southern California, at a depth of 8 km, mag. 3.2, P. Felt in Northridge area.

July 2. 07:48:54.4 (15:48). Epicenter 34.1° N., 118.3° W., southern California, at a depth of 8 km, mag. 3.0, P. Int. IV at Hollywood (press).

July 3. 09:47. Int. III at San Francisco.

July 9. 13:00:29.6 (21:00). Epicenter 36.8° N., 121.6° W., central California, at a depth of 2 km, mag. 3.3, B. Int. III at San Juan Bautista.

July 14. 00:00:20.0 (08:00). Epicenter 34.4° N., 116.8° W., southern California, at a depth of 8 km, mag. 4.8, P. Int. V. Felt over about 10,400 km^2 (4,000 mi^2), principally in southwestern San Bernardino County. At Lucerne Valley, observer reported slight damage in the form of cracks in a cement block building. Items fell from store shelf. Loud earth noises. Int. V effects also were noted at Angelus Oaks, Apple Valley, Arrowbear Lake, Big Bear City, Big Bear Lake, Crest Park, Fawnskin, Lake Arrowhead, Lucerne Valley, Lytle Creek, Newberry Springs, Redlands, Running Springs, San Jacinto, Twin Peaks, and Yucca Valley. Int. IV at Cedar Glen, Cedarpines Park, Colton, Crestline, East Highlands, Forest Falls, Green Valley Lake, Hinkley, Loma Linda, Moreno, Morongo Valley, Mount Baldy, Rimforest, San Bernardino, Sunnymead, Temecula, Twentynine Palms, Wildomar, Winchester, and Yucaipa. Int. I-III at Gilman Hot Springs, Highland, Hollywood, Norton Air Force Base, and Wrightwood.

July 15. 08:52. Int. III in east Hollywood area.

July 24. 05:48:50.7 (13:48). Epicenter 39.1° N., 123.2° W., northern California, at a depth of 6 km, mag. 3.7, B. Int. V. Felt over about 3,250 km^2 (1,250 mi^2). At Calpella, felt by and awakened many; frightened few. Felt by and awakened all in community at Talmage. At Ukiah, the shock awakened many in community and disturbed water in swimming pools; a general jolt with very loud, rumbling earth noises and sharp twisting motion. Small objects fell and furniture shifted at Witter Springs. Int. IV at Boonville, Lakeport, Nice, Potter Valley, Redwood Valley, Upper Lake, Willits, and about 11 km south of Willits. Int. I-III at Hopland, Kelseyville (about 0.6 km south of), and at Summit Rancho (about 11 km west of Upper Lake).

Aug. 1. 21:44:44.3 (Aug. 2, 05:44). Epicenter 36.9° N., 121.6° W., central California, at a depth of 7 km, mag. 3.1, B. Felt at Hollister and San Juan Bautista.

Aug. 2. 02:18:36.9 (10:18). Epicenter 34.3° N., 118.3° W., southern California, at a depth of 8 km, mag. 3.4, P. Felt in San Fernando–Pasadena area.

Aug. 6. 15:29:16.6 (23:29). Epicenter 34.0° N., 119.5° W., off coast of southern California, near Anacapa Island, at a depth of 13 km, mag. 4.7, P. Int. V. Felt over about 7,800 km^2 (3,000 mi^2), from Carpinteria on the coast of Santa Barbara County, northeast to Castaic in Los Angeles County, thence southeast through the Los Angeles area to Huntington Beach in Orange County. The press reported that minor rockslides occurred on Anacapa Island and that landslides occurred on San Nicolas Island (about 86 km south of Anacapa Island); however, the Weather Service observer on San Nicolas Island made no mention of any landslides on the island. A few windows cracked at Oxnard. Pavement cracked at Camarillo State Hospital. Int. V effects also were noted at Carpinteria, El Segundo, Lakewood area (eastern section), Malibu, Oxnard, Point Mugu, Port Hueneme, San Pedro, Santa Susana, and Simi Valley. Int. IV at Castaic, Compton, Fillmore, Hawthorne, Long Beach, North Hollywood, Norwalk, Palos Verdes Peninsula, San Nicolas Island, Thousand Oaks, Torrance, Ventura, and Whittier. Int. I-III at Baldwin Park, Camarillo, Cuyama, Downey, Glendale (downtown area), Huntington Beach, La Mirada, Los Angeles (downtown area), Manhattan Beach, Newhall, Pacific Palisades, Piru, Redondo Beach, Santa Monica, Saugus, Venice, Wilmington, and Woodland Hills. Also reported felt at Beverly Hills, San Fernando Valley area, west Los Angeles, and Westwood.

Aug. 6. 20:17:01.1 (Aug. 7, 04:17). Epicenter

36°45.7′ N., 121°32.2′ W., central California at a depth of 3 km, mag. 2.7, B. Int. IV at Harris Ranch (about 11 km south of Hollister).

Aug. 7. 05:00. Very slight shock felt at Petrolia.

Aug. 8. 18:18:25.8 (Aug. 9, 02:18). Epicenter 40.3° N., 124.2° W., near coast of northern California, at a depth of 2 km, mag. 4.7, B. Int. VI. Felt over about 7,800 km^2 (3,000 mi^2) of Humboldt and Mendocino Counties, principally in the Ferndale–Scotia area. At Ferndale, plaster cracked and broke; tile loosened; windows cracked. Some merchandise fell in stores. At Centerville Beach (about 9.7 km west by south of Ferndale), seven windows broke in home (press). In the Howe Creek area (about 11 km southeast of Ferndale and about 8 km west of Scotia), glass broke and two persons were reportedly knocked down. At Rio Dell, slight cracks in ground, foundation, and exterior stucco were reported at one home. Articles fell in stores and homes. Many bottles broke in a grocery store at Scotia. About 25 persons started to run from the store as foodstuffs fell from shelves. A number of persons reported this earthquake consisted of two shocks very close together—first a trembling, then a sharp jolt. An observer at Eureka reported feeling an aftershock about 4 hours later (not felt by many).

INTENSITY VI

Centerville Beach (about 9.7 km southwest of Ferndale).—Seven windows broke in house (press). Furniture shifted.

Ferndale.—Felt by and frightened all in community. Plaster cracked and broke; tile loosened; some windows broke. Some merchandise fell in stores. Damage slight. Small objects shifted, overturned, and fell in homes; furniture shifted. Electrical wires swung and poles swayed. Trees and bushes shook; vehicles rocked. Man and son reported they left house as second shock gained momentum. Registered moderately on water-pressure gram in local reservoir.

Howe Creek area (about 11 km southeast of Ferndale and about 8 km west of Scotia).—Ferndale resident reported that people living on Russ fault in Howe Creek area said the shock was violent, knocking two persons down. Glass broke. Objects shifted.

Rio Dell.—Felt by all in community; frightened few. An observer reported: "On August 8, a 1.9-cm-wide vertical crack appeared in the cement foundation under the house—the September 29 shock pushed it back together a little. A horizontal line crack was made in the outside stucco—this crack was deepened by the September 29 shock. Under the house, 2.5-cm-wide ground cracks were observed—these were widened by the September 29 shock. The catch on my gate and fence does not mesh since the shocks. A heavy bed and other articles of furniture were moved 15 cm. All wall pictures were askew. Some articles fell in stores and homes. Slight quiver of building, then a heavy jolt."

Scotia.—Felt by all in community; frightened few. Grocery store sustained much damage to bottled goods, and about 25 persons started to run from the store as foodstuffs fell from shelves. The store was closed for an hour for cleanup. Small objects shifted, overturned, and fell in homes. Hanging objects swung violently east-west. Vehicles rocked.

INTENSITY V

Bridgeville, Eureka, Fields Landing, Fortuna, Hough Ranch (about 13 km west of Petrolia), Hydesville, Loleta, Myers Flat, Pepperwood (some dishes broke in trailer), Petrolia, Samoa, Shelter Cove, and Weott.

INTENSITY IV

Alderpoint, Bayside, Blocksburg, Blue Lake, Cutten, Kneeland, Leggett, Littleriver, Miranda, Phillipsville, Piercy, Westhaven, and about 8 km northwest of Whitethorn.

INTENSITY I-III

Fort Bragg, Garberville, Harris, Hoopa, Korbel, Mendocino, Trinidad, and Zenia.

Aug. 14. 18:17. Mag. 2.3, P. Int. IV at Ventura. Reported felt only in Ventura and vicinity (press).

Aug. 15. Between 18:30 and 21:30. Int. III at Vandenberg Air Force Base.

Aug. 19. 19:47:40.5 (Aug. 20, 03:47). Epicenter 34.4° N., 118.3° W., southern California, at a depth of 8 km, mag. 3.7, P. Int. IV at Glendale; I-III in east Hollywood area, Van Nuys, and in west Los Angeles area. Also felt at Eagle Rock (Los Angeles).

Aug. 20. 05:55. Int. IV in east Hollywood area.

Aug. 30. Between 07:59 and 11:39. Press reported five small earthquakes, with magnitudes of about 3.0, were felt in the Imperial–Brawley area.

Sept. 4. 01:11:26.4 (09:11). Epicenter 34.3° N., 119.4° W., southern California, at a depth of 8 km, mag. 3.6, P. Small shock felt at Carpinteria, Santa Barbara, and Ventura (press).

Sept. 10. 18:39:48.2 (Sept. 11, 02:39). Epicenter 37.6° N., 118.9° W., California–Nevada border

region, near Mammoth Lakes in southern Mono County, at a depth of 11 km, mag. 3.6, B. Int. III at Long Valley Dam (about 40 km northwest of Bishop).

Sept. 13. 09:30:39.7 (17:30), 09:44. Epicenter 32.9° N., 116.3° W., southern California, at a depth of 8 km, mag. 4.8, P. Int. V. Generally felt over about 7,800 km^2 (3,000 mi^2) of Imperial and San Diego Counties. Beyond this generally felt area, there were reports of the shock being felt at Anza and Winchester in Riverside County; Huntington Beach, Laguna Beach, and San Clemente in Orange County; and at San Diego in San Diego County. At Boulevard, windows cracked, small objects shifted and fell, and vehicles rocked. "People outside observed ground roll." Several pictures fell off wall at a ranch house in the Dixieland–Seeley area (west of El Centro). Small objects fell at Mount Laguna. The shock was felt by all in community at Potrero; slight aftershock at 09:44. Int. IV at Alpine, Borrego (press), Brawley, Campo, Dulzura, El Centro (press), Escondido, Guatay, Heber, Jacumba, Lakeside, Ocotillo, Ocotillo Wells (press), Palm Canyon (Anza–Borrego Desert State Park), Pine Valley, Plaster City, and San Diego (press). Int. I-III at Anza, Huntington Beach (press), Imperial, Julian, Laguna Beach (press), Mission Viejo (press), San Clemente, and Winchester.

Sept. 13. 13:06. The press reported a light shock "jiggled" Sylmar.

Sept. 14. 17:03:16.8 (Sept. 15, 01:03). Epicenter 36.6° N., 119.4° W., central California, at a depth of 18 km, mag. 4.2, B. Int. V. Felt over an area of about 20,800 km^2 (8,000 mi^2), principally in eastern Fresno and northwestern Tulare Counties. The only damage reported was a cracked window at Orange Cove. At the Haas Powerhouse (Balch Camp, 36°55′ N., 119°05′ W.), conduits shifted in the tailrace tunnel. Int. V effects also were noted at Badger, Cutler, Dunlap, Kingsburg, Kings Canyon National Park (Grant Grove), Lemon Cove, Meadow Lakes (near Auberry), Miramonte, Piedra, Prather, Sequoia National Park (Giant Forest), Shaver Lake, and Sultana. Int. IV at Auberry, Biola, Clovis, Corcoran, Del Rey, Fresno, Goshen, Kerman, Laton, Lindsay, New Auberry, O'Neals, Parlier, Pinedale, Raisin, Sanger, Selma, Springville, Three Rivers, Tollhouse, Traver, Tulare, Visalia, Woodlake, and Yettem. Int. I-III at California Hot Springs, Caruthers, Delano, Earlimart, Exeter, Fowler, Hanford, Herndon, Hume, Johnsondale, Lemoore, Lone Pine, Mariposa (southeast area), Mendota, Milo area (about 16 km east-northeast of Springville), Pixley, Porterville, Posey, Squaw Valley, Stratford, Terra Bella, Tipton, Wishon, and Woodville.

Sept. 16. 18:08:54.1 (Sept. 17, 02:08). Epicenter 38.6° N., 122.1° W., northern California, at a depth of 2 km, mag. 4.7, B. Int. V. Generally felt over an area of about 6,500 km^2 (2,500 mi^2), principally in the Berryessa Lake area of Napa County. Beyond the limits of the generally felt area, the shock was reported felt slightly at Alameda, San Francisco, and Stinson Beach. At Angwin, plaster cracked; woodpile overturned; small objects shifted; damage slight. At Berryessa Lake (south shore, near Spanish Flat, at 38°33′ N., 122°14′ W.), landslides occurred; small objects and furniture shifted; trees and bushes shook; vehicles rocked; loud earth noises were heard. At Steele Park (south shore of Berryessa Lake, about 8 km south of Spanish Flat), small objects shifted, overturned, and fell; large glass windows "crawled"; loud, rumbling earth noises were heard. At Calistoga, small objects shifted. "Rocks fell onto roads in the hills. Felt more in the hills than here on the valley floor." Int. IV at Capay, Glen Ellen, Napa, Novato, Oakville, Saint Helena, and Winters. Int. I-III at Alameda (press), Boyes Hot Springs, Esparto, Larkspur, Point Reyes Station, Port Costa, Rumsey, San Francisco (press), Sonoma, Stinson Beach (press), Vacaville, Vallejo, and Yountville.

Sept. 18. 02:08:04.9 (10:08). Epicenter 37.2° N., 118.9° W., central California, at a depth of 5 km, mag. 3.7, B. Int. V at Balch Camp (36°55′ N., 119°05′ W.) where the shock was felt by all, awakened all, and frightened few. Furniture and small objects shifted. Int. IV at Piedra and Wishon. At New Auberry, an observer said the shock was almost as strong as the one on September 14.

Sept. 18. 16:01:00.6 (Sept. 19, 00:01). Epicenter 33.2° N., 116.4° W., southern California, at a depth of 8 km, mag. 3.4, P. Felt at Borrego Springs.

Sept. 24. 04:59:37.3 (12:59). Epicenter 34.4° N., 118.4° W., southern California, at a depth of 8 km, mag. 3.6, P. Int. IV at Van Nuys. The press reported a light earthquake jarred residents of the San Fernando Valley.

Sept. 25. 20:04:46.1 (Sept. 26, 04:04). Epicenter 37.3° N., 122.4° W., central California, at a depth

of 9 km, mag. 3.4, B. Int. IV in southwest Woodside area. The press reported that a mild earthquake shook parts of Woodside and Portola Valley. The Woodside Fire District received a number of calls.

Sept. 29. 21:47:36.5 (Sept. 30, 05:47). Epicenter 40.3° N., 124.2° W., near coast of northern California, at a depth of 5 km, mag. 4.1, B. Int. IV at Bayside, Eureka, Ferndale, and Rio Dell. An observer at Rio Dell reported that small cracks in house and ground (caused by shock of Aug. 8) were slightly increased or decreased by the shock. Also felt at Trinidad. The press reported that residents from McKinleyville to Ferndale (about 48 km south of McKinleyville) felt their homes shake and deluged police offices with calls.

Oct. 3. 02:07:27.4. (10:07). Epicenter 37.2° N., 121.6° W., central California, at a depth of about 6 km, mag. 4.7, B. Int. V. Felt over about 9,100 km ^{2} (3,500 mi ^{2}), principally in the Morgan Hill–San Jose area. One press report stated that a waterpipe broke at a bowling alley in San Jose, but another press report stated that it was an activated sprinkler system that caused the leakage of water at the bowling alley. Int. V at Anderson Reservoir, Coyote, El Granada, Gilroy and 13 km northeast of, Half Moon Bay, Morgan Hill, Mount Hamilton, San Jose, San Martin, and Santa Clara. Int. IV at Atherton (press), Boulder Creek, Burlingame, Busch residence (about 16 km north of Hollister, on Shoreline Rd.), Capitola, Corralitos, Freedom, Freemont, Harris Ranch (about 11 km south of Hollister; two light shocks), Hercules, Holy City, Larkspur, Los Gatos, Moss Landing, Redwood Estates, Saint Mary's College (Moraga), San Francisco, Soquel, and Walnut Creek. Int. I-III at Bolinas, Daly City, Gustine, Menlo Park, Monte Sereno, Oakland (press), Palo Alto, San Mateo, and Sunol.

Oct. 4. 04:24:10.6 (12:24). Epicenter 37.9° N., 122.3° W., central California, at a depth of 6 km, mag. 2.8, B. Int. IV at Berkeley, Oakland, Orinda, San Francisco, and San Leandro.

Oct. 7. 08:01:24.0 (16:01). Epicenter 37.9° N., 122.3° W., central California, at a depth of 1 km, mag. 3.2, B. Int. IV at Berkeley, El Cerrito, and Richmond.

Oct. 7. 09:30:51.8 (17:30). Epicenter 37.6° N., 119.0° W., central California, at a depth of 5 km, mag. 3.9, B. Felt in the Mammoth Lakes area.

Oct. 16. 06:53:52.4 (14:53). Epicenter 31.6° N., 115.8° W., Baja California, Mexico, at a depth of 8 km, mag. 4.9, P. Press reported a light earthquake rattled the San Diego area. This epicenter is approximately 177 km southeast of San Diego. It is questionable that the shock actually was felt at San Diego.

Oct. 17. 08:55:13.6 (16:55). Epicenter 37.8° N., 121.9° W., central California, at a depth of 7 km, mag. 3.3, B. Felt in the east Danville area.

Oct. 18. 17:41:37.2 (Oct. 19, 01:41). Epicenter 32.6° N., 116.7° W., California–Mexico border region, at a depth of 8 km, mag. 3.1, P. Int. IV at Alpine (San Diego County).

Oct. 22. 20:57:57.1 (Oct. 23, 04:57). Epicenter 33.8° N., 117.7° W., southern California, at a depth of 8 km, mag. 3.6, P. Felt in Anaheim and Santa Ana areas. The Santa Ana Police Department reported a few calls from persons who felt a slight shock lasting 5 or 6 seconds.

Oct. 28. 14:00:02.7 (22:00). Epicenter 32.7° N., 118.1° W., off coast of southern California, at a depth of 8 km, mag. 4.5, P. Int. IV at Escondido and San Diego (press); III at Leucadia; II at Alpine. The press reported the shock shook San Clemente Island and was felt as far as Laguna Beach.

Oct. 30. 20:52. Epicenter in south Clear Lake area (Lake County), mag. 2.7, B. Int. IV at Lakeport; III at Kelseyville; II at Finley.

Nov. 2. 05:52. Int. IV at Alpine.

Nov. 11. 19:39:39.0 (Nov. 12, 03:39). Epicenter 39.3° N., 123.4° W., northern California, at a depth of 18 km, mag. 4.4, B. Int. V. Felt over an area of about 7,800 km ^{2} (3,000 mi ^{2}), principally in the Ukiah–Willits area of Mendocino County. At Willits, a supermarket sustained some damage to its "tower," and explosionlike earth noises were heard (press). At Redwood Valley, an observer reported wall cracks around bathtub; at Witter Springs, plaster cracked above door in house. Press reported that food fell from store shelves at Potter Valley, Redwood Valley, Ukiah, and Willits, and that some windows were cracked. Int. V effects also were noted at Boonville, Calpella, Comptche, Elk, Laytonville, Littleriver, and Talmage. Int. IV at Cloverdale, Finley, Fort Bragg, Gualala, and Mendocino. Int. I-III at Dos Rios, Glenhaven, Hopland, Lakeport, Leggett, Manchester, Nice, and Upper Lake.

Nov. 12. 10:17:13.5 (18:17). Epicenter 37.2° N.,

122.0° W., central California, at a depth of 14 km, mag. 4.5, B. Int. V. Felt over about 9,100 km² (3,500 mi²), principally in the Los Gatos–San Jose area of Santa Clara County. The press reported that a skylight was cracked at the Los Gatos Civic Center and that pictures were knocked off walls. Loud, explosionlike earth noises were heard in the area. An observer reported that a small amount of plaster cracked, broke, and fell, and that small objects fell from shelves at a supermarket. An observer at San Carlos reported that plaster was cracked slightly over the doorway. Int. V effects also were experienced at Ben Lomond, Capitola, Coyote, Cupertino, Monte Sereno, Morgan Hill, Mount Hamilton, New Almaden, Palo Alto, San Jose, Santa Clara, and Saratoga. Int. IV at Alviso, Anderson Reservoir (Metcalf Substation, PG&E), Boulder Creek, Brookdale, Burlingame–Hillsborough, Campbell, Centerville (press), Daly City, Hayward (press), Holy City, Irvington (press), La Honda, Mountain View, Redwood City, Redwood Estates, Saint Mary's College (Moraga), San Francisco, San Mateo (San Mateo Substation, PG&E), Sunnyvale, Union City (press), and Warm Springs (press). Int. I-III at Aptos, Brisbane, Danville, Diablo, Felton, Fort Ord, Gilroy, Half Moon Bay, Los Altos, Menlo Park, Milpitas, Moffett Field, Monterey Bay Academy (Watsonville), Oakland, Richmond (press), San Martin, Sunol, and Walnut Creek.

Nov. 14. 20:24. Mag. about 2.5, B. The press reported a slight earthquake jarred residents of east San Jose (int. IV). Mirror fell off wall; furniture shook.

Nov. 17. 23:30:00.2 (Nov. 18, 07:30). Epicenter 34.0° N., 118.4° W., southern California, at a depth of 8 km, mag. 3.2, P. Int. IV at Inglewood, Santa Monica, and west Los Angeles. The press reported that numerous calls were received by police in the Santa Monica and west Los Angeles areas; described as very short, but sharp.

Nov. 24. 21:00 (about). Willits area. Int. V. The press reported the Pine Mountain area was the hardest hit—pictures fell from walls and knickknacks fell into shelves. Hard jolt, with explosionlike earth noises.

Nov. 25. 21:44:58.6 (Nov. 26, 05:44). Epicenter 33.0° N., 115.6° W., southern California, at a depth of 8 km, mag. 3.2, P. Felt at Brawley.

Nov. 28. 08:43:35.9 (16:43). Epicenter 38.8° N., 122.8° W., northern California, at a depth of 6 km, mag. 3.2, USGS. Int. V. At the Big Geyser Resort, some glasses and bottles broke. Felt very strongly at the Geysers Powerplant (PG&E). The shock was accompanied by a loud noise, like a sonic boom (press). Int. IV at Cobb.

Nov. 29. 09:56, 12:59:41.0 (20:59). Epicenter 39.5° N., 119.9° W., western Nevada, at a depth of 5 km, mag. 3.0, USGS. The press reported shocks were felt at Reno and Verdi, Nev., and were the main shocks of a swarm occurring in the Dog Creek area just northwest of Verdi.

Nov. 29. 13:05:40.0 (21:05). Epicenter 38°47.9′ N., 122°49.5′ W., northern California, at a depth of about 5 km, mag. 1.9, USGS. Int. IV at the Geysers Powerplant (PG&E).

Nov. 29. 13:16:55.6 (21:16). Epicenter 38°49.2′ N., 122°48.2′ W., northern California, at a depth of about 5 km, mag. 2.3, USGS. Int. IV at Cobb, The Geysers, and the Geysers Powerplant (PG&E).

Dec. 1. 21:45:30.6 (Dec. 2, 05:45). Epicenter 38°50.2′ N., 122°47.6′ W., northern California, at a depth of about 5 km, mag. 2.6, USGS. Int. II at the Geysers Powerplant (PG&E).

Dec. 2. 23:28:41.8 (Dec. 3, 07:28). Epicenter 34.4° N., 118.3° W., southern California, at a depth of 8 km, mag. 3.0, P. Felt in Saugus.

Dec. 10. 22:35. Mag. 2.6, B. Generally felt in the Hollister area (press).

Dec. 11. 01:43. Mag. 2.2, B. Int. IV at Santa Rosa and vicinity. The press reported that a light earthquake was felt at Santa Rosa and other parts of central and southern Sonoma County. Many were awakened. A man in the Rincon Valley area (just east of Santa Rosa) said the ground shook so violently he thought there had been an explosion.

Dec. 12. 18:15. Int. IV at Harris Ranch (about 11 km south of Hollister).

Dec. 14. 02:47:56.1 (10:47). Epicenter 34.2° N., 117.6° W., southern California, at a depth of 8 km, mag. 3.1, P. Felt at Ontario.

Dec. 21. 11:12:44.0 (19:12). Epicenter 40.6° N., 124.6° W., near coast of northern California, at a depth of 18 km, mag. 4.6, B. Int. V. Felt principally along the coastal areas of Humboldt County, with a generally felt area of about 2,600 km² (1,000 mi²). The shock frightened all in community at Fields Landing; damage slight (no details). Felt by all in community and frightened few at Ferndale where small objects shifted. Generally felt at

Eureka; small objects shifted slightly. Int. IV at Bayside, Cutten, Fortuna, Hackett Ranch (about 6 km due west of Scotia), Honeydew, Petrolia, Rio Dell, and Scotia. Int. I-III at Arcata, Burnt Ranch, Orleans, Salyer, Trinidad, and Willow Creek.

Dec. 28. 07:30:26.5 (15:30). Epicenter 33.6° N., 117.7° W., near coast of southern California, at a depth of 17 km, mag. 3.6, P. The press reported most calls to the press and police came from the Laguna Beach area where a short, sharp, jolting motion was reported. Also felt at Costa Mesa, Dana Point, El Toro, Irvine, Mission Viejo (near El Toro), and Santa Ana.

Dec. 28. 20:15:37.2 (Dec. 29, 04:15). Epicenter 37.4° N., 121.8° W., central California, at a depth of 7 km, mag. 3.6, B. Int. IV at Los Gatos, Milpitas, and San Jose. The press reported that most calls to them and to police came from the east San Jose area, in the Evergreen and Willow Glen districts. There also were numerous calls from Los Gatos and Milpitas.

WASHINGTON AND OREGON[6]

[The time is given in Pacific standard. If an epicenter is quoted, Greenwich mean time is given in parentheses.]

Jan. 31. 08:00 (about). Oregon. Int. III at South Beach (just south of Newport), Tidewater (about 24 km southeast of Newport), and Toledo (about 11 km east of Newport). The press reported that the shock also was felt in the Siletz area north of Newport and at Newport.

Feb. 21. 20:47:19.2 (Feb. 22, 04:47). Epicenter 47.2° N., 122.9° W., Washington, at a depth of 20 km, mag. 3.5, S. Int. IV at Anderson Island, Belfair, Eatonville, Elbe, Hoodsport, Olympia, and Port Orchard. Int. II about 4 km north and about 5 km northeast of Elbe.

Mar. 17. 15:17:13.7 (23:17). Epicenter 47.8° N., 120.0° W., Washington, at a depth of 10 km, mag. 3.0, S. Int. IV at Chelan and Chelan Falls.

Mar. 18. 05:30. Felt by some at Chelan Falls, Wash. Milder than shock of March 17.

June 9. 03:12 (11:12). Epicenter 47.6° N., 121.8° W., western Washington, mag. 3.5, S. Int. V. Felt by and awakened many at Carnation. Loud earth noises. At Snoqualmie, wallboard seams were twisted. Damage very slight. Explosionlike earth noises were heard. Int. IV at Fall City and Preston. Int. I-III at Issaquah.

June 16. 06:43:47.5 (14:43), 06:50. Epicenter 45.0° N., 125.8° W., off coast of Oregon, mag. 5.1 (M_S), USGS. Int. IV at Depoe Bay, South Beach, and Yachats (about 5 km north of); III at Agate Beach (Newport) and Toledo. At Wheeler (north of Tillamook), a man said he felt one sharp shock followed by a smaller one at 06:50 (press).

July 18. 13:58:05.2 (21:58). Epicenter 46.8° N., 121.8° W., western Washington, at a depth of 11 km, mag. 4.0, S. Int. IV. Felt over about 3,380 km^2 (1,300 mi^2) of Lewis and Pierce Counties. Int. IV at Ashford, Elbe, Puyallup, and South Prairie; I-III at Eatonville, Kapowsin, La Grande, Packwood, Randle, Silver Creek, and Wilkeson.

Nov. 3. 08:22. Mag. 3.5, S. Washington. The press reported a slight earthquake was felt in Seattle's north section. About a dozen calls were received by the press. Reported as part of a swarm of miniquakes which have been recorded in the area during the past month.

Dec. 19. 17:08:27.3 (Dec. 20, 01:08). Epicenter 46.9° N., 119.3° W., Washington, at a depth of 1 km, mag. 4.1, USGS. Int. V. Othello and vicinity, Wash. Press reports indicated the shock was mild, although objects fell from shelves and pictures fell from walls. Christmas trees swayed. Man at a drive-in said his bucket of fried chicken crept to the edge of the counter where he stopped it from falling off. Reported felt only in the Othello area.

ALASKA

[The time is given in Alaska standard (150° meridian). If an epicenter is quoted, Greenwich mean time is given in parentheses. Authority for all epicenters and magnitudes for Jan.–May 1973, unless otherwise indicated is NOAA, Environmental Research Laboratories. Authority for arrival times is given in parentheses. The U.S. Geological Survey National Earthquake Information Service is the authority for listings from June–Dec. 1973.]

Jan. 4. 21:13:30.2 (ADK). Int. III on Adak Island.

Jan. 9. 01:57:21.0 (11:57). Epicenter 60.3° N., 146.0° W., southern Alaska, at a depth of 18 km, mag. 4.8. Felt at Cordova.

[6] Prepared by Nina H. Scott, U.S. Geological Survey, San Francisco, Calif.

Jan. 9. 07:07:55.5 (17:07). Epicenter 51.4° N., 178.2° W., Andreanof Islands, at a depth of 52 km, mag. 5.1 (m_b). Int. II on Adak Island.

Jan. 10. 07:13:08.7 (17:13). Epicenter 55.2° N., 159.9° W., Alaska Peninsula, at a depth of 58 km, mag. 4.2 (m_b). Int. II at King Cove.

Jan. 12. 15:00:37.6 (Jan. 13, 01:00). Epicenter 51.8° N., 177.0° W., Andreanof Islands, at a depth of 61 km, mag. 5.4 (m_b). Int. V effects were reported from Adak Observatory (no details).

Jan. 13. 03:36:28.3 (13:36). Epicenter 51.7° N., 177.0° W., Andreanof Islands, at a depth of 58 km, mag. 4.7 (m_b). Int. IV on Adak Island.

Jan. 15. 00:34:33.5 (ADK). Int. II on Adak Island.

Jan. 15. 23:57:38.6 (Jan. 16, 09:57). Epicenter 54.1° N., 165.5° W., Fox Islands, at a depth of 81 km, mag. 5.3 (m_b). Int. II at Cape Sarichef (Unimak Island) and Nikolski (Umnak Island).

Jan. 16. 21:46:11.2 (ADK). Int. II on Adak Island.

Jan. 17. 07:48:07.2 (17:48). Epicenter 52.4° N., 175.9° W., Andreanof Islands, at a depth of 123 km, mag. 3.9 (m_b). Int. I on Adak Island.

Feb. 1. 07:24:00.9 (17:24). Epicenter 51.8° N., 176.3° E., Rat Islands, at a depth of 51 km, mag. 5.3 (m_b). Int. II at the NOAA Weather Service Office at Shemya, Shemya Island.

Feb. 7. 08:52:23.1 (18:52). Epicenter 61.3° N., 150.5° W., southern Alaska, at a depth of 45 km, mag. 3.4. Int. II at Anchorage.

Feb. 8. 05:00:48.9 (15:00). Epicenter 61.8° N., 150.2° W., southern Alaska, at a depth of 54 km, mag. 3.8 (m_b). Felt at Willow and Whites Crossing.

Feb. 13. 09:53:53.5 (19:53). Epicenter 51.2° N., 179.2° W., Andreanof Islands, at a depth of 46 km, mag. 5.4 (m_b). Int. II on Adak Island.

Mar. 5. 20:09:19.1 (ADK). Int. II on Adak Island.

Mar. 10. 15:17:22.5 (Mar. 11, 01:17). Epicenter 64.8° N., 147.8° W., central Alaska, at a depth of 19 km, mag. 3.0. Int. III at Fairbanks.

Mar. 10. 22:03:53.8 (Mar. 11, 08:03). Epicenter 56.9° N., 136.4° W., off coast of southeastern Alaska, at a depth of 33 km. Int. II at Sitka.

Mar. 19. 01:41:07.7 (11:41). Epicenter 52.8° N., 173.8° E., Near Islands, at a depth of 81 km, mag. 5.8 (m_b). Int. V. On Shemya Island, mirrors broke, furniture shifted, and objects fell from shelves.

Mar. 20. 01:14:48.7 (11:14). Epicenter 61.6° N., 150.9° W., southern Alaska, at a depth of 81 km. Int. II at Palmer.

Mar. 20. 19:40:37.9 (Mar. 21, 05:40). Epicenter 64.8° N., 147.8° W., central Alaska, at a depth of 18 km. Int. III at Fairbanks.

Mar. 22. 10:58:36.0 (20:58). Epicenter 51.2° N., 179.2° W., Andreanof Islands, at a depth of 40 km, mag. 4.9 (m_b). Int. II on Adak Island; IV on Shemya Island.

Mar. 22. 20:55:33.1 (Mar. 23, 06:55). Epicenter 51.3° N., 174.2° E., Near Islands, at a depth of 27 km, mag. 5.9 (M_S). Felt on Shemya Island.

Mar. 26. 11:47:53.7 (21:47). Epicenter 52.8° N., 173.8° E., Near Islands, at a depth of 102 km, mag. 5.0 (m_b). Int. II on Shemya Island.

Mar. 27. 02:32:05.0 (12:32). Epicenter 52.6° N., 172.9° E., Near Islands, at a depth of 43 km, mag. 5.2 (M_S). Int. V. Small objects shifted and fell on Shemya Island. Also felt on Attu Island.

Mar. 27. 21:26:33.9 (Mar. 28, 07:26). Epicenter 64.8° N., 147.5° W., central Alaska, at a depth of 21 km, mag. 3.3. Int. IV in the College–Fairbanks area.

Apr. 2. 06:49:29.3 (16:49). Epicenter 51.9° N., 177.4° W., Andreanof Islands, at a depth of 63 km, mag. 5.2 (m_b). Int. IV on Adak Island.

Apr. 4. 23:30:38.3 (Apr. 5, 09:30). Epicenter 52.0° N., 176.0° W., Andreanof Islands, at a depth of 59 km, mag. 3.9 (m_b). Int. II on Adak Island.

Apr. 5. 15:46:18.2 (Apr. 6, 01:46). Epicenter 51.4° N., 178.4° W., Andreanof Islands, at a depth of 50 km, mag. 5.0 (m_b). Int. II on Adak Island.

Apr. 5. 19:22:57.3 (Apr. 6, 05:22). Epicenter 61.2° N., 149.5° W., southern Alaska, at a depth of 39 km, mag. 3.6. Int. II at Anchorage, Goat Creek, and Palmer.

Apr. 10. 19:12:18.1 (Apr. 11, 05:12). Epicenter 64.6° N., 160.1° W., central Alaska, at a depth of 15 km, mag. 4.2 (m_b). Int. V. At Galena Air Force Station (64°44′ N., 156°56′ W.), trees and bushes shook; vehicles rocked; felt by many and awakened few. Int. IV at Unalakleet (63°53′ N., 160°48′ W.).

Apr. 11. 08:59:53.4. Mag. 4.6 (ADK). Int. II on Adak Island.

Apr. 16. 04:48:02.8 (14:48). Epicenter 51.1° N., 178.8° W., Andreanof Islands, at a depth of 54 km, mag. 5.5 (m_b). Int. IV on Adak Island.

Apr. 22. 11:42:16.1 (21:42). Epicenter 51.1° N., 179.8° W., Andreanof Islands, at a depth of 54 km, mag. 4.8 (m_b). Felt on Amchitka Island.

Apr. 27. 11:02:16.6 (COL). Int. II at College.

Apr. 30. 01:55:29.2 (11:55). Epicenter 61.0° N., 151.1° W., southern Alaska, at a depth of 33 km, mag. 3.4 (m_b). Felt at Anchorage and Silver Tip.

Apr. 30. 13:32:36.0 (23:32). Epicenter 51.6° N., 177.8° E., Rat Islands, at a depth of 61 km, mag. 4.8 (m_b). Felt on Amchitka Island.

May 5. 22:05. Int. IV on Shemya Island.

May 10. 01:39:31.5 (11:39). Epicenter 51.4° N., 179.5° W., Andreanof Islands, at a depth of 61 km, mag. 5.3 (m_b). Felt on Amchitka Island.

May 15. 05:21:27.2. Mag. 4.2 (ADK). Int. II on Adak Island.

May 18. 08:32:55.7 (18:32). Epicenter 63.1° N., 151.0° W., central Alaska, at a depth of 128 km, mag. 4.7 (m_b). Int. II at Summit.

May 19. 18:01, 18:05, 18:53. Int. III on Shemya Island.

May 20. 04:20:33.7 (14:20). Epicenter 51.7° N., 176.7° W., Andreanof Islands, at a depth of 56 km, mag. 5.1. Int. IV on Adak Island.

May 20. 08:18:18.0 (18:18). Epicenter 61.0° N., 152.4° W., southern Alaska, at a depth of 118 km, mag. 4.9 (m_b). Int. II at Anchorage and Palmer.

May 24. 08:47:11.6 (18:47). Epicenter 51.6° N., 173.4° W., Andreanof Islands, at a depth of 43 km, mag. 5.1 (M_S). Int. IV on Adak Island; II on Atka Island.

May 25. 17:06:53.5 (May 26, 03:06). Epicenter 51.7° N., 175.4° W., Andreanof Islands, at a depth of 59 km, mag. 4.6 (m_b). Int. II on Adak Island.

May 26. 02:19:34.4 (12:19). Epicenter 51.4° N., 179.7° W., Andreanof Islands, at a depth of 39 km, mag. 5.7 (M_S). Int. V was reported on Adak Island (effects not described); also felt on Amchitka Island.

May 26. 13:04:38.0 (23:04). Epicenter 60.2° N., 154.0° W., southern Alaska, at a depth of 171 km, mag. 4.4 (m_b). Int. II at Anchorage and Palmer.

May 28. 20:14:22.3 (May 29, 06:14). Epicenter 54.0° N., 163.8° W., Unimak Island region, at a depth of 30 km, mag. 5.5 (M_S). Int. V. Trees and bushes shook at Cold Bay; small objects shifted. Small earthslides occurred on the headlands overlooking Cold Bay. Also felt at Cape Sarichef.

May 31. 15:23:53.9. Mag. 4.3 (ADK). Int. I on Adak Island.

May 31. 18:52:44.6 (June 1, 04:52). Epicenter 65.1° N., 147.3° W., central Alaska, at a depth of 32 km, mag. 4.2. Int. V. At Fairbanks, furniture shifted slightly; small objects shifted, overturned, and fell.

June 11. 15:18:25.2 (ADK). Int. II on Adak Island.

June 15. 02:11:02.3 (12:11). Epicenter 51.3° N., 179.4° W., Andreanof Islands, at a depth of 48 km, mag. 4.8 (M_S). Int. IV on Adak Island.

June 15. 03:38:23.1 (13:38). Epicenter 51.3° N., 179.4° W., Andreanof Islands, at a depth of 50 km, mag. 5.4 (m_b). Int. III on Adak Island.

June 17. 15:49:05.4 (June 18, 01:49). Epicenter 65.1° N., 147.0° W., central Alaska, at a depth of 29 km, mag. 3.8. Int. IV at College; III at Fairbanks.

June 19. 06:13:13.3 (16:13). Epicenter 64.8° N., 147.5° W., central Alaska, at a depth of 26 km, mag. 3.8. Int. IV at College; III at Fairbanks.

June 22. 19:26:49.0 (June 23, 05:26). Epicenter 51.9° N., 176.9° W., Andreanof Islands, at a depth of 62 km, mag. 5.5 (m_b). Int. V was reported on Adak Island (effects not described).

June 23. 05:00:50.0 (15:00). Epicenter 64.9° N., 147.5° W., central Alaska, at a depth of 22 km. Int. IV at College.

June 24. 18:36:59.8 (June 25, 04:36). Epicenter 61.7° N., 150.1° W., southern Alaska, at a depth of 15 km, mag. 3.1, Felt at Mile 60.5 on the Anchorage–Fairbanks highway.

June 25. 19:35:17.0 (June 26, 05:35). Epicenter 52.2° N., 174.1° E., Near Islands, at a depth of 41 km, mag. 4.5 (M_S). Int. II on Shemya Island.

June 30. 07:55:55.9 (17:55). Epicenter 52.7° N., 172.3° E., Near Islands, at a depth of 44 km, mag. 4.8 (M_S). Int. III on Shemya Island.

July 1. 03:33:34.6 (13:33), 05:12:05.0 (15:12). Epicenter 57.8° N., 137.3° W., off coast of southeastern Alaska near Sitka, both at a depth of 33 km, mag. 6.7 (M_S) and 5.2 (m_b), respectively. The main shock (03:33) was felt widely—as far as Yakutat (about 321 km northwest) and Juneau (about 129 km northeast). Int. V. Minor damage was reported at Sitka by the press (no details). The aftershock at 05:12 also was felt in the Juneau–Sitka area. Int. V effects occurred at Gustavus, Hoonah, Juneau and vicinity, Sitka, and Yakutat and vicinity. Int. IV at Tenakee Springs.

July 3. 06:59:35.1 (16:59). Epicenter 58.0° N., 138.0° W., southeastern Alaska, at a depth of 33 km, mag. 6.0 (M_S). Int. V. Felt by all at Gustavus.

Trees and bushes shook; vehicles rocked. Int. IV at Juneau and Yakutat; III at Sitka.

July 4. 09:54:30.7 (19:54). Epicenter 64.8° N., 147.5° W., central Alaska, at a depth of 6 km, mag. 3.2. Felt at Fairbanks.

July 4. 21:49:04.5 (July 5, 07:49). Epicenter 57.9° N., 137.9° W., off coast of southeastern Alaska, at a depth of 33 km, mag. 4.9 (M_S). Int. IV at Gustavus and Sitka.

July 8. 03:47. Int. III at Cape Spencer and Juneau.

July 11. 13:23:11.7 (23:23). Epicenter 52.0° N., 176.1° W., Andreanof Islands, at a depth of 63 km, mag. 5.4. Int. IV on Adak Island.

July 11. 21:51:07.9 (July 12, 07:51). Epicenter 52.2° N., 174.2° E., Near Islands, at a depth of 47 km, mag. 4.3 (M_S). Int. V effects were reported on Shemya Island (no details).

July 14. 19:53:27.7 (July 15, 05:53). Epicenter 61.6° N., 150.3° W., southern Alaska, at a depth of 49 km, mag. 3.1. Int. I at Palmer.

July 17. 21:30:22.2 (SIT). Int. II at Sitka.

Aug. 6. 01:19:10.0 (11:19). Epicenter 51.5° N., 178.0° W., Andreanof Islands, at a depth of 55 km, mag. 4.6 (m_b). Int. II on Adak Island.

Aug. 16. 02:16:59.8 (12:16), 02:36:28.6 (12:36). Epicenter 51.3° N., 176.6° W., Andreanof Islands, at depths of 47 and 48 km, mag. 5.8 (M_S) and 5.2 (m_b), respectively. The first shock was int. IV on Adak Island; the second was int. III.

Aug. 16. 04:25:34.4 (14:25). Epicenter 51.4° N., 176.6° W., Andreanof Islands, at depth of 62 km, mag. 5.6 (m_b). Int. III of Adak Island.

Aug. 17. 00:08:10.0 (10:08). Epicenter 51.4° N., 176.6° W., Andreanof Islands, at a depth of 51 km, mag. 4.9 (m_b). Int. II on Adak Island.

Aug. 21. 22:02:14.5 (Aug. 22, 08:02). Epicenter 62.6° N., 149.3° W., central Alaska, at a depth of 83 km, mag. 3.6 (m_b). Felt at Palmer.

Aug. 22. 08:14:37.2 (18:14). Epicenter 57.1° N., 154.1° W., Kodiak Island region, at a depth of 38 km, mag 5.6 (M_S). Felt on Kodiak Island.

Aug. 26. 11:47:12.0 (21:47). Epicenter 51.2° N., 179.3° W., Andreanof Islands, at a depth of 48 km, mag. 5.3 (M_S). Int. III on Adak Island.

Aug. 26. 14:07:26.5 (Aug. 27, 00:07). Epicenter 51.5° N., 178.4° W., Andreanof Islands, at a depth of 59 km, mag. 5.2 (m_b). Int. IV on Adak Island.

Aug. 26. 15:58:08.3 (Aug. 27, 01:58). Epicenter 51.3° N., 175.9° W., Andreanof Islands, at a depth of 40 km, mag. 4.7 (m_b). Int. II on Adak Island.

Aug. 26. 18:37:05.4 (Aug. 27, 04:37). Epicenter 51.7° N., 173.7° W., Andreanof Islands, at a depth of 45 km, mag. 4.8 (m_b). Int. II on Adak Island.

Aug. 27. 17:22:14.7 (ADK). Int. II on Adak Island.

Aug. 30. 16:30:57.9 (Aug. 31, 02:30). Epicenter 61.1° N., 147.4° W., southern Alaska, at a depth of 49 km, mag. 5.0 (M_S). Int. III at Anchorage; I at Cordova, Palmer, Seward, and Valdez.

Sept. 6. 00:59:36.7 (10:59). Epicenter 61.0° N., 146.8° W., southern Alaska, at a depth of 29 km, mag. 5.3 (M_S). Int. III at Anchorage and Valdez.

Sept. 7. 15:13:52.2 (Sept. 8, 01:13). Epicenter 51.3° N., 179.2° W., Andreanof Islands, at a depth of 54 km, mag. 4.9 (m_b). Int. II on Adak Island.

Sept. 11. 12:54:33.5 (ADK). Int. II on Adak Island.

Sept. 13. 21:01:31.4 (ADK). Int. II on Adak Island.

Sept. 19. 21:30:20.3 (ADK). Int. III on Adak Island.

Oct. 4. 23:22:06.3 (Oct. 5, 09:22). Epicenter 66.3° N., 157.4° W., Alaska, at a depth of 68 km, mag. 4.1 (m_b). Int. IV at Hogatza.

Oct. 5. 19:52:53.8. Mag. 4.4 (ADK). Int. III on Adak Island.

Oct. 7. 16:36:22.3. Mag. 4.4 (ADK). Int. III on Adak Island.

Nov. 1. 06:50:22.0 (16:50). Epicenter 62.0° N., 150.6° W., central Alaska, at a depth of 69 km, mag. 3.9 (m_b). Int. IV at Skwentna.

Nov. 1. 22:30. Int. IV on Atka Island.

Nov. 2. 07:35. Int. IV on Atka Island.

Nov. 5. 23:18:24.0 (ADK), 23:36:05.0 (09:36 main shock), 23:50:59.7 (ADK). Epicenter of main shock 51.6° N., 175.4° W., Andreanof Islands, at a depth of 34 km, mag. 3.5 (ADK), 6.4 (M_S), and 4.5 (ADK), respectively. The main shock caused int. IV effects on Adak Island; the first shock was int. I and the third int. II.

Nov. 6. 00:07:55.5 (10:07). Epicenter 61.6° N., 150.0° W., southern Alaska, at a depth of 52 km. Felt at Anchorage.

Nov. 6. 08:26:35.1 (18:26), 08:39:47.5 (18:39). Epicenter (1) 51.6° N., 175.2° W.; (2) 51.8° N., 175.3° W., Andreanof Islands, at depths of 41 and 49 km, respectively, mag. 6.3 (M_S) and 4.5 (m_b), respectively. The first shock was int. IV on Adak Island; second shock int. III.

Nov. 6. 18:44:59.5 (Nov. 7, 04:44), 21:27:49.8 (ADK). Epicenter of first shock 52.6° N., 175.2° W., Andreanof Islands, at a depth of 162 km, mag. 4.6 (m_b). Both shocks were int. II on Adak Island.

Nov. 7. 03:44:30.7. Mag. 4.5 (ADK). Int. II on Adak Island.

Nov. 8. 12:39:34.8 (22:39). Epicenter 51.1° N., 175.2° W., Andreanof Islands, at a depth of 16 km, mag. 4.1. Int. I on Adak Island.

Nov. 8. 20:22:47.7. Mag. 4.0 (ADK). Int. I on Adak Island.

Nov. 9. 11:35:22.4 (21:35). Epicenter 61.9° N., 150.6° W., southern Alaska, at a depth of 60 km. Int. I at Anchorage and Palmer.

Nov. 11. 07:03. Int. IV at Homer (NOAA Weather Service Office).

Nov. 26. 02:56:01.3. Mag. 4.5 (ADK). Int. II on Adak Island.

Nov. 27. 01:06:46.8 (11:06). Epicenter 51.3° N., 176.0° W., Andreanof Islands, at a depth of 19 km, mag. 3.9 (m_b). Int. IV on Adak Island.

Dec. 3. 09:18:41.0. Mag. 4.4 (ADK). Int. II on Adak Island.

Dec. 9. 07:41:29.1 (17:41). Epicenter 51.4° N., 179.1° W., Andreanof Islands, at a depth of 48 km, mag. 4.8 (m_b). Int. II on Adak Island.

Dec. 9. 07:48:17.1 (17:48). Epicenter 58.4° N., 151.8° W., Kodiak Island region, at a depth of 39 km, mag. 4.2 (m_b). Int. III on Kodiak Island.

Dec. 13. 01:40:35.5 (11:40). Epicenter 64.8° N., 148.0° W., central Alaska, at a depth of 11 km. Int. II at Fairbanks.

Dec. 13. 17:44:43.7 (Dec. 14, 03:44). Epicenter 51.3° N., 178.3° W., Andreanof Islands, at a depth of 54 km, mag. 5.4. Int. III on Adak Island.

Dec. 13. 19:36:30.8 (ADK). Int. II on Adak Island.

Dec. 14. 07:37:35.4 (17:37). Epicenter 51.4° N., 177.9° W., Andreanof Islands, at a depth of 53 km, mag. 5.8. Int. V effects were reported on Adak Island (no details).

Dec. 16. 21:11:24.8. Mag. 4.3 (ADK). Int. II on Adak Island.

Dec. 31. 18:29:16.8 (ADK). Int. III on Adak Island.

HAWAII [7]

[The following list includes felt earthquakes of magnitude ≥3.0, as determined by the Hawaiian Volcano Observatory. The time is given in Hawaiian standard. If an epicenter is quoted, Greenwich mean time is given in parentheses.]

Jan. 2. 20:20:10.8 (Jan. 3, 06:20). Epicenter 19°10.4′ N., 155°34.0′ W., at a depth of 6 km, mag. 3.6. Felt at Honaunau and Pahala.

Jan. 13. 11:30:00.1 (21:30). Epicenter 19°17.9′ N., 155°48.1′ W., at a depth of 8 km, mag. 3.7. Felt at South Kona.

Jan. 14. 06:01:49.9 (16:01). Epicenter 19°58.8′ N., 155° 34.1′ W., at a depth of 9 km, mag. 3.1. Felt at Kamuela.

Jan. 14. 06:40:17.2 (16:40). Epicenter 19°58.6′ N., 155°34.0′ W., at a depth of 10 km, mag. 3.2. Felt at Kamuela and Kapapala.

Jan. 22. 13:12:04.3 (23:12). Epicenter 19°55.1′ N., 155°38.6′ W., at a depth of 14 km, mag. 3.1. Felt at Honokaa, Kamuela, and Pohakuloa.

Jan. 22. 13:57:44.9 (23:57). Epicenter 19°55.3′ N., 155°38.4′ W., at a depth of 14 km, mag. 3.3. Felt at Honokaa, Kamuela, and Pohakuloa.

Feb. 9. 11:16:43.1 (21:16). Epicenter 19°15.8′ N., 155°27.3′ W., at a depth of 8 km, mag. 3.1. Felt at Kapapala.

Feb. 12. 19:46:58.3 (Feb. 13, 05:46). Epicenter 19°20.1′ N., 155°20.3′ W., at a depth of 29 km, mag. 3.9. Felt at Hilo, Honomu, Kurtistown, Pahala, South Kona, and Volcano.

Feb. 23. 07:47:51.0 (17:47). Epicenter 19°59.2′ N., 155°43.7′ W., at a depth of 44 km, mag. 4.1. Felt at Kamuela.

Mar. 6. 18:49:45.9 (Mar. 7, 04:49). Epicenter 19°25.1′ N., 155°26.6′ W., at a depth of 7 km, mag. 3.9. Felt at Kapapala, South Kona, and Volcano.

Mar. 7. 06:51:45.6 (16:51). Epicenter 19°18.4′ N., 155°13.2′ W., at a depth of 8 km, mag. 3.3. Felt at Hilo, Keaau, and Volcano.

Mar. 13. 17:06:55.1 (Mar. 14, 03:06). Epicenter 20°09.0′ N., 155°40.3′ W., at a depth of 40 km, mag. 3.0. Felt at Kamuela.

Apr. 15. 00:59:38.1 (10:59). Epicenter 19°18.1′ N., 155°06.5′ W., at a depth of 3 km, mag. 4.2. Felt at Kapapala, Keaau, Mauna Kea Observatory, and Volcano.

Apr. 22. 21:07:52.1 (Apr. 23, 07:07). Epicenter 19°58.3′ N., 154°41.1′ W., at a depth of 48 km, mag. 4.8. Felt islandwide on Hawaii and Maui.

[7] Prepared by Hawaiian Volcano Observatory, U.S. Geological Survey, Hawaii National Park, Hawaii.

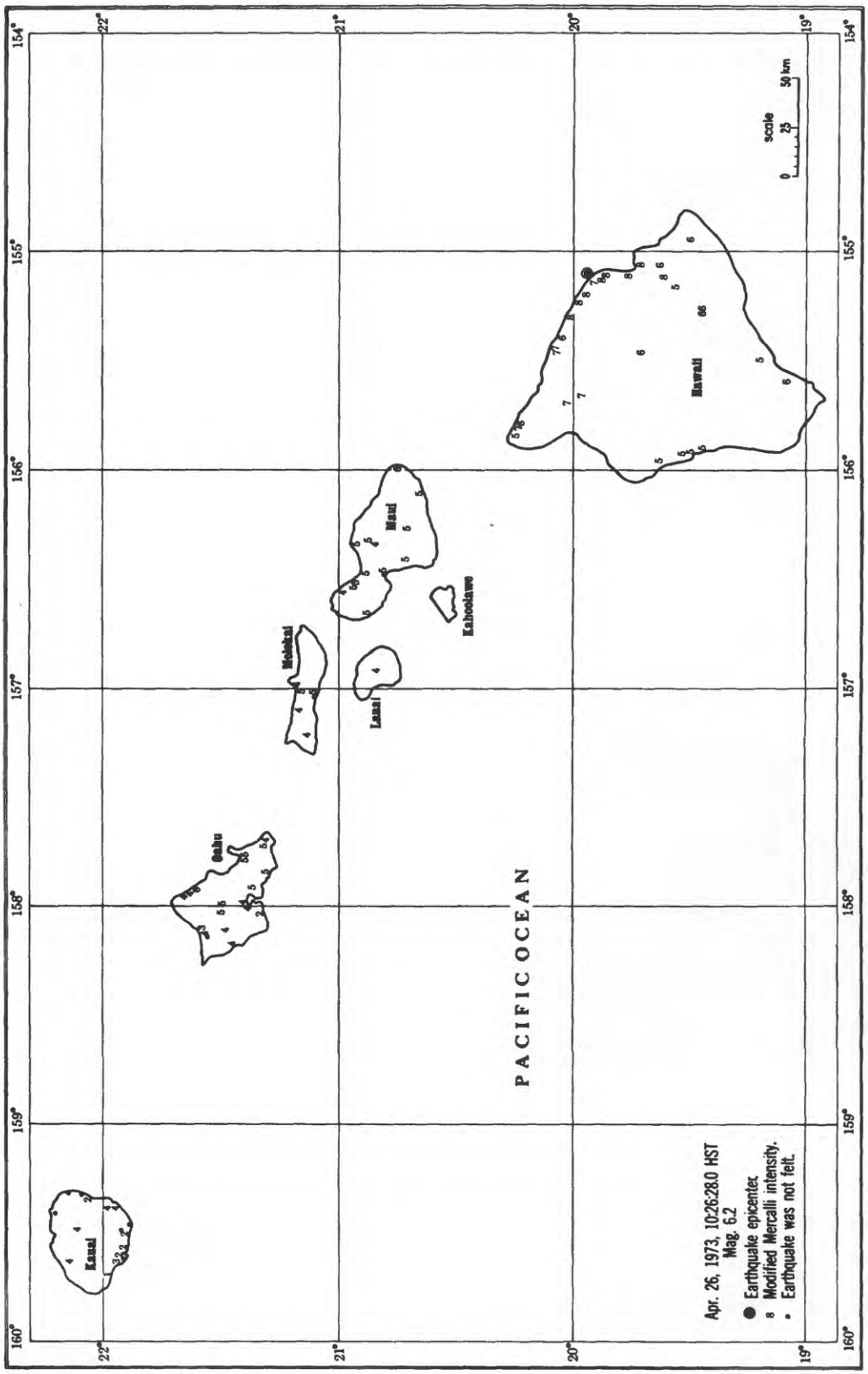

FIGURE 14.–Area affected by Hilo, Hawaii, earthquake of April 26.

Apr. 24. 06:16:22.2 (16:16). Epicenter 19°53.9′ N., 155°43.6′ W., at a depth of 40 km, mag. 3.9. Felt at Honokaa, Kamuela, Mauna Kea Observatory, and Volcano.

Apr. 26. 10:26:30 (20:26). Epicenter 19°52′ N., 155°07′ W., near coast of northeast Hawaii Island, at a depth of 45 km, mag. 6.2. Felt over a very large area, from the east coast of Hawaii Island northwest through the principal islands of Maui, Kahoolawe, Lanai, Molokai, Oahu, and Kauai, a distance of approximately 595 km (fig. 14). Int. VIII. Property damage in and around Hilo was estimated at about $5.6 million. No fatalities occurred, but 11 persons were injured. Damage to buildings, roads, water, gas, and power facilities caused authorities to declare a state of emergency over most of the northeast coastal areas of Hawaii Island. Ground effects, principally landslides, but including ground cracks from lateral displacement and local subsidence, were severe locally. The main wharf in Hilo sustained damage from subsidence, and landslides caused damage to roads and structures over a wide area. A few buildings collapsed and many were displaced slightly on their foundations (fig. 15).

FIGURE 15.—April 26 earthquake collapsed house foundation in area of Amauulo, Hawaii. (Photo—Hawaii Civil Defense)

The following was excerpted from a press report: "Through the afternoon of April 27, 200 homeowners covering an area from Hilo northwest to Waimea, a distance of approximately 64 km, had reported losses exceeding $700,000. The Civil Defense Administration said 70 'Big Island' business firms, many of which lost their display windows, had reported damage totaling $375,000, and that this figure was expected to rise. State facilities sustained at least $950,000 damage. Figures included at least $500,000 damage to four schools which were closed temporarily.

"State roads sustained more than $100,000 in damage, the heaviest damage occurring along the Laupahoehoe Gulch areas where the Belt Highway was closed at three points during most of the day on the 26th and limited to local one-way traffic on the 27th. County losses were estimated at $893,000. County roads sustained the heaviest damage with an estimated $600,000 needed for immediate repairs—$300,000 damage to Wainaku and Kaiwiki County roads near Hilo; $15,000 in the Waimea area; $90,000 in the Hamakua district; $135,000 in North Hilo; and $60,000 elsewhere. The next highest damage estimates were for waterworks in the Kaiwiki, Kaiele, and Papaikou areas, where ten major problems cost $278,000 to repair. Several hundred residents north of Hilo remained without water throughout the 27th. Many powerlines were down between Hilo and Hakalau. The power was switched off between Pepeekeo and Hakalau. The telephone company reported only one exchange, at Kawailani, was out of order. On the 27th, most electric, telephone, and gas services had been restored to all areas of the Island except for isolated outages in the Wainaku, Kaiwiki, Amauulu, and Kaumana areas. Between Pepeekeo and Hakalau, lines which had been knocked down were back on poles. Seven major landslides occurred along the Hamakua Highway, closing off three gulches and completely cutting off the Laupahoehoe Point Beach Park. The makai side of Waihau Lane in Puueo (Hilo) collapsed, damaging the roadway, chain-link fence, a telephone pole, and breaking a waterpipe which sent a geyser of water into the air. Police barricaded the entrance to Wainaku Overlook because of ever-widening cracks of 20 to 25 cm in the roadway. There were 46- to 68-m-long cracks in the earth along Kaiwiki Road in Wainaku. (fig. 16).

"On the Amauulu slopes, just north of the Wailuku River, an older plantation house collapsed. It was reported that 17 homes (no specific location given) were shaken off their foundations and that five collapsed completely."

INTENSITY VIII

Haakeo (near Hilo).—Heavy damage to waterlines. "Haakeo School is not expected to open until May 1 owing to a major water leak" (press).

FIGURE 16.—Highway shoulder failure at Wainaku, Hawaii, caused by April 26 tremor. (Photo—Hawaii Civil Defense)

Hakalau.—Felt by and frightened all in community. Loud earth noises. Ground crack; landslides; water disturbed. Tombstones overturned. Electricity off; telephone out. A television fell off stand. "Nearly every home suffered loss. We live in a sugar plantation community. The water systems were poor. Damage to our pipelines was heavy; all required repair. Residents were without water for about 4 days. Even schools were closed for 2 days owing to shortage of water. It's back to normal now (May 4). Some people are still scared, even when a small shock occurs."

Hilo.—Felt by and frightened all in community. Building creaked severely. Loud earth noises. Trees and bushes shook; vehicles rocked. Ground cracked; landslides occurred; water was disturbed. Chimneys, tombstones, elevated water tanks, cracked, twisted, and overturned. Hanging objects swung violently. Furniture shifted and overturned. Plaster cracked, broke, and fell. Windows broke. Cement cracked. "Many residents on this island sustained considerable damage to kitchen goods. Cabinet and refrigerator doors were opened and food was lost along with glassware and dishes."

Following are excerpts from a press report:

"One downtown building collapsed. Buildings cracked and shifted on foundations. The Federal Building was roped off because of wide cracks at all three levels. Hilo College buildings sustained structural damage. Damage at the Central Fire Station was estimated at $10,000; County Building, $5,000; Hilo Processing Corporation, $159,000; and Mauna Kea Sugar Company, $260,000. At Hilo Union High School, plaster fell and some acoustical panels popped open in the school's newest building; one student was hit on the head by a flying panel.

"Downtown Hilo was ordered closed. One man was pinned in the rubble of the collapsed Typewriter Center (fig. 17). Traffic lights were knocked out. Plaster fell from many buildings to the sidewalk. All around the block bordered by Kamahameha Avenue, Haili Street, Keawe Street, and Kalakaua Street, many plate glass windows were shattered. There were no reports of major damage at the Hilo Airport, but cracks were observed in the airport restaurant walls. In the control tower, men were forced to hold on to a rack to keep their balance. The Malia Apartment Building (Hilo), a two-story cinder block building, was damaged. The outside walls on the two ends of the rectangular-shaped, 24-unit building were torn loose and cinder blocks fell. The top of the building's underground cesspool collapsed, leaving a gaping hole in the ground (fig. 18). The Hawaiian Telephone Company building on Kinoole Street (Hilo) sustained structural damage but the extent was not known on April 27. A house in Hilo's Puueo district reportedly collapsed. Damage to homes on Halaulani Street was extensive. Most homes on Halaulani Street have rock foundations, which were shifted several centimeters from their original locations. Most rock walls around the foundations caved in.

"Damage at Hilo's Pier 1 was estimated at $350,000 for necessary repairs alone. A 366-m-long concrete pier was split from end to end by a 1.27- to 2.54-cm crack. Two other piers sustained damage to a lesser degree."

Honomu.—Felt by and frightened all in community. Buildings creaked very loudly. Loud earth noises. Trees and bushes shook; vehicles rocked; woman driving truck was frightened. Ground cracks; many landslides along with fallen trees; water disturbed. Many tombstones twisted and overturned. Hanging objects swung violently, north-south, and fell. Furniture moved, some broke;

FIGURE 17.—April 26 earthquake inflicted severe interior damage to Typewriter Center, downtown Hilo, Hawaii. (Photo—Hawaii Tribune-Herald)

freezer and refrigerator moved and doors opened. Windows cracked. Plaster cracked, broke, and fell. Concrete floor cracked. "Many items fell from my store shelves. It took me 3 days to clean up the mess. My TV and transistor also were damaged. Damage great."

Kaumana (about 8 km southwest of Hilo).—The press reported heavy damage to waterlines. Some houses were shaken loose from foundations.

Ninole.—Felt by and frightened all in community. Loud earth noises. Trees and bushes shook; vehicles rocked. Ground cracks; landslides; water disturbed. Chimneys, tombstones, elevated water tanks, cracked, twisted, and overturned. Hanging objects swung violently. Small objects shifted, overturned, and fell. Plaster cracked, broke, and fell. Damage moderate.

Ookala.—Felt by and awakened all in community; frightened many. Faint earth noises. Trees and bushes shook; vehicles rocked. Ground cracks; landslides; water disturbed. Chimneys, tombstones, elevated water tanks, etc., twisted and overturned. Furniture shifted. Plaster cracked, broke, and fell. Some windows cracked. Some houses shifted slightly off foundations.

Papaaloa (north Hilo.)—Felt by, awakened, and frightened all in community; general panic. Loud earth noises. Trees and bushes shook; vehicles rocked. Ground cracks; landslides; water disturbed. Chimneys, tombstones, and water tanks cracked and overturned. Hanging objects swung violently. Furniture shifted and broke. Plaster cracked, broke, and fell. Windows cracked. Roof leaked. Damage great.

FIGURE 18.—Collapse of cesspool at Puueo, Hawaii, was attributed to April 26 tremor. (Photo—Hawaii Civil Defense)

Papaikou (about 6 km north of Hilo).—Felt by, awakened, and frightened all in community. Loud earth noises. Trees and bushes shook and swayed; vehicles rocked. Ground cracks; landslides; water disturbed. Main waterline broke; cesspool caved in. All hollow tile concrete steps crumbled and fell to the ground. Hanging objects swung violently east-west. Furniture shifted and overturned. Plaster broke and fell. Windows cracked. Foundation moved about 7.6 cm. "Many concrete buildings had ceiling and wall cracks. Wood frame structures moved from foundations." Damage great. The press reported some homes were shaken loose from foundations. The front door of one home came completely off and back door was damaged. One report to police stated a telephone pole was "hanging" and a water tank had collapsed. Heavy damage to waterlines. The most severe structural damage to schools occurred at the Kalaniaonaole School at Papaikou, one of the hardest hit areas. The roof dropped 7 to 10 cm and a ceiling warp appeared between the two principal sections of the main building.

Pepeekeo.—Felt by, awakened, and frightened all in community. Loud earth noises. Trees and bushes shook; vehicles rocked. Ground cracks; landslides; water disturbed. Chimneys, tombstones, and water tanks were shaken severely. Stone wall overturned. Hanging objects swung violently. Furniture shifted, overturned, and broke. Plaster cracked, broke, and fell. Building cracked and settled. Windows cracked. Damage moderate.

INTENSITY VII

Honakaa.—Felt by all and frightened many in community. Building swayed and seemed as though it would collapse. Loud earth noises. Vehicles

rocked. Ground cracks; landslides; water disturbed. Some tombstones and elevated water tanks cracked and overturned. Hanging objects swung violently. Small objects shifted, overturned, and fell. Furniture shifted. Plaster cracked, broke, and fell in some buildings. Windows cracked in few buildings. Damage moderate. The press reported that the 3-year-old State Building had extensive interior damage. At the Honokaa School, electricity and water were off for a while; steam pot plumbing dislodged; one building was vacated temporarily owing to suspicious-looking cracks.

Kamuela.—Loud earth noises. Ground cracks; landslides. Chimneys and tombstones cracked, twisted, and overturned.

Keakealani.—School building and water tank shifted on foundations (press).

Kohala (Kapaau).—Felt by and frightened all in community. Building creaked loudly. Loud earth noises. Trees and bushes shook; vehicles rocked. Small objects shifted, overturned, and fell. Furniture shifted. Plaster cracked between ceiling and walls. Damage slight. The press reported that damage to the Kalokikiola Church was estimated at $75,000; to Kohala High School, $20,000; and to Mahukona Bridge (North Kohala district), $20,000. Miscellaneous damage to a number of houses in the North Kohala district was estimated at $45,000. Damage at Pololu Valley Lookout was estimated at $40,000 (press).

Laupahoehoe.—Felt by, awakened, and frightened all in community. Loud earth noises. Small objects fell. Furniture shifted. At the Laupohoehoe School, press reported damage at the community-school library was estimated at $25,000. Nearly all of the new library ceiling panels fell and one of the minor columns was split. Also, there was much shattering of glass panels facing makai.

Paauhau.—Felt by and frightened all in community. Loud earth noises. Trees and bushes shook; vehicles rocked. Landslides. Tombstones cracked, twisted, and overturned. Hanging objects swung violently. Small objects fell. Furniture shifted. Windows cracked.

Waimea (Hawaii Island; about 64 km northwest of Hilo).—(Press) In the Waimea area, road damage was estimated at $15,000. At the Waimea School, damage was estimated at $25,000, owing to broken lenses and light fixtures. A stone chimney fell through the roof at the Waimea Steakhouse. Police reported shattered glass and other minor damage at various other places, including two schools.

INTENSITY VI

Halaula (windows cracked), Hana (landslides; old stone walls surrounding pasture crumbled), Hana district (east Maui Island area; press reported papaya trees were knocked down), Hauula (underground pipeline broke), Hawaii National Park (press reported considerable rubble fell into famed Thurston Lava Tube, closing tube and eruption area; at eruption site, cracks widened significantly at the ledge overlooking Mauna Ulu vent eruption; landslides occurred at Kilauea caldera; few pipes shook loose; ground cracked), Keaau (plaster cracked), Kealakekua Bay (rocks fell), Kurtistown (water tank almost overturned), Maui Island (West Maui–Pali Highway; press reported rocks fell onto highway), Naalehu (damage slight), Noniloa (press reported waterpipes broke at hotel; walls cracked; damage very slight), Paauilo (walls cracked; plaster fell; damage moderate), Pahoa, Parker Ranch (shopping center; press reported damage to fallen merchandise at $500), Pohakuloa, Puainako (much fallen merchandise at stores), Volcano, West Hawaii Island (Kohala, Kona, and Kau districts; press reported rocks on several highways; old stone walls collapsed in Kona and Kau).

INTENSITY V

Aiea, Captain Cook, Haiku, Hawi (plaster cracked; damage slight), Hickam Air Force Base (Honolulu), Holualoa, Hanaunau (some plaster cracked; damage slight), Honolulu (several wall cracks), Kahului (plaster on joints opened), Kailua, Kailua Kona, Kamalo, Kaneohe and Kaneohe Marine Corps Air Station, Kaunakakai, Kaupo Ranch (small slides of loose rock), Kealakekua, Kihei, Kualapuu (Molokai), Kula, Lahaina, Makowao, Mountainview (ceiling panels in school loosened; press), Mount Haleakala Summit (Maui Island), Pahala, Puunene, Ulupalakua, Wahiawa, Wailuku, Waimanalo, and Wheeler Air Force Base (near Kunia).

INTENSITY IV

Ewa, Haliimaile, Haleiwa, Hanalei, Hoolehua, Kaaawa, Kahakuola, Kahuku, Kalaupapa, Kokee Ranger Station (northwest coastal area of Kauai Island), Kunia, Laie, Lanai City, Lihue, Makapuu Point (Coast Guard Light Station, southeast Oahu), Makawao, Maunaloa, Mount Kaala (north-

west Oahu Island), Pearl City, Puhi, Wahiawa, Waialua, Waianae, and Waipahu.

INTENSITY I-III

Eleele, Ewa Beach, Hanamaulu, Hanapepe, Kapaa, Kekaha, Kilauea, Lawai, and Waimea (Kauai Island).

Apr. 26. 23:33:38.6 (Apr. 27, 09:33). Epicenter 19°55.4′ N., 155°36.7′ W., at a depth of 9 km, mag. 4.0. Felt at Honokaa and Kamuela.

Apr. 27. 10:34:31.0 (20:34). Epicenter 19°57.3′ N., 155°01.9′ W., at a depth of 53 km, mag. 3.0. Felt at Honokaa.

May 5. 10:07:28.6 (20:07). Epicenter 19°53.7′ N., 155°02.5′ W., at a depth of about 53 km, mag. 3.8. Felt at Hilo.

May 5. 23:00:29.3 (May 6, 09:00). Epicenter 19°55.8′ N., 155°05.9′ W., at a depth of 47 km, mag. 3.8. Felt at Hilo.

May 7. 17:20:11.3 (May 8, 03:20). Epicenter 19°54.3′ N., 155°07.9′ W., at a depth of 53 km, mag. 3.5. Felt at Laupahoehoe.

May 19. 03:12:23.8 (13:12). Epicenter 19°54.4′ N., 155°10.6′ W., at a depth of 47 km, mag. 3.4. Felt at Honokaa and Kamuela.

May 29. 15:22:01.6 (May 30, 01:22). Epicenter 19°23.4′ N., 155°16.9′ W., at a depth of 14 km, mag. 3.4. Felt at Volcano.

May 30. 20:42:59.7 (May 31, 06:42). Epicenter 19°55.8′ N., 155°10.1′ W., at a depth of 45 km, mag. 3.2. Felt at Hilo, Honokaa, and Kamuela.

June 10. 19:36:27.3 (June 11, 05:36). Epicenter 19°20.4′ N., 155°19.4′ W., at a depth of 28 km, mag. 3.0. Felt at Kapapala.

June 20. 19:12:50.6 (June 21, 05:12). Epicenter 19°20.6′ N., 155°08.0′ W., at a depth of 6 km, mag. 3.3. Felt at Kapapala.

June 21. 14:26:05.9 (June 22, 00:26). Epicenter 19°17.4′ N., 155°15.9′ W., at a depth of 7 km, mag. 4.0. Felt at Ainahou Ranch, Hilo, Kapapala, and Volcano.

June 24. 02:41:25.6 (12:41). Epicenter 19°57.0′ N., 155°18.5′ W., at a depth of 49 km, mag. 3.4. Felt at Honokaa.

June 29. 22:49:06.5 (June 30, 08:49). Epicenter 19°21.1′ N., 155°13.5′ W., at a depth of 8 km, mag. 3.0. Felt at Honokaa, Kapapala, and Volcano.

July 1. 21:02:26.8 (July 2, 07:02). Epicenter 19°48.3′ N., 155°18.9′ W., at a depth of 11 km, mag. 3.2. Felt at Honokaa and Laupahoehoe.

July 1. 23:12:58.3 (July 2, 09:12). Epicenter 19°50.3′ N., 155°19.6′ W., at a depth of 17 km, mag. 3.6. Felt at Hilo, Honokaa, Laupahoehoe, and Mauna Kea Observatory.

July 4. 06:59:22.0 (16:59). Epicenter 19°53.4′ N., 155°06.5′ W., at a depth of 48 km, mag. 3.6. Felt at Honokaa, Honomu, and Kapapala.

July 14. 14:23:04.0 (July 15, 00:23). Epicenter 19°56.9′ N., 155°35.6′ W., at a depth of 47 km, mag. 3.7. Felt at Honokaa.

July 20. 04:27:49.8 (14:27). Epicenter 19°57.5′ N., 155°25.5′ W., at a depth of 12 km, mag. 3.5. Felt at Hilo, Honokaa, and Volcano.

July 27. 00:31:51.8 (10:31). Epicenter 19°19.3′ N., 155°24.4′ W., at a depth of 8 km, mag. 3.0. Felt at Kapapala.

Aug. 11. 03:18:04.3 (13:18). Epicenter 19°56.9′ N., 155°30.3′ W., at a depth of 44 km, mag. 3.7. Felt at Honokaa.

Sept. 3. 14:05:35.3 (Sept. 4, 00:05). Epicenter 19°42.5′ N., 156°05.0′ W., at a depth of 0 km, mag. 3.4. Felt at Holualoa, Honokahau, and Kealakekua.

Sept. 14. 06:27:17.9 (16:27). Epicenter 19°12.1′ N., 155°34.9′ W., at a depth of 7 km, mag. 3.3. Felt at Kapapala.

Sept. 15. 23:49:11.1 (Sept. 16, 09:49). Epicenter 19°21.4′ N., 155°16.0′ W., at a depth of 30 km, mag. 3.8. Felt at Honokaa, Kapapala, and Volcano. This epicenter has been recomputed and does not agree with that listed in table 1 of this report.

Sept. 19. 12:29:00.5 (22:29). Epicenter 19°10.9′ N., 155°32.1′ W., at a depth of 5 km, mag. 3.5. Felt at Kapapala and Pahala.

Sept. 19. 19:22:39.0 (Sept. 20, 05:22). Epicenter 19°49.3′ N., 155°36.5′ W., at a depth of 13 km, mag. 3.0. Felt at Honokaa.

Oct. 1. 06:43:06.6 (16:43). Epicenter 20°06.5′ N., 155°50.9′ W., at a depth of 33 km, mag. 3.9. Felt at Hilo, Honokaa, Honokahau, Kamuela, Kawaihae, Kealakekua, Kohala, and Puu Anahulu.

Oct. 2. 06:51:14.9 (16:51). Epicenter 20°13.4′ N., 155°30.3′ W., at a depth of 4 km, mag. 3.3. Felt at Honokaa.

Oct. 2. 07:18:14.4 (17:18) Epicenter 20°13.8′ N., 155°30.2′ W., at a depth of 6 km, mag. 3.1. Felt at Honokaa.

Oct. 9. 01:53:45.2 (11:53). Epicenter 19°19.1′ N., 155°15.9′ W., at a depth of 30 km, mag. 4.6. Felt islandwide on Hawaii.

Oct. 9. 02:01:02.4 (12:01). Epicenter 19°18.7′ N., 155°16.3′ W., at a depth of 30 km, mag. 4.3. Felt at Hilo, Honokaa, Kapapala, and Volcano.

Oct. 13. 06:11:11.6 (16:11). Epicenter 20°37.9′ N., 155°55.6′ W., at a depth of 15 km, mag. 4.3. Felt at Honokaa and Kamuela, Hawaii, and at Haleakala and Kula, Maui.

Oct. 18. 02:31:50.0 (12:31). Epicenter 19°20.4′ N., 155°15.1′ W., at a depth of 26 km, mag. 3.6. Felt at Kapapala.

Oct. 26. 07:53:19.5 (17:53). Epicenter 19°12.9′ N., 155°30.3′ W., at a depth of 7 km, mag. 4.3. Felt at Hilo, Honokaa, Kamuela, Kapapala, Pahala, South Kona, and Volcano.

Nov. 3. 11:12:41.7 (21:12). Epicenter 19°23.3′ N., 155°26.0′ W., at a depth of 8 km, mag. 4.0. Felt at Glenwood and Kapapala.

Nov. 10. 23:38:58.0 (Nov. 11, 09:38). Epicenter 20°20.2′ N., 155°26.7′ W., at a depth of 11 km, mag. 4.1. Felt at Hilo, Honokaa, and South Kona.

Nov. 28. 02:59:14.7 (12:59). Epicenter 19°17.9′ N., 155°13.4′ W., at a depth of 7 km, mag. 3.8. Felt at Hilo, Honokaa, Kapapala, Keaau, Mountainview, and Volcano.

Nov. 28. 19:29:46.6 (Nov. 29, 05:29). Epicenter 19°23.8′ N., 155°25.6′ W., at a depth of 8 km, mag. 3.2. Felt at Kapapala and Volcano.

Dec. 13. 04:25:56.0 (14:25). Epicenter 19°21.0′ N., 155°17.6′ W., at a depth of 32 km, mag. 4.6. Felt islandwide on Hawaii.

Dec. 14. 16:46:39.8 (Dec. 15, 02:46). Epicenter 19°18.9′ N., 155°13.7′ W., at a depth of 7 km, mag. 3.5. Felt at Hilo.

PANAMA CANAL ZONE

No earthquakes were reported felt in this area during 1973.

PUERTO RICO

[The time given is 60° meridian time. If an epicenter is quoted, Greenwich mean time is given in parentheses.]

Dec. 4. 20:24:49.6 (Dec. 5, 00:24). Epicenter 17.8° N., 66.4° W., Puerto Rico region, at a depth of 17 km, mag. 3.9 (m_b), USGS. Felt in the Ponce-Villalba area of south-central Puerto Rico.

VIRGIN ISLANDS

No earthquakes were reported felt in this area during 1973.

PRINCIPAL EARTHQUAKES OF THE WORLD

Table 2 lists and briefly describes the principal earthquakes of the world during 1973. This list is included in the *United States Earthquakes* series because of it is unavailable in this format in other earthquake reports. It includes earthquakes of magnitude greater than 6¾; shocks of smaller magnitude that were locally destructive and/or caused fatalities; and tremors of unusual interest.

TABLE 1.—*Instrumentally determined locations of earthquakes and related phenomena that occurred in the United States during 1973 (excluding felt and damaging earthquakes)*

[Source: *Preliminary Determination of Epicenters Monthly Listing*, published by NOAA/Environmental Research Laboratories Jan.–May 1973, and by USGS/National Earthquake Information Service June–Dec. 1973]

Date	Origin time[1] G.M.T.	Geographic coordinates N. lat.	W. long.	Region and comments[2]	Depth
	h m s	°	°		*km*
Jan. 2	08:16:12.3	62.6	143.7	Central Alaska. Mag. 3.7 M_L.	33
3	21:14:16.4	44.3	129.2	Off coast of Oregon, Mag. 5.3 m_b; 4.5 M_S.	18
5	02:24:20.3	60.1	153.0	Southern Alaska, Mag. 3.7 m_b.	105
5	12:35:56.5*	46.5	112.7	Montana.	5
6	13:42:06.1	62.6	151.3	Central Alaska. Mag. 3.7 m_b.	93
6	15:04:11.9	53.3	162.4	South of Alaska. Mag. 4.9 m_b.	33
7	04:45:06.4	60.8	150.1	Kenai Peninsula, Alaska. Mag. 3.5 M_L.	31
7	22:56:06.1J	37.4	87.3	Kentucky. Mag. 3.2, J.	15
8	09:11:36.8S	33.8	90.6	Mississippi. Mag. 3.5, J.	7
8	21:55:57.7	60.0	153.2	Southern Alaska.	124
10	01:27:30.2	62.8	149.0	Central Alaska.	107
11	02:12:27.5	52.1	169.6	Fox Islands, Aleutian Islands. Mag. 5.4 m_b; 5.2 M_S.	30
11	02:50:49.1*	52.2	169.6	Fox Islands, Aleutian Islands. Mag. 4.3 m_b.	24
11	02:52:11.4*	52.0	169.8	Fox Islands, Aleutian Islands. Mag. 4.7 m_b.	56
11	05:01:11.6*	52.2	169.6	Fox Islands, Aleutian Islands. Mag. 3.9 m_b.	22
11	06:02:35.4*	52.2	169.7	Fox Islands, Aleutian Islands. Mag. 4.3 m_b.	49
11	19:53:48.3P	35.7	118.1	Central California. Mag. 2.5, P.	8
12	01:52:27.9*	40.2	116.7	Nevada.	10
12	05:59:31.7*	56.1	135.8	Southeastern Alaska. Mag. 3.9 m_b.	33
12	06:07:15.4B	37.3	121.7	Central California. Mag. 3.3, B.	7
12	09:33:11.6*	63.1	150.6	Central Alaska.	33
13	10:55:13.1*	37.3	115.5	Southern Nevada.	8
13	18:26:19.0	37.1	115.5	.....do.	8
13	18:46:21.4P	33.5	116.5	Southern California. Mag. 3.5, P.	8
13	21:58:22.0	51.8	176.3 E.	Rat Islands, Aleutian Islands. Mag. 5.0 m_b.	52
14	04:58:42.6	62.9	151.2	Central Alaska. Mag. 3.2, M_L.	33
15	01:44:10.2	51.9	178.2 E.	Rat Islands, Aleutian Islands. Mag. 4.3 m_b.	117
15	04:41:13.3	44.6	111.3	Hebgen Lake, Mont., region.	33
15	14:41:22.3B	36.7	121.4	Central California. Mag. 3.5, B.	8
15	19:32:39.0*	36.3	114.9	Southern Nevada.	10
16	10:33:00.4*	40.8	125.1	Off coast of nothern California. Mag. 4.2 m_b.	33
18	21:23:41.0	63.0	149.7	Central Alaska.	93
18	21:34:30.5*	60.1	153.4	Southern Alaska. Mag. 4.0 m_b.	144
19	00:50:57.3	57.1	153.9	Kodiak Island region. Mag. 4.9 m_b.	32
19	04:36:04.5	64.8	149.3	Central Alaska.	12
21	16:06:45.5	58.3	151.8	Kodiak Island region. Mag. 4.7 M_L.	29
21	21:59:19.8	57.1	152.5	Kodiak Island region. Mag. 4.2 m_b.	79
22	05:10:18.8*	54.3	162.8	Alaska Peninsula. Mag. 4.2 m_b.	60
22	08:07:18.9*	37.3	113.8	Utah. Mag. 2.5 M_L.	5
22	11:23:53.2*	37.3	113.7	Utah.	5
22	13:39:54.6	62.0	149.5	Central Alaska. Mag. 3.6 m_b.	57
23	13:05:37.9B	35.9	120.5	Central California. Mag. 3.3, B; 3.5, P.	18
24	15:54:43.7	60.1	152.0	Southern Alaska.	72
25	16:50:42.2*	52.6	170.9	Fox Islands, Aleutian Islands. Mag. 4.1 m_b.	90
26	07:40:55.9	51.0	179.2	Andreanof Islands, Aleutian Islands. Mag. 4.4 m_b.	46
27	13:55:14.4P	34.4	118.4	Southern California. Mag. 3.5, P.	8
29	05:53:28.8*	61.0	146.7	Southern Alaska. Mag. 3.0 M_L.	33

* See footnotes at end of table.

TABLE 1.—*Instrumentally determined locations of earthquakes and related phenomena that occurred in the United States during 1973 (excluding felt and damaging earthquakes)*—Continued

Date	Origin time[1] G.M.T.	Geographic coordinates N. lat.	W. long.	Region and comments[2]	Depth
	h m s	°	°		*km*
Feb. 2	03:11:02.7	60.1	152.9	Southern Alaska. Mag. 3.5 m_b.	103
2	17:12:43.3	60.3	153.7	Southern Alaska.	186
3	05:15:27.0	37.4	115.7	Southern Nevada.	5
3	19:52:57.4	51.4	179.0	Andreanof Islands, Aleutian Islands. Mag. 4.7 m_b.	60
3	23:45:13.3P	34.1	116.8	Southern California. Mag. 3.0, P.	8
4	02:30:50.3P	34.4	118.4	Southern California. Mag. 3.2, P.	8
4	07:09:12.2	63.1	150.8	Central Alaska.	111
5	04:52:15.1	62.3	150.8	.....do.	96
5	17:36:02.8	66.3	157.5	Alaska. Mag. 4.3 m_b	56
6	01:00:51.8P	33.6	118.4	Southern California. Mag. 3.5, P.	8
6	02:19:00.6	41.8	126.8	Off coast of northern California. Mag. 4.7 m_b.	33
6	14:14:10.7*	66.2	142.1	Alaska. Mag. 3.1 M_L.	37
6	20:29:34.8	60.0	152.7	Southern Alaska.	134
7	15:26:44.2	59.4	143.3	Gulf of Alaska. Mag. 3.9 M_L.	33
9	07:41:05.7P	34.1	116.1	Southern California. Mag. 3.3, P.	8
9	09:39:29.9	62.1	151.2	Central Alaska. Mag. 3.6 m_b.	95
9	12:34:12.4*	57.1	155.9	Alaska Peninsula. Mag. 4.3 m_b.	103
9	14:09:53.1	62.3	150.7	Central Alaska. Mag. 3.0 M_L.	34
9	17:38:37.0*	36.4	110.4	Eastern Arizona. Mag. 3.2 M_L.	5
9	23:09:51.9	36.8	115.9	California-Nevada border region.	5
10	16:32:37.0*	38.1	113.3	Utah.	5
11	04:02:39.8	36.8	116.0	California-Nevada border region	5
11	06:38:54.9	36.8	115.9	.....do.	4
12	12:12:24.1	50.1	178.0	Andreanof Islands, Aleutian Islands. Mag. 4.6 m_b.	24
13	20:21:50.0	36.8	115.9	California-Nevada border region.	5
14	04:00:50.8	38.1	113.1	Utah.	10
14	04:26:29.8	38.1	113.2	.....do.	10
14	06:11:46.8*	44.6	111.6	Hebgen Lake, Mont., region.	15
14	07:11:32.0	53.8	158.9	South of Alaska. Mag. 4.9 m_b.	32
14	13:57:53.0	43.9	111.2	Eastern Idaho.	16
15	00:15:45.9	36.8	115.9	California-Nevada border region.	9
16	02:25:23.8	53.0	150.6	Central Alaska. Mag. 3.8 M_L.	109
16	05:32:53.6	36.8	115.9	California-Nevada border region.	6
18	05:16:01.5*	52.8	163.9	South of Alaska. Mag. 4.5 m_b.	33
18	08:31:34.8	58.2	152.7	Kodiak Island region. Mag. 3.8 m_b.	71
18	09:31:40.8	38.1	113.2	Utah.	19
18	10:23:47.5	63.5	151.6	Central Alaska.	33
18	14:48:01.6*	63.4	151.1	.....do.	33
18	18:04:44.3	36.8	115.9	California-Nevada border region. Mag. 4.0, P; 3.8, B.	11
19	03:10:41.6	36.8	115.9	California-Nevada border region.	6
19	11:15:21.7	36.8	115.9	California-Nevada border region. Mag. 4.0, B.	6
19	11:39:00.4	36.8	115.9	California-Nevada border region.	6
19	12:22:31.7	36.8	115.9	.....do.	3
19	12:55:56.7	36.8	115.9	.....do.	5
19	13:43:19.0	36.8	115.9	.....do.	4
19	14:07:17.3	59.9	153.4	Southern Alaska.	143
19	14:41:07.7	36.8	115.9	California-Nevada border region.	3
19	17:27:06.2	36.8	115.9	.....do.	3
19	17:32:33.3	36.8	115.9	.....do.	5
19	17:46:11.7*	36.8	115.8	.....do.	12
19	18:25:01.9	36.8	115.9	.....do.	11

* See footnotes at end of table.

TABLE 1.—*Instrumentally determined locations of earthquakes and related phenomena that occurred in the United States during 1973 (excluding felt and damaging earthquakes)*—Continued

Date	Origin time[1] G.M.T.	Geographic coordinates N. lat.	W. long.	Region and comments[2]	Depth
	h m s	°	°		*km*
Feb. 19	18:53:02.0*	36.8	115.8	California-Nevada border region	15
19	19:35:46.0*	36.8	115.9	.....do.	3
19	20:58:08.3	36.8	115.9	.....do.	4
19	23:06:22.0*	64.1	146.9	Central Alaska. Mag. 2.3 M_L.	33
20	07:40:34.7	58.3	149.8	Gulf of Alaska. Mag. 5.1 M_S; 5.5 m_b.	12
20	10:49:05.0P	32.7	115.9	California-Mexico border region. Mag. 3.5, P.	8
20	15:43:08.1	36.8	115.9	California-Nevada border region.	8
21	00:28:09.2	36.8	115.9	.....do.	5
21	04:30:11.0*	36.8	115.9	.....do.	5
21	09:57:46.9	36.8	115.9	.....do.	5
21	10:01:07.5*	36.8	115.9	.....do.	5
21	11:05:08.6	36.8	115.9	.....do.	4
21	14:55:08.0P	34.0	119.0	Southern California. Mag. 3.8, P.	18
21	14:56:45.0P	34.1	119.0	Southern California. Mag. 4.1, P.	16
21	15:59:26.8P	34.1	119.0	Southern California. Mag. 3.8, P.	15
21	18:15:46.1	36.8	115.9	California-Nevada border region.	7
21	23:55:03.1P	34.1	119.0	Southern California. Mag. 3.4, P.	12
22	00:14:41.8P	34.0	118.9	.....do.	12
22	01:23:24.2*	36.8	115.9	California-Nevada border region.	9
22	04:16:47.0P	34.1	119.0	Southern California. Mag. 3.0, P.	12
22	09:30:19.4P	34.0	119.0	Southern California. Mag. 4.0, P.	17
22	13:17:50.3*	45.1	113.3	Montana.	33
23	04:13:19.1*	36.8	115.9	California-Nevada border region.	8
23	08:10:39.9	61.5	150.8	Southern Alaska. Mag. 3.1 m_b.	64
24	23:24:08.8P	34.4	116.3	Southern California. Mag. 3.1, P.	8
25	03:14:20.6*	40.3	124.1	Near coast of northern California. Mag. 3.6, B.	10
25	04:09:25.2*	36.8	115.8	California-Nevada border region.	12
25	04:11:31.3*	36.8	115.9	.....do.	9
25	05:41:41.9P	33.2	116.8	Southern California. Mag. 3.5, P.	8
25	06:35:58.7*	36.8	115.9	California-Nevada border region.	2
25	07:34:14.9*	37.4	115.7	Southern Nevada.	10
25	13:00:41.0*	36.8	115.9	California-Nevada border region.	5
25	15:38:37.4*	36.8	115.9	.....do.	5
25	20:25:42.6*	36.8	115.9	.....do.	5
26	03:55:10.1*	36.7	115.3	California-Nevada border region. Mag. 3.6 m_b.	5
26	04:09:08.0*	36.8	115.9	California-Nevada border region.	5
26	08:34:47.8*	36.8	115.9	.....do.	5
26	19:16:21.7	63.1	150.4	Central Alaska.	111
27	00:52:29.1	61.9	151.0	Southern Alaska.	70
27	01:55:48.1*	36.8	115.9	California-Nevada border region.	5
27	02:43:09.6*	36.8	115.9	.....do.	9
27	03:43:28.6	36.8	115.9	.....do.	5
27	06:50:35.0	59.5	152.7	Southern Alaska.	100
27	08:38:49.6*	36.8	115.9	California-Nevada border region.	5
27	09:47:07.9	36.8	115.9	.....do.	5
27	09:55:21.8*	36.8	115.8	.....do.	5
27	11:50:35.2	36.8	115.9	.....do.	8
27	13:03:01.0	36.8	115.9	.....do.	9
27	18:05:53.2	52.5	168.7	Fox Islands, Aleutian Islands. Mag. 4.7 m_b.	47
27	18:17:07.4	52.5	168.6	Fox Islands, Aleutian Islands. Mag. 3.9 m_b.	47
27	19:01:39.4*	36.8	115.8	California-Nevada border region	11

* See footnotes at end of table.

TABLE 1.—*Instrumentally determined locations of earthquakes and related phenomena that occurred in the United States during 1973 (excluding felt and damaging earthquakes)*—Continued

Date	Origin time[1] G.M.T.	Geographic coordinates N. lat.	W. long.	Region and comments[2]	Depth
	h m s	°	°		*km*
Feb. 28	02:00:34.1*	36.8	115.9	California-Nevada border region	5
28	03:34:17.7*	36.8	115.9	.....do.	3
28	08:00:06.9	36.8	115.9	.....do.	5
28	11:01:15.6	36.8	115.9	.....do.	4
28	19:03:51.2	65.6	150.0	Alaska.	39
28	21:42:29.1	53.6	164.3	Unimak Island region. Mag. 4.5 m_b.	33
Mar. 1	06:00:19.2	44.8	111.1	Hebgen Lake, Mont., region. Mag. 4.3 m_b.	5
1	06:12:27.5	36.8	115.9	California-Nevada border region.	5
1	11:38:10.7*	51.4	179.2	Andreanof Islands, Aleutian Islands. Mag. 4.3 m_b.	47
2	10:47:51.6*	51.6	178.1 E.	Rat Islands, Aleutian Islands. Mag. 3.7 m_b.	73
2	11:28:42.3	41.8	118.5	Nevada. Mag. 4.6, B.	5
3	03:00:03.3	41.8	118.5	.....do.	5
3	03:34:51.0	41.8	118.7	Nevada. Mag. 4.0, B.	5
3	18:52:04.3	41.8	118.4	.....do.	5
5	08:30:49.2	63.7	148.4	Central Alaska. Mag. 4.0 m_b.	106
5	08:34:14.7	37.0	115.1	Southern Nevada.	5
5	13:43:08.9	61.4	144.2	Southern Alaska. Mag. 3.6 m_b.	44
5	15:52:50.8*	57.9	151.9	Kodiak Island region. Mag. 3.0 M_L.	10
6	08:16:00.8*	40.4	125.6	Off coast of northern California. Mag. 3.4, B.	33
7	01:22:00.4	59.8	153.5	Southern Alaska.	142
7	02:15:34.4*	57.4	153.6	Kodiak Island region.	86
7	18:11:31.2	62.2	151.2	Central Alaska.	78
8	01:10:24.7*	51.9	179.3	Andreanof Islands, Aleutian Islands. Mag. 4.6 m_b.	103
8	11:21:47.9*	51.2	179.6 E.	Rat Islands, Aleutian Islands. Mag. 3.8 m_b.	38
8	16:10:00.2A	37.1	116.0	Southern Nevada. Nevada Test Site. Mag. 5.4, B.	0
10	04:34:08.4	62.0	150.8	Central Alaska.	73
10	05:03:08.7	38.2	113.2	Utah.	5
10	12:32:30.9	63.1	150.8	Central Alaska.	143
11	19:45:32.6*	60.3	151.3	Kenai Peninsula, Alaska.	68
12	03:20:16.8*	52.6	168.1	Fox Islands, Aleutian Islands. Mag. 4.8 m_b.	15
12	12:50:00.8*	40.4	124.3	Near coast of northern California. Mag. 4.3 m_b.	33
12	15:08:37.0P	36.0	117.1	California-Nevada border region. Mag. 3.3, P.	8
13	11:17:05.8	36.8	115.9	California-Nevada border region.	10
13	22:31:33.6	36.8	115.9	.....do.	3
14	10:31:02.5*	58.4	149.5	Gulf of Alaska. Mag. 3.6 M_L.	33
14	21:01:50.5	63.6	150.8	Central Alaska.	34
15	07:51:37.5*	53.1	168.4	Fox Islands, Aleutian Islands. Mag. 3.7 m_b.	56
15	22:48:47.1	60.6	150.8	Kenai Peninsula, Alaska. Mag. 3.0 M_L.	37
16	02:49:19.4	62.2	151.1	Central Alaska. Mag. 4.3 m_b.	72
16	09:12:41.9*	61.1	147.7	Southern Alaska. Mag. 3.8 M_L.	46
17	00:54:35.8P	34.0	119.0	Southern California. Mag. 3.7, P.	8
17	21:55:43.0	63.1	150.5	Central Alaska.	132
19	01:53:37.9	36.8	115.9	California-Nevada border region.	10
19	02:13:48.5P	33.6	118.4	Southern California. Mag. 3.5, P.	8
19	07:51:16.7	59.4	145.8	Gulf of Alaska. Mag. 3.3 M_L.	36
19	08:22:22.6	59.4	145.5	Gulf of Alaska. Mag. 3.9 M_L.	35
20	06:59:33.2	52.9	166.7	Fox Islands, Aleutian Islands. Mag. 4.7 m_b.	16
20	19:17:02.8*	40.3	125.9	Off coast of northern California. Mag. 4.2, B.	33
20	19:40:17.4*	59.5	152.9	Southern Alaska.	128
21	09:30:12.0*	59.8	153.5	.....do.	141
22	21:24:23.3	51.1	179.4	Andreanof Islands, Aleutian Islands. Mag. 4.2 m_b.	51

* See footnotes at end of table.

TABLE 1.—*Instrumentally determined locations of earthquakes and related phenomena that occurred in the United States during 1973 (excluding felt and damaging earthquakes)*—Continued

Date	Origin time [1] G.M.T.	Geographic coordinates N. lat.	W. long.	Region and comments [2]	Depth
	h m s	°	°		*km*
Mar. 23	09:19:48.6	61.1	148.4	Southern Alaska. Mag. 3.0 M_L.	30
23	11:42:08.7	65.4	148.2	Alaska. Mag. 2.6 M_L.	19
23	13:56:07.8*	51.2	174.0 E.	Near Islands, Aleutian Islands. Mag. 4.4 m_b.	33
23	16:15:47.1	62.6	151.5	Central Alaska.	113
24	05:31:08.1P	33.0	116.4	Southern California. Mag. 3.0, P.	8
24	07:51:43.5	63.2	150.8	Central Alaska. Mag. 4.2 m_b.	122
24	08:11:31.5P	34.5	116.5	Southern California. Mag. 3.0, P.	8
24	08:23:30.4P	34.4	116.5	Southern California.	8
24	23:20:04.5*	44.0	110.2	Yellowstone National Park, Wyo.	10
25	07:30:24.2	51.4	174.1 E.	Near Islands, Aleutian Islands. Mag. 4.9 m_b.	33
25	09:56:21.5*	44.1	110.2	Yellowstone National Park, Wyo.	10
25	11:25:38.1*	51.4	174.0 E.	Near Islands, Aleutian Islands. Mag. 4.6 m_b.	33
25	16:33:13.1	44.5	110.5	Yellowstone National Park, Wyo. Mag. 3.4 m_b.	10
25	18:09:31.0*	58.4	151.1	Kodiak Island region. Mag. 3.9 M_L.	28
25	21:53:52.0P	33.4	117.0	Southern California. Mag. 3.0, P.	8
26	02:10:11.2	51.6	173.6	Andreanof Islands, Aleutian Islands. Mag. 4.1 m_b.	44
26	04:09:12.1*	44.4	110.4	Yellowstone National Park, Wyo.	10
26	07:46:32.9*	67.3	161.0	Alaska. Mag. 4.3 m_b.	44
27	01:00:19.0	37.4	115.7	Southern Nevada.	6
27	01:42:41.3P	34.7	121.5	Off coast of California. Mag. 3.3, P.	8
27	03:41:04.0	41.2	126.1	Off coast of northern California. Mag. 4.2, B; 3.7 M_S.	10
27	10:03:10.2	44.4	110.4	Yellowstone National Park, Wyo.	10
27	10:44:56.6P	34.3	116.3	Southern California. Mag. 3.2, P.	8
27	12:31:06.7	44.4	110.4	Yellowstone National Park, Wyo.	10
27	12:43:51.3*	44.4	110.5	.....do.....	10
27	19:02:13.3	44.4	110.5	.....do.....	10
28	03:02:30.1*	44.4	110.4	Yellowstone National Park, Wyo. Mag. 4.5 m_b.	10
28	10:07:02.9	44.4	110.5	Yellowstone National Park, Wyo. Mag. 4.0 m_b.	10
28	11:31:29.1*	37.9	118.2	California-Nevada border region.	5
28	11:51:41.7*	36.8	115.9	.....do.....	5
28	15:38:43.0*	44.2	110.4	Yellowstone National Park, Wyo.	10
29	10:40:26.3*	44.1	110.2	.....do.....	10
29	11:19:45.9*	61.0	146.4	Southern Alaska.	70
29	17:54:16.7P	34.4	119.7	Southern California. Mag. 3.7, P; 3.8, B.	8
29	21:35:34.7P	34.0	118.5	Southern California. Mag. 3.3, P.	8
30	00:10:40.7	44.3	110.4	Yellowstone National Park, Wyo.	10
30	01:32:14.4	44.4	110.4	Yellowstone National Park, Wyo. Mag. 3.7 m_b.	10
30	01:55:16.5*	44.6	110.6	Yellowstone National Park, Wyo.	10
30	02:13:27.9*	44.6	110.6	.....do.....	10
30	06:59:17.0*	44.4	110.4	.....do.....	10
30	14:16:34.0*	38.5	117.7	Nevada.	5
30	14:36:25.2*	44.1	110.3	Yellowstone National Park, Wyo.	10
30	20:18:59.0	44.4	110.5	.....do.....	10
31	05:54:33.0*	57.0	152.4	Kodiak Island region. Mag. 3.4 m_b.	65
31	16:13:15.2*	44.4	110.6	Yellowstone National Park, Wyo.	10
31	20:33:33.5	44.5	110.5	Yellowstone National Park, Wyo. Mag. 5.1 m_b.	10
Apr. 1	09:44:08.1	44.4	110.4	Yellowstone National Park, Wyo.	5
1	13:22:10.9	19.2	64.3	Virgin Islands. Mag. 4.4 M_S; 4.7 m_b.	33
1	18:25:44.8	19.3	64.2	Virgin Islands. Mag. 4.6 M_S; 4.7 m_b.	34
2	00:42:45.0*	53.2	162.3	South of Alaska. Mag. 4.2 m_b.	33
2	18:57:43.1*	44.4	110.4	Yellowstone National Park, Wyo.	5

* See footnotes at end of table.

TABLE 1.—*Instrumentally determined locations of earthquakes and related phenomena that occurrred in the United States during 1973 (excluding felt and damaging earthquakes)*—Continued

Date	Origin time [1] G.M.T.	Geographic coordinates N. lat.	W. long.	Region and comments [2]	Depth
	h m s	°	°		*km*
Apr. 2	19:48:40.3*	44.4	110.4	Yellowstone National Park, Wyo.	5
3	01:29:06.5	63.1	150.5	Central Alaska.	117
4	03:42:39.0	61.5	151.9	Southern Alaska.	109
4	15:14:30.0*	44.6	110.6	Yellowstone National Park, Wyo.	5
4	15:43:26.6	63.0	150.8	Central Alaska. Mag. 4.2 m_b.	124
4	17:05:02.3	62.2	151.4	Central Alaska.	46
5	10:20:05.4	60.1	151.2	Kenai Peninsula, Alaska.	88
5	16:30:24.7	44.4	110.5	Yellowstone National Park, Wyo.	5
6	12:22:06.9*	51.3	174.1 E.	Near Islands, Aleutian Islands. Mag. 4.2 m_b.	33
6	17:54:32.4*	69.5	144.4	Alaska.	33
6	18:28:56.9	51.8	173.5	Andreanof Islands, Aleutian Islands. Mag. 4.9 M_L.	21
6	18:46:13.7*	51.6	173.3	Andreanof Islands, Aleutian Islands. Mag. 4.7 m_b.	40
6	23:46:08.7*	44.7	110.6	Yellowstone National Park, Wyo.	5
7	07:24:54.5	64.7	160.2	Central Alaska.	33
7	19:16:49.9*	44.1	110.2	Yellowstone National Park, Wyo.	5
7	22:51:13.7P	34.3	116.3	Southern California. Mag. 3.2, P.	8
8	11:32:20.0*	64.7	160.0	Central Alaska.	33
9	09:46:25.6P	34.3	116.3	Southern California. Mag. 3.0, P.	8
9	10:30:58.7	44.1	110.5	Yellowstone National Park, Wyo. Mag. 3.6 m_b.	5
9	13:44:08.0	51.8	178.3 E.	Rat Islands, Aleutian Islands. Mag. 4.1 m_b.	66
10	05:09:22.7	63.6	149.8	Central Alaska. Mag. 3.6 m_b.	120
10	19:01:03.7*	52.2	177.1	Andreanof Islands, Aleutian Islands. Mag. 4.0 m_b.	217
11	10:40:53.2*	51.1	178.1 E.	Rat Islands, Aleutian Islands. Mag. 4.7 m_b.	43
12	03:15:06.9	44.4	110.5	Yellowstone National Park, Wyo.	10
12	03:19:59.7	44.4	110.5	.....do.....	10
12	03:24:14.2	44.4	110.5	Yellowstone National Park, Wyo. Mag. 4.2 m_b.	10
12	05:41:42.6	51.7	179.9	Andreanof Islands, Aleutian Islands. Mag. 3.8 m_b.	111
12	10:57:48.3*	35.4	113.7	Western Arizona.	8
12	13:57:02.8P	34.3	116.3	Southern California. Mag. 3.7, P.	8
12	21:22:33.3P	34.3	116.4	Southern California. Mag. 3.0, P.	8
13	03:31:07.0*	38.2	117.1	Nevada.	13
13	04:36:59.2*	36.0	116.1	California–Nevada border region.	8
13	06:50:37.3	42.1	112.6	Eastern Idaho.	10
13	08:45:32.3P	35.7	116.5	Central California. Mag. 3.0, P.	8
13	21:17:52.6	41.9	106.7	Wyoming.	10
13	23:35:40.6*	61.2	146.8	Southern Alaska.	57
14	14:09:57.4*	60.6	150.6	Kenai Peninsula, Alaska. Mag. 3.5 m_b.	57
14	18:44:44.8*	59.8	146.7	Gulf of Alaska.	87
15	19:18:55.8*	52.8	172.7 E.	Near Islands, Aleutian Islands. Mag. 4.1 m_b.	79
16	02:43:51.3	59.8	153.4	Southern Alaska.	146
16	20:47:41.1*	60.8	150.7	Kenai Peninsula, Alaska. Mag. 3.2 M_L.	33
17	09:08:57.1*	51.5	179.6 E.	Rat Islands, Aleutian Islands. Mag. 3.9 m_b.	66
17	19:41:38.5	59.7	146.3	Gulf of Alaska. Mag. 3.6 m_b.	11
18	06:40:15.6	60.9	152.9	Southern Alaska. Mag. 3.8 m_b.	146
18	11:20:43.0	62.5	152.0	Central Alaska. Mag. 3.0 M_L.	33
18	12:21:53.3J	38.5	90.2	Eastern Missouri. Mag. 2.5, J.	15
19	10:25:30.8P	34.7	118.7	Southern California. Mag. 3.5, P.	8
19	16:59:42.7E	34.3	112.6	Western Arizona. Chemical explosion. Mag. 4.5 m_b.	0
20	00:49:33.8	36.5	118.0	Central California.	8
20	03:44:44.4	37.1	118.2	California–Nevada border region.	10
20	12:38:51.7*	57.7	156.0	Alaska Peninsula.	157

* See footnotes at end of table.

TABLE 1.—*Instrumentally determined locations of earthquakes and related phenomena that occurred in the United States during 1973 (excluding felt and damaging earthquakes)*—Continued

Date	Origin time [1] G.M.T.	Geographic coordinates N. lat.	W. long.	Region and comments [2]	Depth
	h m s	°	°		*km*
Apr. 20	19:06:54.1*	43.9	111.1	Eastern Idaho.	17
21	05:50:40.4*	37.1	118.3	California-Nevada border region.	8
21	08:00:11.5	44.4	110.4	Yellowstone National Park, Wyo. Mag. 3.6 m_b.	10
22	03:40:54.1	63.6	150.9	Central Alaska. Mag. 4.5 M_L; 4.4 m_b.	14
22	05:27:56.6*	44.8	160.4	Alaska Peninsula. Mag. 4.2 m_b.	33
22	15:00:38.0*	52.7	175.2	Andreanof Islands, Aleutian Islands. Mag. 3.9 m_b.	211
22	21:44:55.4*	51.0	179.9	Andreanof Islands, Aleutian Islands. Mag. 4.0 m_b.	45
22	22:45:11.9*	51.0	179.9	Andreanof Islands, Aleutian Islands. Mag. 4.1 m_b.	42
23	00:30:08.6	52.5	175.8	Andreanof Islands, Aleutian Islands. Mag. 3.6 m_b.	178
23	06:58:36.3	37.3	115.2	Southern Nevada.	5
23	08:35:40.3*	37.2	115.2	.....do.	5
23	20:53:38.8*	66.4	157.5	Alaska.	33
25	22:25:00.0A	37.0	116.0	Southern Nevada. Mag. 4.3, B.	0
26	15:15:00.8*	37.0	116.0	Southern Nevada. Mag. 4.1 m_b.	5
26	17:15:00.2A	37.1	116.1	Southern Nevada. Mag. 5.3, B.	0
27	11:00:19.8*	43.6	127.1	Off coast of Oregon. Mag. 4.9 m_b.	33
27	22:53:30.3	60.2	153.2	Southern Alaska.	149
28	02:30:32.2*	52.4	175.8	Andreanof Islands, Aleutian Islands. Mag. 3.7 m_b.	167
28	17:01:30.1	61.6	151.5	Southern Alaska.	97
28	22:13:16.9*	37.5	118.5	California-Nevada border region.	5
29	04:55:10.4*	50.8	178.7	Andreanof Islands, Aleutian Islands. Mag. 3.7 m_b.	33
May 1	20:16:38.3*	50.0	178.5	Andreanof Islands, Aleutian Islands. Mag. 4.6 M_L.	33
2	07:58:59.6	61.8	151.3	Southern Alaska.	85
3	10:09:47.7P	34.2	116.2	Southern California. Mag. 3.6, P.	8
4	02:35:19.2*	19.0	65.0	Puerto Rico region. Mag. 4.1 m_b.	54
4	07:38:44.7	64.7	149.4	Central Alaska. Mag. 3.3 M_L.	22
4	10:30:10.0	64.7	149.5	Central Alaska. Mag. 3.1 M_L.	24
6	07:02:24.2	57.2	153.2	Kodiak Island region. Mag. 4.4 m_b.	53
6	10:00:16.9*	56.8	153.2	Kodiak Island region. Mag. 3.9 m_b.	95
6	10:54:08.4	63.2	150.7	Central Alaska.	154
6	18:16:57.3	59.5	152.1	Southern Alaska. Mag. 3.9 m_b.	70
7	17:39:45.7	65.4	150.0	Alaska. Mag. 3.4 M_L.	39
8	10:26:11.2	63.1	150.7	Central Alaska. Mag. 3.5 m_b.	125
8	12:41:26.0P	34.3	116.3	Southern California. Mag. 3.6, P.	8
9	11:53:51.3P	34.2	116.2	Southern California. Mag. 3.0, P.	8
9	17:00:06.2*	61.3	143.3	Southern Alaska. Mag. 3.6 M_L.	33
10	05:32:24.4P	35.9	117.2	Central California. Mag. 3.1, P.	8
10	13:30:48.7P	33.4	116.3	Southern California. Mag. 3.1, P.	8
12	06:05:10.0*	58.4	151.7	Kodiak Island region. Mag. 3.8 M_L.	48
12	07:05:16.6*	53.6	163.7	Unimak Island region. Mag. 4.3 m_b.	33
12	07:13:58.6*	53.4	163.9	Unimak Island region. Mag. 3.9 m_b.	33
12	07:23:49.4	53.5	163.7	Unimak Island region. Mag. 4.5 m_b.	30
12	14:47:09.6	62.1	149.7	Central Alaska. Mag. 3.3 m_b.	59
12	21:55:23.5P	34.0	119.0	Southern California. Mag. 3.4, P.	8
12	23:39:50.4	37.4	114.2	Southern Nevada.	10
13	06:12:01.5*	41.9	126.7	Off coast of northern California. Mag. 4.5 m_b.	33
14	01:01:08.5	37.3	114.2	Southern Nevada.	10
14	22:33:37.4	63.8	148.5	Central Alaska.	112
15	15:21:01.5	38.0	114.7	Nevada.	10
16	05:03:01.3*	60.5	151.7	Kenai Peninsula, Alaska.	73
16	11:44:03.7	63.3	150.3	Central Alaska. Mag. 2.6 M_L.	33

* See footnotes at end of table.

TABLE 1.—*Instrumentally determined locations of earthquakes and related phenomena that occurred in the United States during 1973 (excluding felt and damaging earthquakes)*—Continued

Date	Origin time [1] G.M.T.	Geographic coordinates N. lat.	W. long.	Region and comments [2]	Depth
	h m s	°	°		*km*
May 16	22:45:13.2	61.7	149.9	Southern Alaska. Mag. 3.0 M_L.	38
17	16:00:00.0A	39.8	108.4	Colorado. Underground explosion. Mag. 5.7, B; 4.1 M_S.	0
18	10:54:15.8	63.5	147.9	Central Alaska.	3
20	16:20:06.8	37.9	113.5	Utah.	6
21	05:36:29.8	61.8	150.2	Southern Alaska.	51
23	17:48:59.0	64.0	150.7	Central Alaska. Mag. 3.7 M_L.	34
24	09:45:32.0B	36.8	121.6	Central California. Mag. 3.1, B.	2
24	10:33:36.1	59.9	148.8	Kenai Peninsula, Alaska. Mag. 3.9 M_L.	33
24	13:30:00.7*	37.2	116.1	Southern Nevada. Mag. 3.9, B.	5
24	22:36:34.8	51.9	173.4	Andreanof Islands, Aleutian Islands. Mag. 4.4 m_b.	50
25	00:02:03.8	51.8	173.4	Andreanof Islands, Aleutian Islands. Mag. 4.1 m_b.	24
25	02:57:50.1	51.7	173.3	Andreanof Islands, Aleutian Islands. Mag. 4.5 m_b.	45
25	03:10:15.0	63.2	150.7	Central Alaska. Mag. 4.0 m_b.	118
25	06:14:09.4*	51.6	173.3	Andreanof Islands, Aleutian Islands. Mag. 4.5 m_b.	47
25	11:36:25.9	43.3	126.8	Off coast of Oregon. Mag. 4.2 m_b.	33
25	13:17:26.1	53.2	161.3	South of Alaska. Mag. 4.9 m_b.	39
25	23:07:51.2	60.4	152.6	Southern Alaska. Mag. 3.4 m_b.	98
26	13:12:10.1	51.3	179.7	Andreanof Islands, Aleutian Islands. Mag. 4.9 m_b.	56
26	23:46:34.9	32.6	118.0	Off coast of California. Mag. 4.3, P.	10
27	02:39:27.0	37.3	115.1	Southern Nevada.	5
27	10:12:40.8*	36.9	114.9	.....do.	5
27	21:59:22.5*	39.3	115.1	Nevada.	5
28	01:53:55.4	59.8	153.3	Southern Alaska.	129
28	18:14:11.3*	51.8	173.8	Andreanof Islands, Aleutian Islands. Mag. 3.7 m_b.	54
29	01:45:26.8	51.2	179.9	Andreanof Islands, Aleutian Islands. Mag. 4.1 m_b.	46
29	01:46:44.9	51.7	176.2 E.	Rat Islands, Aleutian Islands. Mag. 5.5, B; 5.7 M_S.	46
29	05:12:02.6*	51.3	176.0 E.	Rat Islands, Aleutian Islands. Mag. 3.9 m_b.	42
29	21:34:13.1*	42.4	107.1	Wyoming.	33
29	22:04:22.7*	40.0	115.2	Nevada.	5
30	17:33:51.0	26.3	110.7	Gulf of California. Mag. 5.0, B.	33
30	21:45:16.7*	41.9	106.7	Wyoming.	33
31	05:34:13.7*	40.6	119.3	Nevada.	5
31	14:35:18.7	58.1	148.7	Gulf of Alaska. Mag. 3.2 M_L; 3.6 m_b.	33
31	17:36:52.9	51.3	176.3 E.	Rat Islands, Aleutian Islands. Mag. 5.0 M_S; 4.8 m_b.	10
June 1	02:42:25.2	57.0	153.3	Kodiak Island region. Mag. 4.0 m_b.	51
1	21:22:21.3	41.9	106.7	Wyoming.	5
4	00:20:16.3	60.1	147.2	Southern Alaska. Mag. 3.3 M_L.	14
4	02:42:39.4*	51.7	176.3 E.	Rat Islands, Aleutian Islands. Mag. 4.3 m_b.	20
4	16:21:22.8	51.6	174.6 E.	Near Islands, Aleutian Islands. Mag. 4.5 m_b.	48
5	02:58:15.3	54.0	164.0	Unimak Island region. Mag. 4.8 m_b.	17
5	03:37:14.6	63.6	150.9	Central Alaska. Mag. 3.1 M_L.	38
5	09:11:02.2B	37.4	118.6	California-Nevada border region. Mag. 3.3, B.	2
5	17:00:00.2A	37.2	116.2	Southern Nevada. Nevada Test Site. Mag. 4.8, B.	0
6	06:20:35.9B	39.8	122.1	Northern California. Mag. 3.6, B.	3
6	07:21:41.9*	52.2	170.2	Fox Islands, Aleutian Islands. Mag. 4.4 m_b.	33
6	13:00:00.1A	37.2	116.3	Southern Nevada. Nevada Test Site. Mag. 5.5, B.	0
6	17:22:22.1*	43.4	126.1	Off coast of Oregon. Mag. 4.5 m_b.	33
7	21:57:58.5*	58.7	152.8	Kodiak Island region.	144
9	12:37:26.2	45.0	111.1	Montana.	5
10	06:38:18.0*	36.3	118.0	Central California.	5
10	22:22:07.7	37.2	116.3	Southern Nevada.	5

* See footnotes at end of table.

TABLE 1.—*Instrumentally determined locations of earthquakes and related phenomena that occurred in the United States during 1973 (excluding felt and damaging earthquakes)*—Continued

Date	Origin time[1] G.M.T.	Geographic coordinates N. lat.	W. long.	Region and comments[2]	Depth
	h m s	°	°		*km*
June 11	07:56:21.9	37.2	116.3	Southern Nevada	10
12	04:51:09.0	63.6	148.0	Central Alaska.	11
12	06:48:51.8	37.2	116.3	Southern Nevada.	10
12	08:15:49.9	37.2	116.3	Southern Nevada. Mag. 4.8 m_b.	5
13	13:12:35.8B	41.4	123.4	Northern California. Mag. 3.5, B.	6
14	21:58:40.6*	42.8	108.5	Wyoming. Probable blast.	0
15	19:18:51.7	41.2	125.5	Off coast of northern California. Mag. 4.1 M_S.	33
15	19:42:30.2P	34.0	117.6	Southern California. Mag. 3.0, P.	8
16	07:34:44.9*	60.3	151.7	Kenai Peninsula, Alaska.	82
16	07:50:45.2	64.7	147.2	Central Alaska. Mag. 3.5 M_L.	7
16	14:36:43.6	37.2	116.3	Southern Nevada.	2
16	16:17:18.3	51.4	179.3	Andreanof Islands, Aleutian Islands. Mag. 4.4 m_b.	51
16	17:40:30.2P	33.0	116.3	Southern California. Mag. 3.4, P.	8
16	18:53:30.0*	39.2	115.1	Nevada.	10
16	23:54:44.2*	40.1	119.2	.....do.	10
17	00:00:46.7	40.1	119.1	.....do.	10
17	01:17:34.1*	42.8	107.2	Wyoming.	10
17	02:41:14.2*	40.1	119.1	Nevada.	10
17	09:17:26.0	44.7	111.0	Hebgen Lake, Mont., region.	10
17	09:34:41.4	65.5	150.2	Alaska. Mag. 3.0 M_L.	26
17	16:53:24.3	51.7	176.4 E.	Rat Islands, Aleutian Islands. Mag. 5.0 m_b.	53
18	06:49:38.7*	40.0	119.1	Nevada. Mag. 3.6 m_b.	10
18	08:20:37.6*	43.5	126.6	Off coast of Oregon. Mag. 4.1 M_S; 4.8 m_b.	33
18	20:34:18.5	37.5	116.6	Southern Nevada.	12
19	10:50:09.9P	32.8	117.7	California–Mexico border region. Mag. 3.2, P.	8
20	16:59:38.8*	60.5	145.2	Southern Alaska.	33
21	13:33:36.6P	33.1	115.6	Southern California. Mag. 3.0, P.	8
21	14:44:59.6	37.1	116.0	Southern Nevada. Mag. 5.4, B.	5
21	14:55:07.1P	33.0	115.6	Southern California. Mag. 3.0, P.	8
21	15:45:29.0P	33.1	115.6	Southern California. Mag. 3.4, P.	8
21	22:02:12.9*	39.2	115.2	Nevada.	5
21	22:47:19.2P	33.1	115.6	Southern California. Mag. 3.0, P.	8
22	13:32:50.8*	58.5	138.6	Southeastern Alaska. Mag. 2.5 m_b.	33
22	17:20:50.3*	37.1	117.0	California–Nevada border region.	5
23	16:23:32.9	63.3	150.4	Central Alaska. Mag. 3.6 m_b.	112
23	21:57:57.1*	39.4	115.0	Nevada.	5
24	11:37:32.8*	37.8	116.2	Southern Nevada. Mag. 4.2 m_b.	5
25	07:11:23.5	52.9	174.7	Andreanof Islands, Aleutian Islands. Mag. 5.2 m_b.	207
26	00:41:48.8	59.4	144.7	Gulf of Alaska. Mag. 3.9 M_L.	15
26	14:41:30.8	60.1	153.4	Southern Alaska.	129
26	21:11:06.0*	59.5	145.1	Gulf of Alaska. Mag. 3.1 M_L.	33
26	23:37:56.5P	34.0	116.8	Southern California. Mag. 3.0, P.	8
27	03:22:25.7*	44.6	111.2	Hebgen Lake, Mont., region	33
27	14:42:36.2	64.9	147.8	Central Alaska. Mag. 3.0 M_L.	14
27	17:07:25.6*	37.1	117.0	California–Nevada border region.	5
28	00:17:57.2P	34.6	117.1	Southern California. Mag. 3.0, P.	8
28	02:30:24.7P	34.9	116.7	Southern California. Mag. 3.3, P.	8
28	07:50:46.8*	37.2	116.6	Southern Nevada.	5
28	19:15:12.4A	37.1	116.1	Southern Nevada. Nevada Test Site. Mag. 5.2, B.	0
28	19:45:00.5*	37.1	116.0	Southern Nevada.	5
29	10:03:50.3	61.9	150.6	Southern Alaska.	60

* See footnotes at end of table.

TABLE 1.—*Instrumentally determined locations of earthquakes and related phenomena that occurred in the United States during 1973 (excluding felt and damaging earthquakes)*—Continued

Date	Origin time [1] G.M.T.	Geographic coordinates N. lat.	W. long.	Region and comments [2]	Depth
	h m s	°	°		*km*
July 1	00:32:09.8P	34.1	116.8	Southern California. Mag. 3.0, P.	8
1	15:06:37.4*	57.6	137.7	Off coast of southeastern Alaska. Mag. 3.8 m_b.	33
2	13:36:52.6*	57.9	136.9	Southeastern Alaska. Mag. 3.8 m_b.	33
2	14:10:39.9	60.9	151.0	Kenai Peninsula, Alaska. Mag. 3.0 M_L.	33
2	22:54:45.9	57.9	137.7	Off coast of southeastern Alaska. Mag. 4.5 m_b.	33
3	11:23:22.7*	52.5	172.0 E.	Near Islands, Aleutian Islands. Mag. 4.7 m_b.	36
3	14:32:47.4	59.8	153.5	Southern Alaska.	154
3	16:30:37.5	58.1	137.7	Southeastern Alaska. Mag. 4.6 m_b.	33
3	17:44:16.5	58.0	137.9	Southeastern Alaska. Mag. 5.1 m_b.	33
3	22:33:42.7*	58.0	138.0	Southeastern Alaska. Mag. 3.7 m_b.	33
4	06:32:04.4P	34.1	116.7	Southern California. Mag. 3.4, P.	8
4	07:17:06.1*	58.1	137.3	Southeastern Alaska. Mag. 4.5 m_b.	33
4	09:50:24.0	52.1	171.4	Fox Islands, Aleutian Islands. Mag. 4.6 M_S.	41
4	12:25:40.1	37.4	118.6	California–Nevada border region. Mag. 3.2, B.	5
4	13:26:20.3	58.0	137.9	Southeastern Alaska. Mag. 4.6 m_b.	33
4	14:17:09.8	44.7	129.4	Off coast of Oregon. Mag. 4.5 m_b.	33
5	07:45:24.9*	58.0	137.3	Southeastern Alaska. Mag. 4.1 m_b.	33
5	08:51:30.3*	58.0	137.4	Southeastern Alaska. Mag. 3.9 m_b.	33
7	02:57:19.2	52.5	168.3	Fox Islands, Aleutian Islands. Mag. 4.8 m_b.	47
8	00:37:02.8*	60.8	147.0	Southern Alaska. Mag. 3.4 M_L.	33
9	10:25:15.0*	57.1	140.0	Off coast of southeastern Alaska. Mag. 3.2 M_L.	33
10	23:57:20.8P	33.5	116.8	Southern California. Mag. 3.1, P.	8
13	00:02:54.0*	37.1	116.4	Southern Nevada.	33
13	05:11:05.0*	60.1	140.9	Southeastern Alaska. Mag. 3.6 M_L.	46
14	04:07:05.3P	34.4	116.9	Southern California. Mag. 3.0, P.	8
14	05:08:22.1	58.0	138.0	Southeastern Alaska. Mag. 5.0 m_b.	33
14	10:54:01.0*	37.0	112.9	Utah.	18
15	02:14:54.8*	59.4	152.4	Southern Alaska. Mag. 4.1 m_b.	79
15	08:20:30.4S	43.9	74.4	New York.	1
15	10:32:37.7S	43.9	74.4	New York. Mag. 3.4 m_b.	1
16	03:43:02.1P	34.0	116.4	Southern California. Mag. 3.0, P.	8
16	05:27:22.2*	30.0	105.9	Texas–Mexico border region. Mag. 3.2 m_b.	33
16	06:36:42.8*	39.1	111.5	Utah. Mag. 4.2 m_b.	10
16	21:20:16.9*	57.7	137.6	Off coast of southeastern Alaska. Mag. 3.8 m_b.	33
17	14:15:23.1P	34.4	116.8	Southern California. Mag. 3.5, P.	8
19	07:14:35.3	52.7	172.1 E.	Near Islands, Aleutian Islands. Mag. 4.6 m_b.	46
19	15:05:03.2	60.2	151.8	Kenai Peninsula, Alaska. Mag. 4.7 m_b.	95
20	20:33:49.4*	58.7	150.8	Gulf of Alaska. Mag. 3.6 M_L.	33
21	00:41:39.8	60.1	151.0	Kenai Peninsula, Alaska. Mag. 3.1 M_L.	33
22	07:33:43.8	63.8	149.1	Central Alaska. Mag. 4.1 m_b.	120
23	15:28:59.9*	50.7	171.6	Aleutian Islands region. Mag. 4.7 m_b.	33
23	18:51:02.3	52.3	174.8	Andreanof Islands, Aleutian Islands. Mag. 4.7 m_b.	84
24	13:50:41.2	61.6	147.4	Southern Alaska. Mag. 3.3 M_L.	33
25	04:58:06.4*	60.3	153.1	Southern Alaska.	153
27	13:54:50.7*	58.1	137.7	Southeastern Alaska. Mag. 4.0 m_b.	5
28	19:58:47.1	58.0	137.9	Southeastern Alaska. Mag. 4.7 m_b.	10
30	01:06:55.2	64.7	149.4	Central Alaska. Mag. 3.1 M_L.	19
30	09:18:42.1	37.6	115.1	Southern Nevada. Mag. 3.5 M_L.	5
30	17:38:34.2	63.0	149.8	Central Alaska. Mag. 3.5 m_b.	102
Aug. 1	09:20:48.8*	36.0	120.5	Central California.	5
2	01:03:26.5P	34.2	117.4	Southern California. Mag. 3.0, P.	8

* See footnotes at end of table.

TABLE 1.—*Instrumentally determined locations of earthquakes and related phenomena that occurred in the United States during 1973 (excluding felt and damaging earthquakes)*—Continued

Date	Origin time[1] G.M.T.	Geographic coordinates N. lat.	W. long.	Region and comments[2]	Depth
	h m s	°	°		*km*
Aug. 2	16:10:42.3B	36.6	121.2	Central California. Mag. 3.3, B.	8
3	02:01:39.2*	57.9	137.5	Off coast of southeastern Alaska. Mag. 3.5 m_b.	33
3	03:57:06.8	53.2	169.8	Fox Islands, Aleutian Islands. Mag. 5.0 m_b.	124
3	21:47:52.0	41.9	106.8	Wyoming. Probable explosion. Mag. 4.1 m_b.	0
5	13:25:17.4P	33.8	117.5	Southern California. Mag. 3.2, P.	8
5	18:41:52.8	60.4	153.1	Southern Alaska. Mag. 3.3 m_b.	133
6	06:26:15.2*	44.7	110.6	Yellowstone National Park, Wyoming.	5
7	11:50:27.4P	32.5	118.1	Off coast of California. Mag. 3.4, P.	8
9	06:28:23.8*	57.8	137.4	Off coast of southeastern Alaska. Mag. 3.8 m_b.	33
10	09:41:25.1	54.2	162.6	Alaska Peninsula. Mag. 4.8 m_b.	53
10	20:47:28.6	41.9	106.7	Wyoming. Probable explosion. Mag. 3.6 m_b.	0
11	02:40:10.0	62.9	150.6	Central Alaska.	120
12	13:53:58.0*	57.9	138.1	Off coast of southeastern Alaska. Mag. 3.3 m_b.	33
15	12:20:56.7P	33.3	116.3	Southern California. Mag. 3.0, P.	8
16	14:34:56.4*	51.6	176.4	Andreanof Islands, Aleutian Islands. Mag. 4.0 m_b.	55
16	16:50:23.9*	51.3	176.5	Andreanof Islands, Aleutian Islands. Mag. 4.1 m_b.	47
16	18:15:06.6*	51.3	176.6	Andreanof Islands, Aleutian Islands. Mag. 4.6 m_b.	53
17	01:31:08.8	63.7	149.5	Central Alaska.	122
17	13:00:49.6*	58.4	151.1	Kodiak Island region. Mag. 3.5 M_L.	33
17	13:55:56.6*	52.4	172.1 E.	Near Islands, Aleutian Islands. Mag. 4.4 m_b.	39
17	20:09:08.9	41.9	106.8	Wyoming.	10
17	21:30:02.3	62.9	151.2	Central Alaska.	137
17	23:58:04.4*	41.9	106.4	Wyoming.	10
18	13:43:38.1	61.3	147.2	Southern Alaska. Mag. 3.0 M_L.	33
18	16:52:00.2	60.0	147.3	Southern Alaska. Mag. 3.4 M_L.	43
18	19:14:04.8	60.1	147.2	Southern Alaska. Mag. 4.7 m_b.	19
19	17:34:51.3	63.2	150.4	Central Alaska. Mag. 4.1 m_b.	130
20	01:16:58.4*	43.5	126.5	Off coast of Oregon	33
20	09:22:15.9	61.9	150.9	Southern Alaska.	77
21	03:18:43.9	64.1	148.2	Central Alaska. Mag. 3.8 M_L.	23
21	03:27:10.8	60.0	153.3	Southern Alaska. Mag. 3.7 m_b.	125
21	03:43:48.1	54.0	166.4	Fox Islands, Aleutian Islands. Mag. 4.9 m_b.	96
21	06:45:45.1	60.2	153.2	Southern Alaska.	143
22	01:01:13.3	51.8	175.5 E.	Rat Islands, Aleutian Islands. Mag. 4.2 m_b.	49
22	23:19:31.5	64.6	147.2	Central Alaska. Mag. 3.3 M_L.	33
23	10:07:54.0	58.2	154.5	Alaska Peninsula.	121
23	20:58:13.6	51.8	173.5	Andreanof Islands, Aleutian Islands. Mag. 4.7 m_b.	38
25	10:26:49.1	64.5	148.1	Central Alaska. Mag. 3.0 M_L.	33
25	12:32:36.0	63.0	148.4	Central Alaska.	88
25	23:09:43.5*	37.4	118.3	California–Nevada border region.	3
27	00:28:21.0*	51.2	179.2	Andreanof Islands, Aleutian Islands. Mag. 4.5 m_b.	53
27	02:11:52.9*	51.3	179.3	Andreanof Islands, Aleutian Islands. Mag. 4.6 m_b.	51
27	06:26:46.1	51.7	173.7	Andreanof Islands, Aleutian Islands. Mag. 5.1 m_b.	51
27	06:45:44.4	51.1	179.0	Andreanof Islands, Aleutian Islands. Mag. 4.5 m_b.	62
27	14:03:51.2	51.2	179.3	.....do.	60
27	16:39:33.7	51.7	173.8	.....do.	58
28	03:34:31.2	63.0	150.5	Central Alaska.	133
29	15:22:45.9	59.9	149.1	Kenai Peninsula, Alaska. Mag. 3.3 m_b.	51
29	22:16:02.6	63.2	150.6	Central Alaska.	130
Sept. 1	10:02:51.0	61.0	147.2	Southern Alaska.	64
2	01:39:41.2*	43.7	127.5	Off coast of Oregon. Mag. 4.6 m_b.	22

* See footnotes at end of table.

TABLE 1.—*Instrumentally determined locations of earthquakes and related phenomena that occurred in the United States during 1973 (excluding felt and damaging earthquakes)*—Continued

Date	Origin time [1] G.M.T.	Geographic coordinates N. lat.	W. long.	Region and comments [2]	Depth
	h m s	°	°		*km*
Sept. 2	02:20:22.4	60.9	147.2	Southern Alaska.	64
2	22:02:08.4	51.9	173.7	Andreanof Islands, Aleutian Islands. Mag. 4.6 m_b.	42
3	13:02:56.1	59.7	149.5	Kenai Peninsula, Alaska.	54
4	17:56:50.9	48.2	121.3	Washington.	12
5	01:07:36.4	51.7	173.4	Andreanof Islands, Aleutian Islands. Mag. 4.9 m_b.	42
5	18:58:49.7	59.9	152.8	Southern Alaska. Mag. 4.3 m_b.	124
6	12:13:12.5	60.9	146.9	Southern Alaska.	58
8	02:22:29.8	61.3	147.6	Southern Alaska. Mag. 3.2 M_L.	32
8	13:02:17.6	61.0	147.0	Southern Alaska. Mag. 3.5 m_b.	57
9	02:54:47.2	60.3	140.8	Southeastern Alaska, Mag. 3.8 m_b.	39
10	06:53:34.7	57.3	154.1	Kodiak Island region. Mag. 4.7 m_b.	28
10	20:11:07.9*	59.3	142.8	Gulf of Alaska. Mag. 3.4 M_L.	33
11	02:39:48.2	37.6	118.9	California–Nevada border region. Mag. 3.9, P; 3.5, B.	11
11	04:32:48.9	61.0	147.5	Southern Alaska.	66
11	21:17:41.7	60.9	146.8	Southern Alaska. Mag. 3.2 M_L.	40
12	07:00:23.4*	60.1	140.8	Southeastern Alaska. Mag. 3.9 M_L.	39
14	05:24:25.3P	32.9	116.3	California–Mexico border region. Mag. 3.0, P.	8
14	21:38:40.9	60.0	153.4	Southern Alaska.	166
14	22:19:07.8	37.7	115.1	Southern Nevada.	12
16	03:00:49.4P	32.4	115.3	California–Mexico border region. Mag. 3.0, P.	8
16	06:58:23.2P	33.0	115.8	Southern California. Mag. 3.2 P.	8
16	09:49:11.4H	19.4	155.3	Hawaii. Mag. 3.7 M_L.	27
17	04:37:17.0	60.3	151.7	Kenai Peninsula, Alaska.	50
17	23:00:37.3*	44.6	129.3	Off coast of Oregon. Mag. 4.5 M_S; 4.4 m_b.	14
17	23:33:33.0	44.4	129.3	Off coast of Oregon. Mag. 4.6 M_S; 5.1 m_b.	33
18	00:29:36.9	44.5	129.4	Off coast of Oregon. Mag. 4.3 M_S; 4.8 m_b.	33
18	10:08:04.9	37.3	119.0	Central California. Mag. 3.7, B.	5
18	10:14:23.6*	52.5	170.1	Fox Islands, Aleutian Islands. Mag. 4.0 m_b.	33
19	10:32:09.6	56.2	154.2	Kodiak Island region. Mag. 4.2 M_S; 5.0 M_L.	33
19	16:48:54.5P	35.6	117.4	Central California. Mag. 3.1 P.	8
20	03:26:18.6	39.0	115.9	Nevada.	10
20	17:19:26.0	62.2	151.5	Central Alaska. Mag. 3.0 M_L.	33
20	18:58:01.4	51.6	173.9	Andreanof Islands, Aleutian Islands. Mag. 4.5 m_b.	39
21	10:35:55.9	57.2	154.0	Kodiak Island region. Mag. 5.0 m_b.	45
22	13:35:51.0*	52.5	172.1 E.	Near Islands, Aleutian Islands. Mag. 4.8 m_b.	33
22	18:36:24.6	51.6	173.7	Andreanof Islands, Aleutian Islands. Mag. 4.5 M_S.	36
22	19:08:02.8*	51.1	173.3	Andreanof Islands, Aleutian Islands. Mag. 4.1 m_b.	33
22	19:27:49.3	51.6	173.7	Andreanof Islands, Aleutian Islands. Mag. 4.5 M_S.	49
22	20:40:20.3P	33.5	116.4	Southern California. Mag. 3.0, P.	8
22	23:38:35.8	34.5	107.0	New Mexico. Mag. 3.1 M_L.	5
23	00:16:02.1P	33.5	116.6	Southern California. Mag. 3.0, P.	8
24	06:48:08.7	50.2	178.4 E.	Rat Islands, Aleutian Islands. Mag. 4.7 m_b.	39
25	02:52:13.3	39.2	116.4	Nevada. Mag. 3.6 M_L.	10
26	13:20:56.9	62.1	147.5	Central Alaska. Mag. 3.5 m_b.	46
26	18:38:26.6S	47.1	106.1	Montana.	25
26	23:40:00.0	61.3	146.6	Southern Alaska.	66
27	03:33:37.0	63.0	151.2	Central Alaska. Mag. 3.8 m_b.	132
28	00:34:46.7	61.4	151.5	Southern Alaska. Mag. 3.6 m_b.	82
28	14:02:23.3	60.7	153.3	Southern Alaska. Mag. 4.4 m_b.	167
28	16:42:10.6*	51.4	178.9 E.	Rat Islands, Aleutian Islands. Mag. 4.3 m_b.	113
29	15:27:40.8*	38.1	113.1	Utah. Mag. 2.5 M_L.	5

* See footnotes at end of table.

TABLE 1.—*Instrumentally determined locations of earthquakes and related phenomena that occurred in the United States during 1973 (excluding felt and damaging earthquakes)*—Continued

Date	Origin time[1] G.M.T.	Geographic coordinates N. lat.	W. long.	Region and comments[2]	Depth
	h m s	°	°		*km*
Sept. 30	12:34:04.1	59.9	152.4	Southern Alaska.	117
30	17:33:49.7	61.7	141.2	Southern Alaska. Mag. 4.0 M_L.	33
Oct. 1	10:06:33.6*	40.3	127.1	Off coast of northern California. Mag. 4.2, B.	33
1	23:36:37.6	64.7	147.6	Central Alaska. Mag. 3.5 M_L.	10
3	03:44:01.0	63.6	150.7	Central Alaska. Mag. 3.3 M_L.	33
3	08:47:47.6	50.1	179.1	Andreanof Islands, Aleutian Islands. Mag. 4.8 m_b.	37
4	01:39:21.9	62.7	151.6	Central Alaska. Mag. 3.5 M_L.	9
4	02:59:49.5	60.2	151.3	Kenai Peninsula, Alaska.	123
5	09:40:39.8	66.2	157.3	Alaska.	42
5	12:20:48.0B	37.2	121.6	Central California. Mag. 3.6, B.	8
5	16:47:47.8P	34.3	116.8	Southern California. Mag. 3.3, P.	8
6	00:05:19.1*	18.9	64.5	Virgin Islands. Mag. 4.3 m_b.	47
6	02:04:57.4*	66.3	157.5	Alaska.	67
7	16:39:30.3*	37.6	118.9	California–Nevada border region.	5
7	17:30:51.8B	37.6	119.0	Central California. Mag. 3.9, B.	5
7	19:50:34.1	60.8	147.1	Southern Alaska.	41
10	06:00:16.6	61.2	146.5	Southern Alaska, Mag. 3.3 M_L.	33
10	15:12:55.6	62.1	149.7	Central Alaska. Mag. 3.6 m_b.	57
11	06:27:20.7	63.2	150.9	Central Alaska.	130
12	05:54:27.7	43.7	127.5	Off coast of Oregon. Mag. 5.4 m_b; 5.2 M_S.	6
12	17:00:00.8A	37.2	116.2	Southern Nevada. Nevada Test Site. Mag. 4.6 B.	0
12	17:20:31.3	37.3	118.7	California–Nevada border region.	10
13	23:43:59.1	60.1	152.9	Southern Alaska. Mag. 4.0 m_b.	147
14	07:31:51.8P	34.4	116.7	Southern California. Mag. 3.3, P.	8
15	07:05:47.8	52.4	168.5	Fox Islands, Aleutian Islands. Mag. 4.1 m_b; 4.4 M_S.	45
16	00:37:16.9	19.5	64.4	Virgin Islands. Mag. 4.6 m_b.	33
16	01:44:07.9	52.9	171.2	Fox Islands, Aleutian Islands. Mag. 4.9 m_b.	112
16	04:42:30.5*	51.2	178.6 E.	Rat Islands, Aleutian Islands. Mag. 4.7 m_b.	64
16	04:42:30.5	51.2	178.6 E.	.....do.	64
16	05:53:37.7	60.9	147.2	Southern Alaska. Mag. 3.2 M_L.	84
16	16:52:08.6*	52.4	168.3	Fox Islands, Aleutian Islands. Mag. 4.3 m_b.	32
17	10:38:36.6*	56.8	153.2	Kodiak Island region. Mag. 3.4 m_b.	100
17	15:34:27.4B	37.6	119.0	Central California. Mag. 3.9, B.	2
18	09:40:49.7*	40.6	126.3	Off coast of northern California. Mag. 4.3, B.	10
19	01:41:37.2P	32.7	116.7	California-Mexico border region. Mag. 3.1, P.	8
19	18:37:19.8P	33.6	118.3	Southern California. Mag. 3.1, P.	8
20	08:09:13.3P	35.0	117.0	Central California. Mag. 3.3, P.	8
21	10:59:53.5	53.8	163.1	Unimak Island region. Mag. 4.8. m_b.	44
21	14:26:13.6	60.7	152.2	Southern Alaska. Mag. 3.5 m_b.	87
21	23:20:52.3P	33.1	116.0	Southern California. Mag. 3.6, P.	8
26	05:40:56.1	59.1	135.4	Southeastern Alaska. Mag. 4.8 m_b.	33
27	00:44:07.9*	42.8	111.1	Eastern Idaho.	11
27	20:42:42.9	59.8	152.8	Southern Alaska. Mag. 4.4 m_b.	118
28	00:46:53.8	61.7	147.0	Southern Alaska.	64
30	03:47:45.0	60.3	152.3	.....do.	118
30	07:41:34.9	63.6	151.2	Central Alaska. Mag. 3.3 M_L.	33
31	03:18:44.3	63.6	151.0	Central Alaska. Mag. 3.8 M_L.	34
31	04:21:19.3	61.4	151.0	Southern Alaska.	67
Nov. 1	21:02:49.6*	51.7	177.8 E.	Rat Islands, Aleutian Islands. Mag. 4.7 m_b.	112
3	05:53:45.6*	53.6	163.2	Unimak Island region. Mag. 4.1 m_b.	40
3	13:08:57.4	51.4	176.6	Andreanof Islands, Aleutian Islands. Mag. 4.8 m_b.	58

* See footnotes at end of table.

TABLE 1.—*Instrumentally determined locations of earthquakes and related phenomena that occurred in the United States during 1973 (excluding felt and damaging earthquakes)*—Continued

Date	Origin time [1] G.M.T.	Geographic coordinates N. lat.	W. long.	Region and comments [2]	Depth
	h m s	°	°		
Nov. 3	21:50:41.8*	51.7	176.2	Andreanof Islands, Aleutian Islands. Mag. 4.1 m_b.	46
4	00:29:24.9P	34.0	116.8	Southern California. Mag. 3.0 P.	8
5	17:21:46.3	57.2	153.9	Kodiak Island region. Mag. 4.1 m_b.	44
7	11:30:16.4	56.8	158.7	Alaska Peninsula. Mag. 4.4 m_b.	103
8	11:19:08.4*	51.6	175.2	Andreanof Islands, Aleutian Islands. Mag. 4.0 m_b.	49
9	12:17:58.4*	51.4	175.4	Andreanof Islands, Aleutian Islands. Mag. 4.3 m_b.	39
9	14:13:03.5	52.4	178.4 E.	Rat Islands, Aleutian Islands. Mag. 5.6 m_b.	182
11	16:44:54.9	60.0	153.5	Southern Alaska. Mag. 4.4 m_b.	141
12	15:26:43.3*	59.6	148.6	Kenai Peninsula, Alaska. Mag. 3.8 m_b.	72
12	23:09:07.8*	59.7	153.1	Southern Alaska.	113
13	05:59:50.1*	45.6	106.6	Montana.	10
13	21:37:53.6	62.5	151.2	Central Alaska.	87
14	01:29:10.6P	34.0	116.5	Southern California. Mag. 3.0, P.	8
14	11:20:06.8*	59.4	153.2	Southern Alaska. Mag. 3.9 m_b.	104
16	12:47:50.2	57.8	153.3	Kodiak Island region. Mag. 4.7 M_L.	55
16	13:03:29.3*	57.9	153.3	Kodiak Island region. Mag. 4.3 M_L.	33
17	15:17:37.3	61.4	150.8	Southern Alaska.	33
17	16:34:08.2*	60.2	153.2	.....do.	141
17	20:27:59.5*	59.8	153.2	.....do.	129
17	22:40:45.5	59.8	153.3	Southern Alaska. Mag. 4.5 m_b.	128
18	06:36:58.9*	54.9	160.2	Alaska Peninsula. Mag. 3.8 m_b.	65
19	02:29:35.4P	34.3	118.4	Southern California. Mag. 3.3, P.	8
19	08:38:26.8B	40.3	124.6	Near coast of northern California. Mag. 3.4, B.	1
19	09:04:07.8*	40.3	126.8	Off coast of northern California. Mag. 3.6, B.	10
19	18:57:56.4P	34.0	117.8	Southern California. Mag. 3.1, P.	8
19	20:39:21.9P	34.0	117.8	Southern California. Mag. 3.0, P.	8
20	04:02:58.9	62.0	149.0	Central Alaska. Mag. 3.0 M_L.	57
20	23:36:30.0	42.0	112.7	Eastern Idaho.	10
21	22:02:38.5*	42.0	107.0	Wyoming. Probable explosion.	0
22	22:09:24.4*	43.5	126.8	Off coast of Oregon. Mag. 4.5 m_b.	17
23	04:18:20.5	60.0	153.3	Southern Alaska. Mag. 4.0 m_b.	119
23	23:43:11.3*	44.9	107.2	Wyoming. Probable explosion.	0
25	21:53:06.6	18.7	64.6	Virgin Islands. Mag. 4.5 m_b.	53
26	05:44:58.6P	33.0	115.6	Southern California. Mag. 3.2, P.	8
27	08:45:31.1	63.3	150.7	Central Alaska. Mag. 3.7 m_b.	137
28	15:30:00.5	36.9	116.0	California–Nevada border region. Mag. 4.4, B.	5
28	16:43:36.8B	38.8	122.8	Northern California. Mag. 3.5, B.	2
30	14:30:36.8	64.9	152.7	Central Alaska. Mag. 3.7 M_L.	33
30	18:46:26.6	65.7	149.8	Alaska. Mag. 3.4 M_L.	33
30	18:54:29.1	59.6	152.2	Southern Alaska.	93
Dec. 2	22:09:54.5	52.3	168.7	Fox Islands, Aleutian Islands. Mag. 5.6 m_b; 5.0 M_S.	40
3	23:35:23.7	63.1	150.8	Central Alaska.	128
4	07:30:06.7	59.7	151.7	Kenai Peninsula, Alaska.	91
4	07:53:01.0	61.9	149.9	Southern Alaska. Mag. 3.0 M_L.	19
4	21:05:10.3*	60.9	150.9	Kenai Peninsula, Alaska. Mag. 3.0 M_L.	8
5	14:39:49.9*	51.5	177.6	Andreanof Islands, Aleutian Islands. Mag. 4.7 m_b.	51
5	15:25:29.3*	57.8	152.5	Kodiak Island region. Mag. 3.6 M_L.	29
6	06:14:19.6*	41.9	126.6	Off coast of northern California. Mag. 3.8, B.	33
6	14:36:11.4	62.5	149.8	Central Alaska. Mag. 3.1 M_L.	33
7	06:53:21.4	65.1	149.0	Alaska. Mag. 3.7 M_L.	33
7	13:14:33.6*	40.9	125.0	Off coast of northern California. Mag. 3.4, B.	33

* See footnotes at end of table.

TABLE 1.—*Instrumentally determined locations of earthquakes and related phenomena that occurred in the United States during 1973 (excluding felt and damaging earthquakes)*—Continued

Date	Origin time [1] G.M.T.	Geographic coordinates N. lat.	W. long.	Region and comments [2]	Depth
	h m s	°	°		
Dec. 7	19:46:09.6	60.8	146.8	Southern Alaska. Mag. 3.0 M_L.	33
7	23:56:39.3	57.0	152.2	Kodiak Island region. Mag. 4.3 m_b.	48
8	02:41:07.9	53.6	163.6	Unimak Island region. Mag. 4.7 m_b.	44
9	04:35:43.0	56.9	151.8	Kodiak Island region. Mag. 4.3 m_b.	47
9	22:27:37.1	63.2	150.2	Central Alaska.	113
10	05:08:09.2*	51.0	178.9	Andreanof Islands, Aleutian Islands. Mag. 4.6 M_L.	33
10	06:21:54.9*	53.6	163.8	Unimak Island Region. Mag. 4.2 m_b.	44
10	11:30:38.3	62.6	148.9	Central Alaska.	46
11	09:23:35.9*	66.3	157.4	Alaska.	43
12	19:00:00.5	36.9	116.0	California–Nevada border region. Mag. 4.4, B.	5
14	05:27:34.3	38.0	118.3	California–Nevada border region.	10
14	13:23:44.3*	52.4	174.6	Andreanof Islands, Aleutian Islands. Mag. 4.1 m_b.	208
15	04:25:07.0	58.4	153.1	Kodiak Island region. Mag. 4.5 M_L.	52
15	04:56:41.0*	61.0	147.5	Southern Alaska.	76
15	05:40:42.8*	58.7	151.3	Kodiak Island region. Mag. 3.3 m_b.	17
16	01:49:40.7	62.5	148.2	Central Alaska.	94
17	15:43:25.3*	61.5	146.6	Southern Alaska. Mag. 3.7 M_L.	33
17	18:02:59.0	66.1	150.1	Alaska.	33
18	02:35:00.3	63.0	151.0	Central Alaska.	123
19	01:18:30.5*	59.6	153.2	Southern Alaska. Mag 4.0 m_b.	140
21	00:30:30.7P	33.3	116.3	Southern California. Mag. 3.5, P.	8
21	09:44:25.3	52.3	169.4	Fox Islands, Aleutian Islands. Mag. 4.7 m_b.	47
21	09:51:41.3	52.2	169.4	Fox Islands, Aleutian Islands. Mag. 4.8 m_b.	44
21	15:28:19.2	52.3	169.4	Fox Islands, Aleutian Islands. Mag. 4.7 m_b; 4.6 M_S.	49
21	15:59:02.4*	52.5	169.5	Fox Islands, Aleutian Islands. Mag. 4.7 m_b.	49
21	16:00:46.0*	53.1	169.4	Fox Islands, Aleutian Islands. Mag. 4.6 m_b.	33
21	16:18:00.3*	52.3	169.3	Fox Islands, Aleutian Islands. Mag. 4.4 m_b.	49
21	16:27:05.1*	52.0	169.2	Fox Islands, Aleutian Islands. Mag. 4.3 m_b.	36
22	06:12:43.7	64.6	148.1	Central Alaska.	40
22	08:19:23.9*	64.3	144.6	.....do.....	16
22	08:41:30.9	63.5	151.3	Central Alaska. Mag. 3.3 M_L.	16
22	08:48:23.5	63.7	149.2	Central Alaska.	47
22	23:24:20.8*	51.9	168.0	Fox Islands, Aleutian Islands. Mag. 4.6 m_b.	33
23	17:15:14.3	66.0	150.6	Alaska.	12
24	13:00:44.2	57.3	149.7	Gulf of Alaska. Mag. 3.9 m_b.	48
25	02:07:58.1	56.8	153.8	Kodiak Island region. Mag. 4.0 M_L.	33
25	22:43:51.5	62.1	144.9	Central Alaska. Mag. 3.6 M_L.	33
26	14:14:56.3*	52.4	169.5	Fox Islands, Aleutian Islands. Mag. 4.0 m_b.	59
26	23:01:15.1*	42.3	106.7	Wyoming. Probable explosion.	0
31	14:00:53.7P	35.0	119.0	Central California. Mag. 3.3, P.	8

[1] Symbols following origin time are as follows:

* Epicenter has been determined from incomplete, or less reliable, data and is not considered so accurate as the computed solution appears to indicate.

A Parameters of explosion supplied by U.S. Atomic Energy Commission (AEC).

B Parameters of hypocenter supplied by University of California, Berkeley.

E Some or all parameters of explosion (controlled or accidental) supplied by any group other than AEC.

H Parameters of hypocenter supplied by USGS Hawaiian Volcano Observatory.

J Parameters of hypocenter supplied by Saint Louis University, Saint Louis, Mo.

P Parameters of hypocenter supplied by California Institute of Technology, Pasadena.

S A National Earthquake Information Service (NEIS) solution based on data from dense local networks, a local crustal model, or other methods not routinely applied by NEIS.

[2] Magnitudes computed by USGS National Earthquake Information Service are as follows:

m_b Computed from body wave data on seismogram.

M_S Computed from surface wave data on seismogram.

M_L Computed only for local earthquakes.

NOTE: Abbreviations following magnitudes are as defined in footnote 1.

TABLE 2.—*Principal earthquakes of the world during 1973*

[Source: *Preliminary Determination of Epicenters Monthly Listing*, published by NOAA/Environmental Research Laboratories Jan.-May 1973, and by USGS/National Earthquake Information Service June-Dec. 1973]

Date	Origin time G.M.T.	Region	Geographic coordinates		Remarks*
			Lat.	Long.	
	h m s		°	°	
Jan. 11	06:50:51.8	Caribbean Sea	12.2 N.	76.9 W.	Believed to be the first instrumentally located epicenter in this area of the Caribbean Sea. Depth 33 km. Mag. 4.5 (m_b).
18	09:28:14.1	New Britain region	6.9 S.	150.0 E.	Felt on New Britain, New Guinea, and adjacent islands. Depth 43 km. Mag. 6.8, P.
30	21:01:12.5	Near coast of Michoacan, Mexico	18.5 N.	103.0 W.	Seventeen killed in Colima, Gomez, Farias, and Tecoman areas; 390 reported injured. Heavy damage in the states of Colima, Michoacán, and Jalisco. Tsunami recorded in American Samoa, Hawaii, and Mexico. Felt at Mexico City and aboard the ship *Jesper Maerski* at position 18°31.0'N., 104°02.5'W. Depth 43 km. Mag. 7.5 (M_S); 7.3 P.
Feb. 6	10:37:10.1	Szechwan Province, China	31.4 N.	100.6 E.	Unspecified casualties and damage reported. Depth 33 km. Mag. 7.4 (M_S); 7.7, P.
21	14:45:57.3P	Southern California	34.1 N.	119.0 W.	Several persons injured; approximately $1 million damage reported in the Oxnard area. Felt from San Diego to San Luis Obispo. Depth 8 km. Mag. 5.2 (M_S); 5.9 P.
28	06:37:49.5	Kuril Islands	50.5 N.	156.6 E.	Felt at Hiroo and Urakawa, Hokkaido, Japan. Minor tsunami recorded. Depth 27 km. Mag. 7.2 (M_S); 7.1 P.
Mar. 17	08:30:51.8	Luzon, Philippine Islands	13.4 N.	122.8 E.	Fifteen killed, 64 injured, approximately $450,000 in damage. Philippine fault ruptured across Tayabas Bay with left-lateral displacement of 1.85 m on the north side 4 km east of Calauag and 3.2 m on the south side where it crossed the shoreline south of Guinayangan. Depth 33 km. Mag. 7.0 (M_S); 6.7 P.

* See footnotes at end of table.

TABLE 2.—*Principal earthquakes of the world during 1973*—Continued

Date	Origin time G.M.T.	Region	Geographic coordinates		Remarks*
			Lat.	Long.	
	h m s		°	°	
Mar. 20	18:13:24.8	Kerguelen-Gaussberg rise	57.9 S.	83.6 E.	First instrumentally computed hypocenter in this part of the Antarctic plate, 1800 km from the nearest seismic zone. One other earthquake was located on the Antarctic plate far from its margins on June 6, 1970. Depth 33 km. Mag. 5.4 (m_b).
Apr. 14	08:34:00.1	Costa Rica	10.7 N.	84.8 W.	Twenty-six killed in Tilarán, Arenal, and Rio Chiquito areas; 100 reported injured. Depth 33 km. Mag. 6.5 (M_S).
24	21:30:09.9	South of Panama	5.0 N.	78.1 W.	One killed and moderate damage in central Colombia. Felt at Maracaibo and San Cristobal, Venezuela. Depth 50 km. Mag. 6.5 (M_S); 6.6, P.
26	20:26:28.0H	Hawaii	19.9 N.	155.1 W.	Eleven persons injured; $5.6 million damage. Felt throughout islands. Depth 50 km. Mag. 6.1 (M_S); 6.3 P; 6.2 M_L.
June 17	03:55:02.9	Hokkaido, Japan, region	43.2 N.	145.8 E.	Twenty-four injured on Hokkaido. Minor damage in Nemuro and Kushiro areas. Felt on Honshu. Tsunami recorded in Alaska, American Samoa, Hawaii, Japan, and Kwajalein. Depth 48 km. Mag. 7.7 (M_S); 7.7, P.
24	02:43:25.5	Kuril Islands	43.3 N.	146.4 E.	One injured and slight damage in Nemuro area. Felt in Kushiro and Urakawa areas; also at Obihiro and Hiroo, Hokkaido, Japan. Minor tsunami reported in Japan and Kuril Islands. Depth 50 km. Mag. 7.1 (M_S); 7.1, P.
July 14	04:51:21.0	Tibet	35.2 N.	86.5 E.	Depth 33 km. Mag. 6.9 (M_S); 6.7, P.
Aug. 28	09:50:40.0	Veracruz, Mexico	18.3 N.	96.6 W.	More than 600 reported killed, thousands injured. Heavy damage in the states of Morelos, Puebla, and Veracruz where thousands were left homeless. Felt strongly at Mexico City. Depth 84 km. Mag. 7.2, P.

* See footnotes at end of table.

TABLE 2.—*Principal earthquakes of the world during 1973*—Continued

Date	Origin time G.M.T.	Region	Geographic coordinates		Remarks*
			Lat.	Long.	
	h m s		°	°	
Aug. 28	15:01:59.1	Central Mid-Atlantic Ridge	0.2 S.	18.0 W.	Depth 33 km. Mag. 6.8 (M_S); 6.9, P.
Sept. 29	00:44:00.8	North Korea	41.9 N.	130.9 E.	Felt in Fukushima, Sapporo, and Tokyo, Japan, areas. Depth 575 km. Mag. 7.0, P.
Oct. 6	15:07:37.3	Southwestern Atlantic Ocean ...	60.8 S.	21.5 W.	Depth 33 km. Mag. 7.0 (M_S); 7.5, P.
25	14:08:59.5	Salta Province, Argentina	22.0 S.	63.7 W.	Felt in Antofagasta, Chile, area. Depth 529 km. Mag. 6.8, P.
Dec. 9	19:55:45.6	New Hebrides Islands	19.9 S.	169.8 E.	Depth 39 km. Mag. 6.8 (M_S); 6.9, P.
28	05:31:06.4	South of Fiji Islands	23.9 S.	180.0	Depth 549 km. Mag. 6.8, P.
28	13:41:45.8	. . . . do.	14.5 S.	166.6 E.	Concrete walls and floors cracked, and water tanks toppled on Espiritu Santo. Felt on Vanua Lava and at Luganville, also felt at Hog Harbour and Port Olry. Depth 26 km. Mag. 7.5 (M_S); 7, P.
29	00:19:31.1	. . . . do.	15.1 S.	166.9 E.	Concrete wharf and walls cracked and water pipes broke at Luganville. Depth 47 km. Mag. 7.2 (M_S).

* Magnitudes computed by USGS National Earthquake Information Service are as follows: M_S—computed from surface wave data on seismogram; m_b—computed from body wave data on seismogram. A magnitude value followed by "P" has been computed by California Institute of Technology, Pasadena.

Miscellaneous Activities

HORIZONTAL CONTROL SURVEYS FOR CRUSTAL MOVEMENT STUDIES[1]

In 1973, surveys for the study of horizontal movements in the Earth's crust were made in California by NOAA's National Geodetic Survey.

Aqueduct Surveys—The cooperative project with the State of California Department of Water Resources for studying movement along the aqueduct was continued during 1973. Resurveys were accomplished at three sites along the aqueduct route: Pear, Union, and Veras.

At the Pear site where the aqueduct straddles the San Andreas fault, preliminary results did not indicate any significant changes from the previous surveys.

Observations at the Union site, along the Hayward fault in the San Francisco Bay area, continued to show about the same rate of relative right-lateral movement—5 to 6 mm per year.

Preliminary tests at the Veras site, which straddles the Calaveras fault, showed continued right-lateral movement at an annual rate of 2.4 mm.

VERTICAL MOVEMENT STUDIES[2]

First- and second-order leveling lines were releveled for two main reasons: (1) to update the vertical control net and (2) to study vertical movements.

In category one, a total of 1,182 km of first-order leveling was done in the following states: Wisconsin, Illinois, New York, Mississippi, California, and Washington.

In category two, a program to investigate the subsidence in the Galveston-Houston area in Texas included the releveling of 1,569 km of first-order and 1,137 km of second-order leveling lines. The descriptions and adjusted elevations from the survey are published in the form of supplements to quadrangle lists covering the area.

Other first-order relevelings in this category were carried out in California at Union site (#18), 4 km; Veras site (#19), 5 km; Pear site, 4 km; and in the Geyser Geothermal area, 79 km.

TSUNAMIS[3]

Five tsunamis were reported to the National Oceanic and Atmospheric Administration during 1973, including three that were recorded on National Ocean Survey tide gages.

An earthquake on January 30 near the coast of Michoacan, Mexico (18.5° N., 103.0° W.), caused a minor tsunami that was recorded at a number of stations. The greatest amplitudes were at Manzanillo and Acapulco, Mexico, with ranges of 1.16 m and 0.40 m, respectively. Amplitudes recorded on other tide gages were: Pago Pago, American Samoa, 21 cm; Hilo, Hawaii, 21 cm; Kahului, Hawaii, 21 cm; and Nawiliwili, Hawaii, 6 cm.

An earthquake on February 28 in the Kuril Islands (50.5° N., 156.6° E.) generated a tsunami that reached a maximum height of 1.5 m on Shumshu Island. There is evidence of this tsunami on the Attu, Alaska, tide record with a maximum amplitude of 21 cm and on the Shemya, Alaska, record with a maximum amplitude of 15 cm.

The Hokkaido, Japan, earthquake of June 17 (43.2° N., 145.8° E.) caused the largest tsunami of the year. Maximum wave heights in Japan included: 304 cm (approximate) at Nemuro; 220 cm at Hiroo; 110 cm at Kushiro and Hachinohe; 104 cm at Urakawa; 38 cm at Ofunato; 36 cm at Onahama; 34 cm at Miyaka; and 22 cm at Muroran. Several fishing boats were sunk. Representative maximum waves recorded elsewhere were: 30 cm at Kahului, Hawaii; 18 cm at Hilo, Hawaii; 9 cm at Pago Pago, American Samoa, and Kwajalein; and

[1] Prepared by B. K. Meade, NOAA, National Geodetic Survey, National Ocean Survey, Rockville, Md.

[2] Prepared by Cecil F. Ellingwood, NOAA, National Geodetic Survey, National Ocean Survey, Rockville, Md.

[3] Prepared by Mark G. Spaeth, NOAA, National Weather Service, Silver Spring, Md.

12 cm at Attu, Alaska. The Pacific Tsunami Warning Center issued a *watch*.

The June 24 earthquake in the Kuril Islands (43.3° N., 146.4° E.) generated a tsunami that had a maximum amplitude of 122 cm in eastern Hokkaido, Japan. The tsunami also was recorded in the Kuril Islands.

Following an earthquake near the coast of central Chile on October 5 (32.5° S., 71.5° W.), a tsunami with a maximum amplitude of 40 cm was reported at Valparaiso.

FLUCTUATIONS IN WELL-WATER LEVELS[4]

In 1943, the Coast and Geodetic Survey (now the National Ocean Survey) first published the section on well-water fluctuations in its annual *United States Earthquakes* series. Data for the years 1944–49 appeared in the 1949 issue. From 1950 to the present, the material has been published annually in this series.

Table 3 lists fluctuations in wellwater caused principally by earthquakes. Table 4 lists the date and location of specific events that may have caused fluctuations noted in table 3. Also included are the states in which fluctuations were recorded.

Complete information on earthquakes possibly associated with the fluctuations tabulated in table 3 may be obtained from the biweekly *Preliminary Determination of Epicenters* listings, published by the USGS National Earthquake Information Service.

[4] Prepared by K. B. Rennick, U.S. Geological Survey, Denver, Colo.

TABLE 3.—*Earthquake fluctuations in well-water levels, January 1 through December 31, 1973*

County and/or well number	Date	Time at recorder (Greenwich mean time)	Depth to water before disturbance (feet)	Water-level fluctuations: From prequake level, Upward (feet)	Water-level fluctuations: From prequake level, Downward (feet)	Water-level fluctuations: Double amplitude (feet)	Earthquake location and remarks
			ALASKA				
AK 1022	Feb. 28	0700	40.35	0.02	0.00	0.02	Kuril Is.
AK 1430	28	0700	58.270	.005	.015	.020	Do.
AK 2049	28	0730	27.53	.05	.02	.07	Do.
			GEORGIA				
Dawson 13KK1	Jan. 30	2126	25.40	0.03	0.03	0.06	Michoacan, Mexico.
Decatur 9F520	30	2126	46.18	.18	.19	.37	Do.
Dougherty 13L3	30	2126	31.08	.10	.06	.16	Do.
Charlton 27E2	30	2126	64.70	.04	.04	.08	Do.
Dougherty 13L3	Feb. 6	1122	28.13	.03	.03	.06	Szechwan Province, China.
Do.	28	0707	25.62	.035	.035	.070	Kuril Is.
Charlton 27E2	28	0707	63.27	.17	.21	.38	Do.
Long 33M4	28	0707	41.66	.035	.035	.070	Do.
McIntosh 35M13	28	0707	11.75	.04	.03	.07	Do.
Dawson 13KK1	June 17	0425	26.15	.05	.02	.07	Hokkaido, Japan.
Decatur 9F520	17	0425	40.41	.03	.05	.08	Do.
Dougherty 13L3	17	0425	21.35	.14	.12	.26	Do.
Charlton 27E2	17	0425	61.64	.30	.32	.62	Do.
Long 33M4	17	0425	42.65	.08	.09	.17	Do.
McIntosh 35M13	17	0425	11.79	.14	.12	.26	Do.
Thomas 14E15	17	0425	195.44	.28	.28	.56	Do.
Dougherty 13L3	24	0305	19.46	.03	.05	.08	Kuril Is.
Charlton 27E2	24	0305	61.59	.07	.06	.13	Do.
Long 33M4	24	0305	42.88	.03	.04	.07	Do.
McIntosh 35M13	24	0305	12.35	.04	.04	.08	Do.
Thomas 14E15	24	0305	195.40	.03	.04	.07	Do.
Long 33M4	Aug. 28	1005	35.54	.01	.03	.04	Veracruz, Mexico.
			IDAHO				
Cassia 13S-21E-18bbcl.	Jan. 30	2045	570.13	0.10	0.05	0.15	Michoacan, Mexico.
Bingham 2N-31E-35dccl	30	2110	582.83	.14	.11	.25	Do.
Blaine 1S-19E-3ccb2	30	2110	16.13	.18	.22	.40	Do.
Butte 4N-30E-7adbl	30	2110	313.22	.70	.71	1.41	Do.
Butte 3N-29E-14adbl	30	2110	449.49	.54	.52	1.06	Do.
Butte 4N-30E-7adbl	30	2115	313.22	.53	.63	1.16	Aftershocks lasted approximately 5 hr.
Butte 3N-29E-14adbl	30	2115	449.49	.42	.43	.85	Michoacan, Mexico.
Jefferson 5N-32E-36addl	30	2115	325.18	.21	.20	.41	Do.
Jefferson 5N-34E-9bdal	30	2115	252.23	.18	.16	.34	Do.
Butte 3N-29E-14adbl	30	2120	449.49	.22	.20	.42	Do.
Butte 2N-28E-35addl	30	2120	602.29	.22	.19	.41	Do.
Butte 4N-30E-7adbl	Feb. 6	1125	313.47	.03	.05	.08	Szechwan Province, China.
Do.	10	1200	313.47	.02	.01	.03	Michoacan, Mexico.

TABLE 3.—*Earthquake fluctuations in well-water levels, January 1 through December 31, 1973*—Continued

County and/or well number	Date	Time at recorder (Greenwich mean time)	Depth to water before disturbance (feet)	Water-level fluctuations: From prequake level, Upward (feet)	Water-level fluctuations: From prequake level, Downward (feet)	Water-level fluctuations: Double amplitude (feet)	Earthquake location and remarks
			IDAHO—Continued				
Butte 5N-31E-28cccl	Feb. 21	1410	260.78	.02	.02	.04	Southern California.
Butte 4N-30E-7adbl	21	1420	313.92	.03	.04	.07	Do.
Do.	28	0715	313.83	.05	.05	.10	Kuril Is.
Do.	28	0720	313.83	.03	.03	.06	Do.
Butte 5N-31E-28cccl.	28	0800	260.28	.13	.12	.25	Do.
Do.	July 1	1350	261.85	.03	.08	.11	Southeastern Alaska.
Butte 4N-30E-7adbl	1	1340	314.08	.07	.09	.16	Do.
Do.	1	1730	314.20	.03	.02	.05	Do.
Do.	16	1825	314.51	.04	.03	.07	
Do.	Aug. 28	1000	315.69	0	.03	.03	Veracruz, Mexico.
Do.	28	1010	315.70	.02	.03	.05	Do.
Butte 5N-31E-28cccl	28	1100	263.65	.02	.02	.04	Do.
Butte 4N-30E-7adbl	Oct. 18	1240	316.54	.02	.02	.04	Jalisco, Mexico.
Butte 5N-31E-28cccl	Nov. 6	1030	262.73	.01	.01	.02	Andreanof Is.
Do.	Dec. 28	1415	261.77	.05	.06	.11	New Hebrides Is.
Butte 4N-30E-7adbl	28	1415	316.87	.03	.05	.08	New Hebrides Is. Aftershocks lasted approximately 45 min.
Butte 5N-31E-28cccl	29	0100	262.02	.02	.02	.04	New Hebrides Is.
			INDIANA				
Sh 2	Jan. 30	2040-2130	17.51	0.05	0.02	0.07	Michoacan, Mexico.
Ma 32	30	2315-0100	9.57	.41	.41	.82	Do.
Sh 2	Feb. 6	1020-1025	17.15	.01	0	.01	Szechwan Province, China.
Ma 32	6	1355-1435	9.49	.04	.05	.09	Do.
Sh 2	28	0640-0720	18.12	0	.12	.12	Kuril Is.
Pu 6	28	0700-0730	7.01	.02	0	.02	Do.
Ma 32	Apr. 25	0035-0055	8.96	.02	.02	.04	South of Panama.
Sh 2	25	0500-0510	15.73	0	.01	.01	Do.
Do.	June 6	0100-0120	17.75	.01	.01	.02	
Ma 32	7	1515-1555	10.51	.02	.03	.05	
Do.	17	0435-0640	10.93	.16	.17	.33	Hokkaido, Japan.
Sh 2	17	0500-0545	17.95	.05	.01	.06	Do.
Do.	24	0450-0500	17.87	.01	0	.01	Kuril Is.
Ma 32	24	0830-0915	11.09	.05	.05	.10	Do.
Pu 6	July 1	1315-1335	8.60	.03	0	.03	Southeastern Alaska.
Ma 32	1	2200-2245	10.87	.10	.10	.20	Do.
Do.	4	0200-0220	11.32	.02	.03	.05	
Do.	Aug. 28	1120-1200	11.30	.04	.09	.13	Veracruz, Mexico.
Sh 2	Oct. 6	0940-1015	21.57	0	.02	.02	Southwestern Atlantic Ocean.
Ma 32	6	1940-2000	11.20	.01	.01	.02	Do.
Do.	Dec. 28	0500-0545	8.29	.02	.02	.04	South of Fiji Is.

TABLE 3.—*Earthquake fluctuations in well-water levels, January 1 through December 31, 1973*—Continued

County and/or well number	Date	Time at recorder (Greenwich mean time)	Depth to water before disturbance (feet)	Water-level fluctuations: From prequake level, Upward (feet)	Water-level fluctuations: From prequake level, Downward (feet)	Water-level fluctuations: Double amplitude (feet)	Earthquake location and remarks
NEVADA							
S17/50-36dcl	Jan. 22	0050	2.935	0.040	0.040	0.080	Jalisco, Mexico.
Do.	30	2030	2.81	.53	.49	1.02	Michoacan, Mexico.
Do.	Feb. 6	1120	2.69	.05	.03	.08	Szechwan Province, China.
Do.	20	1410	2.785	.100	.155	.255	
Do.	28	0630	2.81	.10	.085	.185	Kuril Is.
Do.	Mar. 8	1555	2.67	.085	.095	.180	Southern Nevada.
Do.	25	2230	2.82	.04	.035	.075	Gulf of California.
Do.	Apr. 6	1830	3.02	.025	.03	.055	Andreanof Is.
Do.	14	0900	3.01	.06	.03	.09	Costa Rica.
Do.	24	2145	3.255	.010	.015	.025	South of Panama.
Do.	26	1650	3.34	.085	.08	.165	Southern Nevada.
Do.	May 6	0010	3.45	.035	.02	.055	
Do.	June 6	1230	3.55	.19	.25	.44	Southern Nevada.
Do.	7	1850	3.495	.130	.115	.245	Chiapas, Mexico.
Do.	21	1420	3.535	.055	.055	.110	Southern Nevada.
Do.	24	0430	3.42	.035	.035	.070	Kuril Is.
Do.	July 1	1400	3.30	.20	.29	.49	Southeastern Alaska.
Do.	3	1730	3.37	.015	.03	.045	Do.
Do.	16	1800	3.51	.025	.04	.065	Guerrero, Mexico.
Do.	Aug. 17	1700	3.345	.025	.030	.055	
Do.	24	1710	3.52	.03	.03	.06	
Do.	28	1000	3.345	.175	.140	.315	Veracruz, Mexico.
Do.	Sept. 4	1730	3.36	.04	.03	.07	Oaxaca, Mexico.
Do.	21	1730	3.51	.04	.03	.07	Tristan Da Cunha region.
Do.	26	1700	3.49	.03	.02	.05	Macquarie Is. ?
Do.	28	1810	3.36	.04	.05	.09	
Do.	Oct. 6	1850	3.29	.035	.03	.065	Southwestern Atlantic Ocean.
Do.	12	2150	3.31	.05	.095	.145	
Do.	15	2150	3.28	.04	.07	.11	
Do.	18	1100	3.405	.025	.040	.065	Jalisco, Mexico.
WISCONSIN							
MI-120	Jan. 22	0100	87.038	0.017	0.012	0.029	Jalisco, Mexico.
Do.	30	2115	87.204	.181	.302	.483	Michoacan, Mexico. 1½-hr. duration.
Lf-57	30	2115	104.60	.53	.50	1.03	Do.
MI-120	Feb. 6	1140	87.150	.050	.043	.093	Szechwan Province, China.
Lf-57	10	1130	104.60	.01	.05	.06	Michoacan, Mexico.
MI-120	10	1230	87.432	.006	.011	.017	Do.
Do.	21	1530	87.152	.001	.015	.016	Southern California.
Lf-57	21	1530	104.37	0	.04	.04	Do.
MI-120	28	0730	87.368	.068	.035	.103	Kuril Is.
Lf-57	28	0730	104.20	0	.07	.07	Do.

TABLE 3.—*Earthquake fluctuations in well-water levels, January 1 through December 31, 1973*—Continued

County and/or well number	Date	Time at recorder (Greenwich mean time)	Depth to water before disturbance (feet)	Water-level fluctuations: From prequake level, Upward (feet)	Water-level fluctuations: From prequake level, Downward (feet)	Water-level fluctuations: Double amplitude (feet)	Earthquake location and remarks
			WISCONSIN—Continued				
Ml-120	Mar. 17	0935	87.712	.015	.014	.029	Luzon, Philippine Is.
Do.	25	1100	86.881	.011	.007	.018	
Do.	Apr. 14	0900	87.204	.013	.008	.021	Costa Rica.
Do.	24	2145	87.173	.015	.020	.035	South of Panama.
Do.	June 7	1905	87.416	.004	.006	.010	Chiapas, Mexico.
Lf-57	17	0315	93.45	.28	.37	.65	Hokkaido, Japan.
Ml-120	17	0430	87.680	.066	.177	.243	Do.
Lf-57	24	0145	93.26	.09	.12	.21	Kuril Is.
Ml-120	24	0315	88.270	.030	.025	.055	Do.
Lf-57	July 1	1150	93.24	.17	.14	.31	
Ml-120	1	1350	88.260	.071	.103	.174	Southeastern Alaska.
Lf-57	3	1510	93.15	.03	.06	.09	
Ml-120	3	1725	88.251	.008	.018	.026	Do.
Do.	14	0520	87.493	.002	.013	.015	Tibet.
Lf-57	14	0550	92.53	.02	.02	.04	Do.
Do.	Aug. 28	0930	92.68	.07	.06	.13	Veracruz, Mexico.
Ml-120	28	0950	86.006	.027	.012	.039	Do.
Lf-57	Sept. 28	2330	93.25	.04	.01	.05	
Ml-120	29	0115	85.442	.002	.012	.014	North Korea.
Lf-57	Oct. 6	1350	93.65	.03	0	.03	Southwestern Atlantic Ocean.
Ml-120	6	1620	85.570	.016	0	.016	Do.
Lf-57	18	1110	93.89	.02	.04	.06	Jalisco, Mexico.
Ml-120	18	1115	85.153	0	.011	.011	Do.
Do.	Nov. 6	0900	84.919	.001	.004	.005	Andreanof Is.
Lf-57	6	1015	94.66	.02	.01	.03	Do.
Do.	6	1830	94.60	.03	0	.03	Do.
Ml-120	6	2050	84.880	.005	.002	.007	Do.
Do.	Dec. 4	2040	83.150	0	.013	.013	
Lf-57	9	1830	95.23	0	.03	.03	
Ml-120	9	2130	84.499	.012	0	.012	New Hebrides Is.
Lf-57	28	?	95.80	.15	.08	.23	
Do.	28	?	95.73	.02	.02	.04	
Ml-120	28	1515	82.728	.029	.033	.062	Do.
Do.	28	1630	82.727	.013	.007	.020	Do.
Lf-57	29	?	95.74	.04	.04	.08	
Ml-120	29	0150	82.594	.019	.009	.028	Do.

TABLE 4.—*Earthquakes in 1973 believed to have caused fluctuations in well-water levels*

[Source: *Preliminary Determination of Epicenters Monthly Listing,* published by NOAA/Environmental Research Laboratories Jan.-May 1973, and by USGS/National Earthquake Information Service June-Dec. 1973]

Date	Location and magnitude	States recording fluctuations
Jan. 22	Near coast of Jalisco, Mexico. Mag. 6.2	Nevada and Wisconsin.
30	Near coast of Michoacan, Mexico. Mag. 7.5	Georgia, Idaho, Indiana, Nevada, and Wisconsin.
Feb. 6	Szechwan Province, China. Mag. 7.4	Do.
10	Near coast of Michoacan, Mexico. Mag. 5.6	Idaho and Wisconsin.
21	Southern California. Mag. 5.2	Do.
28	Kuril Islands. Mag. 7.2	Alaska, Georgia, Idaho, Indiana, Nevada, and Wisconsin.
Mar. 8	Southern Nevada. Mag. 5.4	Nevada.
17	Luzon, Philippine Islands. Mag. 7.0	Wisconsin.
25	Gulf of California. Mag. 5.5	Nevada.
Apr. 6	Andreanof Islands. Mag. 4.7	Do.
14	Costa Rica. Mag. 6.5	Nevada and Wisconsin.
24	South of Panama.* Mag. 6.5	Do.
26	Southern Nevada. Mag. 4.7	Nevada.
June 6	Southern Nevada. Mag. 6.1	Do.
7	Near coast of Chiapas, Mexico. Mag. 6.2	Nevada and Wisconsin.
17	Hokkaido, Japan, region. Mag. 7.7	Georgia, Indiana, and Wisconsin.
21	Southern Nevada. Mag. 5.3	Nevada.
24	Kuril Islands. Mag. 7.1	Georgia, Indiana, Nevada, and Wisconsin.
July 1	Off coast of southeastern Alaska. Mag. 6.7	Idaho, Indiana, Nevada, and Wisconsin.
3	Southeastern Alaska. Mag. 6.0	Nevada and Wisconsin.
14	Tibet. Mag. 6.9.	Wisconsin.
16	Guerrero, Mexico. Mag. 5.7	Nevada.
Aug. 28	Veracruz, Mexico. Mag. 7.2	Georgia, Idaho, Indiana, Nevada, and Wisconsin.
Sept. 4	Near coast of Oaxaca, Mexico. Mag. 5.2	Nevada.
21	Tristan Da Cunha region. Mag. 5.0	Do.
26	West of Macquarie Island. Mag. 4.9	Do.
29	North Korea. Mag. 7.0	Wisconsin.
Oct. 6	Southwestern Atlantic Ocean. Mag. 7.0	Indiana, Nevada, and Wisconsin.
18	Near coast of Jalisco, Mexico. Mag. 5.5	Idaho, Nevada, and Wisconsin.
Nov. 6	Andreanof Islands. Mag. 6.4	Idaho and Wisconsin.
6	Andreanof Islands. Mag. 6.3	Wisconsin.
Dec. 9	New Hebrides Islands. Mag. 6.8	Do.
28	South of Fiji Islands. Mag. 6.8	Indiana.
28	New Hebrides Islands. Mag. 7.5	Idaho and Wisconsin.
29	New Hebrides Islands. Mag. 7.2	Do.

* Several aftershocks occurred through April 25.

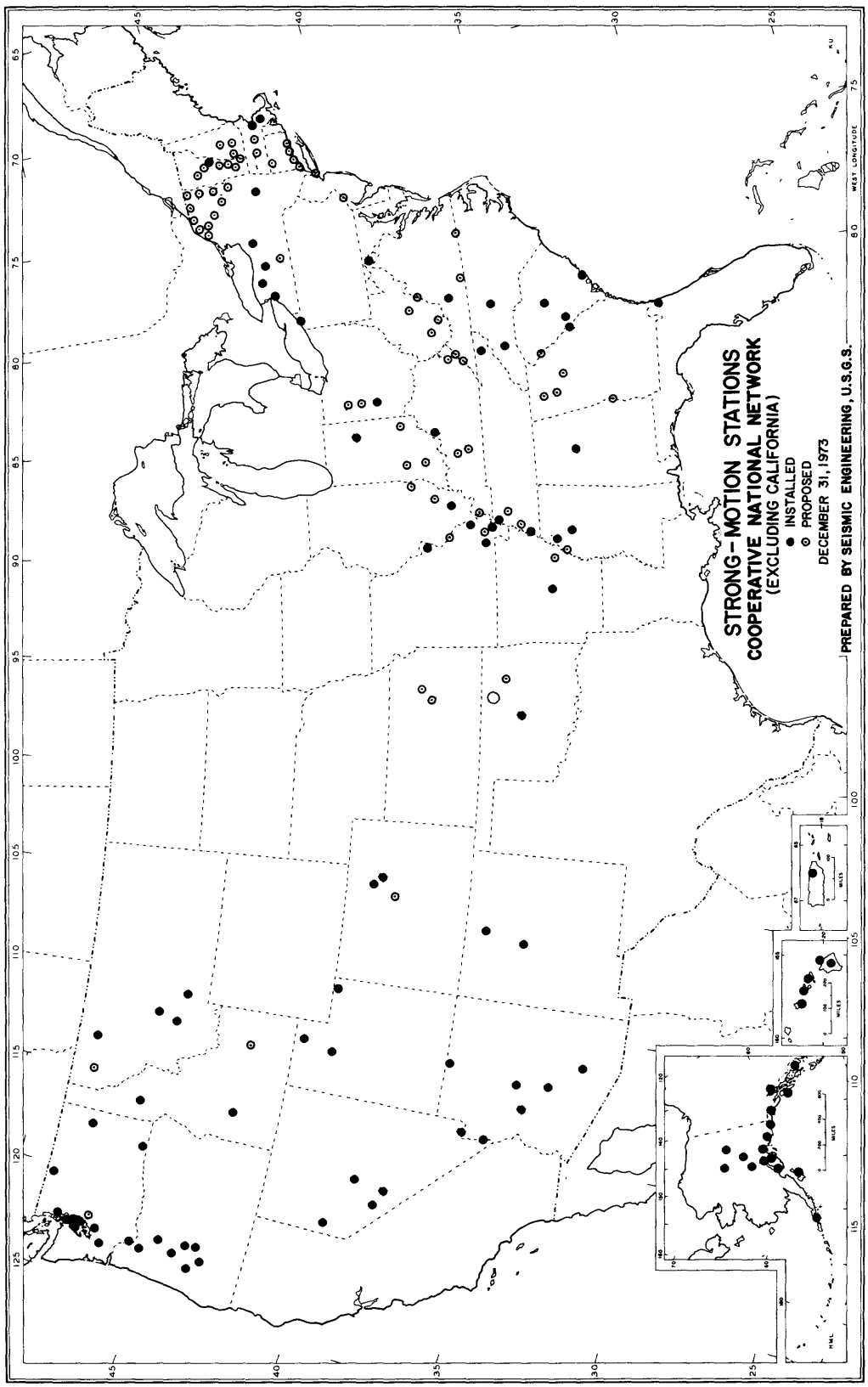

FIGURE 19.—Strong-motion stations in Cooperative National Network (excluding California).

Strong-Motion Seismograph Data[1]

INTRODUCTION

The Seismological Field Survey has conducted an engineering seismology program in the United States and Latin America since 1932. The Survey, with cooperation of state and municipal governments, private industry, and state and private educational institutions, has installed and maintained strong-motion seismographs and analyzed the records. Results of these analyses have been published in Government bulletins and scientific journals, and the records, either originals or copies, have been made available to research scientists. As a result of the reorganization of Government earthquake research in May 1973, the Seismological Field Survey operations were transferred to the U.S. Geological Survey and the organization was renamed Seismic Engineering Branch.

A list of strong-motion stations in the United States and Central and South America is available from the Seismic Engineering Branch (address in footnote). This list, which gives the geographic location of each station and instrumental constants, has been cataloged through 1973.

The number of strong-motion accelerographs in the United States and Central and South America has risen from 75 in 1963 to 936 in December 1973. With the exception of six $\frac{1}{2}g$ instruments, all accelerographs are capable of recording acceleration pulses as large as 1g without going off scale. Figure 19 shows the locations of accelerographs in the network (excluding California) operated by the Seismic Engineering Branch. The rapid growth in the network is attributable largely to the development of modern low-cost accelerographs, to the cooperative programs instituted with the State of California Department of Water Resources, California Division of Mines and Geology, Army Corps of Engineers, Veterans Administration, and California Institute of Technology, and to numerous cities that have adopted building code provisions requiring three accelerographs in most structures taller than six stories.

Notes pertinent to this engineering seismology program may be found in preceding issues of the *United States Earthquakes* series, and in *Publication 41-2, Earthquake Investigations in the Western United States, 1931-1964,* U.S. Department of Commerce, Coast and Geodetic Survey, Washington, D.C., 1965. The latter is much broader in scope, containing data on structural and ground vibrations and detailed descriptions of the many activities that constitute the seismological program as a whole.

ACCELEROGRAPH RECORDS

Table 5 presents a complete listing of all earthquakes recorded in 1973 and the maximum accelerations scaled from those considered more significant. The earthquakes are listed in chronological order and include locality, geographic coordinates, magnitude, and maximum intensity when available. This information has been gathered from *Preliminary Determination of Epicenters* and *Abstracts of Earthquake Reports for the United States,* both published by the U.S. Geological Survey. The recording stations are listed in alphabetical order with a brief description of the building in which the instrument is housed. Epicentral distances were calculated to show the relative proximity of the individual recording stations. Maximum accelerations are listed for those events where ground accelerations were $>0.05g$. These criteria were arbitrarily adopted to reduce the amount of insignificant data reported. Although the maximum recorded acceleration poorly defines the nature of motion at a site, it is the most easily and quickly obtained quantity. It should be pointed out that these measurements have no relation to frequency or duration of shaking, and, in fact, the amplitudes

[1] Prepared by Charles F. Knudson, U.S. Geological Survey, 390 Main Street, San Francisco, Calif. Appreciation is extended to Virgilio Perez, Stephen Schwartz, Richard P. Maley, and Christopher Rojahn for their assistance in preparing this section.

recorded as maximum acceleration were observed as only one or two prominent peaks in many instances.

Listed below is a summary of the results of two important United States earthquakes recorded in 1973. The area felt and the maximum intensity of these earthquakes are included.

Point Mugu, Calif.—Feb. 21

A magnitude 5.9 (California Institute of Technology) earthquake near Point Mugu triggered 320 strong-motion accelerographs in central and southern California, the majority installed in high-rise buildings in the Los Angeles area. A peak acceleration of 0.13*g* was recorded in a north-south direction by the nearest instrument located at Port Hueneme, 18 km from the epicenter. Eight ground records obtained in Los Angeles showed horizontal accelerations of 0.05*g* to 0.09*g*, all at distances greater than 50 km. The maximum building accelerations recorded were 0.22*g* on the 11th floor (top) of a building located near Marina del Rey. The earthquake was felt over 60,000 km ^{2} and had a maximum intensity of VII.

Honomu, Hawaii—Apr. 26

A magnitude 6.2 (USGS) earthquake near Honomu, Hawaii, was recorded by an accelerograph recently installed at Namakani Paio Campground at Kilaua, thus providing the first strong-motion recording of a Hawaiian earthquake. The event, located 50 km northeast of the campground (hypocenter at 50 km), produced maximum recorded horizontal accelerations of 0.11*g* and 0.17*g*. A second instrument installed at Honolulu, 325 km epicentral distance, showed minor ground amplitudes of 0.03*g* and less. Following the earthquake, the Hawaiian network was enlarged with the installation of three additional accelerographs on Hawaii and one each on Molokai and Maui. The April 26 earthquake had a maximum intensity of VIII and was felt on Kauai, 595 km from the epicenter.

TABLE 5.—*Summary of accelerograph records obtained from earthquakes in 1973*

Event	Station location	Station coordinates (°)	Epicentral distance–km (mi)	Component	Maximum acceleration [1] (g)		
Earthquake of Jan. 15. Hollister, Calif. Epicenter 36.7° 6., 121.3° W. Magnitude 4.0. Maximum intensity V.	Hollister, Calif., City Hall. (1-story bldg.)	36.85 N 121.40 W	....	....	[2]		
Earthquake of Jan. 30 Managua, Nicaragua. Epicenter unknown. Magnitude unknown.	Managua, Nicaragua, National University. (small 1-story bldg.)	12.11 N 86.24 W	....	East	.09		
				Up	.05		
				South	.07		
	Managua, Nicaragua, Esso Refinery. (1-story bldg.)	12.14 N 86.32 W	....	....	[2]		
					Grnd	4th fl	8th fl
Earthquake of Feb. 21. Point Mugu, Calif. Epicenter 34.1° N., 119.0° W. Magnitude 5.9. Maximum intensity VII.	Culver City, Calif., 5990 Green Valley Cir. (8-story bldg.)	33.98 N 118.38 W	61 (38)	S45°W	.04	.05	....
				Down	.03	.04	.05
				S45°E	.05	.08	.14
					Bsmt	5th fl	9th fl
	Los Angeles, Calif., 9750 Airport. (9-story bldg.)	33.95 N 118.38 W	62 (39)	North	.04	.08	.11
				Down	.02	.02	.02
				West	.03	.06	.10
					Bsmt	7th fl	14th fl
	Los Angeles, Calif., 9841 Airport. (14-story bldg)	33.95 N 118.39 W	61 (38)	North	.05	.06	.05
				West	.05	.06	.04
				Up	.02	.04	.04
					Grnd	6th fl	12th fl
	Los Angeles, Calif., 4827 Central. (12-story bldg.)	34.00 N 118.26 W	72 (45)	North	.05	.06	.14
				Down	.02	.02	.03
				West	.06	.06	.14
					Grnd	5th fl	
	Los Angeles, Calif., 5249 Century. (10-story bldg.)	33.94 N 118.37 W	63 (39)	East	.04	.06	
				Down	.02	.05	
				South	.05	.07	

[1] Unless otherwise noted, maximum acceleration was recorded at ground or basement level.
[2] Maximum acceleration less than 0.05g.

TABLE 5.—*Summary of accelerograph records obtained from earthquakes in 1973*—Continued

Event	Station location	Station coordinates (°)	Epicentral distance–km (mi)	Component	Maximum acceleration [1] (*g*)		
					Grnd	4th fl	Roof
Earthquake of Feb. 21—Cont.	Los Angeles, Calif.,	33.95 N	63 (39)	East	.05	.02	.03
	5260 Century.	118.37 W		North	.05	.03	.04
	(7-story bldg.)			Up	.01	.02	.09
					Grnd	6th fl	12th fl
	Los Angeles, Calif.,	34.00 N	66 (41)	West	.05	.06	.11
	4411 Eleventh.	118.33 W		Down	.04	.05	.05
	(12-story bldg.)			South	.06	.13	.14
					Grnd	7th fl	Roof
	Los Angeles, Calif.,	34.16 N	50 (31)	S77°E	.06	.05	.06
	16633 Ventura.	118.50 W		Down	.01	.02	.03
	(14-story bldg.)			N13°E	.03	.06	.04
					Grnd	6th fl	11th fl
	Los Angeles, Calif.,	33.98 N	54 (33)	S53°W	.09	.12	.22
	415 Washington.	118.45 W		Down	.02	.04	.06
	(11-story bldg.)			S37°E	.07	.09	.22
	Port Hueneme, Calif.,	34.15 N	18 (11)	Up		.04	
	Naval Laboratory.	119.20 W		South		.13	
	(1-story warehouse)			West		.08	

Note: Smaller amplitude records [3] also were generated at the following stations:

Alhambra: 900 S. Fremont.

Beverly Hills: 450 Roxbury, 8383 Wilshire, 8601 Wilshire, 9100 Wilshire, 9401 Wilshire, 9450 Wilshire, 9595 Wilshire, 9665 Wilshire.

Bakersfield: Bakersfield High School.

Costa Mesa: 666 W. 19th.

El Segundo: 101 Continental, 909 Sepulveda.

Glendale: 633 E. Broadway.

Lake Hughes: Station Nos. 1 and 4.

Loma Linda: Loma Linda University Hospital.

Long Beach: State University, Terminal Island, Utilities Building.

Los Angeles: 1900 Ave. of Stars, 1901 Ave. of Stars, 1177 Beverly, Century City Ground, 1800 Century Park E., 1801 Century Park E., 1880 Century Park E., 1888 Century Park E., 414 Commercial, 222 Figueroa, 234 Figueroa, 445 Figueroa, 250 E. First, 800 W. First, 525 Flower, 533 Fremont, 750 Garland, 420 Grand, 930 Hilgard, 1150 Hill, 7060 Hollywood, 7080 Hollywood, 3663 Hoover, 111 Hope, Jensen Filtration Plant, 3838 Lankershim, 3010 Leeward, 1640 Marengo, 616 Normandie, 646 Olive, 808 Olive, 1625 Olympic, 2555 E. Olympic, 1760 Orchid, 8244 Orion, 120 Robertson, 10100 Santa Monica, 11661 San Vicente, Sepulveda VA Hospital, 14500 Sherman Circle, 611 Sixth, 3407 Sixth, 210 Spring, 4867 Sunset, 6255 Sunset, 6464 Sunset, 945 Tiverton, UCLA, 3440 University, Van Norman Dam, 15107 Van Owen, 14724 Ventura, 15250 Ventura, 15433 Ventura, 15910 Ventura, 16055 Ventura, 16255 Ventura, 16661 Ventura, 18321 Ventura, 930 Westwood, 637 Wilshire, 800 Wilshire, 3250 Wilshire, 3255 Wilshire, 3345 Wilshire, 3470 Wilshire,

[3] Maximum acceleration recorded at ground or basement level was less than 0.05*g* (upper stories less than 0.1*g*).

TABLE 5.—*Summary of accelerograph records obtained from earthquakes in 1973*—Continued

Event	Station location	Station coordinates (°)	Epicentral distance–km (mi)	Component	Maximum acceleration [1] (g)
Earthquake of Feb. 21—Cont.	3550 Wilshire, 3710 Wilshire, 4680 Wilshire, 6300 Wilshire, 6420 Wilshire, 10740 Wilshire, 10747 Wilshire, 10850 Wilshire, 10960 Wilshire, and 2011 Zonal. Maricopa: Station Nos. 1, 2, 3, and 4. Orange: One City Boulevard. Pacoima Dam: Abutment. Palmdale: Fire Station. Pasadena: Milikan Library, Jet Propulsion Lab., and Seismological Lab. Puddingstone Dam: Abutment. Pyramid Dam: Toe. San Antonio Dam: Crest. Santa Ana: Orange County Engineering Building, 1600 N. Broadway. Santa Anita Dam: Abutment. Santa Barbara: Courthouse. Santa Felicia Dam: Crest. Santa Monica: 201 Ocean. Taft: Lincoln School. Vernon: Central Manufacturing District Terminal. Whittier Narrows Dam: Spillway.				
Earthquake of Mar. 12. Off coast of northern California. 40.3° N., 124.2° W. Magnitude 4.3. Maximum intensity V.	Eureka, Calif., Federal Building. (3-story bldg.)	40.80 N 124.16 W	....	....	[2]
	Ferndale, Calif., City Hall. (2-story bldg.)	40.58 N 124.26 W	....	....	[2]
Earthquake of Mar. 31. Managua, Nicaragua. Epicenter unknown. Magnitude unknown.	Managua, Nicaragua, National University. (small 1-story bldg.)	12.11 N 86.24 W	....	East Up South	.60 .53 .26
Earthquake of Apr. 26. Honomu, Hawaii. Epicenter 19°52′ N., 155°07′ W. Magnitude 6.2. Maximum intensity VIII.	Kilauea, Hawaii, Namakani Paio Campground. (small 1-story bldg.)	19.43 N 155.30 W	50 (31)	S30°W Down S60°E	.17 .07 .11
	Honolulu, Hawaii, Maluhia Service Club. (small 1-story bldg.)	21.29 N 157.86 W	....	....	[2]

TABLE 5.—*Summary of accelerograph records obtained from earthquakes in 1973*—Continued

Event	Station location	Station coordinates (°)	Epicentral distance–km (mi)	Component	Maximum acceleration [1] (g)
Earthquake of May 20. Off north coast of California. Epicenter 40.3° N., 124.5° W. Magnitude 4.0. Maximum intensity IV.	Ferndale, Calif., City Hall. (2-story bldg.)	40.58 N 124.26 W	....	....	([2])
Earthquake of July 14. Southwestern San Bernardino Co., Calif. Epicenter 34.4° N., 116.8° W. Magnitude 4.8. Maximum intensity V.	Cedar Springs Dam, Calif., Crest/Toe. (Concrete vault/Box)	34.30 N 117.31 W	....	....	([2])
Earthquake of July 24. Ukiah, Calif. Epicenter 39.1° N., 123.2° W. Magnitude 3.7. Maximum intensity V.	Coyote Dam, Calif., Crest/Toe/Abutment. (Concrete vaults)	39.20 N 123.18 W	....	....	([2])
Earthquake of Aug. 6. Off coast of southern California. Epicenter 34.0° N., 119.5° W. Magnitude 4.7. Maximum intensity V.	Los Angeles, Calif., 415 Washington. (11-story bldg.)	34.98 N 118.45 W	....	....	([2])
	Port Hueneme, Calif., Naval Laboratory. (1-story warehouse)	34.15 N 119.20 W	....	....	([2])
Earthquake of Aug. 8. Off north coast of California. Epicenter 40.3° N., 124.2° W. Magnitude 4.7. Maximum intensity VI.	Ferndale, Calif., City Hall. (2-story bldg.)	40.58 N 124.26 W	25 (15)	Up S44°W N46°W	.03 .10 .14
	Butler Valley, Calif., Station No. 2. (Instrument shelter)	40.79 N 123.88 W	....	....	([2])
	Eureka, Calif., Federal Building. (3-story bldg.)	40.80 N 124.16 W	....	....	([2])
Earthquake of Sept. 16. Berryessa, Calif. Epicenter 38.6° N., 122.1° W. Magnitude 4.7. Maximum intensity V.	Berryessa, Calif., CDF Fire Station. (1-story bldg.)	38.54 N 122.23 W	10 (6)	S78°W Down N12°W	.18 .04 .08

TABLE 5.—*Summary of accelerograph records obtained from earthquakes in 1973*—Continued

Event	Station location	Station coordinates (°)	Epicentral distance-km (mi)	Component	Maximum acceleration [1] (g)
Earthquake of Sept. 29. Off north coast of California. Epicenter 40.3° N., 124.2° W. Magnitude 4.1. Maximum intensity IV.	Ferndale, Calif., City Hall. (2-story bldg.)	40.58 N 124.26 W	....	....	[2]
Earthquake of Oct. 3. Near Santa Clara, Calif. Epicenter 37.2° N., 121.6° W. Magnitude 4.7. Maximum intensity V.	Santa Clara, Calif., 890 Main. (11-story bldg.)	37.38 N 121.56 W	....	....	[2]
Earthquake of Oct. 5. Near Santiago, Chile. Epicenter 33.5° S., 71.5° W. Magnitude 6.7.	Santiago, Chile, University of Chile. (3-story bldg.)	33.47 S 70.67 W	....	....	[2]
Earthquake of Oct. 9. Honomu, Hawaii. Epicenter 19.32° N., 155.26° W. Magnitude 4.6.	Honomu, Hawaii [4], C. Tanimote Res. (1-story house)	19.87 N 155.12 W	....	....	[2]
Earthquake of Nov. 11. Near Ukiah, Calif. Epicenter 39.3° N., 123.4° W. Magnitude 4.4. Maximum intensity V.	Coyote Dam, Calif., Crest/Toe/Abutment. (Concrete vaults)	39.20 N 123.18 W	....	....	[2]
Earthquake of Nov. 12. Near Corralitos, Calif. Epicenter 37.2° N., 122.0° W. Magnitude 4.5. Maximum intensity V.	Corralitos, Calif., Koinonia Conf. (small 1-story bldg.)	37.05 N 121.80 W	....	....	[2]
	Oakland, Calif., 2730 Adeline. (2-story bldg.)	37.63 N 122.12 W	....	....	[3]
	Santa Clara, Calif., 890 Main. (11-story bldg.)	37.38 N 121.56 W	....	....	[3]

[4] Temporary station

TABLE 5.—*Summary of accelerograph records obtained from earthquakes in 1973* —Continued

Event	Station location	Station coordinates (°)	Epicentral distance–km (mi)	Component	Maximum acceleration [1] (g)		
					Grnd	5th fl	
Earthquake of Nov. 30.	Los Angeles, Calif.,	33.94 N	....	East	.04	.01	
Near Los Angeles Airport.	5249 Century.	118.37 W		Down	.01	.01	
Epicenter 34.0° N., 118.4° W.	(10-story bldg.)			South	.09	.03	
Magnitude 3.2. Maximum intensity IV.							
					Bsmt	7th fl	12th fl
	Los Angeles, Calif.,	33.95 N	....	North	.07	.04	.04
	9901 La Cienega.	118.37 W		Down	.01	.02	.02
	(12-story bldg.)			East	.02	.01	.01
	Note: Smaller amplitude records [3] also were generated at the following station: 5855 Century, Los Angeles.						
Earthquake of Dec. 21.	Butler Valley, Calif.,	40.79 N	....	....		[2]	
Off north coast of California.	Station No. 2.	123.88 W					
Epicenter 40.6° N., 124.6° W.	(Small prefab bldg.)						
Magnitude 4.6. Maximum intensity V.							
	Eureka, Calif.,	40.80 N	....	....		[2]	
	Federal Building.	124.16 W					
	(3-story bldg.)						
	Ferndale, Calif.,	40.58 N	....	....		[2]	
	City Hall.	124.26 W					
	(2-story bldg.)						
	Petrolia, Calif.	40.35 N	....	....		[2]	
	(Instrument shelter)	124.35 W					

Corrections to Previous Issues

United States Earthquakes, 1972. The following recomputations have been made:

Page 30, column 2, Apr. 11 earthquake. On line 5 of description, mag. 3.3 should read "3.4."

Page 32, column 1, Jul. 16 time and epicenter should read "06:42:09.2 (14:42), 08:50:39.8. Epicenter 40°02′ N., 121°18′ W., northern California, mag. 4.1, B."

Page 32, column 2, Aug. 23 time and epicenter should read "14:03:35.4 (22:03). Epicenter 37°58′ N., 121°45′ W., central California, at a depth of 2 km, mag. 3.0, B."

Page 33, column 1, Sept. 4 time and epicenter should read "10:04:40.9 (18:04), 12:00, 20:30. Epicenter 36°38.5′ N., 121°15.8′ W. . . ." On figure 6, change time to 10:04:40.9 and Mag. to 4.7.

Page 35, column 2, Oct. 2 time and epicenter should read "02:45:04.8 (10:45), 02:48:12.3 (10:48), 02:56:25.5 (10:56), 07:07:48.2 (14:07; main shock). Epicenter (1) 36°49′ N., 121°32′ W., (2) 36°49′ N., 121°32′ W., (3) 36°48′ N., 121°32′ W., (4) 46°48′ N., 121°32′ W., central California, at depths of about 5, 5, 4, and 4 km, respectively, mag. 3.5, 3.5, 4.0, and 4.1, respectively, B."

Page 35, column 2, Oct. 2 time and epicenter should read "21:59:38.5 (Oct. 3, 05:59), 22:30:02.2 (Oct. 3, 06:30, main shock). Epicenter 36°48′ N., 121°32′ W. . . ."

Page 38, column 2, Oct. 3 epicenter should read "36°48′ N., 121°35′ W. . . ."

Page 39, column 2, Nov. 13 time and epicenter should read "18:10:13.8 (Nov. 14, 02:10). Epicenter 40°18′ N., 124°40′ W., near coast of northern California, at a depth of 21 km, mag. 4.7, B."

Page 39, column 2, Nov. 16 time and mag. should read "15:45:54.7 (23:45)." "Mag. 3.2, B."

Page 40, column 1, Nov. 26 epicenter should read "38°29.8′ N., 122°44.4′ W. . . ."

Page 46, column 1, Oct. 21 earthquake. Add "int. IV at Summit."

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