UNITED STATES EARTHQUAKES

1929

Serial No. 511

U. S. DEPARTMENT OF COMMERCE
COAST AND GEODETIC SURVEY

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U. S. DEPARTMENT OF COMMERCE
R. P. LAMONT, Secretary
COAST AND GEODETIC SURVEY
R. S. PATTON, Director

UNITED STATES EARTHQUAKES 1929

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INTRODUCTION

This publication includes earthquakes of regions under the jurisdiction of the United States, though in the case of the Hawaiian and the Philippine Islands earthquakes of volcanic origin are not included and only severe earthquakes are included in the case of the Philippine Islands since reports are published in Manila. Earthquakes adjacent to the United States and felt within its borders or those in the regions under its jurisdiction are described except that, in the case of the Canadian earthquakes felt within the United States, a general description only is given, as details are given in the Canadian report. As a reciprocal arrangement United States earthquakes felt in Canada are published in detail in this volume. The principal earthquakes of the year which were very widely recorded are given regardless of location, and instrumental details for these are included.

It has been decided not to give individual credit for information by individuals. In omitting this the bureau wishes to express its appreciation to the various organizations and individuals who have made it possible to prepare descriptions of the earthquakes of this country with a completeness and accuracy that has never before been possible. The principal sources of information are as follows:

United States Weather Bureau.

Division of geology and geography of the National Research Council, Arthur Keith, chairman.

Central office of the Jesuit Seismological Association at St. Louis, Mo.

The San Francisco field station of the Coast and Geodetic Survey, cooperating with the Seismological Laboratory of the Carnegie Institution and California Institute of Technology (H. O. Wood, research associate, in charge), University of California (Perry Byerly in charge of the seismological station), and Stanford University. These persons are responsible for instrumental determination of epicenters in California when given. Among the commercial agencies in this section there are a number of cooperators, including the Pacific Telephone & Telegraph Co., Great Western Power Co., National Board of Fire Underwriters, Southern California Telephone Co., Standard Oil Co. of California, Associated Oil Co., Southern Pacific Railroad, and the San Diego & Arizona Railway Co.; also a large number of other organizations and individuals.

Press dispatches (received through the courtesy of Georgetown University).

Telegraphic reports collected by Science Service. This cooperative service was inaugurated in 1925, but through an inadvertence was not mentioned in the report preceding this, Serial No. 483.

Reports from individuals. Prof. Harry Fielding Reid has furnished data of historic value.

Bulletin Seismological Society of America, 1929.

As a number of organizations are actively interested in the collection of noninstrumental data, a plan was adopted whereby each organization will undertake to cover a specified territory, thus avoiding needless overlapping of effort. This work will be in addition to that now carried on by other agencies such as the Weather Bureau and is intended to cover the special investigation of earthquake areas. The accompanying map (fig. 1) shows how this activity is being distributed. The eastern half of the United States, except the central

Mississippi Valley region, will be covered by the division of geology and geography of the National Research Council. The central Mississippi Valley region will come under the Central Office of the Jesuit Seismological Association at St. Louis. The Washington office of the Coast and Geodetic Survey will cover the greater part of the western half of the country, while its field station at San Francisco will serve as a central station for the various information services now being effectively organized in California.

It should be pointed out that this volume and that for 1928 are extensions of the information which appears in Special Publication No. 149 of this bureau, entitled "Earthquake History of the United States Exclusive of the Pacific Region." This publication, however, is more complete, since it includes earthquakes of all grades of intensities and also includes earthquakes of the Pacific coast region. In this connection it should be stated that that region is covered through the year 1927 by the Holden and McAdie catalogues [1] and by a forthcoming publication under the auspices of the Seismological Society of America, which will extend the record to the close of 1927. There is hope that this, as well as republication of the older catalogues now out of print, will become possible in the near future.

It will be noted that the appraisal of intensities has not generally been made. Since isoseismal maps appear which are based on intensities, the Rossi-Forel scale, which will be used until there is general sentiment for the adoption of a more precise scale, is given below in abbreviated form:

ROSSI-FOREL SCALE OF INTENSITIES

1. *Microseismic shock.*—Recorded by a single seismograph or by seismographs of the same model, but not by several seismographs of different kinds; the shock felt by an experienced observer.
2. *Extremely feeble shock.*—Recorded by several seismographs of different kinds; felt by a small number of persons at rest.
3. *Very feeble shock.*—Felt by several persons at rest; strong enough for the direction or duration to be appreciable.
4. *Feeble shock.*—Felt by persons in motion; disturbance of movable objects, doors, windows; cracking of ceilings.
5. *Shock of moderate intensity.*—Felt generally by everyone; disturbance of furniture, beds, etc.; ringing of some bells.
6. *Fairly strong shock.*—General awakening of those asleep; general ringing of bells; oscillation of chandeliers; stopping of clocks; visible agitation of trees and shrubs; some startled persons leaving their dwellings.
7. *Strong shock.*—Overthrow of movable objects; fall of plaster; ringing of church bells; general panic, without damage to buildings.
8. *Very strong shock.*—Fall of chimneys; cracks in the walls of buildings.
9. *Extremely strong shock.*—Partial or total destruction of some buildings.
10. *Shock of extreme intensity.*—Great disaster; ruins; disturbance of the strata, fissures in the ground; rock falls from mountains.

Within the United States the same regional arrangement has been followed as in the case of Special Publication No. 149 mentioned above. In the case of the Pacific coast region, Washington and Oregon have for convenience been treated separately from California.

In this report time will be indicated as continuous from 0 to 24 hours, beginning and ending with midnight.

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[1] Smithsonian Miscellaneous Collections, 1089. A Catalogue of Earthquakes on the Pacific Coast, 1769–1897. Edward S. Holden. Smithsonian Miscellaneous Collections, 1721. Catalogue of Earthquakes on the Pacific Coast, 1897–1901. Alexander G. McAdie.

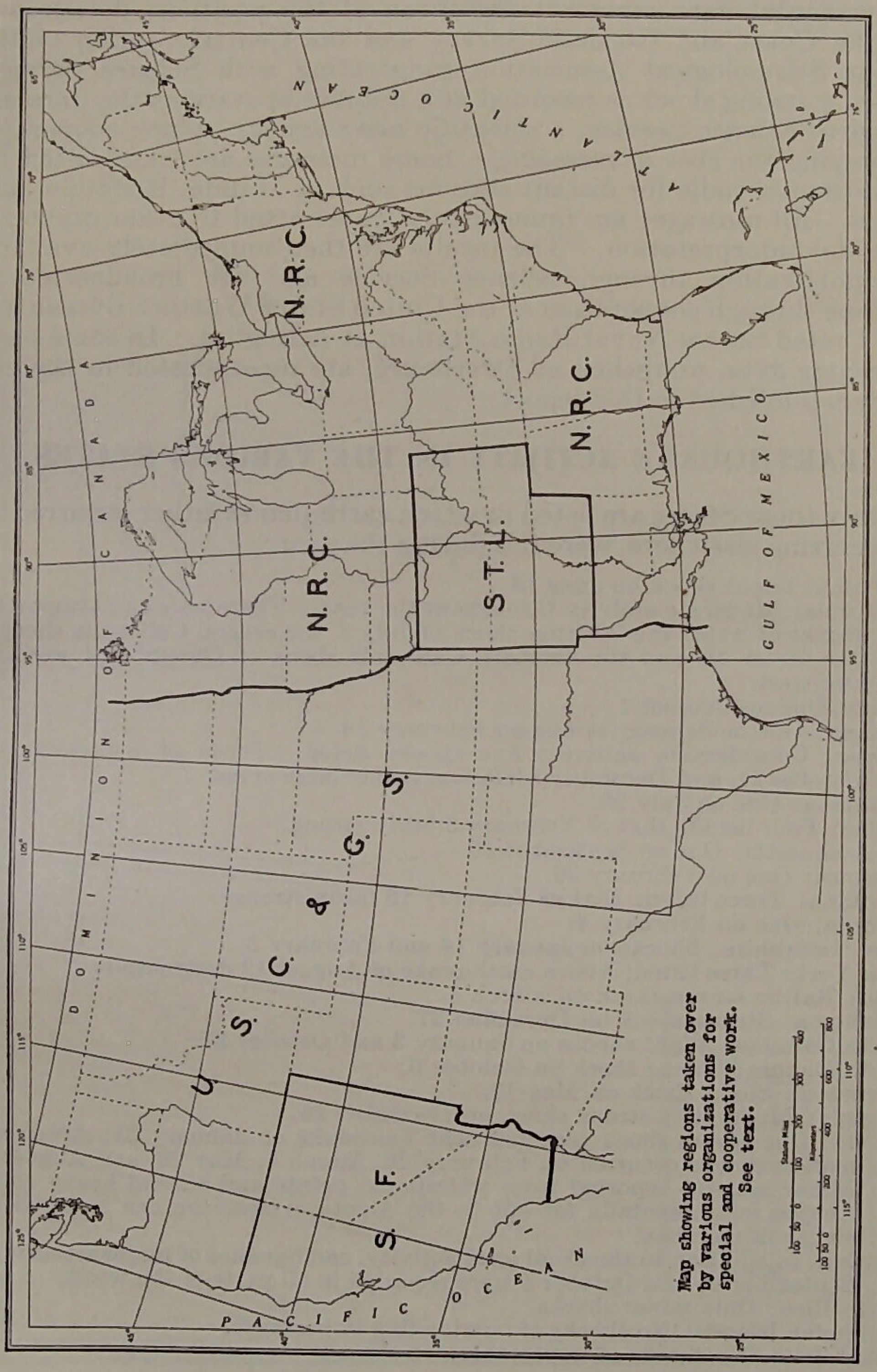

FIGURE 1

Map showing regions taken over by various organizations for special and cooperative work. See text.

All the epicenters indicated in this report are either estimates from noninstrumental data or determined from instrumental results. When the epicenters are based on instrumental data, a statement to that effect is made in each case. As a rule the epicenters based on instrumental data represent the mean of the positions determined by the Coast and Geodetic Survey and the Central Station of the Jesuit Seismological Association cooperating with Science Service. When a strong shock is recorded at a number of stations the data are wired to Science Service, a scientific news agency, which cooperates by paying the cost of messages. Some messages are transmitted by Government radio for distant stations such as Manila, Honolulu, and Sitka. All messages are immediately transmitted to other organizations for interpretation. The results are then immediately available for publication through Science Service and are broadcasted to Europe through cooperation of the United States Weather Bureau and the United States Naval Radio Station at Arlington. In some cases epicenter data, published at Strasbourg, are incorporated in the epicenters published in this report.

EARTHQUAKE ACTIVITY IN THE VARIOUS STATES

Only those States are listed in which earthquakes either occurred or, if occurring elsewhere, were felt during the year.

Alabama: Slight shock on June 13.
California: Moderate activity throughout the year. There were eight important shocks of which the Whittier shock of July 8, the central California shock of November 28, and the northern California shock of December 4 were the strongest.
Idaho: One on October 1.
Indiana: One moderately strong on February 14.
Kansas: Considerable activity; five shocks listed. Those of September 20, October 21, and December 7 felt over rather large areas.
Louisiana: One on July 28.
Maine: Four listed; that of February 5 fairly strong.
Massachusetts: One on September 16.
Missouri: One on February 26.
Montana: Three listed; that of February 15 fairly strong.
Nevada: One on February 4.
New Hampshire: Shocks on January 14 and February 5.
New York: Three listed; Attica earthquake of August 12 destructive.
Ohio: Rather strong shock on March 8.
Oklahoma: Strong shock on December 27.
South Carolina: Slight shocks on January 3 and October 27.
South Dakota: Strong shock on October 6.
Tennessee: Slight shock on May 12.
Virginia: Moderately strong shock on December 26.
Alaska: One severe shock centered near Fairbanks on January 21; strong submarine shocks occurred on February 26, March 6, May 26, and August 19. Minor activity reported from widespread points and several heavy shocks located instrumentally far out in the Aleutians near the one hundred and eightieth meridian.
Hawaii: In addition to the usual local activity, earthquakes of major intensity on September 25 and October 5 were recorded in all parts of the world.
Porto Rico: Only minor shocks.
Philippine Islands: No shocks of outstanding importance.
Canal Zone: No shocks of importance.

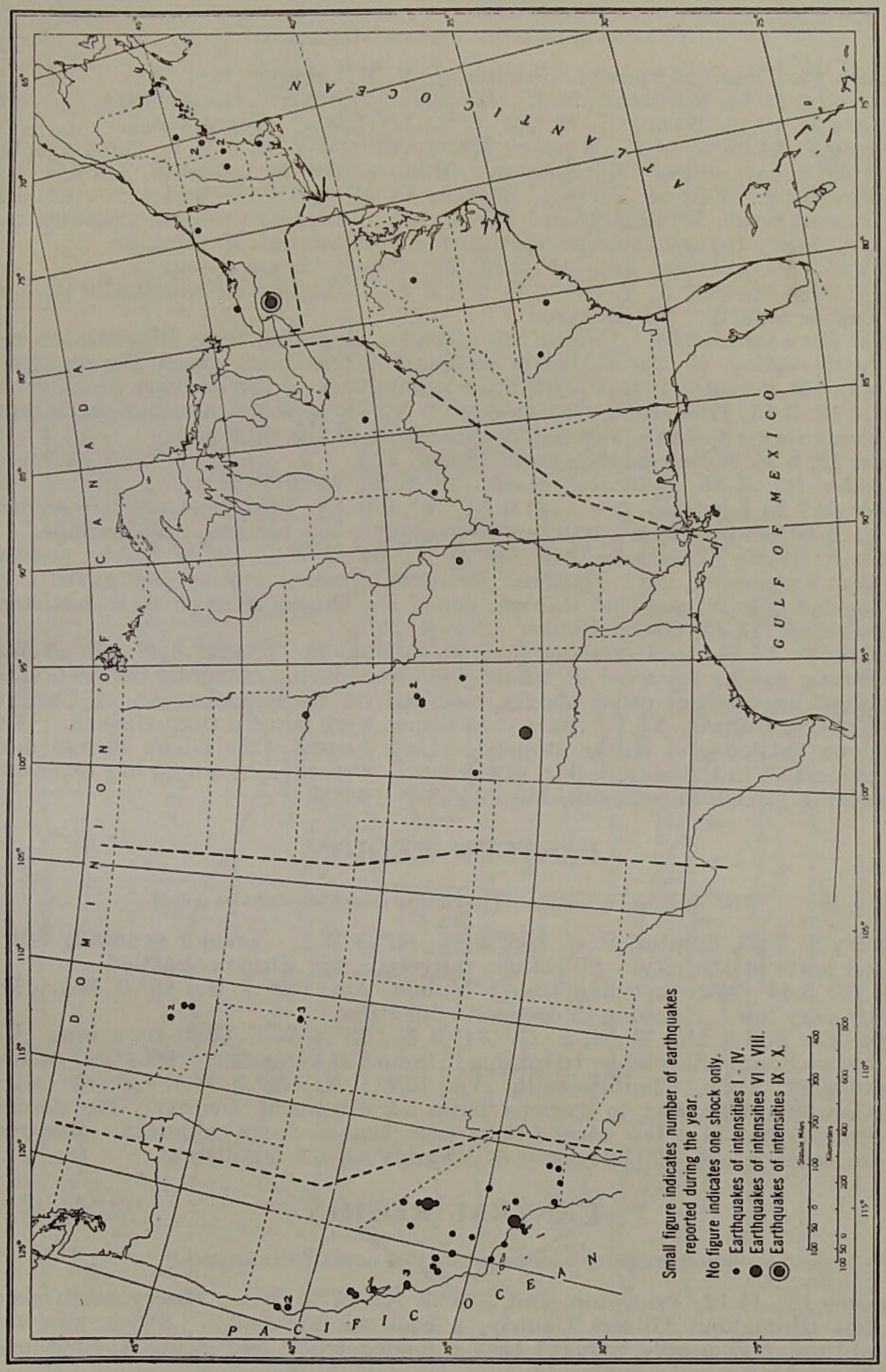

FIGURE 2

NORTHEASTERN REGION

[75th meridian or eastern standard time]

January 13: Time not known. Rochester, N. H. Slight.
January 14: 21.45, Rochester, N. H. (43°.3 N., 71°.0 W.). Local shocks.
February 5: 12.10, Weare, N. H. (43°.3 N., 71°.7 W.). Slight shock.
February 5: 14.09 to 14.17, Western Maine (44°.0 N., 70°.3 W.). Area affected 2,000 square miles. Windows and dishes rattled at Lewiston, Auburn, and Raymond. Felt at Norway, Bryants Pond, and Paris and a few minutes later at Gray, Windham, and Brunswick. It seems probable that this was one shock, though the reported times varied through 10 minutes.
March 28: 19.00, Calais, Me. (45°.2 N., 67°.3 W.). Local shock.
June 5: 2.00, Malone, N. Y. (44°.8 N., 74°.3 W.). Light shock lasting 30 seconds. Dishes rattled. No damage.
August 12: 1.00 to 2.00. Center not known. Reported from Binghamton and Little Valley, N. Y., which are far apart. The shock was in the night and was not strong. It was probably a preliminary of the stronger shock.
August 12: 3.45, Port Hope, Ontario (44°.0 N., 78°.4 W.). Another preliminary shock seems to have been felt in this region at the time given.
August 12: 6.25, Attica earthquake. (See p. 17.)
September 16: 23.45, Holbrook, Mass. (42°.2 N., 71°.0 W.).
October 8: 7.20 Lewiston, Me. (44°.0 N., 70°.2 W.). Two shocks of two seconds each 10 minutes apart, both accompanied by low rumble. No damage.
October 8: 19.30, Waterville, Me. (44°.5 N., 69°.5 W.). It is barely possible that cooperator with National Research Council erroneously gave p. m. instead of a. m. and that this was one of the shocks referred to in last item.
November 18: 15.35, Grand Banks. (See p. 28.)
December 2: 17.14, to December 3, 7.50, Attica, N. Y. (42°.8 N., 78°.3 W.). Strong shocks occurred at times given and during intervals between them there were seven other shocks recorded on the seismograph at Canisius College, Buffalo, N. Y. At Attica dishes were thrown from shelves. Windows rattled and clocks stopped. Like August 12th shock it was more noticeable in the eastern part of the city. Preceded by sound like explosion.
December 5: 10.00, Skowhegan, Me. (44°.8 N., 69°.7 W.).

EASTERN REGION

[75th meridian, or eastern standard time except as otherwise noted]

January 3: 7.05, Sumter, S. C. (33°.9 N., 80°.3 W.). Tremor generally felt in all parts of the city. Structures quivered, and windows rattled.
June 13: 8.44 (90th meridian time), Mobile, Ala. (30°.7 N., 88°.0 W.). Felt by very few. Swaying in east-west direction.
October 27: 21.15, Due West, S. C. (34°.3 N., 82°.4 W.). Felt by a few. One heavy bump followed by trembling. Sound like thunder. Windows rattled.
December 26: 21.56, Charlottesville, Va. (38°.1 N., 78°.5 W.). Shock felt in Charlottesville and in various parts of Albemarle County. No damage except that in a few cases bricks were shaken from chimneys. Recorded on seismograph of University of Virginia as not far distant.

CENTRAL REGION

[90th meridian or central standard time unless otherwise stated]

February 14: 14.12, Princeton, Ind. (38°.3 N., 87°.6 W.). Heavy earth shock felt throughout Gibson County, a coal mining region. Shock was very abrupt, and people thought that a loaded truck had struck their houses. Resembled a mine explosion.
February 26: 2.15, Arcadia, Mo. (37°.6 N., 90°.6 W.). Slight shock with rattling noise.

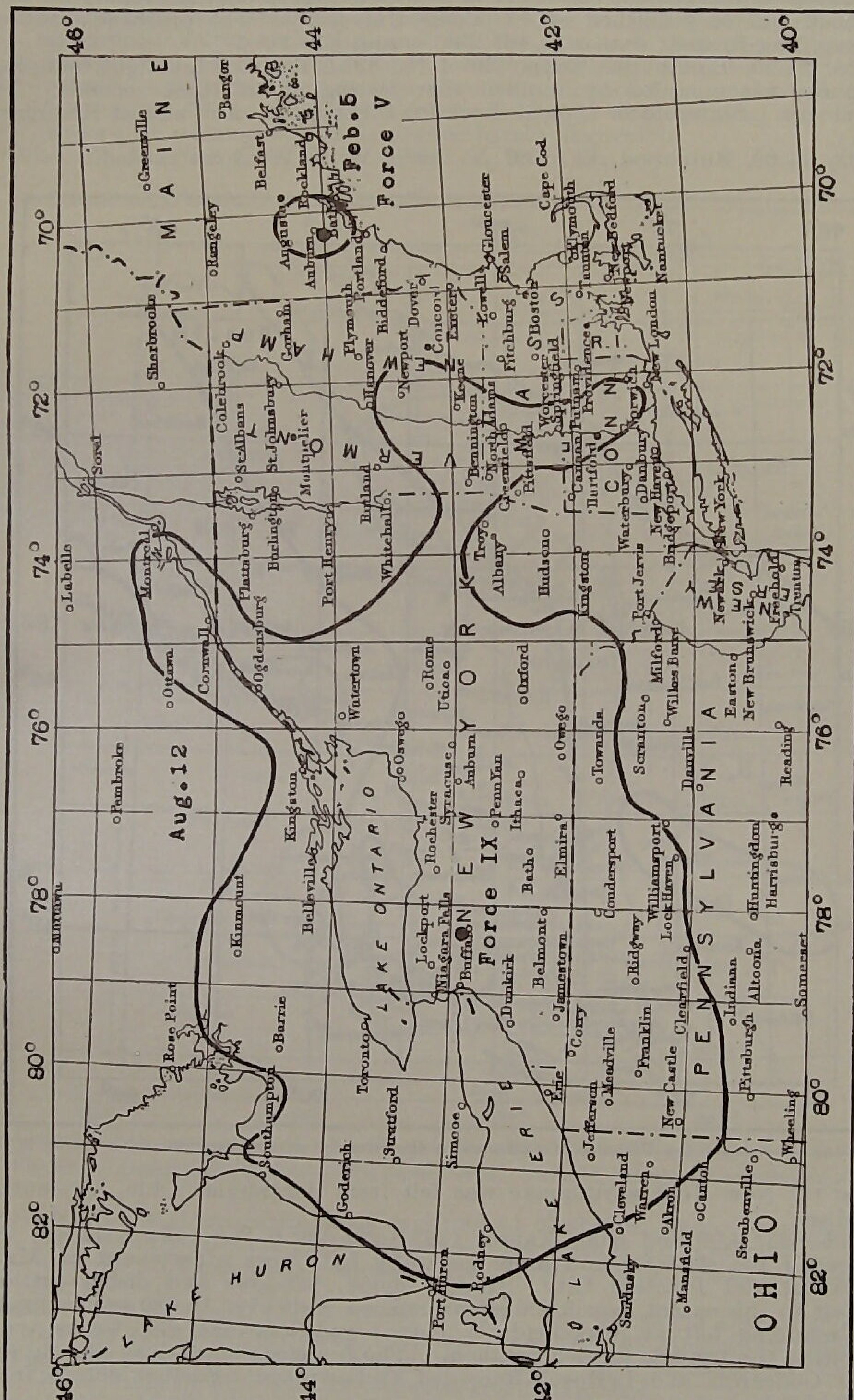

FIGURE 3.—Areas affected by shocks of February 5 and August 12

March 8: 4.06 (75th meridian time), Bellefontaine, Ohio (40°.3 N., 84°.2 W.). Full report by St. Louis. Felt from Bellefontaine to the Indiana line. Buildings shaken. Furniture shifted. No damage. Generally felt in Cincinnati and at Piqua, Ohio. It is expected that a detailed report on this shock will be published by St. Louis University. The probable location according to their data was 40° 23′ N. and 84° 11′ W.

May 12: 21.50, Tiptonville, Tenn. (36°.4 N., 89°.5 W.). A few light bumping shocks accompanied by muffled roar lasting about three seconds. No damage. Stated to be typical shock for this region. Felt also at Hickman, Ky.

July 28: 11.00, Burrwood, La. (29° N., 89°.4 W.). Windows rattled.

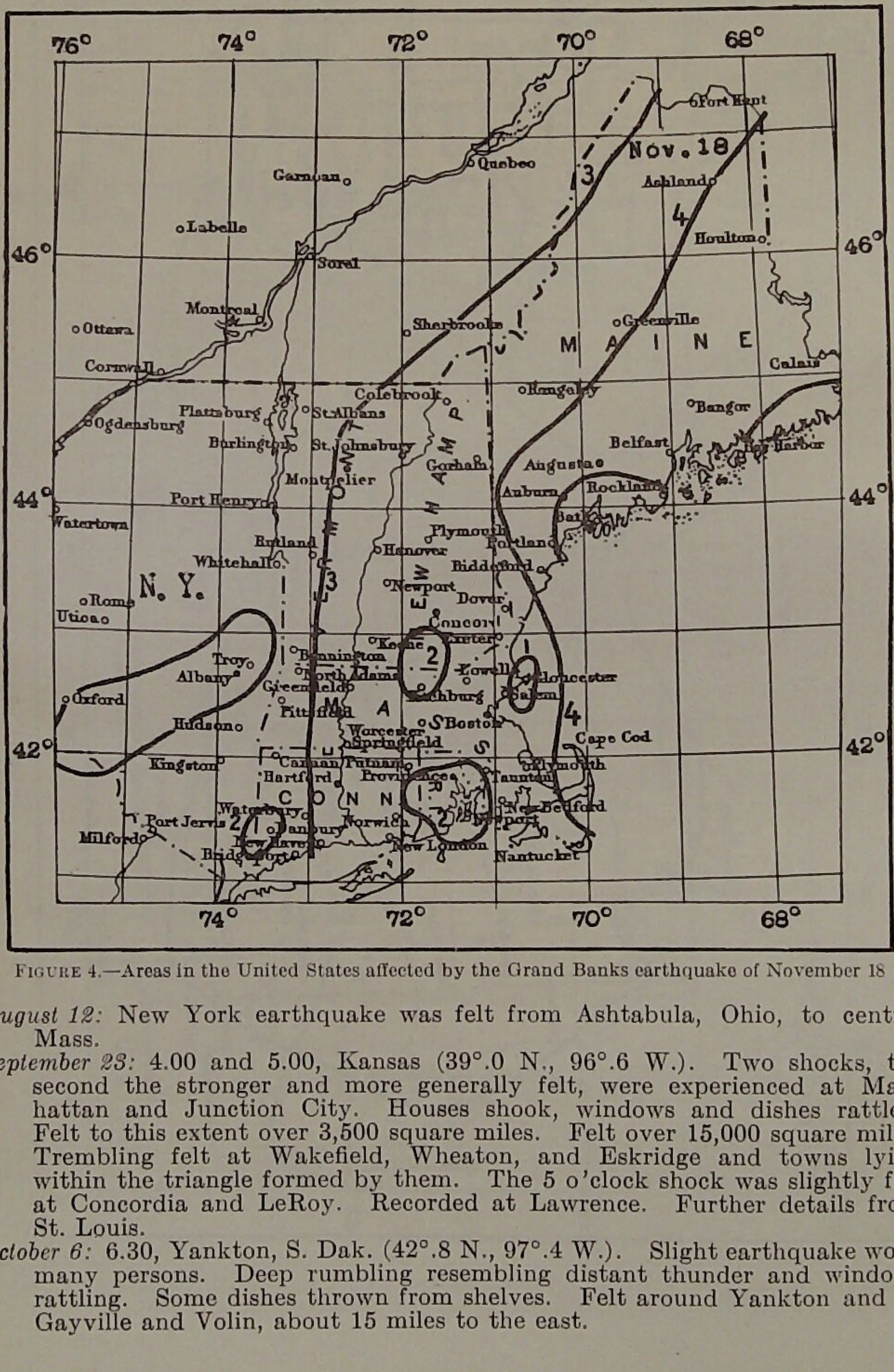

FIGURE 4.—Areas in the United States affected by the Grand Banks earthquake of November 18

August 12: New York earthquake was felt from Ashtabula, Ohio, to central Mass.

September 23: 4.00 and 5.00, Kansas (39°.0 N., 96°.6 W.). Two shocks, the second the stronger and more generally felt, were experienced at Manhattan and Junction City. Houses shook, windows and dishes rattled. Felt to this extent over 3,500 square miles. Felt over 15,000 square miles. Trembling felt at Wakefield, Wheaton, and Eskridge and towns lying within the triangle formed by them. The 5 o'clock shock was slightly felt at Concordia and LeRoy. Recorded at Lawrence. Further details from St. Louis.

October 6: 6.30, Yankton, S. Dak. (42°.8 N., 97°.4 W.). Slight earthquake woke many persons. Deep rumbling resembling distant thunder and windows rattling. Some dishes thrown from shelves. Felt around Yankton and at Gayville and Volin, about 15 miles to the east.

October 18: Earthquakes were erroneously reported on account of exceptionally large blasts in use of seismic methods in prospecting. Those interested will find details in Science for February 14, 1930.

October 21: 15.30, Kansas (39°.2 N., 96°.5 W.). Area about 8,000 square miles over which felt, same general region and type as that of September 23, but apparently felt over about one-half the area. In Junction City, Manhattan, and McFarland abrupt bumping, rattling windows and cooking utensils, and other sounds like thunder. Reported from Council Grove, Concordia, Chapman, Clay Center, Emmett, Wamego, and St. George. Record on seismograph at Lawrence barely discernible.

October 23: Junction City, Kans. (39°.0 N., 96°.8 W.).

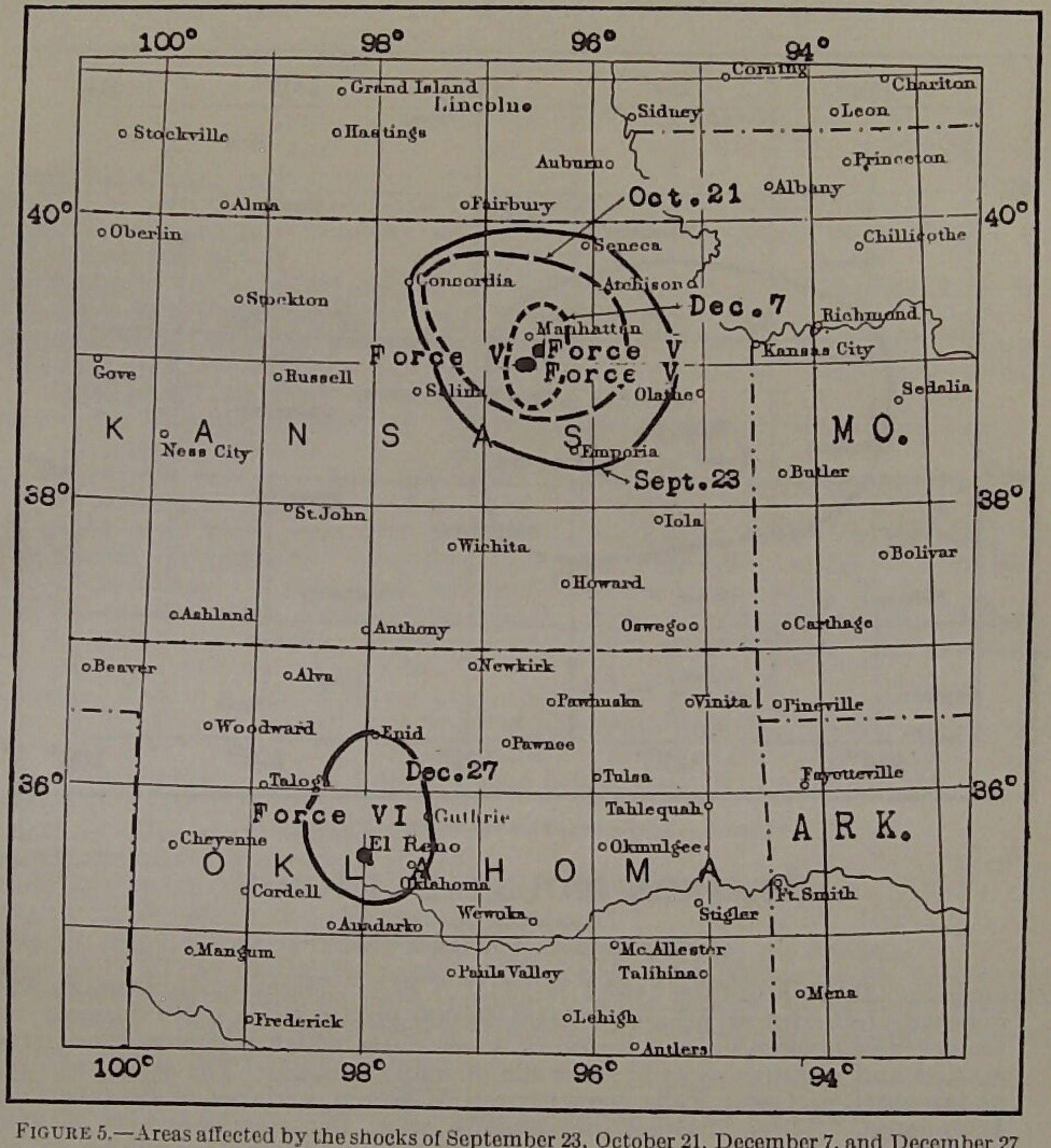

FIGURE 5.—Areas affected by the shocks of September 23, October 21, December 7, and December 27

November 20: A sharp earth shock reported at Nashville, Tenn., was found by Walter F. Pond, State geologist, to have been due to a heavy blast.

November 26: 22.20, Ashland, Kans. (37°.2 N., 99°.7 W.). Shock of intensity 4 or 5.

December 7: 2.02, Kans. (39°.2 N., 96°.5 W.). Felt in central area of shock of October 21. Felt over about 1,000 square miles. At Manhattan, buildings shook, windows rattled. Many awakened. No damage. At Council Grove, beds shook. Felt at Wamego and McFarland.

December 27: 18.30, Okla. (35°.5 N., 98°.0 W.). About 8,000 square miles. A shock of sufficient intensity to cause people to rush from their homes in alarm was felt at El Reno, Union City, Oklahoma City, and adjacent region. At El Reno, walls and floors seemed to sway, objects moved, clocks stopped.

Some plaster cracked and at least one chimney fell. Persons thought that a heavy truck had struck the building in which they were. Generally felt that a few more seconds duration would have resulted in serious damage. Strongly felt at Piedmont, 22 miles northeast. At Oklahoma City a roar was heard. Doors jarred as if someone were trying to enter. Union City, buildings rocked. Geary, two shocks a minute apart. Houses shook as if struck by a gust of wind. Minco, two shocks. At place 8 miles north, plaster cracked in a building. Strong at Okarche. Weatherford, windows rattled. Fort Reno, two sharp shocks caused some alarm. Slight at Yukon and Hennessy. Shocks were not felt at Chandler, Okemah, Shawnee, Okmulgee, Stillwater, Norman, Pauls Valley, Medford, Blackwell, Perry, Chickasha, and Clinton. This information makes it possible to outline the area with unusual certainty.

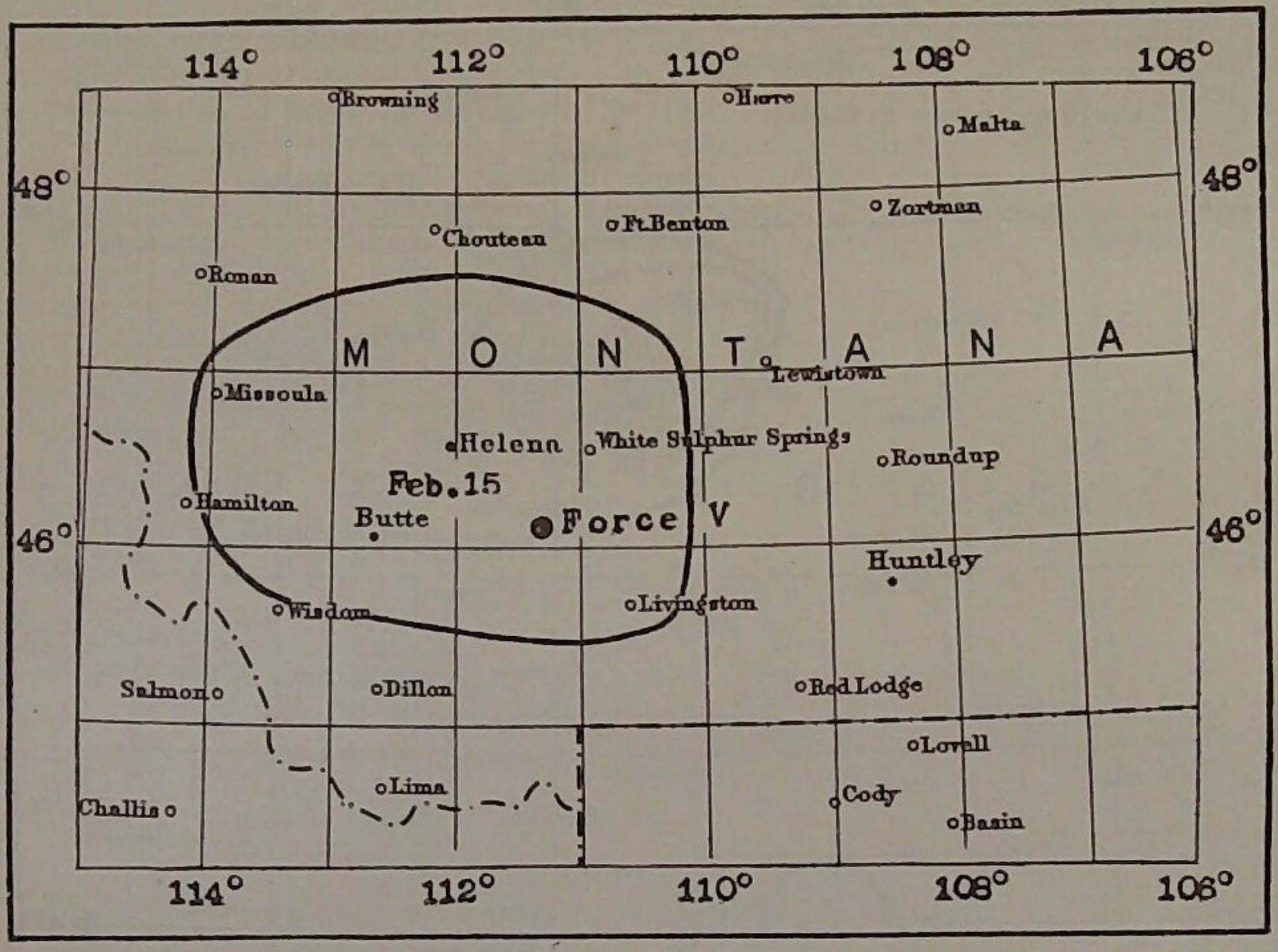

FIGURE 6.—Area affected by the shock of February 15

WESTERN MOUNTAIN REGION

[105th meridian or mountain time]

February 15: 20.00, Montana (46°.1 N., 111°.3 W.). Slight earth tremors were generally felt over an area of at least 40,000 square miles. No damage, but tremor was noticeable in a dozen or more cities which reported that dishes rattled and pictures swayed on walls of many houses. The shock was felt as far north as Great Falls, west toward Missoula, and east of Bozeman and Livingston. Three distinct movements were felt northward of Trident between Lombard and Toston (a region of considerable activity in the June, 1925, earthquake). The shock was noticeable in Helena and Anaconda where dishes fell from the shelves. Quite severe at Deer Park. Later shocks in central region at 22.30 and 22.40.

May 31: 5.30 and 5.33, Helena, Mont. (46°.5 N., 112°.0 W.). Two shocks at time given rattled windows and small articles on dresser. Noted by only a few.

June 11: 5.00, Montana (45°.9 N., 111°.3 W.). Two slight shocks felt at Manhattan, Three Forks, Bozeman, and other points in Gallatin County.

September 30: 9.15 and 23.30, Montpelier, Idaho. (See October 1; 1.00.)

October 1: 1.00, Montpelier, Idaho (42°.2 N., 111°.2 W.). First trembling. Other abrupt. Sounds like heavy van moving about. The 23.35 shock was not generally felt. East-west swaying and trembling afterwards.

PACIFIC COAST REGION

[120th meridian or Pacific standard time]

NOTE—All places are in California unless otherwise stated.

February 4: 7.57, Reno, Nev. Recorded at Reno and estimated within 10 miles.
February 17: 19.25, Santa Rosa. Dishes shaken from tables.
February 28: 23.31 (53° N., 132° W.), submarine. Heavy.
March 2: 17.10, Scotia. Two short shocks. Bumping north-south.
March 10: 19.03, Stockton. Slight.
March 11: 18.18, El Centro. Sharp, 10 seconds duration. Instrumentally recorded. Epicenter (Wood) near Calexico.
March 12: 18.28 (instrumental). Stated by Wood that epicenter is probably near Kern Lake, southwest of Bakersfield. Following data from Wood.
Chandler's: Not felt in small frame outbuilding (refreshment stand) or in garage (cement floor); but felt distinctly in main building of hotel; caused some excitement. Persons at table at the time. Rattled dishes. Nothing upset or spilled, but a lamp shook so that it was taken down for fear of its falling. Sounds due to earthquake, none or slight.
Grapevine Station: Rumble heard. Rattled stools at lunch counter.
Reed's: (Located at crossroad 11½ miles north of Grapevine.) Barely felt; not noticed at all.
San Emigdio Ranch: Very light shake, felt by only a few. The ranch is on hard, stony soil of an alluvial fan—not valley fill.
Oil lease near Maricopa: On road 4 miles east of Maricopa. Felt distinctly. Two light shocks a few seconds apart. No damage, nothing upset, no noise. Ground rolling, edge of valley fill.
Maricopa: Not felt or heard of (two reports). The town is on hard ground at the edge of the hills.
Taft: Not felt or heard of by any of three persons in the office of the Auto Club of Southern California. Taft is in the hills.
Oil leases near Taft: Four and seven miles northeast of Taft on the main road toward Bakersfield. Not felt or heard. Ground (upper end of Buena Vista Valley): Fairly hard, not quite like the main valley fill.
Old River: (One mile west of the place). Felt. Shook the dishes (at table). Creaking and rattling of house (old, poorly constructed). No earthquake rumble. Ground: Valley fill.
Panama: Felt. No damage, nothing upset.
East of Panama: One-half mile west of the State highway. Felt; slight shake.
State highway: Seven miles north of Reed's. Slight shake. No sounds. Shook doors slightly. Small 1-story frame house, very light construction.
Glennville: One abrupt bump.
Fairmont: One abrupt bump.
March 18: 15.00, Stockton. Slight.
April 25: 14.00, Eureka. Felt by many. Abrupt bumping.
May 4: 2.50, Mendota. Slight; no damage.
May 4: 15.30, Montebello, Humboldt County. Slight, no damage.
May 4: 17.10, at Santa Fe pump station near Los Nietos shook asbestos off steam pipe and large tank groaned. Two shocks 15 minutes apart at Rivera. Light at Los Angeles, Wilmington, Norwalk, and Santa Fe Springs.
May 4: 23.35, Los Nietos. Slight.
May 6: 22.45, Los Nietos. Slight.
May 17: 20.44, One north-south bump at Scotia, felt at Fortuna.
May 17: 21.34, Los Nietos. Slight.
May 18: 4.05, Los Nietos. Slight; no damage.
May 23: 15.17, San Francisco, Ferry Building. One quick shock. Light fixtures swung through considerable amplitude. Swinging continued for some time.
May 27: 23.10, Report received from Coalinga. Slight; no damage.
May 31: 4.52, Niland. Slight; no damage.
May 31: 16.50, Calipatria. Slight; no damage.
June 5: 14.27, Dos Cabezas. Slight.
June 14: 15.00, Cottonwood power plant. Slight.
June 23: 14.12, Scotia. Bumping in north-south direction. Crack appeared in concrete pavement with one side 2 inches higher than the other. Persons reported seeing poles and lights swinging.

July 3: 1.29, Santa Barbara. Two slight shocks. Felt at Summerland and Gaviota.

July 6: 15.00, Crescent City. Moderate.

July 8: 8.45, Whittier. A moderately severe shock was felt in the region surrounding Los Angeles, within a region bounded by Santa Anna, Riverside, Pomona, Pasadena, Burbank, Santa Monica, San Pedro, and Long Beach. Damage was done in the suburb of East Whittier, including the caving in of a section of wall of a schoolhouse, fortunately unoccupied at the time. Two houses were wrecked and several damaged by falling chimneys. The shock was felt in the down-town section of Los Angeles, though little damage was done. Windows were broken. Pictures and other swinging objects swayed. Not generally noticed by persons in the streets. Several buildings in Long Beach were rocked, this being especially noticed in a newspaper office and in the Spalding Building. Inglewood noted two shocks quite close together, severe enough to send people into the streets. Pasadena felt the shock as if from a distance. Electric lights swayed. Sawtelle, west of Los Angeles did not feel it. At Yorba Linda, three or four shocks generally felt. These started as a sharp bump followed by a rocking-swaying motion. Water in a water cooler was agitated. There was considerable alarm. Several oil wells reported damaged. About 200 aftershocks from this earthquake were instrumentally recorded during July.

Wood states that epicenter is in vicinity of East Whittier and that he is preparing a more complete study for publication in the Bulletin of the Seismological Society of America. Reports from numerous places received by the Coast and Geodetic Survey field station at San Francisco follow:

Dishes broken at Los Neitos and Norwalk. Strong at former where slight shocks were felt through 36 hours. At Montebello five other shocks were felt during the day, some between 8.00 and 8.30.[2] Fall of brickbats at Clearwater. Slight damage at Artesia. Slight shock at Rivera, Alhambra, Lancaster, Pomona, and Burbank. No damage at Los Angeles, Huntington Beach, Signal Hill, Seal Beach, Van Nuys, Arcadia, San Dimas, Balboa, San Juan Capistrano, Pasadena, Monrovia, Montrose, Charter Oak, Arlington, El Modena, and Tajiguas. Not felt at Mecca, Ventura, Sunland, Perris, San Fernando, Oxnard, Phelan, Waldemar, Summit, De Luz, Wilsonia, and Fairmont City.

July 12: 5.10, Coalinga. Slight.

July 14: 2.43, Lone Pine. No damage. Recorded.

July 15: 17.04, Los Nietos. No damage.

July 16: 13.36, Felt at Los Nietos, Cavieta, Santa Barbara, and Ventura. Felt as far as Carpenteria.

July 23: 3.55, Dos Cabezas. Sleepers wakened.

July 24: 12.59, Whittier. Very slight.

July 30: 5.45, Los Nietos. Very slight.

August 2: 2.02, Oakland and Berkeley. This earthquake as indicated on the seismograms at the Berkeley station was about 3 miles distant. The earthquake reached an intensity of 4–5 on the Rossi-Forel Scale in North Berkeley, El Cerrito, and Richmond. Here sleepers were awakened, dishes rattled, and some clocks stopped. The earthquake was not felt, according to reports, at La Fayette, Concord, Bodeo, San Rafael, Alameda. One observer in San Francisco, near the corner of Page and Baker Streets, was awakened by the earthquake.

Comparison of the Lick Observatory seismogram with the field data point to the probability of the earthquake having occurred on the Hayward Fault, 2 or 3 miles north of the University of California. However, it may have been from some other source close by.

August 28: 10.10, Santa Barbara. Very slight.

September 2: 9.45, Middletown and Calistoga and St. Helena. Slight.

September 8: 10.45, Calistoga. Very slight.

September 8: 21.15, Strong at Naples and west of Santa Barbara. Slight at Santa Barbara and Gaviota. Recorded.

September 11: 7.00, Santa Rosa. Slight.

September 13: 5.23, Off the north point of Catalina Island (Wood). Felt at San Pedro, Los Angeles, and Long Beach, where it awoke sleepers.

September 14: 21.30, St. Helena. Very slight.

September 15: 19.16, Cayucos. No damage.

September 15: 22.15, Cayucos. No damage.

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[2] Shocks from 8.47 to 10.35 at Santa Fe pumping station.

September 24: 9.27, 9.37, and 9.52. A series of slight shocks at Monterey.
September 26: 12, Mohave Desert, east of Barstow. Felt at Pasadena (Wood).
September 28: 13.00, Coachella. Very slight.
October 2: 9.35 and 9.38, Brawley and Niland. Slight shocks.
October 2: 9.51, Niland. Slight.
October 5: 12.03, Coalinga and Lighthipe. Very slight.
October 6: 13.14, Coalinga. Very slight.
October 7: 0.00, Coalinga. Very slight.

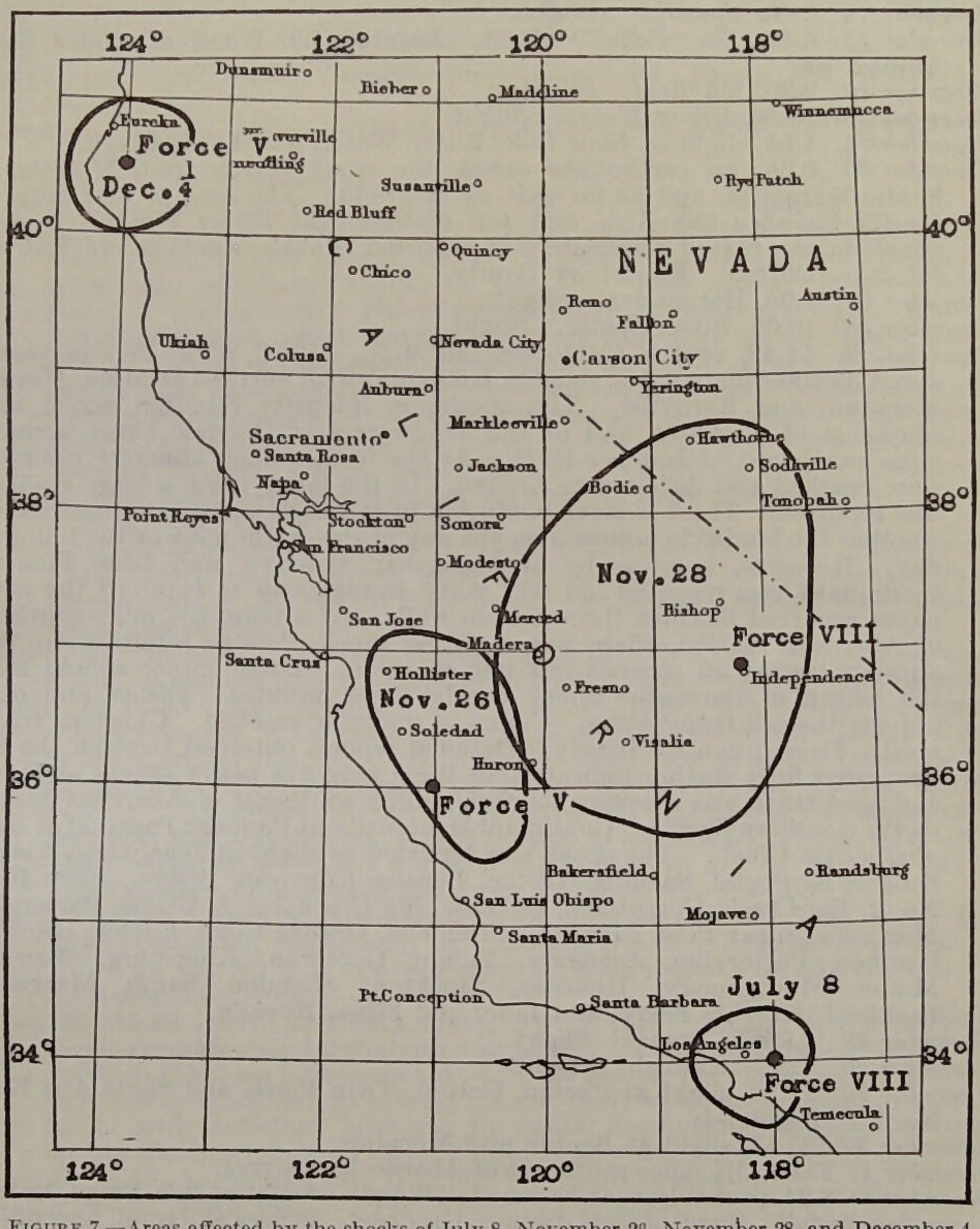

FIGURE 7.—Areas affected by the shocks of July 8, November 26, November 28, and December 4

October 7: 3.30, Orcutt. Very slight.
October 9: 17.10, slight shock felt Kern River No. 3 and Sand Canyon. Noise heard at Freeman. Not felt at Vestal substation.
October 11: 9.55, very slight shock at Coalinga Station A and Station C.
October 14: 23.57, slight shock at Eureka. Two moderate shocks at Scotia.
October 15: 14.02, slight shocks felt at Priest Valley and Kettlemen Hills and very slight shock at Coalinga and Oilfields.
October 31: 10.54, Scotia. Light.

October 31: 11.39, in San Pedro Channel (Wood). Strong in hill section of San Pedro and Wilmington. Slight at Long Beach, Avalon, Redondo, and Los Angeles.
November 4: 9.50, Willits. Slight.
November 5: 2.00, Monterey and Santa Cruz. Slight.
November 6: 9.55, Mocalno and Big Creek. Slight.
November 6: 22.30, Hanford; two slight shocks.
November 8: 18.30, slight at McKittrick, Bitter Water, Coalinga, and A. O. Station No. 3, near Coalinga. Recorded.
November 13: 2.40, Mocalno. Slight.
November 15: 6.40, San Pedro. Slight. Located by Wood as under Santa Monica Bay.
November 20: 2.30, Mayfield. Slight.
November 20: 14.50, Bitter Water. Slight.
November 24: 1.54, slight at Lone Oak, Bitter Water, and Lewis Creek.
November 26: 0.05, an earthquake shook the coast region from Hollister to Santa Margarita, and as far east as Mendota. The area of maximum intensity included San Ardo and the district near Bitter Water. In some places in the region glassware was reported broken, windows cracked, and furniture shifted. Report by Byerly.
November 26: 1.00, Hernandez. Slight.
November 26: 10.06, Bitter Water. Slight.
November 28: 11.49, central California (36°.9 N., 118°.2 W.). Felt in area of about 35,000 square miles, roughly triangular with vertices at Mina, Nevada, Stockton, and Kernville. The maximum intensity reported was 5 miles southeast of Aberdeen and at the headwaters of Goodale Creek some 15 miles northwest of Independence. At the former place concrete reservoirs were cracked and dishes were broken. In the latter place a large landslide was reported. There is some confusion in the reports, and it is not certain whether the landslide occurred on the day of the earthquake or the following day. However, as close by as Manzanar, Owenyo, and Lone Pine the earthquake was reported not felt, while as far away as Hanford the newspaper reported pictures thrown from walls. At a point 5½ miles southeast of Aberdeen station, there was a strong shock, then an intermission, then another lasting 30 seconds but not so severe. Other minor shocks made the length of the entire shock nearly three minutes. Dishes and other objects thrown from tables. Concrete reservoir cracked. Chickens frightened. Description by Byerly. Detailed reports obtained through the San Francisco field station indicate that there were five heavy shocks at Fresno and that there was a severe shock 5½ miles southeast of Aberdeen Station on the Southern Pacific. Considerable intensity at Panoche Pass and at Head of Goodale Creek. The shock was reported as slight at Jerseydale, Visalia, Sanger, El Portal, Snelling, Tipton, Benton, Corcoran, Bishop, Kern River No. 3, Big Creek, Carruthers, Oakdale, Big Creek 2–3–8, Clovis, Porterville, Mariposa, Sugar Pine, Mocalno, Coachella, Orange Cove, Exeter, Hanford, Ivanhoe, Porterville, Academy, Tulare, Corcoran, Kingsburg, Wawona, Mount Montgomery, Hollister, Stockton, Shandon, Santa Margarita, Parkfield, Knights Ferry, and Lido; and Mina, Nevada.
November 29: 2.05, El Portal. Slight.
November 29: 12.07, Kaweah. Slight.
November 29: 21.32, slight at Phelan, Colton, Twin Pines, and Santa Ana River No. 1 E. Highlands.
November 30: 23.15, slight at Benton and Mocalno.
December 1: 23.00, 5½ miles southeast of Aberdeen. Severe.
December 2: 3.24, probably near Ensenada (Wood). Slight at San Diego, though generally felt. Small objects displaced or upset. Strong at Jamul, Escondido, and Point Loma.
December 3: 1.05, Chino, three moderate shocks.
December 4: 2–3, Ukiah. Slight.
December 4: 3.00, San Jacinto. Slight.
December 4: Between 4 and 4.30, northern California coast (40°.5 N., 124°.0 W.). One moderate shock, generally felt. Reported as slight from many places, probably varied in severity but persons suddenly wakened did not discriminate. Reported from Arcata, Westport, Alderspoint, Zenia, Capetown, Bayside, Scotia, Homes, Bridgeville, Miranda, Blocksburg, McCann, Fortuna, Garbersville, Dyerville, Eel Rock, Yager, Fields Landing, Ettersburg, Briceland, Beatrice, Eureka, and Forest Glen.

December 4: 22.45, Willets, slight.
December 4: 23.40, Hanford, slight.
December 5: 14.00, Cabazon, slight.
December 8: 4.45, 5½ miles southeast of Aberdeen station, severe.
December 11: 1.15, Watsonville. Instrumentally recorded.
December 20: 20.00, Calipatria, slight.
December 25: 11.29, 11.44, 14.29, vicinity Big Pine. Three distinct shocks.

ALASKA

[150th meridian time, unless otherwise stated]

January 9: 18.15 (165th meridian time), Chernofski Harbor (54° N., 161° W.). No details.
January 16: 7.30 (165th meridian time), Chernofski Harbor (54° N., 161° W.). No details.
January 17: 19.16, Kodiak Island (58° N., 152° W.). No details.
January 20: 12.24, Chickaloon (62° N., 148° W.). No details.
January 21: 0.30 to 4.20, Alaska, centering near Fairbanks (65° N., 150° W.) area about 200,000 square miles. Shocks lasted nearly four hours, and there were additional shocks on the 22d. First shock, the most severe, lasted several seconds. Shock seemed to travel southwestward. Beds and furniture moved about, awakening every one, and many rushed into the streets. Many of the houses are one-story and built of logs, specially developed for the winter conditions and are especially suited to resist earthquakes. Broken windows and displaced articles are about the extent of the damage. Heavy rumbling. Shocks felt much more lightly at Anchorage, Cordova, Nenana, Tanana, Curry, Eagle, Lignite. Variations in time indicate that possibly the same shock was not felt at all of these places.
January 25: 8.00, Valdez. No details.
February 25: 23.00, and February 26, 14.00 (165th meridian time). Felt at False Pass. No details. Strong submarine earthquake at 23^h located instrumentally at 54° N., 163° W. Recorded very widely. Second shock probably aftershock of this.
March 3: 0.04 (135th meridian time), Sitka (57° N., 136° W.). Two shocks about 10 seconds apart. Pictures moved. Dishes rattled. Low rumbling.
March 6: 14.35 (165th meridian time), (51° N., 170° W.). Severe submarine earthquake was felt aboard a number of ships at sea and at Dutch Harbor in the Aleutian Islands. Two Japanese ships were near the Island of Four Mountains. They reported shocks as very severe and lasting nearly a minute. The steamer *Shihara Maru* reported that strong vibrations caused the belief that the ship had struck bottom in latitude 51° 17′ N., 171° 16′ W. The *Yokohama Maru* felt a strong earthquake in 51° 32′ N., 169° 31′ W. The *President Madison* felt the shock at 49° 55′ N., 165° 03′ W.
April 5: 18.50. April 6: 0.33 and 6.05, Matanuska (62° N., 179° W.). Three shocks estimated respectively as intensity 4, 5, and 3, Rossi-Forel scale.
May 20: 4.53 (G. M. T.). Severe submarine earthquake at 54° N., 178 ° W. (instrumental).
May 26: 15.39 (135th meridian time), (54° N., 137° W.). Heavy submarine shock strongly felt throughout the Queen Charlotte Islands. At Masoet, north end, houses rocked, people were thrown down, clocks stopped. There were heavy landslides at several places. Felt at Hyder at head of Portland Canal with sufficient intensity to cause excitement. Shocks continued during the two following days, but no details are known.
July 2: 15.53, Anchorage (61° N., 150° W.). No details.
July 3: 19.22, Eagle (64° N., 141° W.). No details.
July 5–7: A series of severe submarine earthquakes occurred at 51° N., 178° W. on these dates. For details see list of severe earthquakes. Instrumentally determined. No reports from shore or from vessels.
July 17: Another shock of same series. See same list.
August 19: 7.40, Kodiak Island (58° N., 153° W.). At Uzinki men at the salmon cannery wharf were nearly knocked off their feet, and thought a vessel had struck the dock. Buildings creaked and cracked and articles moved. Report at the same time without details from Whale Island. The Coast and Geodetic Survey steamer *Surveyor* at Larsen Bay did not observe the earthquake. The following day there was a shock at Dry Spruce Bay at 2.30. The earthquake was probably of volcanic origin, since both Mageek and Katmai were observed to be smoking and volcanic dust fell on the steamer. Visability was reduced to 2 miles.

September 17: 8.17 (135th meridian time) (52° N., 135° W.). Submarine earthquake off Queen Charlotte Islands. Not reported as felt on land.
September 21: 10.00, Whale Island (58° N., 150° W.). No details.
September 26: 9.15, strong shock at Valdez (61° N., 146° W.).
November 11: 20.45 (135th meridian time), epicenter doubtful. Widely felt in Panhandle and to north, but nowhere very strongly. At Juneau hanging objects swayed. Reported though with times varying from 20.35 to 21.15 from Haines, Skagway. There was a shock at Matanuska at 20.36, but owing to distance from other points it is uncertain whether it was the same shock. At that place the shock was sharp and apparently northeast-southwest.
November 26: 15.55 and 16.40, Valdez (61° N., 146° W.). Two shocks. No details.
December 17: 10.59 (G. M. T.) (54.5° N., 171° E.). Severe submarine earthquake recorded throughout the earth. No report from vessels.

HAWAIIAN ISLANDS

[157½ meridian time]

NOTE.—In the case of these islands with their many earthquakes of volcanic origin only the more severe ones are listed. Reports of the Volcano Research Laboratory under the jurisdiction of the United States Geological Survey and the Hawaiian Volcano Research Association give more details. The earthquakes of 1929 culminating in the strong shocks of September 25 and October 5 are described in detail by T. A. Jagger in The Volcano Letters of November 28 and December 24, 1930.

February 5: 14.25, districts of Kohola, Kona, and Hilo shaken severely. Hilo, swaying; people awakened Waiohinu; generally felt. Hamakua, two moderate shocks; moderately loud noise.
September 25: 18.21, walls and buildings fell in Kona district. People badly frightened; rushed from homes.
September 28: 7.10, Hilo strongly shaken. Street damaged. Church badly cracked and moved on foundations.
September 29: 5.00, another strong shock shook Hilo. Almost continual shocks till the most severe, which occurred on October 5.
October 5: 21.21, Holualua. Furniture upset. Water tanks burst. Walls fell, house foundations displaced. Waimea, strongest shock in memory of oldest inhabitants. Landslide occurred on steep bluff along highway. Clocks stopped. Two shocks, first light and second severe. At Hilo dishes fell from shelves and people left motion-picture theater; no serious damage. Strong at Kilauea. Force 5 Rossi-Forel scale at Lanai City, Maui, and fairly strong at Waimanalo, Oahu.
October 22: Holualua very strongly shaken; 36 shocks in less than two hours.

PORTO RICO

[60th meridian time]

October 16: 5.25 and 6.20, San Germain. People generally alarmed. Mayaguez, two shocks with east-west oscillation caused alarm. Central Canovanas. Rocking motion generally felt.

PHILIPPINE ISLANDS

Earthquakes are completely listed in the Seismological Bulletin of the Philippine Weather Bureau. Only earthquake attaining force 7 Rossi-Forel scale was on November 17: 3.46 (G. M. T.), Zamboanga.

CORRECTIONS AND ADDITIONS TO PRECEDING ISSUE OF UNITED STATES EARTHQUAKES

United States Earthquakes, 1928.—H. O. Wood has called attention to the following corrections which should be made to published reports on seismic activity in the Pacific coast region:

February 28: 19.00. Gildale should be Oildale.

February 28: 19.25. This certainly was not an earthquake. There is no possibility of a failure to record at Pasadena an earthquake felt at Glendale, however light. It was probably an air disturbance due to gunfire. This probably applies also to February 28: 19.00.

A case similar to this, also reported from the Bakersfield region as felt strongly on January 28, 1930, is known positively to be due to gunfire.

March 19: 20.45. The origin was not near Niland. It was the preceding shock on March 19 at 3.50 which originated near Niland.

April 3: 4.40. Our seismograms show definitely that the date of the shock is April 3. Allen's report must be in error as to date.

July 18: 22.48. The Pacific standard time of this shock was 21.18. The difference of 1 hour is due to use of mountain time at Yuma (?).

September 5: 6.42. ". . . Pinto Fault at Hill" is a misunderstanding. This should read "Pinto Fault (Hill)" or "Pinto Fault named by Hill." However, further detailed study has shown that this shock probably originated a few miles farther to the northwest than the point previously given.

September 23: The shock at 8.00 originated near the Superstition Mountains; those at 9.41 and 9.44 near Calexico.

November 15: 6.43. This shock belongs to 1929 instead of 1928.

THE ATTICA (N. Y.) EARTHQUAKE OF AUGUST 12

The shock occurred at $6^h\ 24.8^m$ a. m., eastern standard time, on Monday, August 12, 1929. The region of maximum disturbance coincides with the epicenter determined from instrumental data, about 42° 52′ N., 78° 21′ W. The maximum intensity was 9, Rossi-Forel scale, and the total area affected about 50,000 square miles, including a large part of Canada. (See fig. 3, p. 7.) An instrumental study of this shock by the Rev. J. S. Joliat, S. J., appears in Earthquake Notes, Vol. I, No. 2, a publication of the Eastern Section of the Seismological Society of America.

The shock was felt with great severity in the eastern part of the city of Attica and the region lying immediately to the eastward. In the region immediately to the south, there was less effect on structures but more on the earth itself as evidenced by the change in ground water conditions.

DAMAGE TO STRUCTURES

In Attica 251 house chimneys were thrown down, and very few escaped in the section most affected. Several very old chimneys on a hotel building failed to fall, since, because of their known weakness, they were attached to the roof by a single guy to the north. Walls were cracked; one brick building had to have a new wall, and a number of brick buildings were damaged. Grocery and drug stores suffered loss through damage to stock which was thrown violently from shelves. South of the town the Bowman house, an old brick structure, was damaged almost beyond repair. This was more likely due to structural weakness than to special strength of the shock at this place. Curiously the owner carried tornado insurance with an earthquake clause and thereby recovered some of the loss.

The damage to house and garage of G. T. Henninger will be described as typical of the many cases which can not be discussed, through lack of space. The front wall was damaged and pulled away from the window. There were cracks in walls on both sides of stairway. The furnace pipe connection was snapped off close to the furnace. A modern garage of cement block had a large vertical crack through the

blocks from window to ground in the west wall and a diagonal crack following the joints from window to ground in the north wall. The wall pulled away from the window.

The Methodist church, which was of excellent construction and materials, but of a poor design to resist earthquakes, was so damaged that tie-rods had to be used to strengthen the building, it fortunately being possible to place them so they would not show from the auditorium. Nearly all the plaster was cracked or thrown down. The Presbyterian church, a simpler structure but with a tall square tower, was less damaged. The tower was twisted through an appreciable angle and considerable of the stuccoed ceiling fell at the corner opposite to the tower, indicating that this part of the building was severely wrenched. The Baptist church, a still simpler structure, was scarcely damaged. All three churches were within a block.

The Attica High School, a new 3-story brick building of the best type of construction, was at first thought to have been damaged, as the chimney of the heating plant fell and a diagonal crack appeared in one wall. However, it was found that the damage was chiefly confined to plaster cracks, diagonal near north and south end of building and vertical in the middle, the cracking being more extensive on the third story.

The effects of the earthquake on the Westinghouse automatic stoker factory are instructive. The main building is of T shape with the upright part of T lying north-south and the crossbar east-west, the latter lying to the south. In the north-south portion the only damage was a diagonal crack on the east wall and several leaks in the roof. Opposite the junction of the portions, three girders were pulled from the wall which was badly damaged. Fortunately one intermediate girder failed to fall and held up the roof until repairs could be made. Otherwise the entire roof would have gone down. The obvious explanation is that the motion was north-south. The portion of the east-west building to both sides of the north-south portion was able to move while the intermediate portion was held from moving and the girders therefore pulled away from the supporting wall. A tall tank near this building was not damaged though wooden framework which held the water column in place was shaken loose and fell. The east wall of a brick structure containing molding sand was forced out, this being the only north-south wall visibly affected, except as before stated. Obviously the sand must have been set into motion while the earthquake was in progress, the strain on the wall due to the motion making it less able to stand the pressure of the sand. There were a number of east-west structures of a single story with parapet wall extending several feet above the building. In every case the north wall was so damaged that the parapet portion had to be replaced. These buildings are of brick with the best construction and walls 13 inches thick. Boring showed a bed of quicksand at a depth of 150 feet below the factory. On an old building across the railroad, the north-south walls though very shaky were undamaged, while the east-west walls were badly wrecked.

In the Brainerd cemetery, a small cemetery to the east of the town, practically every monument went down. Nearly all fell a little to the west or south or in the opposite direction, though two made an angle of 45° with this direction and one fell at right angles to it. In the Forest Hill cemetery to the west of the town, no monuments went

down though a spherical ornament on one monument was thrown down. A number of monuments rotated through a small angle in a clockwise direction.

To the westward of the Attica reservoir a number of wells went dry and an east-west crack was found in the bottom of one. Deeper drilling restored the flow. In the region of the reservoir there was a sudden increase of about 1,000,000 gallons per day in a reservoir normally holding about 55,000,000 gallons and this without any rain. This flow continued for some days.

CHARACTER OF SHOCK AND SOUNDS

One observer stated that there was a terrific vibration followed by a loud report, then quiet followed by lesser tremors and a crackling sound, as dishes fell from the shelves and pictures and mirrors from the walls. Sounds were compared to thunder. Clocks stopped. On Horseshoe Lake there was a miniature tidal wave. Very little evidence of the shock could be seen in the earth itself as this sort of disturbance was below the surface. There was a crack in the railroad embankment near the Attica Erie Railroad station but this was found to be at the division between an old embankment and a recent extension.

SOURCES OF INFORMATION

Reports have been received from about 250 persons who include postmasters, observers of the Weather Bureau, and many other individuals. Some special investigations have been made by H. O. Wardell, curator, Rochester Municipal Museum, and W. M. Dawley of Cleveland, Ohio, who was in Attica, N. Y., and made a careful investigation of the damage. Many details collected by them are not published but may be consulted at the office of the Coast and Geodetic Survey. As a whole the reports received were unusually accurate and complete. Many excellent newspaper reports were received. Leroy Snyder arranged special cooperation of the Gannett Newspapers, while Science Service, Washington, D. C., in addition to its usual collection and transmission of instrumental results made special efforts to secure information.

ABSTRACTS OF NONINSTRUMENTAL REPORTS

NEW YORK

SHOCKS OF SPECIAL INTENSITY

Batavia: Several house chimneys fell. Some cracks in masonry walls, though damage was confined to somewhat deteriorated structures. Small lake in vicinity reported to have overflowed highway. Objects of all kinds were moved. Thought to be a bomb explosion. Rumbling like thunder. Many alarmed. All kinds of animals badly frightened.

Johnsonburg: Bricks fell from chimneys. Stated that creeks and springs increased flow without rain occurring. Water in tub badly disturbed. Buildings swayed.

Niagara Falls: This general region seems to have been a secondary center, since the shock was more severe than at places between this region and the central Attica region. Furniture was displaced. Dishes thrown from tables and shelves and pictures from walls. Rattling and roaring with shock. Trembling like vibration caused by very heavy truck.

Norwich: Three or four shocks felt by nearly everyone. East-west direction. Strong swaying, gradually decreasing. Buildings creaked. Furniture moved. Swinging objects displaced. Noise like heavy thunder.

Warsaw: Several house chimneys fell, and an old chimney on the electric light plant fell. Wall in Erie Railroad station cracked. Shock was abrupt lasting 15 seconds, during which buildings and objects shook. Some alarmed.

Wyoming: Several chimneys cracked. Dishes thrown from shelves.

ADDITIONAL REPORTS

Addison: Objects moved.
Akron: Buildings swayed. Sounds like large truck crossing bridge.
Albany: People wakened in some parts of city.
Alden: Table moved back and forth on casters.
Alfred: Dishes on shelves and pictures thrown to floor and broken.
Alma: Rocking motion.
Allentown: Furniture swayed.
Alpine: Two shocks close together. North-south motion.
Ashford: Felt by several. Roaring sound.
Attica: Special.
Auburn: Two shocks. Pictures swayed. People wakened.
Avon: Felt by most. Rumble like heavy truck.
Barker: Slight.
Bath: Generally felt. Two shocks. Pictures tilted.
Belfast: Walls and beds swayed. Rocking east-west. Moderately loud sounds.
Belmont: Light furniture vibrated. Sounds like distant thunder.
Binghamton: Shock between 1 and 3 a. m. Later shock shook windows and aroused sleepers.
Bolivar: Slightly felt.
Bristol Center: Generally felt. Thought that heavy truck was passing. Dishes moved slightly.
Brockport: East-west swaying. A few delicately balanced objects moved.
Buffalo: Building swayed in north-south direction. Generally felt. Loose objects rattled. Sound varied in places from faint hum to sound like truck going over rough pavement.
Caledonia: Generally felt. Pictures on walls tilted. Moderately loud rattling. General alarm.
Cameron: Trembling.
Canandaigua: Widely felt. Trembling in east-west direction.
Canastota: Furniture shook.
Canisteo: Moderate.
Canton: Slight.
Carthage: Slight.
Cassadega: Generally felt, lasted 10 seconds.
Castile: Northeast-southwest swaying. Felt by nearly all. Sound like heavy passing truck.
Cato: Felt by many. Windows rattled, beds shook.
Cattaraugus: Felt by most. Trembling and swaying.
Chambers: Felt by several. Cracking and rattling.
Chateaugay: Not felt.
Cheektowaga: Dishes broken. Windows rattled. Generally felt.
Chemung: Felt by several.
Chestertown: Furniture rattled and swayed.
Cincinnattus: East-west swaying felt by many. A few pendulum clocks stopped.
Clyde: Felt by many. Rattling. Dishes broken.
Clymer: Generally felt. Hanging objects swayed in east-west direction.
Conesus Lake: Generally felt. Rocking and swaying. Lake surface not disturbed.
Conewango Valley: Felt by several.
Corning: Three rapid shocks close together. Objects rattled.
Cuba: Felt by many. Pictures swung. Dishes rattled.
Cuylerville: Felt in salt mine.
Dale: Goods thrown from shelves. Chimneys thrown down.
Dalton: Felt by all. Swaying of electric light wires and poles in east-west direction. Faint roaring.
Danville: Felt by many. Doors and chandeliers swung. Beds moved.
Dayton: East-west rocking motion. Felt by many.
Delhi: Slight.
Deposit: Rapid trembling felt by many.

Dundee: Generally felt. Hanging objects swayed.
Dunkirk: Slight.
Eagle: North-south swaying noted by a few.
East Bethany: Felt by nearly all. Movable objects displaced. Two walls slightly cracked. Building swayed. Sound just before shock like heavy object falling.
East Greenwich: Not felt.
East Pembroke: Several shocks noted.
Elma: Felt by many. Water in container moved north-south. Sound like passing heavy truck.
Elmira: Felt by many. Furniture moved. Poles and trees swayed.
Fillmore: Generally felt. Rumbling like truck in distance. Wires outside and electric fixtures inside swayed.
Fort Covington: Mirrors and pictures swung on wall. Not felt by all.
Franklinville: North-south rocking. Rattling sounds.
Fulton: Felt by majority. Plaster cracked slightly. Sound like passing truck. General alarm.
Geneseo: Felt by many. Swaying north-south. No sounds heard. Top broken off chimney.
Geneva: Slight.
Glens Falls: Dishes rattled. Chairs rocked.
Glenwood: Felt by most. Sound like distant thunder.
Gloversville: Felt by those in bed or resting. Not by others.
Gouverneur: Felt by about half. Windows rattled. Sound like racing automobile motor in the distance.
Greene: Trembling and north-south swaying felt by half; 4-foot light cord swung through 6 inches.
Groton: Generally felt. Mirrors swung, doors creaked, beds shook.
Groveland: Felt by many. Objects moved. Roaring like movement of heavy truck.
Guilford: Slight.
Hamburg: Felt by many. Sound like passing heavy truck.
Hamilton: Swaying north-south. House shook.
Hancock: Three shocks within 30 seconds. Can thrown from shelf.
Harris: Not felt.
Haverstraw: Not felt.
Hemlock (Rochester water works): North-south swaying generally felt. Hanging articles swayed. Rumbling and cracking.
Herkimer: People wakened by swaying of beds.
Hinsdale: Felt by several.
Hoosick Falls. Not felt.
Hornell: Pictures swayed. Articles thrown to floor.
Hudson Falls: Felt.
Hulbertson: Shock lasting 20 seconds generally felt. Rattled doors and windows. Moderate rumbling.
Humphrey: Felt by many. East-west swaying. Dishes rattled. Cabinet doors opened.
Ilion: Slight.
Ischua: Not felt.
Ithaca: Two shocks three minutes apart. Pictures on walls displaced north-south on west wall. Bottles rattled on dressing table. Church bell gave single peal. Like passing of heavy truck.
Jamestown: Felt by many. Loose objects rattled. In place near Jamestown, beds swayed. Dishes rattled. Large steel bridge vibrated.
Java: Felt by several.
Lacona: Mirrors swayed.
Lake George: Slight.
Lake Placid: Three shocks lasting one-half minute.
Lake View: Felt by many.
Lebanon: Two shocks close together.
Le Roy: Two shocks. Light objects tipped over.
Liberty: Buildings vibrated.
Lima: Felt by most. Roaring sound just before shock. Dishes and stove lids rattled.
Little Falls: Not felt.
Little Valley: Everything shook. Pictures and mirrors thrown askew. Water in basin disturbed. Many wakened. Sound like heavy truck. One man observed shock between 1^h and 2^h.

Lockport: Trembling felt by many, accompanied by sound like thunder.
Long Eddy: Not felt.
Lydonville: Felt by all. Rumbling sound like passing truck. Dishes rattled.
Lyons: Felt by nearly all. No sounds. Dishes broken.
Lyons Falls: Felt by many. Slight.
Machias: Felt by many. Dishes rattled. Hanging lights swayed. Roaring sound.
Mallory: East-west swaying felt by many.
Malone: Felt by few.
Manchester: Generally felt.
Marion: Felt by many. Bed swayed, windows rattled. Sound like rumble of big truck.
Mayville: Felt by few. No sounds.
Media: Felt by everyone. Houses swayed violently and people rushed into the street. Nausea in some cases. Sound like large truck.
Medina: Houses rocked for several seconds.
Mendon: Felt by all. Doors rattled. Heavy objects swayed east-west. Moderately loud rattling.
Middleburg: Not felt.
Middleport: Felt by several. Sound faint at first, increasing, then dying away.
Middletown: Not felt.
Naples: Felt by many. Pictures moved on walls. One clock stopped. Moderately loud roar.
Neversink: Not felt.
Newark: People wakened. Shook soot out of factory chimney.
New York: Buildings rocked slightly.
Nichols: Felt by several.
Norfolk: Moderate. Wakened few.
North Collins: Two shocks two minutes apart.
North Hudson: Not felt.
North Salem: Not felt.
Nunda: Felt by all. Roaring sound.
Ogdensburg: Not felt.
Old Forge: Very slight.
Olean: Buildings in business section shook.
Olsen: Felt by many lying down. Not by pedestrians.
Oneida: Beds rocked. Dishes rattled. Pictures swayed.
Oswego: Generally felt. Beds shook.
Owego: Five or six distinct tremors widely felt. Pictures and mirrors moved on walls. Beds shook. Low rumble like passing truck. Felt more in some parts of town than in others.
Painted Post: East-west swaying felt by many.
Palmyra: Generally felt. Two cracks in wall.
Pavilion: Generally felt. Hanging objects swayed.
Peekskill: Not felt.
Penn Yan: Felt by most. Some loose plaster dropped.
Phelps: Felt by all. Rumbling like loaded truck.
Philadelphia: Not felt.
Pittsford: Generally felt. Dishes displaced on shelves. Moderate rumbling.
Pottersville: Not felt.
Prattsburg: Felt by more than half. Pictures displaced.
Pulaski: Two 2 to 3 second shocks felt by many. North-south direction.
Ransomville: Felt by several.
Raquette Lake: Not felt.
Rexville: Not felt.
Ripley: Felt by many. Moderate.
Rochester: Two shocks about two minutes apart with north-south motion. Loose objects rattled. Newspaper shook so that man could not read it. Windows shook. Water on Lake Ontario disturbed. Noise compared to passing heavy truck. Others thought that a garage had exploded or that an airplane was passing unusually low.
Rome: Slight.
Rosiere: Felt by few. Houses swayed.
Rouses Point: Not felt.
Rushville: Felt by several.
Sacketts Harbor: Houses shaken. Dishes rattled.
Salamanca: Felt by several.

Saratoga: Objects swayed.
Savannah: Felt by several.
Scarsdale: Slight.
Schuyler: Slight.
Scottsville: Up-and-down motion.
Sherburne: East-west swaying. Increasing then decreasing, repeating then dying out. Electric-light bulbs swung.
Sherman: Two shocks felt by many. Moderately loud rumbling.
Sinclairville: Felt by many. Loose objects swayed.
Sodus: Felt by several.
Sodus Point: Felt by all. Like heavy truck moving fast. Pictures displaced.
South Wales: Felt by several. Beds moved.
Spencerport: Trembling for 30 seconds felt by all.
Springville: Hanging objects swayed.
Stanley: Felt by most. Windows rattled.
Steambury: Felt by several. Roaring.
Swain: Felt by many with alarm. Heavy objects swayed.
Syracuse: East-west swaying felt by all. Objects displaced. Deep rumble.
Tonawanda: Felt by most. Dishes rattled.
Trumansburg: Slight.
Tuscarora: Generally felt. Roaring.
Utica: Slight.
Van Buren: Felt by many.
Van Etten: Not felt.
Varysburg: Many chimneys fell.
Wallace: Felt by many.
Waneta Lake (locality not known): Shock noted at 1.45 a. m. The later shock was accompanied by sound like passing of heavy truck.
Waterloo: Felt by few.
Waterport: Felt by many. Seemed like explosion or blast.
Watertown: Felt by a few.
Watkins Glen: Moderate.
Waverly: Not felt.
Webster: Slight rumble like heavy truck.
Webster Crossing: Felt by several. Buildings trembled. Roar.
West Bloomfield: Felt by many. Doors and windows rattled. Noise like heavily loaded truck.
Westdale: Felt by a few.
West Falls: East-west swaying. Distinct. Fireplace slightly cracked. More violent than vibration due to heavy truck passing close to building.
Whitehall: Felt by several.
Whitesville: Felt by several. Bumping and quivering.
Williamsville: Felt by many. Rumble.
Wolcott: Felt by a few.
Yonkers: East-west rocking.
York: Felt by all. Rumble.
Yorkshire: Felt by nearly all. East-west swaying. Furniture swayed. Dishes tipped over.

PENNSYLVANIA

Bald Eagle Township, Clinton County: Distinct rocking felt by most. Buildings shook, beds swayed, wakening people.
Bradford: Felt by many. Houses shook. Windows rattled.
Brookville: Two shocks felt by several. Sound like thunder.
Butler and vicinity: Windows rattled. Houses swayed. North-south motion.
Cabot: Slight.
Carbondale: Not felt.
Corry: Three shocks felt by many. Pictures swayed.
Du Bois: Felt by several.
Emporium: Felt by several.
Erie: Rapid east-west swaying felt by many. Like shock from explosion. No disturbance of surface of Lake Erie. Windows broken.
Franklin: Two shocks, close together. Trembling and swaying felt by many. Many wakened.
Hazleton: Not felt.
Honesdale: North-south motion felt by several.
Laporte: Not felt.

Lock Haven: Distinct rocking and shaking of buildings felt by most. Beds swayed. Many wakened.
Marienville: Trembling like some one walking over floor in one house.
Meadville: Felt by many.
Mercer: Two shocks felt by many. No sound.
Montrose: Not felt.
Nanticoke: Not felt.
New Castle: Felt by all. Beds shook. Windows rattled. Articles thrown from shelves like an explosion.
North East: Felt by many. Windows cracked in one cottage and stone wall in another. Low rumbling.
Oil City: Felt by many. Beds swayed.
Pittsburgh: Slight.
Plainfield: Not felt.
Punxsutawney: Felt by most. Windows and dishes rattled. Hanging objects swayed like an explosion.
Ridgway: Felt by many. Brass bed rattled.
Sayre: Generally felt. Post-office wall cracked. People wakened. Dishes rattled.
Smethport: North-south rocking felt by many.
Tionesta: Generally felt. Described as if house was struck by heavy body. Dishes rattled. Several reported two shocks. Beds shaken. No sounds.
Titusville: People wakened.
Towanda: Felt by several. No sounds.
Troy: Generally felt. Plate-glass window vibrated.
Tunkhannock: East-west swaying felt by a few.
Tyrone: Not felt.
Union City: North-south swaying felt by many.
Warren: North-south rocking felt by many. Everything rattled and vibrated.
Wellsboro: Slight shock.
Williamsport: Three shocks followed by trembling felt by most. First shock shook beds and moved pictures.

CONNECTICUT

Bethel: Northwest-southeast motion felt by a few. House on swampy land. Vibrations quite different from those of frequently passing trucks.
Danbury: Felt by many. Beds swayed.
Hartford: East-west swaying felt by many. Buildings shook. Dishes displaced.
Milford: Not felt.
New Haven: Slight. Pictures and glassware shook.
Norfolk: Slight.
Waterbury: Slight.
Winsted: Not felt.

MASSACHUSETTS

Greenfield: Not felt.
Holyoke: Slight.
Northampton: Like passing truck but different. Objects rattled. Reports indicated possibility of two shocks one hour apart, but investigation seems to indicate that there was a misunderstanding due to variable application of daylight saving time.
Palmer: Not felt.
Pittsfield: Not felt.
Springfield: Felt by many. Trembling stated to be more severe than 1925 St. Lawrence Valley shock. Beds shook.

NEW HAMPSHIRE

Claremont: Three shocks felt by several. Objects swayed a little.
Hillsboro: Not felt.
Walpole: Felt by many. Furniture swayed.

VERMONT

Brattleboro: Two shocks close together felt by several. East-west motion.
Manchester: Pictures swayed. Table moved in east-west direction. Not generally felt.
Northfield: Slight.
Proctor: Not felt.

Wallingford: Two shocks with 5-second interval felt by a few. East-west motion. Furniture swayed.
Woodstock: Slight.

NEW JERSEY

Belvidere: Not felt.
Morristown: Not felt.

OHIO

Ashtabula: People wakened.
Cleveland: North-south swaying.
Conneaut: Two short shocks north-south. No sounds.
Kinsman: Felt by several. Beds swayed.
Madison: Faint.
Painesville: Two shocks a half minute apart, felt by many. Pictures swung in east-west direction. Pendulum clock setting east-west stopped, other north-south did not. Dishes rattled. Rumble like big truck.

DISTRICT OF COLUMBIA

Washington: Rattling of furniture and trembling of bed felt by one.

MICHIGAN

Lansing: Slight.

MAINE

Portland: Three slight but distinct shocks felt by one.

CANADA

The following is a résumé of visual and felt reports received through the courtesy of the Dominion Observatory at Ottawa, Canada, relating to the Attica, N. Y., earthquake of August 12, 1929. All places are in Ontario unless otherwise stated.

Bancroft: A steady tremble with a couple of shocks near the end, lasting nearly a minute, with a wave motion. Window shades and curtains swinging east-west. House creaked and windows rattled. Series of earth tremblings which ended with quite a violent shake.
Barrie: One shock of a few seconds duration wakened observer. Wave motion. Windows rattled. Rumblings like heavy train passing.

One shock with a wave motion lasting about two minutes, giving bed a swinging motion. Glass on window sill with a spoon in it started tingling. Rumbling sound like a tractor in the distance, which lasted about five minutes. There were three shocks about 10 seconds duration, rather jerky. A vase fell toward the west. Windows rattled. Rumbling like a passing train.

Belleville: Two distinct shocks. First about 20 seconds; second longer, probably about 30 seconds. Mostly wave motion—could be described as short waves, one steady but some jerky motion in last shock. Windows rattled slightly, also pictures on wall. Slight rumbling.
Brockville: Not felt here or near vicinity.
Chapleau: Not felt.
Cochrane: Not felt.
Collingwood: Not felt.
Cornwall: One person getting out of bed states there were four shocks lasting five minutes with a wave motion. Objects swinging east-west. Windows rattled.
Cornwall: In second story in bed when shock was felt of two or three seconds, duration with a jerky motion.
Glenburnie: In the rural district 7 miles from Kingston, a person dressing in bedroom felt two shocks of a few seconds' duration. Windows rattled. Low rumbling with hissing sounds. A jug on washbasin in bedroom rattled. Door rattled on lock on ground floor. Intelligent Scotch Collie dog gave sharp yelps as in fear. Sleepers wakened. Mirror on dresser vibrated.
Goderich: Two shocks lasting about a minute with a wave motion.
Grimsby: Shock lasted about 30 seconds, starting with a jerk and closing with a slow motion. Slight rumble probably from shaking house.
Haliburton. Shock was felt by one in bed, stating it lasted between 5 and 10 seconds, having a jerky motion. Another states that there was one long vibration lasting about half a minute. Building trembled. Doors and windows rattled.

Kincardine: Shock was of very short duration and felt as if someone had given the bed a quick jerk.
Kingston: Shock was felt for a half minute. Rumbling and trembling. Windows rattled. Earth sounds and rumblings.
Lindsay: While walking upstairs from basement, noticed shock lasting about one minute with a wave motion. Objects swinging with a north and south motion. Creaking, and windows rattled. Rumbling like heavy furniture being moved about the floor. Quite a strong wind of less than five minutes' duration immediately following earth tremors.
London and 3 miles west: A shock was felt having a jerky motion. Windows rattled for about 10 seconds, and objects were observed swinging.
London: Tremor lasted 15 seconds, having a wave motion. Creaking, and windows rattling. Pictures shifted on walls.
Maniwaki, Quebec: Not felt.
Midland: One long shock lasting approximately 1½ minutes shook bed. Felt by several.
Montreal, Quebec: Very slight tremors were felt for a couple of seconds on the south shore at points such as Boucherville and Longueuil.
Niagara Falls: One shock felt for about 20 seconds, having a wave motion. Windows and dishes rattled, and objects appeared to be swinging. Felt like a heavy truck passing the house very fast.
North Bay: Shock first came on with a rumbling noise, then shaking began. Observer thought furniture was being moved in attic.
Oakville: There was a steady tremor, lasting about 10 seconds. Double hardwood floors seemed to shake. Effect like heavy passing truck, but more violent.
Orangeville: The shock here lasted about two minutes, having a wave motion. Windows rattled and house shook and trembled. Another person stated the shock lasted about a minute.
Oshawa: Two shocks lasting possibly 15 seconds, with north-south motion. Plants and ferns were observed swinging with a north-south direction and up and down. Mirrors upstairs moved east and west. Windows rattled. Rings on furniture swung and rattled. The effect was much the same as a very heavily loaded truck passing over a defective railway crossing at a high speed, but more accentuated.
Peterboro: Two shocks were noticed which lasted about 10 seconds with a wave motion. Mirrors and lights swung. Rumble like heavy truck rolling along pavement. Telephone bells rang.
Port Colborne: A shock lasting two or three seconds which seemed to be up-and-down motion noticed by one. Chair shook.
Port Hope: Two slight shocks were felt. Shock lasted about three-fourths of a minute, having a wave motion. Windows rattled.
Rimouski, Quebec: Not felt.
Roberval, Quebec: Not felt.
St. Catharines: One shock lasted 40 seconds with a wavy motion, which resembled that of a heavy freight train passing. Some plaster fell; objects were observed swinging north and south.
Sarnia: Bed springs vibrated for about 12 seconds, 8 seconds of which the vibration proceeded N–N–W, and later 4 seconds of vibrations seemed directed at right angles. Tremor very pronounced. Another noticed a shock which lasted 3 or 4 seconds with 4 or 5 even throbs. Roof and ceiling rattled. Another noted a vertical wavy motion. Sandy soil.
Sault Ste. Marie: Not felt.
Sherbrooke, Quebec: Not felt.
Smith's Falls: Not felt.
Southampton: Not felt.
Stratford: One shock lasting about 30 seconds, having a wavy motion. Earthquake was noticed more by people in the northwest section of the city and more so by those who were still in bed. Beds shook very noticeably.
Sudbury: Two shocks, one minute, jerky motion.
Three Rivers, Quebec: Not felt.
Vanluk Hill: Two or three slight wavy motions of the bed noted.
Welland: A brief tremor was felt here by one. Windows in bedroom fell down, and there was a rumbling sound.
Wiarton: Three or four shocks at intervals of 3 or 4 seconds lasting about same time, with a jerky motion. A watch hanging on the bedpost swung east to west.

Windsor: Not felt.
Wooler: Two shocks a minute apart, having a jerky motion. A shaving set which was on the dresser fell to the east. One family living near were eating breakfast, and the dishes began to rattle in such a manner as to cause alarm; and they left their room and went into the open.
Woodstock: Four or five shocks were felt here by one. Shocks lasted about five seconds, having a jerky motion. Creaking and windows rattling.
Woodstock: One shock lasting 10 seconds with a swaying motion from north to south. Windows rattled. Dishes moved on table. Swaying motion as if in a tree during a breeze, distinctly felt. Pictures swayed on wall.

REPORTS FROM CANADIAN NEWSPAPERS

Brampton: Wall paper and plaster were cracked in several places.
Brantford: Felt generally throughout the district as confirmed by phone calls from Paris, Simcoe, Port Dover, Waterford, St. Williams, Norwich, Onondaga, and other local points. Dishes and windows rattled, furniture moved; sensation such as is caused by passing of heavy truck. Disturbance accompanied by rumbling sound. Noticed by persons in cellar, but very distinctly felt by persons in bed in upper stories.
Galt: Felt also at Preston and Blair. Windows and dishes in cabinet rattled; pictures and mirrors disturbed; several persons wakened by tremor.
Guelph: Reported as mild and of about 15 seconds' duration.
Hamilton: Felt in all parts of the city; more noticeable in upper stories; duration variously estimated from 7 to 60 seconds; mostly lateral movement with very little up-and-down movement; quake started with dull, deep, rumbling sound followed by lateral vibrations which gradually increased and culminated with a sharp jolt. One observer at Ancaster near Hamilton noticed tree tops shaking in a decided manner although there was no wind at the time. Floors creaked; doors and windows rattled; chairs, tables, and beds were observed to move.
Kingston: Beds moved, pictures on the walls were disturbed; flowers in vase knocked over.
Kitchener: Beds shaken violently, tremor accompanied by a roaring sound; loose plaster shaken from walls and ceiling of St. Peters Church, large picture in same church shaken out of place; mirror of dresser observed to swing. Steam pipes in a local garage made to vibrate with sufficient intensity to make it appear that they were hitting on the wall. Duration of tremors from 15 to 20 seconds.
London: Windows rattled, pictures on walls shifted; disturbance was accompanied by a rumbling noise which died down after a few seconds only to occur two minutes later.
Aylmer: Railroad operator at this point on the Michigan Central Railroad felt tremors and communicated with operators both east and west of his station. His report is that to the east of Aylmer it was very noticeable, but beyond St. Thomas there was very little disturbance.
Niagara Falls: Strong tremor felt at Niagara Falls, also at Chippewa, St. Davids, and Queenston. Tremor duration was about one-half minute and was accompanied by a jarring rumble. Windows and dishes were rattled.
Orillia: Two distinct shocks felt, the second being the more severe. Pictures were disturbed, and glassware rolled off shelves. Furniture moved on a third story in the Y. M. C. A. building. Hardly any person living on the hill felt this shock, but it was reported by a great number living near the lake.
Oshawa: Felt in all parts of the city but was more pronounced in the north section, which is on the hill. Houses rocked; furniture and utensils shaken from their positions; dishes rattled. Several people roused by the shaking of beds and the rattling of windows. Tremors continued for about one minute.
Ottawa: Reported from practically all sections of the city and described by all observers as a vibration such as caused by the passing of a heavy truck. One observer noticed a can opener which was hanging on a north-south wall swinging like a pendulum.
Peterboro: Tremors were of about 10 seconds' duration and were accompanied by a rumbling sound. Leaves on trees were oberved to shake as if by breeze until after rumble ceased. More pronounced at points south of Peterboro as at Millbank and Baihiboro where tremor rattled dishes. Not felt at Lakefield, which is only 10 miles north of Peterboro.

St. Catherines: Windows rattled; created impression that heavy explosion had taken place; variously estimated in duration as from one-fourth to 1½ minutes. Campers along the lake assert it was more violent there than in city, as also was the case at Port Weller and St. Davids at foot of the mountain and along the height of land.

St. Thomas: Felt generally in city and also at Chatham, Port Stanley, and Sparta. Duration of 5 to 10 seconds. Windows and dishes rattled, pictures on walls rocked gently. Rumbling sound followed by vibrations increasing in intensity and ending with a sharp jolt.

Toronto: Felt throughout city but more particularly by people whose residences are located along the various ravines. Tremor was reported as from 10 to 30 seconds' duration and was accompanied by a rumbling sound. Windows rattled and wall pictures swung and shifted. In one instance a vase was thrown from top of piano. Disturbance traveled as waves from east to west, and two distinct shocks were noted. No report of a disturbance in the lake waters.

Woodstock: Tremor of about 15 seconds' duration. Pictures on walls disarranged. Rocking-chairs and kitchen utensils hung on hooks set in motion. Marbles left on floor were started rolling around.

THE GRAND BANKS EARTHQUAKE OF NOVEMBER 18

The outstanding features of this submarine shock are described by E. A. Hodgson and W. W. Doxee, of the Dominion Observatory, Ottawa, Canada, in a paper which was presented before the Eastern Section of the Seismological Society of America in May, 1930. The paper was a preliminary report and is to be followed by a final one which will include all the data collected in the United States, both instrumental and noninstrumental. The following statements are taken largely from the above report.

The earthquake occurred on November 18 at 20^h 31.9^m, G. C. T. It was recorded by seismographs all over the world. The coordinates of the epicenter were provisionally reported by Hodgson and Doxee as 44.5° N. lat., 55° W. long. It was generally felt throughout the New England States (see fig. 4, p. 8) and that part of Canada lying south of the St. Lawrence River and Belle Isle Strait, but damage on land resulting directly from earth movements was only of superficial character. A seismic sea wave resulting from displacements of the ocean floor caused considerable damage and some loss of life on the south coast of Newfoundland.

Twelve Atlantic cables crossing the epicentral region were broken. Four of them broke at the time of the shock; the remaining eight went out at intervals during the following 13 hours. In each case they were broken at several points. There were instances in which the same cable broke at points 150 miles apart. These breaks resulted in heavy losses to the cable companies because great lengths of cable were either lost entirely or damaged beyond repair.

The nature of the changes in the contour of the ocean floor is unknown. Hydrographic surveys were not made in sufficient detail before the shock to draw satisfactory conclusions by comparison with surveys after the shock. Surveys afterward were made by cable ships and by Coast Guard vessels while en route from the international ice patrol area and their base at Halifax, Nova Scotia. That there was some vertical displacement is indicated with practical certainty by the generation of the seismic sea wave. The opinion is held by many that there were multiple parallel faults extending along the prolongation of Cabot Strait. Others believe that submarine slides are the destructive factor when multiple cable breaks occur

over such a wide area. There is undoubtedly some feature of submarine seismic movements which makes a cable peculiarly susceptible to damage or destruction in an epicentral region. This is evidenced quite frequently in Alaskan waters where cables are put out of commission at times when near-by seismic activity on land is only of moderate intensity.

Cable breaks have occurred before in this part of the Atlantic. Prof. F. P. Shepard of the University of Illinois has called attention to an article by John Milne in the Geographical Journal for 1892 (vol. 10, pp. 261 and 262) from which the following quotations are taken:

The following is a table of North American cable interruptions.

"Near Southeastern slope of the Newfoundland Bank (46° W. and 50° W. long.), September, 1887 (about); October 3, 9.15 p. m., 1884; October 4, 4.8 a. m., 1884; October 4, 4 and 8 a. m., 1884; September, 1889."

A very significant fact is the case when three cables running in parallel lines, about 10 miles apart, broke at points nearly opposite to each other on the same straight line. This was October 4, 1884.

It will be noted that the breaks of 1884 occurred 350 or 450 miles east by south of the Grand Banks epicenter of 1929; that is, on an opposite side of the bank.

Seismic sea-wave effects resulting from the Grand Banks earthqauke of 1929 were recorded on tide gauges of the Coast and Geodetic Survey. Almost equal effects were noted at Ocean City, Md., and Atlantic City where changes of approximately nine-tenths of a foot were noted. The record at Charleston shows an offset on the tide curve lasting about one hour. Whether or not this represents the onset of a seismic sea wave is open to question as there is a complete absence of oscillatory motion. The following figures are based on the assumption that the epicenter was 44.5° north latitude and 55.0° west longitude.

	Times of arrival, G. C. T.	Elapsed time	Distance traveled	Approximate rate of travel
	h. m.	*Hours*	*Miles*	*Miles per hour*
Atlantic City, N. J	0 55	4.39	1,060	241
Ocean City, Md	0 23	3.85	1,138	299
Charleston, S. C	2 18	5.78	1,570	272

An article discussing in particular the geological features of the shock has been prepared by Arthur Keith under the title The Grand Banks Earthquake and appears as a supplement to the proceedings of the 1930 meeting of the eastern section of the Seismological Society of America. In the December 21 number of Nature (London) there is an article by J. W. Gregory, entitled "The Earthquake South of Newfoundland and Submarine Canyons."

ABSTRACT OF NONINSTRUMENTAL REPORTS

CONNECTICUT

Ansonia: Not felt.
Bantam: Not felt.
Bridgeport: Shock felt by several. Meriden office building shaken perceptibly in north-south direction.

Hartford: Two persons stated building creaked and furniture swayed. Building swayed for two minutes like a boat on sea but more gently. Shock seemed to come from a little west to northwest. Dresser rocked back and forth. Water splashed out of fish bowl, north-south motion. Pendulum clock stopped. One clock pendulum was observed to start and stop with motion.

Abrupt shock felt by person lying on couch. Windows rattled. Water in fish bowl and a palm, also chandelier, swayed from north to south; when it swayed south the clock would stop and when it swayed north it would start again, lasting about 10 minutes.

Middletown: Not felt.

New Britain: One man felt shock and noticed loose objects rattling.

New Haven: Large buildings jarred. In one case employees left the building.

New London: Not felt.

New Milford: Shock felt by several. Abrupt. Doors, glasses in china closet, mirrors on small table swayed, and pictures on walls running east and west shook north to south.

Norwich: Two shocks of a few minutes interruption. Buildings of poor construction swayed. also hanging fixtures.

Plainfield: Not felt.

Putnam: Swaying felt by two.

Rockville: Not felt.

Stonington: Not felt.

Waterbury: Not felt.

Winsted: Two shocks felt by one. Clock with 8-inch pendulum, direction of swing north-south, stopped. One with 22-inch pendulum did not stop.

Woodbury: Windows rattled. Furniture vibrated.

DELAWARE

Claymont: Bed rocked.

MAINE

Alfred: Furniture moved.

Anson: Felt by most. Rattling of loose objects.

Auburn: Trembling and swaying from northwest to southeast felt by nearly all. Pictures swayed. Clocks stopped.

Augusta: Felt by a few. Several made ill by swinging of building.

Bangor: Felt by many. Articles thrown on floor. Objects disturbed. Buildings swayed.

Bar Harbor: Generally felt. Objects moved slightly. Tide receded very rapidly and returned quickly.

Bath: Not felt on rock, but sharply felt on made land and along bed of old watercourse. Houses shook and pictures swayed. Particularly felt in clubhouse where loose objects were thrown about. Some loose plaster dropped. Heavy gale at time but sound like thunder was heard, evidently due to the earthquake.

Belfast: Two shocks felt by several. Sound like auto truck at a distance.

Bethel: Two shocks felt by many. Buildings trembled. Doors swung.

Biddeford: Shock felt by several. Moderately loud rumbling like very heavy truck in the distance. Building swayed.

Blaine: Two shocks felt by many. Moderately loud rumbling like a locomotive.

Brownville: Trembling felt by most. Heavy rattling of windows and dishes. Swaying of mirrors. Effect like heavy truck or dragging heavy furniture across floor. Light shock 15 minutes earlier.

Calais: Vibrations generally felt, like that due to heavy truck. Moderate rumbling.

Caribou: Felt by many. Rumbling noise.

Cherryfield: Felt by most. A few vases broken. Sounds described as whistling.

Chesuncook: Felt by several. Sounds resembling thunder.

Eastport: Generally felt. Building trembled, also radiators and bookcases, east-west direction. Plaster fell. Objects thrown from shelves. A few persons reported two shocks.

Frenchville: Trembling felt by several.

Greenville: Felt by a few. Sounds like thunder.

Grindstone: Trembling felt by a few. Curtains and leaves of plants seen to shake.

Hallowell: Building swayed.

Jackman: Two shocks, north-south swaying. Buildings creaked. Suspended objects swayed. Children frightened almost to point of leaving school.

Kennebunk: An observer 65 years old stated that this was the strongest earthquake he had felt in New England. Several tremors in succession. Several persons felt a shock on the morning of the same day. Buildings strongly shaken. Noise like gigantic rapping.
Kittery: Not felt.
Kokadjo: Not felt.
Leeds Junction: Railroad station strongly shaken.
Lincoln: Felt by many. Swinging objects swayed, in north-south direction.
Lubec: Strong shock.
Machias: Felt by most. Moderately loud roaring. In East Machias, east-west trembling. Loose objects rattled.
Millinocket: Loose objects rattled. Hanging objects swayed.
Milo: Especially severe. Dishes thrown from shelves. Doors swayed.
Newport: Trembling and steady rumbling noise noted by several.
Oldtown: Trembling or rocking felt by most. Pictures slightly displaced. Rumbling increasing then dying away.
Paris: Felt by several.
Northeast Carry: Swaying noted by several, north-south direction. Telephone wires swayed.
Norway: Buildings strongly shaken.
Portland: Two distinct shocks in north-south swaying felt by many. Windows rattled. Doors slammed. Water slopped over from glass tank. Bridge between Portland and South Portland swayed but no damage resulted. Some nausea.
Ripogenus Dam: Not felt.
Rockland: Dishes crashed from shelves.
Rockwood: Not felt.
Rumford: Work stopped temporarily at paper mill through frightening of employees.
Sanford: Slight.
Seven Islands: Not felt.
Sheridan: Swaying felt by several. Windows rattled.
Skinner: Rapid trembling noticed by a few. Stove and pipes rattled.
South Paris: Windows vibrated so strongly that it was expected that they would break.
Springvale: Slight.
Vinal Haven: Two shocks close together, felt by several. Hanging objects swayed. Doors and windows rattled.
Waterville: Trembling felt by many. Pictures moved. Vases swayed.

MASSACHUSETTS

Amesbury: Electric light fixtures swayed, chairs rattled. Water splashed from goldfish bowl.
Athol: Felt by many. North-south swaying, increasing then dying away. Chairs and pictures displaced.
Attleboro: A few houses shook as if a heavy truck was passing.
Barnstable: Trembling felt by many. High course tides followed by earthquake.
Brockton: Felt by several. Vases swayed. Telephone pole appeared to sway back and forth.
Boston: Felt with special force in high buildings. People in upper floors of custom house took the elevators as they were frightened by the swaying. One observer on the eighteenth floor estimated that the motion was through 5 or 6 inches, more than that due to high winds. On twenty-fifth floor doors swung and various objects swayed. Water slopped back and forth in jar of water cooler. On thirteenth floor several shocks noted in north-south direction. Dizziness experienced. Elevator cables swayed. Similar occurrences in other high buildings. Sharply felt at state house, where pendulum clocks stopped. Shock was accompanied by strong rumbling, like muffled explosions in some cases and in others like heavy trucks. Clocks stopped in a number of places.
Bourne: Large counter weights on Cape Cod Canal bridge swayed. Four distinct shocks noted.
Brookline: Furniture rocked. People ran into street.
Cambridge: Radio towers at Harvard University seemed to sway. Chairs swayed in northwest-southeast direction. Doors swung.
Danvers: Trembling felt by several.

Dedham: Felt by many. Houses swayed. Dishes rattled.
East Harwich: Felt by two. Open door swung back and forth.
East Walpole. Person seated in chair noted swaying with dizziness. Electric lights went off and on.
Everett: Not felt.
Fall River: Not felt.
Framingham: At least three shocks at 1-minute intervals. Swaying south to north. Rattling of loose objects.
Gloucester: Not felt.
Greenfield: Several tremors generally felt. Buildings vibrated. Suspended objects swayed.
Haverhill: Felt by a few. Mirrors and beds swayed.
Holyoke: Swaying felt by many. Breaks in water mains and cracks in cast-iron pipes, all lying in northeast-southwest direction, reported. Objects moved and light fixtures swayed.
Hyannis: Buildings swayed. People rushed into street.
Lowell: Generally felt. Dishes thrown from shelves and pictures from walls.
Lynn: Employees generally frightened and left factories but soon returned.
Malden: Pictures shaken violently.
Medford: Slight.
Milford: Not felt.
Nantucket: Felt by many. Slight.
Needham: Objects upset. Man nearly thrown from chair.
New Bedford: Swaying. House trembled and jarred as if by heavy truck passing.
Newburyport: Felt by many. Buildings rocked. Pictures shaken from walls. Jar like heavy truck passing. Much stronger in outskirts than in center of city.
Palmer: Shocks with east-west swaying felt by many. Suspended objects swayed. Mild nausea in several cases.
Pittsfield: Not felt.
Plymouth: Windows rattled. Some alarm.
Provincetown: Continuous trembling for several minutes felt by many. Rumbling like heavy truck and sickening sensation.
Quincy: Slight.
Rockport: Very slight.
Salem: Pictures rattled. Some alarm.
South Wellfleet: Felt by one. Door rattled. Slight vibration of building.
Springfield: Pronounced trembling felt by many. Moderately loud sounds. Telephone bells rang. Clocks stopped.
Taunton: Generally felt. Hanging objects swayed. Pictures displaced.
Waltham: Swaying felt by many. Hanging objects swayed. Dishes and pans vibrated.
West Roxbury: Houses trembled. Furniture vibrated. Chairs moved.
Williamstown: Not felt.
Worcester: Continuous trembling generally felt, increasing in intensity then dying away. Chandeliers swung. Doors rattled. Pictures swung, apparently motion was northeast-southwest.

NEW HAMPSHIRE

Berlin: Trembling of chair and plants noted. Rocking chairs rocked in northeast-southwest direction. Rattling of loose objects.
Bristol: Trembling and rocking felt by several.
Conway: North-south rocking felt by several.
Exeter: Trembling felt by many.
Farmington: Trembling and shaking felt by several. Buildings swayed slightly.
Franklin: Trembling felt by several. Slight rumbling.
Gorham: Slight east-west rumbling felt by several. Objects trembled.
Greenville: Not felt.
Keene: Shock moderate and not felt by more than half of population. Hanging objects swayed. Some alarmed.
Laconia: Felt by many. Sleepers awakened.
Lakeport: Trembling of stove funnel observed. Dishes rattled; a lamp was nearly tipped over; and men ran out of a barn, expecting it to fall.
Lancaster: Buildings swayed. Steam radiator on third floor rocked. Generally felt.
Meredith: Vibration felt by one.
Nashua: Safe moved.

North Stratford: Doors swayed and windows rattled.
Pembroke: Not felt.
Raymond: Chairs swayed, and floor and walls seemed to sway.
Somersworth: Not felt.
Stark: Slight trembling felt by a few.
Wentworth: Not felt.
Wolfeboro: Trembling felt by several. Safe doors rattled.
Woodsville: Furniture moved. Dishes broken. People in upper stories frightened.

NEW YORK

Albany: Felt slightly.
Amenia: Not felt.
Binghamton: Felt slightly.
Brooklyn: Couch trembled.
Burlingham: Not felt.
Canton: Slight sound heard by one at time of earthquake. No vibration.
Chateaugay: Not felt.
Cooperstown: Shock not felt in this vicinity, although clock in railroad station stopped at 15:40 m.
Dannemora: Not felt.
Delhi: Felt slightly.
East Greenwich: Not felt.
Ellenburg: Trembling felt by many. Loose objects rattled.
Ellenville: Chair swayed, southwest-northeast direction.
Flushing: Tremors like heavy truck passing.
Glens Falls. Distinct and persistent east-west swaying. Buildings and furniture vibrated, and hanging objects swayed.
Gloversville: Not felt.
Hamilton: Shock felt by one. Hanging objects swayed. Rocking motion north-south.
Hoosick Falls: Not felt.
Hunter: Not felt.
Lake George: Not felt.
Lake Pleasant: Not felt.
Little Falls: Not felt.
Milton: Not felt.
Monticello: Not felt.
Newburgh: Not felt.
New York: Paper held by man started to shake, and chair swayed on third floor of building. Different from vibration due to truck. Bed felt to sway. Not generally felt.
Norwich: Felt slightly.
Peekskill: Not felt.
Plattsburg: Trembling felt by several.
Raquette Lake: Not felt.
Rouses Point: Not felt.
Saratoga Springs: Continuous trembling and swinging from north to south felt by many. Lamp and pictures swayed.
St. George, Staten Island: Floor appeared to vibrate.
Scarsdale: Slight trembling.
Schenectady: Felt slightly.
Sherburne: Shock felt by one in central part of village.
Sidney: Felt slightly.
Troy: Felt slightly. Three rapid shocks felt by one.
Walton: Felt slightly.
Whitehall: Not felt.
Windsor: Felt slightly.

RHODE ISLAND

Block Island: Shock reported here north-northwest-south-southeast. Electric lights and pictures swayed. Fishermen reported unaccountable cross motion to sea.
Bristol: Not felt here.
Chepachet: Trembling like vibration of electric sewing machine. Radiator vibrated. Motion apparently north-south.
Clayville: Not felt.
Coventry: Not felt.
Howard: Not felt.

Jamestown: Not felt.
Newport: Rocking felt by many either sitting still or lying down, not by others. Noticed leaves of fern swaying in a north-south direction.
Providence: Felt at statehouse. Water in cooler rose and fell through an inch. In other buildings lights swayed. Chairs and pictures moved.
Westerly: Buildings jarred and stoves rattled. Most people thought a heavy truck was passing. Radiators vibrated. Safe door swinging back and forth.

VERMONT

Barre: Two distinct shocks 10 minutes apart, first at same time as generally felt.
Bellows Falls: Trembling and swaying with continuous rumbling. Dishes rattled. Not noticed by all.
Bennington: Not felt.
Bethel: Trembling and swaying felt by several.
Burlington: Shocks lasted about two minutes. Linotype machine swayed in newspaper office. Buildings creaked.
Danville: Not felt.
Hanford: Felt by several. Building swayed. Some plaster cracked.
High Gate: Felt by one, north-south.
Lyndon: Not felt.
Middlebury: Not felt.
Montgomery: Not felt.
Montpelier: Two shocks felt.
Newport: Two shocks two minutes apart, swaying north-south. Pictures, beds, and dishes rattled. Few alarmed.
Northfield: Two shocks close together. Furniture, windows, and doors rattled.
Pawlet: Not felt.
Proctor: Not felt.
Randolph: Lighting fixtures swayed.
St. Albans: Not felt.
St. Johnsbury: At least three shocks in north-south direction. Curtains shook.
Wallingford: Not felt.
Wardsboro: Two shocks about one minute apart. North-south swaying. Telephone and electric light wires swayed.
Waterbury: Two shocks half a minute apart.
Williamstown: Not felt.

INSTRUMENTAL REPORT ON PRINCIPAL EARTHQUAKES

STATION SYMBOLS

APIA	Samoa.	DEN	Denver, Colo.	OTT	Ottawa, Canada.
BROM	West Bromwich, England.	GEO	Georgetown, D. C.	SIT	Sitka, Alaska.
CHA	Charlottesville, Va.	HAR	Cambridge, Mass.	STL	St. Louis, Mo.
CHIU	Chicago, University of.	HON	Honolulu, Hawaii.	TUC	Tucson, Ariz.
CIN	Cincinnati, Ohio.	MAN	Manila, P. I.	VIC	Victoria, B. C.
CZB	Balboa Heights, Canal Zone.	MICH	Ann Arbor, Mich.		
		NOR	New Orleans, La.		
		NYF	New York (Fordham).		

[Greenwich civil time]

Date, station, and hour	Phase	Time. Component		Provisional epicenters and remarks [1]
		North	East	
January 13				Origin, $0^h\ 03.4^m$. Epicenter, 51° N., 154° E. GEO, OTT, NOR, CIN, NYF, STL, BROM, HAR.
Balboa, Canal Zone:		*m. s.*	*m. s.*	
0^h	P	20 43	----------	Slight tremors on E.-W. between $0^h\ 20^m\ 43^s$ and $1^h\ 30^m\ 0^s$.
	S	30 07	----------	
	L_1	32 47	----------	
	M_1	36 07	----------	
1^h	F	30	----------	
Charlottesville:				
0^h	P	15 12	15 13	
	ePR_2	20 20	20 30	
	iS	25 03	25 03	
	SR_1	30 24	30 25	
	SR_2	34.4	33 52	
	L_1	44.0	44.0	

[1] Provisional epicenters are usually based on the tabulated data and preliminary reports from the additional stations listed in this column.

Instrumental report on principal earthquakes—Continued

Date, station, and hour	Phase	Time. Component				Provisional epicenters and remarks
		North		East		
January 15—Continued						
Charlottesville—Continued.		*m.*	*s.*	*m.*	*s.*	
3h	F	38		38		
Chicago:						
0h	iP	14	39	14	36	
	PR_1	----------		17	47	
	iS	23	46	23	48	
	SR_1	28	40	28	30	
	SR_2	31	44	32	00	
	L	38	05	37	50	
3h	F	35		35		
Honolulu:						
0h	iP	11	28	11	33	
	ePR_1	13.3		----------		
	iPR_1	----------		13	20	
	i	17	49	----------		
	iS	18	18	18	22	
	iSR_2	22	30	----------		
	iL	23	41	23	16	
3h	F	33		33		
Sitka:						
0h	eP	11	04	10	39	
	ePR_1	12	40	12	21	
	iS	16	38	16	41	
	iSR	17	28	17	15	
	iL	19	36	19	47	
1h	F	34		34		
Tucson:						
0h	iP	14	04	14	03	
	e	----------		18	32	
	iS	22	56	22	56	
	e	30	46	31.0		
	L	----------		35.2		
3h	F	14		14		
January 17						Origin, 11h 45.2m. Epicenter, 11° N., 64° W. GEO, NYF, VIC, HAR, STL. Destructive in Cumana. Venezuela.
Balboa, Canal Zone:						
11h	P	49	02	----------		E.–W. record lost.
	S	51	46	----------		
	L_1	52	44	----------		
	M_1	54	16	----------		
12h	F	38		----------		
Charlottesville:						
11h	eP	52	00	----------		
	S	56	45	56	44	
	L_1	58	40	58.0		
13h	F	27		27		
Chicago:						
11h	P	53	07	53	07	
	PR_1	54	29	54	50	
	S	58	49	58	49	
	SR_1	61	11	----------		
	L	62	31	61	33	
13h	F	45		45		
Honolulu: 12h	S_oP_oS	----------		09	14	Nothing on N.–S.
	PS	----------		10	39	
	eL	----------		48.0		
	F	----------		51		
Tucson:						
11h	P	54	23	54	21	
	PR_1	56	13	55	50	
12h	eS	01	39	01	05	
	eSR_1	----------		04	17	
	eSR_2	04	59	----------		
	eL	09	33	08.3		
	F	54		54		
January 21						Origin, 10h 30m 45s. Epicenter, 65° N., 150° W. GEO, HAR, VIC, NYF, STL, MICH, Felt in Alaska.
Charlottesville:						
10h	P	39	32	----------		
	S	46	28	----------		
	SR_1	50.2		----------		
	L	59.2		54.5		
	iL	55	48	55.8		
11h	F	30		30		

Instrumental report on principal earthquakes—Continued

Date, station, and hour	Phase	Time. Component North		Time. Component East		Provisional epicenters and remarks
January 21—Continued						
Chicago:		*m.*	*s.*	*m.*	*s.*	
10h	eP	38	43	38	40	
	PR_1	40	10	40	12	
	S	44	49	----------		
	SR_1	----------		47.2		
	eSR_1	47.2		----------		
	L	51.3		51.3		
	iL	----------		51.8		
	eL	----------		55.0		
11h	F	50		50		
Honolulu:						
10h	ePR_1	40.8		----------		
	eS	45.3		--- ------		
	i	----------		45	49	
	SR_1	----------		48	44	
	L	51	50	51	50	
11h	F	22		22		
Sitka: 10h	e	35	23	35	40	
	L	35	53	35	53	
	iL	----------		36	07	
	eL	----------		36	35	
	L	----------		37	15	
Tucson:						
10h	P	38	30	38	31	
	ePR	39	10	39	10	
	S	44	58	44	41	
	eSR_1	47	55	----------		
	eL	49.8		49.3		
11h	F	44		44		
January 24						Origin, 20h 36.3m. Epicenter, 12° N., 90° W. GEO, DEN, NOR, STL, NYF, CIN, OTT, MICH, HAR.
Balboa, Canal Zone:						
20h	P	39	25	39	21	
	S	41	37	41	37	
	L_1	42	24	42	27	
	M_1	55	26	54	49	
21h	F	53.0		45.0		
Charlottesville:						
20h	P	42	26	42.0		
	ePR_1	43	28	----------		
	S	47	00	47	04	
	e	49	36	49	24	
	L_1	52	06	51	00	
23h	F	10		10		
Chicago:						
20h	P	42	40	----------		
	eP	----------		42.9		
	S	47	37	47	50	
	L	50	17	----------		
	eL	----------		50.3		
23h	F	15		15		
Honolulu:						
20h	iS	55	57	56	00	
21h	iSR_1	14		----------		
	iL	40		----------		
	L	----------		03	37	
	L	06	14	06	20	
22h	F	28		28		
Sitka: 21h	e	05.4		04.3		
	F	31		49		
Tucson:						
20h	iP	42	21	42	20	
	PR_1	43	46	43	47	
	S	46	56	47	03	
	SR_1	48	34	49.0		
	L	50	17	50	20	
23h	F	19		19		
February 2						Origin, 0h 00.5m. Epicenter, 1° S., 23° W. GEO, OTT, STL, MAN, HAR.
Balboa, Canal Zone: 0h	P	10	04	10	06	
	S	18	00	18	04	
	L	24	20	24	00	
	M	33	28	32	58	
	F	30		45		

Instrumental report on principal earthquakes—Continued

Date, station, and hour	Phase	Time. Component				Provisional epicenters and remarks
		North		East		
February 2—Continued						
Charlottesville:		*m.*	*s.*	*m.*	*s.*	
0h	eP	11	00	11	00	
	iS	19	48	19	48	
	e	21	00	----		
	iSR_1	23	42	----		
	eSR_1	----		25	36	
	iSR_2	26	36	----		
	eSR_2	----		26	52	
	L_1	32	18	31.9		
2h	F	51		51		
Chicago:						
0h	iP	----		11	50	
	i	13	25	13	23	
	iS	21	15	21	17	
	SR_1	24	19	25	36	
	L	29.4		31.1		
3h	F	01		01		
Honolulu:						
0h	ePR_1	----		22	41	
	e	23.9		----		
	SR_1	----		39	31	
	eSR_1	40.0		----		
	L	55.2		60.9		
2h	F	31		31		
Sitka:						
0h	eL	----		49.5		
1h	F	----		50		
Tucson:						
0h	P	13	30	13	30	
	eS_oP_oS	23	06	23	17	
	eSR_1	29	24	28	52	
	L	36	16	41.0		
3h	F	16		16		
February 5						Local shock. Felt in Hawaiian Islands. HON.
Honolulu:						
12h	iP	----		55	23	
	i	55	39	55	39	
	i	55	49	----		
	L	----		56	07	
13h	F	00.0		00.0		
February 10						Origin, 15h 38.5m. Epicenter, 13° N., 91° W. GEO, STL, OTT, MICH, VIC, HAR.
Balboa, Canal Zone:						
15h	P	42	12	42	12	
	S	44	44	44	44	
	L	46	58	45	26	
	M	46	58	46	56	
16h	F	07.0		17.0		
Charlottesville:						
15h	iP	44	58	44	58	
	S	49	28	49	32	
	eSR_1	52	44	51	56	
	L_1	56	00	53	36	
17h	F	13		13		
Chicago:						
15h	P	45	10	45	13	
	PR_1	46	00	----		
	S	49	49	49	57	
	L	52	39	51	50	
17h	F	16		16		
Honolulu:						
15h	iS	----		58	27	
	S	58	26	----		
16h	eSR_2	05.9		----		
	L	----		09.0		
	F	30		30		
Tucson:						
15h	P	43	50	----		Not well recorded; no time control.
	L	53.0		----		
17h	F	13		----		

Instrumental report on principal earthquakes—Continued

Date, station, and hour	Phase	Time. Component North		Time. Component East		Provisional epicenters and remarks
February 15						Origin, 8h 04.0m. Epicenter, 9° N., 87° W. Arc intersections poor. Possible error of 2° in position. GEO, OTT, VIC, STL.
		m.	*s.*	*m.*	*s.*	
Balboa, Canal Zone: 8h	P	07	16	07	16	
	S	09	26	----		
	L	10	22	11	14	
	M	12	34	----		
	F	43.0		36.0		
Charlottesville:						
8h	eP	10	24	----		
	e	----		14	28	
	S	15	25	----		
	SR_1	----		17.0		
	e	18	26	----		
	L_1	22.0		21.8		
9h	F	15		15		
Chicago:						
8h	P	10	41	----		
	ePR_1	11.3		----		
	S	15	42	15	28	
	L	19	33	18	30	
9h	F	30		30		
Honolulu: 8h	e	----		43.2		
	F	----		50		
Tucson:						
8h	P	10	45	10	34	
	S	15	52	15	54	
	L	19	24	19	36	
9h	F	39		39		
February 22						Origin, 20h 41.6m. Epicenter, 8° N., 46° W. Arc intersections poor; epicenter approximate. GEO, VIC, NYF, OTT, STL, MAN, BROM, HAR.
Balboa, Canal Zone:						
20h	P	49	02	----		Slight tremors on E.-W. from 20h 49m 03s to 21h 32m 00s.
	S	54	50	----		
	L	57	35	----		
	M	57	46	----		
21h	F	42.0		----		
Charlottesville:						
20h	P	49	46	49	46	
	ePR_1	51	35	51	36	
	iS	56	00	56	06	
	eSR_1	----		57	47	
	SR_2	59	15	58	55	
21h	L	01	40	00	48	
22h	F	49		49		
Chicago:						
20h	iP	50	47	50	47	
	PR_2	53	13	----		
	iS	58	03	57	56	
21h	SR_1	02	29	00	45	
	L_1	05	02	05	23	
22h	F	45		45		
Honolulu:						
21h	eS_oP_eS	----		06.9		
	PS	----		10	22	
	SR_1	16.2		16.2		
	eL_1	26.9		----		
	L_1	----		39.5		
22h	F	12		12		
Tucson:						
20h	P	52	47	52	41	
21h	S	02	22	01	35	
	iSR_1	----		05	51	
	iSR_2	09	02	----		
	L	----		12	57	
	F	17		17		

Instrumental report on principal earthquakes—Continued

Date, station, and hour	Phase	Time. Component				Provisional epicenters and remarks
		North		East		
February 26						Origin, 9h 00.7m. Epicenter, 54° N., 163° W. GEO, HAR, OTT, NYF, VIC, MAN, STL.
Charlottesville:		*m.*	*s.*	*m.*	*s.*	
9h	iS	18	28	18	24	
	eSR1	20	19	----		
	eL	28	39	26.0		
10h	F	44		44		
Chicago:						
9h	P	09	37	09	38	
	iS	16	40	16	39	
	SR1	19	25	19	17	
	SR2	----		20	22	
	eL	23.0		23.0		
10h	F	16		16		
Honolulu:						
9h	S	12.8		----		
	eS	----		12	50	
	eL	15.0		14.3		
	L	16.3		16.3		
10h	F	12		12		
Sitka: 9h	eL	----		08.6		
	F	----		45		
Tucson:						
9h	P	08	49	08	48	
	eS	15	05	15	06	
	L	18	38	18	32	
10h	F	10		10		
March 1						Origin, 7h 30.6m. Epicenter, 53° N., 132° W. GEO, NYF, STL, MICH, HAR.
Charlottesville:						
7h	S	44	40	----		
	e	----		47.0		
	e	50	24	50	36	
	L	51	35	51	32	
8h	F	43		43		
Chicago:						
7h	P	----		37	13	
	S	42	32	42	23	
	SR1	46	13	45	46	
	L	47	32	47	33	
8h	F	45		45		
Honolulu:						
7h	SR1	----		46.7		
	L	47.3		47.1		
8h	F	26		26		
Sitka:						
7h	eS	32	50	32	50	
	eL	33	42	33	42	
	iL	----		34	10	
8h	F	15		15		
Tucson:						
7h	P	36	26	36	28	
	ePR1	38	05	38	01	
	S	40	53	40	57	
	eL	43	35	----		
	L	----		44	27	
8h	F	46		46		
March 2						Local shock in the Hawaiian Islands.
Honolulu: 20h	iP	54	32	54	34	
	i	55	08	55	23	
	F	58.7		58.7		
March 3						Felt at Sitka, Alaska.
Chicago: 9h	e	21	23	21.1		
	eL	21	43	21	45	
	F	31		31		
Sitka: 9h	iP	04	28	04	00	Felt. Sharp record. Time uncertain.
	i	04	35	04	06	
	F	08.7		08.7		

Instrumental report on principal earthquakes—Continued

Date, station, and hour	Phase	Time. Component				Provisional epicenters and remarks
		North		East		
March 7						Origin, 1h 34.6m. Epicenter, 51° N., 170° W. GEO, VIC, OTT, CIN, DEN, BER, NYF, MAN, STL, MICH, BROM, HAR, APIA.
Balboa, Canal Zone:		*m.*	*s.*	*m.*	*s.*	
1h	P	47	20	47	20	
	S	57	26	57	36	
2h	L	22	00	----------		
3h	F	17.0		15.0		
Charlottesville:						
1h	iP	45	03	45	04	
	ePR1	47	49	47	19	
	ePR2	48	43	49	06	
	iS	53	36	52	40	
	eSR1	58.0		57	27	
	iSR2	59	24	----------		
2h	iL1	02	56	01.0		
5h	F	53		53		
Chicago:						
1h	iP	----------		43	51	N.-S. record lost by drift.
	iPR1	----------		45	58	
	iS	----------		51	28	
	iSR1	----------		55	41	
	L1	----------		59	01	
5h	F	----------		00		
Honolulu:						
1h	iP	41	00	41	00	Difficult to read because of overlapping traces.
	iS	----------		46	16	
	L	----------		47	17	
6h	F	40		40		
Sitka:						
1h	L	----------		45	08	No time marks.
5h	F	----------		06		
Tucson:						
1h	iP	43	09	43	09	
	iS	49	59	49	53	
	iSR1	53	00	53	19	
	i	55	40	56	17	
	iL	----------		57	23	
6h	F	26		26		
March 19						Origin, 20h 53.5m. Epicenter, 13° N., 90° W. GEO, STL, HAR.
Balboa, Canal Zone:						
20h	P	57	22	57	53	
	S	59	54	----------		
21h	L	00	26	----------		
	F	17.0		16.5		
Chicago:						
20h	P	59	57	----------		
21h	S	04	24	05	10	
	eL1	----------		06.1		
	L1	06	31	----------		
	F	47		47		
Honolulu: 21h	S	----------		12	43	Nothing on N.-S.
	L	----------		23.7		
	F	----------		33		
Tucson:						
20h	P	59	27	59	25	
21h	ePR1	----------		00	15	
	S	03	56	03	58	
	L	07	25	07	21	
	F	53		53		
March 21						Origin, 2h 36.6m. Epicenter, 13° N., 90° W. GEO, OTT, STL, NYF, HAR. Felt in San Salvador.
Balboa, Canal Zone:						
2h	P	39	55	39	36	
	S	42	16?	----------		
	L	43	06	----------		
3h	F	06		06		
Charlottesville:						
2h	iP	42	39	----------		
	ePR1	----------		44	00	
	eS	47	48	47	46	
	eSR1	52	34	51.0		
	L1	54	36	52	00	
3h	F	54		54		

Instrumental report on principal earthquakes—Continued

Date, station, and hour	Phase	Time. Component				Provisional epicenters and remarks
		North		East		
March 21—Continued						
Chicago:		*m.*	*s.*	*m.*	*s.*	
2h	P	42	55	43	20	
	PR1	43	41	----		
	S	48	05	48	15	
	SR1	49	34	49	41	
	eL	53.7		51.2		
4h	F	30		30		
Honolulu:						
2h	S	----		56	14	Weak record. Not recorded on N-S.
	eL	----		05.7		
3h	F	----		21		
Tucson:						
2h	P	42	40	42	39	
	PR1	43	36	----		
	S	47	10	47	13	
	L	51	05	51	04	
3h	F	40		40		
May 1						Origin, 15h 37.7m. Epicenter, 41° N., 53° E. VIC, GEO, STL, OTT, MAN, BROM.
Charlottesville:						
16h	e	01	28	01.5		
	e	----		17.3		
	eL1	24.1		23.7		
18h	F	12		12		
Chicago:						
15h	PR1	54	44	54	40	
16h	S_eP_eS	01	27	01	25	
	PS	03	12	----		
	SR1	----		07	54	
	SR2	----		12	07	
	eL	----		16.4		
	L	23	45	----		
18h	F	28		28		
Honolulu:						
16h	eSR1	13.0		12.6		
	eL	23.5		26.1		
18h	F	00		00		
Tucson:						
15h	PR1	56	50	----		E.-W. record lost.
16h	PS	06	04	----		
	e	19.7		----		
	e	27.1		----		
	eL	41.7		----		
17h	F	19		----		
May 20						Origin, 4h 53.0m. Epicenter, 54° N., 178° W. GEO, OTT.
Charlottesville:						
5h	iP	03	38	03	38	
	iS	12	22	12	20	
	eSR1	16	36	16.2		
	eL1	22	00	24.0		
6h	F	56		56		
Chicago:						
5h	P	02	40	02	43	
	S	10	34	10	34	
	eSR1	14.2		----		
	SR1	----		15	27	
	L	19	37	19	42	
7h	F	04		04		
Honolulu:						
5h	eP	00.5		00.5		
	e	04.8		05.0		
	L	06.5		06.7		
7h	F	06		06		
Sitka: 6h	e	01.9		----		E.-W. not operating.
	F	26		----		
Tucson:						
5h	P	01	52	01	53	
	PR1	----		03	44	
	eS	09	04	09	10	
	eSR2	12	44	----		
	eL	14.6		17.0		
6h	F	50		50		

Instrumental report on principal earthquakes—Continued

Date, station, and hour	Phase	Time. Component North		Time. Component East		Provisional epicenters and remarks
May 26						Origin, 22h 40.1m. Epicenter, 51.3° N., 131° W. BROM, BER, DEN, STL, NYF, GEO, OTT, MAN, MICH, HAR. Felt on Queen Charlotte Islands, British Columbia.
Charlottesville:		*m.*	*s.*	*m.*	*s.*	
22h	eP	47	32	47	30	
	ePR1	49	00	----------		
	eS	53	28	53	12	
	eSR1	----------		57	00	
	iL1	60	26	59	50	
26h	F	10		10		
Chicago:						
22h	P	46	16	46	17	Poorly recorded on N.-S.
	PR1	47	41	47	39	
	S	51	29	51	30	
	SR1	----------		53	51	
	eL	----------		55.3		
	L	56.1		----------		
	iL	----------		56	21	
26h	F	33		33		
Honolulu:						
22h	eP	47	32	47.5		
	iPR1	48	59	48	59	
	eS	53	20	----------		
	iS	----------		53	13	
	eSR1	55.6		----------		
	iL	55	50	55	32	
26h	F	40		40		
Sitka: 22h	P	41	34	----------		Stylus became disconnected on N.-S. E.-W. not operating.
	iP	41	40	----------		
	S	42	26	----------		
	S	42	51	----------		
Tucson:						
22h	eP	----------		45	15	N.-S. record lost.
	iP	----------		45	29	
	iS	----------		50	12	
	iL	----------		52	58	
26h	F	----------		04		
June 2						Origin, 21h, 38.5m. Epicenter, 41° N., 140° E. GEO, BER, STL.
Honolulu:						
21h	iP	47	57	47	56	
	ePR1	----------		49.5		
	iS	55	33	55	31	
22h	L	02	32	----------		
	eL	----------		03.7		
	F	48		48		
Tucson:						
21h	P	50	49	50	49	Long waves scarcely visible.
	PR1	----------		54	20	
22h	S	00	46	00	47	
	PS	----------		02	43	
	eSR	----------		10.8		
	eL	15.7		15.8		
	F	30		30		
June 9						Origin, 9h 08.1m. Epicenter, 46° N., 152° E. GEO, BER, HAR.
Charlottesville:						
9h	eS	30	59	----------		
	ePS	34	38	34	16	
	eSR1	37	36	37	44	
	L1	54	00	50.0		
10h	F	49		49		
Chicago:						
9h	P	19	53	19	53	
	PR1	22	50	22	54	
	PR2	24	45	24	44	
	S	29	45	29	42	
	SR1	34	51	34	13	
	eL	38.5		44.0		
11h	F	10		10		
Honolulu:						
9h	eP	----------		16	57	
	iS	23	37	23	26	
	SR2	27	36	27	31	
	L	29 3		29.2		
10h	F	50		50		

Instrumental report on principal earthquakes—Continued

Date, station, and hour	Phase	Time. Component				Provisional epicenters and remarks
		North		East		
June 9—Continued						
Sitka:		*m.*	*s.*	*m.*	*s.*	
9h	eP	----------		17	07	N.-S. not operating.
	iS	----------		22	43	
	eL	----------		25	52	
10h	F	----------		37		
Tucson:						
9h	P	19	26	----------		No record on E.-W.
	S	28	45	----------		
	e	37.0		----------		
	eL	38.5		----------		
11h	F	01		----------		
June 13						Origin, 0h 12.5m. Epicenter, 47° N., 153° E. GEO, NOR, NYF, OTT, MICH, STL, MAN, HAR.
Charlottesville:						
0h	iS	35	24	35	22	
	i	48	58	48	58	
	e	54	52	53.0		
	eL_1	58	53	58	00	
2h	F	27		27		
Chicago: 0h	P	24	19	24	27	Surface waves lost in beginning of next shock.
	S	34	12	33	07	
Honolulu: 0h	eP	----------		21.3		Finish lost in next shock.
	ePR_1	----------		23.0		
	iS	27	54	27	49	
	SR_1	29	32	29	50	
	L	33.9		33.5		
Sitka:						
0h	eP	27.0		----------		Faint record; not well recorded. Time marks lacking; times are all approximate.
	iP	----------		27	12	
	e	40.9		44	24	
	i	----------		41	12	
2h	F	25		25		
Tucson: 0h	P	23	47	23	43	This record overlaps that of next shock.
	S	33	05	33	07	
	eSR_1	----------		38	08	
	eL	43.6		43.8		
June 13						Origin, 0h 26.1m. Epicenter, 47° N., 153° E. GEO, NOR, NYF, OTT, MICH, STL, MAN, HAR.
Chicago:						
0h	S	47	35	47	36	Preliminary phases lost in previous quake.
	eSR_2	----------		54.8		
1h	L	07.6		01	09	
3h	F	11		11		
Honolulu:						
0h	iS	41	31	41	26	
	SR_1	----------		44	50	
	L	47	30	47	50	
2h	F	58		58		
Tucson:						
0h	eP	37	41	37	52	
	S	46	43	46	40	
	eSR_1	----------		49	45	
	eSR_2	----------		55.9		
	L	54	39	----------		
	eL			59.2		
2h	F	52		52		
June 13						Origin, 9h 24.9m. Epicenter, 13° N., 126° E. NYF, OTT, BER, MICH, STL, MAN, HAR.
Charlottesville:						
9h	ePR_1	45	51	45	52	
	ePS	----------		56	00	
10h	eSR_1	03	21	03	00	
	eSR_2	08	00	----------		
	eL	22	00	14.9		
11h	F	50		50		
Chicago:						
9h	PR_1	45	02	45	18	
	PS	54	53	54	55	
10h	SR_1	00	09	01	18	
	SR_2	06	58	06	09	
	L	15	09	14	15	
12h	F	00		00		

Instrumental report on principal earthquakes—Continued

Date, station, and hour	Phase	Time. Component				Provisional epicenters and remarks
		North		East		
June 18—Continued						
Honolulu:		*m.*	*s.*	*m.*	*s.*	
9h	iP	35	25	36	16	
	iS	45	43	45	46	
	eSR$_2$	54.9				
	L			58	28	
10h	eL	00.0				
11h	F	16		16		
Sitka:						
9h	iP			37	40	Faint record; not well recorded. Time marks missing; times uncertain.
	iPS			48	30	
10h	L			00	32	
	eL	00.7				
11h	F	00		00		
Tucson:						
9h	?e	42	49			E.-W. not well recorded.
	ePR$_1$	44	21	43	57	Weak record in general.
	eS	51	47			
	ePS	53	39	53	26	
	eSR$_1$	59	25			
10h	eL	10.5				
11h	F	55		55		
June 16						Origin, 22h 47.5m. Epicenter, 41.7° S., 172.2° E. GEO, NYF, OTT, BROM, DEN. Destructive in New Zealand.
Charlottesville:						
23h	ePR$_1$	08	34	08	32	
	ePS	18	00			
	iPS			18	44	
	eSR$_1$	25	46	25	34	
	e	39	37	39	48	
	e	41	50	47.0		
	eL$_1$	51	00	52	12	
26h	F	20		20		
Chicago:						
23h	PR$_1$	08	09	08	08	
	eS$_o$P$_o$S	13.4				
	eS	16.2		15.2		
	PS	18	09	17	51	
	eSR$_1$	24.2		23.6		
	eL	38.2		39.0		
26h	F	25		25		
Honolulu:						
22h	iP	58	32	58	33	
23h	PR$_2$			02	47	
	e	07	30	07	39	
	iS	08	05	08	19	
	eSR$_1$	11	19			
	eSR$_2$	14	50			
	L	15	51			
	eL			15.0		
26h	F	05		05		
Sitka:						
23h	iPR$_1$			06	26	
	PS			15	24	
	e	21.6				
	eL	37.6				
	L			38	21	
24h	F	51		51		
Tucson:						
23h	P	01	34			
	P′	05	02	05	02	
	PR$_1$	05	40	05	40	
	S	13	09	13	16	
	SR$_1$	20	36	19	57	
	L	35	07	35	01	
26h	F	00		00		
June 18						Local shock felt in the Hawaiian Islands.
Honolulu: 20h	eP	02	33			
	iP			02	40	
	i			02	52	
	i			03	13	
	iL			03	48	
	F	11.0		11.0		

Instrumental report on principal earthquakes—Continued

Date, station, and hour	Phase	Time. Component		Provisional epicenters and remarks
		North	East	
June 27				Origin, 12h 47.9m. Epicenter, 58.5° S., 40.0° W. GEO, OTT, NYF, VIC, MICH, BER, STL, MAN. Epicenter quoted from La Paz.
		m. s	m. s.	
Charlottesville:				
13h	i	11 40	----------	Beginning lost when changing paper.
	iS	19 53	19 54	"S" waves of larger amplitude than "L" waves.
	e		25 44	
	L_1	34.5	32 40	
16h	F	20	20	
Chicago:				
13h	P	01 35	01 32	Finish lost on E.-W.
	PR_1	06 07	06 02	
	ePR_2	08.5	07.8	
	i		09 41	
	e	10.8	----------	
	iPS	15 30	15 13	
	iSR_1	20 39	20 33	
	eL	32.1	31.7	
	iL	----------	35 37	
16h	F	54	54	
Honolulu:				
13h	iP′	06 22	06 18	
	iPR_1	08 33	08 31	
	e	09.7	09.8	
	S	15 57	----------	
	PS	18 48	----------	
	L	46.9	41.0	
16h	F	49	49	
Tucson:				
13h	eP	01 51	02 17	Most of E.-W. record lost.
	e	05 29	----------	
	ePR_1	06 23	06 17	
	ePS	15 23	15 53	
	iSR_1	22 07	----------	
	iSR_2	25 38	----------	
16h	F	32	32	
July 5				Origin, 14h 19.1m. Epicenter, 51° N., 178° W. OTT, VIC, GEO, STL MAN, DEN.
Charlottesville:				
14h	eP	30 00	30 00	
	iS	38 50	38 47	
	e	46 45	44 57	
	e	49 28	50.0	
	L_1	54 23	53.6	
17h	F	20	20	
Chicago:				
14h	P	29 05	29 05	
	PR_2	32 38	----------	
	iS	37 12	37 09	
	SR_1	40 46	40 54	
	SR_2	43 29	43 17	
	L	46 23	46 02	
17h	F	43	43	
Honolulu:				
14h	eP	25 50	----------	
	P	----------	25 40	
	PR_1	26 50	26 55	
	e	30 29	30 43	
	S	31 08	31 09	
	SR_1	32 44	32 36	
	L	34 12	34 40	
18h	F	25	25	
Sitka:				
14h	eS	29.0	----------	E.-W. lost by overlap.
	eL	32 10	----------	
15h	F	43	----------	
Tucson:				
14h	eP	28 16	28 12	
	e	28 42	----------	
	iS	35 31	35 34	
	iSR_1	38 00	----------	
	eSR_1	----------	39 02	
	eL	41.0	43.5	
17h	F	21	21	

Instrumental report on principal earthquakes—Continued

Date, station, and hour	Phase	Time. Component				Provisional epicenters and remarks
		North		East		
July 5						Origin, 22h 36.2m. Epicenter, 51° N., 178° W. GEO, VIC, STL.
Charlottesville:		*m.*	*s.*	*m.*	*s.*	
22h	e	47	16			
	S	55	58	55	57	
23h	e	00				
	L_1	08	16	06.0		
24h	F	39		39		
Chicago:						
22h	P	46	16	46	15	
	S	54	16	54	18	
	SR_1	58	07			
	eSR_2			59.4		
23h	eL	02.7				
	L			04	51	
24h	F	55		55		
Honolulu:						
22h	PR_1	44	07			
	iS	48	26			
	eS			48	07	
	L	51	12	50	57	
25h	F	13		13		
Sitka:						
22h	ePR_1	42	23	42	23	
	eS	46	04			
	iS			46	04	
	iL			48	35	
	eL	51	15			
24h	F	09		09		
Tucson:						
22h	P	45	34	45	31	
	iS	52	33	52	40	
	SR_1	55	10	56	25	
	eL	59.0		62.8		
24h	F	02		02		
July 6						Origin, 2h 03.7m. Epicenter, 51° N., 178° W. GEO, VIC, STL.
Charlottesville:						
2h	e			14	40	
	S	23	18	23	32	
	eL_1	36	00	35	40	
4h	F	03		03		
Chicago:						
2h	P	13	49	13	46	
	ePR_1	16.1		15.7		
	S	21	47	21	47	
	eL	30.5		30.7		
5h	F	00		00		
Honolulu:						
2h	P	10	49	10	38	
	ePR_1			11.2		
	S	15	48	15	40	
	SR_1	17	57	17	52	
	iL	18	56	18	51	
6h	F	16		16		
Sitka: 2h	eP			09	13	
	S	13	50	13	48	
	L	17	34	17	35	
	F	47		47		
Tucson:						
2h	P	13	09	12	55	Last part of E.-W. record lost.
	e			16	07	
	S	20	16	20	14	
	eL	25	43			
4h	F	24				
July 6						Origin, 9h 46.1m. Epicenter, 13° N., 46° W. GEO, VIC, STL.
Charlottesville:						
9h	eP	53	40	53	40	
	iPR_1	55	00	54	52	
	iS	59	08	59	23	
10h	L_1	01	52	02	10	
11h	F	15		15		

Instrumental report on principal earthquakes—Continued

Date, station, and hour	Phase	Time. Component				Provisional epicenters and remarks
		North		East		
July 6—Continued						
Chicago:		*m.*	*s.*	*m.*	*s.*	
9h	P	51	39	54	46	Time marks missing on both components. Times are approximate as given.
	PR_2	----------		56	53	
10h	iS	01	17	01	14	
	SR_1	04	14	04	36	
	eL	07.9		07.4		
11h	F	17		17		
Honolulu:						
10h	eSR_1	20.0		----------		Weak record. E.-W. not recording.
	e	30.0		----------		
	eL	44.2		----------		
11h	F	15		----------		
Sitka:						
10h	i	----------		24	43	Nothing on N.-S.
	e	----------		38.6		
11h	F	----------		14		
Tucson:						
9h	P	56	40	----------		E.-W. record lost.
10h	S	04	56	----------		
	SR_2	11	42	----------		
	eL	15.9		----------		
	F	56		----------		
July 7						Origin, 21h 23.2m. Epicenter, 51° N., 178° W. OTT, STL, APIA.
Charlottesville:						
21h	iP	34	04	34	02	
	iS	42	50	42	52	
	eSR_1	----------		47	50	
	eSR_2	----------		50	00	
	L_1	56	56	55	00	
24h	F	45		45		
Chicago:						
21h	P	33	10	33	11	
	PR_2	36	59	----------		
	S	41	16	41	09	
	SR_1	45	00	----------		
	eSR_1	----------		45.8		
	L	50	11	50	53	
25h	F	30		30		
Honolulu:						
21h	iP	29	58	29	58	
	iPR_1	31	07	30	52	
	iS	35	20	35	22	
	iSR_1	37	20	36	59	
	iL	38	09	38	10	
26h	F	50		50		
Sitka:						
21h	iP	----------		28	16	
	iS	33	16	33	06	
	eL	40	12	----------		
25h	F	16		16		
Tucson:						
21h	eP	32	19	32	20	
	PR_1	----------		34	37	
	iS	39	41	39	36	
	SR_1	43	13	43	23	
	SR_2	44	54	----------		
	eL	46	58	47	33	
24h	F	55		55		
July 17						Origin, 8h 34.1m. Epicenter, 51° N., 180° W. GEO, OTT, VIC, STL.
Charlottesville:						
8h	eSR_1	57	58	58.2		
9h	eSR_2	11	00	10.0		
	L_1	17	50	14	00	
10h	F	13		13		
Chicago:						
8h	P	48	04	48	04	
	S	56	11	56	10	
	e	57	40	----------		
9h	eL	05.4		05.9		
10h	F	21		21		

Instrumental report on principal earthquakes—Continued

Date, station, and hour	Phase	Time. Component				Provisional epicenters and remarks
		North		East		
July 17—Continued						
Honolulu:		*m.*	*s.*	*m.*	*s.*	
8h	P	44	50	44	54	
	PR_1	46	07			
	iS	50	19			
	S			50	17	
	eSR_1	52	20	51	53	
	L	53	11	53	22	
10h	F	55		55		
Sitka:						
8h	eP			44	00	
	e			47	02	
	iS			48	24	
	e	50.7				
	iL			52	00	
10h	F			02		
Tucson:						
8h	eP	47	20	47	19	
	S	54	44	54	41	
	SR_1			58	17	
9h	eL	02.1		03.0		
10h	F	24		24		
August 12						Origin, 11h 24.8m. Epicenter, 42° 55′ N., 78° 20′ W. (Attica, N. Y.) GEO, OTT, MICH, STL.
Charlottesville: 11h	i	26	06	26	06	
	e	26	11			
	i	26	16	26	19	
	e	26	27	26	27	
	i	27	01	27	01	
	S	27	14	27	17	
	L	27	29	27	29	
	L	27	42			
Chicago: 11h	e	27	39			Time marks missing on E.–W.
	e	27	42			
	e	27	56			
	S	28	18			
	iL	28	22			
	F	33.0				
Tucson: 11h	e	39	14	39	14	
	e	40.2		40.2		
	F			48.0		
August 15						Origin, 19h 56.0m. Epicenter, 4.5° N., 81.5° W. NYF, OTT, GEO, CZB.
Charlottesville: 20h	e	06	00			
	eS			08	24	
	eL_1	11	00	10	40	
	F	48		29		
Chicago: 20h	S			09	07	N.–S. record off sheet.
	eSR_1			11.7		
	L			14	04	
	F			56		
Honolulu:						
20h	iS	17	42	17	45	
	eL	28.0		29.0		
21h	F	22		22		
Sitka: 20h	eS			09	35	Nothing on N.–S.
	e			18	01	
	eL			31	46	
	F			47		
Tucson: 20h	P	03	40	03	40	
	iPR_1	05	12	05	11	
	S	09	34	09	40	
	eSR_1	12	10			
	e			12	38	
	eL	15	10	13	54	
	iL	16	07	16	07	
	F	54		54		
August 17						Origin, 23h 40.3m. Epicenter, 14° N., 93.5° W DEN, STL, GEO.
Charlottesville: 23h	iP	46	42			
	eP			46	44	
	eS	51	20	51	32	
	eL_1			56.6		
	L_1	57	12			
25h	F	03		03		

Instrumental report on principal earthquakes—Continued

Date, station, and hour	Phase	Time. Component				Provisional epicenters and remarks
		North		East		
August 17—Continued						
Chicago:		*m.*	*s.*	*m.*	*s.*	
23h	iP	46	30	46	30	
	S	51	10	51	16	
	SR_1	----------		52	37	
	L	56	47	56	23	
25h	F	00		00		
Sitka:						
23h	eS	----------		57	00	
24h	e	08	20	04	32	
	eL	----------		13	12	
	F	55		55		
Tucson:						
23h	P	45	19	45	17	
	iS	48	56	49	01	
	SR_1	50	35	50	35	
	iL	51	05	50	52	
25h	F	01		01		
September 1						Origin, 8h 34.6m. Felt at Sitka, Alaska. Nothing on N.–S.
Sitka: 8h	iP	----------		34	36	
	F	----------		36	24	
September 17						Origin, 19h 17.1m; Epicenter, 52° N., 133° W. GEO, NYF, VIC, OTT, DEN, MICH, BER.
Charlottesville:						
19h	eP	25	08	25	08	
	ePR_1	26	36	26	34	
	eS	30	50	31	00	
	eSR_1	33	48	33	42	
	e	36	09	35	56	
	iL_1	37	56	37	05	
21h	F	47		47		
Chicago:						
19h	iP	23	50	23	50	Not well recorded on N.–S. because of overlap.
	iPR_1	24	49	24	47	
	iS	28	56	28	53	
	iSR_1	----------		30	56	
	L	----------		32	26	
21h	F	55		55		
Honolulu:						
19h	eP	24	48	----------		E.–W. not operating.
	ePR_1	25	47	----------		
	eS	30	34	----------		
	SR_1	32	29	----------		
	iL	33	37	----------		
21h	F	57		----------		
Sitka:						
19h	iP	----------		19	13	E.–W. finish lost in overlap.
	eP	19	24	----------		
	iS	20	56	20	39	
	iL	----------		21	18	
20h	F	21		----------		
Tucson:						
19h	iP	22	49	22	49	Record of another shock superimposed on the finish of this.
	ePR_1	23	30	23	36	
	iS	27	12	27	11	
	e	28	29	27	45	
	eL	30.2		30.5		
22h	F	25		25		
September 28						Origin, 4h 51.0m. Epicenter, 20° N., 157° W. Felt in Hawaiian Islands.
Chicago:						
5h	iS	09	32	09	31	
	eSR_2	16	32	----------		
	L	20	32	21.2		
6h	F	21		21		
Honolulu:						
4h	iP	51	36	51	36	
	i	----------		52	03	
	iL	52	09	52	41	
6h	F	20		20		

Instrumental report on principal earthquakes—Continued

Date, station, and hour	Phase	Time. Component				Provisional epicenters and remarks
		North		East		
September 26—Continued						
Sitka:		*m.*	*s.*	*m.*	*s.*	
4h	P	----------		58	34	Nothing on N.-S.
5h	eS	----------		04	02	
	L	----------		07	56	
6h	F	----------		05		
Tucson:						
4h	P	58	52	58	52	
5h	PR_1	01	04	----------		
	S	05	15	05	16	
	L	08	39	08	42	
6h	F	33		33		
September 27						Origin, 23h 15.8m. Epicenter, 24° N., 111° W. GEO, OTT, DEN, STL.
Charlottesville:						
23h	eS	27	00	27	15	
	e	27	56	----------		
	iL_1	31	40	30	37	
24h	F	14		14		
Chicago:						
23h	P	21	36	21	38	
	iS	25	51	25	52	
	L	28	29	28	45	
24h	F	33		33		
Sitka: 23h	eL	----------		37	09	N.-S. not operating.
	F	----------		58		
Tucson:						
23h	eP	17	55	17	56	
	i	18	22	18	21	
	eS	19	34	19	34	
	iL	20	09	20	05	
24h	F	18		18		
October 5						Origin, 17h 00.2m. Epicenter, 54° N., 160° E. GEO, OTT, STL, MAN.
Chicago:						
17h	P	11	54	11	55	
	eS	20	58	----------		
	iS	----------		20	52	
	eL	25.5		35.9		
18h	F	20		20		
Honolulu: 17h	iS	14	50	----------		
	S	----------		14	47	
	L	20.8		19.9		
	F	40		40		
Tucson: 17h	eP	10	32	10	33	
	ePR_1	13	07	----------		
	S	19	08	19	11	
	eSR_1	----------		23	26	
	eL	26.1		31.0		
	F	50		51		
October 6						Origin, 7h 51.3m. Epicenter, 19° N., 156° W. GEO, OTT, MAN. Felt in Hawaiian Islands.
Charlottesville:						
8h	eP	02	52	02	36	
	S	11	38	11	38	
	eSR_1	16	00	----------		
	eL_1	23.0		25.0		
10h	F	05		05		
Chicago:						
8h	P	02	43	02	41	Possible error in time of about 1 minute.
	S	11	02	10	53	
	e	12	22	----------		
	eSR_1	----------		15	00	
	SR_2	17	55	18	09	
	L	21	13	23.5		
10h	F	32		32		
Honolulu: 7h	iP	52	13	52	12	Sharp local shock upset both instruments.

Instrumental report on principal earthquakes—Continued

Date, station, and hour	Phase	Time. Component		Provisional epicenters and remarks
		North	East	
October 6—Continued				
Sitka:		*m.* *s.*	*m.*	
7h	iP		50 11	
8h	iPR1		00 50	
	iS		05 24	
	eS	05 27		
	SR1		08 22	
	eSR1	08 23		
	L	11.2	11 12	
10h	F	45	45	
Tucson:				
7h	P	59 28		E.–W. record lost.
8h	PR1	01 23		
	eS	05 51		
	eSR1	09.2		
	eL	11.5		
11h	F	21		
October 19				Origin, 10h 13.0m. Epicenter, 20.5° S., 72.5° W. GEO, OTT, NYF, BER, MAN, STL. Destructive in Chile.
Chicago:				
10h	eP		24 26	N.–S. record lost.
	iS		32 45	
	SR1		36 30	
	L		38 58	
12h	F		03	
Honolulu:				
10h	eS	37.7		
	ePS		39.4	
	L	57.7	56.6	
11h	F	01	01	
Sitka:				
10h	e		38.5	Practically nothing on N.–W.
	eL		58.0	
11h	F		28	
Tucson:				
10h	eP		23 42	
	P	23 46	23 51	
	iS	32 37	32 39	
	eL		40.7	
	L	41 15		
12h	F	11	11	
November 15				Origin, 18h 50.7m. Epicenter, 8° N., 143° E. NYF, GEO, OTT, APIA, STL, VIC, MICH, MAN, HAR.
Charlottesville:				
19h	e	15 08		E.–W. lost by overlap.
	ePS	20 22		
	eSR1	26 20		
	eSR2	33 16		
	eL1	40 42		
21h	F	23		
Chicago:				
19h	PR1	10 08	10 11	
	eSePeS	16 01		
	S	17 31		
	PS	19 20	19 24	
	SR1	25 22	25 32	
	SR2		29 30	
	L	36 36	37 58	
21h	F	53	53	
Honolulu:				
19h	P	00.4?	00.4?	Beginning lost in hour marks.
	PR1		02 49	
	e	03 24		
	iS	08 36	08 40	
	L	14 27	16 40	
21h	F	40	40	
Sitka: 19h	eS	12 38		E.-W. record lost.
	eSR1	17 17		
	L	22 57		
	F	43		

Instrumental report on principal earthquakes—Continued

Date, station, and hour	Phase	Time. Component North		Time. Component East		Provisional epicenters and remarks
November 17						Origin, 3h 43.2m. Manila reports this shock felt in the region of 8° N., 126° E. Arcs intersect at about 124° E. for distant stations. MAN.
Charlottesville:		*m.*	*s.*	*m.*	*s.*	
4h	iPR1	05	00	----------		
	ePS	16	40	17	22	
	eSR1	20	52	22	20	
	eSR2	----------		27	00	
	eL1	41	34	37.0		
5h	F	54		54		
Chicago:						
4h	PS	13	09	13	46	
	SR1	20	16	20	54	
	eSR2	----------		25.8		
	L	34.5		----------		
6h	F	00		00		
Honolulu:						
3h	eP	55	19	----------		
	iP	----------		54	52	
4h	iS	04	43	04	46	
	eSR1	09.2		----------		
	eL	12.5		----------		
	L	----------		16.7		
5h	F	10		10		
Tucson:						
4h	e	----------		02.7		
	eS	10	44	----------		
	e	12	17	12	16	
	eSR1	18	13	18	20	
	eL	29.4		34.3		
5h	F	56		56		
November 18						Origin, 20h 31m 55s. Epicenter, 44.5° N., 55° W. Provisional epicenter as reported from the Dominion Observatory, Ottawa, Canada, on the basis of reports from 32 stations in all parts of the world.
Charlottesville:						
20h	P	36	06	36	06	
	e	39	25	39.2		
	iS	39	39	39	39	
21h	F	50		50		
Chicago:						
20h	eP	37	09	37	09	
	iP	37	15	37	15	
	i	----------		40	48	
	iS	41	21	41	21	
	e	42	24	42	03	
23h	F	00		00		
Honolulu:						
20h	P	44	36	44	30	Heavy microseisms mask the record.
	iS	54	50	54	49	
21h	L	11	44	----------		
	eL	----------		12.0		
22h	F	22		22		
Sitka:						
20h	eL	56	51	----------		E.-W. record lost.
21h	F	50		----------		
Tucson:						
20h	P	40	08	40	08	
	iPR1	42	12	42	12	
	iS	----------		46	37	
	eS	46	42	----------		
	e	47	06	----------		
	SR1	----------		50	02	
	eSR2	----------		52	32	
	L	53	22	53	54	
23h	F	24		24		

Instrumental report on principal earthquakes—Continued

Date, station, and hour	Phase	Time. Component				Provisional epicenters and remarks
		North		East		
December 17						Origin, 10h 58.6 m. Epicenter, 53° N., 172° E. GEO, NYF, NOR, OTT, DEN, STL, VIC, MICH, MAN, APIA, HAR.
		m.	*s.*	*m.*	*s.*	
Charlottesville: 11h	iP	09	53	----		Finish lost in changing records.
	eP	----		10	00	
	ePR_1	11	49	12	00	
	iPR_2	14	24	14	20	
	iS	19	08	18	58	
	i	25	51	28	00	
	iL	32	33	31	00	
Chicago:						
11h	iP	09	09	09	10	
	iPR_2	13	00	13	04	
	iS	17	40	17	39	
	iSR_1	21	44	21	46	
	iSR_2	24	09	24	42	
	L	28	33	29	20	
15h	F	00		00		
Honolulu:						
11h	P	06	17	06	16	Sharp shock. Record of large amplitude.
	PR_1	07	48	----		
	S	12	10	----		
	iS	----		12	10	
	L	15.0		14	40	
14h	F	45		45		
Sitka:						
11h	iP	----		04	39	
	eP	05.0		05	20	
	e	05	48	----		
	iS	09	48	09	20	
	eL	11.8		----		
15h	F	09		09		
Tucson:						
11h	P	08	27	08	26	
	eS	16	26	----		
	iS	----		16	38	
	SR_1	20	28	20	22	
	SR_2	21	50	22	29	
	eL	22	51	24	32	
15h	F	27		27		

SUMMARY OF INSTRUMENTAL RESULTS

Date, 1929	G. C. time of origin	Region	Provisional epicenter (degrees)
	h. *m.*		
Jan. 13	0 03.4	Kamchatka	51 N., 154 E.
Jan. 17	11 45.2	Venezuela, South America	11 N., 64 W.
Jan. 21	10 30.8	Alaska	65 N., 150 W.
Jan. 24	20 36.3	Pacific Ocean	12 N., 90 W.
Feb. 2	0 00.5	Atlantic Ocean	1 S., 23 W.
Feb. 5	12 55	Hawaiian Islands	(1)
Feb. 10	15 38.5	Pacific Ocean	13 N., 91 W.
Feb. 15	8 04.0	Pacific Ocean	9 N., 87 W.
Feb. 22	20 41.6	Atlantic Ocean	8 N., 46 W.
Feb. 26	9 00.7	Aleutian Islands	54 N., 163 W.
Mar. 1	7 30.6	Queen Charlotte Islands	53 N., 132 W.
Mar. 2	20 54.5	Hawaiian Islands	(2)
Mar. 3	9 04.0	Alaska	(3)
Mar. 7	1 34.6	Aleutian Islands	51 N., 170 W.
Mar. 19	20 53.5	Pacific Ocean	13 N., 90 W.
Mar. 21	2 36.6	Central America	13 N., 90 W.
May 1	15 37.7	Persia	41 N., 53 E.
May 20	4 53.0	Aleutian Islands	54 N., 178 W.
May 26	22 40.1	Queen Charlotte Islands	51.3 N., 131 W.
June 2	21 38.5	Pacific Ocean	41 N., 140 E.
June 9	9 08.1	Pacific Ocean	46 N., 152 E.
June 13	0 12.5	Pacific Ocean	47 N., 153 E.
June 13	0 26.1	Pacific Ocean	47 N., 153 E.
June 13	9 24.9	Philippine Islands	13 N., 126 E.
June 16	22 47.5	New Zealand	41.7 S., 172.2 E.
June 18	20 02.5	Hawaiian Islands	(2)
June 27	12 47.9	South Atlantic Ocean	58.5 S., 40 W.
July 5	14 19.1	Aleutian Islands	51 N., 178 W.
July 5	22 36.2	Aleutian Islands	51 N., 178 W.
July 6	2 03.7	Aleutian Islands	51 N., 178 W.
July 6	9 46.1	North Atlantic Ocean	13 N., 46 W.
July 7	21 23.2	Aleutian Islands	51 N., 178 W.
July 17	8 34.1	Aleutian Islands	51 N., 180
Aug. 12	11 24.8	Attica, N. Y	42.9 N., 78.3 W.
Aug. 15	19 56.0	Pacific Ocean	4.5 N., 81.5 W.
Aug. 17	23 40.3	Pacific Ocean	14 N., 98.5 W.
Sept. 1	8 34.6	Alaska	(3)
Sept. 17	19 17.1	Pacific Ocean	52 N., 133 W.
Sept. 26	4 51.0	Hawaiian Islands	20 N., 157 W.
Sept. 27	23 15.8	Pacific Ocean	24 N., 111 W.
Oct. 5	17 00.2	Kamchatka region	54 N., 160 E.
Oct. 6	7 51.3	Hawaiian Islands	19 N., 156 W.
Oct. 19	10 13.0	Chile, South America	20.5 S., 72.5 W.
Nov. 15	18 50.7	Caroline Islands	8 N., 143 E.
Nov. 17	3 43.2	Philippine Islands	8 N., 126 E.
Nov. 18	20 31.9	Grand Banks	44.5 N., 55 W.
Dec. 17	10 58.6	Aleutian Islands	53 N., 172 E.

[1] Felt in Hawaii. [2] Local shock. [3] Felt at Sitka.

MISCELLANEOUS SEISMOLOGICAL ACTIVITY

GEODETIC WORK

During the months January to April, 1929, an arc of first-order triangulation was extended from the California coast in the vicinity of Newport Beach northeastward to Lucerne Valley, the reconnaissance and signal building having been done in November and December, 1928. Numerous stations were established with second-order accuracy along the various fault lines crossed by this arc of triangulation. In July, August, and September, 1929, a base was measured at Lucerne Valley and the triangulation was extended northward to a connection with the thirty-fifth parallel arc of triangulation.

In October, November, and December, 1929, work was started on a similar arc of triangulation extending northeast from Point Reyes. The reconnaissance and signal building were completed and a few stations were occupied, but it became necessary to stop work because of unfavorable weather conditions. Observations were resumed in May, 1930. This triangulation consists of a first-order arc with many second-order stations located in the vicinity of the fault lines.

HYDROGRAPHIC WORK

After the Grand Banks earthquake of November 18, 1929, Coast Guard vessels on ice patrol duty in that region made observations with sonic depth finders to locate, if possible, any outstanding changes in the ocean bottom.

Vessels of the Coast and Geodetic Survey are directed to make reports of visible or felt effects of earthquakes, but no reports were received for the period covered by this report.

TIDAL OBSERVATIONS

The only tidal disturbances recorded on the gauges of the Coast and Geodetic Survey occurred at the time of the Grand Banks earthquake. A brief summary of the results appears in this publication under The Grand Banks Earthquake of November 18. (See p. 29.)

PUBLICATION NOTICES

The Coast and Geodetic Survey maintains mailing lists of persons and firms desiring to receive prompt notice of the issuance of its publications.

Should you desire to receive such notices, you may use the form given below, checking the lists covering the subjects in which you are interested.

(Date) ----------

The DIRECTOR, U. S. COAST AND GEODETIC SURVEY,
Washington, D. C.

DEAR SIR: I desire that my name be placed on the mailing lists indicated by check below to receive notification of the issuance of airway maps, nautical charts, and miscellaneous publications of the Coast and Geodetic Survey:

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