

UNITED STATES EARTHQUAKES 1932

SERIAL No. 563



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Daniel C. Roper, Secretary

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1932

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Mathematician



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UNITED STATES EARTHQUAKES, 1932



INTRODUCTION

This publication is a summary of earthquake activity in the United States and the regions under its jurisdiction for the calendar year 1932. The period up to 1927 for the United States is covered (for all except minor earthquakes) by Special Publication No. 149 of this bureau, *Earthquake History of the United States Exclusive of the Pacific Region*, and by several publications for the Pacific region. These include the Holden and McAdie catalogs¹ and a forthcoming publication of the Seismological Society of America which will extend the record through 1927. The period from 1928 on is covered by the series to which the present publication belongs.

Earthquakes of volcanic origin in the Hawaiian and Philippine Islands are not included, and only severe shocks are included in the case of the Philippine Islands, as complete reports are published by the Manila Central Observatory. Earthquakes adjacent to the United States and felt within its borders are described only in a general way when detailed descriptions are published elsewhere. The instrumental results are given for the principal earthquakes of the year regardless of location.

The noninstrumental information has been furnished by a large number of individuals and organizations whose voluntary cooperation has made it possible to prepare descriptions of the earthquakes of this country with a completeness and accuracy never before attained. Lack of space prohibits giving individual credit to all of these cooperators. The principal sources of information are as follows:

United States Weather Bureau.

Division of geology and geography of the National Research Council.

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 usually responsible for instrumental determinations 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, San Diego & Arizona Railway Co., Associated Factory Mutual Fire Insurance Cos., Clay Products Institute of California, Board of Fire Underwriters of the Pacific, with more than 20,000 correspondents, the Southern Sierras Power Co., also a large number of other organizations and individuals. In the State of Washington the supervisor of geology (H. E. Culver), department of conservation and development, Pullman, actively cooperates.

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

The large number of reports received from Alaska in 1932 is due largely to the successful efforts of Dr. C. E. Bunnell, president of the Alaska Agricultural College and School of Mines, in organizing a corps of volunteer observers.

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

Telegraphic reports collected by Science Service, Washington.

Reports from individuals.

Bulletin Seismological Society of America, 1932.



In addition to the above sources of information, the Coast and Geodetic Survey, or its field station at San Francisco, canvasses all areas affected by shocks of unusual intensity. In this way the extent and the maximum intensities of all heavy shocks are determined and the data are usually sufficient to construct isoseismal maps. The destructive features of these shocks are enumerated in the abstracts, but otherwise the descriptive matter is reduced to a minimum. The original reports are open for inspection by anyone interested in unpublished details. For 1932 more detailed descriptions of earthquakes on the west coast will be found in mimeographed reports issued by the San Francisco Field Station.

CHANGE IN INTENSITY SCALES

Beginning with the preceding number of this series, Serial 553, the Coast and Geodetic Survey has used and will continue to use, the Modified Mercalli Intensity Scale of 1931, in place of the Rossi-Forel scale, to designate the intensity of earthquakes activity. All intensity numbers therefore refer to the new scale. The reasons for this change are set forth in an article entitled "Modified Mercalli Intensity Scale of 1931," by Harry O. Wood and Frank Neumann, in the December 1931, number of the Bulletin of the Seismological Society of America, volume 21, no. 4. This article contains the original unabridged scale and also an abridged scale. The latter is given here together with equivalent intensities according to the Rossi-Forel scale.

MODIFIED MERCALLI INTENSITY SCALE OF 1931

[Abridged]

- I. Not felt except by a very few under especially favorable circumstances. (I Rossi-Forel scale.)
- II. Felt only by a few persons at rest, especially on upper floors of buildings. Delicately suspended objects may swing. (I to II Rossi-Forel scale.)
- III. Felt quite noticeably indoors, especially on upper floors of buildings, but many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibration like passing of truck. Duration estimated. (III Rossi-Forel scale.)
- IV. During the day felt indoors by many, outdoors by few. At night some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy truck striking building. Standing motor cars rocked noticeably. (IV to V Rossi-Forel scale.)
- V. Felt by nearly everyone; many awakened. Some dishes, windows, etc., broken; a few instances of cracked plaster; unstable objects overturned. Disturbance of trees, poles, and other tall objects sometimes noticed. Pendulum clocks may stop. (V to VI Rossi-Forel scale.)
- VI. Felt by all; many frightened and run outdoors. Some heavy furniture moved; a few instances of fallen plaster or damaged chimneys. Damage slight. (VI to VII Rossi-Forel scale.)
- VII. Everybody runs outdoors. Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable in poorly built or badly designed structures; some chimneys broken. Noticed by persons driving motor cars. (VIII Rossi-Forel scale.)

- VIII. Damage slight in specially designed structures; considerable in ordinary substantial buildings with partial collapse; great in poorly built structures. Panel walls thrown out of frame structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned. Sand and mud ejected in small amounts. Changes in well water. Disturbs persons driving motor cars. (VIII+ to IX to Rossi-Forel scale.)
- IX. Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb; great in substantial buildings, with partial collapse. Buildings shifted off foundations. Ground cracked conspicuously. Underground pipes broken. (IX+ Rossi-Forel scale.)
- X. Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations; ground badly cracked. Rails bent. Landslides considerable from river banks and steep slopes. Shifted sand and mud. Water splashed (slopped) over banks. (X Rossi-Forel scale.)
- XI. Few, if any (masonry), structures remain standing. Bridges destroyed. Broad fissures in ground. Underground pipe lines completely out of service. Earth slumps and land slips in soft ground. Rails bent greatly.
- XII. Damage total. Waves seen on ground surfaces. Lines of sight and level distorted. Objects thrown upward into the air.

EXPLANATORY NOTES

Within the United States the same regional arrangement has been followed as in Special Publication No. 149, previously mentioned, except that Washington and Oregon have for convenience been treated separately from California.

The published epicenters have been determined at the Washington office unless otherwise stated. Quite often they represent the mean of the positions determined by the bureau and the central station of the Jesuit Seismological Association cooperating with Science Service. Immediate epicenter determinations from telegraphic reports are frequently made through the cooperation of these institutions and individual seismograph stations and the results broadcast without delay to Europe and points in the Pacific. As the published epicenters are based on only a portion of the available data, they must be considered provisional.

In the noninstrumental reports an asterisk (*) indicates that the time is taken from an instrumental report and is reliable. In other instances quite large deviations are frequently reported. In the case of California, earthquakes reported as feeble at only one point are not plotted on the epicenter map of the United States, nor are minor aftershocks plotted for heavy earthquakes in California or any other region. The reader should bear in mind that the information service in California has been developed to a point not approached in any other section of the country. Attention is again called to the fact that more detailed information on California earthquakes of 1932 has been published in mimeograph form by the San Francisco Field Station of the Coast and Geodetic Survey. As the Pacific coast epicenters obtained from instrumental data have not been published in their entirety, the forthcoming publications of the Research Laboratory at Pasadena, and the seismological station at Berkeley should be consulted for a complete record of the year's activities.

Time is indicated as continuous from 0 to 24 hours, beginning and ending with midnight. In noninstrumental reports local standard time is indicated. In the summary of instrumental results Greenwich civil time is used.

EARTHQUAKE ACTIVITY IN THE VARIOUS STATES

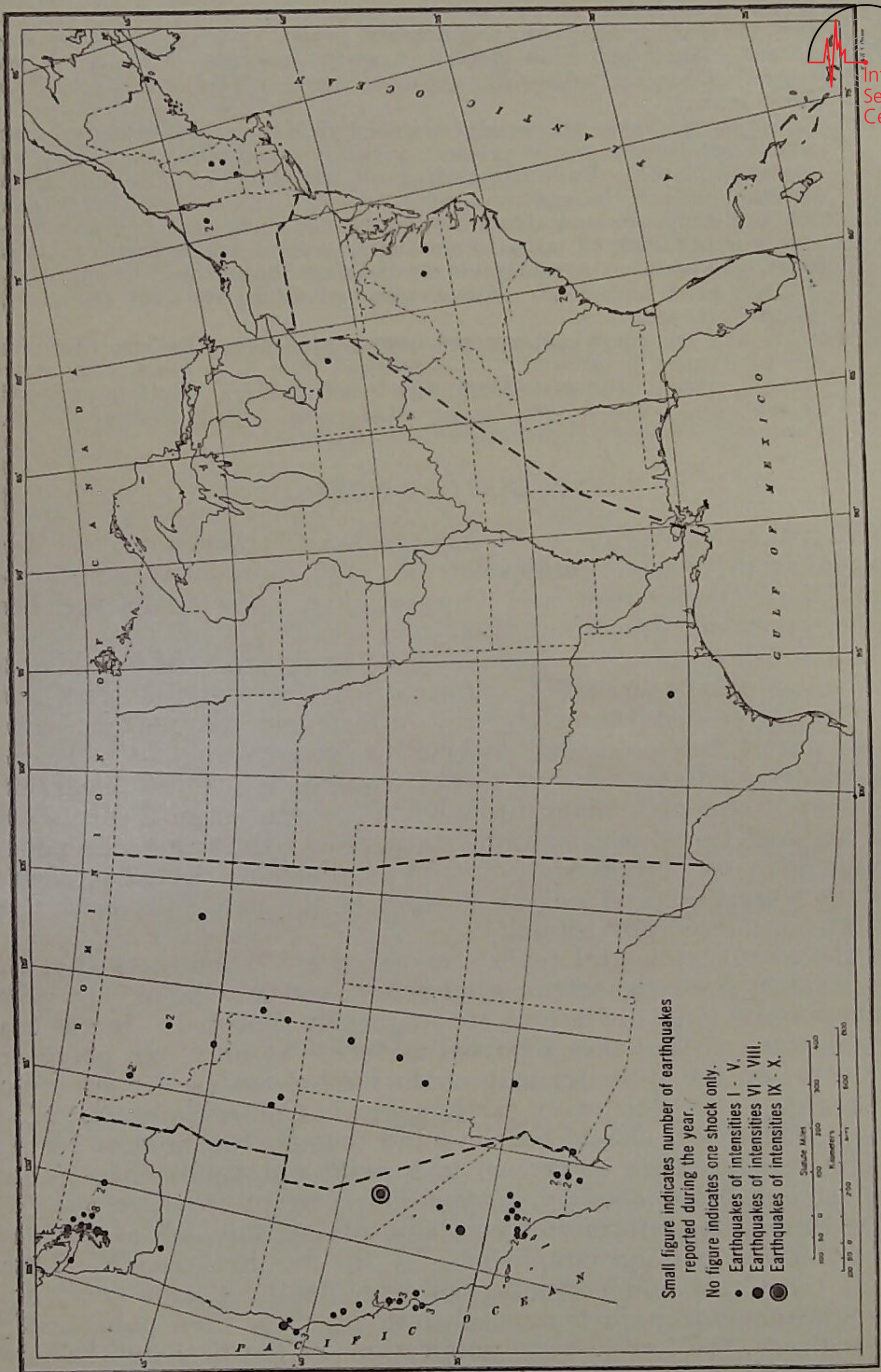


FIG. 1.—Earthquake epicenters, 1932.

Arizona: The Nevada shock of December 20 was felt in part of the State. Slight shocks on February 7 and December 29.

California: No shocks of major importance. The most destructive was on June 6 in northern California, intensity VIII. The Nevada shock of December 20 was felt over practically the entire State. The illustrations show the extent of these two shocks and several others of less importance.

- Idaho: Slight shocks on June 6 and December 21.
 Montana: Slight shocks on January 9, March 21, October 3, 11, 31, and December 24.
 Nevada: A major shock X-XI occurred on December 20.
 New Hampshire: Slight shocks on October 14, 16, and November 4.
 New York: Slight shocks in northern part on December 6, 7, and 28.
 Ohio: Slight shock on January 21.
 Oregon: Slight shock of doubtful place of origin on January 14.
 South Carolina: Feeble shocks on January 6 and 13.
 Texas: Moderate shock in eastern part on April 9.
 Utah: Slight shocks on May 21, June 18, and November 12.
 Virginia: Slight shocks on January 4 and December 5.
 Washington: Slightly destructive shock on August 6, VI. Of the 18 other shocks reported only 3 were rather generally felt in the Puget Sound region.
 Wyoming: V on January 26 and a weak shock on June 8.



NORTHEASTERN REGION

[75th meridian or eastern standard time]

- July 20:* 18:30. Lake Garfield, Mass. Slight disturbance thought due to an earthquake.
October 14: 22:10. Meredith, Center Harbor, and Glendale, all near Lake Winnepesaukee, N.H., slight.
October 16: 14:12. Keene, N.H., slight.
November 4: Just after midnight. Concord, N.H., weak.
December 6: 22:15, 23:05. Gabriels, Lake Placid, and Saranac Lake, in northeastern New York, slight. Also felt at Hopkinton, Lake Clear Junction, Lake Kushaqua, and Tupper Lake, in northeastern New York.
December 7: 11:45. Gabriels, Lake Clear, Lake Kushaqua, Lake Placid, and Saranac Lake, in northeastern New York, slight. An aftershock of December 6 and not as strong.
December 28: 23:28. Watertown, N.Y. First thought to be explosion. Awakened many, and some rushed to streets. Not observed at other nearby points. Seismic?

EASTERN REGION

[75th meridian or eastern standard time]

- January 4:* 23:05. Buckingham County, Va., III. Strongest at Buckingham, Dillwyn, and New Canton. Also felt at Arvon, Gold Hill, Johnston Station, Penlan, and Warminster, Va. Recorded at Charlottesville, Va.
January 6: 7:35. Summerville, S.C., slight.
January 13: 7:40. Summerville, S.C., feeble.
December 25: Night. Petersburg, Va., 3 miles north, slight. Seismic origin uncertain.

CENTRAL REGION

[90th meridian or central standard time]

- January 21:* P.m. Akron, Ohio. Windows cracked; furniture moved. Felt on west side of Summit Lake.
April 9: 4:15. Mexia and Wortham, Tex., V. Loose bricks thrown down. Plaster cracked. Damage slight. Also felt at Cooledge, Currie, Groesbeck, Hillsboro, League, and Richland. A detailed report by E. H. Sellards was published in University of Texas Bulletin, issued in February 1933.

WESTERN MOUNTAIN REGION

[105th meridian or mountain time]

- January 9:* 23:40, 23:46. Colstrip, Mont. Recorded on graphic meter chart of 100-ton power shovel. Caused cables of shovel to whip strongly.
January 26: 3:13. Grovemont, Kelly, Moran, and Jackson, Wyo., V. All awakened, plaster cracked, dishes broken. Telephone line westward into Idaho put out of order presumably as result of shock. Felt at Dubois and Lander. Aftershocks were felt in Jackson, two sharp ones occurring within 10 minutes after first. Slight shocks were felt throughout the day until 17:00, when another sharp shock was felt. Others felt at 21:00 on the same day, and at 1:00 on the 27th.

February 7: 23:30. Perkinsville, Ariz., slight.
March 21: 12:35. Dillon, Mont., slight. Felt by about three-quarters of population. No damage.
May 21: 23:00. Venice, Utah, feeble.
June 6: 4:00. Hagerman, Idaho, weak.
June 8: 14:30. Grover, Wyo., weak.
June 18: 13:50. Parowan, Utah, weak.
October 3: 22:19. Helena, Mont., weak.
October 11: 16:05. Helena, Mont., weak.
October 31: 11:40. Lonepine, Mont., weak.
November 11: 3:00. Midway, Utah, IV. (This probably refers to shock felt at Salt Lake City, Nov. 12. Only one report.)
November 12: 2:45. Salt Lake City, Utah, IV. No damage.
December 14: 20:15. Lonepine, Mont., weak.
(December 20): 22:10. See report for California and western Nevada.
December 21: 1:00. Twin Falls, Idaho, slight.
December 29: (—) Somerton and Yuma, Ariz., slight.



CALIFORNIA AND WESTERN NEVADA

[120th meridian or Pacific standard time]

ALL PLACES ARE IN CALIFORNIA UNLESS OTHERWISE STATED

January 3: 13:07.* San Francisco, slight. Epicenter probably near Crystal Springs Lake (Byerly).
January 5: 6:00.* Near Cape Mendocino, IV. IV at Alderpoint, Arcata, Blocksburg, Cape Mendocino Light Station, Ferndale, Fortuna, Hydesville, Samoa, Shively, and Westport. III and under at Bayside, Eureka, Forest Glen, Miranda, Punta Gorda Light Station, Table Bluff Light Station, Waddington, and Whitlow.
January 8: 10:17.* Near Salinas, III. Hayward, Hollister, and Sargent.
January 10: 18:55. Watsonville, IV.
January 13: 19:16.* Keeler, IV. Lone Pine. $36^{\circ}35'$ N., $117^{\circ}49'$ W.
January 14: 6:10. Potter Valley, IV. Comptche and Ukiah.
January 14: 11:36.* Whittier, Downey, Santa Fe Springs and vicinity, weak. $33^{\circ}55'$ N., $118^{\circ}02'$ W. (Wood.)
January 25: 18:38.* San Bernardino, IV. Rialto. $34^{\circ}14'$ N., $117^{\circ}25'$ W. (Wood.)
January 26: 12:52. Potrero, III.
January 28: 28:14.* Hollister and Salinas, III.
January 31: 6:29.* Hynes, Long Beach, Wilmington, and near Torrance, weak. $33^{\circ}53'$ N., $118^{\circ}19'$ W. (Wood.)
February 2: 12:52.* Metz, III. $36^{\circ}34'$ N., $120^{\circ}36'$ W. (Wood.)
February 4: 8:03*. Santa Barbara, and Ventura, slight. $34^{\circ}33'$ N., $119^{\circ}44'$ W. (Wood.)
February 4: 20:15*, 22:47*, and 23:10. Piedras Blancas Light Station and Salmon Creek region, slight. First two shocks $35^{\circ}50'$ N., $121^{\circ}28'$ W. (Wood.)
February 5: 8:44*. Banning, slight. $34^{\circ}03'$ N., $117^{\circ}02'$ W. (Wood.)
February 9: 22:55. Watsonville, III.
February 10: 18:57*. Wilmington, slight. $33^{\circ}54'$ N., $118^{\circ}17'$ W. (Wood.)
February 11: 15:11*. In and near San Bernardino Mountain, moderately heavy. Baldwin Lake, Big Bear City, Mentone, Pine Knot, Seven Oaks, and Victorville. $34^{\circ}25'$ N., $116^{\circ}51'$ W. (Wood.)
February 24: 23:35*. Alameda and Oakland, IV. Berkeley, Burlingame, Hayward, San Francisco, and San Leandro. Epicenter on east shore of San Francisco Bay, some 8 km N.W. of Hayward. (Byerly.)
February 25: 18:27*, 19:43*, and 20:00. Calexico, Imperial, and Brawley, moderately strong. First two shocks $32^{\circ}36'$ N., $115^{\circ}37'$ W. (Wood.)
February 26: 8:59*. Monterey Bay region. IV at Aptos, Asilomar, Gonzales, Paraiso Springs, Point Sur Light, and Santa Cruz; III and under at Carmel, Del Monte, Metz, Monterey, Pacific Grove, Pebble Beach, Point Pinos Light Station, Salinas, Spreckels, and Watsonville.
February 29: 9:15. Monterey, weak.
March 6: Midnight. Pattiway, slight.
March 13: 15:09*. Buellton, slight. $34^{\circ}26'$ N., $120^{\circ}11'$ W. (Wood.)
March 20: 15:35. Point Fermin Light Station, slight.

- March 21: 2:45. Los Angeles region. Lawndale, IV. Inglewood, Los Angeles, Manhattan Beach, North of Nigger Slough, Redondo Beach, San Rafael Hills, South Bay district, Walnut Park. $33^{\circ}54'$ N., $118^{\circ}17'$ W. (Wood.)
- March 22: 16:20*. Ludlow, slight. $35^{\circ}36'$ N., $116^{\circ}58'$ W. (Wood.)
- March 24: 22:58*. Simi, slight. $34^{\circ}16'$ N., $118^{\circ}47'$ W. (Wood.)
- March 25: 22:58*. West of Brawley, near San Jacinto fault. $33^{\circ}02'$ N., $115^{\circ}58'$ W. (Wood.)
- April 13: 7:20. Baldwin Park, Etiwanda, Monrovia, Pasadena, San Gabriel, slight.
- April 16: 10:48.* Gustine and Merced. $36^{\circ}40'$ N., $121^{\circ}13'$ W. (Wood). Some 5 to 10 miles east of Ingomar. (Byerly).
- April 19: 11:40.* Kernville; Kern River, near Isabella, moderate. $35^{\circ}41'$ N., $118^{\circ}21'$ W. (Wood).
- April 20: 19:36. Atascadero, weak.
- April 21: 4:24. Petaluma, no damage.
- April 23: 5:38*. Arlington, Fontana, and Rialto, slight. $34^{\circ}05'$ N., $117^{\circ}30'$ W. (Wood).
- April 26: 14:50. Near Cape Mendocino, IV. Strongest at Upper Mattole and Punta Gorda Light Station. Eureka, Ferndale, Fortuna, Humboldt Bay Fog Signal, Scotia, and Waddington.
- April 29: 8:53*. Brawley, sharp. El Centro and Calexico. $32^{\circ}15'$ N., $115^{\circ}40'$ W. (Wood).
- May 4: 0:00. Upper Mattole, feeble.
- May 4: 1:30. Eureka, Fortuna, Scotia, and Waddington, feeble.
- May 15: 19:37*. Parkfield. $36^{\circ}00'$ N., $120^{\circ}30'$ W. (Wood).
- May 15: 21:52*. Near Torrance. $33^{\circ}48'$ N., $118^{\circ}14'$ W. (Wood).
- May 21: 15:00. Glendale.
- May 27: 22:40. Fortuna, Upper Mattole, and Scotia, feeble.
- May 28: 14:55*. Brawley, slight. $32^{\circ}35'$ N., $115^{\circ}40'$ W. (Wood).
- June 1: 18:05. Fortuna, feeble.
- June 4?: 0:45. Montgomery Creek.
- June 5: Afternoon. Eureka.
- June 6: 0:45*. Eureka, VIII. Epicenter 40.8° N., 124.3° W. Area affected about 50,000 square miles. See map. Damage in Eureka and Arcata consisted chiefly of shattered plate-glass windows, hundreds of broken chimneys, cracked plaster and ceilings, and damage to merchandise and household articles thrown from shelves. One person was killed by a falling chimney and several injured. A huge oil-storage tank was reported to have moved about 4 inches on its base. At Fields Landing hardly a chimney was left intact and a crack 6 inches wide appeared in the highway. At Loleta part of a brick wall was thrown out. At Table Bluff Light Station a 10-foot brick chimney collapsed and the light was temporarily out of commission because of displacement of the mantle holder. On Cock Robin Island near the mouth of the Eel River a 28-inch crack appeared and there were numerous blowholes some 7 or 8 feet in diameter at the surface. The shock was recorded by seismographs all over the country but it is difficult to reconcile all the data with a precise epicenter. It may have been beneath Humboldt Bay or slightly farther offshore than indicated by the above coordinates. Byerly places the epicenter at $40^{\circ}45'$ N., $124^{\circ}30'$ E.

VIII at Arcata, Bayside, Beatrice, Eureka, Fields Landing, Humboldt Bay Fog Signal, Loleta, Samoa, and Table Bluff Light Station; VII at Blue Lake, Ferndale, and Kneeland; VI at Bridgeville, Crannell, Crescent City, Fort Jones, Fortuna, and Korbel; V at Alderpoint, Alton, Ashland, Benbow, Bieber, Capetown, Dyerville, Fernbridge, Forks of Salmon, Fort Dick, Garberville, Hydesville, Little River, Longvale, Montgomery Creek, Mount Shasta, Orick, Punta Gorda Light Station, Round Mountain, St. George Reef Light Station, Scotia, Shasta Springs, Shively, Somes Bar, Stumpville, Trinidad Light Station, Upper Mattole, Weitchpec, Westport, and Willow Creek, all in California. Also at Grants Pass, Hugo, Medford, and Takilma in Oregon.

IV at Anderson, Baird, Bayles, Black Bear, Blocksburg, Briceland, Burney, Carrville, Castella, Cecilville, Chico, Clipper Mills, Colusa, Copco, Cottonwood, Dedrick, Del Loma, Dos Rios, Dunsmuir, Durham, Edgewood, Etna, Ettersburg, Fort Bragg, French Gulch, Gazella, Grass Valley, Greenville, Happy Camp, Harris, Hartsook, Hoopa, Horse Creek, Hyampom, Island Mountain, Junction City, McCloud, Mendocino, Millville, Mina, Minersville, Miranda, Montague, Nevada City, Palo Cedro, Paradise, Peanut, Piercy,



Point Arena Light Station, Point Cabrillo Light Station, Pollock, Redding, Salyer, Santa Cruz, Scott Bar, Shasta, Shasta Springs, Smith River, South Fork, Trinity Alps, Trinity Center, Ukiah, Waddington, Walker, Weaver-ville, Weed, Whitlow, Willits, Yreka, and Zenia. In Oregon at Agness, Applegate, Ashland, Azalea, Brookings, Central Point, Coquille, Dryden, Galice, Glendale, Gold Beach, Grave Creek, Harbor, Holland, Jackson, Kerby, Klamath Falls, Marshfield, Merlin, Murphy, Myrtle Point, O'Brien, Persist, Pistol River, Poe Valley, Provolt, Reston, Riddle, Rogue River, Roseburg, Selma, Summer Lake, Takilma, Talent, Wedderburn, and Wolf Creek.

III and under at Big Bend, Bodega, Branscomb, Callahan, Calpella, Caution, Challenge, Dorris, Fern, Forest, Forest Glen, Foresthill, Gerber, Grenada, Hamburg, Hayfork, Hazel Creek, Hilt, Hornbrook, Inwood, Island Mountain, Laytonville, Larkspur, Lewiston, Live Oak, Log Cabin, Magalia, McCloud, Old Station, Quincy, Red Bluff, San Francisco, Sattley, Surveyors Bar, Seiad Valley, Tomales, Twain, White Horse, and Yuba City. Also felt in Oregon at Algoma, Anchor, Bandon, Broadbent, Bullards, Canyonville, Coos Bay, Dothan, Empire, Fort Klamath, Gaylord, Leland, McKenzie Bridge, Marial, North Bend, Port Orford, Prospect, Siskiyou, Tiller, Umpqua, and Wilderville.

Aftershocks were reported from Waddington at 1:27*, Humboldt Bay Fog Signal Station, 1:50; Peanut, 4:00; Davis Creek, 14:30; and Irvington, 16:25. On the following day at Upper Mattole, 4:55 and Scotia, 21:34.

June 11: 22:38. Fortuna, feeble.

June 12: 2:00. Cupertino, feeble.

June 13: 1:05. Novato, windows rattled.

June 14: 1:44*. San Jose region, IV-V. $37^{\circ}15'$ N., $122^{\circ}05'$ W. (Wood). Between San Jose and Mount Hamilton (Byerly). See map. At Campbell and Irvington, IV-V, slight damage such as cracked plaster. IV at Boulder, Burlingame, Colma, Half Moon Bay, Milpitas, Mount Hermon, Oakland, Petaluma, San Francisco, Santa Clara, Santa Cruz, Redwood City, and San Rafael. III and under at Agnew, Alameda, Alvarado, Aptos, Berkeley, Bolinas, Centerville, Corte Madera, El Granada, Felton, La Honda, Los Gatos, Manteca, Menlo Park, Morgan Hill, Newark, Niles, Oakland, Olema, San Anselmo, San Gregorio, San Jose, Santa Clara, Saratoga, Southampton, Shoal Light Station, Sunol, Tomales, Watsonville, and Yerba Buena Light-house. Aftershocks felt at Redwood City about 2:14, and at San Jose at 4:45.

June 16: 3:10. Near Taylorsville, IV. Allegheny, La Porte, Sierra, and Twain.

June 21: 1:00. Glenn Ranch, weak.

June 21: 2:55*. Cajon, three weak shocks in quick succession. $34^{\circ}10'$ N., $117^{\circ}35'$ W. (Wood).

June 22: 18:26*. Jamul, and Santa Ysabel. $33^{\circ}10'$ N., $116^{\circ}30'$ W. (Wood).

June 22: 23:29. Point Arena Light Station, III.

June 27: 14:10. Campo. Possibly same as shock at 2:07* reported by Wood at $31^{\circ}50'$ N., $116^{\circ}20'$ W.

June 29: 16:23*. Irvington, weak. Epicenter in region of Niles, Sunol, and Irvington (Byerly).

July 11: 5:00. Peanut, IV.

July 11: 16:33*. Livermore, III. Epicenter some 5 miles west of Livermore (Byerly).

July 19: 15:35*. Aptos, weak. Epicenter between Corralitos and Watsonville (Byerly).

July 21: 17:14. Ukiah, slight 8 miles south of.

July 25: 22:52*. Upper Kern River. See map. VI near Mineralking, where several tons of rock were reported loosened from one of the peaks, and at Springville, where brick chimneys were cracked. V at Glenville, Greenhorn Mountain, Independence, Kern River No. 3, Lemon Cove, Porterville. IV at California Hot Springs, Isabella, Kaweah, Lindsay, Little Lake, Posey, Sequoia National Park, Tulare, Visalia, and White River. III and under at Allensworth, Amboy, Balch Camp, Bodfish, Corcoran, Farmersville, Fawnskin, Fresno, Goshen, Hanford, Inyokern, Kern River No. 1 and No. 2, Kingston, Oildale, Onyx, Orosi, Patton, Sultana, Terra Bella, Three Rivers, Tipton, Vestal Substation, and Woodlawn. $35^{\circ}48'$ N., $118^{\circ}32'$ W. (Wood).

July 28: 22:53. Haiwee power house, slight.

July 30: 11:31*. Bell, and Los Angeles, weak. $33^{\circ}55'$ N., $118^{\circ}10'$ W. (Wood).

August 23: 11:10. Laws, IV.

- August 24: 22:13. Laws, IV.
 August 26: 11:12. Huntington Park, IV.
 August 29: 18:50*. Santa Ana Canyon, IV-V. Mentone, IV. Camp Angelus
 San Bernardino, Seven Oaks, Yucaipa. $34^{\circ}05' \text{ N.}, 117^{\circ}05' \text{ W.}$ (Wood).
 August 29: 21:15. Pineflat, II-III.
 September 22: 12:50. Calistoga, weak.
 September 22: 23:48. Calistoga, and St. Helena, IV. Epicenter between these
 places (Byerly).
 September 23: 3:45. Calistoga, weak.
 September 28: 13:30. Laws, IV.
 September 29: 7:31*. Mount Hamilton, IV. Epicenter 10 miles east of Lick
 Observatory (Byerly).
 October 5: 16:38. Scotia, III. Ferndale, Fortuna, and Whitlow.
 October 7: 16:57. Alton, III.
 October 7: 20:00. Brawley, slight foreshock.
 October 7: 23:48. Brawley, IV or more. Imperial, III. Intermittent after-
 shocks continued at Brawley on October 8.
 October 8: 13:15. Calexico, El Centro, and Heber, IV. Several shocks at
 Calexico.
 October 9: 14:45. Brawley, IV. El Centro, and Imperial. Two aftershocks
 at Brawley, 15:50, and 20:00. Five minor shocks (excluding that of Oct. 8)
 were reported in this region between the shock at 23:48 on October 7 and
 this shock.
 October 10: 12:00. Brawley, slight.
 October 16: 6:15. Gilroy, Hollister, and Watsonville, IV. III and under at
 Aptos, Pacific Grove, Santa Cruz, and Spreckels.
 October 18: 20:00. Upland, weak.
 October 19: 8:41. Del Monte, Monterey, Santa Cruz, IV. III and under at
 Hollister, Jamesburg, Metz, Paraiso Hot Springs, Soquel, and Spreckels.
 October 19: 20:12. Upland, Pomona, San Bernardino, weak. Probably Navy
 target practice.
 October 20: 13:25. Watsonville, III.
 October 21: 2:30. Petaluma, III.
 October 21: 7:26 and 9:29. Los Angeles and vicinity, IV. Felt at Hollywood,
 Lennox, Long Beach, San Pedro, Point Vicente Light Station, and $33.7^{\circ} \text{ N.},$
 118.3° W.
 October 21: 20:46. Upland, Ontario, and Cucamonga, III. Felt in San Bernar-
 dino, Riverside, and other cities. Patton and Highland section indicated in
 press as origin.
 October 23: 6:30. Monterey Peninsula, weak.
 October 23: 20:45. Paso Robles, weak.
 October 24: 2:05. San Francisco, III.
 October 24: 17:07. Oakland, San Francisco, and Soquel, IV. See map. III at
 Alviso, Aptos, Ben Lomond, Carquinez Strait Light Station, Centerville,
 Colma, Fort Point Light Station, Half Moon Bay, Hollister, Niles, Oakland
 Harbor Light Station, Redwood City, San Anselmo, Santa Cruz, Stanford,
 Sunol, and Watsonville. Weaker at Agnew, Corte Madera, Pacific Grove,
 Richmond, and San Jose.
 October 26: 1:00. Colma, III.
 October 31: 7:00. Hopland, IV. III and under at Cloverdale, Ukiah, and Upper
 Lake.
 October 31: 20:45. Fontana, and Rialto, V. IV at Placentia, Riverside, San
 Gabriel, and Upland. III and less at Acton, Cajon, Colton, Cucamonga,
 Devore, El Mirage, Highland, La Verne, Mentone, Ontario, Patton, San
 Bernardino, San Gabriel Lookout Station, Summit, and Victorville.
 November 2: 21:58. Spreckels, III.
 November 3: 8:05*. Los Angeles County. T 4 S, R 14 W. (Wood).
 November 3: 10:56*. San Francisco Bay region, IV. See map. Very slight
 damage reported from Alviso and Boulder Creek. IV at Alviso, Aptos,
 Boulder Creek, Centerville, Cupertino, Hayward, Olympia, Palo Alto,
 Pigeon Point Light Station, Redwood City, San Anselmo, San Francisco,
 Santa Cruz, San Jose, San Luis Obispo Light Station, Saratoga, Stanford,
 and Willow Glen. III and under at Agnew, Berkeley, Bonita Point, Corte
 Madera, Colma, Gilroy, Half Moon Bay, Los Gatos, Moss Beach, Mount
 Hermon, Niles, Oakland Harbor Light Station, Oakland, Morgan Hill,
 Salinas, Soquel, Spreckels, Stockton, Sunol, and Watsonville.
 November 9: 10:58. San Jose, weak.
 November 13: 19:—. Summit, IV. Devore, III.



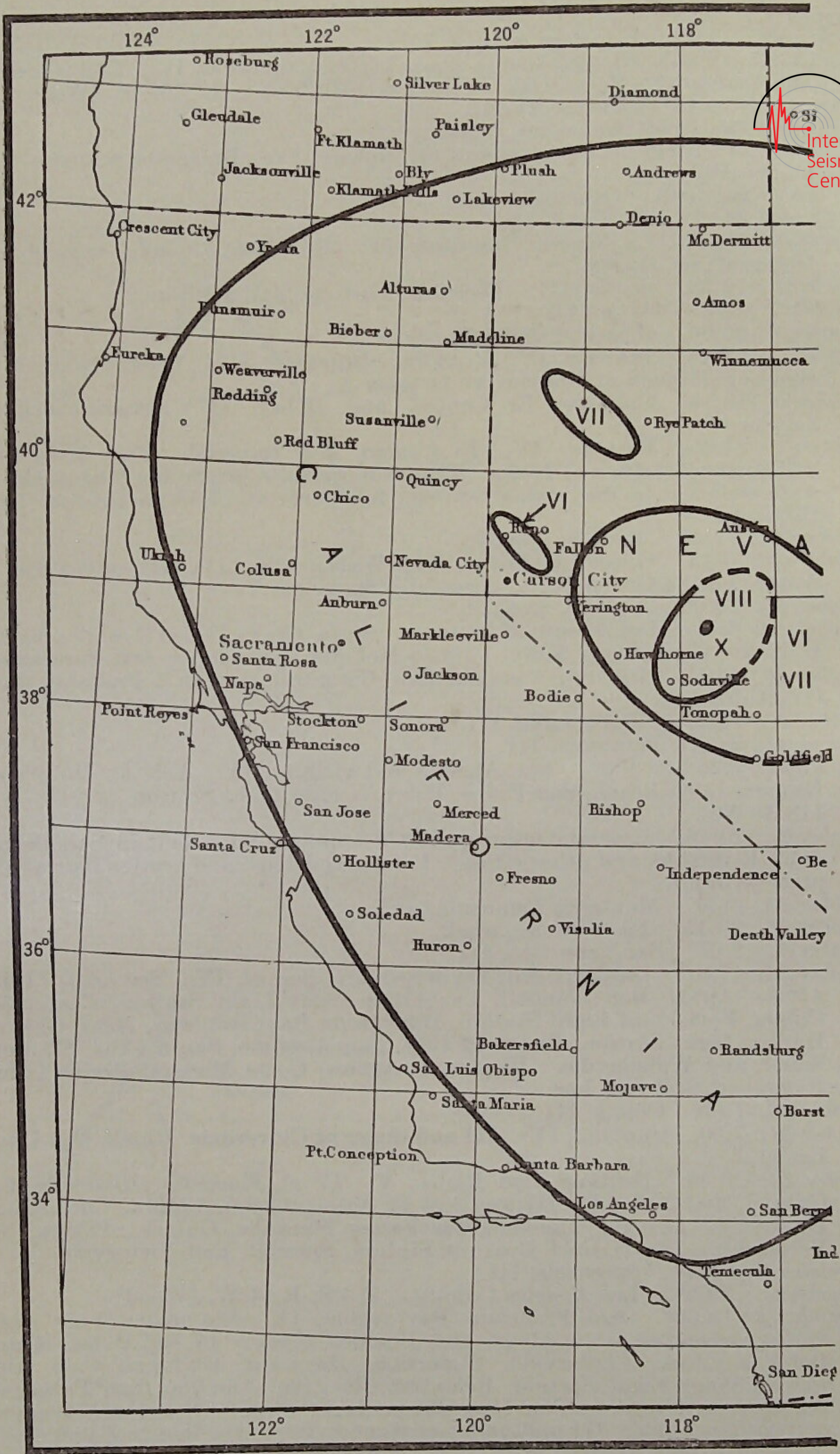
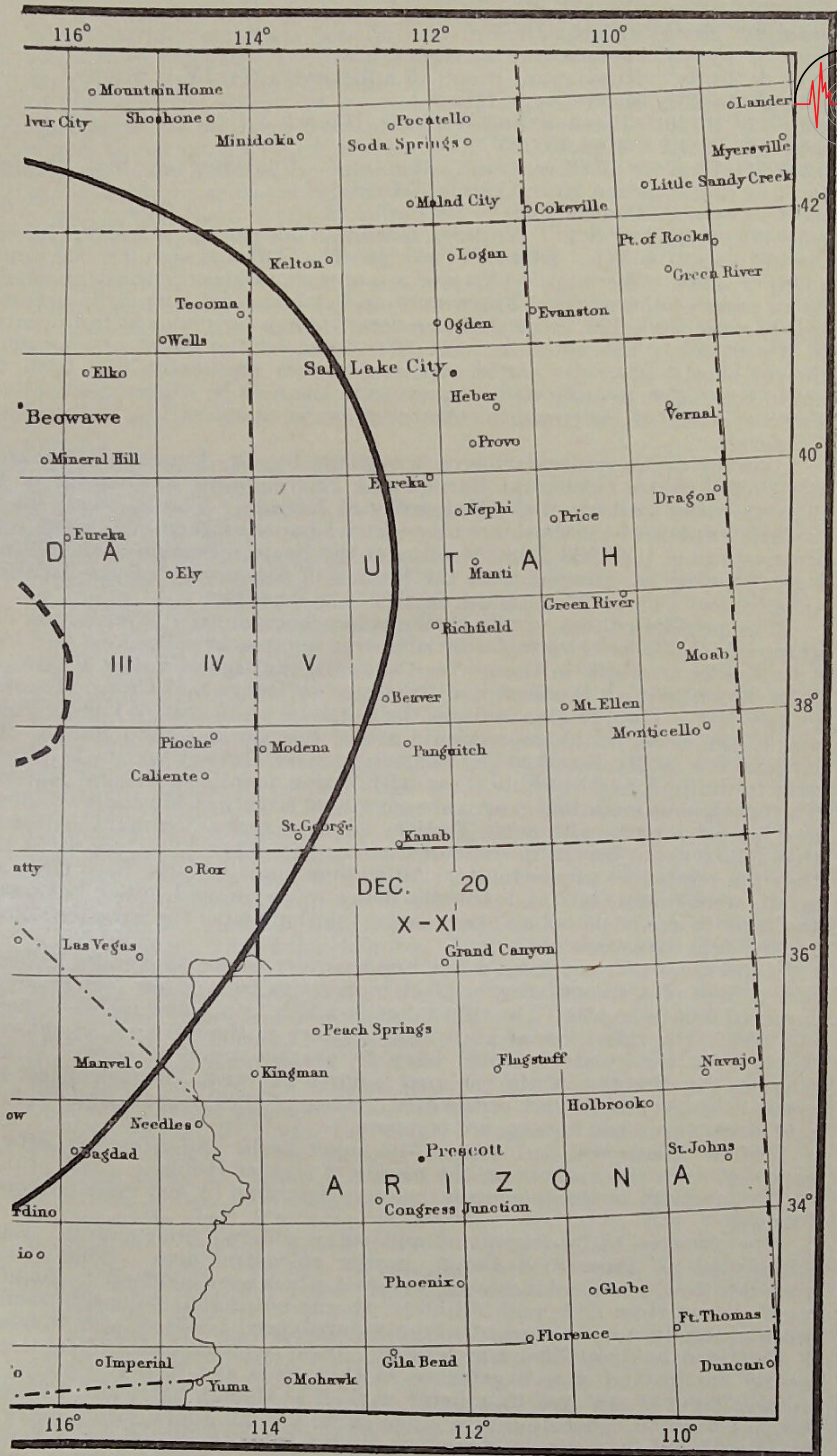


FIGURE 2.—Area affected by the



earthquake of December 20.



- November 29:* 14:40. Huntington Park, III.
November 31: 20:45. Rialto, IV.
December 3: 16:53*. Monterey Bay region, felt.
December 6: 10:08. Huntington Beach (5 miles north of), IV. Blast?
December 6: 11:03. Keen Camp, III.
December 11: 16:20. Fortuna, and Hollister, III.
December 12: 22:12. Modesto, IV.
December 14: 17:37*. Pattiway and Maricopa. Epicenter on San Andreas fault in southwestern Kern County (Wood).
December 16: (—). Cowell, IV.
December 20: 22:10.* P.S.T. Western Nevada. Maximum intensity in epicentral area, X to XI. $38^{\circ}44'$ N., $117^{\circ}49'$ W. Affected area 500,000 square miles or more. See map. This was a major shock recorded instrumentally in all parts of the world. There were no fatalities and very little property loss because the shock originated in a desert region far removed from centers of population. The epicenter was determined by the Coast and Geodetic Survey shortly after the earthquake and agrees reasonably well with the epicentral region as indicated by surveys in the field by other organizations. Further study of instrumental records is being made at the University of California.



A survey of the epicentral area was made by Dr. Eugene Callaghan of the United States Geological Survey and Prof. Vincent P. Gianella of the department of geology of the University of Nevada. The following quotations descriptive of the shock are taken from a paper by them published in the Proceedings of the 1933 Joint Meeting of the Eastern Section of the Seismological Society of America with the Section of Seismology of the American Geophysical Union, Washington, April 27, 28, and 29.

"The principal shock of the earthquake accompanied the formation of a group of tension or open faults or rifts over an area 38 miles long and from 4 to 9 miles in width in the lowland between the Gabbs Valley Range and Pilot Mountains on the west and the Paradise Range and Cedar Mountain on the east. The rift area ends to the north in south side of Gabbs Valley and to the south in the depression north of the Monte Cristo Range. The lowland is a partly dissected pediment-surface on Tertiary lake beds (Esmeralda formation) and volcanic rocks with a thin mantle of detrital material. The contiguous mountain ranges are composed largely of Mesozoic sediments and intrusive rocks with some Tertiary volcanic rocks. In many places the rifts follow sharp breaks in slope or the margins of low hills, indicating that they are related to earlier faults. Altogether, some 60 rifts, both large and small, were found, but undoubtedly many more escaped notice because of the snow in many places and because of the short time the weather allowed for the field investigation.

"Individual rifts are from a few hundred feet to nearly 4 miles in length and consist of a zone of fissures that may range from a few feet to several hundred feet in length. The rifts range in width from a few inches to nearly 400 feet. The rifts form an en echelon pattern in the rift area, as shown in figure 1, as the greater number have an average trend of north 11° east, whereas the direction of the rift area is north 21° west. The strongest rifts occur in the southern part of the area. Some of them have a sigmoid form, and sharp turns and zigzags are common."

Further details will be found in the paper itself. Additional reports are expected from the authors on the results of further studies.

The intensity in the epicentral region is described by the same authors as follows:

"People were badly frightened and many suffered from nausea. Cattle stampeded at Fingerrock Camp, in the epicentral area. Some springs ceased to flow, some had increased flow, and others were unaffected. Boulders were shaken from cliffs and hillsides. It was noted that balanced boulders were generally not overturned whereas unbalanced boulders were displaced if the bond holding them was broken. In at least one place boulders on nearly flat ground were overturned in their beds and in many places the surface layer of soil was thoroughly shaken as though harrowed. Damage was confined to demolition of a stone cabin and an adobe cabin, cracks in the few brick or concrete structures in the vicinity, dislodged chimneys, damage to ore-treating plants and mines, broken dishes and other articles thrown from shelves, and minor items.

"A roar accompanied the inception of the principal shock, and the after-shocks, where observed on hard rocks, were preceded by a rumble like distant thunder."

Other reports from the area state that cattle were thrown off their feet; a mine property caretaker was thrown from his bed; and ore mill machine bases were cracked. Probably not more than a dozen people were in the area at the time of the shock.

The observed effects at several hundred places, as ascertained from a canvass of the area and from press dispatches, are abstracted in detail in a report issued by the San Francisco Field Station of the Coast and Geodetic Survey. Only a few of the outstanding features of the shock at towns nearest the epicentral region are briefly described here.

At Luning, Nev., about 30 miles west of the epicentral area, on the Southern Pacific Railroad, the onset was abrupt. There was a great rumble and roar. The motion was twisting and "seemed to be in great waves." A correspondent reports that china was thrown across a room, lamps were thrown down, and heavy furniture moved a foot from the wall. There was "considerable" damage. Chimneys and walls fell, furniture broke, and cracks appeared in the ground. At Mina chimneys fell and trees and bushes were shaken strongly. At Hawthorne damage was slight in brick masonry and concrete. Trees were shaken strongly. Strong motion with serious damage was reported from many other places just beyond the epicentral area.

Ground movements were detected while making astronomical observations at the International Latitude Observatory at Gaithersburg, Md. Star images were turbulent and at another time the leveling bubble reversed itself about seven or eight times over 10 divisions corresponding to 10'' of arc. This station is 2,200 miles from the epicenter.

Intensity IX at Luning, Nev. VIII at Candelaria, Gerlach, Mina, Round Mountain, and Simon, Nev. VII at Austin, Currie, Fallon, Gilbert, Hawthorne, Lovelock, Mason, Schurz, and Weeks, in Nevada. VI at Broken Hills, Dayton, Dyer, Elko, Ely, Goldfield, Halleck, Millers, Nyala, Pahrump, Potts, Reno, Silver City, Silver Peak, Sparks, Steamboat Springs, Steptoe, Sunnyside, Verdi, and Winnemucca in Nevada, and Newman in California. V at Beatty, Carson City, Deeth, Dixie Valley, Fernley, Flanigan, Gardnerville, Huntington Valley, Hazen, Imlay, Jiggs, Minden, Mountain City, Mount Montgomery, Preston, Pyramid, Red House, Ruby Valley, Simpson, Stillwater, Tonopah, Ursine, Virginia City, Wabuska, Wichman, Yerington, and Zephyr Cove on Lake Tahoe in Nevada. In California at Brooks, Carquinez Strait Light House, Colma, Dinuba, Easton, Gustine, Keeler, Lodi, Lone Pine, Los Banos, Modesto, Mendota, Nevada City, Omo Ranch, Patterson, Owenyo, Sanger, Sattley, Selma, Sonora, Stanislaus, Sutter Creek, Tahoe, Trona, Waterford, and Woodland. In Utah at Callao.

IV at Alamo, Antioch, Baker, Beowawe, Bodie, Carlin, Charleston, Cherry Creek, Contact, Dry Lake, Eureka, Glenbrook, Golconda, Goldpoint, Hiko, Hudson, Jean, Kimberly, Lamoille, Las Vegas, Lee, Lund, Midas, Mill City, Montello, Nixon, North Fork, Oreana, Orovida, Panaca, Ruth, Shoshone, St. Thomas, Simonsen, Strawberry, Sulphur, Tuscarora, Unionville, Uvada, Valmy, and Wellington, in Nevada. In Utah at Adamsville, Beryl, Gandy, Ibapah, and Milford, all in Nevada. In California at Aberdeen, Atwater, Bass Lake, Bayles, Big Creek, Bigpine, Blythe, Brown, Byron, Caliente, Coalinga, Colma, Comptonville, Corcoran, Dos Palos, Douglas Flat, Dove Springs, Ducor, El Nodo, El Portal, Freeport, Fresno, Georgetown, Giant Forest, Graeagle, Grass Valley, Herald, Independence, Isleton, Knights Landing, Laws, Le Grand, Lemoore, Ludlow, Mare Island, Martell, Merced, Meridian, Milton, Mossdale Bridge, Mojave, Oakland Harbor Light Station, Oakland, Oroville, Pittsburg, Placerville, Prattville, Rio Vista, Roseville, Sacramento, Sequoia National Park, Spreckels, Stockton, Three Rivers, Tollhouse, Tracy, Tulare, Vallejo, Ventura, Visalia, Wheatland, Wheeler Ridge, Woodlake, and Yolo. In Utah at Adamsville, Beryl, Callao, Gandy, Ibapah, and Milford.

Intensity III and under at Arthur, Bunkerville, Cortez, Goodsprings, Jarbridge, McDermitt, McGill, Mesquite, Metropolis, Overton, Pioche, Rochester, Rowland, Sharp, Tobar, Tybo, Vya, and Wells in Nevada. In California at Agnew, Alameda, Alcatraz, Auburn, Avenal, Bakersfield, Benicia, Bethany, Biggs, Charleston, Chico, Davis, Eagleville, Fair Oaks, Fillmore, Forest, Fowler, Fullerton (4 miles northwest), Greenville, Haiwee, Hollister, Imperial, Inyokern, Jamestown, Janesville, Jaw Bone, Kennett, Kernville, Lancaster, Little Lake, Livermore, Los Angeles, Long Beach, Magunden, Manteca, McFarland, Mentone, Napa, Needles, Newman,

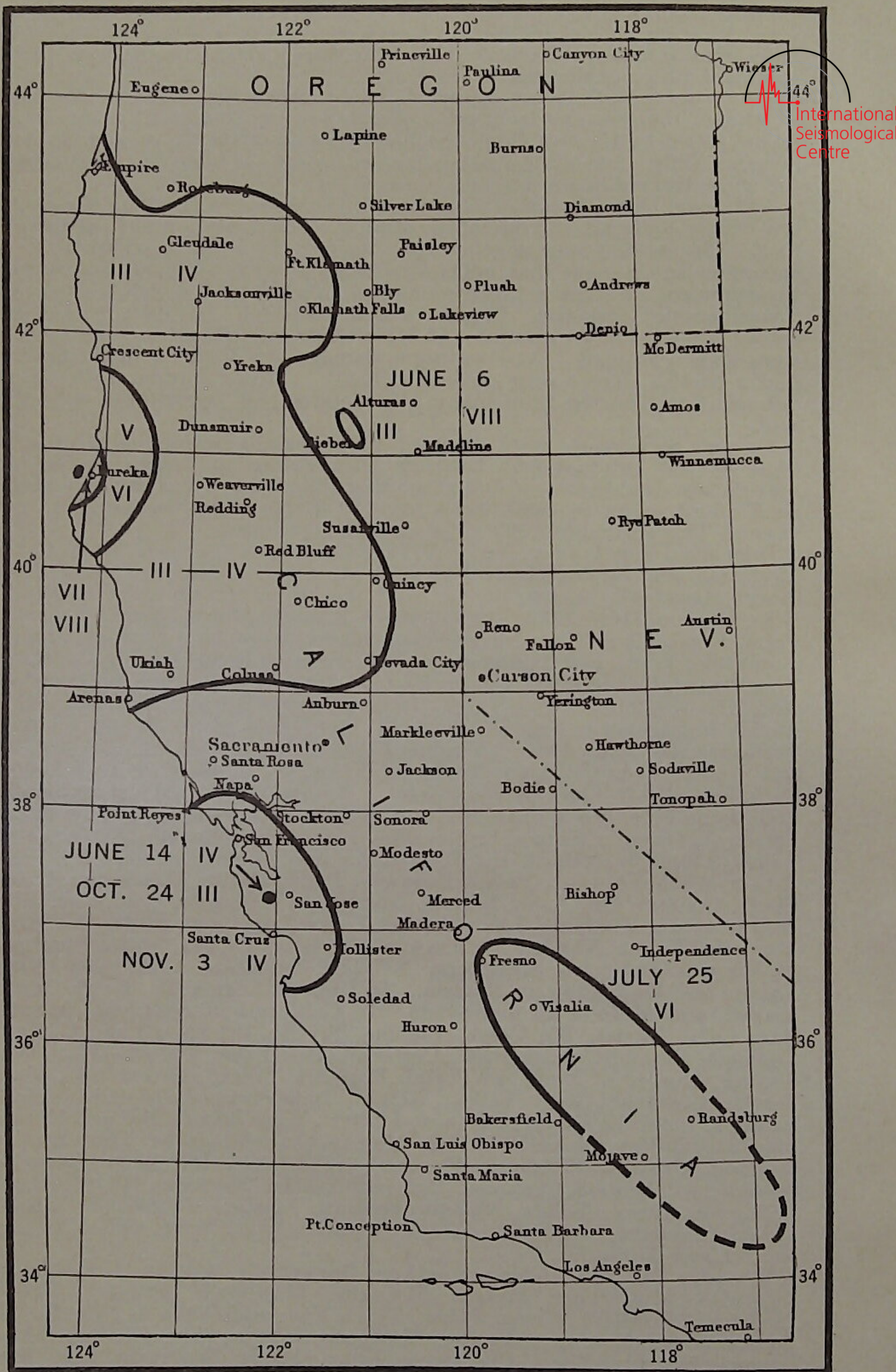


FIGURE 3.—Areas affected by the California shocks of June 6 and 14, July 25, October 24, and November 3

Olancho, Onyx, Oxnard, Petaluma, Quincy, Ravendale, Robbins, Rosamond, St. Helena, San Diego, San Jose, Scotia, Squaw Valley, Suisun, Tahoe Pines, Taylorsville, and Volcanoville. In Arizona at Apache, Cordes (9 miles east), Jeddito, Oatman, Sanders, Tuweep Valley, Wilcox, and Wintersburg. In Idaho at Boise, Cottonwood, Rogerson, and Weston. In Oregon at Andrews (25 miles southwest), Carson, Jordan Valley, Klamath Falls, and Vistillas. In Washington at Sultan. In Utah at Hurricane, Rockville, Salt Lake City, and Virgin.

It was reported not felt at about 500 places in the surrounding territory.

A foreshock was reported to have occurred about 40 minutes before the main shock.

The earthquake was featured by hundreds of aftershocks, many of which were felt in the epicentral zone or either recorded at the seismological station at Tinemaha where about 2,000 were counted. The recorded shocks were practically continuous for a day or more after the main shock and occurred at frequent intervals for weeks after. An especially strong one was recorded on December 25 at 21:03.

Five or six were quite generally felt at Tonopah during the following month, but light shocks were noticed by experienced observers almost daily. A disturbance was reported from Austin on December 24 and another from Yerington on December 30. The three places mentioned are widely separated around the epicentral region.

December 21: 22:30. San Francisco, slight.

December 22: —. Huntington Beach, slight.

December 26: 6:00. Mecca, slight.

WASHINGTON AND OREGON

[120th meridian or Pacific standard time]

January 5: 15:13.* Near Sultan, Wash., about 30 miles northeast of Seattle, IV. See map. Moderate shock recorded at the University of Washington, near Seattle. Superficial damage reported at Monroe, although it is doubtful whether grade V was reached. IV at Bothell, Carnation, Darrington, Granite Falls, Monroe, Port Madison, Seattle, Silverton, Snohomish, and Sultan. Force III and under at Bellingham, Bryant, Bucoda, Chehalis, Goldbar, Longmire, Lowell, Mukilteo, Olalla, Olympia, Oso, Poulsbo, Quilcene, and Rollingbay.

January 6: 14:35. Pysht, Wash., II.

January 14: 8:18. Portland, and Willamette, Oreg., IV. Also felt at Forest Grove, Hillsboro, Longview, Ridgefield, Vancouver, and Yacolt, Wash.

January 31: 7:25. Alderwood Manor, Wash., III.

February 10: 23:10. Sultan, Wash., III+.

February 19: 12:13. Sultan, Wash., III+.

February 29: 9:45. Florence, Wash., slight.

April 23: 5:20. Sedro-Wooley, Wash., no damage.

June 10: 18:55. Fortson, IV. Also felt at Bryant, Granite Falls, and Hartford. Felt most strongly at Edgecomb.

June 13: 10:30. Sultan, Wash., feeble.

July 17: 22:03.* Near Sultan, Wash., about 30 miles northeast of Seattle, IV. See map. The most widespread shock of the year in this locality. No damage reported. Recorded on the University of Washington seismograph which indicated a distance of about 70 km, ignoring depth of focus. It was relatively deep-seated judging from the distribution of intensity. IV at Bothell, Bryant, Carnation, Cedar Falls, Everett, Goldbar, Hunts Point, Index, Lakeside, Leavenworth, Maple Valley, Miller River, Nigger Creek, Olalla Canyon, Pateros, Renton, Robe, Silverton, Snohomish, Sultan, Tracyton, and Wenatchee. III and under at Big Four, Birdsvie, Black Diamond, Campville, Cashmere, Chelan, Cle Elum, Concrete, Conway, Coupeville, Custer, Darrington, Easton, Edgecomb, Edmonds, Ellensburg, Entiot, Florence, Granite Falls, Issaquah, Kanskat, Kent, Lake Sammamish, La Grande, Longmire, Lowell, Mansfield, Monitor, McMurray, Monroe, Mount Vernon, Mukilteo, Olympia, Peshastin, Pinehurst, Port Orchard, Port Townsend, Puyallup, Quilcene, Ronald, Seattle, Sedro-Wooley, Sequim, Snoqualmie, Snoqualine Pass, Summit, Sunnyside, Tacoma, Waterville, Winslow, Winton, and Yakima.

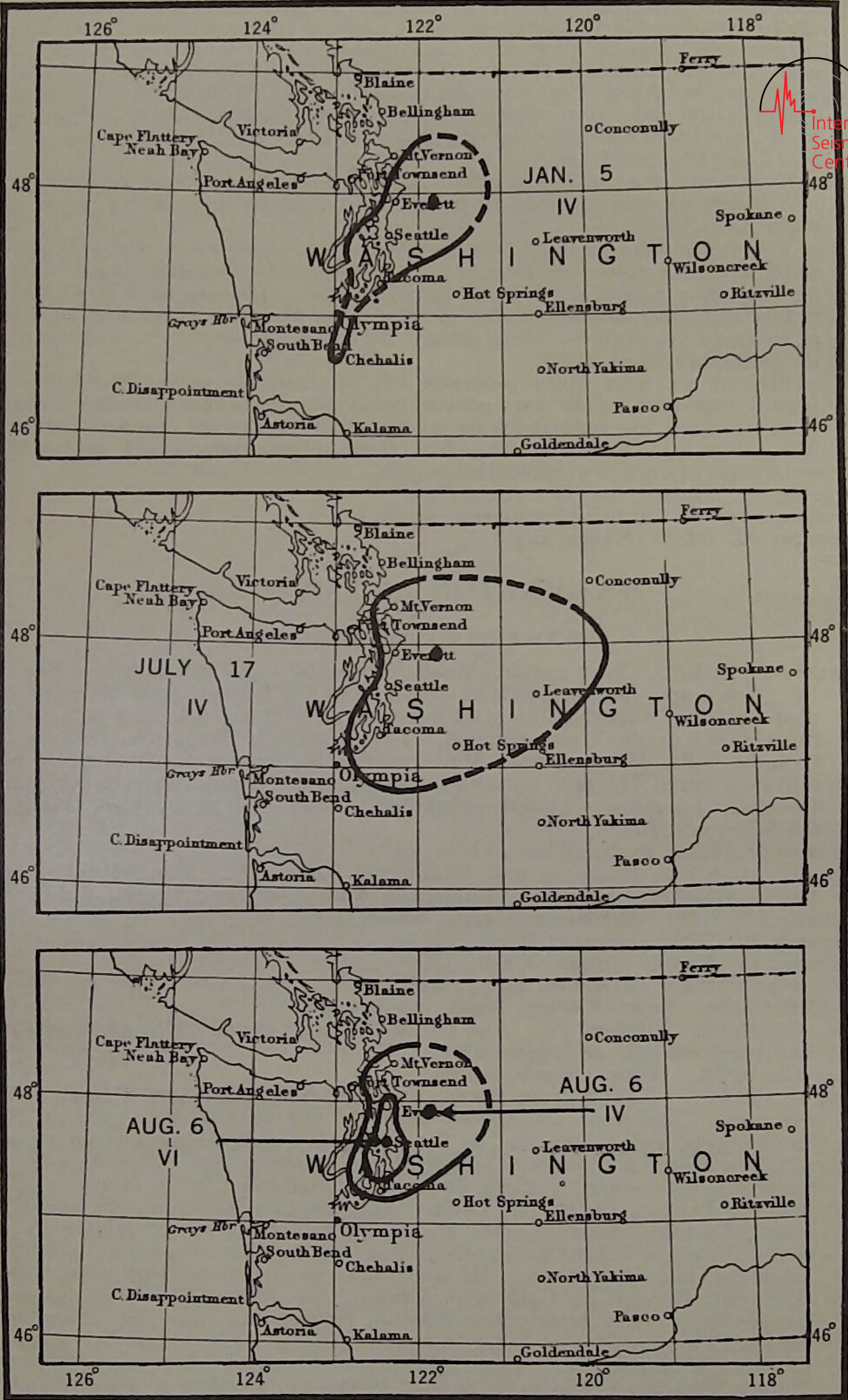


FIGURE 4.—Areas affected by the shocks of January 5, July 17, and August 6.

August 6: 14:16. Seattle, Wash., VI. See map. Strongly localized. No other towns report intensity higher than IV. Recorded at Seattle, where a few chimneys were demolished, and others badly damaged. IV at Langley and Medina. III and under at Bainbridge Island, Bellevue, Bothell, Burien, Cove, (Des Moines), Earlington, Fletcher Bay, Maple Valley, Mukilteo, Moran School, Olalla, Port Madison, Possession, Richmond Beach, (Richmond Highlands), (Rollingbay), Southworth, Suquamish, Tracyton, and Vashon. (Parentheses indicate time of day not reported, and possible confusion with shock at 22 h.)

August 6: 22:00. Near Sultan, Wash., about 30 miles northeast of Seattle, IV. See map. Moderate. IV at Baring, Burley, Kerriston, and Startup, Wash. III and under at (Alder), Algona, Auburn, (Black Diamond), (Clinton), Dash Point, Ellisport, Fort Steilacoom, Lakebay, Lakota, Lyman, (Maple Valley), Norman, Oak Harbor, Portage, and Waterman, Wash. (Parentheses indicate time of day not reported, and possible confusion with shock at 14 h.)

August 15: 2:30. Chelan, Wash., III.

August 25: 3:20. Seattle, Wash., III.

August 30: 23:50. Sultan, Wash., III.

September 5: 10:30. Lakeside, Wash., III. Slight shock.

September 19: 23:05. Sultan, Wash., III. Slight shock.

October 5: 11:20. Anacortes, Wash., IV. Also felt at Prevost.

ALASKA

[Local time at the place reporting is used here]

NOTE.—There is some uncertainty concerning the standard time used in many Alaska towns, but it is believed that most places use the time of 150th meridian.

January 9: 17:40 (150°+). Fairbanks. No details.

January 10: 1:29. Girdwood, weak.

January 11: 16:30. Valdez, weak.

January 11: 16:52. Girdwood, IV.

January 14: 13:43. Whale Island, Afognak. No details.

January 18: 12:12. Girdwood, weak.

January 24: 4:08. Girdwood, slight.

January 24: 4:30. Homer, weak.

January 24: 5:21. Homer, weak.

January 24: 5:35. Girdwood and Seward, weak. Series of small shocks lasting half hour.

January 26: 16:20 (150°+). Whale Island, Afognak. No details.

February 7: 20:10. Porcupine Creek, near Miller House, slight.

February 8: 2:00. Girdwood, weak.

February 13: 5:47. Girdwood, weak.

February 15: about 3:00. Girdwood, weak.

February 20: 22:51. Girdwood, slight.

February 24: 9:16. Juneau, weak.

February 24: Time uncertain. Porcupine Creek, Haines. "Two distinct earth shocks."

March 1: 9:35. Girdwood, weak.

March 3: 2:31. Girdwood, sharp. Awakened everyone. Walls creaked. Rattled windows and doors.

March 3: 23:34. Mount McKinley National Park, weak. Felt by all.

March 7: 15:15 (150°). Nenana. No details.

March 25: 13:58 (150°). Seward, VII. Girdwood, IV, Avik, Dillingham, Naknek, Lakotna, and Wasilla, III and under. At Seward, a water main burst. Slides occurred on railroad to north. Fishermen reported fish driven off nearby banks.

March 25: 15:03 (135°). Mile 7 (Cordova), several seconds. No other details.

March 25: 22:42. Girdwood and Anchorage, slight.

March 29: 18:35. Girdwood, slight.

March 31: 17:06. Girdwood, IV.

April 19: 10:10. Whale Island. No details.

April 21: 2:14. Fairbanks, about V.

April 26: 11:10. Annex Creek, near Thane and Juneau, slight.

May 26: 21:30. Porcupine Creek, near Haines, 5 seconds.

June 2: 11:05. Whale Island, half minute.

- June 5: 13:01.* Girdwood, slight.
June 5: 20:22. Girdwood, weak.
June 5: 21:33. Girdwood, IV.
June 5: 21:40. Girdwood, weak.
June 6: 21:25. Seward, slight.
June 7: 18:45. Takotna, weak.
June 7: 23:00. Holy Cross, slight.
September 1: 3:00. Homer, about IV.
September 2: 18:30. Homer, weak.
September 13: 22:43. Ellamar, Homer, Valdez, and Wasilla, V. Clocks stopped.
 Widely recorded on seismographs. 60° N., 147° W.
October 3: 8:30. Anthracite Camp, slight.
October 6: 5:40. Seldovia, slight.
October 6: 6:49. Homer, slight. May be same one felt at Seldovia.
October 6: 7:05. Homer. Awakened all. Moved small objects slightly. No damage.
October 12: 4:30. Seldovia, slight.
October 12: 5:00. Homer, slight.
November 17: 12:30. Susitna, slight.
November 19: P.M. College, slight.
December 5: 18:00. Susitna, slight.
December 9: 17:05. Sitka. Felt by few. Recorded on seismograph at Sitka.



HAWAIIAN ISLANDS

[$157\frac{1}{2}$ meridian (West) 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 Research Association give all details.

- September 17: 2:33.* S.S. *Mericos H. Whittier*. "Ship vibrated violently for about a minute." Lat. $26^{\circ}15'$ N., long. $148^{\circ}36'$ W.

PHILIPPINE ISLANDS

[$157\frac{1}{2}$ meridian (East) time]

NOTE.—Only the more important shocks are included in this report. (See reports of Weather Bureau, Manila Central Observatory, for complete data.)

- June 14: 14:00.* Northern Luzon. Looag and Cape Bojeador, VI, R-F. (See instrumental reports.)
September 15: 19:13. Zamboanga, VI, R-F. Jolo, V, R-F. Felt in southwest Mindanao and Sulu Archipelago. Epicenter in region 5° N., 122° E., according to Manila. Aftershock felt at 19:55.

PUERTO RICO

[60th meridian time]

Nothing.

CANAL ZONE

[75th meridian time]

- February 5: 16:16.* Balboa.
February 20: 5:48. Balboa.
August 24: 14:22. Balboa and Panama City.

INSTRUMENTAL REPORTS

It has been decided for reasons of economy to omit publication of instrumental data in this report. Anyone interested in them may find substantially the same material in the monthly instrumental seismological reports of the Bureau, copies of which will be furnished upon request to those interested in seismological work.

In the following list of provisional epicenters attempts have been made in some instances to improve on the values given in the monthly reports, especially in cases of North American earthquakes. The epicenter locations are based on the readings of seismograms sent direct to this office for interpretation, and also on a limited number of instrumental reports received from stations exchanging reports with this Bureau. In the former group are Bozeman, Mont. (Montana State College); Chicago, Ill. (University of Chicago and U.S. Weather Bureau); Charlottesville, Va. (University of Virginia); Columbia, S.C. (University of South Carolina); Honolulu, Hawaii (University of Hawaii); Huancayo, Peru (Carnegie Institution of Washington); Pittsburgh, Pa. (University of Pittsburgh); San Juan, P.R.; Sitka, Alaska; Technology, Maine (Massachusetts Institute of Technology); Tucson, Ariz.; Seattle, Wash. (University of Washington); and Ukiah, Calif. (International Latitude Observatory).

SUMMARY OF INSTRUMENTAL RESULTS

Date, 1932	Greenwich civil time of origin	Region	Provisional epicenter	
			Latitude	Longi- tude
	<i>h</i> <i>m</i>		°	°
Jan. 5.....	1 53.5	Pacific Ocean, near Easter Island.....	32.0 S.	117.7 W.
Jan. 9.....	10 21.1	Near New Guinea.....	6 S.	155 E.
Jan. 20.....	2 30.5	Peru, damage at Lima.....	11 S.	77 W.
Jan. 24.....	3 44.0	New Hebrides Islands, South Pacific Ocean. Ap- proximate epicenter.	18 S.	168 E.
Jan. 29.....	13 41.0	Solomon Islands (Epicenter reported by Apia).....	6.4 S.	154.8 E.
Jan. 31.....	9 23.6	California, off coast. Epicenter reported by Pasa- dena.	40 N.	130 W.
Feb. 3.....	6 16.0	Cuba, destructive in Santiago.....	19.8 N.	75.8 W.
Feb. 16.....	13 48.9	Near Fiji Islands.....	14 S.	179 W.
Feb. 17.....	16 07.0	Caribbean Sea.....	12 N.	74.5 W.
Feb. 23.....	0 16.2	South Atlantic Ocean (Epicenter by St. Louis). Approximate epicenter.	55.8 S.	29.7 W.
Mar. 2.....	17 40.8	Oregon, off coast. Approximately.....	43 N.	131 W.
Mar. 8.....	4 29.6	Probably Aleutian Islands.....	51 N.	176 W.
Do.....	18 00.9	Fiji Islands, felt in Suva. Approximately.....	18 S.	179 E.
Mar. 10.....	23 01.5	Mexico, felt in Vera Cruz and Oxaca. Approxi- mate epicenter.	18 N.	95 W.
Mar. 14.....	4 05.8	Mexico, off west coast. Felt at sea.....	20.5 N.	109 W.
Do.....	22 42.9	Colombia, South America. Felt at Cucuta.....	8 N.	72 W.
Mar. 15.....	4 31.8	Near Guam, felt. Epicenter by Manila.....	12.6 N.	146.3 E.
Mar. 19.....	10 59.0	do.....	16.5 N.	149 E.
Mar. 25.....	23 58.6	Alaska. Damage at Seward.....	61.5 N.	153.0 W.
Mar. 26.....	9 52.2	Banda Sea north of Australia.....	4.3 S.	128.3 E.
Apr. 3.....	20 39.1	Near New Zealand.....	32 S.	177 W.
Apr. 12.....	23 52.5	Near Solomon Islands.....	5 S.	152 E.
Apr. 14.....	1 38.2	North Atlantic Ocean. Approximately.....	60 N.	34 W.
Apr. 24.....	6 10.8	Lower California.....	24.5 N.	111.3 W.
Apr. 26.....	7 54.8	Chile, South America.....	26.2 S.	70.3 W.
Apr. 29.....	18 18.5	Aleutian Islands.....	51 N.	178 W.
Apr. 30.....	1 06.4	Atlantic Ocean.....	4 S.	12 W.
May 1.....	19 10.4	Mexico.....	26 N.	104.5 W.
May 14.....	13 10.7	Celebes Islands. Destructive at Menado. Epi- center reported by Batavia.	0.5 N.	126.0 E.
May 21.....	10 10.1	San Salvador, destructive.....	13.0 N.	88.1 W.
May 22.....	11 29.4	Tonga Islands. Approximately.....	20 S.	174 W.
Do.....	22 39.9	San Salvador, off coast. Approximately.....	13 N.	90 W.
May 26.....	16 09.5	Near Fiji Islands.....	23 S.	177 W.

Date, 1932	Greenwich civil time of origin		Region	Provisional epicenter	
				Latitude	Longitude
	<i>h</i>	<i>m</i>		°	
June 3.....	10	36.7	Mexico, west coast. Destructive.....	18.5 N.	104 W.
Do.....	17	39.9	Mexico, west coast. Aftershock.....	18.5 N.	104 W.
June 4.....	21	39.3	do.....	18.5 N.	104 W.
June 5.....	9	04.6	do.....	18.5 N.	104 W.
June 6.....	8	44.7	Eureka, Calif. Destructive.....	40.8 N.	124.3 W.
Do.....	11	49.9	Santiago de Cuba, felt.....	19.8 N.	75.8 W.
June 8.....	4	53.6	Alaska, felt. Approximately.....	63 N.	155 W.
Do.....	7	52.7	Alaska. Aftershock. Approximately.....	63 N.	155 W.
June 9.....	4	35.8	Mexico, west coast.....	18.5 N.	104 W.
June 14.....	5	59.7	Philippine Islands, felt. Epicenter by Manila.....	18.3 N.	120.2 E.
Do.....	9	44.3	California, felt. Epicenter by Pasadena.....	37.2 N.	122.1 W.
June 18.....	10	12.1	Mexico. Destructive.....	18.5 N.	104.0 W.
Do.....	21	59	Mexico, west coast.....	18.5 N.	104 W.
June 20.....	9	01.8	San Salvador, off coast.....	12 N.	90 W.
Do.....	9	25.8	Pacific Ocean, off Oregon. Approximately.....	42 N.	133 W.
June 21.....	4	19.0	Mexico, off west coast.....	14 N.	96 W.
Do.....	4	33.6	do.....	14 N.	96 W.
June 22.....	12	59.4	Mexico, west coast. Destructive.....	18.5 N.	104 W.
June 27.....	10	07.3	California, felt at Campo. Epicenter by Pasadena.....	31.8 N.	116.3 W.
June 29.....	22	20.0	Colombia, South America, west coast.....	5 N.	77 W.
July 6.....	15	07.2	Near Santiago, Cuba, off coast.....	19 N.	75 W.
July 7.....	16	15.7	Lower California.....	28.0 N.	114.0 W.
July 9.....	12	56.2	South Pacific near New Hebrides.....	14 S.	167 E.
July 10.....	7	45.5	Near Japan Deep.....	41 N.	144 E.
July 12.....	19	24.1	Gulf of California.....	25 N.	110 W.
July 13.....	2	26.1	Mexico, off west coast. Approximately.....	21 N.	109 W.
Do.....	4	05.7	Gulf of California. Approximately.....	25 N.	110 W.
July 20.....	20	05.6	Near Tonga Deep.....	27.7 S.	176.9 W.
July 21.....	0	06.6	Lower California.....	29 N.	114 W.
Do.....	12	39.8	New Guinea.....	3.5 S.	137.5 E.
July 25.....	9	12.8	Mexico. Destructive.....	18.5 N.	104 W.
July 26.....	6	52.0	California, felt. Epicenter by Pasadena.....	35.8 N.	118.5 W.
July 27.....	21	19.7	East Indies, Sunda Islands, felt.....	7 S.	130 E.
Aug. 2.....	4	25.7	East Indies, Molucca Passage.....	1 N.	127 E.
Aug. 4.....	6	37.5	Off Kamchatka.....	51 N.	163 E.
Aug. 11.....	9	42.1	Aleutian Islands. Approximately.....	49 N.	166 W.
Aug. 12.....	3	24.1	Aleutian Islands.....	52 N.	168 W.
Aug. 13.....	20	56.3	New Zealand, off south coast.....	50 S.	165 E.
Aug. 14.....	4	39.6	Burma.....	27 N.	97 E.
Aug. 17.....	8	46.7	Guatemala, off coast.....	14 N.	92 W.
Aug. 21.....	4	15.5	Near Formosa.....	24 N.	122 E.
Aug. 24.....	3	40.1	Mexico, off west coast.....	17 N.	104 W.
Aug. 25.....	8	05.7	do.....	19 N.	107 W.
Sept. 3.....	11	59.0	Near Japan Deep.....	41 N.	144 E.
Sept. 8.....	1	41.2	Mexico, felt.....	18.5 N.	104 W.
Sept. 14.....	8	43.4	Alaska, felt.....	60 N.	147 W.
Sept. 15.....	11	13.5	Philippine Islands. Felt in Mindanao. Epicenter by Manila.....	5 N.	122 E.
Do.....	13	54.8	New Zealand. Destructive at Gisborne. Epicenter by Wellington.....	39.1 S.	178.6 E.
Sept. 23.....	14	22.2	Near Japan Deep. Epicenter by St. Louis.....	42.9 N.	138 E.
Sept. 26.....	19	20.8	Greece. Destructive.....	40 N.	24 E.
Sept. 29.....	3	57.3	do.....	40 N.	24 E.
Do.....	17	46.7	Near Kamchatka.....	47 N.	153 E.
Oct. 2.....	2	59.3	Nicaragua, felt at Managua.....	12 N.	86 W.
Oct. 3.....	4	37.5	Near Galapagos Islands, off Ecuador. Approximate epicenter.....	1 S.	93 W.
Oct. 11.....	19	08.4	Gulf of California.....	25 N.	110 W.
Oct. 16.....	12	08.1	Alaska Peninsula.....	54 N.	159 W.
Oct. 17.....	13	25.0	Near Solomon Islands. Approximately.....	7 S.	160 E.
Oct. 29.....	3	36.6	Mexico, near west coast.....	18 N.	105 W.
Oct. 30.....	20	47.1	Alaska Peninsula.....	54 N.	159 W.
Nov. 2.....	11	03.3	Near Easter Islands.....	24 S.	113 W.
Nov. 13.....	4	46.9	Sea of Japan.....	44 N.	137 E.
Nov. 17.....	6	02.8	Mexico, near west coast.....	18 N.	103.6 W.
Nov. 18.....	0	59.5	Guatemala, off west coast.....	14 N.	95 W.
Nov. 26.....	4	24.1	Near Japan Deep.....	42 N.	142 E.
Nov. 29.....	11	11.1	Chile, destructive.....	32 S.	72 W.
Dec. 3.....	6	19.9	Near Samoa Islands.....	14 S.	172 W.
Dec. 4.....	4	04.1	North Atlantic Ocean.....	35 N.	36 W.
Do.....	8	11.0	Celebes Sea, East Indies. Epicenter by Batavia.....	2.1 N.	121.9 E.
Do.....	10	32.8	do.....	2.9 N.	121.8 E.
Dec. 7.....	16	22.2	Mexico. Felt in Colima.....	19 N.	103.5 W.
Dec. 9.....	8	35.0	Peru.....	15 S.	75 W.
Dec. 19.....	6	28.9	Guatemala, near west coast.....	14 N.	92 W.
Dec. 20.....	2	39.5	Mexico. Destructive. Approximately.....	20 N.	105 W.
Dec. 21.....	6	10.2	Western Nevada. Destructive.....	38.7 N.	117.8 W.
Dec. 24.....	6	30.6	Near New Guinea.....	2 S.	147 E.
Dec. 25.....	2	04.5	Kansu Province, China. Destructive.....	39 N.	96 E.

MISCELLANEOUS SEISMOLOGICAL ACTIVITY**GEODETTIC WORK**

During the year 1932, three arcs of triangulations for the investigation of earth movements were completed in California. One arc extends northeastward from the coast in the vicinity of San Luis Obispo, another extends from San Fernando to Bakersfield, and the third is located in the vicinity of Taft. These arcs all consist of a main scheme of first-order accuracy with numerous second-order stations located in the vicinity of the fault lines.

At the beginning of the calendar year 1932, a field party was engaged in rerunning several lines of first-order levels in the area roughly bounded by Santa Barbara, Chatsworth, Burbank, Los Angeles, Ontario, Riverside, Santa Ana, and the Pacific coast. The releveling was completed in May 1932. Considerable movement of bench marks was found, especially in the southeastern portion of the area, and in December 1932 releveling was started on the line from Santa Ana to San Diego, Calif. This work was in progress at the end of the year.

HYDROGRAPHIC WORK

Vessels of the Coast and Geodetic Survey are directed to make reports of visible or felt effects of earthquakes. No shocks were reported.

TIDAL OBSERVATIONS

Tidal records from the numerous gages on the Atlantic and Pacific coasts were examined. No records of seismic sea waves were found.



PUBLICATION NOTICES

To make immediately available the results of its various activities to those interested, the Coast and Geodetic Survey maintains mailing lists of persons and firms desiring to receive notice of the issuance of charts, Coast Pilots, maps, and other 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)-----

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 publications referring to the subjects indicated:

- ☐ 109. Astronomic work.
- ☐ 109-A. Base lines.
- ☐ 109-B. Coast Pilots.
- ☐ 109-C. Currents.
- ☐ 109-D. Geodesy.
- ☐ 109-E. Gravity.
- ☐ 109-F. Hydrography.
- ☐ 109-G. Leveling.
- ☐ 109-H. Nautical Charts.
- ☐ 109-I. Oceanography.
- ☐ 109-J. Traverse.
- ☐ 109-K. Seismology.
- ☐ 109-L. Terrestrial magnetism.
- ☐ 109-M. Tides.
- ☐ 109-N. Topography.
- ☐ 109-O. Triangulation.
- ☐ 109-P. Cartography.
- ☐ 109-R. Airway maps.

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A catalog of the publications issued by all bureaus of the Department of Commerce may be had upon application to the Chief, Division of Publications, Department of Commerce, Washington, D.C. It also contains a list of libraries located in various cities throughout the United States, designated by Congress as public depositories, where all publications printed by the Government for public distribution may be consulted.