SMITHSONIAN MISCELLANEOUS COLLECTIONS
PART OF VOL. XLIX

CATALOGUE OF EARTHQUAKES

ON THE

PACIFIC COAST

1897 to 1906

BY

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(No. 1721)

CITY OF WASHINGTON
PUBLISHED BY THE SMITHSONIAN INSTITUTION
1907

WASHINGTON, D. C.,
PRESS OF JUDD & DETWEILER, INC.
1907

ACKNOWLEDGMENTS

This catalogue of earthquakes on the Pacific Coast has been compiled, at the request of the Secretary of the Smithsonian Institution, as a continuation of the catalogue prepared by Prof. Edward S. Holden, formerly director of the Lick Observatory, issued in 1898 in the series of Smithsonian Miscellaneous Collections No. 1087.

The sources of information are:

1. Records of United States Weather Bureau; the notes of regular and coöperative observers, made as nearly as practicable at the time of each earthquake and submitted at the close of each month.

2. Lick Observatory records, kindly furnished by Doctor Wallace Campbell, director of the observatory, including the lists of earthquakes in California in 1886-7-8, compiled by Prof. Charles D. Perrine and published as Bulletin Nos. 155 and 161 of the United States Geological Survey.

3. The records of the Students' Observatory at Berkeley, University of California, under the direction of Prof. A. O. Leuschner; the Chabot Observatory at Oakland, under the direction of Prof. Charles Burckhalter; the personal notes of Prof. A. G. McAdie, at San Francisco.

4. A manuscript list of earthquakes compiled by Prof. Harry Fielding Reid, of Johns Hopkins University, for the United States Geological Survey, the use of which was kindly granted by the Director of the Survey.

5. The records of the observatory at Mare Island, under Prof. T. J. J. See, and the official report upon the earthquake of March 30, 1898, furnished by Admiral H. W. Lyon, U. S. N.

ALEXANDER G. MCADIE.

CATALOGUE OF EARTHQUAKES ON THE PACIFIC COAST 1897 to 1906[1]

By ALEXANDER G. McADIE

1897. **January 1**; Berkeley; 1:10 p. m. Distinct shock; duration, 5 seconds; recorded on duplex seismograph at Students' Observatory.—Prof. A. O. Leuschner.

1897. **January 16**; Mount Hamilton; 3:58:41±5 a. m. Intensity II on R-F. scale.—Prof. W. W. Campbell.

3:58:35±5 a. m. R. F. I. Two rather long, slow waves, lasting one and a half or two seconds; scarcely any trace on duplex seismograph; did not start the Ewing instrument.—Prof. C. D. Perrine.

1897. **January 17**; San Francisco; 1:09:52 p. m. Sharp shock felt in all parts of the city. Two well-defined counter-vibrations of considerable force.—Prof. A. G. McAdie.

Two slight shocks about four seconds apart. Motion vertical.—Prof. George Davidson.

Oakland; Chabot Observatory. Seismograph showed heavy disturbance, vibrations mainly from east to west.—Prof. Charles Burckhalter.

Alameda; 1:11 p. m. Complicated record made on duplex principally east and west. The magnified record is 6 mm. long in this direction and 2 mm. north and south.—Prof. C. D. Perrine.

Oakland; 1:11:11 p. m. Reported by A. H. Babcock two sharp shocks about a second apart; time of second shock given and believed to be correct within a second.

1897. **January 17**; Oakland; 1:10:55±2 p. m. The shock was accompanied by a distinct report.—G. R. Lukens.

Mills College; 1:11 p. m. Shock short, but sharp and distinct. Reported by Josiah Keep. The duplex record shows an area of 7 mm. north and south and 4 mm. east and west, containing a great number of individual vibrations impossible to unravel. There are also one double wave and one or two single ones extending to the west (?) of the main disturbance.—C. D. P.

San Leandro.

[1] The Roman numerals I to X, placed next after the date, represent the intensity on the Rossi-Forel scale.

1897. January 20; Oakland. Reported at Chabot Observatory.

San Francisco.

1897. January 23; San Leandro.

1897. January 26; Newport, Oregon, 2:45 p. m. Sharp; lasted about 3 seconds.

1897. January 29; Niles; 3:03 a. m. Observer, Wm. Barry.

1897. February 16; Descanso.

1897. February 18; Mount Hamilton; 8:3:40 p. m. R.-F. I. and 8:4:30 p. m. R-F. 11. 8:3:52 p. m. doubtful.

1897. February 25; Descanso.

1897. March 6; Eureka, Cal. Earthquake from 9:28:30 a. m. to 9:29:10 a. m. There were five distinct shocks, increasing in violence to the third shock and then diminishing to the fifth. Slight tremors were felt for nearly two minutes after the first shock. The shocks followed each other at intervals of from five to ten seconds. The third shock rattled the doors and windows and swayed the building considerably. The movements were from the southwest to northeast. No gyratory movement perceptible. It was very dark along the whole line seaward, as if smoke had been belched up from the sea depths, covering fully fifteen degrees of the sky. Little or no wind at the time; barometer 29:55, temperature 40°.—A. H. Bell, Observer, Weather Bureau.

1897. March 15; Ukiah; 11 p. m. Vibrations north to south and lasted about ten seconds.

Highland Springs, near Lakeport, 10:51 p. m. Heavy shock, lasting 10 seconds.—W. B. Collier.

1897. May 14; Reno, Nevada; about 6 p. m., lasting several seconds; direction from north to south.

1897. May 15; Crescent City, Edmanton.

1897. May 15; San Diego; about 4 a. m. Light.

1897. May 15; Carson City, Nevada. Severe shock at 11:04 a. m., lasting 2 seconds. Seismograph showed vibration from northeast to southwest. Plaster broken in many buildings.

1897. May 22; San Diego; 6:58 a. m. Sharp, lasting 2 seconds.

1897. May 23; Crescent City.

1897. May 29; Crescent City.

1897. June 20; San Francisco; 12:14:40 p. m. Lasted 20 seconds; severe shock.—Prof. A. G. McAdie.

F. W. Edmonds, of U. S. Coast and Geodetic Survey, says there was a slight shock at 6:37 a. m. There was a tremor at 12:59 p. m. This shock stopped many clocks in San Francisco. Most of these stopped at 12:13 p. m. This disturbance was felt at Oakland, Berkeley, Campbell, Centerville, Hollister, Milton, Rio Vista, Sacramento, San José, San Leandro, Santa Cruz, Stockton, Napa, Niles, Mount Hamilton, College Park, Mills College, Gilroy, Salinas, Los Gatos, Templeton, Monterey, Pacific Grove, Modesto, Newman, Cantau Creek, Merced, Visalia, Santa Rosa, Haywards, Decoto, Watsonville, Hanford, Fresno, Gonzales, Redwood City, San Rafael.

Lick Observatory; 12:12:55 to 13:5 p. m. Direction, northeast and southwest; heavy; rocked pictures on the wall. Prof. W. W. Campbell. Both Ewing and duplex seismographs recorded the shock. record of duplex not complete; pen obstructed. The record is 16 mm. in length and north and south direction and 9 mm. east and west. The Ewing instrument gave all three components; duration slightly over 30 seconds; waves of considerable amplitude and slow, the greatest motion being east and west. The heaviest wave seems to have occurred one second after the commencement of the shock, the amplitude magnified being 16.3 mm., or an earth motion of 4.1 mm. east and west. There is also a north and south component of this wave of 6.3 mm. magnified, corresponding to an earth movement of 1.5 mm. Hence the greatest double amplitude of this wave is 4.4 mm. with a period of 1.5 seconds, which gives an intensity of 39 mm. per one second, or 11 on the Rossi-Forel scale. The next move recorded by the east and west pen is probably the one of greatest intensity, although of small magnitude; amplitude, 0.25 mm.; time, 0.37 second, from which intensity would be IV on the R.-F. scale. The greatest vertical disturbance occurred about the middle of the shock, when the record showed four waves of 4 mm. double amplitude magnified with an average period of about 2 seconds. The whole shock exhibits marked irregularities; none of the waves are smooth, but all have lesser vibrations superposed upon the larger.

College Park. The seismograph at the University of the Pacific registered the shock. The tracing is very complicated and is three times the size of the tracing by a similar instrument at the Lick. The axis of greatest disturbance is northwest and southeast, the record measuring 50 mm. in this direction. At right angles to this the record measured 28 mm. Allowing for a magnification of 4.0 diameters, this makes the greatest actual motion of the earth about 12 mm.

Mills College, 12:13 p. m. Severe, set chairs to rocking; double, the latter part being heavier. Total length of tracing northeast and southwest is 30 mm. and at right angles to this 18 mm. A compact mass of vibrations covering 8 mm. in diameter, from

which there extends on all sides several larger excursions of the pen.—Josiah Keep.

Cantau Creek, Fresno County. At 12:13 p. m. S. C. Lillis felt shock, duration about 15 seconds, ninth shock; undulation and whirling motion.

San José. Almost every clock in town stopped.

Gilroy. Much damage done to brick buildings; chimneys all over town cracked or demolished and plastering fell to floor. Sargents reports destruction of adobe building.

Hollister. Scarcely a brick building in town that has not suffered. Top of north fire wall of McMahon House fell upon adjoining buildings. Much window glass broken.

Salinas. Much damage done. Firewalls tumbled into street; chimneys down and plate glass cracked.

Monterey. Portion of adobe wall of San Carlos Mission Church fell, frightening worshipers, and several fainted.

Gonzales. Heaviest earthquake ever felt in this locality occurred today. The vibrations were from north to south and lasted a full quarter of a minute.

Fresno. Duration variously estimated at from 3 to 10 seconds. Hughes Block and Temple Bar buildings shaken. No damage reported, but a general feeling of alarm. At the residence of T. C. White a vase was broken.

Redwood City. Shock rang the bell in the dome of the new High School building and cracked the plaster in some of the old buildings.

Oakland; 12:13:35 p. m. The big clocks of the city were stopped at thirteen minutes after the hour of noon today by as violent an earthquake as ever visited Oakland. The shock probably lasted seven seconds, although it seemed much longer. It was followed by another decided tremor, which, however, was not comparable with the first. The excitement for a time was great. People ran out of their houses and into the middle of the street. In all the big churches of the city the congregations were attentively listening to sermons, and the shock abruptly ended several of these services. As far as can be learned, there were no windows broken or other actual damage done, although many are complaining that valuable china and glass ware were knocked from tables and shelves and ruined. The seismograph at the Chabot Observatory shows that there were three distinct tremors. The direction of the first was from northwest to southeast, while the others were from northeast to southwest. The successive tremors lasted a trifle over eight seconds and the time recorded at the observatory is 12h. 13m. 35s. The quake was distinctly felt in Berkeley, Alameda, and other towns in the vicinity.

1897. **June 21**; Gilroy. Light shock at 5:15 a. m.

Salinas. Light shock just after midnight.

1897. **June 24**; Santa Barbara. Light shock at 6:10 a. m.

1897. **July 14**; Niles. Light shock at 10:19 p. m.

1897. **July 18**; Castle Pinckney.

1897. **July 19**; Santa Barbara. Two strong shocks at 11:45 p. m. The first shock lasted about 4 seconds; second shock much stronger, but of shorter duration; caused the old tower-clock bell to strike.

1897. **July 26**; San Francisco; 5:40:35 p. m. Moderate shock; lasting about 2 seconds; quick, jerky motion.—Prof. A. G. McAdie.

Mount Hamilton; 5:40:50 p. m. The duplex seismograph shows a small mark, which, however, more resembles creeping of pen than an earthquake.—Prof. E. S. Holden.

Alameda. Mr. Perrine's seismograph gives a record of the shock, which, however, was very light—only one or two irregular, short waves.

Berkeley; 5:42 p. m. Vibrations east and west.

Oakland. Very light. At Chabot Observatory the instruments showed only a slight mark on the plate. Duration, about 3 seconds.

1897. **August 19**; Ukiah.

1897. **September 2**; Hollister.

1897. **September 6**; Descanso.

1897. **September 17**; Eureka. Quite a severe shock at 9:10 p. m., lasting over 40 seconds. Motion south to north and very steady. No gyratory movement noticed. Barometer 30:03, temperature 74°, wind light.—A. H. Bell, Observer.

1897. **September 22**; Descano.

1897. **September 27**; Olympia, Washington. Light shock at 1:30 a. m.

1897. **October 2**; Campbell, Niles.

Niles; 8:41 a. m.—Wm. Barry.

College Park; 8:41:57 a. m. Shock quite marked, especially on upper floors of building.—Prof. H. D. Curtis.

San Francisco; 8:42 a. m.; intensity II, R.-F. scale.—Mr. W. M. Pierson.

Santa Cruz; 8:45 a. m.; also at Alma.

1897. October 5; Stockton; 7:44 p. m.

1897. October 17; Campbell; San José, 3:30 p. m.

Niles; 3:30 p. m. Heavy shock.—Wm. Barry.

Lick Observatory; 3:30:26 31 p. m. Record on duplex, entirely southeast and northwest.

San Francisco; 3:30:30 p. m.—A. G. McAdie.

1897. October 27; Descanso.

1897. October 28; Eureka. Slight earthquake shock reported as having occurred at 5:30 p. m. Barometer 30:06, temperature 62.

1897. November 8; Lick Observatory; 3:30:8 p. m.

1897. November 12; Descanso.

1897. November 21; Randsburg; 11:30 a. m. and 12:30 p. m.

1897. November 22; Descanso, Escondido, Fallbrook.

1897. November 25; Eureka. Slight shock of earthquake from 5:20 to 5:20:07 (?). Movement all lateral, west to east, in three successive jolts. Windows and doors rattled slightly. Barometer about 30:25, temperature 38.

1897. November 27; Eureka. Slight shock at 7:8 to 7:8:5 a. m. Buildings swayed considerably and windows and doors rattled loudly.

1897. December 6; Forest Grove, Oregon; 8:30 p. m. Slight.

1897. December 10; Lick Observatory. Slight shock felt by several persons after midnight. Barely a trace on the duplex. Ewing instrument not started.

1897. December 15; Waterville, Washington. Duration, 4 to 6 seconds; direction, northwest to southeast.

Lakeside, Washington. Severe.

1897. December 16, 17, and 20; Lakeside, Washington. All light.

1897. December 23; San Francisco; 5:20 a. m. Double tremors.—Prof. A. G. McAdie.

Mills College; 5:15 a. m. Distinct shock.—Josiah Keep.

1897. December 26; Niles; 7:06 a. m. Direction, north and south; duration, 5 seconds.—Wm. Barry.

1898.—January 1; Peachland.

Santa Rosa. Two distinct shocks shortly after 5 a. m.; west to east; duration, 25 seconds.

1898. **January** 29; Eureka. Light earthquake was felt at 4:04 a. m. and lasted about 8 seconds. Doors and windows rattled. Barometer 30:32, temperature 38.

1898.—**February** 6; Bishop.

1898. **February** 7; Lick Observatory; 0:38:03 a. m. A single tremor; then, after 2 seconds, two rather long waves, north and south, lasting 1½ to 2 seconds. R.-F. I and II.—Prof. C. D. Perrine.

1898. **February** 15; Bishop (five distinct shocks).

1898. **March** 2; 1:52 p. m. The shock was light and did no perceptible damage.—J. P. Bolton, U. S. Weather Bureau.

1898. **March** 3; Descanso.

1898. **March** 7; Pacific Ocean midway between Mazatlan and Hawaiian Islands. Barkentine "Portland," Capt. Larsen, reported four shocks; first at 10:12 p. m., G. M. T., very severe and lasted 20 seconds; milder shock 30 minutes later, and two more during afternoon. Weather nearly calm.

1898. **March** 17; Upper Lake.

Highland Spring, at midnight; west to east.

1898. **March** 30; Lick Observatory; 11:42:22 p. m.; duration, 40 seconds. A heavy shock. Good record on duplex instrument.

San Francisco; 11:42:38 p. m. One of the severest earthquakes experienced in San Francisco; intensity VII on the R.-F. scale; chimneys twisted, chandeliers broken, and considerable damage done in the city; duration, about 40 seconds; vibrations southwest to northeast and violent gyratory motion.—A. G. McAdie.

Alameda, College Park, Carson, Nevada (11:45 p. m.), Agnews, Campbell, Fort Ross, Antioch, Auburn, Benicia, Bolinas, Colusa, Lodi, Martinez, Monterey, Pacific Grove, Del Monte, Port Costa, Petaluma, Sonoma, San José, Georgetown, Hollister, Iowa Hill, Lytton Springs, Niles, North San Juan, Oakland, Oleta, Peachland, Santa Rosa, Rio Vista, Sacramento, San Leandro, Santa Cruz, Stockton, Upper Lake, Vacaville, Vallejo, and West Point.

Napa; 11:44 p. m. Heavy. W. H. Martin.

Chabot Observatory, Oakland. Professor Burckhalter gives the time as 11:42 p. m. Intensity V on R.-F. scale. Stopped mean time clock.

Berkeley; 11:42:26 p. m.; duration, 14 seconds; direction, east to west and north to south and also vertical.

This earthquake wrought such damage at Mare Island Navy Yard that it may properly be known as the Mare Island earth-

quake. Fortunately the loss of life was small, owing to the hour. Had the shops been crowded there probably would have been many fatalities.

Admiral H. W. Lyon, U. S. N., has furnished the following information:

"On the night of March 30, 1898, at 11:40 p. m., there was an earthquake at this yard which lasted forty seconds. The violence of the shock was greater than any shock previously experienced on this island, as far as can be learned from the oldest inhabitants.

"A detailed account of the damages done is set forth in a report to the commandant, dated April 5, 1898.

"Upon the recommendation of the Secretary of the Navy, both Houses of Congress being at that time in session, very promptly made an appropriation of $350,000 to repair and reconstruct buildings and property damaged by the earthquake."—From annual report of Civil Engineer R. C. Hollyday, U. S. N., dated August 1, 1898.

In addition to the appropriation of $350,000 made by Congress, a separate appropriation was made for a new hospital of about $95,000.

1898. **April 7**; Napa; 12:30 a. m.—W. H. Martin.

1898.—**April 12**; College Park; 4 p. m.

1898. **April 14**; San Francisco; 10:53 p. m. and 11:7 p. m. Short, gentle, shocks.—A. G. McAdie.

Oakland, Chabot Observatory; 11:9:13 p. m. Intensity V on R.-F.—Prof. C. Burckhalter.

Napa. Two shocks at 10:45 and 11:10 p. m.—W. H. Martin.

Eureka; 10:50 and 11:10 p. m. Latter shock heavier. Big city clock stopped.

Mendocino. Much damage to property; many chimneys thrown down and cracked; many monuments in Evergreen Cemetery thrown, twisted on bases.

Little River. On stage road from Mendocino to Ukiah many trees down.

Point Arena. Much damage. Lighthouse tower cracked for several feet and lights extinguished.

Greenwood. Four houses wrecked and portion of wharf destroyed. Stages for interior compelled to return, as roads were impassable. Vessels in harbor felt grinding motion. In lumber yards, stacks blown down.

Ukiah. There were 22 distinct shocks in this city.

Fort Bragg; 11:05 with vibrations from south to north, and again at 11:22 heavier shock, which continued for 15 seconds, vibrations from west to east.

Mills College; 11:5 p. m.

Alameda. Mr. Perrine's seismograph gives a record of an extensive shock. Waves clearly marked into east and west, north and south, and southeast and northwest.

College Park; 11:10:39 p. m.

Berkeley. Ewing seismograph records only one shock although two were felt by many persons. "The disturbance commenced with minute vibrations in all three components, which gradually increased in the north-south and the east-west components, reaching a first maximum in the east-west direction at thirty-seven seconds (reckoned from the beginning), and a second and principal one at seventy-two seconds. The principal disturbance in the north-south direction commenced at about thirty-two seconds and lasted to the fiftieth second. During this interval the intensest vibration occurred at forty-nine seconds, almost exactly from south to north. . . ." "By treating the displacement as belonging to a simple harmonic motion, the actual velocity of the ground at forty-nine seconds is found to be 0.47 inch (12 mm.) per second, and its actual acceleration 1.29 inches (33 mm.) per second. . . . The velocity of the greatest westerly displacement is 0.13 inches (3 mm.) and acceleration 0.32 in. The greatest displacements were north-south 0.34 inch; east-west 0.10 inch."—Prof. A. O. Leuschner.

1898. **April 16**; Crescent City; 5:40 a. m. R.-F. III or IV.

1898. **April 18**; Prairie Camp (Mendocino County). Nine severe shocks. Possibly the shocks of April 14.

1898. **April 21**; Descanso.

1898. **April 25**; Albion, Mendocino. Severe shock.

1898. **April 26**; College Park; 10:30 p. m. Recorded on seismograph and also felt. (Explosion of Santa Cruz powder works (?).—C. D. P.)

1898. **April 30**; Claremont, Pomona.

1898. **May 2**; College Park; 6:2 a. m.—H. D. Curtis.

Salinas. Two distinct shocks at 6:5 a. m.

Santa Cruz.

1898. **May 9**; Gilroy, about 7 a. m. Light.

1898. **May 17**; Cedarville.

1898. **May 19**; Cedarville.

1898. **May 20**; Lick Observatory. Light shock; 6:48:53 a. m.

College Park; 6:49 a. m.—H. D. Curtis.

1898. **May** 22; College Park; 11:15 a. m. Left a mark one-eighth inch on seismograph.—H. D. Curtis.

1898. **May** 28; Hollister.

1898. **May** 29; Santa Barbara; 7:3 p. m. Light.

1898. **May** —; Fort Bragg. Frequent shocks.

1898. **June** 3; Los Olivos; 10:20 p. m. Felt throughout the Santa Ynez Valley.

Santa Barbara; 10:18 p. m. Heaviest for some years. Vibration from east to west.

1898. **June** 8; Ukiah.

Point Arena; 11:30 a. m. Two severe ones. Another at 1 p. m.

1898. **June** 9; Ukiah, Upper Lake.

1898. **June** 11; Ukiah.

1898. **June** 23; Descanso.

1898. **June** 24; Descanso.

1898. **June** 30; Los Angeles; 11:26 p. m. Sharp.

1898. **August** 7; Oakland, Chabot Observatory. Charles Burckhalter, observer. 2:6:00 p. m. Duration, 5 seconds; direction of vibration, southwest to northeast; intensity III on R.-F. scale.

San Francisco; 11:57 a. m.—A. G. McAdie.

Berkeley; 11:58 a. m. Direction, northwest. Light shock.

1898. **August** 12; Alameda. Several vibrations, covering an area of 9 mm. east and west by 4 mm. north and south.—C. D. P.

Mills College; 6:10 a. m.—Josiah Keep.

1898. **August** 19; Albion; 2:30 p. m.—R. B. Funk.

1898. **August** 28; San Leandro.

Berkeley (?). Very light shock, southeast to northwest.

1898. **August** 31; San Leandro.

1898. **September** 9; Eureka. Quite a severe shock of earthquake occurred at 12:53 p. m., lasting about 5 seconds; the movement was from southeast to northwest; the building in which office is located shook considerably.

1898. **October 13**; Bishop.

1898.—**October 15**; Ukiah.

1898. **October 19**; Eureka. Light shock of earthquake occurred at 11:35 p. m. Barometer about 29:98, temperature about 46.

1898. **October 23**; San Bernardino.

1898. **October 25**; Oakland, Chabot Observatory. Prof. Chas. Burckhalter; 3:15:17 p. m.; duration, 5 seconds; direction of vibration, southwest to northeast; intensity, II on R.-F. scale. Very feeble shock, direction circular.

1898. **October 27**; Lick Observatory; 2:22:24 p. m. Northeast and southwest. R.-F. II. Duplex shows a single nearly straight line.

1898. **November 5**; Summerdale.

Lick Observatory; 9:9:8 p. m.

1898. **November 14**; Niles; 1:10 p. m.; second shock, 1:57 p. m. Observer, Wm. Barry.

1898. **November 19**; Lick Observatory; 11:27:1. Three close vertical shocks; last two very light, first one fairly strong.—Prof. W. W. Campbell.

1898. **November 25**; Eureka. Light shock of earthquake occurred at 9:22 p. m. Barometer about 30:18, temperature about 35°.

1898. **December 7**; San Leandro.

Niles; 7:29 p. m. Observer, Wm. Barry.

Alameda; 7:38:47 p. m. R.-F. III or IV. Direction, east and west; duration, 4 seconds. A grinding noise preceded the heaviest shock. Seismograph (duplex) shows jagged irregular mark 3½ mm. northwest and southeast by 1½ mm. at right angles.—Prof. C. D. Perrine.

1899. **January 2**; Guerneville; 5 a. m.

1899. **January 6**; Berkeley; 2:41:28 a. m. (?).

1899. **January 9**; Berkeley. Ewing seismograph records slight southwest motion; duplex seismograph shows slight southeast motion.

1899. **January 10**; Berkeley. Ewing records southwest motion; duplex records northeast.

1899. **January 11**; Berkeley. Ewing records southwest motion.

1899. **January 12**; Lick Observatory; 11:40:29 p. m. Intensity II.

1899. **January 13**; Suisun, Sonoma.

Napa; 1:20 p. m. Sharp.—W. H. Martin.

1899. **January 24**; San Bernardino.

1899. **February 3**; Lick Observatory; 9:8:57 (?).

1899. **February 10**; Napa-Calistoga. Sharp shock reported at Calistoga at 10:10 a. m.—W. H. Martin.

1899. **February 18**; Crescent City; 4:40 a. m.

1899. **March 7**; Ukiah.

1899. **March 30**; Point Arena; 9:50 a. m. Intensity IV.

1899. **April 4**; Berkeley; 5:46:20 a. m. Felt at 2023 Bancroft Way by S. D. T. 5:46:22 a. m. noted by H. K. P.

Alameda.

Mills College.

1899. **April 5**; Oakland, Chabot Observatory. Direction circular; intensity II on the R.-F. scale.

1899. **April 14**; Cuyamaca.

1899. **April 16**; Eureka. One of the severest shocks of earthquake ever experienced here occurred at 2:41 a. m. The vibrations were from south to north and lasted about 15 seconds. Although the shock was violent and long-continued, the only report of damage came from Dolbeer and Carson's lumber mill, where the shock loosened the iron flue connecting boilers and smokestack, and in consequence the mill was closed pending repairs. Barometer about 30:11 inches, temperature about 46°.

1899. **April 16**; Hydesville.

1899. **April 18**; Hydesville.

Eureka. Light shock of earthquake was felt at 4:53 a. m. The vibrations were from east to west, and lasted about 5 seconds. Barometer about 30:05, temperature about 46°.

1899. **April 24**; Fort Bragg; 10:10 p. m. and again at 10:20 p. m.

1899. **April 30**; Berkeley; 2:41:30 p. m. Duration, 14 seconds; principal motion west; slight motion to north. R.-F. II. First shocks 2 seconds; first half second 3 distinct vibrations; total displacement,

1/25 inch. Felt also at Alvarado, Campbell, Capitola, Coyote, Gilroy, Glenwood, Hollister, Los Gatos, Monterey, San José, Oakland, Pacific Grove, Salinas, San Leandro, Santa Cruz, Soledad, Stanford University, Stockton, Modesto.

Oakland, Chabot Observatory; 2:41:29 p. m. Observer, Prof. Burckhalter; duration, 10 seconds; direction, southeast to northwest; intensity III.

Niles; 2:41 p. m. Observer, Wm. Barry.

Lick Observatory; 2:41:15 to 2:41:39 p. m.—Dr. C. D. Perrine. Time, 2:41:21-24.—Dr. W. W. Campbell. "A long-continued shock; waves long and rather even; heaviest disturbance after the first 10 or 12 seconds." Intensity R.-F. III or IV.
San Francisco; 2:41:35 p. m.—A. G. McAdie.

1899. **May 2**; Vallejo; 5:37:35 p. m. Intensity I.

1899. **May 3**; Vallejo; 5:24:54 (?). Intensity I.

1899. **May 10**; Mare Island; 5:21:48 p. m. Intensity III.

1899. **May 13**; Bishop.

1899. **May 15**; Lick Observatory; 6:54:20 p. m. Intensity I.

1899. **June 1**; 11:20 p. m. Campbell, Capitola, Livermore, Mills College, Morena Dam, Napa, Peachland, Stanford University.

Oakland, Chabot Observatory; 11:19:26 p. m. Observer, Prof. Burckhalter; duration, 8 seconds; direction, southwest to northeast; intensity IV. Stopped mean time clock 11:19:26 p. m. and the Ferry clock at San Francisco 11:19:14 p. m.

San Francisco; 11:19 p. m. Stopped three clocks in Weather Bureau Office.—A. G. McAdie.

Niles; 11:18 p. m. Two sharp shocks. Observer, Wm. Barry.

Napa; 11:18 p. m.—W. H. Martin.

Berkeley; 11:19:07 p. m. Direction, north to south.

1899. **June 3**; Oakland.

1899. **June 5**; Bradley.

1899. **June 11**; Keeler, Milo, Porterville.

Mare Island; 12:56:31 p. m., 12:56:38 p. m., 12:56:52 and 12:56:56 p. m.

1899. **June 13**; College Park, Vallejo, San José, Napa.

San Francisco; 5:39:31 a. m.—A. G. McAdie.

Berkeley; 5:39:40 a. m. Light shock, with westerly direction predominating. Total displacement less than 1.5 inch.—Prof. A. O. Leuschner.

1899. **June** 19; Mare Island; 12:13:25 p. m. One jolt.

1899. **June** 21; Berkeley; 2:52:17 a. m.

1899. **June** 21; Mare Island; 6:46 a. m. Intensity III.

1899. **June** 25; San Miguel.

1899. **July** 6; Boulder Creek, Campbell, Capitola, Coyote, Elmwood, Gilroy, Glenwood, Gonzales, Hollister, Lathrop, Le Grande, Los Gatos, Merced, Milbrae, Modesto, Mount Eden, Napa, Niles, Oakland, Pacific Grove, Salinas, San José, Santa Cruz, Stockton.

Oakland; Chabot Observatory; 0:09:35 p. m. Observer, Prof. Burckhalter; duration, 20 seconds; direction, northeast to southwest; intensity III.

San Francisco; 12:09:40 to 12:10:11 p. m.—A. G. McAdie.

Niles; 12:08 p. m. Observer, Wm. Barry.

Napa; 12:10 p. m.—W. H. Martin.

Lick Observatory. Moderately strong shock; 12:09:29 p. m. Good record on both instruments.

San Luis Obispo.

Berkeley; 7:09:57 p. m.

1899. **July** 22; San Diego; 0:31:30 p. m. Intensity III R.-F.; vibrations east to west. Stopped the office clock at the Weather Bureau.—F. A. Carpenter, U. S. Weather Bureau.

Los Angeles. Quite a heavy shock at 0:37:22 p. m.—A. B. Wollaber.

1899. **August** 4; Berkeley; 12:44:29 p. m. Direction south to east (?).

1899. **August** 4; Lick Observatory. Very light shock. Prof. Tucker was the only one on the summit who noticed it. His time is 12:44 p. m. A telephone message from Saratoga reports it quite severe there. Neither seismograph showed the least record.—R. T. C.

San Francisco; 12:45:30 p. m. Three or four waves.—A. G. McAdie.

Napa; 12:45 p. m.—W. H. Martin.

1899. **August** 4; Ben Lomond, Boulder Creek, Campbell, Capitola, Glenwood, Lathrop, Los Gatos, Napa, Oakland, San José, Santa Cruz, Tequisquita.

Oakland; Chabot Observatory; 0:44:10 p. m. Observer, Prof. Burckhalter; duration, 6 seconds and 2 seconds; direction uncertain; in-

tensity III. Double shock; first lasted 6 seconds, an interval of 4 seconds, then the shock of 2 seconds.

Niles; 12:45 p. m. Observer, Wm. Barry.

1899. **August** 5; Ben Lomond, Boulder Creek, Campbell, Capitola, Glenwood, Lathrop, Los Gatos, Napa, Niles, Oakland, San José, Santa Cruz, Tequisquita.

Niles; 9:42 p. m. Observer, Wm. Barry.

Lick Observatory; 9:42 p. m. Noticed by Mrs. Keeler and Mrs. Painter.

San Francisco; 9:41:30 p. m.—A. G. McAdie.

Berkeley; 9:41:30 p. m.

1899. **August** 21; San Diego.

1899. **September** 13; Berkeley. Slight shock recorded on duplex.

1899. **September** 16; San Miguel, San Luis Obispo.

Lick Observatory, about 7 a. m. Attachment on duplex Ewing instrument did not go off. The shock was felt by Paul Soto; time, about a quarter past 7.

1899. **September** 20; Needles.

1899. **October** 11; Moreno Dam.

Lick Observatory; 8:57:42 to 47 (?). Intensity III.

1899. **October** 12; Cuyamaca, Peachland, Santa Rosa.

1899. **October** 14; Berkeley; 10:23:05 p. m.

1899. **October** 28; Moreno Dam.

1899. **November** 9; Lick Observatory.

1899. **November** 16; Napa; 7:10 p. m.—W. H. Martin.

1899. **November** 22; Berkeley; 1:17:06 p. m. Direction, east to west.

1899. **December** 12; Chico.

1899. **December** 13; Chico.

1899. **December** 19; Chico.

1899. **December** 20; Chico.

1899. **December 25**; Arcadia, Banning, Claremont, Crafton, Cuyamaca, Duarte, El Cajon, Elsinore, Escondido, Fall Brook, Follows Camp, Girard, Hemet, Indio, La Mesa, Long Beach, Monte, Moreno Dam, Napa, Needles, North Ontario, Norwalk, Ontario, Palm Springs, Pomona, Ravenna, Riverside, San Bernardino, San Dimas, San Jacinto, Sierra Madre, Tehachapi, Tustin, Whittier, Redlands.

San Diego; 4:25:19 a. m. Intensity IV R.-F. Most severe shock for years.—F. A. Carpenter, U. S. Weather Bureau.

Los Angeles. Severe shock at 4:25:20 a. m. Three shocks at intervals of about half a minute.—Observer, U. S. Weather Bureau.

1900. **January 1**; San Jacinto.

1900. **January 2**; San Jacinto.

1900. **January 4**; San Jacinto.

1900. **January 5**; Napa.

1900. **January 6**; Los Gatos.

1900. **January 9**; San Jacinto.

1900. **January 13**; San Jacinto.

1900. **January 14**; Campbell, Niles, San Leandro.

Niles 11:27 a. m.—Wm. Barry.

Napa; 11:30 a. m.—W. H. Martin.

Lick Observatory; 11:26:14 a. m. Sharp shock record on duplex. Ewing started, but did not run properly.

1900. **January 15**; San Jacinto.

1900. **January 21**; Eureka. Light earthquake occurred at 4:11 a. m., lasting about 20 seconds. The vibrations seemed to be from southeast to northwest. Barometer about 30:08, temperature about 44.

1900. **January 27**; San Jacinto.

1900. **January 28**; Moreno Dam.

1900. **January 31**; Peachland.

1900. **January —**; Palm Springs (frequently during first part of month).

1900. **February 2**; Claremont.

1900. **February 7**; San Jacinto.

1900. **February 8**; Berkeley; 4:40 a. m. Light shock.

1900. **February 9**; Petaluma; 4:30 a. m. Intensity VI.

San Jacinto.

1900. **February 13**; Cuyamaca.

1900. **February 28**; Winnemucca, Nevada. Heavy earthquake shock felt at 1:30 p. m. Vibrations west to east for about 8 seconds. Although the shock was severe enough to give a good shaking, no damage resulted.—W. J. Olds, U. S. Weather Bureau.

1900. **March 18**; San Jacinto.

1900. **March 12**; Mills College; 6:45 a. m. Intensity I or II.

1900. **March 20**; Peachland.

1900. **March 21**; Claremont.

1900. **March 26**; Napa, Vacaville, Vallejo.

Napa; 6:50 a. m.—W. H. Martin.

1900. **March 31**; Lick Observatory; 1:51:40 p. m. Intensity III.

1900. **April 5**; 5:47 a. m.

1900. **April 9**; Fallbrook.

1900. **April 14**; Eureka. Light earthquake shock occurred at 6:41 a. m.; duration about 8 seconds; vibrations from east to west. Barometer about 30:16, temperature about 49.

1900. **April 15**; San Jacinto.

1900. **April 16**; San Jacinto.

Napa; two shocks at 1:45 p. m.—W. H. Martin.

1900. **April 23**; Cuyamaca.

1900. **April 30**; Lick Observatory; 2:41:14-39 p. m. Intensity III or IV. Berkeley, Decoto, San Carlos, Oakland, San José, Stockton, San Francisco, Alameda, San Quentin, Salinas, Monterey, Modesto, Los Gatos, Pacific Grove.

1900. **May 10**; San Jacinto.

1900. **May 20**; Mount Eden.

Niles; 5:05 a. m. Heavy.—Wm. Barry.

1900. **June 9**; San Ardo.

1900. **June 13**; San Francisco; 5:39:5 a. m. Intensity II.

Berkeley, Mare Island, College Park.

1900. **June 17**; Mare Island; 12:56:31½ and 12:56:55½ (?).

1900. **June 19**; Cuyamaca.

Mare Island; 12:13:25 p. m. Intensity I.

1900. **June 20**; Cuyamaca.

1900. **June 21**; Mare Island; 6:45:52 a. m.

1900. **June 26**; Keeler.

1900. **July 10**; Lick Observatory. Light short shock felt by Prof. Tucker and Dr. Crawford; no record on either seismograph; time, about 7:30 a. m.

1900. **July 12**; Branscomb.

1900. **July 13**; Branscomb.

1900. **July 23**; San Diego; 6:40 a. m.

1900. **July 28**; San José.

Lick Observatory; 0:20:56 p. m.; duration, 4 seconds; intensity R.-F. II. Slight record on duplex.

1900. **July 29**; Mills College; 5:7 a. m.

San Francisco; 7:25 (?). Intensity II or III.

1900. **August 16**; Ferndale.

Eureka. Very light earthquake occurred at 8:58 a. m., lasting a few seconds; the vibrations were from south to north. Barometer about 30:07, temperature about 58°.

1900. **August 18**; Elsinore.

1900. **August 19**; San Jacinto.

1900. **August 31**; Mills College, Niles, San José, Stanford University, Tequisquita.

Oakland, Chabot Observatory. Observer, E. W. 7:21:10 p. m. Intensity II.

Niles; 7:21 p. m.—Wm. Barry.

Berkeley; 7:21 p. m.

Lick Observatory; 7:21:1 p. m.

1900. **September 10**; Berkeley; 1:57:32 p. m.

1900. **September 12**; Berkeley; 8:13:31 p. m. Light shock.

1900. **September 19**; Oakland, Chabot Observatory. Midnight; intensity II.

Berkeley; 11:54 p. m.

1900. **September 28**; Gilroy; 4:17 a. m. Intensity V.

1900. **September 28**; Tequisquita Rancho.

1900. **October 1**; Eureka. Light earthquake shock occurred at 6:15 a. m.; vibrations from east to west. Barometer about 29:87, temperature about 55°.

1900. **October 18**; San Luis Obispo.

1900. **October 24**; Tequisquita Rancho.

1900. **November 5**; Cuyamaca.

1900. **November 8**; Branscomb.

Westport; 8:15 to 8:50 (?). Two shocks.

1900. **November 13**; Penn Grove; 9:59 a. m. Intensity IV.

1900. **November 14**; Fall Brook.

1900. **November 19**; Cuyamaca, Moreno Dam.

1900. **November 24**; Oakland, Chabot Observatory. Observer, Prof. Burckhalter. 2:20:12 a. m.; duration, 8 seconds; direction, southwest to northeast; intensity II.

1900. **November 25**; Napa; 12:45 a. m.—W. H. Martin.

Berkeley; 12:39 a. m. Light shock.

1900. **December 5**; Lick Observatory; 10:24:14 a. m. Intensity I.

1900. **December 30**; San José.

Lick Observatory; 8:06:0 p. m. Timed by several. Slight mark on duplex. Plate of Ewing started, but not the clock.

1901. **January 11**; Ukiah.

1901. **January 21**; Berkeley, Mills College, Niles, Oakland, San Francisco.

Niles 11:00 p. m.—Wm. Barry.

1901. **January** 23; Ukiah.

1901. **January** 25; Tequisquita Rancho.

1901. **January** 28; Tequisquita Rancho.

1901. **February** 5; Berkeley; 5:42:12 p. m.

1901. **February** 13; Berkeley; 4:42:35 a. m. Severe enough to rattle windows and furniture.

1901. **February** 13; Kentfield, Mills College, Napa, Oakland.

Oakland, Chabot Observatory. Observer, Prof. Burckhalter. 4:42:10 a. m.; duration, 8 seconds; direction, northeast to southwest; intensity II.

Napa; 4:42 a. m.—W. H. Martin.

San Francisco; 4:43:12 a. m.—A. G. McAdie.

1901. **February** 18; San Francisco; 6:30 a. m.—A. G. McAdie.

1901. **March** 2; Hollister, Huron, Paso Robles, Porterville, San Ardo, San Miguel, Santa Maria, Summerdale, Visalia.

Lick Observatory. Good record duplex and Ewing, but coördinates not worked up.

San Francisco; 9:37:30 p. m.—A. G. McAdie.

1901. **March** 3; San Francisco, San Luis Obispo.

1901. **March** 4; Porterville, San Francisco.

1901. **March** 5; Paso Robles, Porterville.

1901. **March** 6; San Ardo, San Luis Obispo.

1901. **April** 13; Tequisquita Rancho.

1901. **April** 14; Palomar Mountain.

1901. **April** 19; Alameda. Intensity III (?).

1901. **May** 22; Cuyamaca, Escondido, Palomar Mountain, San Jacinto.

1901. **June** 3; San Luis Obispo.—John R. Williams, U. S. Weather Bureau.

1901. **June** 26; Point Lobos, San Francisco.

Berkeley; 2:41:16 p. m. Direction northwest to southeast; light; and again, at 4:55:45 p. m., light northwest to southeast.

1901. **July** 30; San Luis Obispo; 11 a. m.—J. R. Williams.

1901. **August 7**; Boulder Creek, Los Gatos, Mills College, San José, Santa Cruz, Tequisquita Rancho.

Niles; 2:23 a. m.—Wm. Barry.

Lick Observatory. Intensity I or II.

1901. **August 10**; Hollister.

1901. **August 14**; Cayucos, Hollister, Santa Cruz, 3:11 a. m.

San Luis Obispo, Salinas.

1901. **August 17**; San Francisco; 8:37:34 (?).—A. G. McAdie.

1901. **August 18**; San Leandro.

1901. **September 2**; Berkeley. Time not given. Light shock on duplex northwest to southeast, then toward west to northwest.

1901. **September 3**; Berkeley; 7:01 (?). Direction northeast to southwest; light shock, lasting a few seconds.

1901. **September 3**; Salinas.

Berkeley. Light shock on duplex toward southeast by east at 12 midnight.

1901. **September 4**; Berkeley; 4:30 (?). Direction, east to southeast; light shock.

1901. **September 17**; San Jacinto.

1901. **September 21**; Branscomb.

1901. **September 22**; Branscomb.

1901. **September 23**; San Jacinto.

1901. **October 12**; Berkeley; 4:35 p. m. light shock.

1901. **October 13**; Mills College.

1901. **October 29**; Oakland, Peachland, Santa Rosa, Sonoma.

Napa; 4:36 p. m.—W. H. Martin.

San Francisco; 4:32 p. m.—A. G. McAdie.

1901. **November 8**; Lick Observatory; 7:34:28 p. m.

1901. **November 13**; Chico; 7 p. m. Intensity III.

1901. **November 16**; Laguna Valley.

1901. **November 23**; Santa Paula.

1901. **December 11**; Campbell, Lick Observatory, San José, Santa Cruz.

Berkeley; 0:53:20 p. m. Direction north to south. Again at 1:14 p. m. Record on duplex. Again at 1:58:59 p. m. Felt by J. W. M.

1901. **December 14**; Antioch, Mills College, Oakland, Rio Vista, Stockton, San Leandro.

Oakland, Chabot Observatory. Observer, Prof. Burckhalter. 8:13:50 a. m. Duration, 6 seconds; direction, northwest to southeast; intensity III. First two seconds, motion gyratory; last four seconds, short and horizontal.

Niles; 8:15 a. m.—Wm. Barry.

Napa; 8:14 a. m.—W. H. Martin.

San Francisco; 8:14:00 a. m.—A. G. McAdie.

Berkeley; 8:14:01 a. m. Direction, east to west; maximum displacement of the earth, 0.02 of an inch.

1901. **December 15**; Antioch, Oakland, San Francisco, San Leandro.

Berkeley; 12:11:10 p. m. Maximum displacement from east to west; probably less than 0.3 mm. No displacement in vertical or north to south.

1902. **January 7**; Oakland.

1902. **January 22**; Cuyamaca.

1902. **January 27**; Berkeley; 5:30 a. m.

1902. **February 7**; Santa Barbara.

1902. **February 9**; Pine Crest, San Luis Obispo.

Berkeley; 8:45 a. m. Displacement of earth particle, one millimeter toward the northwest.

1902. **February 10**; Berkeley; 7:41 a. m. Displacement, 0.27 mm. due west.

1902. **February 20**; Vacaville.

1902. **March 16**; North San Juan.

1902. **March 23**; Iowa Hill.

1902. **April 2**; Cuyamaca, Escondido.

1902. **April 6**; San Luis Obispo.

1902. **April 9**; San Jacinto.

1902. **April 13**; San Francisco; 5:49:43 a. m., few tremors; 2:59:55 p. m., two sharp jars; 3:04:50 p. m., light.—A. G. McAdie.

1902. **April 19**; Berkeley; 8:09:09 a. m. Direction northwest to southeast; displacement, 0.17 mm.

1902. **April 19**; San Francisco; 8:08:30 to 8:08:40 a. m. Short waves from west to east.—A. G. McAdie.

Mills College, San Jacinto, San Leandro.

Oakland, Chabot Observatory. Observer, Prof. Burckhalter; time, 8:09:02 a. m.; duration, 4 seconds; direction, east to west; intensity III.

Niles; 8:11 a. m.—Wm. Barry.

Napa; 8:10 a. m. Short, sharp jar.—W. H. Martin.

1902. **April 27**; Cuyamaca, Hollister.

1902. **May 1**; Campo, Laguna Valley.

1902. **May 2**; Campo, Laguna Valley.

1902. **May 19**; Berkeley; 10:31:20-40 a. m. Direction northwest to southeast; displacement, about 0.74 mm.

1902. **May 19**; Antioch, Calistoga, Colusa, Dixon, Dunnigan, Elmira, Guinda, Healdsburg, Ione, Iowa Hill, Lodi, Nevada City, Petaluma, Point Richmond, Rio Vista, Sacramento, Santa Rosa, Sonoma, Stockton, Suisun, Vacaville, Vallejo, Winters, Woodland. (Quite heavy shocks on the 19th in the central and northern portion of the State.)

Oakland, Chabot Observatory. Observer, Prof. Burckhalter; time, 10:30:36 a. m.; duration, 16 seconds; direction, circular; intensity IV.

Napa; 10:32 a. m. Short, heavy shake.—W. H. Martin.

San Francisco; 10:31:20 a. m. to 10:31:40 a. m. Movements up and down; duration, 20 seconds.—A. G. McAdie.

1902. **May 20**; Antioch, Elmira, Nevada City, Rio Vista, Sacramento, Suisun, Vacaville.

Napa; 10:20 p. m. Short, heavy roll.—W. H. Martin.

San Francisco; 10:22:15 p. m.—A. G. McAdie.

1902. **May 21**; Santa Ana, Sacramento.

1902. **May 25**; Winters.

1902. **June 3**; Branscomb.

1902. **June 6**; Keeler.

1902. **June 9**; Campo, Laguna Valley.

Berkeley. Light shock about noon.

1902. **June 10**; Campo, Imperial, Laguna Valley, Lowe Observatory, Redlands, San Bernardino, San Diego.

1902. **June 20**; Imperial.

1902. **July 12**; Cuyamaca.

1902. **July 13**; Redlands.

San Francisco; 6:21 a. m.—A. G. McAdie.

1902. **July 21**; Pine Crest, Upper Lake.

1902. **July 22**; Upper Lake.

1902. **July 23**; Ukiah, Willits.

1902. **July 25**; Willits.

1902. **July 27**; Berkeley; 5:08:21 a. m.

Lompoc; 10:55 p. m.

1902. **July 28**; San Luis Obispo.

Berkeley. Direction, south to southeast; very slight shock; displacement, 0.08 mm.

1902. **July 30**; Severe shocks occurred from the 27th to the 31st at Lompoc, Los Alamos, San Luis Obispo, Santa Maria, and other places in Santa Barbara and San Luis Obispo counties. A few buildings were thrown down, but the property loss was not great and no lives were lost.

1902. **July 31**; Berkeley. Very light shock.

Los Alamos; 7:30 p. m.

1902. **August 1 to 3**; Los Alamos. Several shocks.

1902. **August 4**; Los Alamos.

1902. **August 11**; Livermore, Oakland.

Niles; 6:10 a. m.—Wm. Barry.

San Francisco; 6:09:09 a. m.—A. G. McAdie.

Berkeley; 6:09:04 a. m. Southwest; displacement, 0.10 mm.

1902. **August 14**; Los Alamos.

1902. **August 15**; Imperial.

1902. **August 24**; Laguna Valley.

1902. **August 28**; San Luis Obispo.

1902. **August 31**; San Luis Obispo.

1902. **September 1**; Tequisquita Rancho.

1902. **September 3**; Tequisquita Rancho.

1902. **September 10**; Rohnerville.

Los Alamos; 9:30 to 11 p. m.

1902. **September 17**; Napa.

1902. **September 18**; Mills College, Mt. Tamalpais, Napa, San Rafael, Santa Rosa.

Oakland, Chabot Observatory. Observer, Prof. Burckhalter; time, 3:50:15 a. m.; duration, 8 seconds; direction, (?); intensity III.

San Francisco; 3:51:07 a. m. Shock lasted 3 seconds; direction, north and south.—A. G. McAdie.

Berkeley; 3:51 a. m. Lasted several seconds.

1902. **September 23**; Oakland, Chabot Observatory. Observer, Prof Burckhalter; 5:31 a. m.; intensity II.

San Francisco; 5.33 a. m.—A. G. McAdie.

1902. **September 25**; Berkeley; 8:53 a. m. Direction, southeast; displacement, .03 mm.

1902. **October 21**; Lompoc, Los Alamos.

1902. **October 29**; Berkeley. Direction, southwest; light shock; displacement, .2 mm.

1902. **November 1**; Los Angeles, San Diego, San Jacinto, Santa Ana.

1902. **November 2**; Berkeley; 7:52 a. m. Light shock. Displacement. .77 mm.

1902. **December 2**; Kerby, Oregon; 2 a. m. Slight shock.—E. F. Meissner.

1902. **December 4**; Hood River, Oregon, between 8 and 9 p. m. Observer, J. Hengst.

1902. **December 12**; Lompoc, Los Alamos, San Luis Obispo, Santa Barbara.

1902. **December 18**; Fox Valley, Linn County, Oregon, 7 a. m., two distinct shocks.—C. D. Wilson.

1902. **December 27**; San Jacinto.

1902. **December 28**; Greenville.

1903. **January 3**; Cuyamaca.

1903. **January 7**; Bakersfield; 4:30 p. m.

1903. **January 11**; San Luis Obispo.

1903. **January 17**; Imperial.

1903. **January 23**; Phœnix, Arizona. Slight shock about 10 p. m.—U. S. Weather Bureau.

1903. **January 23**; Yuma, Arizona. A heavy jolt or shake occurred at 9:30 p. m.—S. Hackett, U. S. Weather Bureau.

1903. **January 23**; Cuyamaca, Los Angeles, Ogilby, Poway, Santa Ana.

1903. **January 23**; San Diego; 9:29:46 p. m. Intensity III R.-F.; vibration, northeast to southwest.—F. A. Carpenter.

1903. **February 4**; Cuyamaca.

1903. **February 8**; Greenville.

1903. **February 11**; Cuyamaca.

1903. **February 15**; Rohnerville.

1903. **February 25**; Eureka. Slight earthquake shock occurred at 8:14 a. m. The vibrations appear to have been from southeast to north, and were of several seconds' duration. Barometer about 30:10, temperature about 50.

1903. **February 27**; Salinas.

1903. **March 4**; Santa Rosa.

1903. **March 7**; Gonzales.

1903. **March 16**; Campo.

1903. **March 24**; Gonzales, Santa Margarita.

1903. **March 29**; Oakland, Chabot Observatory. Observer, Prof. Burckhalter; 0:56:16 a. m.; duration, 7 seconds; direction, southwest to northeast; intensity III.

1903. **April 18**; Fort Ross.

1903. **April 24**; Santa Margarita.

1903. **April 26**; Dixon, Fort Ross, Napa, North Bloomfield, Rio Vista, Sacramento, Point Arena, 8 p. m., Woodland.

Napa; 5:20 a. m.—W. H. Martin.

Berkeley; 5:21:37 a. m. Direction, east to west; very light, lasting several seconds; again at 9:09 a. m., and again at 8:21:08 p. m.

1903. **May 17**; Berkeley; 1:50:59 a. m.

1903. **May 21**; San Jacinto.

1903. **June 8**; Lick Observatory; 9:59:33 (?). Intensity R.-F. I. A single tremor, followed by a faint vertical jolt. Reported only by Dr. Perrine. No record on instrument.

1903. **June 11**; Antioch, Boulder Creek, Brentwood, Elmwood, Farmington, Fort Ross, Haywards, Iowa Hill, King City, Livermore, Lodi, Los Banos, Los Gatos, Mills College, Mt. Tamalpais, Napa, Newman, Peachland, Petaluma, Rio Vista, Sacramento, Salinas, San Francisco, San José, San Leandro, San Luis Obispo, San Mateo, San Miguel, San Rafael, Santa Margarita, Santa Rosa, Sargent, Sonoma, Stanford University, Stockton, Tiburon, Vallejo, Watsonville.

Oakland, Chabot Observatory. Observer, Prof. Burckhalter; 5:11:41 a. m.; duration, 12 seconds; direction, east to west; intensity IV. Stopped the mean-time clock. First six seconds gentle, then for two seconds very feeble; then four seconds sharp gyratory, ending with extreme suddenness.

Campbell; 5:11:18 a. m., the most severe earthquake occurred at this station; duration, 60 seconds.

Niles. Two sharp earthquake shocks on June 11. The last one was very sharp, the most severe noticed since October 21, 1868. Time, 5:15 a. m.; observer, William Barry.

Santa Cruz. Heavy earthquake shock at 5:13 a. m.—W. R. Springer, Observer.

Napa; 5:13 a. m. Medium.—W. H. Martin.

Lick Observatory. Time of beginning, 5:11:22 a. m. Heavy wave for 6 seconds, gradually decreasing in force until about 20 seconds, when a second maximum occurred, but much less heavy than the first. Vibrations were easily noticeable until 32 seconds. Motion

in all directions. No very violent vibrations—*i. e.*, sharp, quick. House rocked uncomfortably, accompanied by some noises. Time of beginning probably 2 seconds late. R.-F. VI or VII. No wind. —C. D. Perrine.

1903. **June 11**; Lick Observatory. About 9:55 p. m., June 10, preceding the earthquake shock by 7 hours and 20 minutes, the mercury was so disturbed that for an interval of more than one minute absolutely no images were visible. At the time, this was attributed to some freak of the wind, which was, however, quite moderate and steady. Ordinarily little trouble is experienced from wind, even when violent, and then only for brief intervals. This disturbance was a continuous quiver which rendered all reflections impossible. Tremors previously noted as connected with earthquake shocks were usually of the nature of vibrations or oscillations.—Prof. R. H. Tucker.

Very severe quake. Good records on both instruments, but the Ewing clock did not start. The record of the clock beats was accordingly impressed later. The general direction of vibration was northeast and southwest, with a strong vertical component. There is evidence of gyratory motion which is clearly shown in the duplex record. The maximum oscillation of the earth's surface was 1/5″, R.-F. VI or VII.—Prof. R. H. Curtiss.

Berkeley; 5:12 a. m. Severe shock.

1903. **June 20**; Berkeley; 1:10 a. m. (date probably wrong; possibly June 21, a. m).

1903. **June 21**; San Francisco.

Oakland, Chabot Observatory; 1:20 a. m.; duration, 10 seconds; direction, east to west; intensity II.

Napa; 1:30 a. m.—W. H. Martin.

1903. **June 26**; Campo, Cuyamaca, San Jacinto.

1903. **June 29**; Cuyamaca.

1903. **July 2**; Campo, Cuyamaca.

1903. **July 12**; Campo.

1903. **July 13**; Hollister, Campo.

1903. **July 24**; Chico, Colusa, Grass Valley, Greenville, La Porte, Marysville, Meadow Valley, Nevada City, Orland, Oroville, Palermo, Sacramento, Tehama, Wheatland, Willows.

(Willows. A severe shock of earthquake at 12:26 p. m. on the 24th; began with a rumbling noise, succeeded by a twister. Several brick walls cracked and plaster fell from many buildings.

The atmospheric conditions prevailing in the valley previous to the shock, as viewed by me from an elevation of 4,500 feet, were very peculiar.—A. W. Schorn.)

Magalia; 0:20:50 p. m. VI.

1903. **July** 30; Elsinore, Redlands, Riverside, Salinas, San Bernardino, San Jacinto, Uplands.

(San Bernardino. The earthquake at 9 p. m. on the 30th was quite severe and lasted about twenty seconds.—Dr. A. K. Johnson.)

1903. **August** 2; Alameda, Boulder Creek, Calistoga, Campbell, Elmwood, Fresno, Hollister, Kentfield, Lick Observatory, Lodi, Mills College, Mount Tamalpais, Oakdale, Peachland, Rio Vista, Sacramento, Salinas, San Francisco, San José, San Rafael, Santa Cruz, Santa Rosa, Sonoma, Stockton, Suisun, Summerdale, Tequisquita Rancho, Yosemite Valley.

Oakland; Chabot Observatory. Observers, C. B. and S. W.; 10:49:29 a. m.; duration, 31 seconds; direction, south to north, east to west; intensity IV. There were two distinct shocks. The first, south to north, lasted about 20 seconds; then, after a quiet interval of 3 seconds, a shock from east to west lasted 8 seconds. Stopped mean-time clock 10:49:42 a. m.

Niles; 10:05 p. m. and 10:59 p. m.—Wm. Barry.

Napa; 10:42 p. m. Lively.—W. H. Martin.

Lick Observatory; 11:36:30 p. m.

1903. **August** 2; Lick Observatory. R.-F. VII or VIII. The most severe shock since the establishment of the Lick Observatory occurred on the night of Sunday, August 2, 1903. The time of beginning of the first shock was recorded by various observers as follows: 10:49:21—3 p. m.—Aitken; 10:49:21—Vogt; 10:49:15—Perrine. Smaller vibrations lasted a few seconds, followed by 15 or 20 seconds of very violent shocks, generally in an east-west direction. Strong vibrations continued 10 seconds longer. This shock proved too severe for the seismometers of the Lick Observatory. The duplex recorded the earlier vibration, but was thrown out of adjustment by the heavier shock. The Ewing plate failed to rotate, but the indicator moved about, practically with the result that the east-west pen was thrown entirely off the disk. The motion of the earth seems to have been about half an inch. None of the astronomical instruments suffered damage. Beyond numerous cracks in plastering, nothing will remain to betray the intensity of the disturbance. Several chimneys on brick houses toppled over. Evidence points to Hall's Valley as the probable center of seismic activity. As in the case of the shock of 1868, minor vibrations have been recorded at small intervals as follows: August 2, 11:36:30 p. m. R.-F. III. Light shock, lasting 1 or 2 seconds. August 3, 3:22:41 p. m. R.-F. II. Single vertical jolt. August 8, 4:17:14 p. m. R.-F. I; duration,

2 seconds; northeast to southwest; slow. August 10, 2:51:07 a. m. R.-F. II. Slight vibrations for about a second. August 10, 3:01:04. Further shocks have been suspected but unrecorded.—Dr. R. H. Curtiss.

1903. **August 2**; Lick Observatory; 10:49:21 p. m., perhaps 3 seconds late. Heavy shocks lasted 20 seconds, strong vibrations 10 seconds longer. Slight shock, lasting 1 or 2 seconds, at 11:36:30.—R. G. Aitken.

Time, 10:49:15. Heaviest waves lasted 15 seconds and some waves for 35 seconds. Plaster thrown down, ornaments, books, and bottles thrown to the floor; guns moved along the wall. A high north wind blowing at the time.—C. D. Perrine.

Clock No. 1 not disturbed. Clock No. 7 stopped at 10:49:24; started again August 3. Small weight shaken from pendulum shelf of No. 4. About 8 shot shaken from the pendulum rod of No. 3 and 1 from the cup of No. 8. A few drops of mercury also shaken from the pendulum of No. 8.—Elliott Smith.

Berkeley; 10:50 p. m.

1903. **August 3**; Lick Observatory; 3:22:41 p. m.

1903. **August 4**; Laguna Valley.

1903. **August 8**; Lick Observatory, San José; 4:17:14 p. m.; duration, 2 seconds; northeast to southwest; slow.—R. H. Curtiss.

1903. **August 10**; Niles, San Francisco, San José.

Niles; 2:50 a. m. and 3 a. m.—Wm. Barry.

Lick Observatory; 2:51:07 a. m.—J. D. Maddrill; 2:51:04 a. m.—R. H. Curtiss; 3:01:04 a. m., 3:01:11 a. m.—C. D. Perrine.

1903. **August 13**; Mills College, Oakland, San Francisco.

Oakland, Chabot Observatory. Observer, Prof. Burckhalter; 3:33:18 a. m., duration (?), intensity III. Motion was probably gyratory.

1903. **August 14**; Mills College; 5:49 a. m.

1903. **August 24**; Los Olivos.

1903. **August 26**; Lick Observatory; 7:51:41 to 45 p. m. R.-F. I. Reported by Dr. Perrine. Vibrations east and west.

1903. **August 28**; Lick Observatory; 3:40:08 to 10 p. m. R.-F. II. Duration, 2 seconds.

1903. **September 16**; **Los Angeles**. Light shock felt in city, but not at Weather Bureau.—A. B. Wollaber.

Santa Ana; 4:10 a. m. VI.

1903. **September 16**; Anaheim, Elsinore, Fall Brook, Los Angeles, Redlands, Riverside, San Bernardino, San Jacinto, Santa Ana, Sierra Madre.

1903. **September 18**; Lick Observatory; 11:37:01 p. m. R.-F. I. Vertical. Reported by C. D. Perrine.

1903. **September 21**; Redlands.

1903. **September 24**; Rohnerville.

1903. **September 30**; Ukiah.

1903. **October 4**; Cuyamaca.

1903. **October 13**; Lick Observatory; 6:02:50 a. m. Reported by Mr. Albrecht.

1903. **November 18**; Imperial (severe).

1903. **December 9**; Eureka. Quite a severe shock occurred at 8:44 a. m. It came in two successive jolts of several seconds duration; the vibrations, apparently from southwest to northeast, being of sufficient violence to shake considerably the building in which is located the Weather Bureau office and to stop clocks in different parts of the city.

1903. **December 14**; Riverside.

1903. **December 15**; Yosemite.

1903. **December 18**; Claremont.

Lick Observatory; 5:20:50 to 53 (?). R.-F. III or IV. Preliminary tremors followed by a heavy jar which appeared to be principally in the vertical.—C. D. Perrine.

Berkeley; 5:21:15 p. m. Light shock.

Santa Cruz.

1903. **December 21**; Redlands, San Bernardino.

1903. **December 25**; Pasadena, Riverside, San Bernardino, Sierra Madre.

Los Angeles. Quite heavy shock at 9:45 a. m.—U. S. Weather Bureau.

1903. **December 31**; Yosemite.

1904. **January 10**; Fort Ross, Healdsburg, Mercury.

1904. **January 11**; Rohnerville.

Eureka. Very light earthquake was felt at 11:14 p. m. Barometer about 30:35, temperature about 46°.

1904. **January** 21; Ukiah.

1904. **January** 22; Los Alamos.

1904. **January** 23; Los Alamos.

1904. **January** 26; Tequisquita Rancho.

1894. **February** 15; Healdsburg.

Lick Observatory; 12:49:58 p. m., duration 2 seconds. R.-F. H. Mostly in the horizontal. Reported by Dr. Perrine; 10:03:56 p. m. R.-F. I. Single, rather long swing noted by Dr. Perrine. Duplex record northeast, 1.1 mm.; displacement, 0.12 mm.

1904. **February** 22; Kentfield, Mount Tamalpais, San Francisco, San José, San Mateo, Sonoma.

Oakland, Chabot Observatory. Observer, Professor Burckhalter; 3 a. m., intensity II.

Napa; 3:30 a. m.—W. H. Martin.

Mills College; 3:00 a. m.—Josiah Keep.

Berkeley; 3:00 a. m.

1904. **February** 25; Campbell.

1904. **March** 1; San Francisco, San Mateo, Sonoma.

Oakland, Chabot Observatory. Observer, Professor Burckhalter; 6:09 a. m., intensity II.

Niles; 6:09 a. m.—Wm. Barry.

Napa; 6:00 a. m.—W. H. Martin.

Mills College; 6:10 a. m.—Josiah Keep.

1904. **March** 5; San Mateo.

1904. **March** 12; Branscomb, Fort Bragg, Willits.

1904. **March** 15; Branscomb, San Mateo.

1904. **March** 16; Seattle, Wash.; 8:20 p. m., intensity III; duration 15 seconds; vibrations east to west. This shock was felt generally over western Washington.—Weather Bureau.

1904. **March** 18; Campo.

1904. **March** 26; Eureka. Quite a heavy shock occurred at 3:53 p. m., lasting about 10 seconds. The vibrations were from southwest to northeast. Barometer about 30:00, temperature about 50°.

1904. **April** 2; Lick Observatory. First shock 11:39:25 a. m., light; second shock 11:39:29 a. m., a little heavy; direction northwest to southeast principally.—Dr. W. W. Campbell.

1904. **April** 4; Berkeley; 7:10:10 p. m. Northeast to southwest. Displacement, 0.25 mm.

1904. **April** 13; San Francisco.

Oakland, Chabot Observatory. Observer, Professor Burckhalter; 5:15:23 p. m., intensity II.

1904. **April** 15; Shasta. Probably 16th.

1904. **April** 16; Redding; 1:20 a. m.

1904. **April** 21; Aptos, Boulder Creek, Campbell, Hollister, Los Gatos, Mills College, Mt. Tamalpais, San Francisco, San José, San Mateo.

Oakland, Chabot Observatory. Observer, Professor Burckhalter; 3:51:10 a. m., intensity II.

Niles; 3:44 a. m.—Wm. Barry.

Lick Observatory; 3:55 a. m.—E. Smith.

1904. **May** 1; Los Angeles, Ventura; 10:30 a. m. IV.

1904. **May** 3; Hollister.

1904. **May** 6; Cloverdale.

1904. **May** 8; Ukiah.

1904. **May** 11; Lick Observatory; 5:16:27 a. m. ± 1 second. R.-F. III, chiefly horizontal. Shock lasted about 3 seconds. Duplex record, slight.—Dr. Perrine.

1904. **May** 19; **San Francisco.**

Niles; 1:30 a. m.—Wm. Barry.

1904. **June** 3; Imperial.

1904. **June** 22; Lick Observatory; 11:25:53 (?). Slight. R.-F. I, lasting 2 or 3 seconds.—C. D. P.

1904. **June** 26; Cuyamaca.

1904. **July** 6; Branscomb, Eureka. Light earthquake reported to have occurred in early morning. Barometer about 29:96, temperature about 54°.

19004. **July** 9; Lick Observatory; 12:34:40 p. m. Vertical jolt followed by slight east and west tremors.

1904. **July 14**; Campo.

1904. **July 21**; Livermore, San Francisco.

Oakland, Chabot Observatory. Observer, Professor Burckhalter; 11:25 p. m., intensity II.

Berkeley; 11:25:03 p. m.

1904. **July 30**; Rio Vista, Sacramento, San Francisco, Santa Rosa, Stockton, Woodland.

Napa; 2:29 a. m.—W. H. Martin.

Berkeley; 2:25:37 a. m., east to west, very light.

1904. **August 2**; Calistoga; 9:50 a. m. III.

1904. **August 3**; Lick Observatory; 8:10:10 p. m. Light.

1904. **August 5**; Lick Observatory; 5:43:08 p. m. Duration 4 seconds of varying intensity. R.-F. I to III.—W. W. C.

1904. **August 11**; Fort Ross.

1904. **August 21**; Healdsburg.

1904. **August 27**; Oakland, Chabot Observatory. Observer, S. W.; 0:59:03 p. m., intensity II.

Lick Observatory; 12:58:47 p. m. Duration 4 seconds. R.-F. V or VI. A second light shock at 12:58:55. Complete records obtained on both the Ewing and duplex seismographs.

1904. **September 8**; Campo, Cuyamaca, Imperial, San Diego.

1904. **September 9**; Campo, Riverside.

1904. **September 10**; San Luis Obispo.

1904. **September 12**; Imperial.

1904. **September 13**; Campo.

1904. **September 14**; Eureka. Light shock occurred at 9:33 a. m., lasting about 10 seconds. The vibrations were from southwest to northeast. Barometer about 30:08, temperature about 51°.

1904. **September 28**; Imperial.

1904. **September 30**; Campo, Tequisquita Rancho.

1904. **October 11**; Berkeley; 2:48:54 p. m.

1904. **October 13**; Berkeley; 4 p. m.

1904. **October** 14; Snedden Ranch, Ventura.

1904. **October** 15; Santa Barbara, Sierra Madre.

Los Angeles. Light shock is said to have occurred.

Berkeley; 2:48:54 p. m.

1904. **October** 20; Snedden Ranch.

1904. **October** 25; Bishop, Campo, Cuyamaca, Laguna Valley.

1904. **October** 27; Campo, Cuyamaca, Laguna Valley.

1904. **October** 29; Brush Creek.

1904. **November** 22; San Francisco; 7:7:46 a. m.

1904. **November** 23; San Francisco.

1904. **November** 25; Oakland, Chabot Observatory. Observer, Professor Burckhalter; 5:50:40 a. m., intensity II.

1904. **November** 26; Cuyamaca, Mills College, Oakland, San Francisco.

1904. **November** 27; San Francisco.

Oakland, Chabot Observatory. Observer, Professor Burckhalter; 8:20:27 a. m. Duration few seconds; direction southwest to northeast, intensity II.

1904. **December** 1; Lick Observatory. At about 8 o'clock a record was found on the plate of the duplex. No report of the shock was turned in.—Dr. J. H. Moore.

San Francisco, San Rafael.

Oakland, Chabot Observatory. Observer, Professor Burckhalter; 1:00:01 a. m. Duration 8 seconds; direction southwest to northeast, intensity IV. 1:04:23 a. m. Duration 3 seconds; direction southwest to northeast, intensity III. 1:09 a. m. Direction southwest to northeast, intensity III. 1:10 a. m. Direction southwest to northeast.

Berkeley; 1:07:10 a. m. Direction north to south.

Napa; 1:00 a. m.—W. H. Martin.

1904. **December** 2; San Francisco.

1904. **December** 3; San Francisco.

Lick Observatory; 7:56:12 p. m. Shock severe enough to rattle windows; lasted about 1 or 2 seconds; preceded by a warning noise so that I was expecting it for about 2 seconds.—Dr. W. W. Campbell.

1904. **December 4**; Rohnerville, San Francisco.

Eureka. Quite a severe earthquake shock occurred at 0:20 a. m., lasting about 10 seconds. The vibrations, apparently, were from south to north. Barometer about 30:04, temperature about 52°.

1904. **December 5**; San Francisco.

1904. **December 7**; San Francisco.

1904. **December 8**; Mills College, San Francisco.

1904. **December 9**; San Francisco.

Oakland, Chabot Observatory. Observer, Professor Burckhalter; 3:40 p. m., intensity II.

1904. **December 11**; San Francisco.

Oakland, Chabot Observatory. Observer, Professor Burckhalter; 11:52:50 a. m., intensity II.

1904. **December 14**; Berkeley, Campbell, Idyllwild, Mills College, Peachland, San Francisco, San José, San Leandro, San Rafael, Santa Rosa, Sonoma.

Oakland, Chabot Observatory. Observer, Professor Burckhalter; 7:09 a. m. Duration 4 seconds; direction northeast to southwest, intensity II.

Niles; 7:10 a. m.—Wm. Barry.

Napa; 7:15 a. m.—W. H. Martin.

Lick Observatory. Light shock 7:10 a. m., reported by K. Burns.

1904. **December 16**; San Francisco.

1904. **December 17**; Idyllwild.

1904. **December 20**; Lick Observatory. Light shock, 11:47:28 a. m.—K. Burns and J. H. Moore.

1905. **January 1**; San Francisco. A number of shocks reported by Weather Bureau. Professor McAdie's personal record gave times of occurrence of ten or more perceptible shocks on this date. This record was destroyed by fire April 18-21, 1906. These note books gave the times for a large number of earthquakes during 1904 and 1905.

Berkeley; 3:38 p. m., southwest to northeast.

Lick Observatory; 3:37:51 p. m. III or IV. 4:25:16 p. m. I or II.

Napa; 3:45 p. m.—W. H. Martin.

Niles; 3:30 p. m.—Wm. Barry.

1905. **January** 1; Mills College, Mount Tamalpais, Niles, San Francisco, Sausalito.

Oakland, Chabot Observatory. Observer, Professor Burckhalter; 10:30 a. m. Duration 2 seconds, intensity II. 3:27:50 p. m. Three seconds' duration; direction east to west, intensity III. 4:25:18 p. m., intensity II.

1905. **January** 2; San Francisco, Sausalito.

Oakland, Chabot Observatory. Observer, Professor Burckhalter; 10:04 p. m. Duration 3 seconds; direction northeast to southwest, intensity III.

Lick Observatory. 10:22:37 to 41 p. m.

1905. **January** 3; San Francisco, Sausalito.

Oakland, Chabot Observatory. Observer, Professor Burckhalter; 2:37:40 a. m. Duration 10 seconds; direction northeast to southwest, intensity III. About twenty vibrations in 10 seconds.

1905. **January** 4; Sausalito.

1905. **January** 5; Sausalito.

1905.—**January** 6; Angiola, Claremont, Lone Pine, Mills College, Sausalito, Wasco.

1905. **January** 7; Fort Bragg.

1905. **January** 8; Oakland, Chabot Observatory. Observer, Professor Burckhalter; 1:09:45 p. m. Duration 6 seconds; direction northeast to southwest, intensity II.

1905. **January** 9; Cuyamaca.

1905. **January** 11; San Francisco.

1905. **January** 23; Fort Bragg.

Berkeley. Light shock during the night.

Lick Observatory; 9:38:44 a. m. II.

1905. **January** 25; Cloverdale.

1905. **February** 4; Claremont.

1905. **February** 13; Cloverdale.

1905. **February** 22; Oakland, Chabot Observatory. Observer, Professor Burckhalter; 8:36 p. m., intensity II.

1905. **February** 23; Lick Observatory; 9:38:44 a. m. Preceded by a rumble. Intensity R.-F. II.—Professor Campbell.

1905. **March 7**; Imperial.

1905. **March 12**; Cloverdale.

1905. **March 18**; Bakersfield, Isabella, Nordhoff, San Francisco, Wasco; 8:40 p. m. VI.

1905. **March 24**; Cloverdale.

1905. **April 3**; Boulder Creek, Hollister, Salinas, San José, Santa Cruz; 2 a. m.

1905. **April 4**; Boulder Creek, Hollister, Salinas, San José, Santa Cruz.

Niles; 2:25 a. m.—Wm. Barry.

Lick Observatory. Light shock 2:23:00 a. m., lasting about 3 seconds, followed by a second shock of equal intensity, also lasting about 3 seconds. Records obtained from both instruments.—E. Smith.

1905. **April 17**; Redding.

1905. **April 18**; San Francisco.

1905. **April 19**; Santa Cruz.

1905. **April 23**; Calexico, Campo, Idyllwild, Imperial.

1905. **April 24**; Point Loma.

1905. **April 27**; Boulder Creek, Imperial, San Francisco, Santa Cruz.

Oakland, Chabot Observatory. Observer, Professor Burckhalter; 9:10 p. m., intensity II.

Niles; 9:53 p. m.

1905. **April 28**; Niles; 12:25 a. m.—Wm. Barry.

Lick Observatory. Light shock. Ewing record shows slight motion north-south and east-west. No vertical motion; 9:41:17 a. m.

1905. **April 29**; Hollister, Riverside, Ventura.

1905. **April 30**; Idyllwild.

1905. **May 6**; Lick Observatory. Light shock accompanied by a rumbling noise; 12:01:20 p. m. No records on instruments.

1905. **May 10**; Zenia.

1905. **May 15**; Nevada City, Oakdale, Yosemite.

1905. **May 16**; Yosemite.

Berkeley; 7:50 p. m.

1905. **May** 19; Sacramento. Light shock at 4:59 p. m.

1905. **May** 23; Independence. Feeble shock at 6:50 p. m. Also noted at Bishop.

1905. **May** 25; San Luis Obispo. Light shock, east to west. Duration 3 seconds; 9:49 p. m.

1905. **May** 25; Elmwood, Huron, Lone Pine, Los Gatos, Sacramento, Salinas, San Francisco, Santa Cruz, Soledad, Summerdale, Yosemite; 6:50 p. m. V.

1905. **May** 26; Lick Observatory. Noticed by no one; recorded by Ewing and duplex; 6:53:12 a. m. Second shock 11:55:11 a. m. Rumbling heard. No record on instruments.

1905. **June** 11; Calexico.

1905. **June** 12; Campo.

1905. **June** 18; Napa.

1905. **July** 13; San Francisco.

1905. **July** 15; Riverside, San Bernardino; 12:41 p. m. VII.

1905. **July** 20; Fort Ross.

Lick Observatory. Light shock. Single vertical jar, distinctly felt; 9:16:39 p. m.—J. D. Maddrill.

1905. **August** 8; San Francisco.

1905. **August** 11; Campo.

1905. **August** 15; Branscomb.

1905. **August** 21; Campo.

1905. **August** 22; San Francisco.

1905. **August** 25; Imperial.

1905. **August** 31; San Francisco.

1905. **September** 2; Pasadena, Sierra Madre.

Los Angeles. Sharp shock at 8:39 p. m.—U. S. Weather Bureau.

1905. **September** 5; Idyllwild.

1905. **September** 16; Fruitvale, San Francisco.

1905. **September 26**; San Francisco.

Niles; 6:35 a. m.—Wm. Barry.

1905. **October 14**; Santa Rosa.

1905. **October 21**; Lick Observatory. Slight shock at 3:52:25 p. m.; record on the Ewing.

1905. **November 7**; Branscomb.

1905. **November 9**; Claremont.

1905. **November 14**; Calexico, Imperial.

1905. **November 22**; Lick Observatory; 11:49:24 p. m. Preceded by a slight rumble.

1905. **November 26**; San Francisco.

1905. **November 27**; San Francisco.

1905. **November 28**; San Francisco.

Oakland, Chabot Observatory. Observer, Professor Burckhalter; 11:24:52 a. m. Duration 2 seconds; direction northeast to southwest, intensity II.

1905. **December 3**; Imperial, Mills College, San Francisco; 11:30 a. m.

Oakland, Chabot Observatory. Observer, Professor Burckhalter; 11:25:58 a. m. Duration 3 seconds; direction southwest to northeast, intensity III.

Niles; 11:23 a. m.—Wm. Barry.

1905. **December 15**; Mercury.

1905. **December 18**; Mills College, San Francisco; 11:59 p. m.

Oakland, Chabot Observatory. Observer, S. W.; time, midnight. Direction northwest to southeast.

1905. **December 19**; San Francisco.

Lick Observatory. Light shock; 12:51:19 a. m. Possibly same as December 18.

1905. **December 23**; Bakersfield, Tejon Rancho, Wasco. At 2:23 p. m.

1905. **December 28**; San Francisco.

1906. **January 2**; Spokane, Wash. Light shock at 5:55 a. m. Motion from east to west.—C. Stewart, U. S. Weather Bureau.

1906. **January 14**; Mono Ranch.

1906. **January 16**; San Francisco; 10:33 a. m. and 2 p. m. Feeble shock.—A. G. McAdie.

1906. **January 17**; Lick Observatory; 12:46:56 a. m. Two light shocks, about 1 second apart. No instrumental record.

1906. **January 25**; Phœnix, Arizona; 1:40 p. m. Marked tremors and rocking motion; north to south. This same shock, but more violent, felt at Flagstaff, Ariz.—L. N. J., Weather Bureau.

1906. **January 31**; Mills College.

San Francisco; 10:58 p. m.—A. G. McAdie.

1906. **February 26**; Lick Observatory; 5:24:40 a. m. Two light shocks, about a second apart. Duplex gave slight displacement to the west.

1906. **March 3**; Calexico, Campo, Cuyamaca, El Cajon, Riverside, Point Loma.

San Diego; 12:24:50 p. m. Force II; direction southwest to northeast.—F. A. Carpenter.

1906. **March 4**; Calexico, Cuyamaca.

1906. **March 5**; San Francisco; 9:30 p. m.—A. G. McAdie.

1906. **March 19**; Napa.

1906. **March 20**; Cuyamaca.

1906. **April 11**; Niles; 12:54 a. m.—Wm. Barry.

1906. **April 18**; San Francisco.

The San Francisco Earthquake.

By Prof. A. G. McAdie, U. S. Weather Bureau.

The morning of Wednesday, April 18, was clear and pleasant over the greater portion of the Pacific coast. An area of high pressure was moving steadily and somewhat slowly eastward over Idaho. The weather map gives the conditions existing a few minutes previous to the great earthquake, and it may be noted that the pressure distribution is of a type which has been found to prevail when certain earthquakes occur in California. A study of the relation of atmospheric pressure and earth movement had been under way in the office of the Weather Bureau at San Francisco for some years, and while no very definite conclusions had been arrived at, it was plain that the greater number of earthquakes

in California occurred apparently without any relation to pressure distribution. It was noticed, however, that some earthquakes occurred during the passage of a marked "high" across the northern portion of the coast. While any relation of this character must be obscure and indefinite, it is conceivable that in a region where quakes and tremors of tectonic origin are frequent—that is, a region where strata are in unstable equilibrium—the passage of an area of high pressure may directly or indirectly affect the stresses at critical times. The relation is involved and is alluded to here only because at Manila and Tokyo microseismic phenomena bear some relation to approaching typhoons: The thought suggests itself that the installation of seismographs on the Pacific coast may lead to the detection of advancing pressure areas.

The earthquake, as timed by the writer, began at 5:13:05 a. m., 120th meridian time. The disturbance lasted for about 40 seconds. The main shock was followed by others. The times are:

April 18, 1906, 5:13:05–45 (?), severest known in San Francisco.
" " 5:19:10 a. m., feeble.
" " 5:21 a. m., feeble.
" " 5:26 a. m., feeble.
" " 5:43 a. m., feeble.
" " *[6:06—6:30—6:42 and 6:56 light].
" " 8:14:28 to 8:14:33, sharp, twisting motion.
" " *[8:19—8:42].
" " 9:14 a. m., sharp, short.
" " 9:26 a. m., moderate.
" " *[9:48 and 10:05].
" " 10:50 a. m., moderate.
" " 11:06 a. m., moderate.
" " *[11:47].
" " 12:04 p. m.
" " 12:11 p. m., very light.
" " 2:24 p. m., very light.
" " 2:28 p. m., very light.
" " 4:51 p. m., very light.
" " 6:50 p. m., very light.
" " 7:01 p. m., very light.
April 19, 1906, 3:07:00 a. m., light.
" " 1:13 p. m., sharp, main portion with twist.
April 20, 1906, 4:45:00 a. m., tremor.
" " 5:31 a. m., moderate.
" " 7:15 a. m., moderate.
April 21, 1906, 6:28 a. m., strong.
April 22, 1906, 7:03:00 a. m., light.
" " 3:19:30 p. m. to 3:19:34 p. m., moderate, rocking.
April 23, 1906, 12:05:00 a. m., lasted about 3 seconds.
" " 3:51 p. m., sharp, downward jolt.
" " 10:34 p. m., moderate.

*[Obtained by voltmeter diagrams furnished by Mr. Nelson Eckart.] All other times by the writer.

April 24, 1906, 1:25 a. m., short.
" " 1:32 a. m., tremors.
" " 1:14 p. m.
April 25, 1906, 4:30 a. m.
" " 3:17:10 p. m., double waves recorded on seismograph.
April 27, 1906, 1:07 p. m.
April 29, 1906, 4:09 p. m.
April 30, 1906, 1:57:30 a. m.
" " 1:59:40 a. m., single swing.
" " 7:10 a. m.

Numerous shocks, mostly light, occurred in May, especially during the first two weeks.

The initial disturbance on April 18, from 5:13:05 to 5:13:45(?) a. m., consisted of heaving, throwing, and racking motions sufficiently intense to dislodge cornices, crack walls, break chimneys, and wrench solid masonry. On made ground and in alluvial soil, crevices and cracks of varying width were opened. While the destruction was great and considerable débris filled the streets, it was noticed that buildings on the hills apparently suffered less than those on lowlands; also that the steel buildings, known as Class A, as well as heavily built stone buildings, were practically intact after the shock. At the office of the Weather Bureau, on the tenth floor of the Mills building, the instruments there and on the roof (12th floor) were examined before 7 a. m. and found to be all in working order, except that the anemometer support had been shaken down. The thermograph on the roof and the telethermograph and barograph in the office showed a displacement of the pens of about 0.75 of an inch on each side, or 1.5 inches in all. Within a few minutes after the shock fire broke out in many parts of the city. For four days the fire raged. About 520 city blocks, or 3,000 acres, were burned, 25,000 buildings were destroyed, one-half of which were residences, ninety-five square miles were devastated, and more than 100,000 people rendered homeless. The financial loss has been estimated at $350,000,000. The insurance loss was estimated at $235,000,000. About 400 lives were lost.

The earthquake was felt distinctly at Eureka and as far south as Los Angeles.* The line of greatest intensity appears to be along one of the old faults running from Mussel Rock southeast through Lake San Andreas, Crystal Springs, Stevens Creek, Campbell Creek, Wrights and Skyland. This is generally known as the San Andreas fault. Dr. John C. Branner, of Stanford University, fortunately made an extensive and detailed survey of the Santa Cruz section shortly before the slip, and has been able to promptly resurvey this section of greatest dislocation. He is of the opinion that the slipping of the fault is plainly shown by surface conditions, especially by tree destruction. Near Loma Prieta he found along the line of the fault marked destruction of trees. "The forest looked," he says, "as though a swath had

* A shock was felt at San Diego at 4:30 p. m., April 18, but was probably an after shock.

been cut through it two hundred feet in width.'' In a little less than a mile he counted no less than 345 cracks running in every conceivable direction. A marked displacement of the pipe lines of the Spring Valley Water Company also indicates a slip of the San Andreas fault. Prof. A. C. Lawson, of the University of California, has shown that the San Francisco peninsula has at least three well-marked faults. Some of these, especially the San Bruno fault, traverse the Gulf of the Farallones and the northern peninsula. It must not be forgotten that the earthquake wrought great damage in Marin, Sonoma, Napa, Lake, Mendocino, and Humboldt counties. At Santa Rosa the destruction was very great.

No tidal wave or disturbance in the water of any character followed the earthquake. The waters of San Francisco Bay were unusually calm throughout the forenoon of April 18.

A number of valuable records have been made on seismographs, of the Omori horizontal pendulum type, of the earth waves at various points. In the Weather Bureau at Washington, D. C., the record obtained by Professor Marvin of an east and west motion showed that the preliminary tremors lasted for six minutes before the larger wave motions were recorded. At Tokyo the duration of these first preliminary tremors was nine minutes and forty-nine seconds; at Birmingham, England, about twenty-five minutes. Other records have been obtained at eight or nine stations where seismographs have been installed, and in due time data will be published showing the probable origin and nature of the earth dislocation. This, it is thought, will be a line or plane rather than a definite point or centrum. From the duration of the tremors the approximate areal distance between the seismograph and the origin, can be determined.

1906. **April 18**; San Francisco Bay. Captain R. Peterson, German steamer ''Varda,'' of Kosmos line, reports: ''5:05 a. m., off the Golden Gate, near the middle buoy, felt a sharp earthquake lasting from 3 to 4 minutes, causing every one on board to think that we had struck a rock or submerged wreck. Sounding 8½ fathoms and afterwards 5 fathoms. While at anchor in San Francisco Bay felt shocks all day.''

NOTE.—This steamer also experienced the Valparaiso earthquake of August 16, 1906, at 8:10 a. m.; also after shocks, August 17 and 18, while lying at anchor in harbor of Valparaiso.

1906. **April 18**; Oakland, Chabot Observatory. Prof. Charles Burckhalter; duplex pendulum seismograph; 5:12:51 a. m.; duration 48 seconds; directions all possible; intensity VIII-IX. Pendulum of sidereal clock wrecked; mean-time clock pendulum jammed behind arc; clock stood at 5:14:48, but experts believe clock raced two minutes. Gravity escapement. Second severe shock 8:19:20, duration 5 seconds; direction northeast to southwest; intensity V. Fifteen additional shocks by 1 p. m., duration from 2 to 5 seconds; directions east to west; intensities II to IV. Three shocks be-

tween 1 and 3 p. m. Five shocks between 3 p. m., April 18, and 6 a. m., April 19.

Niles; 5:15 a. m.—Wm. Barry.

Lick Observatory; 5:12:45 a. m. Duration of record on the Ewing seismograph 3 minutes 45 seconds. A large number of reports are to be found in the observatory record.

"Duration of (the 5:12) shock about 30 seconds; vibrations stopped in house at end of that time. Heaviest shock 11 seconds after start, shocks coming about one a second. Heaviest R.-F. VIII; northwest to southeast. First secondary maximum about 5 seconds after beginning—maximum 11 seconds after beginning. Another secondary maximum about 15 or 20 seconds from beginning, accompanied by sound as of flight of birds; no rumbling; no vertical component. (Other shocks during same day:) 6:46:34 a. m. R.-F. II. 9:16:52 a. m. R.-F. III. 11:53:37 a. m. R.-F. III, vertical. 6:51:58 p. m. R.-F. II, vertical."—K. Burns.

"Time of heaviest shock 5:12:45 a. m. Eight slight shocks felt in the half hour following. Also one at 6:30 a. m., 6:45 a. m., 8:15 a. m., 9:30 a. m., and one other between 6:45 and 8:15 a. m."—R. G. Aitken.

"Time 5:12:19 a. m. At first a jar, then a perceptible pause, then a tremble. Counted up to 25 seconds positively, then continued mechanically. I would put the time of duration between 30 and 35 seconds. Heard no sound preceding the shake. Other shocks same day 8:14:39, 9:16:52, 11:53:34 a. m., 2:28:36 p. m."—Miss A. M. Hobe.

"At the first shock awake and began to count seconds. Took watch from under pillow counted 10 or 12 seconds when the very heavy shock came and plaster dust began to rain down on the bed. * * * Standing in the doorway and looking out of the east window could see the walls of the brick house shaking * * *"—H. K. Palmer.

"Clock in director's office stopped at 5:12:52 a. m. This clock has a very small and steady rate, was noted as correct within a half minute April 15. Conclusion; violent part of earthquake was between 5:12:22 and 5:13:22."—J. D. Maddrill.

G. A. Vogt states beginning of shock 5:11:50.

"Time of beginning 5:12:13. Counted for one minute before getting time from watch; heavy vibration still felt at that time, 60 seconds after first count. Motion was felt for nearly a minute longer, or nearly two minutes after first count. The motion was almost entirely horizontal, no vertical movement of consequence was noticed. The waves were very long but smooth. The heaviest seemed to be nearly east and west. Intensity on the R.-F. scale VIII or IX. Water in Smith creek 12 noon was densely milky, light slate color, not yellowish as after heavy freshet."—C. D. Perrine.

Ewing seismograph north-south pen left plate about one-quarter minute after beginning and returned about one-half revolution

of the plate later. East-west record continuous, though the swing carried pen over edge of plate a number of times. Vertical weight was thrown off its pivots by the violence of the horizontal motions and in consequence shows no displacement after the very start. Barograph seems to have been quite strongly disturbed in the vertical. Duplex seismograph pen was found off the plate on the west side. It seems likely therefore that the duplex recorded only the first 10 or 15 seconds of the shock, if so much as that. Comparison with duplex records from Oakland and Carson bears this out.—J. D. Maddrill.

1906. **April 18**; Los Angeles; moderate shock at 5:16 a. m., lasting between 5 and 10 seconds.—U. S. Weather Bureau.

1906. **April 18**; Southeast Farallon Island, Cal. (26 miles due west of the beach at San Francisco; solid rock rising from the sea; the Weather Bureau building is located 15 feet above sea level). The direction of motion, from the east. A stone weighing about one hundred pounds slid six inches west by south and was rotated slightly in a direction opposite to the hands of a clock. There were two maxima. No vertical motion. No damage done except a crack across the entire front of the fireplace. Two rock slides of about one hundred tons each occurred on west end of the island.

"At 10:06 a. m., April 18, two distinct vibrations were felt. These were felt by Mr. Legler, observer of the Weather Bureau at Point Reyes, distant directly north twenty miles. He was talking to me over the Weather Bureau cable and the vibrations were noted by him 3 seconds before they were felt on the island."—J. A. Boyle, Observer, Weather Bureau.

Santa Rosa; the damage at this point was extensive and the loss of life heavy, owing to the destruction of several hotels. Many brick walls collapsed, chimneys were generally demolished, and frame buildings thrown from their supports.

Petaluma; the damage was considerable; but compared with the destruction at Santa Rosa, distant only a few miles, the loss was small.

Palo Alto; much damage was done by the shock to the newer buildings of Stanford University. The oldest buildings withstood the shock much better. One life was lost.

1906. **April 18**; Eureka.

At Eureka, California.

A. H. Bell, Observer, U. S. Weather Bureau.

According to my office clock, and ink mark on barograph sheet, the shock occurred at 5:11 o'clock in the morning (Pacific time). It was the most severe shock of earthquake of which there is any

record. It lasted 47 seconds and the vibrations were from southwest to northeast. There were no preliminary tremors, the shock being sudden and the vibrations continuous, with the maximum intensity toward the end. Buildings shook to an alarming degree and several were slightly twisted. One frame building moved about 12 inches to the west. Many chimneys toppled over and several hundred panes of glass were broken. There was no loss of life and the loss to property did not exceed $8,000. The chimneys fell in all directions, but most of them towards the west. The statue of Minerva on the dome of the Court House tipped toward the south until it leaned at an angle of 43 degrees.

North of Eureka the shock was slight, and reports indicate that the seismic disturbance did not extend more than thirty miles northward, but south of Eureka the earthquake was more severe. At Ferndale, 22 miles south, several buildings were demolished and many others badly twisted. Naturally there were wild rumors about crevices, upheavals, and depressions in the earth, but upon investigation it was found that such reports could not be verified. With the exception of a few cracks in the subsoil, and possibly a slight depression in some made land, there were no evidences of an earthquake. All the towns along the coast between Eureka and San Francisco were badly damaged. The nearer they are to San Francisco the greater is the damage.

Summing up the situation in Eureka and throughout Humboldt county, the earthquake did not do any considerable damage in the aggregate. The sections to suffer the worst were those on low or filled-in land. I am of the opinion that if our buildings had been higher, or the maximum intensity of the vibrations had lasted 20 seconds longer, the damage in Eureka would have been much greater.

A second shock of earthquake occurred on April 18, at 5:22 a. m. and another was felt at 12:25 p. m. These shocks were slight and of short duration. Slight shocks of earthquake also occurred in early morning of April 19; 3 a. m., 20; 6:07 a. m., 23; 10:30 a. m., 27, and at 11:10 p. m., 30. There was quite a severe shock on April 23, at 1:10 a. m., lasting about 14 seconds. The vibrations were from southerly to northerly, being of sufficient violence to shake buildings and stop clocks in different parts of the city.

1906. **April 18**; American steamer "Mackinaw," coal laden, from Washington to San Francisco, at 5:10 a. m., while in lat. 38° 23′ and long. 123° 24′, experienced heavy shock as if ship had struck bottom three distinct times and then slipped over a shoal. Weather calm, sea smooth, no disturbance of sea.—F. S. Meady.

1906. **April 18**; San Luis Obispo.

1906. **April 18**; Steamer "National City," lat. 38° 24′ N., long. 123° 57′. James Denny, chief engineer, states: "The ship seemed to jump clear out of the water, the engines raced fearfully, as though the

shaft or wheel had gone, and then a violent trembling fore and aft and sideways, reminding me of running full speed against a wall of ice."

At Rio Vista.

1906. April 18; Rio Vista.

The shake at this point was very severe. It commenced with a number of quite long vibrations from northwest to southeast and wound up with the figure of 8 motion which often accompanies seismic disturbances. It was quite difficult for one to maintain his footing, and, strange to say, nothing was thrown down or overturned, which may be attributed to the gyrating motion. The duration was about 30 seconds, and I am convinced that had it continued 30 seconds longer hardly a house would have been left standing in town. Some lumber piles were thrown down in a lumber yard situated upon a pile wharf, where the disturbance seemed worse than anywhere else. Also the water-tower, 60 feet in height, consisting of two large tanks containing 100,000 gallons, was seen to sway violently. The time of occurrence was 5:13:15 a. m., as determined by myself from stellar observation a few nights before; my clock set to it was stopped upon the above time.—J. C. Stanton, C. E.

1906. April 18; Fort Ross.

At Fort Ross.

Beginning at the coast three miles south of Fort Ross and running nearly parallel to the coast, at the base of the high hills and back of the table land, is a large crack or fissure. I have followed it for two miles and have heard of it for twenty miles. All fences and a water-pipe line crossing this fissure show positively that there has been a slip sidewise of about eight feet. The width or spread of the fissure and the rise and fall of the ground vary.—G. W. Call.

Ferndale, California; 5:13 a. m. Most severe shock ever experienced here. Nearly all business buildings damaged, some very badly. The ground opened and in places sank as much as 3 feet. Bureaus, clothes-presses, piano-players, thrown down, and two pianos reported thrown over. A standing chimney top was a novelty after the quake. The shock came from about 15 degrees south of west and the severe portion of it lasted about 25 seconds.—J. A. Shaw, C. E.

1906. April 18; Napa.

At Napa State Hospital.

At 5:14 a. m. on the morning of the 18th of April, 1906, a severe earthquake commenced and lasted about 80 or 90 seconds. The apparent motion at the beginning was from the west-south to

the east-north, a rolling motion for about 15 to 20 seconds, then a light interval for a few seconds, then a renewed force of a twisting nature, intensity IX+.

The ground, to the eye, seemed to be quivering, the hills seemed to have a rocking motion, the trees seemed to be shaken by the hands of a giant, everything looked to be in motion; the air was hazy and still.

Many brick and stone walls were thrown to the ground and others damaged to such an extent that they will have to be taken down. Nearly all chimneys were thrown down, and of those standing some are turned a quarter way round. Milk in pans was thrown out in an easterly and westerly direction.

The estimated damage to the city of Napa is about $150,000.

The damage to this institution was very light, except that the main tower will have to come down.—W. H. Martin.

Spokane, Washington; no shock felt at Weather Bureau office; but an abnormal jarring movement was found recorded on all the recording devices in the office at 5:12 a. m. The clock on triple register was working properly at 5 a. m., but at 6 a. m. it was found to be 25 minutes behind time.—C. Stewart, U. S. Weather Bureau.

Paisley, Oregon. "Earthquake shocks were reported at Marshfield and Paisley, but no details were given."—E. A. Beals, U. S. Weather Bureau, Portland, Ore.

1906. **April 18**; San Diego; 4:29:45 p. m. Force III; vibration southwest to northeast. Lasted 20 seconds; most severe shock in years.

Phœnix, Arizona; slight shock occurred about 5:48 a. m.; motion west to east.—U. S. Weather Bureau.

Yuma, Arizona; 4:30 p. m. Slight rolling vibration from east to west.—S. Hackett, U. S. Weather Bureau.

1906. **April 19**; Oakland, Chabot Observatory. Observer, C. B. Seven shocks between 6 a. m. and 2:15 p. m.; duration 2 to 3 seconds; intensity II-III.

Los Angeles; moderate shock at 12:31:41 p. m.

Points in western Nevada; 8:15 p. m. This list reported by Prof. George D. Louderback, University of Nevada, Reno:

Hazen; windows rattled; gas jets swung north to south.

Olinghouse; windows rattled; crowd in hotel bar-room scared and ran outside.

Wadsworth; sharp, quick shock like a blast; windows rattled.

Finley; quite strong in tent. Mr. Post at Reclamation Service Camp.

Carson Dam, 12 miles west of Fallon; shock plainly felt.

Brown's Station; men preparing for bed scared and ran out of house.

Not felt at Reno, Fallon, Lovelocks, and east.

The time was variously given as about 8, about 9, somewhat after 8 and between 8:30 and 9 p. m. Mr. L. H. Taylor, engineer in charge at Survey Camp, gives 8:15 as the time, and the more reliable reports confirm this.

Eureka; early morning.

1906. **April 20**; Oakland, Chabot Observatory. Moderate shock in afternoon.

Napa; 4:50 a. m.

Eureka; slight shock 3 a. m. Vibrations from south to north, lasted about 3 seconds.

1906. **April 21**; Napa; 3:00 a. m.—W. H. Martin.

1906. **April 22**; Oakland, Chabot Observatory. Time 3:18:22 p. m.; duration 2 seconds; direction from east; intensity III.—Observer, C. B.

Napa; 3:00 p. m.—W. H. Martin.

San Francisco; sharp shock 3:19:30 to 3:19:34, about 4 waves, moderate rocking.—A. G. McAdie.

1906. **April 23**; Oakland, Chabot Observatory. Time 8:10:10 a. m.; duration 3 seconds; direction from east; intensity III. Second shock 10:55:00 p. m.; intensity II.—Observer, C. B.

San Francisco; 3:51 p. m., about 1 second. Second shock 10:34 p. m., moderate shock.—A. G. McAdie.

Eureka; quite a severe shock at 1:10 a. m.; duration 14 seconds. Vibration from south to north. Sufficiently violent to shake buildings and stop clocks. Slight shock at 6:07 a. m. Vibrations from south to north, and lasted 4 seconds.

Ferndale; at 1:11 a. m. Severe shock, over-turning movable objects, chimney tops, etc. It came from about the same direction as on 18th. Duration 10 seconds.—J. A. Shaw, C. E.

1906. **April 23**; Ferndale; 6:30 a. m. Smart shocks of three seconds' duration.—J. A. Shaw, C. E.

1906. **April 24**; Oakland, Chabot Observatory. Time 10:45:00 p. m., and again at 11:42:00 p. m.

San Francisco; 1:25 a. m., short shock. 1:32 a. m., 2 (?) a. m., 1:14 p. m., light throw.—A. G. McAdie.

1906. **April 25**; San Francisco; 4:30 a. m.—A. G. McAdie.

Oakland, Chabot Observatory. Time 6:30:22 a. m.; duration 3 seconds; direction northeast to southwest; intensity III. Second shock 3:15 p. m.; duration 3 seconds; intensity III.—Observer, Prof. C. Burckhalter.

Niles; 3:22 p. m. And many shocks during month.—Wm. Barry.

Napa; 3:15 p. m. Sharp.—W. H. Martin.

Lick Observatory; 3:17:40 p. m.

San Francisco; 3:17:10 p. m. Double swing. Recorded on seismograph at No. 3018 Clay street. Slight horizontal motion.—W. R. Eckart and A. G. McAdie.

1906. **April 26**; Oakland, Chabot Observatory. Time 10:29:55 a. m. Explosion.

Lick Observatory; very slight shock 10:33:35 a. m., jolt only, no swing.—Professor Tucker.

1906. **April 27**; Oakland, Chabot Observatory. Time 6:15 a. m. Intensity II. Again at 1:08:10 p. m.; duration 3 seconds; direction east to west; intensity III.

Eureka-Ferndale; sharp shock at 10:30 a. m.

1906. **April 28**; Napa; 12:35 a. m. Sharp.—W. H. Martin.

1906. **April 29**; Lick Observatory; 4:09:21 p. m. Northwest and southeast; duration 1 or 2 seconds.—Dr. Campbell.

San Francisco; 4:09 p. m.—A. G. McAdie.

1906. **April 30**; Oakland, Chabot Observatory. Time 1:00 a. m. and 7:20 a. m. Shocks from this date until May 17 seemingly of circular motion, no decided direction shown by seismograph. They were in the nature of tremors with vertical motion predominating.—Observer, Prof. Chas. Burckhalter.

San Francisco; 1:57:30 a. m., and again at 1:59:40, and again 7:10 a. m.—A. G. McAdie.

Eureka; slight shock reported to have occurred at 11:10 p. m.

1906. **May 1**; Cloverdale, Napa, Peachland.

Napa; three light shocks reported.—W. H. Martin.

1906. **May 2**; Calistoga, Napa, Oakland, Laurel.

Oakland, Chabot Observatory. Time 6:56:20 a. m.; intensity II.

Napa; 12:35 a. m. Sharp.—W. H. Martin.

San Francisco; 6:51:30 a. m., light shock, and again at 8:50 a. m., and again 9:22 a. m.—A. G. McAdie.

Lick Observatory; 4:51:12–14 p. m. R.-F. I.—Dr. Perrine.

1906. **May 3**; San Francisco; 6 a. m., light, and again at 9:41:22 a. m.—A. G. McAdie.

Oakland, Chabot Observatory; 6:00:20 a. m.

Glenwood.

1906. May 4; Campbell.

Lick Observatory; 5:25 a. m. R.-F. H. Duration 5 seconds. Two distinct principal shocks one-half second apart, 3 seconds after beginning; direction north to south (?). No vertical vibration felt; no sound heard.—J. G. Maddrill.

San Francisco; 5:32 a. m. Feeble shock.—A. G. McAdie.

San Francisco; 10:29:30 a. m. Sharp jar.—A. G. McAdie.

1906. May 5; Oakland, Chabot Observatory; 10:28 a. m.

Napa; 10:30 a. m.—W. H. Martin.

San Francisco; sharp jar, 10:29:30 a. m.—A. G. McAdie.

Lick Observatory; 10:30:05 a. m. Duration 1 second, very faint.—Dr. Campbell.

1906. May 6; San Francisco; slight shock, 7:29 a. m. and again at 8:59:20; last one double wave and felt like a push, then more waves.—A. G. McAdie.

Blocksburg, Ukiah.

1906. May 7; San Francisco; several light tremors during the night and early morning. Shock at 5:07 a. m., another sharp shock at 4:17:10 p. m.—A. G. McAdie.

1906. May 8; San Francisco; 12:12 p. m. and 11:42 p. m. Sharp.—A. G. McAdie.

Campbell, Salinas.

1906. May 9; San Francisco; 5:20 a. m.—A. G. McAdie.

Salinas.

Ferndale; 9:30 p. m. Slight shock of 3 seconds' duration.—J. A. Shaw, C. E.

1906. May 9; Eureka; slight shock about 7:25 p. m., lasting several seconds. Vibrations south to north. Shook windows.

1906. May 10; Blocksburg, Zenia, Laurel, Montague.

San Francisco; 12:15 a. m.—A. G. McAdie.

Eureka; slight shock 6:59 a. m. Sudden jolt; duration 4 seconds. Vibrations south to north.

Ferndale; 6:55 a. m. Slight shock; 3 seconds.—J. A. Shaw, C. E.

1906. May 11; Oakland, Chabot Observatory; 1:27:46 p. m.

Napa; 1:30 p. m. and 3:30 p. m.—W. H. Martin.

San Francisco; 1:30:49 p. m. Heavy shock, lasting 3 seconds.—A. G. McAdie.

Kentfield, Salinas.

1906. **May 14**; Campbell.

1906. **May 14**; San Francisco; 5:21 p. m. and again at 9:03 p. m.—A. G. McAdie.

1906. **May 15**; Lick Observatory; 11:56:46–48 a. m. R.-F. III. Duration 5 seconds ending with a jolt.—Mrs. R. G. A.

1906. **May 16**; Heber.

Ferndale; 5:20 a. m. Moderate shock; 3 seconds.—J. A. Shaw, C. E.

1906.—**May 17**; Oakland, Chabot Observatory, 8:20 p. m.

Napa; 8:21 p. m.—W. H. Martin.

San Francisco; 11:05:45 a. m. and again at 8:24:30 p. m.—A. G. McAdie.

Lick Observatory; 8:21:24 p. m. Mrs. T. called attention to shock 3 or 4 seconds at least before I noticed it. I first felt it at 8:21:24 light for 2 seconds then heavy for 2 to 3 seconds, heavy part beginning 8:21:26. Possible error 3 seconds.—Dr. W. W. Campbell.

Campbell, Gonzales, Imperial, Livermore, San Luis Obispo.

Ferndale; 3:40 a. m., and 2 more before 6 a. m.—J. A. Shaw, C. E.

1906. **May 18**; Blocksburg, Ft. Bragg.

San Francisco; 5:23 a. m. Light shock.—A. G. McAdie.

Ferndale; 8:55 p. m. Slight shock, 2 seconds.—J. A. Shaw, C. E.

1906. **May 19**; Lick Observatory; 2:32:10 a. m. R.-F. III. Slight motion east and west.—Dr. Campbell.

Blocksburg, Ft. Bragg, Campbell.

Ferndale; 4:47 a. m. Very slight shock.—J. A. Shaw, C. E.

1906. **May 20**; Ft. Bragg.

1906. **May 22**; Ferndale; before daylight. Very light.—J. A. Shaw, C. E.

1906. **May 30**; San Francisco; 12:37:20 (?). Very feeble.—A. G. McAdie.

1906. **May 31**; San Francisco; 5:50 a. m.—A. G. McAdie.

Napa; 5:45 a. m.—W. H. Martin.

1906. **June 4**; Oakland, Chabot Observatory. Time 11:50:50 p. m. Duration 3 seconds; direction southwest to northeast; intensity III.

Niles; 11:55 p. m.

San Francisco; 11:52 p. m.—A. G. McAdie.

Berkeley; 11:51:07 p. m., 11:51:45 p. m.—A. O. Leuschner.

Campbell, Mills College, Napa.

Ferndale; 9:40 p. m. Very slight shock.—J. A. Shaw, C. E.

1906. **June 7**; Ferndale; 4:13 p. m. Slight shock, about 15 seconds duration.—J. A. Shaw, C. E.

Blocksburg, Ft. Bragg, Upper Mattole.

Berkeley; 12:21:39 a. m.

1906. **June 7**; Eureka; heavy shock at 4:15 p. m., lasting 26 seconds. Vibrations from a little south of west to east, of sufficient violence to shake buildings. The shock came suddenly with greatest intensity a few seconds after the first shock was felt, and then gradually died away. This was the most severe shock since morning of April 18.—A. H. Bell, observer, U. S. Weather Bureau.

1906. **June 8**; Fort Ross.

1906. **June 9**; Ft. Ross, Mills College.

San Francisco; 7:41 p. m.—A. G. McAdie.

1906. **June 10**; Ferndale; 6:26 p. m. Slight shock, 2 seconds.—J. A. Shaw, C. E.

Eureka, Napa.

1906. **June 13**; Eureka; very light shock, 11:50 a. m.

Tequisquita Rancho, Campbell.

Ferndale; 11:51 a. m. Very light.—J. A. Shaw, C. E.

1906. **June 14**; Ferndale; 4:50 a. m. Very light.—J. A. Shaw, C. E.

1906. **June 15**; Oakland, Chabot Observatory. Time 9:39:45 p. m. Duration 3 seconds; direction from northeast; intensity III.

Niles; 9:42 p. m.—Wm. Barry.

Napa; three shocks reported.—W. H. Martin.

Lick Observatory; Ewing instrument started. Shock felt by no one. Slight record on duplex.—E. Smith.

Ft. Bragg, Livermore, Mills College, Peachland, Sonoma.

San Francisco; 9:41 p. m. and again at 10:35 p. m.—A. G. McAdie.

Berkeley; 9:39:35 p. m., 9:40:52 p. m., 9:41:52 p. m., 9:51:39 p. m., 10:32:04 p. m.—A. O. Leuschner.

Ft. Bragg, 3:40 a. m.; Livermore, 9:45 p. m.; Mills College 9:41 p. m.; Niles, 9:42 p. m.

1906. **June** 16; Peachland.

Ferndale; 4:50 p. m. and 11:50 p. m. Two very light shocks.—J. A. Shaw, C. E.

1906. **June** 18; Fort Ross.

1906. **June** 20; Ferndale; 8:10 a. m. Very light.—J. A. Shaw.

1906. **June** 22; Berkeley; 11:51:03 p. m., 11:51:10 p. m.—A. O. Leuschner.

San Francisco; 6:07 a. m.—A. G. McAdie.

Mt. Tamalpais, Kentfield.

1906. **June** 25; Ferndale; 9:16 a. m. Light shock of about 6 seconds duration.—J. A. Shaw, C. E.

1906. **June** 26; Napa, Peachland.

1906. **June** 27; Ft. Ross.

1906. **June** 28; Peachland.

1906. **June** 30; Upper Mattole. Mr. W. H. Roscoe states that since the 18th of April there have been at least one hundred shocks.

1906. **July** 1; Mt. Tamalpais.

1906. **July** 2; Fort Bragg; 5:45 a. m.

1906. **July** 4; Lick Observatory; 5:39 a. m.—E. A. F.

San Francisco; 1:15:30 p. m. Single swing.—A. G. McAdie.

Salinas, 5:45 a. m.; Campbell, 5:45 a. m.

1906. **July** 6; Lick Observatory; two light shocks, 10:32 a. m. Three vibrations felt; duration 1 second. 10:55 p. m., light east to west.—Professor Aitken.

Berkeley; Omori seismograph at Students' Observatory, recorded the shock at 10:52:15 ± 2 seconds, p. m., and again at 10:58 p. m. Salinas, 10:52 p. m.

Los Banos.

San Luis Obispo.

1906. **July** 9; Eureka; 10 p. m., 11:37 p. m.

Ferndale; 11:40 p. m. Very light.—J. A. Shaw, C. E.

1906. **July** 12; San Francisco; 5:38 a. m. (?)—A. G. McAdie.

Mt. Tamalpais.

1906. **July** 13; Sierra Madre; 5:20 a. m. Newhall 5:35 a. m.

Los Angeles; moderate shock felt at 5:30 a. m.—U. S. Weather Bureau.

1906. **July 18**; San Francisco; 6:27:35 p. m.—A. G. McAdie.

1906. **July 20**; San Francisco; 1:20 a. m.—A. G. McAdie.
Berkeley; 1:19:36 a. m.—A. O. Leuschner.
Mt. Tamalpais.

1906. **July 21**; San Luis Obispo.

1906. **July 22**; San José; 10:39:30 p. m., 11:48:20 p. m.—H. F. Reid.

1906. **July 23**; San José; 5:41 a. m.—H. F. Reid.
Helen Mine; 11 p. m.

1906. **July 24**; Imperial; 6 p. m.

1906. **July 25**; San José; 11:04:30 p. m.—H. F. Reid.

1906. **July 26**; Mills College; 9:20 p. m.
Berkeley; 9:18:30 p. m.—A. O. Leuschner.
San José; 4:37:30 a. m.—H. F. Reid.

1906. **July 27**; Pt. Loma; 10:10 p. m.

1906. **July 28**; Berkeley. Prof. H. Fielding Reid reports light shocks at 0:22:40 a. m., 5:25 a. m., 5:44 a. m., 6:01 a. m., 7:25 a. m., 7:46 a. m.

1906. **July 29**; Berkeley. Prof. H. Fielding Reid reported light shock at 6:46:20 a. m.

1906. **July 30**; Eureka; light shock 6:45 p. m.
Berkeley; 5:35 a. m.—H. F. Reid.

1906. **August 1**; Eureka; light shock at 11:32 a. m. Vibrations from southwest. Duration about 2 seconds.
Ferndale; 11:31 a. m. Very light.—J. A. Shaw, C. E.
Peachland; 6 a. m. Light.
San Luis Obispo.

1906. **August 2**; Berkeley; 6:15:05 a. m. Recorded on Omori seismograph.

1906. **August 2**; Fort Ross; 6:04 a. m.—G. W. Call.

1906. **August 3**; Fort Ross; 5:02 p. m.—G. W. Call.

1906. **August 3**; in latitude N. 25° 35′, longitude W. 110° 06′, ship "Alex. Gibson," Capt. J. A. Wayland, experienced a tremendously heavy shock lasting about 40 seconds, shaking the ship from stem to stern as if she were bumping over a ledge of rocks; it shook tools out of the racks in the carpenter shop, pots and pans down in the galley and cups and pitchers from hooks in the pantry and all lamp glasses off the lamps. The crew came running aft, not knowing what was the matter and the captain thought the yards were coming down. The sea at the time was perfectly smooth, wind light from the southwest. No land in sight; all sails set

in fine clear weather. At 7:10 p. m., ship's time, felt another light shock of about 15 seconds duration and from 8 to 12 midnight felt two more very light shocks; but did not note the time. The captain states that he had experienced an earthquake at sea on a former occasion so he knew what it was; but the one felt before was nothing to this one either in force or duration.—J. T. McMillan.

1906. August 4; Berkeley; 11:19 p. m.

Lick Observatory; 5:39 a. m. I.

1906. August 5; Berkeley; 1:53 a. m., 3:25 a. m., and 6:15 a. m.—Prof. A. O. Leuschner.

1906. August 5; Fort Ross; 1:50 p. m.—G. W. Call.

1906. August 6; Lick Observatory; 10:32:2 a. m. II.

1906. August 12; Rio Vista; 6 a. m.

1906. August 14; Salinas; 8:30 a. m. and 9:35 a. m. Light.

1906. August 15; Tequisquita Rancho; 4:40 a. m.

1906. August 16; Berkeley; 4:17:58 p. m. Recorded on Omori seismograph. This is the "great Valparaiso earthquake."

1906. August 19; San Francisco; 9:00 a. m. Tremor and jolt.—A. G. McAdie.

1906. August 19; Tequisquita Rancho; 2 a. m.

Salinas; 1:59 a. m. Sharp.

1906. August 21; in the Gulf of California. Latitude N. 26° 19″, longitude W. 110° 25″ at 2:15 p. m.; duration 1 minute. The vessel trembled and the sensation was as if the ship were bumping on rocks. Shock felt by all hands. Bark, "St. James;" Captain, F. O. Parker. On arrival at Guaymas, shortly afterward, inquiry made if shock had been felt there but none had been noted.—J. T. McMillan.

1906. August 22; Napa; 1:55 a. m.—W. H. Martin.

1906. August 25; Ferndale; 1:40 p. m. Light shock.—J. A. Shaw, C. E.

1906. August 26; Ferndale; 9:09 p. m. Light shock; 3 seconds' duration.—J. A. Shaw, C. E.

1906. August 27; Point Loma; 10 a. m.

1906. August 28; Ferndale; about 3 a. m.—J. A. Shaw, C. E.

Tequisquita Rancho; 11:40 a. m.

1906. August 29; Mt. Tamalpais; 7:59:35 a. m. Vibration southeast to northwest; duration 2 seconds.—W. W. Thomas, Weather Bureau.

1906. August 30; Sonoma; 2:12 a. m. Light.

1906. August 31; Ft. Ross; 9:52 a. m.

1906. **September 1**; Sonoma; 3:12 a. m. Light shock.

Tequisquita Ranch; 5:50 a. m.

1906. **September 2**; in latitude 43° 40′ N., longitude 128° 50′ W. Bark "Agate," Capt. C. H. McLeod. Experienced a heavy shock, lasting nearly a minute; sensation being as if the vessel had struck a coral reef or rock. The wind was northwest and light; weather clear, sea smooth, barometer 30.00. At 3:55 a. m. felt another shock, not quite so severe as the first, nor of as long duration.—J. T. McMillan.

1906. **September 6**; Branscomb; 12:10 a. m.—A. J. Haun.

1906. **September 7**; Lick Observatory; 9:24:59 a. m. II-III. Perceptible vibration; duration about 10 seconds. One slight jolt. Duplex indicated slight east-west motion.

1906. **September 8**; Berkeley; 12:32 p. m.—Prof. A. O. Lauschner.

1906. **September 9**; Carson City, Nevada. A light earthquake at 4:55 a. m.—C. W. Friend.

Wabuska, Nevada; a tremor about 5 a. m.—J. G. Young.

Grass Valley, California; 4:15 a. m.—I. Sanks.

Nevada City, California; 5 a. m. Was quite generally felt in Grass Valley and Nevada City. It was of short duration; but very distinct.—Sherman W. Marsh.

Pilot Creek; 4:55 a. m. Two distinct shocks.—E. W. Stanton.

1906. **September 13**; Ferndale; 8:45 p. m. Short.—J. A. Shaw, C. E.

1906. **September 14**; on board schooner "Robert Searles" in latitude N. 41° 18′, longitude W. 125° 52′; severe earthquake or other submarine disturbance; duration 25 seconds; time, 11:30 a. m.; it shook vessel considerably; weather unsettled and sun extremely hot when visible.—Capt. J. H. Piltz and J. T. McMillan.

Berkeley; 8:46 a. m. Recorded on Omori seismograph at Students' Observatory.

1906. **September 16**; Lick Observatory; 7:12:02 a. m. III (?). Observers noting direction agree on north-south. Duplex showed E. 30° S.

1906. **September 17**; Ferndale; 5:15 p. m., lasted 10 seconds; and again at 8:10 p. m.—J. A. Shaw, C. E.

1906. **September 18**; Ferndale; 8:45 p. m.—J. A. Shaw, C. E.

1906. **September 20**; Berkeley; 11:39 p. m.—Prof. A. O. Leuschner.

1906. **September 21**; Berkeley; 11:24 p. m.—Prof. A. O. Leuschner.

1906. **September 25**; Berkeley; 5:36 a. m.—Prof. A. O. Leuschner.

1906. **October 5**; San Francisco; 6:30 a. m.

1906. **October 7**; Fort Ross; 11:57 p. m.—G. W. Call.

1906. **October 10**; Tequisquito Rancho; 5:45 a. m.
San Francisco; 11:45 p. m.

1906. **October 11**; Salinas; 5:30 a. m.

1906. **October 17**; Fort Ross; during night.—G. W. Call.

1906. **October 18**; Tequisquito Rancho; 5 a. m.

1906. **November 6**; 8 a. m., latitude 46° 09′ N., longitude 125° 32′ W. American schooner "Stanley." Willapa Harbor to San Francisco. Heavy southerly gale blowing and heavy swell on, when suddenly wind died down to a calm, but swell still continued. About the time when wind dropped to a calm, felt a sharp earthquake shock lasting about two or three seconds. Immediately afterwards we were looking toward the southwest, when we saw mountainous waves coming toward us; when they struck the vessel she began to pitch and roll violently, and we thought every minute we would be swamped. In the midst of the confusion all the sailors became alarmed and took to the rigging. I immediately began using oil to help calm the seas and to protect the vessel from serious injury. The wind finally sprang up from the northwest, light, hazy, and misty. Barometer 28:60 inches. The dangerous seas lasted for about one hour and thirty minutes. The mate was certain that the mountainous seas were caused by the earthquake shock.—K. Peterson and K. Magensen.

1906. **November 11**; American bark "Carondelet," Capt. Thomas Doyle. Latitude 42° 51′ N., longitude 127° 31′ W. 6:40 a. m. I felt a quick rolling sensation, and a few seconds after felt the ship tremble fore and aft. I thought at the time that we had run on top of some sunken vessel or a whale. It looked like a heavy tide rip all around the vessel. The second shock was light. As to the tides, for 24 hours after had about one-half mile per hour. Bound from Port Gamble to San Francisco; experienced very rough weather for 11 days; nothing but gales from southeast round to southwest.

1906. **November 4**; Fort Ross; 11:58 a. m.

1906. **November 7**; Eureka.

1906. **November 9**; Fort Bragg; 2 a. m.

1906. **November 12**; Salinas in a. m. Light.

1906. **November 13**; Fort Bragg; 3 a. m.
Glenwood; 7:48 p. m.
Tequisquito Rancho; 7:48 p. m.
San José; 7:48 p. m. Sharp, lasting 3 seconds; east to west.
Lick Observatory; 7:47:49 p. m. One jolt north-south direction.

1906. **November 14**; Fort Bragg; 2:30 a. m.
Fort Ross; night of 14-15.

1906. **November 22**; Isabella; 10:45 p. m.

Glenwood; 3:53 p. m.

1906. **November 25**; San Francisco; 1:15 p. m. Very light.

1906. **November 26**; San Francisco; 1:50 a. m. Very light.

1906. **November 26**; American steamer "Newport." Position 14° 41′ N., 92° 36′ W. Time 10:27 p. m. Felt sharp shock lasting about 8 or 10 seconds. Shook the steamer considerably, frightening passengers. Weather clear, barometer 29:24, temperature 83, temperature of water 83 and sea smooth.—W. J. Russell and A. Koppe.

1906. **December 6**; San Luis Obispo; 10:40 p. m. Duration 30 seconds; from north to south. A second shock an half hour later. Felt also at Santa Maria.

Tequisquito Rancho; 6:45 a. m.

1906. **December 7**; San Miguel; 10:55 p. m. Followed by slight tremble for 15 seconds.

1906. **December 8**; Idyllwild; 10:40 a. m.

Mt. Tamalpais; 5:48:54 p. m. Light shock, lasting 2 seconds.

1906. **December 9**; San Francisco; 3:20 a. m. Intensity about III on R.-F. scale. Duration a few seconds; one marked wave from southwest to southeast.—A. G. McAdie.

Oakland, Chabot Observatory. Time 3:20:40 a. m.; duration 6 seconds; direction northeast to southwest.—Prof. Charles Burckhalter.

Mills College; 3:20 a. m.—Josiah Keep.

Berkeley; Students' Observatory. Seismograph recorded heaviest shock since last June. Duration 6 seconds. Movement from southwest to northeast.—Prof. A. O. Leuschner.

1906. **December 19**; Cuyamaca; 3 p. m.

Escondido; 2:46 p. m. Light.

1906. **December 22**; Calexico; 8:45 a. m.

1906. **December 23**; Calexico; 4:55 a. m.

Cuyamaca; 4 a. m.

Fort Ross; 5:48 a. m.

Berkeley; 9:26:35 a. m. Seismograph recorded a distant shock; origin probably not less than 2,300 miles nor more than 4,000 miles distant.—A. J. Champreux.

1906. **December 24**; Napa; 2 a. m. Sharp jar.

1906. **December 25**; Eureka; 8:18 p. m. Short. In some parts of city vibrations strong enough to upset vases.

Rohnerville; 8:15 p. m.

1906. **December 28**; Lytle Creek; early morning. Light.