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Preparation of Isoseismal Maps and Summaries of Reported
Effects for Pre-1900 California Earthquakes

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Summary

This is the second annual report of a three year project to clarify the earthquake history of California for the period before 1900. More than four thousand additional newspaper issues were searched for earthquake reports, bringing the total number of issues examined to more than eleven thousand. About one quarter of the issues searched have provided earthquake reports. Summaries of these reports, emphasizing the information used to assign earthquake intensities, were prepared. The strength and spatial distribution of the reported earthquake effects were used to estimate the magnitude and epicentral location of the earthquakes. The third annual report, projected for August 1981, will provide isoseismal maps showing the distribution of the intensity reports which control the estimates of magnitude and epicenter.

Thirty four additional earthquakes were studied this year, and the hundred twenty five earthquakes studied last year were re-evaluated in light of the newly obtained data.

The epicentral distribution of pre-1900 earthquakes is generally similar to that of twentieth century earthquakes. Comparison with the Epicenter Map of California (Real et al., 1978), which displays post-1900 epicenters, shows that the following areas were more strongly affected by earthquakes before 1900 than after 1900:

<u>Area</u>	<u>Date</u>	<u>Magnitude</u>	<u>Imax</u>
San Diego County	24 February 1892	6.9	VIII-IX
Santa Barbara Channel	21 December 1812	7.2	VIII
Inyo County	26 March 1872	7.8	IX+
Western Stanislaus County	10 April 1881	6.0	VI
East San Francisco Bay	June 1836 & Oct. 1868	6.8	VIII & IX
Yolo and Solano Counties	19 April 1892	6.8	IX
San Pablo Bay	31 March 1898	6.5	IX
Mendocino County	15 April 1898	6.7	VIII
Lassen and Plumas Counties	24 January 1875	6.0	VII
Del Norte County	23 November 1873	7.0	VII

Other significant findings include information suggesting surface faulting, that was not previously identified, during the following earthquakes:

<u>Date</u>	<u>M</u>	<u>Imax</u>	<u>Possible Fault Rupture</u>
11-31 October 1800		VII	San Andreas
2 February 1881	5.9	VIII	San Andreas
24 February 1892	6.9	VIII-IX	10 km NW of Jacumba
19 April 1892	6.8	IX	between Vacaville & Winters
20 June 1897	6.3	VIII-IX	Calaveras
25 December 1899	6.7	IX	San Jacinto

Serious doubts have been raised as to the occurrence of an earthquake reported to have caused fault rupture on the Big Pine fault in 1852. The 1875 earthquake that was reported to have ruptured the Mohawk Valley fault zone, appears from the felt effects to be centered to the northeast near Honey Lake Valley.

Introduction

This is the second annual report of a three-year project to clarify the earthquake history of California for the period before 1900. The first annual report was published by California Division of Mines and Geology as Open-File Report 79-6 SAC. The second annual report supersedes OFR 79-6 SAC in that (a) additional earthquakes were studied, (b) earthquakes studied during the first year were re-evaluated in the light of newly obtained information, (c) the bibliographies of data sources were updated, (d) for every locality reporting an earthquake a summary of the reported effects is given with the assigned intensity, (e) brief descriptions of the earthquakes are provided, and (f) a measure of epicentral uncertainty is given for each earthquake. The third annual report projected for August 1981, will provide isoseismal maps showing the distribution of the intensity reports which control the estimates of epicenter and magnitude.

Organization

The report consists of a brief descriptive text, three tables, two figures, and four Appendixes which summarize the descriptions of the earthquakes and specify the sources of information searched to obtain these descriptions.

Appendix A provides a brief description of each earthquake. Appendix B lists the sources of earthquake information that are not newspapers. Appendix C is a bibliography of all the newspapers searched, specifying the more than 11,000 issues searched and whether they contained earthquake information. Appendix C consists of 388 pages, and consequently is presented in microform (computer generated, 48 times reduction). Appendix D is a summary of the effects at each locality reporting an earthquake, giving the source of this information and the value of intensity assigned. Appendix D consists of

495 pages, and consequently is presented in microform (manual photography, 20 times reduction).

Data Sources

Townley and Allen's catalog (1939) was our source of preliminary information, and defined the time and the general locality to search for additional data. Newspapers were the main source of additional data starting in 1846, when the first newspaper was published in California. Newspapers in the area surrounding each earthquake were searched for several issues following the date of the earthquake. The union list of newspapers (Gregory, 1937) informed us of the newspapers in print on any given date, and provided a guide to locating where the issues were stored. Table I lists the 71 libraries that were visited in searching for data during the past 2 years, and identifies the 40 visited during the past year.

Appendix C lists, by county, the newspaper issues searched for each earthquake. A total of more than 11,000 newspaper issues have been searched, and about one quarter provided earthquake reports. A county map is provided in Figure 1. Available histories, letters, diaries, and the professional literature were also searched for data. A list of these non-newspaper sources is given in Appendix B, only for those sources providing earthquake reports.

For the pre-1846 period, before newspapers were published in California, the sources of data were limited to those in Appendix B, which include government correspondence and records from the Franciscan Missions. About sixty pages of hand written documents from the Franciscan Missions have been translated. These documents were indexed under "earthquake" at the Santa Barbara Mission Archives. A group of translators of Portuguese and Spanish, including a specialist in 18th and 19th Century Spanish, was contracted to provide as

literal a translation as possible. For the relatively high cost of translation (about \$20.00 per page), very little usable information resulted. About 20 additional annual and biennial reports of the various missions were examined. About 12 pages were found to have earthquake information and await translation.

Thirty four earthquakes ranging in magnitude from 4.4 to 6.8 were added to the study list this year. Of these events, five are unaccounted for in previous catalogs. The largest of these "new" earthquakes is a M6.7 aftershock of the great Owens Valley earthquake of 1872. The data sources were searched for these 34 additional earthquakes as well as for the 125 earthquakes studied last year.

Intensity Determination

The reported effects were interpreted in terms of earthquake intensity and an intensity value was assigned to each location reporting the earthquake. All the intensity values assigned are given in Appendix D, with the reported effects and the source of this information. For each earthquake, the reporting locations were plotted on a map with their assigned intensities, and isoseismal lines were drawn to separate zones of different intensity. These isoseismal maps will accompany the third annual report, projected for August 1981.

When we assigned values of intensity based on the reported earthquake effects, we altered the Modified Mercalli scale of Wood and Neuman (1931) to make it more applicable to the limited information given in newspaper articles. Our most significant alteration of the intensity scale concerns the quality of 19th Century building construction. It is assumed that

damaged structures are of the poorest quality construction; masonry D of Richter (1958): "weak materials, such as adobe; poor mortar; low standards of workmanship; weak horizontally." This has led to the following modifications

V Minor cracking of plaster (It is felt that cracking plaster is a lower intensity than fall of plaster particularly when the reported cracks may have predated the earthquake and were either enlarged by the earthquake or were noticed for the first time.)

VI Fall of plaster (same as MM scale); minor cracks in masonry walls (when it is stated that walls were cracked without specifying whether it was the plaster or the masonry which was cracked an intensity of V-VI is assigned); a few loose bricks fell from the top of walls or chimneys (it is assumed the shaking required to dislodge loose bricks is about the same that is required to knock items from shelves).

VII One or more chimneys fell or were badly damaged (it is assumed that all damaged chimneys were weak); moderate damage to masonry walls such as large cracks or fall of bricks, tilework; fall of cornices from high buildings and towers; fall of some firewalls (non-structural unreinforced brick walls usually one brick thick).

VIII Partial collapse of masonry walls, frame houses shifted on their foundations, collapse of weak adobe buildings; all chimneys twisted or knocked down.

IX Partial collapse of a number of masonry buildings or total collapse of a few masonry buildings; wood frame buildings shifted off of their foundations. (Richter states that Masonry D is destroyed at this intensity. For this reason we assign no higher intensity than IX. When most masonry buildings are destroyed a IX+ is assigned recognizing that the intensity could be higher but we have no evidence that the structures were stronger than masonry D.)

Another area where clarification was needed was in the area of the reactions of people. Part of the problem is that newspaper writers of that time had a tendency to exaggerate or romanticize the response of the populace. For this reason statements that people were frightened were treated with skepticism unless substantiated by other evidence such as people rushing out of buildings. The system used to assign intensities based on the response of the populace is as follows: A few people were frightened at IV; many were frightened and a few ran outside at V; most or all were frightened and many ran outside at VI. No higher intensities were assigned based on people's reactions alone.

The final items which we have modified in our application of the scale are those items dealing with ground effects or ground failure such as landslides, changes in springs or cracks in the ground. It has been our experience that the intensities derived from these effects, using the intensity scale as written, are often much higher than those indicated by structural damage in the same area. Landslides, rockfalls, and ground cracking due to slumping sometimes occur without being triggered by earthquakes, so their use as indication of ground shaking is suspect. We have found that these features generally occur within the intensity VI zone. Consequently we assign an intensity of VI+, meaning VI or larger, to these effects.

Table 2 shows Wood and Neuman's (1931) Modified Mercalli scale. The items of the scale that we do not apply are underlined. The items that we have added in our application of the scale are inserted within square parentheses.

Earthquake Data

Table 3 lists the epicentral coordinates, maximum reported intensities, and areas shaken at various intensity levels. A separate estimate of Richter local magnitude was derived from each of the isoseismal areas (Toppozada, 1975) as well as from the maximum reported intensity (Gutenberg and Richter, 1956). The magnitude assigned to each earthquake is the mean of these estimates. When an earthquake had separate estimates of magnitude which were questionable those estimates were excluded in determining the mean value of magnitude.

For any given earthquake, the center of the area of most intense shaking was assumed to approximate the epicenter. Although this approximation suffers from site effects, radiation effects, and limitations imposed by the distribution of reporting localities, it is superior to assuming the epicenter at the locality reporting the highest intensity. The quality of the epicenters, or intensity centers, determined in this way depends on the number and distribution of the reporting localities, in the same way that the quality of seismographic determination depends on instrument distribution. Some of the epicenters in the densely populated San Francisco Bay area might have an uncertainty of 15 kilometers or even less in some case, whereas others in sparsely populated areas might have an uncertainty of 60 kilometers or more. An estimate of uncertainty of the epicentral location is given in Table 3 based on the intensity information plotted on the isoseismal maps. The density and distribution of the intensity reports, which control the estimates of magnitude and epicenter, will be displayed as isoseismal maps in the next annual report

(August 1981). When the scarcity of reporting locations make it impossible to estimate an epicenter (quality E), the location listed is that of the reporting locality, or of an intermediate point if more than one locality reported the earthquake.

In some cases, other information, in addition to the intensity distribution, was used to locate the epicenter. Earthquakes accompanied by surface fault-rupture were assumed to be located on the rupture. When aftershocks or foreshocks were reported, the epicenter was assumed to lie near the locality reporting them. The absence of reported aftershocks for earthquakes ($M \geq 6$) in which the highest reported intensities are low ($I_{\max} \leq VI$) and border an unpopulated area, such as the Pacific Ocean suggests that the epicenter is probably not near the reporting localities.

The geographic distribution of all pre-1900 earthquakes studied that have been assigned locations is shown in Figure 2. Epicenters were plotted using a symbol of size proportional to magnitude. When it was not possible to estimate a magnitude, it was also not possible to estimate an epicenter (quality E), and the value of maximum reported intensity was plotted at the single reporting location, or in the case of more than one reporting location it was plotted at an intermediate point.

Results

The epicentral distribution of pre-1900 earthquakes is generally similar to that of twentieth century earthquakes. Comparison with the Epicenter Map of California (Rea et al., 1978) which displays post-1900 epicenters, shows that the following areas were more strongly affected by earthquakes before 1900 than after 1900:

<u>Area</u>	<u>Date</u>	<u>Magnitude</u>
San Diego County	24 February 1892	6.9
Santa Barbara Channel	21 December 1812	7.2
Inyo County	26 March 1872	7.8
Western Stanislaus County	10 April 1881	6.0
East San Francisco Bay	June 1836 & Oct. 1868	6.8
Yolo and Solano Counties	19 April 1892	6.8
San Pablo Bay	31 March 1898	6.5
Mendocino County	15 April 1898	6.7
Del Norte County	23 November 1873	7.0
Lassen and Plumas Counties	24 January 1875	6.0

It is noteworthy that in the closing decade of the nineteenth century, four earthquakes of magnitude 6.5 or greater occurred on or near the San Andreas fault system north of San Francisco, two in 1892 and two in 1898. Other earthquakes of this size have not occurred between San Francisco and Cape Mendocino since 1850. The 1892 and 1898 earthquakes may have been premonitory to the great 1906 earthquake on the northern San Andreas fault. This observation was reported at the 1979 meeting of the Seismological Society of America in a paper summarizing the salient features of pre-1900 California seismicity (Toppozada, et al, 1979).

Other significant findings include information suggesting surface faulting, that was not previously identified, during the following earthquakes:

<u>Earthquake</u>			<u>Possible Fault</u>
<u>Date</u>	<u>M</u>	<u>I_{max}</u>	<u>Rupture</u>
11-31 October 1800		VII	San Andreas
2 February 1881	5.9	VIII	San Andreas
24 February 1892	6.9	VIII-IX	10 km NW of Jacumba
19 April 1892	6.8	IX	between Vacaville & Winters
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25 December 1899	6.7	IX	San Jacinto

Serious doubts have been raised as to the occurrence of an earthquake reported to have caused fault rupture on the Big Pine fault in 1852. The 1875 earthquake that was reported to have ruptured the Mohawk Valley fault zone, appears from the felt effects to be centered to the northwest near Honey Lake Valley. Possible faulting or the doubts about reported faulting are discussed in Appendix A, Earthquake Descriptions.

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Gregory, Winifred (1937) American Newspapers 1821-1936, A Union List of Files Available in the United States and Canada, Bibliographical Society of America, New York.

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Townley, M.D. and M.W. Allen (1939) Descriptive Catalog of Earthquakes of the Pacific Coast of the United States, 1769 to 1928, Bull. Seis. Soc. Am., v. 29, p. 1-297.

Wood, Harry O. and Frank Neuman (1931) Modified Mercalli Intensity Scale of 1931, Bull. Seis. Soc. Am., v. 21, p. 277-283.

TABLE I . LIBRARIES VISITED

A.K. Smiley Public Library, Redlands

*Anaheim Public Library

Archdiocies, Los Angeles

Archdiocies, San Francisco

*Benicia Public Library

California State Historical Society, San Francisco

California State Library, California Section, Sacramento

California State University, Chico

*California State University, Fullerton

California State University, Sacramento

*California State University, San Bernardino

*California State University, Stanislaus

*Calistoga Public Library

*Cloverdale Reveille (Newspaper Office)

*Corona Public Library

*Escondido Public Library

Hemet Public Library

Hemet News (Newspaper Office)

Humboldt State University, Arcata

Huntington Library, San Marino

*Lodi Public Library

Long Beach Public Library

*Los Angeles County Public Library System

 *Lancaster Branch

 *Rosemead Branch

 *San Fernando Branch

Los Angeles Museum of Natural History

Los Angeles Public Library

*Marin County Library, San Rafael

*Mendocino County Library, Ukiah

Mission Santa Barbara, Archives

Nevada State Historical Society, Reno

Nevada State Library, Carson City

*Oceanside Public Library

Ojai Public Library

*Ontario Public Library

Pasadena Historical Society

*Pomona Public Library

Riverside Public Library

*Sacramento City Library

Sacramento County Public Library

San Bernardino County Museum, Redlands

*San Diego County Library, Fullbrook

San Diego Historical Society, Library and Manuscripts Collection

*San Diego Public Library

San Jacinto Public Library

San Jacinto Valley Register (Newspaper Office)

*San Joaquin County Library, Stockton

*San Luis Obispo City-County Library

*Santa Barbara Public Library

*Santa Monica Public Library

*Siskiyou County Library, Yreka

*Solano College, Fairfield

- *Solano County Library, Fairfield
- *Solano Republic, Fairfield (Newspaper Office)
- *Sonoma County Library
 - *Cloverdale Branch
 - *Petaluma Branch
 - *Santa Rosa Branch
 - *Sebastopol Branch
 - *Sonoma Branch
- *Stanford University
- *Tehama County Library, Red Bluff
- University of California, Berkeley, Bancroft Library
- *University of California, Davis, Main Library
- *University of California, Los Angeles, Special Collections
- University of California, Riverside
- University of Nevada, Reno
- *University of the Pacific, Stockton
- *Vallejo Public Library
- Ventura County Library
- *Whittier Public Library
- *Willows Public Library

* Libraries visited in the 1979-1980 fiscal year.

Table 2. MODIFIED MERCALLI SCALE (Wood and Neumann, 1931).

Items that were not applied by the present authors are underlined. Items that were added by the present authors are enclosed in square parentheses.

- I Not felt--or, except rarely under especially favorable circumstances.
Under certain conditions, at and outside the boundary of the area in which a great shock is felt:
sometimes birds, animals, reported uneasy or disturbed;
sometimes dizziness or nausea experienced;
sometimes trees, structures, liquids, bodies of water, may sway--
doors may swing, very slowly.
- II Felt indoors by few, especially on upper floors, or by sensitive, or nervous persons.
Also, as in grade I, but often more noticeably:
sometimes hanging objects may swing, especially when delicately suspended;
sometimes trees, structures, liquids, bodies of water, may sway,
doors may swing, very slowly;
sometimes birds, animals, reported uneasy or disturbed;
sometimes dizziness or nausea experienced.
- III Felt indoors by several [a number, some], motion usually rapid vibration. Sometimes not recognized to be an earthquake at first.
Duration estimated in some cases.
Vibration like that due to passing of light, or lightly loaded trucks, or heavy trucks some distance away.
Hanging objects may swing slightly.
Movements may be appreciable on upper levels of tall structures.
Rocked standing motor cars slightly.
- IV Felt indoors by many, outdoors by few.
Awakened few, especially light sleepers.
Frightened no one, unless apprehensive from previous experience.
Vibration like that due to passing of heavy, or heavily loaded trucks.
Sensation like heavy body striking building, or falling of heavy objects inside.
Rattling of dishes, windows, doors; glassware and crockery clink and clash.
Creaking of walls, frame, especially in the upper range of this grade.
Hanging objects swung, in numerous instances.
Disturbed liquids in open vessels slightly.
Rocked standing motor cars noticeably.
[Frightened a few or several.]

V Felt indoors by practically all, outdoors by many or most: outdoors direction estimated.
Awakened many, or most.
Frightened few [many]--slight excitement, a few [or some] ran outdoors.
Buildings trembled throughout.
Broke dishes, glassware, to some extent.
Cracked windows--in some cases, but not generally.
Overturned vases, small or unstable objects, in many instances, with occasional fall.
Hanging objects, doors, swing generally or considerably.
Knocked pictures against walls, or swung them out of place.
Opened, or closed, doors, shutters, abruptly.
Pendulum clocks stopped, started, or ran fast, or slow.
Moved small objects, furnishings, the latter to slight extent.
Spilled liquids in small amounts from well-filled open containers.
Trees, bushes, shaken slightly.
[Minor cracking of plaster.]
[Felt by most at an hour when most would be asleep.]
[Rang very small bells, i.e. door bells.]

VI Felt by all, indoors and outdoors.
Frightened many [most or all], excitement general, some alarm, many [or all] ran outdoors.
Awakened all.
Persons made to move unsteadily.
Trees, bushes, shaken slightly to moderately.
Liquid set in strong motion.
Small bells rang--church, chapel, school, etc.
Damage slight in poorly built buildings.
Fall of plaster in small amount.
Cracked plaster somewhat, especially fine cracks, chimneys in some instances.
Broke dishes, glassware, in considerable quantity, also some windows.
Fall of knick-knacks, books, pictures.
Overturned furniture in many instances.
Moved furnishings of moderately heavy kind.
[Some brick walls cracked slightly.]
[A few loose bricks knocked from walls.]
[Many plaster walls cracked.]

VII Frightened all--general alarm, all ran outdoors.
Some, or many, found it difficult to stand.
Noticed by persons driving motor cars [or horse drawn carriages].
Trees and bushes shaken moderately to strongly.
Waves on ponds, lakes, and running water.
Water turbid from mud stirred up.
Incaving to some extent of sand or gravel stream banks.

Rang large church bells, etc.

Suspended objects made to quiver.

Damage negligible in buildings of good design and construction, slight to moderate in well-built ordinary buildings, considerable in poorly built or badly designed buildings, adobe houses, old walls (especially where laid up without mortar), spires, etc.

Cracked chimneys to considerable extent, walls to some extent.

Fall of plaster in considerable to large amount, also some stucco.

Broke numerous windows, furniture so some extent.

Shook down loosened brickwork and tiles.

Broke weak chimneys at the roof-line (sometimes damaging roofs).

Fall of cornices from towers and high buildings.

Dislodged bricks and stones.

Overtured heavy furniture, with damage from breaking.

Damage considerable to concrete irrigation ditches.

[Fall of a few fire walls.]

VIII Fright general--alarm approaches panic.

Disturbed persons driving motor cars.

Trees shaken strongly--branches, trunks, broken off, especially palm trees.

Ejected sand and mud in small amounts.

Changes: temporary, permanent; in flow of springs and wells; dry wells renewed flow; in temperature of spring and well waters.

Damage slight in structures (brick) built especially to withstand earthquakes.

Considerable in ordinary substantial buildings, partial collapse, racked, tumbled down, wooden houses in some cases [those on stilts]; threw out panel walls in frame structures, broke off decayed piling.

Fall of walls.

Cracked, broke, solid stone walls seriously.

Wet ground to some extent, also ground on steep slopes.

Twisting, fall, of [most or all] chimneys, columns, monuments, also factory stacks, towers.

Moved conspicuously, overturned, very heavy furniture.

[Moved frame structures on their foundations.]

[Weak adobe buildings may collapse.]

IX Panic general.

Cracked ground conspicuously.

Damage considerable in (masonry) structures built especially to withstand earthquakes:

threw out of plumb some wood-frame houses built especially to withstand earthquakes;

great in substantial (masonry) buildings, some collapse in large part [partial collapse of a number of buildings or a few buildings largely collapsed or both]; or wholly shifted frame buildings off foundations; racked frames; serious to reservoirs; underground pipes sometimes broken.

- X Cracked ground, especially when loose and wet, up to widths of several inches; fissures up to a yard in width ran parallel to canal and stream banks.
Landslides considerable from river banks and steep coasts.
Shifted sand and mud horizontally on beaches and flat land.
Changed level of water in wells.
Threw water on banks of canals, lakes, rivers, etc.
Damage serious to dams, dikes, embankments.
Severe to well-built wooden structures and bridges, some destroyed.
Developed dangerous cracks in excellent brick walls.
Destroyed most masonry and frame structures, also their foundations.
Bent railroad rails slightly.
Tore apart, or crushed endwise, pipe lines buried in earth.
Open cracks and broad wavy folds in cement pavements and asphalt road surfaces.
- XI Disturbances in ground many and widespread, varying with ground material.
Broad fissures, earth slumps, and land slips in soft, wet ground.
Ejected water in large amount charged with sand and mud.
Caused sea-waves ("tidal" waves) of significant magnitude.
Damage severe to wood-frame structures, especially near shock centers.
Great to dams, dikes, embankments, often for long distances.
Few, if any, (masonry) structures remained standing.
Destroyed large well-built bridges by the wrecking of supporting piers, or pillars.
Affected yielding wooden bridges less.
Bent railroad rails greatly, and thrust them endwise.
Put pipe lines buried in earth completely out of service.
- XII Damage total--practically all works of construction damaged greatly or destroyed.
Disturbances in ground great and varied, numerous shearing cracks.
Landslides, falls of rock of significant character, slumping of river banks, etc., numerous and extensive.
Wrenched loose, tore off, large rock masses.
Fault slips in firm rock, with notable horizontal and vertical offset displacements.
Water channels, surface and underground, disturbed and modified greatly.
Dammed lakes, produced waterfalls, deflected rivers, etc.
Waves seen on ground surfaces (actually seen, probably, in some cases).
Distorted lines of sight and level.
Threw objects upward into the air.

Date			Time (GMT)	Location Lat. °N Long. °W		Qual. ¹	$I_{\max.}$ ²	$(M_I)^2$	A_{II} ²	$(M_{II})^3$	A_V	(M_V)	A_{VI}	(M_{VI})	A_{VII}	(M_{VII})	A_{VIII}	(M_{VIII})	Mean M
15	May	1851	16:10	37.9	122.6	C	VI	(5.0)			5	(4.9)							5.0
*26?	Oct	1852 ⁴	-----	----	-----														
9	Nov	1852 ⁴	-----	----	-----														
23	Nov	1852 ⁴	07:00	----	-----														
29	Nov	1852	20:00	32.5	115.0	C	IX	(7.0)			130	(6.4)	30	(6.4)					6.6
17	Dec	1852 ⁴	-----	----	-----														
1	Feb	1853	21:00	35.6	121.1	E	VI	(5.0)											
23	Oct	1853		40.8	124.2	E	VI+	(5.0)											
25	Jan	1855	06:00	39.5	120.0	D	VI+	(5.0) ⁵			34	(5.7)							5.7
11	July	1855	04:15	34.1	118.1	C	VIII	(6.3)	53	(5.3) ⁵					0.6	(5.9)			6.1
27	Aug	1855	11:00	38.0	122.5	B	VI	(5.0)			2.8	(4.6)							4.8
2	Jan	1856	18:15	37.5	122.5	C	VI-VII	(5.3)			24	(5.6)	2.3	(5.4)					5.4
10	Jan	1856 ⁴	13:00	----	-----														
15	Feb	1856	13:25	37.6	122.4	B	VII	(5.7)			57	(6.0)	7.0	(5.9)					5.9
21	Sep	1856	07:30	33.0	117.0	E	VI	(5.0)											
9	Jan	1857	16:00	35.3	119.8	A	IX+	(8.3) ⁵							100	(7.9) ⁵			7.9 ⁶
3	Sep	1857	03:05	39.5	120.0	D	V-VI	(4.7) ⁵	260	(6.4)	41	(5.9)							6.2
26	Nov	1858	08:35	37.5	121.9	B	VIII	(6.3)			49	(6.0)			5.1	(6.7)			6.3
*16	Dec	1858	10:00	34.0	117.5	C	IX	(7.0)			15	(5.4)							5.4
5	Oct	1859	20:16	37.8	122.4	E	VI	(5.0)											
27	Jan	1860	08:30	34.1	118.2	E	V	(4.3)											
15	Mar	1860	19:00	39.5	119.5	D	VI+	(5.0) ⁵	320	(6.6)	130	(6.4)	6.3	(5.8)					6.3
26	Mar	1860 ⁴	-----	----	-----														
13	Nov	1860	00:00	40.8	124.2	E	VII	(5.7)											
4	July	1861	00:11	37.8	122.0	A	VIII	(6.3) ⁵	33	(5.0)				3.2	(5.5)				5.3

Date			Time (GMT)	Location Lat. °N Long. °W		Qual. ¹	I _{max.} ²	(M _I) ²	A _{II} ³	(M _{II}) ³	A _V	(M _V)	A _{VI}	(M _{VI})	A _{VII}	(M _{VII})	A _{VIII}	(M _{VIII})	Mean M
*27	May	1862	20:00	32.6	117.2	C	VII	(5.7)	75	(5.6)	20	(5.6)							5.6
19	Dec	1863	22:38	37.4	122.2	C	V-VI	(4.7)			8.5	(5.1)							4.9
26	Feb	1864	13:47	36.9	121.5	C	VI	(5.0) ⁵	130	(5.9)	54	(6.0)	8.1	(5.9)					5.9
5	Mar	1864	16:49	37.2	121.5	C	VI	(5.0) ⁵	110	(5.8)	40	(5.9)							5.9
*21	May	1864	02:01	37.5	122.0	C	VI	(5.0) ⁵	95	(5.7)			9.8	(5.9)					5.8
22	July	1864	06:41	37.5	122.0	C	V	(4.3) ⁵	23	(4.8)	9.8	(5.2)							5.0
18	Aug	1864	13:18	39.2	121.0	B	VI+	(5.0) ⁵	7.8	(4.1)	0.2	(3.3) ⁵							4.1
8	Mar	1865	14:30	38.4	122.6	A	VIII	(6.3) ⁵	6.6	(5.0)	0.6	(4.9)							5.0
*24	May	1865	11:21	37.1	121.7	C	VI	(5.0)			7.5	(5.0)							5.0
1	Oct	1865	17:15	40.8	124.0	C	VII	(5.7)			19	(5.5)			0.4	(5.8)			5.7
8	Oct	1865	20:46	37.2	121.9	A	IX	(7.0)	190	(6.2)	76	(6.2)	35	(6.4)	4.9	(6.7)	0.3	(6.4)	6.5
8	Oct	1865 ⁴	-----	-----	-----														
16	Dec	1865	05:00	38.8	123.1	C	IV	(3.7)											<4.0
*26	Mar	1866	20:12	37.1	121.6	B	VII	(5.7)	110	(5.8)	43	(5.9)							5.9
*15	July	1866	06:30	37.3	121.2	C	V	(4.3) ⁵	130	(5.9)	15	(5.4)							5.7
2	Dec	1867	08:20	39.6	120.9	C	V	(4.3)	5.3	(3.8)	1.3	(4.2)							4.1
30	May	1868	05:10	39.4	119.7	B	VII	(5.7)	170	(6.1)	43	(5.9)	1.4	(5.2) ⁵					5.9
	*May	1868 ⁴	-----	-----	-----														
2	June	1868	17:30	39.5	120.8	B	Felt												<4.0
25	July	1868	02:30	36.3	119.3	E	Severe												
*4-17	Sept	1868		36.6	118.4	C	VI+	(5.0)											
*17	Sept	1868	16:55	38.6	119.7	C	VI+	(5.0) ⁵	59	(5.4)			0.4	(4.8)					5.1
26	Sept	1868	08:40	39.2	123.2	E	IV	(3.7)											
21	Oct	1868	15:53	37.7	122.1	A	IX	(7.0)	260	(6.4)	77	(6.2)	51	(6.6)	15	(7.1)	2.6	(7.3)	6.8

Date	Time (GMT)	Location		Qual. ¹													Mean M
		Lat.°N	Long.°W		I _{max.} ²	(M _I) ²	A _{II} ³	(M _{II}) ³	A _V	(M _V)	A _{VI}	(M _{VI})	A _{VII}	(M _{VII})	A _{VIII}	(M _{VIII})	
8 Oct 1869	09:30	39.1	123.1	B	VII	(5.7)			2.5	(4.6)							5.2
*21 Dec 1869	04:00	39.6	120.5	B	V-VI	(4.7)	27	(4.9)	4.5	(4.8)							4.8
27 Dec 1869	01:55	39.4	119.6	B	VII-VIII	(6.0)	140	(6.0)	57	(6.0)	7.7	(5.9)	0.7	(6.0)			6.0
27 Dec 1869	10:00	39.1	119.7	B	VII-VIII	(6.0)			42	(5.9)	2.6	(5.5)					5.8
*17 Feb 1870	20:12	37.2	122.0	B	VII	(5.7)	82	(5.6)	13	(5.3)	1.6	(5.3)					5.5
2 Apr 1870	19:48	37.8	122.2	B	VI	(5.0)			9.2	(5.2)							5.1
2 Mar 1871	21:05	40.4	124.2	D	VIII	(6.3)			39	(5.9)			2	(6.4)			6.2
5 July 1871	21:06	36.5	118.0	C	VI+	(5.0)	43	(5.2)	6.1	(5.0)	0.7	(5.0)					5.1
*1871 ⁴ -----																	
17 Mar 1872 ⁴	09:00	-----	-----														
26 Mar 1872	10:30	36.7	118.1	A	IX+	(7.0) ⁵			740	(7.3) ⁵	320	(7.3) ⁵	127	(7.9) ⁵	50	(8.4) ⁵	7.8 ⁶
*26 Mar 1872	14:06	36.9	118.2	A	V	(4.3) ⁵	400	(6.7)									6.7
*28 Mar 1872	13:00	39.5	120.5	C	VI	(5.0)	48	(5.3)									5.2
*3 Apr 1872 ⁴ -----																	
*3 Apr 1872	12:15	36.9	118.2	D	V	(4.3) ⁵			210	(6.6)							6.6
11 Apr 1872	19:00	37.5	118.5	C	IX	(7.0)	470	(6.8)									6.9
18 Apr 1872	12:00	36.5	117.8	E	Severe												
*3 May 1872	01:00	33.0	115.0	D	VII	(5.7)	150	(6.0)									5.9
17 May 1872	21:00	36.6	118.1	E	VI	(5.0)											
14 Sep 1872 ⁴ -----																	
23 Nov 1873	05:00	42.0	124.2	C	VIII	(6.3) ⁵	900	(7.2)	380	(6.9)	87	(6.8)	18	(7.2)			7.0
24 Jan 1875	12:00	40.3	120.4	C	VII	(5.7)			75	(6.2)	2.3	(5.4) ⁵					6.0
*30 Sept 1875	12:30	40.7	124.0	C	VII	(5.7)			27	(5.7)			0.9	(6.0)			5.8
*3 Jan 1876 ⁴ -----																	
*29 May 1876	18:55	38.5	122.9	B	VI	(5.0) ⁵	6.6	(4.0)	1.1	(4.2)							4.1

Date	Time (GMT)	Location		Qual. ¹	I _{max.} ²	(M _I) ²	A _{II} ³	(M _{II}) ³	A _V	(M _V)	A _{VI}	(M _{VI})	A _{VII}	(M _{VII})	A _{VIII}	(M _{VIII})	Mean M
		Lat. °N	Long. °W														
*9 May 1878	04:25	40.0	124.5	D	VIII	(6.3)			190	(6.6)	25	(6.3)	5.0	(6.7)			6.5
*7 Jan 1881	02:25	40.0	122.0	C	V-VI	(4.7)	16	(4.6)		3.0(4.7)							4.7
*2 Feb 1881	00:11	36.0	120.5	B	VIII	(6.3)	68	(5.5)									5.9
10 Apr 1881	10:00	37.3	121.3	C	VI	(5.0) ⁵	190	(6.2)	50	(6.0)	8.0	(5.9)					6.0
6 Mar 1882	21:45	36.7	121.2	C	VI	(5.0)	96	(5.7)	17	(5.5)	1.4	(5.2)					5.4
30 Mar 1883	15:45	36.9	121.6	B	VII	(5.7)	81	(5.6)	14	(5.4)	4.7	(5.7)	0.9	(6.0)			5.7
5 Sep 1883	12:30	34.5	120.0	D	VI	(5.0) ⁵			68	(6.1)	3.5	(5.6)					5.9
22 Oct 1883 ⁴	14:00	----	-----														
28 Jan 1884	07:30	41.0	123.5	D	V	(4.3) ⁵			28	(5.7)							5.7
26 Mar 1884	00:40	37.0	122.2	C	VI	(5.0)	75	(5.6)	12	(5.3)							5.3
6 June 1884	09:00	40.3	122.3	C	V	(4.3)				1.1	(4.1)						4.2
31 Jan 1885	05:45	40.4	120.5	B	VII	(5.7)	93	(5.7)	22	(5.6)	2.4	(5.4)	0.2	(5.6)			5.6
31 Mar 1885	07:56	36.7	121.0	D	VII	(5.7)					2.7	(5.5)					5.6
2 Apr 1885	15:25	36.5	120.7	D	V	(4.3) ⁵	75	(5.6)									5.6
12 Apr 1885	04:05	36.5	120.5	D	VII	(5.7)	240	(6.4)	49	(6.0)							6.2
1 Aug 1885	00:10	38.8	123.0	E	VI	(5.0)											
*3 June 1887	10:48	39.1	119.8	B	VIII	(6.3)			87	(6.2)	25	(6.3)	2.6	(6.5)			6.3
*3 Dec 1887	18:55	39.3	123.5	B	VII	(5.7)				7.0	(5.1)	1.3	(5.2)				5.3
16 Dec 1887	12:15	39.2	123.6	D	VI	(5.0)				1.6	(4.3)						4.7
18 Feb 1888	10:50	39.2	123.5	C	V	(4.3)				3.5	(4.7)						4.5
29 Feb 1888	22:50	38.3	122.7	B	VI?	(5.0) ⁵				8.1	(5.1)	0.3	(4.7)				4.9
*14 Apr 1888	03:30	41.5	120.5	C	VI	(5.0)	7.9	(4.1)									4.6
29 Apr 1888	04:48	39.7	120.7	B	VII	(5.7)	150	(6.0)	42	(5.9)	6.4	(5.8)					5.8
17 Sep 1888	11:51	37.1	121.8	C	V	(4.3)	17	(4.6)		2.6	(4.6)						4.5
18 Nov 1888	22:28	37.8	122.2	A	VII	(5.7) ⁵	8.7	(4.2)		1.2	(4.2)						4.2

Date	Time (GMT)	Location Lat.°N Long.°W	Qual. ¹	I _{max.} ²	(M _I) ²	A _{II} ³	(M _{II}) ³	A _V	(M _V)	A _{VI}	(M _{VI})	A _{VII}	(M _{VII})	A _{VIII}	(M _{VIII})	Mean M
7 Feb 1889	05:20	34.1 116.8	D	VI+	(5.0) ⁵	53	(5.3)	6.0	(5.0)							5.1
15 Apr 1889	03:28	37.0 121.8	C	V-VI	(4.7)	47	(5.3)	5.7	(5.0)							5.0
19 May 1889	11:10	38.0 121.9	A	VIII	(6.3)			38	(5.8)	7.6	(5.9)	1.2	(6.2)			6.1
20 June 1889	06:00	40.5 120.7	B	VII	(5.7)	100	(5.8)	12	(5.3)	1.2	(5.2)					5.5
31 July 1889	12:47	37.7 122.2	A	VII	(5.7)	53	(5.4)	12	(5.3)	0.8	(5.0)					5.4
28 Aug 1889	02:15	34.1 117.9	C	VI	(5.0)	62	(5.4)	11	(5.3)	1.4	(5.2)					5.2
30 Sep 1889	05:20	37.5 118.8	D	VI+	(5.0) ⁵	110	(5.8)	19	(5.5)							5.7
9 Feb 1890	12:06	33.5 116.5	D	VI+	(5.0) ⁵			68	(6.1)	5.7	(5.8)					6.0
24 Apr 1890	11:36	36.9 121.6	A	IX	(7.0) ⁵			26	(5.7)	8.9	(5.9)	0.5	(5.9)			5.8
26 July 1890	09:40	40.5 124.5	C	VII	(5.7)			62	(6.1)	12	(6.0)					5.9
23 Aug 1890 ^a	-----	-----														
2 Jan 1891	20:00	37.1 121.8	C	VI	(5.0)	62	(5.5)	16	(5.4)	2.0	(5.4)					5.3
12 Oct 1891	06:28	38.3 122.3	A	VIII	(6.3) ⁵			18	(5.5)	3.5	(5.6)	0.3	(5.6)			5.6
24 Feb 1892	07:20	32.6 116.3	C	VIII-IX	(6.7)	820	(7.2)	270	(6.8)	71	(6.7)	8.5	(6.9)			6.9
*19 Apr 1892	10:50	38.5 122.0	B	IX	(7.0)			150	(6.5)	29	(6.4)	8.5	(6.9)	1.4	(7.0)	6.8
*21 Apr 1892	17:43	38.6 121.9	B	IX	(7.0)	160	(6.1)	68	(6.1)	18	(6.2)	3.8	(6.6)	1.3	(7.0)	6.5
*30 Apr 1892	00:09	38.4 121.9	C	VI	(5.0)	42	(5.0)	5.0	(4.9)							5.0
*28 May 1892	11:15	33.5 116.0	D	V-VI	(4.7) ⁵			57	(6.0)							6.0
*14 June 1892	13:25	34.1 117.7	C	VI	(5.0) ⁵	82	(5.6)	17	(5.5)							5.6
13 Nov 1892	12:45	36.8 121.5	B	VII	(5.7)			69	(6.1)	10	(6.0)	1.0	(6.1)			6.0
4 Apr 1893	19:40	34.3 118.6	B	VIII	(6.3) ⁵			18	(5.5)	3.6	(5.6)					5.6
19 May 1893	00:35	34.0 119.5	D	V-VI	(4.7) ⁵	130	(5.9)	28	(5.7)							5.8
30 June 1893	13:30	38.0 122.3	B	V-VI	(4.7)	18	(4.6)	1.3	(4.2)							4.5
9 Aug 1893	09:15	38.4 122.6	B	VII	(5.7) ⁵	38	(5.1)	4.9	(4.9)	0.4	(4.9)					5.0
30 July 1894	05:12	34.5 117.5	D	VI+	(5.0) ⁵	190	(6.2)	62	(6.1)	11	(6.0)					6.1

Date	Time (GMT)	Location		Qual. ¹													Mean M
		Lat. °N	Long. °W		I _{max.} ²	(M _I) ²	A _{II} ³	(M _{II}) ³	A _V	(M _V)	A _{VI}	(M _{VI})	A _{VII}	(M _{VII})	A _{VIII}	(M _{VIII})	
*30 Sep 1894	17:36	40.2	124.5	D	VII	(5.7)	87	(5.7)	19	(5.5)							5.6
23 Oct 1894	23:03	32.8	116.5	C	VI+	(5.0) ⁵	200	(6.2)	89	(6.3)	6.1	(5.8)					6.1
17 Aug 1896	11:30	36.8	118.1	C	VIII	(6.3)			130	(6.4)							6.4
20 June 1897	20:14	37.0	121.5	A	VIII-IX	(6.7)	200	(6.2)	68	(6.1)	13	(6.1)			0.3	(6.4)	6.3
31 Mar 1898	07:43	38.2	122.4	A	IX	(7.0)	200	(6.2)	92	(6.3)	18	(6.2)	4.8	(6.7)			6.5
15 Apr 1898	07:07	39.2	123.8	B	VIII	(6.3)			120	(6.4)			9.7	(7.0)	1.6	(7.1)	6.7
16 Apr 1899	13:40	40.5	125.5	D	VI	(5.0) ⁵			120	(6.4)							6.4
30 Apr 1899	22:41	36.9	121.6	B	VII	(5.7)	72	(5.6)	17	(5.5)	2.6	(5.5)					5.6
2 June 1899	07:19	37.8	122.6	C	VII	(5.7)	56	(5.4)	12	(5.3)							5.5
6 July 1899	20:10	36.9	121.7	C	VII	(5.7)	87	(5.7)	18	(5.5)	0.9	(5.1)					5.5
*22 July 1899	00:46	34.2	117.4	D	VII	(5.7)	70	(5.5)			2.6	(5.5)					5.6
22 July 1899	20:32	34.3	117.4	D	VIII	(6.3)			104	(6.3)	39	(6.5)	6.7	(6.8)			6.5
13 Oct 1899	05:00	38.4	122.7	A	VII	(5.7) ⁵	2.6	(3.3)	0.2	(3.4)							<4.0
25 Dec 1899	12:25	33.8	117.0	A	IX	(7.0)			200	(6.6)	42	(6.5)	6.1	(6.8)	0.3	(6.4)	6.7

¹ Quality: A - Epicentral uncertainty probably not more than 15 km, or fault rupture is identified.

B - Epicentral uncertainty probably not more than 30 km.

C - Epicentral uncertainty probably not more than 60 km.

D - Epicentral uncertainty more than 60 km.

E - No epicenter is estimated; the coordinates given are of the reporting locality when only one locality reports the earthquake, or of a convenient intermediate point when the earthquake is reported from more than one locality.

² Maximum reported intensity (Modified Mercalli), and the magnitude (M_I) estimated from the maximum intensity.

³ Area in 1000 km² shaken at the intensity indicated or at higher intensities, and the magnitude estimated from that area.

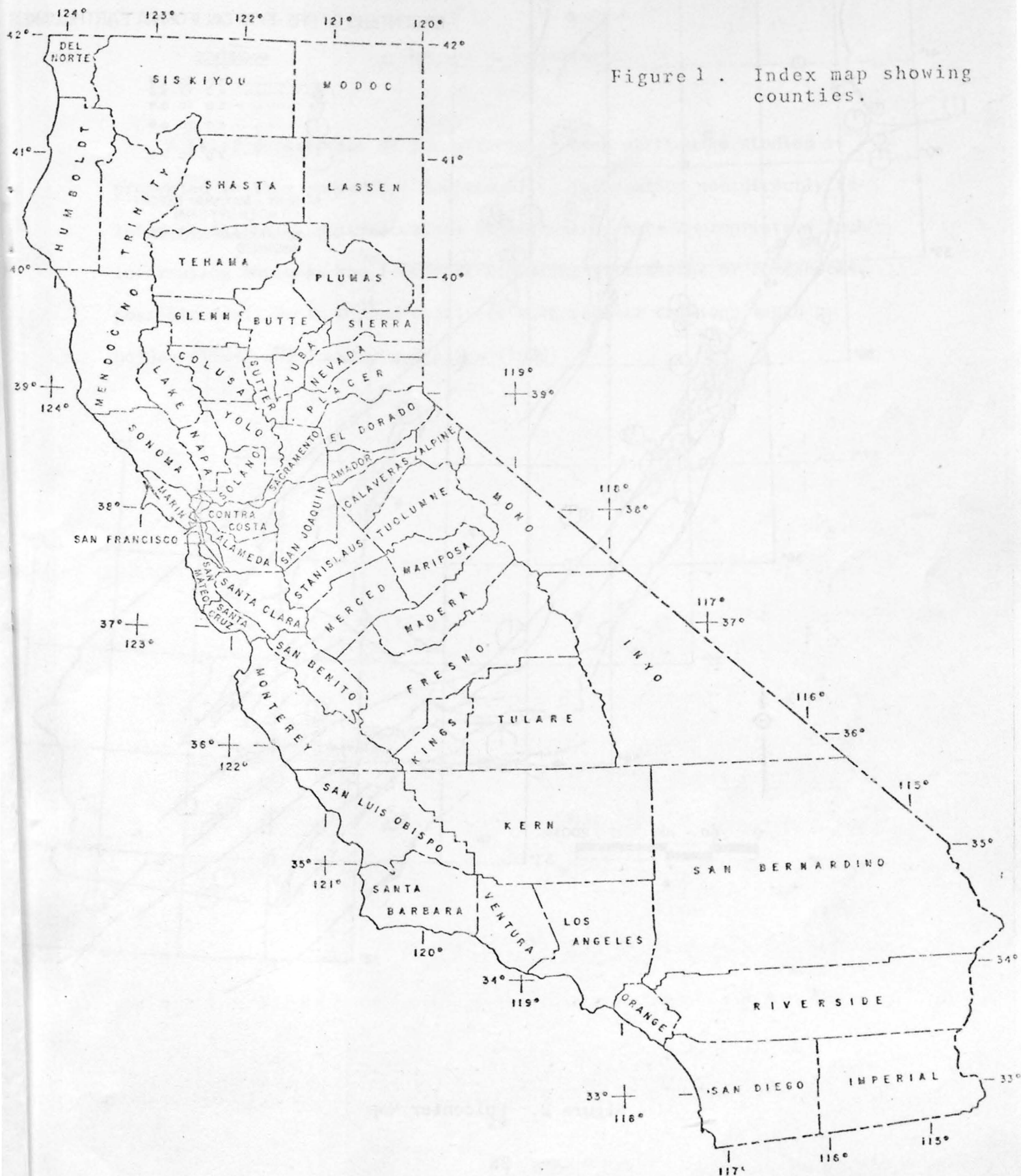
⁴ No parameters assigned, see description in Appendix A.

⁵ Magnitude estimate questionable; not used in computing the mean magnitude.

⁶ Moment magnitude (Hanks and Kanamori, 1979).

* Earthquakes added in fiscal year 1979-1980.

Figure 1. Index map showing counties.



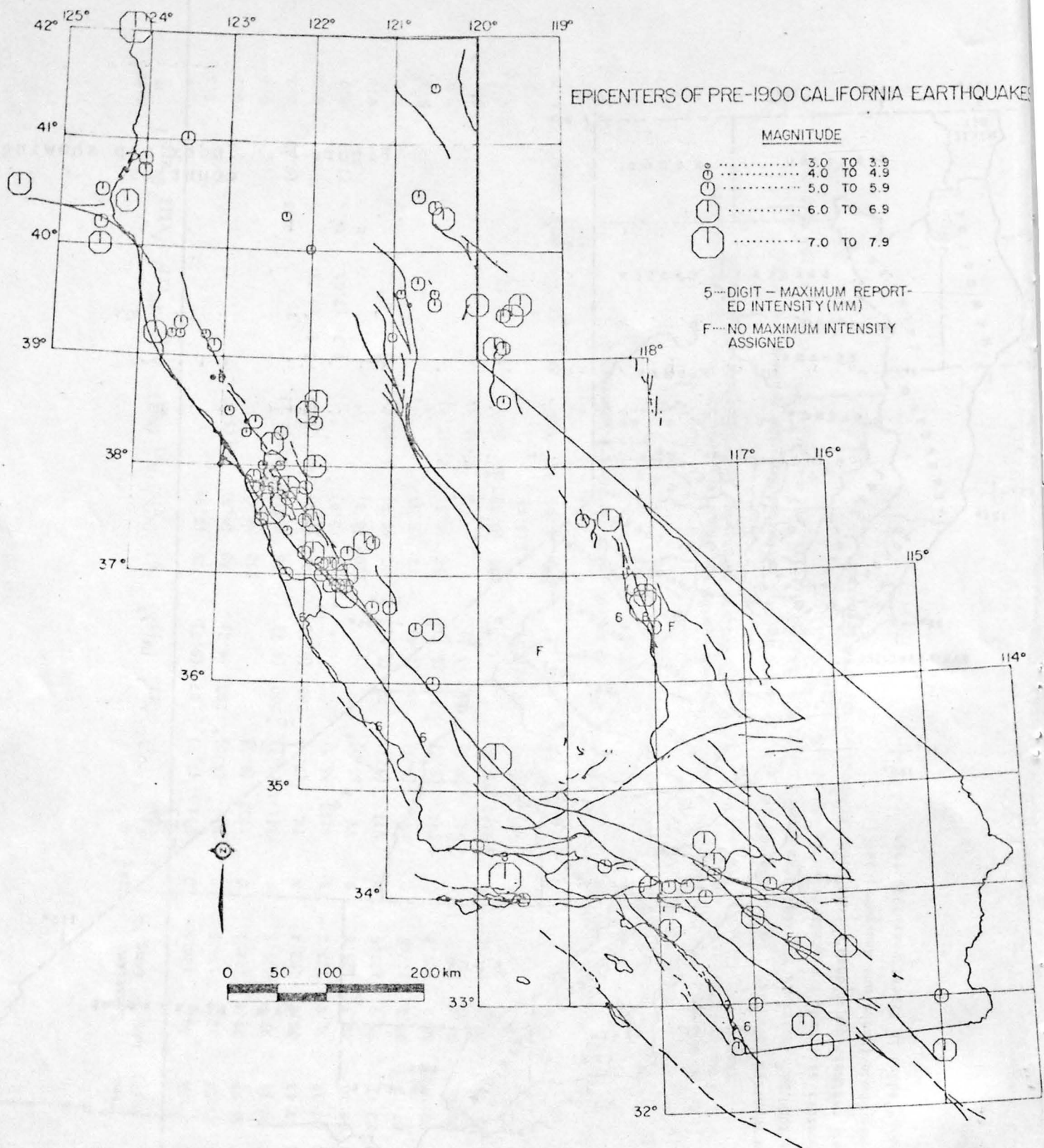


Figure 2. Epicenter Map

APPENDIX A

EARTHQUAKE DESCRIPTIONS

A brief description of the effects of each earthquake studied is presented in this appendix. Additionally, information not directly related to intensity determinations is discussed where appropriate. Such information includes the locations reporting aftershocks or foreshocks, possible fault rupture, and conflicts with earlier catalogs, such as Holden (1898) and Townley and Allen (1939).

28 July 1769 - According to the diary of Miguel Costanso, the Portola expedition of 1769-1770, while camped by what is now known as the Santa Ana River, experienced a "terrible" earthquake which was repeated four times during the day. The first shock was reported to be the most violent. During the following week, as the expedition traveled into the Los Angeles Basin, more earthquakes were felt. From the description, it would appear that a significant earthquake occurred on July 28 followed by many aftershocks. The epicenter of the event was likely near the Los Angeles Basin to account for the numerous aftershocks.

27 December 1775 - In his diary of Anza's second expedition, Fray Pedro Font reported feeling a short earthquake accompanied by a loud noise at San Carlos Pass (about 40 km. southeast of Hemet, Riverside County). It is likely that this was a small local event because it was described as brief and with no mention of additional shocks.

1790 - According to the Daily Alta California, 6 April 1872, "The oldest Indian in the valley reports that about eighty years ago Owens Valley had a similar (to 1872 M 7.8) shock". At this time there were no European settlements in the interior of California so it is highly unlikely that any additional information can be obtained for this earthquake.

11-31 October 1800 - Hermenegildo Sal relates that Fray Pedro Martinez reported from San Juan Bautista "...that there is not a single habitation,

although built with double walls, that has not been injured from roof to foundation, and that all are threatened with ruin; and that the fathers are compelled to sleep in the wagons to avoid danger, since the houses are not habitable. At the place where the rancheria is situated, some small openings have been observed in the earth, and also in the neighborhood of the river Pajaro there is another deep opening, all resulting from the earthquakes". The San Andreas Fault passes through San Juan Bautista near the Mission and crosses the Pajaro River about 11 km northwest of San Juan Bautista. This segment of the San Andreas also ruptured during the magnitude 5.8 earthquake on 24 April 1890 which caused similar damage in San Juan Bautista.

Bancroft (1888) states that the most severe shock was on the 18th. This is not correct. On the 18th one Lieutenant Don Raymondo Carillo arrived at San Juan Bautista and reported to Sal that at supper "a shock was felt that was so powerful, and attended with such a loud noise as to deafen them, when they fled to the court without finishing their supper". Lieutenant Carillo was not at San Juan Bautista on the 11th to make a comparative judgement.

22 November 1800 - Adobe walls were cracked (7 MM) at San Diego and at San Juan Capistrano. An earthquake of at least magnitude 6.5 is required to damage the two Missions which are 90 km apart.

1800 - According to Engelhardt (1923), "In 1800, a violent earthquake was

felt at Santa Barbara. Only little damage was done to the mission buildings, however". Engelhardt assigned the wrong year to this earthquake. The reference he sites, California Archives, Prov. St. Pap. vol XIX, p. 327 describes the 25 March 1806 earthquake.

25 May 1803 - An earthquake damaged the church at San Diego slightly (Bancroft 1888).

25 March 1806 - An earthquake cracked the chapel walls at Santa Barbara in three places (Bancroft, 1888).

21 June 1808 - From 21 June to 17 July, 18 earthquakes were felt in the Presidio of San Francisco, cracking houses, destroying an ante chamber, and threatening the barracks of the fort with entire ruin.

1812 - An earthquake-triggered tidal wave was reported at San Francisco.

In a separate report (Hall, 1871) "An earthquake cracked the church (Santa Clara) considerably, but did not cause any portion of it to fall". However, the occurrence of a destructive earthquake near San Francisco Bay in 1812 is not confirmed in the 1812 annual reports of the three Missions, Santa Clara, San Jose and San Francisco Dolores.

8 December 1812 - This earthquake destroyed the church at San Juan Capistrano;

the bell tower fell on the church roof which collapsed killing 40 worshippers. At San Gabriel "An earthquake occurred on December 8th, 1812, at sunrise, and over threw the main alter, breaking the statues of Our Lord, St. Joseph, St. Dominic, and St. Francis. Moverover, the top of the steeple was brought down, and the sacristy, the covenant of the missionaries and other buildings were damaged" (Engelhardt, 1897). An earthquake of magnitude about 6.5 centered between Capistrano and San Gabriel (for example near Newport Beach) could explain the damage at these two missions.

San Fernando and San Buenaventura were also damaged, but it is not certain whether this occurred on the 8th or the 21st of December. Annual reports have been obtained from these two missions and will be translated in an attempt to resolve this ambiguity. Based on available information, it appears that San Fernando was possibly damaged on the 8th, but that San Buenaventura was more likely damaged on the 21st. The damage at both Missions is described below under the 21 December 1812 earthquake.

There is a report from a secondary source that San Luis Rey was damaged in 1812, but this was not mentioned in the 1812 annual report from this mission. The 1812 annual report for San Diego has been obtained and indicates that the earthquake was not "observed" at San Diego.

21 December 1812 - Fray Senan wrote to the Bishop of Sonora about the effects of this earthquake at Santa Barbara "there are many cracks in the houses, church, and other buildings, and a chapel of Saint Michael, which was in the Rancheria of Mescaltitan fell down completely, and the land was opened up in the vicinity, to such an extent that it causes horror. The Presidio of Santa

Barbara is all on the verge of falling down, and there is not one room in it that can be used. People from the Rancheria are living on the plains around the Mission, to where they withdrew since they were very close to the ocean, which threatened to flood them".

At Mission Purisima, Fathers Payeras and Ripoll wrote (Doc. 941) that this earthquake "ruined the church completely, knocked down the altar, various images and canvases and ruined most of its decorations. The buildings of the Mission are leveled and others (if the damage does not get worse), after careful inspection can be used for houses, otherwise, for minor use, which does not require much safety". There is information that some of the Mission buildings had walls of an adobe and a half thick only (i.e. thin walls). Engelhardt mentioned a foreshock, "On December 21st, 1812, there was an earthquake while the Fathers were making their examination of conscience. The earth shook so violently that it was difficult to stand. A brief examination showed that the church walls had been thrown out of plumb. Just before 11 o'clock, there came another more violent shock which brought down the church and nearly all the mission buildings, besides about 100 nearby houses of adobe. The earth opened in several places and emitted water and black sand. Several persons were wounded, but none were killed. Subsequent floods completed the devastation, so that very few buildings were worth repairing".

Also, at Santa Inez, two shocks about a quarter of an hour apart occurred on 21 December near 10 o'clock according to Geiger's (1974) quotation from Fathers Uria and Olbes' report: "The first made a considerable aperture in one corner of the church, the second shock threw down the said corner and a quarter of the new houses fell down, demolished

all the tiles and opened many a new wall. Engelhardt indicates, however, that "the Fathers did not deem the damage irreparable". Fray Senan reported to the Bishop of Sonora (Doc. 944): "The Church of Santa Inez has quite a few cracks. Two rooms and various walls fell down entirely; and almost all of the tiles from the roofs fell to the ground".

San Buenaventura was damaged on 21 December according to Geiger (1974), but 8 December was given by other historians such as Bancroft. We hope to resolve this ambiguity when the 1812 and 1813 annual reports of San Buenaventura are translated. Geiger notes that: "Fathers Senan and Victoria reported that from the dreadful earthquakes they feared that the buildings would collapse. The upper front of the church was three varas (yards) out of plumb and there was considerable aperture at the rear of the sanctuary. The tower was no longer serviceable and had to be torn down". Ocean flooding was reported by Fray Senan from San Buenaventura to the Bishop of Sonora: "it has been necessary for us to withdraw for now, for somewhat more than half a league inland, for fear of the ocean, which we knew had flooded in two parts..." The sea waves are associated with the earthquakes in Fray Marcos Antonio Victoria's baptismal entry: "On January 9, 1813, in the provinsional church of Jacal (at a place called San Joaquin y Santa Ana, distant from the mission [San Buenaventura] a little less than three quarters of a league, whither we had gone because of the terrible tremors or earthquakes we experienced and which were very strong, and because the sea was greatly stirred up by the tremors described above, in such a way that we feared that the waters might flood the mission)..."

At San Fernando, Engelhardt (1897) states: "The earthquake of December 21st, 1812, did no further damage to necessitate the introduction of thirty new

beams to support the church wall". The date is not confirmed in a letter from Geiger (Santa Barbara Mission Archivist) to CDMG: "The date of San Fernando Mission earthquake in December 1812 is not given. It could have been either December 8th or 21st".

An earthquake of about magnitude 7 located in the Santa Barbara Channel near 34.2°N and 119.7°W, could explain the damage from San Fernando to Purisima, and the numerous aftershocks felt at Santa Barbara and San Buenaventura into 1813. If San Fernando was not damaged on 21st December the magnitude would be between 6.5 and 7 and the epicenter would move about 20 km northwest. If San Buenaventura also was not damaged on 21st December the magnitude would be about 6.5 and the epicenter would move to the coast about 20 km west of Santa Barbara. This last possibility seems unlikely, because the similar reports of numerous aftershocks and threatened flooding at Santa Barbara and San Buenaventura suggest they were damaged by the same earthquake.

1822 - According to Hall, an earthquake in 1822 injured the churches at Santa Clara and San Jose considerably. Bancroft doubts that this occurred because, among other things, Hall gave no date or source reference. We have checked the 1822 annual reports of these two Missions and found no mention of earthquakes.

24 September 1827 - Duhaut - Cilly reports, from the Los Angeles area, an earthquake that caused people to rush outdoors (5-6 MM). We searched the 1827 annual reports of Missions San Gabriel and San Fernando and found no

mention of an earthquake. The 1827 annual report of Mission San Buenaventura mentions an earthquake, but it has to be translated before determining if it refers to this event.

1830 - According to Engelhardt, Fray Gil reported in the 1830 annual report from San Luis Obispo that: "The hospital and portions of the neophyte village are in ruins, and the rest of the village threatens to fall into ruins. All the walls of the house at Santa Margarite have been cracked by earthquakes. The ranch and buildings of San Miquelito are destroyed. The front of the Mission church had to be taken down, because it threatened to tumble over".

10 June 1836 M6.8 - This earthquake appears to be comparable to the 1868 earthquake in the extent of rupture on the Hayward fault, and consequently the same magnitude was assigned. The Oakland Daily News of 10 November 1868 carried the following: "An Earthquake Reminiscence.-We are informed that in June, 1836, there was an earthquake in what is now the Oakland Valley, the effects of which were felt along the foothills from San Pablo to Mission San Jose. There were large fissures in the earth, and the shocks must have been much heavier than those we have lately experienced. After the first and most violent shock, there were innumerable lesser ones, and for a month afterward there were continuous tremors of the earth, uniformly decreasing in violence. Since the earthquake of the 21st ult., there have been numerous shocks, diminishing in violence, and the phenomena appear to have been a repetition of those observed in 1836, and noted by persons then residing the valley". Louderback interprets the effects from San Pablo to Mission San Jose as indicating an origin on the Hayward fault, and that the fissures probably included "fault-trace

phenomena". Louderback was able to document that this earthquake caused

"havoc in Monterey and Santa Clara, and arousing great fear among the people. Intensity apparently at least VII(RF) at Monterey and Mission Carmel." These effects are similar to those of the 1868 earthquake which damaged brick walls and chimneys in Santa Clara and was described as very heavy and of long duration in Monterey.

June 1838 M 7 - Probable rupture on the San Andreas fault was reported from near Santa Clara to San Francisco, about 60 km. This suggests a magnitude of about 7, which is a minimum estimate because no reports were available north of San Francisco or south of Santa Clara, except at Monterey. Walls were cracked in San Francisco in the 1838 earthquake, which is comparable to the effects of the 1906 earthquake. In Monterey, crockery and glassware were broken and some adobe walls were reportedly cracked in 1838, compared to 1906 when the only damage reported was of some glassware and some furniture moved. Louderback states that "The fault rupture may have occurred throughout all or most of the line active in 1906, but north and south beyond the limits indicated...it lay under water or in wild country uninhabited by whites (except at Fort Ross, from which we have no report). The evidence of greater intensity at Monterey than in 1906 may mean that the fault rupture extended farther south in 1838 than in 1906."

3 July 1841 - Deflot de Mofras reported feeling an earthquake in Monterey strong enough that he had to support himself against a tree, but no damage was done to the houses (6 MM). The shock was felt on the farms inland.

23 June 1843 - According to Townley and Allen (1939), Perrey states that a severe earthquake extended from southern California to Mexico. We have been unable to find any reports of this earthquake, perhaps because of the general lack of references during this time period.

15 May 1851 M5.0 - Goods were thrown from shelves (6MM) in San Francisco. People rushed outside. In Benicia and Vallejo people were considerably startled (4-5MM). The shock was not felt at Sacramento. No aftershocks were reported.

26 October 1852 - Holden (1898), citing Perrey, states that there were eleven shocks at San Simeon, Los Angeles, and San Gabriel as well as shocks felt at San Luis Obispo, San Diego, and the Colorado River on this date. A search of Los Angeles and San Francisco papers has not yielded any report of an earthquake in southern California during October 1852. Trask (1856) lists November 26, 1852 as the date of the 11 shocks at San Simeon, Los Angeles and San Gabriel. Unfortunately, the Los Angeles Star, for December 1852, is not available. The San Francisco papers do not mention an earthquake in southern California in November other than the 29 November 1852 Yuma earthquake. An earthquake was felt in Los Angeles and San Gabriel on December 26th (The San Francisco Daily Herald, 13 Jan. 1853, p. 1) and an earthquake was reported in Santa Barbara on December 29th (Daily Alta California, 27 Jan. 1853, p. 1). No newspaper report of an earthquake felt at San Simeon in late 1852 has been found.

Holden reports that the 26 November earthquake produced fissures 30 miles long in Lockwood Valley. There is a Lockwood Valley in both Monterey and Ventura Counties. The Lockwood Valley in Ventura County is preferred by Harry O. Wood as the site of the ground fissures (Townley and Allen, 1939). As there are no reports of damage from Santa Barbara or Los Angeles, it seems unlikely that an earthquake large enough to cause 30 miles of rupture occurred in Ventura County in 1852. There are reports of earthquakes at San Simeon and San Luis Obispo in early 1853. An earthquake on 1 Febru-

ary 1853 damaged the house of Don Jesus J. Pico at San Simeon. Also, Trask (1856) reports earthquakes felt in the San Joaquin Valley in early 1853. An earthquake centered near Lockwood, Monterey County, could cause damage at San Simeon and be felt in the San Joaquin Valley.

9 November 1852 - The report of an earthquake on this date at Fort Yuma appears in the Explorations for a Pacific Railroad. It is probably a misdated description of the 29 November earthquake (Balderman et al., 1978).

23 November 1852 - At a farm about eight miles west of San Francisco "...a severe shock of an earthquake was experienced...which was so violent as to create a commotion among the domestic animals. On the next morning it was discovered that a deep chasm, about half a mile in width and three hundred yards in length had been opened, from Lake Merced to the ocean, and that the lake was nearly dry."(Daily Alta California, 27 Nov. 1852 p. 2). If an earthquake were responsible for the draining of Lake Merced, it was small as no earthquake was felt in San Francisco. A subsequent article in the Alta suggests that the winter floods may have cut the channel (Daily Alta California, 6 Dec. 1852, p. 2).

29 November 1852 M 6.6 - Near Fort Yuma, fissures were opened in the ground from which sand and water issued. A detailed study of this earthquake was made by Balderman et al. (1978).

17 Dec 1852 - Trask (1856) states: "Two smart shocks occurred in San Luis Obispo, which fractured the walls of two adobe buildings, and threw down part of the wall of the house belonging to, and occupied by Don Jesus Pico and family." No newspaper account of an earthquake on this date has yet

been found. Don Jesus Pico's house was near San Simeon not San Luis Obispo and it was damaged by an earthquake on 1 Feb. 1853 (Daily Alta California, 24 Feb. 1853, p. 2).

1 February 1853 - The adobe house of Don Jesus J. Pico was cracked (6 MM) and the occupants ran out for fear of the walls falling. No reports from any other locality have been found. An earlier shock was reported at Captain Dana's rancho, twenty-five miles south of San Luis Obispo on January 17th.

23 October 1853 - People were thrown from their beds and a wharf sank four feet at Eureka. No additional reports have been found.

25 January 1855 M5.7 - No reports of damage were found for this earthquake which was felt from Gibsonville, Sierra County to Nashville, El Dorado County. Trask (1864b, p. 138) reports that a large pinnacle of rocks on the summit of Downieville (Sierra?) Buttes was thrown down (6+ MM). No aftershocks were reported. The epicenter was likely centered to the east, in the California-Nevada border region.

11 July 1855 M 6.1 - The bells at Mission San Gabriel were thrown down (8 MM). Trask (1964b, p. 139) reports that the earthquake was felt at Santa Barbara, but the Santa Barbara Gazette does not confirm this. The Gazette does report the earthquake in Los Angeles and reports an earthquake on July 25 that was felt in Santa Barbara.

27 August 1855 M 4.8 - Furniture was moved at St. Ann's Valley (San Francisco) and an adobe house on Gen. Vallejo's ranch was cracked (6 MM).

This earthquake was probably centered in either southern Sonoma County or Marin County.

2 January 1856 M 5.4 - Iron shutters were warped and masonry walls were injured in San Francisco. In Monterey, some were frightened and ran outside. No aftershocks were reported.

10 January 1856 - Holden lists earthquakes at 5:00 am and 8:00 am at San Francisco, Los Angeles and throughout the southern part of California. No reports of an earthquake on this date has been found in Los Angeles, San Diego, Santa Barbara, or in San Francisco newspapers. There was no major earthquake on this date in California. The times given for the events and the area affected by the earthquake is consistent with reports for the Fort Tejon earthquake of 9 Jan. 1857 and a foreshock. Most likely, the source of this earthquake is a misdated reference to the 9 January 1857 Fort Tejon earthquake.

15 February 1856 M 5.9 - Cornices were thrown down, brick walls were cracked, and people were thrown from their feet in San Francisco (7 MM). The earthquake was felt as far as Marysville. Several aftershocks were felt at San Francisco.

21 September 1856 - At Santa Ysabel, San Diego County, plaster was shaken down and the plaster was cracked at San Diego (5 MM). One aftershock was reported felt at Santa Ysabel on the night of the 21st. No attempt has been made to assign either an epicenter or magnitude to this earthquake.

9 January 1857 M 7.9 - This is the great Fort Tejon earthquake, centered in southern California. It was accompanied by up to 9 1/2 meters of offset along the San Andreas Fault, which ruptured from Cholame Valley almost to San Bernardino. This earthquake has been studied in detail by Sieh (1978) and Agnew and Sieh (1978).

3 September 1857 M 6.2 - Objects were shaken from shelves (5-6 MM) at North San Juan, Last Chance, and Michigan Bluffs. No aftershocks were reported felt and no high intensities were reported even though the earthquake was felt as far as San Francisco. It is, therefore, likely that the epicenter was probably to the east, in the largely unpopulated California-Nevada border region.

26 November 1858 M6.3 - At San Jose, an adobe building and the corner of a new building were thrown down (8 MM). A cornice was thrown down in San Francisco and part of a chimney was thrown in Mountain View (7 MM). The quake was felt to Downieville on the north, Mariposa on the east, and Monterey on the south. No reports of aftershocks have been found.

16 December 1858 M 5.4 - At San Bernardino, the gable end of a house was knocked down (7 MM). At Agua Manza, near San Bernardino, a house was thrown down (8 MM). The report for Agua Manza did not give a date or time. An earlier earthquake at 2:30 GMT broke dishes and cracked walls (6 MM) in San Bernardino. Neither earthquake is mentioned by Townley and Allen (1939).

5 October 1859 - In San Francisco, bells rang, plastering fell, walls were cracked in several brick buildings, and objects were knocked from shelves (6 MM). No reports have been found for any other town.

27 January 1860 - In Los Angeles, people were awakened and doors and windows rattled. No report from any other locality was found.

15 March 1860 M 6.3 - Rock slides were reported between Pyramid Lake and Carson City, Nevada (6 MM or greater). Goods were shaken from shelves and a general panic prevailed at Carson City, Nevada (6 MM). The quake was felt by a few in San Francisco (2 MM). Seven aftershocks were reported felt in the neighborhood of Pyramid Lake, Nevada, indicating that Pyramid Lake was probably near the epicenter. Townley and Allen (1939) reported that the quake was felt as far as Utah to the east; also, The Deseret News (Salt Lake City), 11 Apr. 1860, p. 48, states that the quake was felt in "the western part of this Territory". In 1860, the western boundary of Utah Territory was the California State Line. Thus, the statements that the quake was felt to Utah does not mean that it was necessarily reported felt any further east than the Carson City area.

26 March 1860 - No report has been found for an earthquake in Los Angeles on this date. Most likely, the earthquake of 27 Jan. (26 January local time) was mistakenly assigned to this date by Holden.

13 November 1860 - Minor damage was done to plaster and chimneys in Eureka, Humboldt County. A house under construction was shifted two inches on its foundation. No other localities report this earthquake. The epicenter could be offshore or onshore near Eureka.

4 July 1861 M 5.3 - At Dougherty's ranch, near the present town of Dublin, the roof of the kitchen was thrown off, chimneys were thrown down, and several persons were thrown violently to the ground (8 MM). In the San Francisco newspaper, Mining and Scientific Press, 20 July 1861, a fissure eight miles long was described in Murray Township (Dublin is in Murray Township). This fissure, described by Whitney (1865) as along the west side of San Ramon Valley, is most likely the result of surface rupture along the Calaveras fault.

27 May 1862 M 5.6 - The epicenter was probably located offshore near San Diego, which had the highest reported intensity of 7 MM. This earthquake was studied in detail by Legg and Agnew (1979).

19 December 1863 M 4.9 - This is the first of a series of earthquakes during 1863 and 1864 which were centered south of San Francisco Bay. People were frightened, some running outside, at San Francisco and San Jose. The shock was felt in Napa, Stockton and Santa Cruz.

26 February 1864 M 5.9 - Adobe walls were cracked (6 MM) in Monterey and the quake was felt as far as Suisun. In Watsonville, small articles and light furniture were tipped over and moved around.

5 March 1864 M 5.9 - Windows and plastering were broken (6 MM) in San Francisco. The quake was felt as far as Visalia.

21 May 1864 M 5.8 - This southern San Francisco Bay area earthquake was

felt from Monterey to Sacramento. A few windows were broken at San Francisco.

22 July 1864 M 5.0 - People were frightened and a few ran outside in San Francisco and San Jose. A foreshock was felt a few minutes earlier and two aftershocks were felt in San Jose (San Jose Mercury, 28 July 1864, p. 3). (A light earthquake was felt at Los Angeles the same evening, but it is unlikely that this is the same earthquake felt in San Francisco.)

18 August 1864 M 4.1 - In Grass Valley, the earthquake shook down a brick and stone wall of a well, and frightened many (6+ MM). Yuba City is the furthest point at which the event was reported felt.

8 March 1865 M 5.0 - Chimneys were thrown down in Bennett Valley near Santa Rosa. A foreshock was felt at 7:05 GMT.

24 May 1865 M 5.0 - At San Juan Bautista, crockery was broken (6 MM). Holden's report that this earthquake was "remarkably heavy in southern California" is erroneous. The Daily Evening Bulletin (San Francisco), 29 May, 1865, states that the earthquake was "remarkably heavy in the southern counties" referring to southern San Francisco Bay counties.

1 October 1865 M 5.7 - Chimneys and most brickwork were damaged at Eureka, Humboldt County. The earthquake was reported felt only in Humboldt and Trinity Counties.

8 October 1865 M 6.5 - Several houses were thrown down (9 MM) at New Almaden. Brick walls cracked in Santa Cruz and many chimneys thrown down (7-8 MM), and brick walls were thrown down in San Jose (8 MM).

8 October 1865 - The Yreka Weekly Union, 28 Oct. 1865, p. 3, reports that on the morning of the quake at San Francisco, Goose Lake was covered by water spouts. As this phenomena occurred before the quake in the San Francisco area, it is probably unrelated to that quake. Nowhere in article is it stated that an earthquake had occurred at Goose Lake.

16 December 1865 M < 4 - This small earthquake was described as heavy at the Hermitage, Mendocino County and along Dry Creek in Mendocino County near the Sonoma County Line. It was also felt at Cloverdale about ten kilometers south of the Hermitage.

26 March 1866 M 5.9 - Several chimneys were knocked down in Gilroy (7 MM).

15 July 1866 M 5.7 - The distribution of felt reports for this earthquake is similar to that of 10 Apr. 1881. As the epicenter was probably in the largely unpopulated area of western San Joaquin Valley, no high intensities were reported. Holden reports a heavy shock at La Porte, Plumas County, and Rowland Flat, St. Luis, and Port Wine, Sierra County, at this time. Local papers do not confirm this. Most likely, the date has been confused with 5 September 1866 which is reported felt at the same localities.

2 December 1867 M 4.1 - People were awakened at La Porte, Plumas County, Downieville, and Forest City, Sierra County (5 MM).

30 May 1868 M 5.9 - Brick buildings were cracked and some bricks were shaken down in Virginia City (7 MM). Plaster fell in nearly all the brick buildings. Two foreshocks were reported at Virginia City at 4:56 and 5:05 GMT (The Daily Tresspass, 30 May 1868, p. 3.). A number of aftershocks were also felt at Virginia City.

May 1868 In an article in the Daily Evening Bulletin (San Francisco), March 29, 1872, it is stated that four years earlier in May, a severe earthquake opened a fissure in the earth at Dos Palmas. Dos Palmas is near the northern end of the Salton Sea. Los Angeles and San Bernardino newspapers of May and June 1868 do not mention any earthquakes felt in southern California. If an earthquake did occur at this time at Dos Palmas, it was probably small.

2 June 1868 M < 4 - This quake was reported as one of the "most violent" ever felt at Downieville; also, the quake was reported felt at Forest City. No other towns in the vicinity of Downieville report having felt this quake.

25 July 1868 - Two earthquake shocks were felt at Visalia. The Tulare Times of 1 August 1868 claims that the shocks were felt in many other portions of the state, but no other reports have been found.

4-17 September 1868 - Earthquakes were felt at the headwaters of the Kern River and at Lone Pine from the 4th to the 17th of September. No earthquakes were felt at Independence, 25 km from Lone Pine, and none were reported felt in the San Joaquin Valley.

17 September 1868 M 5.1 - At Monitor and Silver Mountain, Alpine County, people rushed out of their houses (6 MM). The earthquake was felt in Sacramento and Nevada City. A number of aftershocks were felt at Silver Mountain. Holden erroneously gave September 19th as the date of this earthquake.

26 Sept 1868 - No communities other than Ukiah report feeling this earthquake. It was described as an "unusually severe shock" that was felt only by those not too soundly asleep (4 MM).

21 October 1868 M 6.8 - Much of the second floor of the Court House at San Leandro collapsed (9 MM). Extensive damage was done to other towns in the San Francisco Bay area. This quake was accompanied by slip on the Hayward fault in the East Bay area (Lawson, 1908).

8 October 1869 M 5.2 - Chimneys were reported knocked down at Ukiah and in "the Clear Lake Country" (7 MM). The shock was reported felt from Healdsburg north to Potter Valley. A possible foreshock and an aftershock were felt at Ukiah at about 7:00 GMT and 10:00 GMT, respectively.

21 December 1869 M 4.8 - People ran into the streets at Eureka, Plumas County. At Webber Lake, Sierra County, buildings rocked and stove doors were thrown open (5-6 MM). No aftershocks were reported.

27 December 1869 (1:55 GMT) M 6.0 - Masonry walls were seriously damaged in Virginia City and Washoe City, Nevada (7 MM). Minor damage was done

in Calaveras County. Plaster fell at Mokelumne Hill (6 MM); a stone chimney fell at Spring Gulch (7 MM); and a house is described as being lifted bodily from its foundation several times. The later account may be an exaggerated description of the sensation inside the house. There is also a report of damage to buildings in Oroville, Butte County, but the local papers do not confirm this.

27 December 1869 (10:00 GMT) M 5.8 - This is the second of the pair of earthquakes which struck the Virginia City Area. Very little damage was attributed to this earthquake in the newspaper accounts.

17 February 1870 M 5.5 - Several chimneys were thrown down at Los Gatos, Santa Clara County (7 MM).

2 April 1870 M 5.1 - Minor damage was done in Oakland and San Francisco (6 MM). The shock was felt in Santa Cruz, Stockton, and Santa Rosa.

2 March 1871 M 6.2 - Nearly every chimney fell in Mattole, Humboldt County. Chimneys were also damaged in the Humboldt County communities of Eureka, Bucksport, Hydesville and Rohnerville (7 MM). Fissures were reported in the ground near Mattole.

5 July 1871 M 5.1 - This possible foreshock to the Owens Valley earthquake of 1872 caused some wells near Lone Pine to dry up and others to become muddy (6+ MM).

1871 - According to Townley and Allen, an earthquake in 1871 "rolled over men who were sleeping on the ground" halfway between Dos Palmas, Imperial County and Yuma, Arizona. No report of the earthquake was found in southern California newspapers of 1871 and early 1872. As the earthquake description came from a letter to Harry O. Wood, which was written after 1871, it is possible that the wrong year was given.

17 March 1872 - The report of a foreshock to the 26 March 1872 earthquake on this date is not confirmed in the Inyo Independent (Independence).

26 March 1872 (10:30 GMT) M 7.8 - This is one of the largest earthquakes in the recorded history of California. Every stone and adobe building was leveled at Lone Pine (9 MM or greater). The quake stopped clocks and woke people (5 MM) as far as San Diego to the south, Red Bluff to the north, and Elko, Nevada to the east. This quake involved major rupture on the Owens Valley fault.

26 March 1872 (14:06 GMT) M 6.7 - This large aftershock of the Owens Valley earthquake was felt from Oroville, Butte County to Los Angeles.

28 March 1872 M 5.2 - Bottles and china-ware were damaged in the stores at Sierra Valley (Sierraville), Sierra County (6 MM). In Reno, Nevada, the shock was reported as stronger than the Owens Valley earthquake of the 26th.

3 April 1872 - A damaging earthquake is reported to have occurred at Antioch, Contra Costa County (Tolman, C., 1931). The Antioch Ledger does

not report any such earthquake; however, a report of an earthquake in Antioch, Syria occurs in the April 20th issue.

3 April 1872 M 6.6 - This large Owens Valley aftershock was felt from Grass Valley to Visalia.

11 April 1872 M 6.9 - Stone buildings were thrown down and a frame building was twisted (9 MM) at Round Valley. The reported effects of this quake suggest that the epicenter was to the north of the main shock of 26 March, probably in the vicinity of Round Valley, Inyo County.

18 April 1872 - A relatively small Owen's Valley aftershock. This quake was reported only from Cerro Gordo, Inyo County, where it was described as being of unusual severity.

3 May 1872 M 5.9 - A building was cracked and people ran into the streets (6 MM) in Arizona City (Yuma). This quake was felt in San Bernardino 300 km northwest of Yuma. The epicenter was probably in or near the Imperial Valley.

17 May 1872 - A relatively small Owen's Valley aftershock. The quake is reported only from Lone Pine, where a person was thrown from his feet.

14 September 1872 - The date of this reported earthquake seems to have come from a wireservice report datelined Visalia, 14 September 1872, describing several small earthquakes in Owens Valley which had occurred a few weeks before.

23 November 1873 M 7.0 - This is the third-largest event in California during the second half of the 19th century. In the Smith River Valley, Del Norte County, all the chimneys were knocked down (8 MM). Chimneys fell at Crescent City, Del Norte County, and Happy Camp, Siskiyou County; also, Grants Pass, Jacksonville, and Port Orford, Oregon (7 MM). Cracks in the ground were reported on the trail from Crescent City to Gasquet, Del Norte County.

24 January 1875 M 6.0 - In Lassen County, a chimney was thrown down at Janesville (7 MM) and at Susanville, stone walls were cracked. The earthquake was felt as far west as Sacramento (5 MM) and Chico (5 MM). The epicenter was probably in the Honey Lake Valley, rather than in Mohawk Valley as indicated on the Fault Map of California (CDMG).

30 September 1875 M 5.8 - In Eureka, Humboldt County, most chimneys were cracked and some were knocked down (7 MM). People were awakened at Weaverville, Trinity County (5 MM).

3 January 1876 - Townley and Allen (1939) list an earthquake in Sonoma County on this date, citing the Sonoma Democrat of January 3. As the Sonoma Democrat was a Saturday weekly in 1876, and January 3 was a Monday in that year, there was no January 3rd issue. However, a June 3rd issue reports an earthquake on Monday, May 29 which matches the January 3 description in Townley and Allen. Townley and Allen do not list an earthquake on May 29.

29 May 1876 M 4.1 - At Freestone, Sonoma County, bottles and crockery were upset and some plaster was cracked (6 MM).

9 May 1878 M 6.5 - All the chimneys in Petrolia, Humboldt County were knocked down (8 MM). Large landslides were triggered along the coast in southern Humboldt County.

7 January 1881 M 4.2 - People rushed from their houses in Red Bluff, Tehama County (5-6 MM). A possible foreshock was felt in Red Bluff and Chico on 2 Jan.

2 February 1881 M 5.9 - Several chimneys were knocked down at Imusdale, San Luis Obispo County (7 MM). Imusdale is located at the northern end of Cholame Valley. Large cracks running across the road were reported at Mr. Parkinson's place, which might indicate rupture on the San Andreas.

10 April 1881 M 6.0 - Minor damage was reported from Stockton to Hollister. The quake was probably centered in the sparsely populated Diablo Range, Stanislaus County. No aftershocks have been identified.

6 March 1882 M 5.4 - A few panes of glass were broken (6 MM) in Salinas. The epicenter of this quake was probably to the southeast of Hollister.

30 March 1883 M 5.7 - A chimney was thrown down (7 MM) at Sargents, Santa Clara County. Eight to twelve aftershocks were reported at Gilroy. Two widely felt aftershocks occurred at about 15:54 and 16:15 GMT.

5 September 1883 M 5.9 - Plaster fell at Santa Barbara (6 MM) and bottles were upset at Los Alamos (5-6 MM). No aftershocks were reported.

22 October 1883 - It is stated in a wire service report that an earthquake shock threw down a section of a bluff near Merced Falls. None of the surrounding communities report an earthquake at that time. If an earthquake was responsible for triggering the landslide, it was probably a small, local event. The same wire service article reports a sharp shock at Merced a few minutes before midnight on the following night. This earthquake is also not reported by any other community.

28 January 1884 - Occurring at 11:30 p.m. local time, this earthquake was felt by quite a number of people at Fort Jones, Siskiyou County (5 MM). At Eureka, Humboldt County, the shock was described as the heaviest for some time. The epicenter was probably in the sparsely populated area between Eureka and Fort Jones.

26 March 1884 M 5.3 - Walls were cracked, window panes were broken, and plaster fell at Santa Cruz (6 MM). Holden (1898, p. 110) states that this quake was felt to Grass Valley, Nevada County. The correct date for the earthquake felt at Grass Valley is March 25th at 2:00 GMT (San Francisco Chronicle, 26 Mar 1884, p. 3).

6 June 1884 M 4.2 - The earthquake awoke people in Red Bluff, Tehama County (5 MM). The quake was also felt sharply at Anderson, Shasta County. Holden (1898, p. 110) reports that walls were cracked at Red Bluff. This was not confirmed by the Red Bluff papers.

31 January 1885 M 5.6 - Chimneys were damaged in the Honey Lake Valley communities of Buntingville and Susanville. Twenty aftershocks were reported felt at Buntingville in the first seventy hours (The Mountain Tribune, 7 Feb. 1885, p. 3). It was estimated that over one hundred shocks were felt in the Honey Lake Valley up to February 8, with the shocks most severe at Janesville and on the Susan River 12 miles from Susanville (Sacramento Daily Record Union, 12 Feb. 1885).

31 March 1885 M 5.6 - Chimneys were thrown down (7 MM) at Mulberry, San Benito County. This quake was probably centered in the Central Coast Ranges to the southeast of Salinas.

2 April 1885 M 5.6 - Crockery was rattled, and people ran out at Merced, Salinas, and Santa Cruz. This quake was probably centered in the sparsely populated region of the Central Coast Ranges to the southeast of Salinas.

12 April 1885 M 6.2 - This earthquake was distinctly felt in the Sacramento and San Joaquin Valleys and in the Sierra Nevada foothills as well as in the Central Coast Ranges, south of San Jose. The distribution of felt effects indicates an epicenter on the east side of the Coast Ranges. At Las Tablas, a chimney was knocked down at the Chesney rancho and at I. Simms' house (7 MM). There is a Las Tablas Creek about forty-five kilometers north of San Luis Obispo. If this is the Las Tablas of the report, the highest intensity known for this event is approximately one hundred kilometers southwest of the estimated epicenter. Only Hanford, Tulare County reports a later earthquake which could be an aftershock.

1 August 1885 - Walls were cracked in several buildings at Cloverdale, Sonoma County. No other community reported this earthquake.

3 June 1887 M 6.3 - Bricks were thrown down and houses shifted on their foundations (8 MM) at Genoa, Nevada. At Carson City, chimneys were reported in bad condition. Brick and stone walls were cracked (7 MM). Near Cradlebaugh's Bridge, Nevada, large fissures opened and spouted water and sand. At Deadman's Ranch, near the toll house on Ophir grade, the ground was reported to have been raised three feet above the old level. The water level at Shaw's Hot Springs near Carson City fell several inches a few weeks before the earthquake, and dried up completely after the shock.

3 December 1887 M 5.3 - Chimneys were knocked down and a cook stove was overturned (7 MM) at Halfway House, Mendocino County, on the road from Mendocino to Ukiah. Clocks were stopped at Ukiah (5 MM).

16 December 1887 - This earthquake was only reported felt at Mendocino and Point Arena light house. Possibly this is an aftershock of the 3 Dec. earthquake.

18 February 1888 M 4.5 - People were awakened at Mendocino and Ukiah. The epicenter was probably located in the Coast Ranges between those two communities near that of 3 Dec. 1887.

29 February 1888 M 4.9 - A wire service report in The Morning Call (San

Francisco), 1 March 1888, p. 8, reports that the walls of several buildings at Petaluma were cracked. The Petaluma Courier, 29 Feb. 1888, p. 3, describes the earthquake as sharp, but does not mention any cracked walls.

14 April 1888 M 4.8 - Some plaster fell and the school bell rang (6 MM) at Alturas, Modoc County. It was felt by a few at Adin (2 MM) and not felt by a few (4 MM) at Cedarville. A light earthquake was reported at Carson City, Nevada on the same date and time (Holden, 1898). Holden might have referred to a record on the seismograph if it were operating in Carson City. At Cedarville, a slight tremor was felt ten minutes earlier.

29 April 1888 M 5.8 - Chimneys were knocked down in Cromberg (7 MM) at the north end of Mohawk Valley. Rock slides were reported north of Downieville on the North Fork of the Yuba River and in Rattlesnake Canyon. Six miles east of Downieville twenty-four distinct shocks were felt during the night and in Rattlesnake Canyon, it is reported that the earth vibrated continuously during the night.

17 September 1888 M 4.5 - This earthquake was reported from San Francisco to Corral de Tierra, south of Salinas. No damage was reported nor were any aftershocks reported.

18 November 1888 M 4.2 - This East Bay earthquake was felt from Napa to San Lorenzo. Chimneys were knocked down (7 MM) at Oakland and East Oakland. These towns lie at the southern extent of the felt area. Holden reports that the earthquake was not felt in the South Bay communities of San Leandro, Hayward, and Niles.

7 February 1889 M 5.1 - Rock slides were reported on the east side of Mt. San Bernardino (6+ MM). In San Jacinto, panic ensued at the Baptist concert and some were injured as a result of jumping through windows. The absence of reported aftershocks suggests that the epicenter lies east of the reporting communities.

15 April 1889 M 5.0 - Plaster was cracked in several houses in Santa Cruz (5-6 MM). The earthquake was felt from Salinas, Monterey County to Martinez, Contra Costa County. Two possible foreshocks were felt in Watsonville two days earlier.

19 May 1889 M 6.1 - Chimneys were knocked down and a house was toppled over (8 MM) at Collinsville. At Antioch, many chimneys were demolished and two small fissures appeared on Main Street (San Francisco Chronicle, 20 May 1868, p. 8).

20 June 1889 M 5.5 - Chimneys were thrown down at Susanville and Willow Creek. Numerous aftershocks were reported from Susanville. Persons in the hills south of Eagle Lake, two days after the earthquake, reported that they "heard loud rumblings to the west, accompanied by detonations like the firing of very heavy artillery, while the earth seemed to keep up an almost uninterrupted trembling motion." (The Morning Call, 26 June 1889, p. 4).

31 July 1889 M 5.4 - This quake knocked down chimneys at Oakland and San Leandro (7 MM). It was felt from Healdsburg on the north to Modesto on the east, and to Salinas on the south. Aftershocks were reported felt at San Francisco, Oakland, and San Leandro.

28 August 1889 M 5.2 - Holden (1898, p. 143) quotes a dispatch to the San Francisco papers that windows were cracked and broken at Pomona. Neither of the Pomona papers confirms this report. Several towns between Los Angeles and Ontario report minor damage, such as bottles being knocked from drug store shelves and the fall of plaster (6 MM). The only aftershocks reported were from Pomona, where several were reported in the night.

30 September 1889 M 5.7 - Rocks rolled down onto Rock Creek grade, between Round Valley and Long Valley, Inyo County (6 MM or greater). This quake was reported to Bakersfield on the south and Sacramento on the north. Fifteen shocks were reported at Round Valley.

9 February 1890 M 6.0 - This quake was felt in Los Angeles, San Diego, and Yuma, Arizona. The lack of reports of damage indicates that the epicenter was probably in the sparsely populated region between Los Angeles and Yuma. A possible foreshock on the 6th was reported felt from San Bernardino to San Diego.

24 April 1890 M 5.8 - Extensive damage was done to chimneys and some damage was reported in brick and frame buildings from San Juan Bautista, San Benito County, to Green Valley, Santa Cruz County (8 MM). At Corralitos, most chimneys were thrown down and buildings were "twisted half around" (9 MM). Probable fault rupture occurred along the San Andreas fault where it crosses the Pajaro River.

26 July 1890 M 5.9 - Chimneys were knocked down at Grizzly Bluff near Ferndale and at the Walker place near Petrolia (7 MM). At the Walker place, a spring stopped flowing three days before the earthquake. After the shock, murky water flowed from the spring at a larger rate of flow than before. An aftershock was reported at about 16:00 GMT at Ferndale, Rohnerville and Hydesville. Certain versions of the wire service accounts of the earthquake at Eureka, Petaluma, and Sisson substitute Suisun, Solano County, for Sisson, Siskiyou County. This is apparently an error due to the similarity of the names of these two towns.

23 August 1890 - The Homer Mining Index of Lundy, Mono County reportedly contains an exaggerated account of an earthquake at Mono Lake (Townley and Allen, 1939). No copies of the Homer Mining Index for late summer 1890 have been located. None of the newspapers in the surrounding communities of Bishop, Inyo County; Hawthorne, Nevada; Bridgeport, Mono County; or Mariposa, Mariposa County report an earthquake in August. If there was an earthquake at Mono Lake at this time, it was a small local event.

2 January 1891 M 5.3 - Plaster was knocked down at Mt. Hamilton and Santa Cruz (6 MM). Windows were broken in San Jose (6 MM). No aftershocks were reported.

12 October 1891 M 5.6 - Several brick buildings were cracked and thrown out of plumb at Napa (8 MM). Eight or ten aftershocks were reported at Sonoma, and at Napa twelve aftershocks were reported.

24 February 1892 M 6.9 - Centered in the California-Mexico border region this earthquake was felt from San Carlos, Baja California (5 MM) to Visalia, Tulare County, a distance of 850 km. In San Diego County, rock slides were reported in the mountains between Campo and Carrizo, at Dulzura, and at Jewel Valley. At the old Carrizo station, all the adobe buildings were destroyed (8-9 MM). In San Diego, plaster was broken and chimneys were damaged (7 MM). Fissures were reported in the ground at McCain Valley and at Jewel Valley (McCain, 1955). These two valleys form a linear trend approximately parallel to the Elsinore fault zone. Between 7:20 GMT and 1:45 GMT, 25 Feb. 1892, 163 aftershocks were felt at Campo (San Diego Union, 25 Feb. 1892, p. 5). Aftershocks continued to be felt there every few days into April (San Francisco Chronicle, 27 Apr. 1892, p.3).

19 April 1892 M 6.8 - This was one of the largest earthquakes to occur in the San Francisco Bay area since 1840; only the 1906 San Francisco earthquake was significantly larger. Extensive damage (8 MM) occurred at Dixon and Vacaville, Solano County and Winters, Yolo County. The highest intensity (9 MM) was assigned to Allendale, between Vacaville and Winters. A number of buildings in the vicinity of Allendale collapsed, were shifted off their foundations, or were wrenched apart. Also, fissures extending about a mile were opened in the ground near Allendale (The Dixon Tribune, 29 Apr. 1892, p. 2).

21 April 1892 M 6.5 - Considerable damage was done to weakened structures in those communities damaged by the April 19th event. This was the largest aftershock of that event.

30 April 1892 M 5.0 - This was an aftershock of the April 19th earthquake. The highest assigned intensity (6 MM) was at Davisville (Davis), Yolo County where a few loose bricks fell. These three Vacaville-Winters earthquakes are discussed by Diana C. Dale (1977). Additional information was evaluated in arriving at the parameters presented here.

28 May 1892 M 6.0 - Dishes were thrown down in San Bernardino (5-6 MM). People were awakened in Los Angeles, Oceanside, and Yuma, Arizona. No reports have been found from the Salton Sea-Imperial Valley area, where the epicenter was most likely located.

14 June 1892 M 5.6 - In Pasadena, the firebell rang (6 MM). Dishes were thrown down (5-6 MM) in Cucamonga, San Bernardino County. The earthquake was felt throughout the Los Angeles Basin and as far south as San Diego. No aftershocks were reported.

13 November 1892 M 6.0 - A chimney was displaced (7 MM) at Hollister. Aftershocks were reported at Monterey, Salinas, and Green Valley.

4 April 1893 M 5.6 - An old, strong adobe house was completely shaken down (8 MM) at the Newhall Ranch, northwest of Newhall. Almost daily aftershocks were reported at Tapo Ranch in the Simi Hills (The Ojai, 17 April 1893).

19 May 1893 M 5.8 - Very little damage was reported for this earthquake. Some goods were thrown from shelves in store in Ventura (5-6 MM) and a wall was cracked at Santa Barbara (5-6MM). It was felt from Santa Maria (3 MM) to San Bernardino (4 MM).

30 June 1893 M 4.5 - Objects were knocked from shelves in Vallejo, Solano County, and San Rafael, Marin County (5-6 MM). The earthquake was felt only in the Bay Area and north to Santa Rosa.

9 August 1893 M 5.0 - In Santa Rosa, chimneys were shaken down, and plaster fell. The earthquake was felt north to Middletown, Lake County, south to Alameda, and east to Sacramento.

30 July 1894 M 6.1 - This quake produced minor damage from the Los Angeles basin to Mojave. The absence of reported aftershocks suggests that the epicenter was not in the Los Angeles basin, but probably in the Mojave Desert.

30 September 1894 M 5.5 - Chimneys were knocked down (7 MM) in southern Humboldt County. This quake was felt strongly at sea 35 miles southwest of Shelter Cove. The shock was felt along the coast from Crescent City, Del Norte County to Mendocino, Mendocino County and inland to Sisson (Mt. Shasta City), Siskiyou County, and Redding, Shasta County.

23 October 1894 M 6.1 - Centered in eastern San Diego County, this earthquake damaged plaster in San Diego (6 MM) and caused the mission bells to ring in San Juan Capistrano, Orange County (6 MM). At San Jacinto, there was considerable alarm. Aftershocks were felt during the night and following morning at Barrett Dam, San Diego County. In the mountains above Buckman's Springs, a dust cloud was seen to travel rapidly along the summit and boulders were heard rolling down the canyons.

17 August 1896 M 6.4 - At Independence, "crumbled adobes slid to the ground" (8 MM). This quake was probably centered along or near the eastern front of the Sierra Nevada.

20 June 1897 M 6.3 - Considerable damage was done to brick buildings in the area of Gilroy and San Felipe (8 MM). The earthquake was felt from Colusa on the north to San Luis Obispo on the south and as far east as Visalia. A fissure was reported near Soap Lake House on the Pacheco Pass Road. On Frank Silva's ranch near San Felipe, a fissure ninety feet long was reported. The Calaveras fault crosses the Pacheco Pass Road 5 kilometers northwest of San Felipe. The reported fissures could be the result of rupture on the Calaveras fault.

31 March 1898 M 6.5 - Several buildings partially or totally collapsed at Mare Island Naval Yard and at Tubbs Island. Houses were knocked from their foundations at Schellville, on the Greenwood Estate, and along Petaluma Creek, Sonoma County. Extensive ground cracks were reported at Mare Island Naval Yard, Schellville, and Greenwood Estate.

15 April 1898 M 6.7 - This is one of the larger earthquakes to affect the northern Coast Ranges in the late nineteenth century. In Mendocino County two houses collapsed at Greenwood and a house toppled over at Noyo (9 MM). Chimneys were knocked down in Mendocino County at Little River, Mendocino (8 MM), Fort Bragg, Pine Grove, and Ukiah. Landslides and fallen trees blocked

the roads leading inland from Mendocino. The shock was reported felt from Crescent City (5 MM) to San Francisco (5 MM). A foreshock was reported at Mendocino at 6:45 GMT and numerous aftershocks were felt there.

16 April 1899 M 6.4 - Felt from Crescent City, Del Norte County to Albion, Mendocino County, the epicenter of this earthquake was probably located off the coast of Humboldt County. A possible aftershock was reported at Crescent City, Ferndale and Arcata at about 13:00 GMT on April 18th.

30 April 1899 M 5.6 - Chimneys were shaken down in Watsonville and Green Valley, Santa Cruz County (7 MM). In Hollister, San Benito County some plaster was knocked down and in Salinas, Monterey County some crockery and window panes were broken (6 MM).

2 June 1899 - In San Francisco chimneys were toppled and several cornices fell in part (7 MM). Chimneys in Oakland were also reported knocked down (7 MM). The earthquake was felt as far as Sacramento (4 MM), Modesto (2 MM) and Santa Cruz. No aftershocks were reported.

6 July 1899 M 5.5 - On this date about noon an earthquake was felt from Petaluma to San Luis Obispo. In Watsonville, Santa Cruz County, several chimneys were thrown down (7 MM). A few windows and lamp chimneys were broken in Salinas (6 MM). At Pleasanton, Alameda County, eighty-five kilometers north of Watsonville, brick buildings were cracked and some wooden structures were more or less twisted (8 MM). This is an anomalous situation in that no high intensities were reported between Watsonville and Pleasanton. Townley and Allen (1939)

suggest that there were two earthquakes, one centered near Watsonville and the other near Pleasanton. However, if this is the case either they occurred within a few seconds of each other or the Pleasanton event was small and reported only locally. Two shocks were felt at San Francisco twelve seconds apart and two shocks were felt at Pacific Grove, Monterey County 2 seconds apart, but these could be P and S wave arrivals from an earthquake centered near Watsonville.

22 July 1899 (0:46 GMT) M 5.6 - This is a large foreshock to the earthquake at 20:32 GMT. Tops of chimneys were knocked off (7 MM) at Squirrel Inn, San Bernardino County. Landslides were reported in the vicinity of Cajon Pass.

22 July 1899 (20:32 GMT) M 6.5 - An old adobe house was knocked down (8 MM) in Lytle Creek Canyon to the north of San Bernardino. Extensive landslides occurred in the mountains north of Cucamonga and San Bernardino; also, in this area the streams greatly increased flow. Aftershocks were felt in the San Bernardino area.

13 October 1899 M<4 - This small earthquake damaged chimneys, plaster and bottles in Santa Rosa (7 MM). It was felt only as far south as Petaluma about twenty-three kilometers from Santa Rosa.

25 December 1899 M 6.7 - Considerable damage was done to the communities of San Jacinto and Hemet in Riverside County. Brick buildings partly collapsed and wood frame buildings were shifted off their foundations. At J.D. Osborne's place near Hemet a fissure one hundred and fifty feet long extended under the house. The wood frame house was badly wrenched and twisted. This fissure could have been surface rupture on the San Jacinto fault zone.

APPENDIX B-DATA SOURCES OTHER THAN NEWSPAPERS

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APPENDIX C

BIBLIOGRAPHY OF NEWSPAPERS EXAMINED

Over 11,000 newspaper issues from 1846 to 1899 have been examined for reported effects of historical earthquakes and are identified in this bibliography. About one quarter of the issues searched have provided earthquake reports. The bibliography consists of 388 pages and, consequently, is printed on microfiche (computer generated, 48X reduction). The bibliography is arranged chronologically by earthquake and includes the date, time, and location of the event followed by a list of newspaper issues examined for that event. All of the newspapers are arranged by county and counties are listed in alphabetical order. Under each county heading are the newspaper titles (which include the town where the newspaper was printed) followed by a chronological list of each issue examined and a code describing the contents of the issue. The letter code translates as follows:

- A - (Previous event) The issue contains a report of the earthquake in the same general area as the earthquake of interest, but occurring earlier;
- B - (Present event) The issue contains a report of the earthquake of interest;
- C - (Subsequent event) The issue contains a report of an earthquake in the same general area of the earthquake of interest, but occurring later;

D - (Other event) The issue contains a report of an earthquake occurring in a different area than that of the earthquake of interest.

A particular newspaper issue may contain any combination of these codes. The absence of a letter code (a blank following the issue date) indicates that the issue does not contain a report of any earthquake in California or adjoining areas.

The terms "previous", "present", and "subsequent" events are used in order to avoid the problems of defining the terms "foreshock", "mainshock", and "aftershock". This scheme still identifies reports on possible foreshocks and aftershocks of the event of interest.

Earthquakes listed in Table 3 that are closely related in time and place of occurrence do not each have separate newspaper listings in the bibliography, because the same newspaper issues were searched. Only the presumed mainshock is identified in the bibliography; reports of previous and subsequent related earthquakes are indicated by A and C, respectively, in the list of newspapers searched under the mainshock. Earthquakes that occurred before 1846, when the first California newspaper was available, are not included in this bibliography and their data sources are given in Appendix B. The 1852 Fort Yuma event and the 1857 Fort Tejon event were researched in detail by other investigators (listed in Appendix B) and are not included in this bibliography.

APPENDIX D

SUMMARIES OF REPORTED EFFECTS AND ASSIGNED INTENSITIES

The following are summaries of the reported earthquake effects used to assign intensities, generate isoseismal maps, and derive estimates of epicenter location and local magnitude for the pre-1900 California earthquakes studied. This appendix consists of 495 pages, and consequently, is presented on microfiche (manual photography, 20 X reduction).

The appendix is arranged chronologically by earthquake. Each heading includes the date, time, and location of the earthquake. Each locality for which the effects of the earthquake were reported is listed followed by the assigned Modified Mercalli intensity. The localities are arranged alphabetically by county. Localities outside California appear last, and are listed alphabetically by state. The reported effects that were used to assign a value of intensity at the locality are summarized and the source of the report is identified. The summaries are not always quotations, but are abstractions containing the information believed to be most diagnostic in evaluating the intensity at a particular locality. In some cases, more than one report was used to assign the intensity and a summary of each is given.

Where there was insufficient information to assign an intensity, a letter code indicating the word describing the earthquake effect was used:

L - Light or slight

H - Heavy or strong

S - Severe or violent

F - Felt, or other description that does not
fall into one of the above groups.

In cases where it was not clear which of two intensities to assign to a location both intensities were used. For instance (5-6 MM) was used for "items fell from shelves" when it could not be determined whether this was an isolated incident (5 MM) or more widespread (6 MM). The notation (5-6 MM) is a statement of uncertainty and should be interpreted as meaning (5 MM) or (6 MM), not as meaning between (5 MM) and (6 MM).

Three categories of the earthquakes studied are not included in this appendix: (1) those earthquakes occurring before 1850, for which the few available reports are included in Earthquake Descriptions (Appendix A); (2) three earthquakes that have been studied by other investigators for which we used available published reports (29 November 1852, 9 January 1857, and 27 May 1862); and (3) the events having no parameters because no reports were available (flagged with footnote 4 in table 3). Each of the earthquakes is discussed in Appendix A.