Bancroft Earthquake Document: transcribed by ChatGPT

Bold = titles and subheadings

Blue Italics = image/layout descriptions (not part of original text)

Highlighted = edited or added for accuracy

Earthquakes on Pacific Coast. –Holden.

*Map of California and Nevada, labeled "*Plate I*," showing earthquake locations.*

MAP OF CALIFORNIA AND NEVADA.
(Map showing earthquake locations on the Pacific Coast—Holden)

- ***California Region:***
  - San Francisco
  - Monterey
  - Sacramento
  - Los Angeles
  - San Diego
  - San Jose
  - Santa Barbara
  - San Bernardino
  - Fort Tejon
  - Salinas
  - Fresno
  - Napa
- ***Nevada Region:***

- Carson City
- Virginia City
- Reno
- Walker Lake
- Lake Tahoe

Other Labels and Annotations:

- ***Roman Numerals****: The map uses* ***Roman numerals*** *to mark specific regions, likely indicating seismic intensity zones, with numbers such as* ***VI****,* ***VII****, and* ***IX****.*
- ***Fault Lines****: Lines representing fault zones are drawn across the map, especially along the coast and through the central part of California, illustrating areas where earthquakes occurred or are most frequent.*

Geographic Features and Areas:

- **Sierra Nevada** *(mountain range)*
- **San Joaquin Valley**
- **Mount Shasta** *(Northern California)*
- **Salton Sea** *(Southern California)*

The map details seismic activities along fault lines that cut across prominent areas, especially in California, showing earthquake-prone zones.

P. 2

SMITHSONIAN MISCELLANEOUS COLLECTIONS
1087

A CATALOGUE OF EARTHQUAKES ON THE PACIFIC COAST 1769 TO 1897
By **EDWARD S. HOLDEN, LL.D.**
Member of the National Academy of Sciences

CITY OF WASHINGTON
PUBLISHED BY THE SMITHSONIAN INSTITUTION
1898

Seal of the Smithsonian Institution: "FOR THE INCREASE AND DIFFUSION OF KNOWLEDGE AMONG MEN"

P. 3

The page features a simple and elegant design with the following elements:

1. ***Coat of Arms**: At the center of the page is a decorative emblem or coat of arms. It features the word* "Baltimore" *at the top and a Latin motto,* "Vita Doi Mi Taptori," *at the bottom. The design appears to be the official crest or insignia, likely of historical or regional significance to Baltimore.*
2. ***Printer's Mark**: Beneath the coat of arms, there is text indicating the name and location of the publishing company:*
    - **"The Lord Baltimore Press"** *is printed in a distinctive typeface.*
    - *Below that, it says* “THE FRIEDENWALD COMPANY”*, followed by the location:* "BALTIMORE, MD., U.S.A."

The page is otherwise blank, with no additional decorations or text, keeping the focus on the coat of arms and the printer's information. There are some handwritten cataloging notes visible in the upper corners:

- *In the upper left corner,* "F851" *and* "H74" *are written.*
- *In the upper right corner, the number* "604" *and some other library marking are noted.*

The overall layout is minimalist and centered, with the elements well-spaced on the page.

P. 4

CONTENTS.

Content	Page
Introduction	1

Content	Page
Bibliography of Works relating to Earthquake Phenomena on the Pacific Coast	3
The Rossi-Forel Scale	7
Table of the number of Earthquakes recorded in each year and each month in California, etc.	11
Table of the number of Earthquakes recorded in each year and each month in San Francisco	13
Table of the number of Earthquakes recorded in each year and each month in San José, etc.	15
Earthquake shocks felt at sea	17
Self-registering Seismometers of the Lick Observatory	18
Use of the Ewing Duplex Seismometer	21
Improvements in the Ewing Seismographs suggested by experience, by C. D. Perrine	22
Reported Volcanic Eruptions in Alaska, Puget Sound, etc., 1800 to 1896, by Frederick G. Plummer	24
Conclusion	28
Catalogue of Earthquakes on the Pacific Coast, 1769-1897	31

P. 5

ILLUSTRATIONS.

Item	*Description*	*Page/Placement*
PLATE I	Map of California and Nevada	to face 1
PLATE II	Map of Washington and Oregon	to face 16
PLATE III	Complete Time-Comparison Seismograph, for Motions in All Directions	to face 18

Item	*Description*	*Page/Placement*
PLATE IV	Duplex Pendulum Seismograph, for Horizontal Motions	to face 20
The Earthquake at Pompeii, A. D. 63	—	to face 23
PLATE V	Relief Map of the Pacific Coast from the Model Constructed by Prof. George Davidson (the cut is furnished by the courtesy of the *Overland Monthly*)	to face 31
Figures and Maps to Illustrate the Earthquake of 1892, April 19 (Vacaville)	Kindly furnished by the United States Geological Survey	—
Fig. 1	Tracing of the Seismograph in San Francisco	172
Fig. 2	Tracing of the Seismograph at the Chabot Observatory	173
Fig. 3	Map of the Country about Vacaville (Solano County)	175
Fig. 4	Map of Napa, Yolo, Solano, and Sacramento Counties	177
Fig. 5	Map of California, showing the district affected by the Earthquake of 1892	179

P. 6

INTRODUCTION.

In the year 1887 the Regents of the University of California authorized the printing and distribution of an octavo pamphlet whose title was "List of Recorded Earthquakes in California, Lower California, Oregon and Washington Territory, compiled by ... Edward S. Holden." This was the first systematic publication of the sort, and it served a useful purpose. The examination of past records naturally led to the consideration of the best

methods of making future ones. The object of such records is to bring to light all the general facts as to distribution of earthquake shocks, as to topographic areas, as to times, and to average intensity, etc., and also to enable a study to be made of particular shocks—as to velocity of transit, area of the disturbed region, intensity, etc. In order to study any of these questions with profit it is necessary to have some kind of a measure of the intensity of each earthquake shock. The most satisfactory instruments that I have seen for this purpose are those invented by Professor Ewing, F.R.S. These are devised on sound mechanical principles and are well constructed by the Cambridge Scientific Company. It was necessary at the Lick Observatory to keep a register of the times of occurrence of all earthquake shocks in order to see if the positions of the astronomical instruments were affected. Accordingly, a set of Professor Ewing's instruments was ordered for the Observatory, and they were delivered in 1887.

The Lick Observatory began its active work in 1888. A part of this work consisted in the registration of earthquake shocks. Reports of shocks felt elsewhere on the Pacific Coast were diligently collected, and the publication of the pamphlet before mentioned brought me into relations with various gentlemen who were kind enough to communicate MS. notes or diaries relating to earthquake phenomena in earlier years.

P. 7

EARTHQUAKES ON THE PACIFIC COAST

Page **2**

The present volume reprints the pamphlet of 1887, with many corrections and additions; and it gives a complete account of the earthquake observations at Mount Hamilton during the years 1887–1897, together with an abstract of the great amount of information which has been collected regarding Pacific Coast earthquakes in the latter period. All previously printed information has been thoroughly reviewed before its admission to these pages.

The chief sources drawn upon are:

1. **First**—Printed lists of earthquake shocks in the scientific journals; such are the lists of Mallet, Perry, Rockwood, Fuchs, Trask and others.
2. **Second**—Accounts of earthquakes in printed books, magazines and newspapers.

3. **Third**—Lists of shocks put at my disposition by various gentlemen, especially a list by Mr. Thos. Tennant, of San Francisco; a list by Prof. H. G. Hanks; and a very extensive collection kindly furnished by Mr. H. H. Bancroft from manuscript records.
4. **Fourth**—Verbal accounts from various friends of the Observatory.
5. **Fifth**—The earthquake records of the University of California (Berkeley); the Chabot Observatory (Oakland); the University of the Pacific (San José); Mills Seminary (Oakland); the Weather Bureau (Carson, Nevada); and of the Lick Observatory (Mount Hamilton). All these stations are supplied with earthquake instruments.

I have to thank Professor Rockwood, of Princeton University, for putting me in the way of gaining much of the printed information. I have also to express my great obligations to the Board of Directors of the Mechanics' Institute Library, to the Council of the California Academy of Sciences, and to the Librarians of the Mechanics' Institute, Mercantile and Academy of Science libraries in San Francisco, the University of California Library at Berkeley, and of the State Library at Sacramento, for exceptional facilities afforded in the consultation of books. Mr. W. C. Winlock, late of the Smithsonian Institution, kindly consulted, in the Library of Congress, books which were not available in California. Various rare sources of information have been critically examined, and the necessary data for a brief reference list, or index, have been extracted and set in order in the catalogue which follows.

P. 8

The list of books and periodicals consulted is given in the following:

BIBLIOGRAPHY OF WORKS RELATING TO EARTHQUAKE PHENOMENA ON THE PACIFIC COAST.

- **Anderson (C. L.)**: Dr. Anderson, of Santa Cruz, has consulted the diaries of Mr. Sawin, of Santa Cruz, and of Dr. C. A. Canfield, who lived 13 or 14 miles northwest of San Benito, Monterey County, and extracted many interesting records of earthquake shocks. (Referred to here as Anderson.)

- **Annual Statistician, San Francisco (to 1888 inclusive)**: S. & Co. (S. & S.)
- **Annals of San Francisco, by F. Soulé, etc.** New York. 8vo.
- **Bache (A. D.)**: Notice of Earthquake Waves, etc. U.S.C. & G. Report, 1855, page 43; and 1859, page 35.
- **Bancroft (H. H.)**: History of the Pacific States. 8vo. (H. H. B.)
- Numerous MS. notes kindly communicated. (MSS. Bancroft.)
- **California State Weather Service**: Annual Meteorological Review, 1889, 1890, 8vo.
- **Cosmos**: Monthly Bulletin, 1891–98. 8vo.
- **Detailed (E.)**: Statistik der Erdbeben in der Livr. D'Adventologia, 1854–87.
- **Friend (C. W.)**: Earthquakes in Nevada—in *Reports of the Nevada State Mining Survey*, for various years, and in private letters. (C. W. F.)
- **Fuchs (C. W.)**: Statistische der Erdbeben [1845–81]. *Sammlung d. Wiener Akad. Wiss.*, 84, page 87, Heft 8.
- **Halley (J.)**: Centennial Book of Alameda County, pp. 257–309. Oakland, 1876, 8vo. Detailed account of the damage done by the shock of 1868, October 21, in Alameda County.
- **Hanks (H. G.)**: Professor Hanks, late State Mineralogist, has been kind enough to place all his manuscript and other material at my disposition. It is here referred to as (H. Mss).
- **Hittel (J. S.)**: History of California. San Francisco. 8vo. (T. H. H.)
- **Holden (E. S.)**: Notes on Earthquake Intensity in San Francisco. *Am. Jour. Sci.*, No. 25, June 1883, p. 447.
- **Holden (E. S.)**: Earthquakes in Central California, 1885, 1886, 1887, May 1890, 8vo.
- **Holden (E. S.)**: Earthquakes in California and elsewhere. *Overland Monthly*, January, 1893.
- **Janus**: Earthquakes, Various Publications (in California). *Publications Astr. Soc. of the Pacific*, vol. 11 (1898), p. 130.

- **Holden (E. S.)**: Earthquakes in California in 1890 and 1891. Washington, 1892, 8vo. Bulletin of the Geological Survey, No. 78.
- **Stein**: Statistik der Erdbeben, 1845–81. *Sammlung d. Wiener Akad. Wiss.*, 84, page 87, Heft 8.
- **Davidson (G.)**: List of Earthquake Shocks felt on the sets of Cape Mendocino. *Publications Astronomical Society of the Pacific*, vol. VIII (1893), p. 121.

P. 9

EARTHQUAKES ON THE PACIFIC COAST

Page **4**

- Hopkins (R. C.): A Report of the Commissioner of the General Land Office for 1871, p. 83. [He has examined the Spanish Archives from 1769 forward, and is of the opinion that the shocks of 1809, 1812, and of October 1865, were about of the same severity.]
- Keeler (C. F.): List of Earthquakes in California during the year 1890. *Publications of the Astronomical Society of the Pacific*, vol. II (1890), p. 74.
- Keeler (C. F.): List of Earthquakes in California during the year 1890. *ibid.*, vol. III (1891), p. 97.
- Keeler (C. F.): Earthquakes in California in 1890. Washington, 1890. 8vo. Suppl. (United States) *Department of the Interior*. (*U. S. Geological Survey. Bulletin 68.*)
- Mallet (R.): Catalogue of recorded Earthquakes from 1606 B. C. to A. D. 1850, by Robert Mallet, C. E., M. R. I. A. In the *Report of the British Association*, 1858. (M. M.)
- Mendelhall, (T. C.): On the Intensity of Earthquakes. *Proc. Amer. Ass. Adv. Sci.*, 1883.
- Milne (J.): Earthquakes and other Earth Movements. New York, 1886. 8vo. Mining and Scientific Press: for the years 1864-72. Weekly newspaper. San Francisco.
- Nature: Vols. 1-60 (1869-1899). London. 8vo.
- Oregon State Weather Service: *Report*. [An incomplete set only is available.]

- Perrey (A.): Note sur les tremblements de terre. *Bull. Acad. de Belg.*, 1841; tome 8 (1841); 1842; tome 9 (1842); 1843; tome 10 (1843); 1844; tome 11 (1844); 1845; tome 12 (1845); 1848; tome 15 (1848); 1850; tome 13 (1859); 1857; tome 17 (1855); 1858; tome 19 (1858); 1859; tome 20 (1859); 1861; tome 13 (1861); 1865; tome 13 (1865); 1866; tome 13 (1866); 1873; tome 13 (1873); 1886; tome 13 (1886); 1887; tome 13 (1887); 1888; tome 13 (1888).
- Perrey (A.): Notes sur les tremblements de terre. *Bull. Acad. de Belg.*, 1850; tome 17 (1850); 1851; tome 18 (1851); 1856; tome 20 (1856); 1865; tome 19 (1865); 1866; tome 13 (1866); 1868; tome 13 (1868); 1879; tome 12 (1879).
- Perrey (A.): Notes sur les tremblements de terre. *Bibliotheque Universelle de Geneve*, 1846; tome 13 (1846); 1855; tome 12 (1855); 1857; tome 13 (1857); 1860; tome 13 (1860).
- Perrey (A.): Note sur les tremblements de terre (suite). *Memoires de l'Acad. des Sciences et Lettres de Lyon*, 1872; tome 10 (1872); 1878; tome 12 (1878).
- Perrey (A.): Notes sur les tremblements de terre. *Bull. Acad. de Belg.*, 1852; tome 19 (1852); 1855; tome 12 (1855); 1859; tome 13 (1859).
- Perrey (A.): Liste des tremblements de terre ressentis en Californie, avec notes sur les tremblements de terre sentis aux Etats-Unis et au Canada. *Ann. de la Soc. d'Emulation du Vesque*, tome X, cahier, 1850. [I have not seen the work and it is not in any library in California nor in the Library of Congress.]
- Perrey (A.): Notes sur les tremblements de terre en Californie, avec l'aide d'autres Etats. *Bull. Acad. des Sci. de Paris*, 1869.
- Perry (A.): Notes sur les tremblements de terre, cites de Lyon.

P. 10

Page **5**

- Perrine (C. D.): Same for 1894, *ibid.*, vol. VII (1895), p. 92.
- Perrine (C. D.): Same for 1893, *ibid.*, vol. VII (1895), p. 89.
- Perrine (C. D.): Same for 1892, *ibid.*, vol. VII (1895), p. 87.
- Perrine (C. D.): Same for 1894, *ibid.*, vol. X (1897), p. 37.

- Perrine (C. D.): Earthquakes in California in 1895. Washington, 1896. 8vo. Suppl. (*United States*) *Department of the Interior*. (*U. S. Geological Survey, Bulletin 132*.)
- Perrine (C. D.): Same for 1897, *ibid.*, Bulletin No. 114.
- Perrine (C. D.): Same for 1898, *ibid.*, Bulletin No. 148.
- Perrine (C. D.): Same for 1900, *ibid.*, Bulletin No. 197.
- Plummer (G. F.): Reported Earthquakes on the Pacific Coast. *Publications of the Astronomical Society of the Pacific*, vol. VIII (1896), p. 78.
- Plummer (G. F.): Reported Volcanic Eruptions. *ibid.*, vol. VIII (1896), p. 178. [I have not entered these in the Catalogue, but have reprinted the list in this Introduction.—H. B.]
- Rockwood (C. G.): Notes on American Earthquakes, by Professor C. G. Rockwood, Jr., Ph. D., Princeton, N. J. (C. G. R.) From the *American Journal of Science and Arts*, vols. 1873-87. (See Whitney.)
- Scharff (T.): Die Erdbeben des Deutschen Reichs. Jena, 1889. Causes and nature of Earthquakes, 1888. (G. F. Scharff.)
- San Francisco (Chamber of Commerce): Report of Sub-Committee on Earthquakes, 1898, pp. 14-15. Report of G. C. C. for 6 mos. of 1879, referred to, in ms. A manuscript report is there referred to, which I have not been able to see.)
- San Francisco Directory ("Chronological History" in each vol.). 1850-87. (See Preface to p. 6.)
- Shaler (N. S.): On California Earthquakes (1860-69). In the *Atlantic Monthly*, October, 1870, p. 150. This paper contains no original data, but is reprinted from the lists of Dr. Trask.)
- Shaler (N. S.): The Stability of the Earth.) *Scribner's Magazine*, vol. I, p. 376 (May, 1887).
- Simpson (Sir George): Narrative of a Journey round the World during 1841 and 1842. Two vols. London, 1847. (See vol. I, p. 344.)
- Silliman (B. D., Jr.): Corresponds to the Students' Observatory of the University of California, Berkeley, 1887-92. [MS. kindly furnished by Professor Silliman.]

- Silliman (B. D., Jr.): Reference to the late Earthquake (1856); *Overland Monthly*, November, 1873.
- Tennant (T.): List of Earthquakes in San Francisco, 1851-57 and 1858-90. [Originally contributed to the *Alta Californian*, March 1877. Tennant's list of observations extend over a period of forty-two years.]
- Trask (B. J.): A Register of Earthquakes in California from 1769-1868. [Reprinted from *Proc. Cal. Acad. Sci., S. F.*] San Francisco, 1864. 8vo.

P. 11

EARTHQUAKES ON THE PACIFIC COAST

***Page* 6:**

- Trask (J. B.): Earthquakes in California from 1812 to 1855 [*Proceedings of the California Academy of Natural Sciences*], by Dr. John B. Trask. Vol. I (1857-58). Vol. III (1858-67). Vol. IV, part 1. (C. B. T.)
- Trask (J. B.): Direction and velocity of the earthquake in California of the 8th and 9th January, 1857. *Amer. Jour. Sci. Arts*, 1858, vol. 35, p. 146.
- Veatch (A. J.): In *Mining and Scientific Press*, 1889, March 31, has an article on Earthquakes in San Francisco, and especially their direction.
- Washington (United States Light House Report): *Annual Reports*.
    - MS. Reports from Lighthouse Keepers, kindly communicated by the Secretary of the Board.
    - Washington (United States Geological Survey): MS. Reports kindly communicated to the Director of the Survey.
    - Washington (United States Signal Service): Monthly Weather Review. (U. S. W. B.)
    - — (United States Weather Bureau): *ibid.* (U. S. W. B.)
- Whitney (J. D.): On the Earthquake of 1852, March 26. There is a résumé of Professor Whitney's article (*Overland Monthly*, vol. 9), by Professor Rockwood, in *Amer. Jour. Soc. Art.*, Vol. VI, 1872.

From the above sources of information the following catalogue has been derived.

For each shock there is given, when possible, first, the year, month and day; second, the hour, minute and second. The time is here given exactly as it is found in the original.

Usually it is expressed in local civil time. In Dr. Trask's list it is intended to be the astronomical time (i.e. noon, and 12h. midnight), though there are probably several errors in this datum. For the later lists it is usually Pacific standard (railway) time.* In Mr. Tennant's observations it is San Francisco local mean time to and including March 28, 1884, and after that date Pacific standard time. Professor Rockwood's plan to avoid the danger of confounding A. M. and P. M. dates, is to adopt the system of numbering the hours in the civil day from 0 to 24 (i.e. midnight, 12h. is noon). I have not brought the hours to a single uniform standard, in order to avoid introducing mistakes in copying, and especially because very few of the times are really accurate. Mr. Tennant's list is without doubt quite the best in this regard. Since January 1, 1887, all the stations of the Southern Pacific Railroad, and since August, 1887, those of the Atlantic and Pacific Railway, receive a noon signal (Pacific standard time) from the…

* *i. e.* Greenwich time *minus* 8 hours.

P. 12

***Page* 7:**

Lick Observatory or from the U. S. Naval Observatory at Mare Island, and since this date, therefore, there is more likelihood that the times in this catalogue are accurate. **Third**, the place or places where the shock has been felt. Here the abbreviation "S. F." stands for San Francisco. When necessary the name of the county is added for convenience. **Fourth**, the intensity of the shock, expressed either in common language or in terms of some arbitrary scale. Professor Rockwood, in indicating the intensity, has used the adjectives: 1, very light; 2, light; 3, moderate; 4, strong; 5, severe; 6, destructive; but has added a Roman numeral to indicate the intensity, according to the Rossi-Forel scale, adopted by Swiss and Italian seismologists. In Professor Rockwood's papers, very light is I or II; light, III; IV, moderate, V or VI; strong, VI or VII; severe, VIII; destructive, IX or X.

Fifth—A brief reference to the source of information, so that in nearly all cases the original record can be consulted, if desired. Exceptionally heavy shocks, such as those of 1865, 1868 and 1872, are treated with much more fulness than the lighter ones.

I strongly recommend the use of the Rossi-Forel scale, on account of the definiteness of the classification and because of the comparative regularity of the graduations. In order to make it better known in California, I reprint it here:

The Rossi-Forel Scale.*

I.
Microseismic shock—recorded by a single seismograph, or by seismographs of the same model, but not putting seismographs of different patterns in motion; reported by experienced observers only.

*First proposed by Rossi in *Archives des Sci. Phys. et Nat.*, IV, p. 371 (1850), and quite independently by Forel, *ibid.*, VI, p. 461. After comparing hundreds of published accounts of California earthquakes, I have found that the words here printed in *italics* (which form no part of the Rossi-Forel scale as proposed by its authors) are frequently employed by California observers. They are here printed for convenience. When any one is describing the effect of a shock he should employ the numerals I, II, III, etc., of the Rossi-Forel scale. When, on the other hand, one is reading an account of a California earthquake and seeking to assign the proper R.-F. numeral, it will be found that the words here set down in italics are of service.

P. 13

II.
Shock recorded by several seismographs of different patterns; reported by a small number of persons who are at rest. *A very light shock.*

III.
Shock reported by a number of persons at rest; duration or direction noted. *A shock; a light shock.*

IV.
Shock reported by persons in motion; shaking of movable objects, doors and windows, cracking of ceilings. *Moderate; sometimes strong; sharp; light.*

V.
Shock felt generally by every one; furniture shaken, some bells rung, some clocks stop. *Smart; strong; heavy; severe; sharp; quite violent; some sleepers waked.*

VI.
General awakening of sleepers; general ringing of bells; swinging of chandeliers; stopping of clocks; visible swaying of trees; some persons run out of buildings; window-glass broken. *Severe; very severe; violent.*

VII.
Overturning of loose objects; fall of plaster; striking of church bells; general fright, without damage to buildings; nausea. *Violent; very violent.*

VIII.
Fall of chimneys; cracks in the walls of buildings.

IX.
Partial or total destruction of some buildings.

X.
Great disasters; overturning of rocks; fissures in the surface of the earth; mountain slides.

The Lick Observatory will be glad to receive corrections or additions to the list of shocks catalogued.

P. 14

The following section contains instructions for recording earthquake observations:

The information can be very conveniently given by answering the following questions, which are copied from a circular prepared by Captain C. E. Dutton, U.S.A., for the U.S. Geological Survey:

1. Place and date of shock.
2. Name and address of the observer, if other than the writer.
3. Position and occupation of observer at the time of the shock, and character of the ground. State whether observer was in the house or out of doors; what kind of a house (wooden or stone); upstairs or down; what doing at the time; whether the ground surface was rock, clay, sand, or loam; about how far down to solid rock.

Note:—If the shock was not felt in your neighborhood, although noticed at places not very far distant, do not fail to answer these first four questions, as negative reports are of great interest in defining the limits of the disturbed area, etc. State also the nearest point to your station where the shock was felt.

5. State as exactly as possible the time of *commencement and the duration* of the shock.

The exact time of the beginning of a shock (to the nearest second), one of the most important of all observations, is difficult to get correctly, because of the great velocity with which the wave travels (about three miles a second), and because the watch or clock must be immediately compared with a clock known to be keeping standard time. If several hours have elapsed before the comparison is made, another comparison should be made an hour later, in order to find whether your timepiece is gaining or losing, and how much. Unless it is stated that this has been done, the observation cannot be regarded as a good one of reliability for the reports. Telegraph operators, railroad officials, watchmakers, etc., have especially good opportunities for answering this question correctly, and their cooperation is most earnestly solicited.

6. Give any facts that you can as to sounds accompanying shocks and as to the direction in which the earthquake wave seemed to travel.

If any sound, other than the mere creaking of woodwork, etc., accompanied the shock, state as fully and accurately as possible whether it preceded, accompanied, or followed the shock, and what interval there was, if any; also what the sound was like. Describe...

P. 15

the character of the shock, whether a tremor or an undulatory motion, etc., and whether you yourself or others had any clear impression as to the direction in which it was moving, the facts upon which this impression was based, and whether people agreed as to the direction.

8. Which number on the Rossi-Forel scale of earthquake intensity best expresses the intensity of the shock in your vicinity?

9. Give, also, any further particulars of interest, whether they are from observation or from hearsay.

If a chandelier was noticed to swing, describe it, and state the direction and amount of swing. If pictures swung, state direction of wall, and whether pictures on other walls at right angles to the first were also put into motion. If doors were closed or opened by the shock, state the direction of the wall in which they are set. If a clock was stopped, give the exact time it indicated (and anything known as to how fast or how slow it was), its position, the direction in which it was facing, and the length of the pendulum. If anything was occurred in the ground, such as depressions or elevations of the surface, fissures, emissions of sand or water, describe them fully. Mention any unusual condition of the atmosphere; strange effects on animals (it is often said that they will feel at the tremors of a shock before people notice it at all); character of damage to buildings, general

direction in which walls, chimneys, etc., were overthrown. Springs, wells, and rivers are often noticeably affected even by slight shocks, and any information as to such change will be valuable.

9. Name of the writer.

Note.—In replying to these questions, they need not be repeated; but the answers should be numbered to correspond to the questions.

The tables which follow give recorded earthquakes in their chronological order. It is desirable to arrange the statistics in various ways—by years, by months, by seasons, etc.—in order to exhibit any periodicity there may possibly be in the phenomena. It is a favorite hypothesis that shocks follow in cycles; and this is true for some regions, apparently.

The tables A, B, C were prepared for the first edition of this book, and are here reprinted without change. The addition of the data since 1887 would not alter the conclusions to be derived from them.

P. 16

Page 11

EARTHQUAKES ON THE PACIFIC COAST

TABLES OF THE NUMBER OF EARTHQUAKES WHICH ARE RECORDED IN EACH MONTH OF EACH OF THE YEARS 1850-1887, IN CALIFORNIA, WASHINGTON AND OREGON.

In the three following tables I have counted the days in each month of each year on which shocks (supposed to be different) have occurred. For example, a shock felt at a given hour at San Francisco and at Oakland is counted as one; but shocks at different places, as San Diego and San Francisco, on the same day, are counted separately when they are not *known* to be parts of the same phenomenon.

Table (A) of the Number of Earthquakes which are Recorded in California, Oregon, etc., in the Years 1850–1887.

Year	Total	January	February	March	April	May	June	July	August	September	October	November	December
1850	8	1	1	1	-	1	1	-	2	1	-	-	-
1851	15	-	-	1	1	3	1	-	-	-	-	4	5
1852	6	-	-	-	1	-	-	-	-	-	-	3	2

Year	Total	January	February	March	April	May	June	July	August	September	October	November	December
1853	22	4	2	1	2	-	1	1	-	1	3	4	3
1854	22	2	1	2	3	4	1	2	1	1	3	1	1
1855	14	2	1	-	1	-	2	2	2	-	2	-	2
1856	25	5	1	3	1	3	-	-	2	5	2	1	2
1857	31	6	1	3	1	3	1	1	2	2	2	6	3
1858	10	-	2	1	-	-	-	-	-	2	5	-	1
1859	19	1	-	1	-	5	8	1	-	1	1	-	1
1860	20	2	1	3	5	2	1	-	-	3	-	2	1
1861	11	2	-	2	2	-	1	2	-	-	1	-	1
1862	19	1	-	1	-	5	8	1	-	1	1	-	1
1863	17	4	2	-	-	-	2	4	1	-	1	-	3
1864	22	-	1	4	-	2	2	4	2	3	3	-	1
1865	42	3	2	6	4	1	1	-	2	3	16	2	2
1866	24	1	3	4	-	3	3	1	2	1	-	1	5
1867	6	1	1	-	1	-	-	-	-	1	-	1	1
1868	54	-	-	1	-	6	2	1	3	26	10	3	2
1869	31	4	2	1	2	2	4	2	-	4	5	-	5
1870	19	2	3	2	6	3	-	-	2	1	-	-	-
1871	19	-	1	2	1	1	2	5	2	2	2	-	1
1872	41	-	3	7	15	2	1	-	1	2	5	2	3
1873	15	-	2	1	3	1	1	1	1	-	2	2	1
1874	10	2	-	2	-	1	1	-	2	-	-	-	2
1875	17	1	1	-	-	-	3	-	1	-	1	5	5
1876	7	1	-	1	-	1	-	-	1	-	2	-	1
1877	16	2	-	-	-	2	1	2	3	3	1	1	-
1878	17	-	1	2	1	2	1	2	-	3	2	1	2
1879	8	-	2	-	-	2	-	-	2	-	1	-	1
1880	26	1	-	2	3	1	1	-	2	1	-	5	10

Year	Total	January	February	March	April	May	June	July	August	September	October	November	December
1881	23	7	3	1	2	-	1	2	1	1	2	3	-
1882	26	1	1	5	2	1	1	3	4	1	5	1	1
1883	28	2	1	3	1	-	-	2	2	4	7	1	5
1884	27	4	-	2	5	-	3	1	3	3	3	3	-
1885	39	5	5	2	7	1	3	4	-	2	3	1	6
1886	12	1	-	-	-	3	1	2	-	1	2	1	1
Sums	**768**	**68**	**45**	**46**	**71**	**56**	**51**	**45**	**53**	**85**	**88**	**57**	**83**

P. 17

Page 12

EARTHQUAKES ON THE PACIFIC COAST

As many of the earthquakes of California are very local phenomena, which depend upon local causes for their production, we cannot expect to obtain very definite laws from a table like this which covers the whole of such a vast territory. Moreover, the facilities for gathering information in the thinly settled portions of the State were imperfect in the earlier years, and even now shocks are not carefully recorded at more than two or three places in the State. For these and other reasons this table can only give approximate results. It does not include every single earthquake set down in the catalogue, since it was compiled before the list was entirely finished. It, however, contains nearly all. It is sufficiently full for its purpose, which is simply to show the relative frequency of shocks in the various months. This is for:

Month	*Shocks Near Event*		*Season*
January	68	-	(Rainy Season)
February	45	-	(Rainy Season)
March	66	182, Near Vernal Equinox	(Rainy Season)
April	71	-	(Dry Season)

1850-1887.

Month	Shocks Near Event		Season
May	56		(Dry Season)
June	51	152, Near Summer Solstice	(Dry Season)
July	45		(Dry Season)
August	53		(Dry Season)
September	85	226, Near Autumnal Equinox	(Dry Season)
October	88	-	(Rainy Season)
November	57	-	(Rainy Season)
December	83	208, near Winter Solstice	(Rainy Season)
January	68		(Rainy Season)

Rainy season, 390; dry season, 378. *Thus for California, Oregon, and Washington at large, shocks are about equally probable in the wet and in the dry season.* Table A includes the data derived from observations at San Francisco. If we form a similar table which includes all the data for California, Oregon, etc., excluding San Francisco, the result will be, for:

Month	Shocks Near Event		Season
January	43	-	(Rainy Season)
February	23	-	(Rainy Season)

Month	*Shocks*	*Near Event*	*Season*
March	40	119, Near Vernal Equinox	(Rainy Season)
April	56	-	(Dry Season)
May	39		(Dry Season)
June	34	105, Near Summer Solstice	(Dry Season)
July	32		(Dry Season)
August	42		(Dry Season)
September	64	159, Near Autumnal Equinox	(Dry Season)
October	53	-	(Rainy Season)
November	27	-	(Rainy Season)
December	61	131, near Winter Solstice	(Rainy Season)
January	43		(Rainy Season)

Rainy season, 250; dry season, 264. *(See the last column of Table B.)*

TABLE (B) OF THE NUMBER OF EARTHQUAKES WHICH HAVE BEEN RECORDED IN EACH MONTH OF EACH OF THE YEARS 1850–1887 IN SAN FRANCISCO.

Year	Total	January	February	March	April	May	June	July	August	September	October	November	December	Total in California except S. F.
1850	5	1	1	-	-	1	1	-	-	1	-	-	-	3
1851	10	-	-	-	-	2	1	-	-	-	-	4	3	5
1852	1	-	-	-	-	-	-	-	-	-	-	1	-	5
1853	5	1	-	1	-	-	-	-	-	-	-	2	1	17
1854	8	1	1	1	2	1	-	-	-	-	2	-	-	14
1855	3	-	-	-	-	-	-	-	1	-	1	-	1	11
1856	10	4	1	2	-	1	-	-	1	-	1	-	1	15
1857	17	1	1	2	-	-	-	1	-	2	2	5	3	14
1858	7	-	1	-	-	-	-	-	2	3	-	1	-	3
1859	8	-	-	-	-	-	-	-	1	2	1	2	2	11
1860	9	1	1	-	2	1	-	-	-	2	-	1	1	11
1861	4	-	-	1	1	-	1	1	-	-	-	-	-	7
1862	2	-	-	-	-	-	-	-	-	1	-	-	1	17
1863	8	1	-	-	-	-	1	2	1	-	-	-	3	9
1864	16	-	1	3	-	2	2	3	-	3	1	-	1	6
1865	23	1	2	4	3	1	-	-	1	-	9	1	1	19
1866	9	1	2	1	-	1	1	1	-	-	-	-	1	15
1867	2	1	-	-	-	-	-	-	-	1	-	-	-	4
1868	14	-	-	1	-	1	-	1	-	-	7	3	1	40
1869	10	2	2	-	1	2	3	-	-	-	-	-	-	21
1870	8	1	3	4	-	-	-	-	-	-	-	-	-	11
1871	2	-	1	-	1	-	-	-	-	-	-	-	-	17
1872	5	-	-	1	-	-	-	-	1	-	3	-	-	36
1873	4	-	2	-	1	-	-	-	-	-	-	1	-	11
1874	6	2	-	1	-	1	1	-	-	-	-	-	1	4

Year	Total	January	February	March	April	May	June	July	August	September	October	November	December	Total in California except S. F.
1875	8	-	1	-	-	-	3	-	-	-	1	3	-	9
1876	2	1	-	-	-	-	-	-	-	-	1	-	-	5
1877	2	-	-	-	-	1	-	-	1	-	-	-	-	14
1878	4	-	1	-	-	-	-	-	-	2	-	1	-	13
1879	1	-	1	-	-	-	-	-	-	-	-	-	-	7
1880	4	-	-	-	1	1	1	-	-	-	-	1	-	22
1881	5	1	-	-	-	-	-	-	-	1	1	2	-	18
1882	9	-	-	1	1	-	1	2	1	3	-	-	-	17
1883	6	1	-	1	1	-	-	-	-	-	3	-	-	22
1884	5	1	-	2	1	-	-	1	-	-	-	-	-	22
1885	5	2	-	-	-	-	-	-	-	-	1	1	1	34
1886	7	1	-	-	-	1	1	1	-	-	1	1	1	5
Sums	254	25	22	26	15	17	17	13	11	21	35	30	22	514

P. 19

Page 14

EARTHQUAKES ON THE PACIFIC COAST

The number of shocks recorded at San Francisco in the separate months (1850–1887) are:

Month	*Shocks Near Event*		*Season*
January	25	-	(Rainy Season)
February	22	-	(Rainy Season)
March	26	63, Near Vernal Equinox	(Rainy Season)

Month	*Shocks*	*Near Event*	*Season*
April	15	-	(Dry Season)
May	17		(Dry Season)
June	17	47, Near Summer Solstice	(Dry Season)
July	13		(Dry Season)
August	11		(Dry Season)
Septe	21	67, Near Autumnal Equinox	(Dry Season)
Octob	35	-	(Rainy Season)
November	30	-	(Rainy Season)
December	22	77, near Winter Solstice	(Rainy Season)
January	25		(Rainy Season)

1850-1887.

Rainy season, 140; dry season, 144. **Shocks in San Francisco are considerably more frequent in the rainy season than in the dry, contrary to the rule for the State at large.** The average number of shocks per month is 4. **January, March, October and November have decidedly more shocks than the average; April, July and August have decidedly fewer than the average.**

A comparison of the monthly totals for San Francisco and for California (excluding San Francisco) seems to indicate that the causes of most San Francisco earthquakes are local and not general in their nature. The records from which this table has been derived are so full that considerable weight must be allowed to the conclusions drawn from it.

As San José is situated near to Mount Hamilton, where accurate earthquake observations will be carried on for many years to come, it is desirable to examine the earthquake records for San José and Santa Clara as carefully as may be.

P. 20

EARTHQUAKES ON THE PACIFIC COAST

TABLE (C) OF THE NUMBER OF EARTHQUAKES WHICH ARE RECORDED IN EACH MONTH OF THE YEARS 1850–1887, IN SAN JOSÉ AND SANTA CLARA.

Year	Total	January	February	March	April	May	June	July	August	September	October	November	December	Shocks in S.F.
1850	3	-	-	1	-	1	-	-	-	1	-	-	-	5
1851	0	-	-	-	-	-	-	-	-	-	-	-	-	10
1852	0	-	-	-	-	-	-	-	-	-	-	-	-	1
1853	2	-	-	-	-	-	-	-	-	-	-	2	-	5
1854	0	-	-	-	-	-	-	-	-	-	-	-	-	8
1855	0	-	-	-	-	-	-	-	-	-	-	-	-	3
1856	1	-	1	-	-	-	-	-	-	-	-	-	-	10
1857	4	1	-	-	1	-	-	-	-	-	1	1	-	17
1858	3	-	-	-	-	-	-	-	-	2	-	1	-	7
1859	4	-	-	-	1	-	-	-	2	-	-	-	1	8
1860	0	-	-	-	-	-	-	-	-	-	-	-	-	9
1861	0	-	-	-	-	-	-	-	-	-	-	-	-	4
1862	0	-	-	-	-	-	-	-	-	-	-	-	-	2
1863	3	-	-	-	-	-	-	2	-	-	-	-	1	8
1864	5	-	1	1	-	-	-	1	-	1	-	-	1	16
1865	4	-	-	-	1	-	-	-	2	-	-	-	1	8
1866	9	-	1	-	-	-	-	-	-	-	-	1	-	9
1867	0	-	-	-	-	-	-	-	-	-	-	-	-	2

Year	Total	January	February	March	April	May	June	July	August	September	October	November	December	Shocks in S.F.
1868	1	-	-	-	-	-	-	-	-	-	-	1	-	14
1869	4	-	1	1	1	-	1	-	-	-	-	-	-	10
1870	1	-	1	-	-	-	-	-	-	-	-	-	-	8
1871	1	-	1	-	-	-	-	-	-	-	-	-	-	2
1872	1	-	-	1	-	-	-	-	-	-	-	-	-	5
1873	3	-	1	-	-	-	-	-	1	-	-	-	1	4
1874	1	-	-	-	-	-	-	-	1	-	-	-	-	6
1875	2	-	-	-	-	-	-	-	-	-	1	1	-	8
1876	2	1	-	-	-	-	-	-	-	-	1	-	-	2
1877	0	-	-	-	-	-	-	-	-	-	-	-	-	1
1878	1	-	-	-	-	-	-	-	-	-	1	-	-	4
1879	0	-	-	-	-	-	-	-	-	-	-	-	-	1
1880	2	-	-	-	-	1	-	-	-	-	-	1	-	4
1881	1	-	-	-	-	-	-	-	-	-	-	1	-	5
1882	0	-	-	-	-	-	-	-	-	-	-	-	-	9
1883	0	-	-	-	-	-	-	-	-	-	-	-	-	6
1884	1	-	-	1	-	-	-	-	-	-	-	-	-	5
1885	2	-	-	-	-	-	-	-	1	-	-	-	1	5
1886	0	-	-	-	-	-	-	-	-	-	-	-	-	7
Sums.	61	2	7	5	3	2	1	4	4	4	9	8	5	254

The data for San José and Santa Clara are far less full than for San Francisco. Probably an equal number of shocks has occurred at each place, but the records of San Francisco (which are well kept) show about four times as many shocks as are shown by the San José records (which have not been carefully kept).

EARTHQUAKES ON THE PACIFIC COAST

The distribution of shocks in the various months is as follows, for:

Month	*Shocks*	*Near Event*	*Season*
January	2	-	(Rainy Season)
February	7	-	(Rainy Season)
March	5	15, Near Vernal Equinox	(Rainy Season)
April	3	-	(Dry Season)
May	2		(Dry Season)
June	1	7, Near Summer Solstice	(Dry Season)
July	4		(Dry Season)
August	4		(Dry Season)
September	4	17, Near Autumnal Equinox	(Dry Season)
October	9	-	(Rainy Season)
November	8	-	(Rainy Season)
December	5	15, near Winter Solstice	(Rainy Season)
January	2		(Rainy Season)

1850-1887.

Rainy season, 30; dry season, 24. **Like San Francisco, and unlike California at large, San José seems to have more shocks in the rainy season.**

The average number of shocks per month is 4, divided by 37. February, October, and November have decidedly more shocks than the average; January, May, and June have decidedly fewer than the average. **July and August have (unlike San Francisco) the average number of shocks.** If the data are sufficient to draw any conclusion from (which very probably they are not), this would show that the shocks at San José are local, and that they are, in general, not dependent upon the same cause as those of San Francisco.

Similar tables can be formed for the places where the catalogue shows shocks to be relatively frequent, as Humboldt, Los Angeles, Oakland, San Diego, Monterey, Santa Cruz, Sacramento, etc., and, so far as the data are sufficient, the same result will be obtained, namely, that the lighter earthquakes common in California are usually rather local than general and widespread phenomena. A curious example of this is the exemption of Santa Barbara from shocks in the years 1860–1872. Before 1860 and after 1872 Santa Barbara was subject to shocks, precisely as other places in the same region, while between these years no shock is recorded. There is no reason to believe that the records were not equally well kept during the whole period.

The immediate and practical conclusion to be drawn from the above tables is that in any future study of California earthquakes we ought to select special regions for examination, as the Valleys of…

P. 22

Page **17**

Plate II

Earthquakes on Pacific Coast – Holden.

Map of Washington and Oregon

Map Details: The map on this page depicts the geographic regions of Washington and Oregon, showing major rivers, mountain ranges, and key cities. Specific features include:

- *Major rivers such as the* **Columbia River** *and its tributaries.*
- *Mountain ranges, likely including the* **Cascade Range** *(although not labeled specifically in the transcription).*

- *Cities and towns marked with their locations within the states, though exact names cannot be fully transcribed from this text.*
- *Political boundaries delineating Washington and Oregon.*

The map emphasizes areas affected by earthquakes, as indicated by markings or labels, providing visual context for seismic activity along the Pacific Coast in these states.