

CENTRAL CALIFORNIA EARTHQUAKES OF THE 1830'S

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EXAMINATION of the most extensive published list of reported California earthquakes, the Townley-Allen catalogue of 1939,¹ leads one to conclude that in the central Coast Range region, in the vicinity of San Francisco, the fourth decade of the nineteenth century showed a greater number of strong shocks than any other decade in the recorded history of that area. Indeed, the reported earthquakes occurred within *half* a decade, 1836-1840. So closely spaced a series of strong shocks in so limited an area raises questions of theoretical interest concerning the origin of earthquakes. It is also a matter of practical importance, for what has occurred in the recent past may well happen again. On both counts it appeared worth while to undertake a critical study of the period, since it might be possible to arrive at a more definite understanding of the actual events and of the sources of the seismic disturbances.

The earthquakes reported for this period in the Townley-Allen catalogue may be listed as follows.

CALIFORNIA EARTHQUAKES 1836-1840

1836 April 25. 5 A.M. Monterey. H. H. B.

1836 June 9 and 10. Monterey. Severe shocks from Monterey northward. H. H. B.

1836 [No month or day]. VIII. East of San Francisco Bay. An earthquake comparable with the shock of 1868. B. MS. Wood estimates intensity X?

1838. June and July. VIII [San Francisco to Monterey]. H. H. B. and W. H. Davis.

1839 [No month or day] IX [Holden], X [Townley-Allen]. Redwood City (Woodside). B. MS. May be shock of June-July, 1838.

1839 [No month or day]. VIII. San Francisco. Annals of San Francisco.

If this earthquake and the one listed for Redwood City actually occurred in 1839, they were, in all probability, one and the same shock.

1840 January 16-18. IX. Santa Cruz. An earthquake and tidal wave. H. H. B.

It may be noted that that part of the Townley-Allen catalogue which covers the earlier earthquakes, that is, from 1769 to 1897, is really a new edition of the list and descriptions of the Holden Catalogue² of 1898, with such revision and comment as the later studies of Townley and Allen made appropriate. In the later catalogue, Holden's descriptions and estimates of intensity are reproduced, and additional material, comment, and revised estimates of intensity are enclosed in square brackets. All estimated intensities are expressed in Roman numerals according to the Rossi-Forel scale of ten grades.

In the list given above, the more extensive descriptive matter or comment of the catalogue is omitted. Where only one number is used to represent in-

¹ Sidney D. Townley and Maxwell W. Allen, "Descriptive Catalog of Earthquakes of the Pacific Coast of the United States 1769 to 1928," *Bull. Seism. Soc. Am.*, 29:1-298 (1939).

² Edwin S. Holden, "A Catalogue of Earthquakes on the Pacific Coast, 1769 to 1897," *Smithsonian Misc. Coll.*, 1087 (1898).

tensity, it is Holden's estimate, accepted without revision or comment in the revised publication. Neither Holden nor Townley-Allen give any estimate of intensity for the first two earthquakes of the list, but, surprisingly enough, Holden, in his 1898 catalogue, page 28, included the second of these shocks, "1836. June 9 and 10 (Monterey and northward)," in his list of the ten strongest earthquakes on the Pacific Coast "during the years 1769 to 1887."

Early-day histories.—Before the appearance of Bancroft's monumental *History of the Pacific States*, seven volumes of which were devoted to California (publication dates from 1883 to 1890), no publication covering the history of part or all of the general San Francisco region even mentioned the existence of any earthquake in the period 1836–1840, except for the bare mention of a strong earthquake in 1839 in the *Annals of San Francisco* (1855). Tuthill's *History of California* (1866) gives about a page to the discussion of earthquakes in California, and briefly describes several, but makes no reference to any shock after 1818. Several county or other local area histories were published before the completion of Bancroft's work, such as the histories of San Mateo County (1878 and 1883), Alameda County (1876), and San Jose and surroundings (1871); they describe certain earthquakes affecting their areas, but none of them mentions any earthquake in the period 1836–1840. Dr. John B. Trask was actively interested in California earthquakes during the 1850's and 1860's, published several articles on them, and in 1864 published a *Register of Earthquakes* from 1800 to 1863; in the *Register* he states, "From 1812 to 1850, the archives are silent on this subject," and he omits all reference to earthquakes between these dates.

Lack of information facilities.—One who undertakes a study of earthquakes in California in the early days is quickly impressed by the total absence of sources of information to which he would normally turn in a study of more recent periods. First of all, there were no newspapers or other periodical news publications in California or adjoining areas, nor any correspondents of news agencies that might have published elsewhere. The country was in general wild, and uninhabited by whites, and the Indians, who were more numerous and widespread, kept no records. The largest white settlements had only a few hundred residents. Communications were poor and uncertain. For the period here under consideration, mission reports, which for earlier periods often contained important historic information, are not available, because none were prepared (1833 to 1839). The missions at that time were undergoing forced secularization, dispossession of their property, and transfer of control to secular administrators.

For the sake of completeness, it may be added that there were not only no seismographs but no scientists in the region or others interested in the study and recording of earthquake phenomena. At the present time, a strong earthquake originating in even an uninhabited region is recorded and its epicenter

and time of origin are approximately determined with the aid of seismographs in other lands; but at that time, suitable instruments and methods for such a purpose had not been invented.

Source material.—When Bancroft was collecting material, chiefly during the 1870's, on which to base his history, he not only used governmental and mission archives, accounts of explorers and other such materials, but also sought actively to obtain statements, old notes, letters, and the like, from pioneers or pioneer families, by advertising, purchase, and personal interviews by himself and his aides. In this way he built up a remarkable collection of manuscript material, which, together with books, pamphlets, maps, and newspaper files and clippings, make up the Bancroft Library, where students of Pacific Coast history still find a wealth of source material. Bancroft was in the midst of publishing his volumes on California history when Edward S. Holden, then President of the University of California and Director-elect of the Lick Observatory, undertook the task of compiling a list of Pacific Coast earthquakes from the earliest recorded date.³ Bancroft aided him materially by supplying him "a very extensive collection of his manuscript records." In the list of earthquakes given in the present paper, H. H. B. is Holden's abbreviation for data taken from the already published volumes of Bancroft's history, and B. MS, for data derived from Bancroft's manuscript notes. Of the seven entries listed, the descriptive material for four came to Holden entirely from Bancroft, and for two others partly from him.

While Bancroft deserves the credit for unearthing the records of these earthquakes, the use of his statements for an attempted scientific appraisal of the shocks is not satisfactory. His descriptions are in general so abbreviated and incomplete that a fair understanding of the events cannot be obtained from them; furthermore, key information is often omitted or undesirably modified, and the resulting statement is sometimes confusing, or even may be incorrect. Several scientific publications might be cited to illustrate the misconceptions or errors that have resulted from attempts to interpret in scientific terms some of Bancroft's (and therefore Holden's) descriptions.

For the present critical study I shall therefore use original sources (for most of which I am indebted to the Bancroft collection), and quote the complete descriptions contained in them, so that the reader, without having to hunt through archives and newspaper files to see if the original reporters did not say something further that might throw more light on some aspect of the subject in which he may be interested, may see clearly the basis on which conclusions are reached.

³ The first edition of Holden's catalogue, recording earthquakes from 1769 to 1887 (inclusive), was *List of Recorded Earthquakes in California, Lower California, Oregon, and Washington Territory*, printed by direction of the Regents of the University of California, Sacramento: State [Printing] Office, (1887).

Later histories of California or the missions.—In searching for references to source material, I consulted available histories of California, of local areas, and of the missions. I have already noted the absence of mention of the earthquakes of the 1830's in the pre-Bancroft histories. It may be added that those printed since Bancroft are equally silent on the same earthquakes, except for a rare local history that copied Bancroft's list. Even Hittell, who worked with Bancroft part of the time, yields us nothing. In his *History of California*, published in 1885, reissued in 1898, although he lists a number (11) of earthquakes from 1800 to 1872, he does not mention a single one in the 1830's.

In contrast to this, the item "1840 January 16-18," first published by Bancroft, has been played up in several historical books and articles. This probably appealed to the imagination because it was supposed to have put a dramatic finish to the Santa Cruz mission. In a recent paper⁴ I have presented evidence that this supposed earthquake never occurred. It is an example of Bancroft's hasty misinterpretation of the record. It was an element of the problem presented by the listing of a series of strong earthquakes in a five-year period, and was therefore included in the list here given, but it will not be referred to again in this paper.

The one-year limit.—Severe earthquakes are reported to have occurred in 1836, 1838, and 1839. One might reasonably expect that, within so short a time, a number of persons would have felt all of them, and would have been able to compare them, stating their effects and relative intensities. Strangely enough, no one who was then in the affected territory has reported earthquakes in more than one of the three years! This suggests the possibility that earthquakes occurred in only one of those years, and that in some of the reports the date was confused or wrongly given. Keeping this possibility in mind, I have not only sought confirming evidence to verify any date, but have also attempted to get evidence that would reasonably explain, with respect to each person reporting an earthquake or earthquakes, why he limited himself to one year, and will comment on that evidence.

The problem of estimating intensity.—People in general have throughout history been interested in reporting earthquakes that have caused important property damage or loss of lives. Even a very great earthquake, although it struck terror to the hearts of those who experienced it, would not, if it occurred in a region of primitive cultural development where no property damage or loss of life ensued, be considered a matter for historic record. Intense thunderstorms also may give rise to great fright, but would normally not be contributed to a historical statement. To the scientist, interested in geological phenomena, and in the intervals of release of great amounts of energy along certain geophysically active zones, such events, even though causing no

⁴ George D. Louderback, "The Reputed Destructive Earthquake of January 16-18, 1840," *Bull. Seism. Soc. Am.*, 34:103-107 (1944).

damage to human life or property, are important; but the problem of estimating the intensity is difficult.

A common method of estimating the relative magnitude of an earthquake, aside from seismographic data—which were of course nonexistent in the early days,—is to take note of the area over which it is described as severe or destructive, and the area within which it is actually felt.

The great California earthquake of April 18, 1906, was destructive in the area we now have under consideration. According to the brief account in the Townley-Allen catalogue, the region of destructive effect extended from the southern part of Fresno County to Eureka, about 400 miles. The earthquake was perceptible from Coos Bay, Oregon, to Los Angeles, and as far east as central Nevada, that is, over an area of 375,000 square miles, approximately half of which was in the Pacific Ocean. Great damage was done in San Francisco and a number of other cities in the Coast Range belt. John R. Freeman⁵ estimated the total property damage (not including the effects of the fire in San Francisco) as probably about \$24,000,000.00. This may be considered an ultraconservative estimate. Hundreds of lives were lost.

Suppose that in the late 1830's there occurred in the San Francisco region an earthquake equaling in magnitude and intensity the earthquake of 1906, what is the possibility that one could estimate it as comparable on the basis of property destruction, area of destructive activity, or area within which it was felt? It would seem desirable to outline the conditions in the region at that time that have a bearing on these aspects of the question.

The population was small, and, except for a few centers, sparsely distributed. According to Bancroft (*California*, III:667), "The Monterey Padron, 1836, shows a population in the town of 225 men, 146 women and 293 children, of whom about 30 were Indians and 42 foreigners." This town was the capital and the official port of entry for vessels. "The population of *gente de razon*⁶ at San Francisco [that is, the mission district and the presidio], given as 300 in 1830, may be regarded as 280, about equally divided between the peninsula and Contra Costa [area east of San Francisco Bay], in 1840, the departure of the soldiers having more than counterbalanced the gain from other sources. Adding 750 for San Jose and 200 for Sonoma and the northern frontier, we have a total for the district of 1,330, a gain of 840 during the decade." (P. 698.)

Yerba Buena was the name used for the area that extended westward from the Bay shore, which was later to become for several decades the chief residential and business district of the City of San Francisco (name formally given in 1847), and at present still its main business district. The first house (a wooden

⁵ John R. Freeman, *Earthquake Damage and Earthquake Insurance*, McGraw-Hill Book Company, Inc., New York and London, 1932.

⁶ This expression was used practically to designate the white population, with a few Indians or halfbreeds who were accepted as part of the white community, but otherwise excluding all Indians.

building) was erected in 1835, and by the end of 1839 only seven or eight building lots had been granted. Even by the end of 1840 the population of Yerba Buena consisted of only about 16 foreigners and 34 Mexicans and Californians.

The country between Mission Dolores (San Francisco) and Mission Santa Clara contained no towns or settlements, only a few large ranchos, and the same was true of the east side of the Bay. Mission San Jose, east of the southern part of the Bay, had the mission staff and a considerable number of Indians. South of the Bay was the Pueblo of San Jose, followed southward and southwestward by sparse habitation until Mission Santa Cruz was reached, with the small settlement of Branciforte near by. On the opposite (southern) side of Monterey Bay was Monterey.

To the north of San Francisco Bay there had been set up two small missions (San Rafael and San Francisco Solano), and in 1835 M. G. Vallejo laid out a pueblo which he named Sonoma, and, with a military force, took charge of the "northern frontier," to protect "California"⁷ from foreign encroachment. Except for the narrow coastal strip from Bodega Bay to Fort Ross, occupied by a small group of Russians, the whole of the northern Coast Range region was occupied only by Indians. The same is true of the great interior valley of California (Sacramento and San Joaquin valleys), which is now occupied by a number of thriving cities, the Sierra Nevada, and the region to the east, now occupied by Nevada.

As Fort Ross is close to the San Andreas fault, any strong earthquake originating along the northern segment of that fault (as in 1906) should have severely shaken the Russian colony. Several lengthy Russian reports on the history and condition of the Russian Pacific colonies are available in manuscript English translation in the Bancroft Library, and I have examined these in the hope of finding some reference to earthquakes. No mention is made of such phenomena. The reports are concerned chiefly with descriptions of the area, history of settlement, relations to the Spanish and Mexican regimes, economic aspects in great detail, and causes of lack of success of the venture, which led to its final abandonment in 1841. The establishment was such that even a very strong earthquake would have caused no pecuniary loss worthy of serious consideration, and it is probable that it would have caused little or no loss of life. It does not seem surprising, therefore, that no mention is made of earthquakes in these primarily economic reports. It seems possible, however, that in Russia there may be some unpublished notes or records that might be very helpful to the study of central California earthquakes.

It should be evident from the foregoing outline that, even if there had been the most favorable conditions for making and keeping records of earthquakes,

⁷ The northern frontier was the practical northern limit of Alta California. The Russians considered their colony at Ross to be in New Albion, not California, and they entered California when they came south to San Francisco Bay.

there was no possibility of getting more than very limited information on the distribution and extent of the "felt area" of any important earthquake; hence the method of comparing areal distribution of earthquake effects for the purpose of estimating relative magnitudes is, at least for the stronger earthquakes, not available for the period under discussion.

In addition, the method of estimating intensities by destructive effects on buildings and other artificial structures finds but limited application. Houses in general were of one story, rectangular in plan, with four adobe walls. The simplest dwelling consisted of one room. Two rooms might be produced by a cross partition. Larger houses had more rooms, sometimes built longitudinally in continuation of the original house, or as outhouses. The better class of houses had roofs of tile resting on roof timbers, but many roofs were built of tule or rods placed on the rafters, and coated with mud and covered with straw or asphaltum. Thatch roofs were also used. The walls were sometimes made of timber frame or posts, the spaces often being filled with adobe.

Considering the small population and the prevailing use of simple-structured, low, and commonly small buildings, it is hardly to be expected that even a severe earthquake would cause any great or widespread property damage, or result in loss of life.

The answer to the question previously raised is, evidently, No; that is, if in the late 1830's there occurred in the San Francisco region an earthquake equal in magnitude and intensity to that of 1906, it would not be possible to estimate this equivalence on the basis of property destruction, area of destructive activity, or area within which it was felt.

Bearing in mind the inapplicability of the most useful methods of the present day, and some of the major handicaps of the present study, let us proceed to a consideration of the available records.

EARTHQUAKES OF 1936

THE GOMEZ DIARY

Among the materials obtained by Bancroft on which to base his history of California were the papers of the Gomez family. These were lent to him and he had copies prepared in manuscript, labeled, "Documentos para la Historia de California 1785-1850. Coleccion de Juan Gomez—copias. Bancroft Library 1876." Attached to these copies is what appears to be an original document, a diary written by Juan's father, Rafael Gomez. It has distinctly the appearance of being much older than the copies of 1876 and is by a different hand and in a different ink. I showed this document to Professor Herbert E. Bolton, who has had many years' experience with old manuscripts of the Spanish and Mexican regimes; he was convinced that it is the original diary, and pointed out that it was written on a high-grade linen paper of a type not used in later years, after the American occupation.

Rafael Gomez was a Mexican lawyer who came to California in 1830 as *asesor*, or legal adviser to the government. In 1836 he lived at Monterey and was a member of the *diputación*. At the time he was thirty-six years old, his son, who later turned the diary over to Bancroft, was only one year old. The document was entitled: "Diario de las cosas mas notables q^e pasan en este puerto de Monterey da principio el dia 6. de Enero de 1836." This may be rendered in English: Diary of the most notable things that take place in this port of Monterey, beginning January 6, 1836.

The diary contains entries on a variety of subjects, and the diarist, following the title, adds a statement to the effect that the object of keeping the diary is the diversion which its reading will cause at the end of each month because of the miscellany of subjects, some serious and others pure gossip or lies which are common everywhere [!]. Bancroft stated, "His *Diario* . . . I have found to be a very useful document."

The last entry in the diary is dated April 18, 1837, and between this date and the opening date, January 6, 1836, he records three earthquakes. The statements concerning these three earthquakes (all in 1836) are as follows:

Abril 25. Hubo un fuerte temblor, como a las cinco de la mañana.

Junio 9. Como a las cuatro de la tarde hubo un pasajero y fuerte temblor de tierra.

Junio 10. A la media p^a las ocho de la mañana repitio el temblor con mas fuerza y duracion.

These entries may be translated:

April 25. There was a strong earthquake about five o'clock in the morning.

June 9. About four o'clock in the afternoon there was a short and strong earthquake.

June 10. At seven-thirty in the morning the earthquake was repeated with more violence and duration.

These brief statements have the defect, so far as earthquake study is concerned, that no information is given about the manifestation of the shocks outside of Monterey, nor any hint of physical phenomena in Monterey on which some estimate of intensities might be based. On the other hand, the date and time of day were entered in the record at the time and not from memory years afterward, and we have, therefore, in this document, the most definite and accurate timing of any of the older earthquakes over several decades.

We may infer from these statements that the strongest earthquake was that of the morning of June 10, 1836, and that the shock of the previous afternoon was a foreshock. The earthquake of April 25 is not known from any other writing or report. It is possible that it was an early foreshock of the main shock of June 10.

It will be noted that no shocks are recorded between June 10, 1836, and April 18, 1837. While small tremors may well have been omitted by the diarist, this absence from the record would suggest that no sharp aftershocks were felt at Monterey, and from this we may infer that the center of disturbance (epi-center) may have been at some distance from Monterey.

It is unfortunate that Gomez did not continue his diary at least three years longer. If he had, we would not now have to worry about the dating of the earthquakes in the later thirties. A few years after 1836 he was accidentally killed at his rancho of Tularcitos and was therefore not available to prepare a statement when Bancroft was canvassing the pioneers for historical reminiscences.

THE ACCOUNT OF MARIANO G. VALLEJO

General Mariano Guadalupe Vallejo responded to Bancroft's campaign for historical data by writing a *Historia de California* in five manuscript volumes. This work was never published, but is in the manuscript collection of the Bancroft Library.

In 1836 Vallejo was in Sonoma as military *comandante* and director of colonization on the northern frontier. In that year there arrived in Monterey, on May 1, Mariano Chico, who had been sent from Mexico to be governor of California. On May 4 he sent an order to Vallejo to come to Monterey with such forces as he could spare from the northern frontier. The order was repeated on the 17th, and Vallejo arrived later in the month. It was while he was at Monterey that the earthquakes occurred which he described in his *Historia* (III, p. 118) as follows:

En el mes de junio se sintieron fuertes temblores de tierra, los primeros, que tuvieron lugar el dia nueve solo duraron medio minuto; pero los que nos sacudieron el dia diez del mismo mes á los cuatro y media de la tarde duraron muy cerca de un minuto y causaron estragos en Monterey y Santa Clara: debido á esa causa que llenò de susto á mucha gente, pudo el señor coronel Chico gobernar á su antojo por algunos dias, pués yò tengo referido en uno de los capitulos anteriores, que esos fenomenos inesplicables de la naturaleza monopolizaban los pensamientos de la gente timida y en especial de las mujeres que los consideraban como precursores de la ira ò enojo del Creador Supremo: estando aun la poblacion de Monterey bajo el dominio del susto causado por los temblores del dia 9 y 10 de junio 1836 llegò del pueblo de nuestra señora de los Angeles un correo violento que habia sido enviado por el alcalde de ese ciudad con pliegos cerrados. . . .

This may be rendered in English:

In the month of June strong earthquakes were felt, the first, which took place on the ninth, only lasted about half a minute; but that which shook us on the tenth of the same month at half past four in the afternoon lasted very close to a minute and caused havoc in Monterey and Santa Clara: owing to that cause which filled many people with fright, señor colonel Chico was able to govern as he liked for several days—as I have already stated in one of the previous chapters that those inexplicable phenomena of nature monopolized the thoughts of timid people and especially of the women, who considered them as precursors of the anger or wrath of the Supreme Creator: while the population of Monterey was still under the domination of fear created by the earthquakes of the 9th and 10th of June, 1836, an urgent courier arrived from the pueblo of Nuestra Señora de los Angeles. . . .

Vallejo's statement agrees with the Gomez diary in the dates of the two earthquakes and in describing that of June 10 as the longer and stronger of the

two. It places the second shock in the afternoon rather than in the morning, as entered in the Diary. I have no hesitation in accepting Gomez' timing, recorded at the time, in preference to that of Vallejo, written almost forty years after the occurrence. Gomez' entries state that the earthquake of the 9th occurred about four o'clock in the afternoon and that of the 10th at seven-thirty in the morning. It would seem likely that Vallejo, in recalling the events, did not remember correctly on which of the two days the afternoon shock occurred.

Vallejo's account gives the added information that the earthquake of the 10th was strong at Santa Clara. His statement that it caused havoc (*estragos*) in Monterey and Santa Clara is indefinite with respect to whether actual property damage was involved or simply a strong shaking that produced the psychological effects which he describes.

The question why Vallejo did not describe other earthquakes of the period under consideration might better be reworded to ask why he describes these earthquakes, for in general in his history he fails to mention other strong earthquakes which he must have experienced. Vallejo's temporary stay at Monterey in 1836 was under peculiar circumstances. He had received peremptory orders from the new Mexican governor to report at once at Monterey to render account of his management. On his way to the capital he was advised by some foreigners that Governor Chico was a dangerous and unprincipled man and that he should not appear there unprotected. He returned to Sonoma and then proceeded with a well-armed force. The governor upbraided him for his delay in complying with his orders, but finally accepted his excuses based on the difficulties involved, especially after learning that his armed band did not consist of government troops, but were maintained at Vallejo's personal expense. On Chico's arrival at Monterey he issued proclamations that alienated many Californians and foreigners, and proceeded rapidly and consistently to make himself disliked, even hated. As popular feeling increased, he finally decided to return to Mexico and sailed from Monterey July 31, only three months after entering the capital. At the time of the earthquakes Vallejo was away from home, marking time in Monterey, uncertain what the governor would do next, and their real or fancied temporary political effect, which he describes, may well have fixed their occurrence in his memory and later made it seem an interesting item to include in his history of the time. Furthermore, the urgent courier who arrived from Los Angeles at that time, according to Vallejo, caused the governor to leave hurriedly for the south—an act which we might expect would also aid in impressing the whole affair and the dates on Vallejo's mind.

OAKLAND "DAILY NEWS" ITEM

After the "great earthquake" of October 21, 1868, much interest was aroused in earthquake theories and history, and a number of articles on these topics were published in various newspapers. The Oakland *Daily News*, November 10, 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 in the valley.

This item was published in several other papers of the time as coming from the *News*. It has the historical defect that it does not name the persons from whom the information was obtained—a common practice with newspapers of that era. However, it is a straightforward and definite account of phenomena which are scientifically credible and not fundamentally inconsistent with other available historic accounts. The distribution indicated is such as would be passed along by word of mouth, among the ranchos lying north of the mission lands, to San Pablo. Persons living on the ranchos east of the Bay were not likely to hear or to care whether the earthquake was felt on the San Francisco peninsula, at Monterey or elsewhere. The date given, June, 1836, is important because it ties in the account with the occurrences reported by Gomez and Vallejo. It may again be noted that in 1868, when this information was given, no book, report, or earthquake list available in the book stores, or any local library in the San Francisco region, mentioned any earthquake in 1836.

Since the report of the State Earthquake Investigation Commission in 1908, it has been recognized that the earthquake of October 21, 1868, originated on the Haywards fault. A geological study of this fault indicates that in the course of its history it has had many movements, undoubtedly productive of a long series of earthquakes. It is the longest and most important "active" fault in the East Bay region. The quoted account of the 1836 earthquake is consistent with, and points strongly to, an origin in the Haywards fault. It is improbable that an origin in any other known active fault of the region would produce "large fissures" in the area mentioned in the description.

A great earthquake originating on the east side of San Francisco Bay would naturally be very strong on the west side. The shock of October 21, 1868, was very destructive in San Francisco, and in Redwood City the court house was wrecked and other buildings were damaged. But the part of San Francisco that

suffered the great damage in 1868 was not built up in 1836. There were only two or three low wooden houses west of the zone of greatest damage of 1868. The old mission was not injured in 1868. Redwood City was not in existence, even as a village, in 1836.

The points farthest south at which actual damage to buildings was reported for the earthquake of 1868 were at Santa Cruz on the coast and at Gilroy, which is of about the same latitude but inland. The *Alta California* (San Francisco) for October 22, 1868, reported from a correspondent in Santa Cruz, as of October 21: "We had a severe shock of earthquake at five minutes before eight this morning . . . preceded by a loud rumbling noise. The shaking continued about fifteen seconds. Several brick buildings were badly cracked. Several smaller shocks have occurred since." The Santa Cruz *Sentinel* of October 24, 1868, said: "Santa Cruz was visited by an earthquake, only second to the one of October 8, 1865. The shock lasted for 30 to 40 seconds. . . . The shock has been followed up by lighter ones. . . . Several chimneys were broken off. . . . The courthouse, with the exception of cracking of plaster, is almost entirely uninjured. Several of the brick business houses gaped open a little." In Gilroy, according to the *Alta California* of October 24, 1868, many chimneys were thrown down, but no serious damage was sustained.

At Santa Clara, mentioned by Vallejo as affected by the earthquake of 1836, the *Alta California* of October 24, 1868, reported "considerable damage to brick walls and chimneys." As to Monterey, the Monterey *Democrat* of October 24, 1868, said: "On Wednesday at about 30 minutes to eight a.m., three distinct and following shocks were felt, apparently passing from North to South. They were very heavy and of longer duration than any we remember since 1850, sometime about the Fall of the year. No injury to either person or property here."

If, then, we had in June, 1836, an earthquake originating on the Hayward's Fault, comparable with that of 1868, it should have been strong enough at Santa Clara to possess potential destructive power, and should have been of sufficient intensity at Monterey to be described as "very heavy" (as in 1868) or "strong" (as by Gomez and Vallejo in 1836), it surely would have appeared in Gomez' diary. The Oakland *News* item is primarily concerned with the occasion of the greatest outburst of energy and it seems reasonable, in the absence of any data to the contrary, to assign to that action the date of June 10, 1836, approximately 7:30 A.M., as recorded for Monterey in the Gomez diary.

It may be noted that Bancroft, in his history (*California*, IV, p. 78), does not list the phenomena on the east side of the Bay as separate from those at Monterey and Santa Clara. He says, "And more severe temblores occurred from Monterey northward on June 9 and 10, of the same year." In giving his sources for this statement he includes the *Solano Herald* (Suisun) of November

21, 1868, which carries a copy of the *Oakland News* item of November 10. Somehow or other, by the time the entry got into Holden's catalogue (1887), the fact that the phenomena east of the Bay had been described as occurring in June had been eliminated from the record, and while the June 9 and 10 entry carried the Bancroft phrase "from Monterey northward," another entry was made to cover the East Bay item and no month was given, as if there were two separate events. This method of recording two separate entries, the second omitting the month, was continued in Holden's second (revised and extended) edition of 1898 and was repeated in the Townley-Allen catalogue of 1939.

Intensity.—In the *News* item the opinion is expressed that "the shocks [of 1836] must have been much heavier than those we have lately experienced" [in 1868]. It is interesting that this conclusion was reached in the face of the marked destruction caused on both sides of the Bay in 1868, and no report of destruction in 1836. There was, of course, little in the way of man-made structures to destroy in 1836, and the writer of the item was probably aware of that fact. He evidently based his opinion on the personal reports and the physical disturbances involved, and these, indeed, seem to indicate a very strong earthquake, comparable to the 1868 shock.

There are two other ways in which we may get some basis for comparison of the 1836 and the 1868 earthquakes. The first is by comparing the descriptions of the two at Monterey with respect to relative intensity indicated at that locality, on the reasonable assumption that the two earthquakes originated in approximately the same area. Gomez describes the earthquakes of June 9 as strong and that of June 10 as having more violence and duration. Vallejo describes them both as strong, but says that the second lasted about twice as long as the first, nearly a minute in duration, and caused havoc in Monterey and Santa Clara. The 1868 shock in Monterey is described as "very heavy" but without property damage. In Santa Cruz, which lies nearer the epicenter, the duration was given by two reporters as 15 seconds and 30 to 40 seconds, respectively. A communication from San Juan (*Alta California*, October 22, 1868), which is somewhat closer to Monterey than is Santa Cruz, says, "The shock was at least thirty seconds in duration, and the heaviest since October, 1865." A comparison of the statements would seem to indicate the 1836 shock as the stronger of the two, but the unknown "personal equations" of the various reporters may indicate a conclusion more apparent than real. It seems reasonable to conclude, however, that the 1836 earthquake, to judge by the descriptions of it as experienced in Monterey, was at least in the same intensity class as that of 1868, and possibly of a somewhat higher intensity.

Another method of comparison of the shocks is by consideration of the after-shocks. The *News* item says of the 1836 earthquake that after the most violent shock "there were innumerable lesser ones, and for a month afterward there were continuous tremors of the earth, uniformly decreasing in violence." As

to the aftershocks of the 1868 earthquake, one person⁸ made a statement recalling those of the 1836 shock, "All the while the ground was shaking and continued to shake for days, and even weeks; but each shock was lighter than the last." The writer of the *News* item also says (almost three weeks after the main shock) that "there have been numerous shocks, diminishing in violence, and the phenomena appear to have been a repetition of those observed in 1836."

In one regard, the statement about the 1836 shock (made thirty-two years afterward) and Mr. Goodell's account of the 1868 earthquake (made thirty-eight years after the event) agree in being scientifically inaccurate. It is improbable that the aftershocks of the 1836 earthquake "uniformly decreased in violence," and it is certainly not true of the 1868 aftershocks that "each shock was lighter than the last." Whenever records have been kept of aftershocks, it is found that stronger shocks are interspersed through weaker ones, and although the intervals between shocks tend to become progressively longer, they do so in an irregular way, with longer and shorter gaps alternating. Looking back at such events, it is common for the untrained person, who did not keep a record of the successive shocks, to feel that the aftershocks rather uniformly decreased in intensity and died out with increasing intervals. Our two informants simply expressed this general impression in too specific and oversimplified terms.

Holden's catalogue has a list of aftershocks of the 1868 earthquake recorded by Dr. Gibbons.⁹ This list gives the number for each day, classifying them as so many heavy and so many light, or for some days only the number, without characterization. The irregular succession of heavier and lighter shocks and the irregular increase in the intervals between shocks are quite clearly shown. The last day of this report is November 16, and the total number of shocks recorded is forty-nine. This record was probably kept in San Francisco. Nearer the epicenter, a larger number of shocks were felt, many of the smaller ones probably not being noticeable in San Francisco. A correspondent in Haywood¹⁰ (*San Francisco Times*, October 24, 1868), writing on October 22,

⁸ George A. Goodell, in the *Report of the State Earthquake Investigation Commission*, Vol. I, Part II, p. 442 (1908).

⁹ Holden does not give Dr. Gibbons' full name, nor the place where he experienced the shocks. It happens that at that time there were three Dr. Gibbonses, all medical men, and each sufficiently interested in scientific matters to become a member of the California Academy of Sciences. Two of them lived in San Francisco and had their offices there, the third in Alameda. The interest in this matter, in a study of the 1868 earthquake, lies in the fact that an observer in San Francisco, because of its greater distance from the source than Alameda, would probably not record so many small shocks as an observer in the East Bay region would do. The observer was probably Henry Gibbons, Sr., a prominent physician of San Francisco who, throughout his life, had wide scientific interests and was one of the founders of the California Academy of Sciences. He is said to have constructed an instrument to indicate earthquake action. The other doctors, in their discussions in Academy meetings, limited themselves to biological subjects.

¹⁰ An alternative spelling of Hayward's (now Hayward) in those days.

1868, said that "up to eight o'clock p.m., there have been thirty-six heavy and light shocks." After the first few days following the great shock, the newspapers are rather barren of reports. Mr. T. Tennent, who gave Holden a manuscript list of earthquakes in San Francisco, 1851-1887, notes local shocks October 26 and 30, and November 1 and 4, and not again until April 1, 1869. From other sources, Holden included in his catalogue shocks on November 5 and 20 (San Francisco), November 30 (Oakland), and December 31 (two light shocks in San Francisco).¹¹ It is difficult, in a region subject to small shocks from various sources, to determine definitely the end of a series of aftershocks, or the classification of a particular shock as an aftershock rather than an independent earthquake, when the intervals become longer, particularly when the aid of local seismographs is not available. Although some, possibly all, of the above-named more widely spaced (in time) shocks, reported from different but not widely separated localities, may belong to the same series, it cannot be said that they are helpful in making a comparison of the 1868 and 1836 earthquakes. They are given here to show, as definitely as possible, the character and extent of the 1868 records. Taking these records as a whole, it seems probable that a person describing the "continuous tremors of the earth, uniformly decreasing in violence" for the 1868 shock, as did the informant for that of 1836, would say that they lasted three or four weeks, or possibly a month. Mr. Goodell did say, "for days or even weeks." I would conclude that the 1836 earthquake was in the same class as that of 1868, so far as aftershocks were concerned.

It may be pointed out that the occurrence of numerous aftershocks in the region east of the Bay, and the absence in the Gomez diary of mention of any shock succeeding the strongest earthquake in June, 1836, indicates an origin in the East Bay region rather than in some area nearer Monterey. From a consideration of the physical phenomena described, the relative intensity and duration in Monterey, and the degree of development of aftershocks, I have no hesitation in rating the earthquakes of June 10, 1836, as of intensity X (Rossi-Forel) in the epicentral region.

THE VISIT OF ABEL DU PETIT-THOUARS

Before leaving the subject of the 1836 earthquakes, I should like to recount some aspects of the story of Abel du Petit-Thouars,¹² captain of the frigate *Venus*, who visited the coast in 1837. He gives an idea of the condition of

¹¹ Not included in the catalogue are a shock at Centerville, December 10, 11 A.M., with no statement of intensity (*Oakland News*, December 12, 1868), and two slight shocks at San Leandro, December 28, at 7 P.M. and 9:30 P.M., respectively, the former being the stronger, as reported by the postmaster of San Leandro to the *San Francisco Times* (*Oakland News*, December 31, 1868).

¹² Abel du Petit-Thouars, Capitaine de vaisseau, Commandeur de la Légion d'Honneur, *Voyage Autour du Monde sur la Frégate La Venus pendant les années 1836-1839*, Paris, Gide, Editeur, 1841, five volumes.

Monterey and Mission Carmel at the time, and describes an effect of a recent earthquake which he does not date but which can reasonably be considered that of June, 1836. They sighted the coast of California October 18, 1837. In Monterey they occupied, for their sick, a large house supplied by David Spence. They had difficulties in getting supplies. San Carlos (Carmel) Mission was entirely abandoned by the Indians and offered no resources. All provisions had to come from farms at considerable distances, and only in small quantities. The summer was dry and they had great difficulty in procuring water, even of bad quality.

They were surprised at the appearance of Monterey, for a capital. There were at most forty to fifty houses. Some appeared comfortable, but most were miserable frames covered with branches—no courts or gardens. The population of the capital of Upper California at that time did not exceed 200 souls, made up of creoles (Spanish and native women), a small number of "naturels" employed in domestic work, and some Mexican families. With these were recently mixed some Scotch, Irish, Americans (U.S.), Kanaka women from the Sandwich Islands, and even some French. These are the *gente de razon*.

They visited Mission San Carlos on October 30, 1837, and were struck by its solitude and ruin. The environs of the establishment, formerly covered with rich harvests, offered to the view only a picture of the most complete barrenness. The court of the mission was deserted. The living quarters were without doors or windows, and the roofs were broken through in several places, having already given way under their own weight. They entered a dark hall, devoid of furniture, and encountered Father José-Maria del Real, the only ecclesiastic who was in service at the mission. They visited the church and entered the lateral chapel, which gives access from the court of the mission. "My attention was particularly aroused by the sight of a large painting of San Isidro, *el labrador*, which was on the left on entering, which was suspended quite obliquely by one of the upper corners of the frame. In this position the saint and his plow appeared inverted. Our reverend guide, after pointing out this painting with his finger, made three genuflexions and as many signs of the cross, and then appeared absorbed by a profound meditation from which I had some trouble to divert him. I desired to know the reason for his special devotions, suspecting that a little of the supernatural could well be mingled there with an event very natural in itself. Finally, pressed by me to explain this mystery, the reverend Father, in a tone pervaded with sadness, and a low voice, informed me that during an earthquake this painting had been inverted in this way, and surely this catastrophe had been a manifestation of the will of God, and a sure prediction of the ruin of the missions."¹³

It will be recalled that Gomez's diary carried entries up to April 18, 1837, and

¹³ *Loc. cit.*, Vol. II, p. 118, 119. The statement within quotation marks is a translation of the original French.

mentioned no earthquake after the strong one of June 10, 1836. There is a six months' interval between the last entry and the coming of Petit-Thouars. There is no record of any earthquake during this period, and one might expect that if one had occurred shortly before the traveler's visit the father would have said "last month," or "this summer," in referring to the shock. It seems unnecessary to introduce a hypothetical strong earthquake in that interval; the known earthquake is recent enough to account for the phenomenon. If this is accepted, it may be pointed out that an earthquake that was strong enough to swing and partly tear loose from its fastenings a large painting was probably at least of intensity VII (Rossi-Forel). This, at a point a few miles south of Monterey, would correspond to the "havoc" and panicky condition of the people described for the latter location. These considerations also suggest that the 1836 shock may have been somewhat stronger than that of 1868.

EARTHQUAKES OF 1838

CAPTAIN PATY'S REPORT

The earliest printed record of the earthquakes that occurred in the vicinity of San Francisco in 1838 is found as an item in the *Sandwich Island Gazette*, Honolulu, issue of November 17, 1838.¹⁴ The item is titled "Latest from California," and reads:

The Barque Plymouth, Capt. John Paty, has arrived: Captain Paty never forgets the Editor. The news are after this shape and colour.

Heavy shocks of earthquakes were experienced at Monterey, St. Francisco and St. Jose, about the last of June: At the latter place one house was shaken down, and the walls of the Missions of St. Francisco, St. Jose and Santa Clara were badly injured: Slight shocks have been frequent since.

According to the editor, Captain Paty had brought him news before, and probably did later. As he made a special point of reporting this 1838 earthquake, we may ask why he said nothing, at the appropriate times, of strong earthquakes in 1836 or 1839.

Captain John Paty first came to California in December, 1837, as master of the Hawaiian schooner *Iolani*, too late to consider the June, 1836, earthquake as news, if, indeed, he heard any talk about it. This ship was wrecked in May, 1838, and Paty became master of the bark *Don Quixote* and between 1838 and 1848 made a number of trips with this vessel between Honolulu and California, sometimes two in a year. The *Don Quixote* had come to California in 1836 with John Meek as master, but did not arrive in Monterey until November, five months after the earthquakes of June, 1836. When the ship was

¹⁴ A copy of this item was kindly obtained for me by H. O. Wood. It was made by Maude Jones, Archivist, Board of Commissioners of Public Archives, Honolulu. Miss Jones also supplied the information that "there were no other papers published in Honolulu between the years 1836 and 1839 and no mention of any other California earthquakes appears in the other issues of the *Sandwich Island Gazette*."

turned over to Captain Paty for a trip to California in 1838, it was renamed the *Plymouth*, but after its return to Honolulu it reverted to its former name. The *Gazette's* article used the official name of the time, but W. H. Davis in his book, and Bancroft, in part, use the name *Don Quixote* even for the 1838 trip.

In January, 1839, the *Don Quixote* sailed from Honolulu for Boston, and it did not appear in California again until April, 1840; hence, even if a severe earthquake occurred in 1839, Captain Paty was not in a position to report it as news to the editor of the *Gazette*.

While nothing in Paty's account indicates directly whether or not he was in the area of high intensity when the main earthquake occurred, the fact that he does not report a definite date can be taken as reasonable evidence that he was not there at the time, for the master of a vessel would normally have entered it in the log, and in his statement to the editor would have said something about its effects so far as the ship was concerned. From the Davis account of the earthquake, which will be given later, it is evident that the ship arrived some time after the main shock, but while it was still an important topic of conversation in Monterey and Yerba Buena.

Paty's account is the only one yet found that mentions damage to the walls of the missions at Santa Clara, San Jose, and San Francisco, and states that a house was shaken down in San Jose. His is also the only statement about aftershocks. A number of these he evidently experienced, for he says that "slight shocks have been experienced since." As he had no source of information concerning the continuation of such shocks after he left California on his return voyage to Honolulu and until his interview by the editor, his statement must be interpreted to mean that the "slight shocks" continued as long as he was in the Monterey-San Francisco Bay region. After leaving Monterey, he sailed up the coast to San Francisco Bay, and fortunately we have the record that the *Plymouth*, Captain Paty master, sailed from Yerba Buena on September 19, 1838.¹⁵ We may conclude that Paty's statement means that aftershocks were continuing two and a half or more months after the main shock.

Bancroft (*California*, IV, p. 78), on the basis of the *Sandwich Island Gazette's* item, says, "The next shocks recorded were in June and July of 1838, doing some damage at San Francisco, San Jose, Santa Clara and Monterey." From this statement Holden and, later, Townley and Allen, in their catalogues, date the earthquake "1838, June and July." Why Bancroft uses "July" is not entirely clear. It has led to doubt whether it meant that destructive shocks occurred in July or that the aftershocks ended in July. There is nothing in Captain Paty's account that suggests any very strong shock in July, and, as shown above, the aftershocks would seem to have continued into September.

¹⁵ Vallejo *Documentos*, V: 282 (Bancroft Library). Formal report for 1838, signed, "Capitania del Puerto de San Francisco 31 de Dic.^{ro} de 1839. Guill^o [William] Richardson."

DESCRIPTIONS REPORTED BY WILLIAM HEATH DAVIS

In the course of gathering material for his histories, Bancroft obtained from William Heath Davis a valuable handwritten account of his early experiences and recollections. It is still preserved in the manuscript collection of the Bancroft Library. No date is inscribed on it, but it was probably written in the 1870's. It was entitled, "Statement of William Heath Davis," but this did not satisfy the author, who had a fondness for striking titles; he later wrote on it, "Glimpses of the Past."

When Bancroft arranged for a personal statement, he gave the writer a blank book and had him use only the right-hand pages, leaving the left-hand pages blank. As originally written, Davis' manuscript contained no description of the 1838 earthquake, and this is apparently the reason why Bancroft did not give Davis as a source of information for the statement quoted above, which he made about this event. A brief account of the earthquake, judged to have been written at a later time, because of the difference in appearance from the main text, was added, apparently by Davis, on a left-hand page of the blank book.

Davis later decided to publish a book, and, in preparing it, made much use of the manuscript he had prepared for Bancroft. Many of the paragraphs of the manuscript were transferred verbatim to the book, and this applies to the description of the earthquake. The book was published in 1889 under the title, "Sixty Years in California," with a lengthy descriptive subtitle.

Still later, Davis began preparation of a new edition with considerable added material. It is said that he had all the text prepared for this enlarged edition and had chosen for it the title "Seventy-five Years in California." All the new material was contained in two dispatch boxes, which were on his desk in his office in the Montgomery Block in San Francisco when the great earthquake of 1906 occurred, followed by a conflagration. When he came to save his precious manuscripts, he was prevented from entering the building by United States marines. The building escaped destruction, but when he returned after the fire the two boxes had disappeared.

At his home he had preserved fragments and notes from which his manuscript had been prepared. But Davis, then eighty-four years of age, did not have the vigor to attack the task of doing over again what had taken years to accomplish. He died in 1909 and his papers passed from his heirs to other hands and eventually to the Huntington Library. Ultimately, Douglas S. Watson undertook the task of preparing and editing the new edition¹⁶ which was published in 1929, twenty years after Davis' death.

¹⁶ William Heath Davis, *Seventy-five Years in California*, edited and with a historical foreword and index by Douglas S. Watson, San Francisco, John Howell, 1929. The outline given above, of the history of this work, is based on the Publisher's Preface to this posthumous edition.

The main reason for detailing this series of writings is that *Seventy-five Years in California*, while repeating verbatim the account of the 1838 earthquake given in "Glimpses of the Past" (written more than thirty years after the event) and in *Sixty Years in California* (published fifty-one years after the event), adds two significant paragraphs that did not appear in the earlier accounts. The quotation given below is from the latest publication; the material added in this 1929 edition is the last two paragraphs of the quotation.

The "Don Quixote" arrived in Santa Barbara from Boston via Honolulu, in May, 1838, and I was a passenger on her, this being my third trip to California. We found Governor Alvarado there, and the department in a revolutionary state. [He then describes the bloodless battle on the Los Angeles plains.]

Previous to this affair our vessel was ordered by Alvarado to go from Santa Barbara to Monterey to enter, that being the only port of entry in the department.

At Monterey I stopped with Major William Warren, then keeping a store there for Nathan Spear, who had also a commercial establishment at Yerba Buena in company with Jacob P. Leese and William S. Hinckley.

During my stay there of two or three weeks, the severe earthquake of June, 1838 took place. . . . [P. 16.]

I sailed from Monterey to Yerba Buena in the ship "Alert." . . . [P. 17]

On arrival at Yerba Buena I went into the employ of Nathan Spear, and soon became his managing active business man. . . .

Mr. Spear informed me that during the earthquake of June, '38, before mentioned, a large sand-hill standing in the vicinity of what is now Fremont street, between Howard and Folsom, and between which and the bay at high tide there was a space of about twenty feet, permitting a free passage along the shore to Rincon Point (the coves of which were then much resorted to for picnics and mussel parties), was moved bodily close to the water, so as to obstruct the passage along the shore. After that no one could pass there at high tide, and we were compelled to go around back of the sand-hill, and wade through loose sand to reach that point, a much more laborious walk.

He further remarked that Loma Alta (Telegraph Hill) swayed from east to west and from west to east, as if the big mountain would tumble over. At the Mission Dolores there was no injury to church buildings or to dwellings; but at the Presidio the walls of some of the old dwellings were cracked.

The earthquake had occurred just before my arrival at Monterey. Major Warren told me that it was the severest one he had ever experienced, and it seemed to him as if the town would be destroyed during the vibration. The inhabitants were frightened out of their wits. Crockery and glassware were broken, and some of the walls of the adobe dwellings were cracked. It was a shake of no ordinary severity, and the town of Monterey was pretty well shaken up. [P. 18]

It is strange that in his earlier writings Davis asserted that the severe earthquake of 1838 took place while he was in Monterey, and only after sixty years, more or less, following the event, prepared a statement that the earthquake "occurred just before my arrival at Monterey." The editor of the posthumous edition overlooked the inconsistency that the contradictory statements appeared in the same book, although they were only two pages apart. The internal evidence supports the idea that Davis was not present at the time of

the main shock, for all his descriptive material is taken from statements made by others; he reports nothing as if he were a witness of the phenomena. His definite statement that the earthquake occurred before his arrival also corroborates the inference concerning Captain Paty's account, because Davis was a passenger on the ship of which Captain Paty was master and they naturally reached Monterey at the same time.

The accounts of Captain Paty and of W. H. Davis supplement each other very well, for in general they deal with different phenomena of the same earthquake. They are inconsistent on only one point. Paty says that the walls of the Mission of San Francisco were badly injured; Davis reports that at the Mission Dolores (San Francisco) there was no injury to the church buildings or to the dwellings, but admits damage at the presidio. There appears to be no satisfactory way to settle this question. As pointed out before, no mission reports were prepared during this period. It may be reasoned that Captain Paty probably visited the mission in the line of duty to find out if he could do any business there, and that Davis, who was immediately plunged into a responsible job on his arrival at Yerba Buena, probably did not. Again, it may be said that Paty made his report while the items were fresh in his mind, and Davis did not mention this aspect in his earlier accounts but only after sixty years more or less. But such considerations, while they suggest possibilities, can hardly be taken as convincing.

Intensity.—If we now turn back to Spear's description of phenomena in the San Francisco area, it is of course recognized that the swaying of Telegraph Hill as if it would tumble over is an optical illusion caused by the strong swaying of the observer, resulting from the earthquake. It must have been a violent earthquake to produce the effects described. As to the sand hill, it may be noted that it was on the eastern edge of the peninsula, where very active dune migration was not going on; the earthquake occurred in the dry season; and the hill had not been cut into or its slopes oversteepened by artificial methods (as was done so frequently in the later development of San Francisco). One would expect the mass to be rather stable, and that it would take a severe earthquake to produce the effects described. As to the cracking of walls at the presidio, one might risk a guess of intensity of at least VIII.

After the great California earthquake of April 18, 1906, Mr. H. O. Wood made a detailed study of damage in San Francisco and prepared a map of the distribution of apparent intensities, which was published in the report of the State Earthquake Investigation Commission (1908). He used an arbitrary scale, the grades of intensity being indicated by letters. It is of interest here that the sites of Spear's sand hill, of Spear's house, and of the presidio buildings all lay in areas designated "D" on Wood's map. In a diagram which Wood gives to show the correspondence between his scale and the Rossi-Forel scale, grade D runs from upper VII to mid-VIII. Such an estimate would seem con-

servative for the phenomena described by Spear. It may be further noted that in the report of the Earthquake Commission no damage in 1906 was mentioned for the Mission Dolores. I would conclude, therefore, on the basis of Spear's account, that if the earthquake late in June, 1838, originated on the San Andreas fault, it may well have been in the intensity class of the earthquake of 1906. It may even have been stronger.

If we next consider Major Warren's account of the earthquake at Monterey, we note that it seemed to him "as if the town would be destroyed." . . . "The inhabitants were frightened out of their wits. Crockery and glassware were broken and some of the walls of the adobe dwellings were cracked."

In the report of the State Earthquake Investigation Commission on the 1906 earthquake, the intensity at Monterey was classed as VI. "I could learn of no damage done to the houses, the only damage reported being of some glassware in a few stores. In some houses furniture was moved slightly, and top-heavy pieces were overturned." (P. 291; reporter, A. S. Eakle.)

If Warren's account is accepted, the 1838 earthquake was definitely of greater intensity at Monterey than the earthquake of 1906.

According to Davis, Major Warren said of the 1838 earthquake that "it was the severest one he had ever experienced." It seemed worth while, therefore, to look into Warren's history, because, if he were in Monterey in June, 1836, his statement would express a judgment that in Monterey the 1838 earthquake was more severe than that of 1836.

Bancroft (*Pioneer Register, in California, V*) describes Wm. R. Warren as a native of Massachusetts who had lived in Honolulu some ten years or more, and was generally called "Major." He dates his coming to California as 1836 but does not give a reference for this, or give the month or the ship in which he came over. His name first appears in Larkin's books of accounts in 1837.

W. H. Davis in his earliest writing ("Glimpses of the Past") says, "Major Warren came to California, about 1837, and was in the employ of Nathan Spear at Monterey, having charge of the establishment there."

Warren may have arrived in California late in 1836 or early in 1837. We have no assurance that he was present at the time of the earthquake of June 10, 1836; hence, while we may accept his statement as correct, it cannot be used for comparative purposes in the present study.

Finally, going back to Captain Paty's description, "the walls of the Missions of St. Francisco, St. Jose and Santa Clara were badly injured," it may be noted that the report of the State Earthquake Commission mentions no cracking or other damage to these missions in 1906. This comparison is based, unfortunately, on negative evidence, but, considering the careful and extensive work done under the auspices of the Commission, it seems reasonable to conclude that if the walls of any of these missions had been "badly damaged" in 1906, the damage would have been reported.

In summary, the descriptions of physical phenomena in the three independent accounts quoted correspond to an earthquake in June, 1838, at least as violent as (Spear, San Francisco), or more violent than (Paty, San Francisco, Santa Clara; Warren, Monterey), the earthquake of April, 1906, at the locations reported.

ONE EARTHQUAKE IN "SEVENTY-FIVE YEARS IN CALIFORNIA"

As mentioned before, William Heath Davis published in 1889 a book called *Sixty Years in California*. For this title he used a round number, since he first saw California on a temporary trip fifty-eight years before the book was published, and came to California as a permanent resident fifty-one years before the publication. In the course of this long period he certainly experienced a number of earthquakes, including some very destructive ones. It is therefore a surprise to learn that in the whole book, and also in the later edition, *Seventy-five Years in California*, the only earthquake noted and described is the earthquake of June, 1838! For the present study it seems important to attempt to arrive at an explanation of this limitation.

William Heath Davis was born in Honolulu in 1822. As a boy of nine years he first visited California in 1831 on the Boston bark "Louisa," Captain George Wood, master. Returning to Honolulu, he spent two years at school, and again visited the coast in 1833 on the Boston bark "Volunteer", Captain Thomas Shaw, master. On both voyages he visited Monterey, and on the latter voyage the ship also anchored in Yerba Buena cove. At that time there were no houses at Yerba Buena. The stay was of several weeks' duration, and Davis visited the mission frequently. He did not again come to California until 1838. His arrival was described previously, and the fact stated that he proceeded to Yerba Buena to work for Spear. This became his permanent residence.

In his book he gives interesting information about his earlier voyages, and it is evident why he gives no description of the earthquake of 1836. It occurred three years after his second visit and two years before his last.

As to why he mentioned no later earthquakes, the question may be limited by a consideration of the contents of his books. The titles of the books are somewhat misleading, since from them one might well expect a historic narrative, or an account of personal experiences, covering a period of sixty or seventy-five years, respectively. As a matter of fact, the books are limited to the author's experiences and to conditions in California in the 1830's and 1840's, and hardly anything is mentioned that goes beyond 1850. It appears to me that the title he gave the manuscript he prepared for Bancroft, "Glimpses of the Past," better expresses their content.

The question therefore limits itself to the period 1839-1849. No reports have yet been found of even moderately strong earthquakes at San Francisco or in near-by territory in the 1840's. On our list, however, we have a violent earth-

quake reported for 1839. Our question therefore simplifies itself materially. Why did Davis describe the earthquake of 1838 and omit all reference to an earthquake in 1839? This is not easy to explain away. It is inconceivable to me that a man who wrote so fully of that period and who described an earthquake that occurred some days before his arrival and took the trouble to add to this description in the later edition of his book, would, if he personally experienced a violent earthquake the year after his arrival, fail even to mention it.

STATEMENT OF DON JOSÉ THOMPSON

Holden, in the first edition of his catalogue (1887), reports a "verbal account" made to him by Don José Thompson to the effect that the earthquake of 1838 was "very severe in the harbor of San Francisco." This item was repeated in the 1898 edition, and in the Townley-Allen catalogue. It is not a very informative statement, as no physical phenomena are described. But I have tried to learn something of Thompson's history, with the idea that if he, like Davis, was in San Francisco in 1838 and 1839 and told Holden of only one strong earthquake, occurring in 1838, this might be taken as confirmatory evidence that the reputed 1839 shock was misdated. Definite data on Don José are, however, elusive, and I have not yet been able to get trustworthy evidence concerning his arrival in California and how long he was in the San Francisco region in the 1830's.

EARTHQUAKE ASSIGNED TO 1839

THE CHARLES BROWN INTERVIEW

Charles Brown, an early pioneer, who was born in New York City on December 10, 1814, lived in San Francisco on Dolores Street in 1879. "With the object of obtaining some of the information relative to the city's growth which is stored away in the mind of the old gentleman, a *Call* reporter visited him . . . a few days ago." The result of the interview was an article in the *Call*, December 21, 1879, in which various matters were discussed, and which was entitled "The Old and the New."

In the midst of the rather long article, Brown says: "The period between 1839 and the gold excitement in 1847-48 and '49 was mostly quiet and uneventful. The Celebration of the Fourth of July, the arrival of Mr. Luse [Leese] the festivities which followed the completion of his store,¹⁷ and the annexation of California by the United States Government, were the only events to relieve the monotony of the settlers peaceful existence."

Soon thereafter follows the description of the earthquake:

The earthquake, however, which took place in 1839, was an event which could never be forgotten by any one who had experienced its terrible and awe-inspiring effects. It occurred

¹⁷ This is included as one illustration of Brown's handling of dates. The great Fourth of July celebration on the completion of Leese's house, the second built in Yerba Buena, was on July 4, 1836, not between 1839 and 1849. The gold excitement did not start until 1848.

shortly after mid-day. Mr. Brown was then living in an adobe house, near where Redwood City now stands. He had been cutting wood, and had just entered the house when he was astonished by a sudden and stunning blow on the back of the head. Looking around he saw a vat which was suspended from the ceiling, and which was used to hold lard, swinging about the room in the most eccentric manner. Just as he was puzzling himself to account for this remarkable phenomenon,

HE FELT THE HOUSE ROCK

And the floor tremble beneath him. Rushing to the door he beheld a spectacle of terrible sublimity. As far as his eye could reach the earth was rising and falling in solid waves. Looking towards the mountains he perceived a strange commotion.

"The redwoods rocked like to lake-side reeds."

Thousands of them were broken off and hurled through the air for immense distances. By his side was a Spaniard, who exclaimed that the end of the world had come, and casting himself on the ground prayed to God for deliverance from impending death. Mrs. Brown, at the time of the awful occurrence, was washing clothes at the side of a creek near the house. Before she was aware that the earthquake had commenced, the bed of the stream was uplifted, and its water poured over her. Adobe houses, with walls seven feet thick, were cracked from top to bottom, and fissures were made in their walls wide enough for a person to walk through. The ground was cracked in all directions, and one immense opening was made which extended from near Lone Mountain to the Mission San Jose. It was ten or twelve feet in width, and its depth was never fathomed by man. Traces of it are said to exist at the present day. Mr. Brown stated to the reporter that, although he had felt many earthquakes since his arrival in California, he had experienced none which approached in violence the one of 1839. He expressed the opinion that it was impossible to make a building so strong as to be earthquake-proof.

This appears to me a graphic and excellent account of earthquake phenomena, even though as frequently happens in a report from a person who has actually been in the midst of such terrifying phenomena, there may be a certain degree of exaggeration. There are a word and a name that seem certainly in error, but I am inclined to think that the reporter (or, for the word, the typesetter) may have been to blame.

In the sentence, "Adobe houses, with walls seven feet thick, were cracked from top to bottom," etc., I believe "seven" should be "several" as there surely were no houses in that region with walls seven feet thick, and I have more than once seen this same error in typesetting.

The statement that "one immense opening was made which extended from near Lone Mountain to the Mission San Jose," has long bothered geologists and seismologists. It is evident, as pointed out by Townley, that Mission Santa Clara is meant. I have a number of times heard people confuse these names. Mission Santa Clara is down the peninsula on the way to, and very near, the city of San Jose. Mission San Jose is on the other side of the Bay and some twelve miles north of the city of San Jose. There is no hint that the fissure plunged into the Bay to reach Mission San Jose. Brown may even have said: the mission near San Jose; or: to the mission and San Jose.

I cannot agree with Townley that the "most serious inaccuracy" in the account is "the statement that Mr. Brown lived where Redwood City now stands" (*Catalog*, p. 25). First of all, Brown did not say that; it came from Holden's first catalogue. Brown said, "near where Redwood City now stands." Brown's adobe house still stands in the foothills some six miles southwest of Redwood City (I do not know the riding distance in those days). I would consider its location to be *near* Redwood City. Townley says that Brown's place was "at Woodside," but if Brown had said that it would have been an "inaccuracy." At the time, Brown's place was at the outer edge of Searsville, some two and one-half or three miles south of Woodside by road. At the time of the earthquake there was no Redwood City, Woodside, or Searsville. When the migration to California set in as a result of the Gold Rush, and San Francisco started to grow, lumber became a pressing need and two lumber camps, Searsville and Woodside, were established and were thriving small communities until the timber supply was about exhausted. When Brown told his story, both these camps had shrunk in population and had become of little importance. Lumbering had moved elsewhere. The reporter probably was not familiar with their names, and, for a San Francisco paper, reference to the county seat, Redwood City, was much more understandable and appropriate than reference to a decadent lumber camp.

Brown's account gives a vivid picture of a violent earthquake and impresses one with the idea that he was describing phenomena of his immediate surroundings, phenomena that were witnessed by him. He says nothing about the effects in Yerba Buena, the presidio, the missions, or at San Jose, which he might well have learned from others. Both what he says and what he does not say aid materially in the interpretation of his descriptions.

The great fissure.—Brown's adobe lies within a few hundred feet of the great San Andreas fault, horizontal rupture along which produced the violent earthquake of April 18, 1906. Action along this fault is the only geological agency, operative in the vicinity of his house, which could reasonably be expected to give rise to "one immense opening . . . which extended from near Lone Mountain to the Mission [Santa Clara]." This brief geographical statement was evidently intended to indicate its general direction and general limits as far as they were known to the narrator. Its extent toward the north and toward the south was probably learned from ranchers and not by a personal inspection the length of the line. Geographical names suitable for describing the course of the line were scarce at the time, and he used points (Lone Mountain and the Mission) which were generally known in San Francisco.

At the time of the earthquake of 1906, the movement on the San Andreas fault ruptured the surface of the earth from San Juan to at least the coast near Point Arena (where it entered the sea), a distance of about 190 miles. If we take the limits as given by Brown for the "1839" fissure to represent a

length of about 40 miles, the 1906 surface rupture extended about 45 miles farther south and at least 105 miles farther north. Must we accept the general extent of the surface break as indicated by Brown as the limit of such action at the time? I think not. Is it possible that the surface phenomena of fault action at the time of Brown's earthquake may have been developed along the fault line to an extent comparable with those of 1906? I believe it quite possible, although no direct evidence is available. It appears worth while to follow this matter more in detail.

In my general introduction I have already described in outline the conditions that existed in California in the 1830's. I have also just suggested that Brown got his idea of the extent of the phenomena from ranchers to his north and south. If we now consider his northern limit, it should be noted that near the latitude of Lone Mountain the fault line leaves the land and enters the Pacific Ocean. Its next appearance on land is west of the mountain range that lay west of the Marin County settlements, where the fault runs between the north end of Bolinas Bay and the south end of Tomales Bay. It then passes under water again, and, except for crossing two small points in Tomales Bay and a narrow neck of land at Bodega Head, does not reappear on land until north of the mouth of the Russian River in the vicinity of Fort Ross. From there on, it manifests itself by a continuous trace to the mouth of Alder Creek, north of the village of Point Arena, where it again enters the Pacific Ocean. Except for the small Russian settlement at Ross, this entire extent is through land that was uninhabited by whites in the 1830's, and I have previously pointed out that the Russian reports available here are not concerned with earthquakes.

Turning now to Brown's southern limit, it may be said that it corresponds approximately to the extent of the ranchos. Farther to the south, the San Andreas fault passes into what was then wild and uninhabited, wooded, mountainous country, in which it is very unlikely that any observations would have been made.

It is evident, therefore, that if the extent of surface rupture at the time of the earthquake described by Brown had equaled or exceeded that at the time of the 1906 earthquake, neither he nor any other Californian was likely to have been aware of it.

Brown described this "one immense opening" as "ten or twelve feet in width, and its depth was never fathomed by man." In connection with the disturbance of 1906, no one reported the main fissure as remaining open after the fault movement ended. The only actual observers of the fault movement reported that in the course of the earthquake it opened sufficiently to engulf a cow as it passed through a corral near Olema, but that it closed again at the end of the action.

On the basis of the 1906 experience one would naturally expect that action at the earlier date would show the same type of phenomena along the surface

trace of the fault, but general considerations do not seem to require us to reject the possibility of a resultant open fissure along at least part of the line. In 1868 a destructive earthquake was caused by movement in the Haywards fault, east of San Francisco Bay. A geological study of this fault shows that in the course of its history it has been subject to many movements of the same character as those which have taken place on the San Andreas fault, that is, horizontal movements on an essentially vertical fault.

The Report of the State Earthquake Investigation Commission on the earthquake of 1906 contains a chapter on the 1868 earthquake. According to this report, on the morning of October 21, 1868, a crack opened along the fault line from the vicinity of Mills College, east of Oakland, to the vicinity of Warm Springs near the Santa Clara County line, for the most part within the hill slopes and not in the alluvium which extends from the base of the hills. "That the crack extended down into the bedrock is testified to by many who observed it closely. Three men reported that they tried to sound the bottom of the crack, but were unable to do so." According to a statement by W. H. Weilbye, given in the report, "It was of unknown depth; several balls of twine, tied together, with an iron sinker, failed to find bottom." No systematic study to determine the extent of the fault trace was made at the time, but a piecing together of the fragmentary reports of personal experiences indicates a length of at least twenty miles, "characterized for the most part by a crack." Various estimates of the width of the opening were given by persons who saw it at different places, the maximum reported being two feet.

Effect on trees.—Brown reported: "The redwoods rocked like to lake-side reeds. Thousands of them were broken off and hurled through the air for immense distances." This sounds like exaggeration, especially in the use of the words "thousands" and "immense." In making a comparison with the effects of the 1906 earthquake, it should be remembered that at the time when Brown observed the phenomena he was living in a practically virgin forest of redwoods, and that trees were very much more numerous, especially the tall ones, than in 1906.

Dr. John C. Branner, at the time of the 1906 earthquake, was Professor of Geology at Stanford University. For a number of years he had been engaged in a study of the geology of the region now under discussion (the Santa Cruz quadrangle and adjoining areas), and he had completed his mapping of the fault line a week or so before the earthquake occurred. Immediately after the earthquake, he traveled along the fault line to learn what had happened. The following month he gave an address on the earthquake at San Jose which was reported in the *Mining and Scientific Press* (May 16, 1906). In the course of his remarks he said:

The greatest effect of the slipping of the fault was noticed in the trees. The houses did not seem to be much more badly damaged there than they are in the valley [Santa Clara Valley];

but limbs of trees were snapped off. Trees were uprooted. On the other side of Loma Prieta, along the line of the fault, the forest looked as though a swath had been cut through it two hundred feet in width.

Apparently, Brown's account was not greatly exaggerated.

Cracking of the ground.—Brown reported the ground "cracked in all directions." Branner said, in his address concerning the 1906 phenomena:

Where we had located the line on the map was a great furrow, marking the line of disturbance. Roads were pushed out of their places, pipes were broken, fences were disarranged, and the surface of the earth was broken up on the summit of the range along the full extent of the fault line, and all the manifestations of a violent character were within a very short distance of the line. . . .

At Black Mountain I found beside the main fault, which ran through the mountain, a sort of branch. Following this the whole side of the mountain seemed to be shattered as though it had been picked up and allowed to drop. In a little over a mile I counted no less than 345 cracks running in every conceivable direction.

In the report of the State Earthquake Investigation Commission, in the section dealing with earth movement along and near the fault, there are several paragraphs (p. 106, by J. C. Branner) describing the more noteworthy phenomena in the vicinity (within two or three miles) of the site of Brown's cabin, as produced in 1906. A number of cracks and belts of cracked ground are described, as well as other forms of disturbance associated with them (ground, trees, fences, etc.). Some of the cracks were 1.5 feet wide, and some had up-thrusts on one side to a maximum of 2 feet.

Ground waves.—Brown's statement that "as far as his eye could reach the earth was rising and falling in solid waves" recalls the statements of two eyewitnesses of the 1868 earthquake as found in the report of the Earthquake Commission.

"Mr. Charles Herman was driving back to Haywards after delivering bread. Looking up the road, he saw the ground coming toward him in waves, and when the motion struck his horse, she went down on her knees. Mr. Herman thought the world had come to an end. As he neared the San Lorenzo Creek, he noticed that the water had been thrown out of the bed of the creek onto the road." (P. 442)

J. McD. Preston said, "As I sat there, I could see the ground in waves like the ocean." (P. 444)

The Herman statement also recalls Brown's description of the fear expressed by the Spaniard at his side, and the incident of the creek water pouring over his wife.

Onset of the earthquake.—In the report of the Earthquake Commission, Reid says, in reference to the earthquake of April, 1906, "The general descriptions show that the earthquake began with a fairly strong movement which continued with increasing strength for an interval variously estimated, but which

really amounted to about half a minute; then very violent shocks occurred . . ." (Vol. 2, p. 3). Brown's account presents an interesting parallelism between his earthquake and that of 1906. His first intimation that something was wrong was a "sudden and stunning blow on the back of the head" by a lard vat suspended from the ceiling, which he then noted was "swinging about the room in the most eccentric manner." "Just as he was puzzling himself to account for this phenomenon," the violent effects of the earthquake began.

Conclusions.—Charles Brown has supplied us a very valuable account of an earthquake because he described a variety of physical phenomena which he observed, in such a way that they can now be compared type by type with the phenomena produced in the same area in 1906 and studied and described in a more systematic, scientific way by trained observers. As a result of the analysis and comparative study of his account, I conclude: (1) that the earthquake described by Brown originated in movements along the San Andreas fault; and (2) that it was of great violence, and of intensity not inferior to that of the earthquake of April 18, 1906, in the area he was cognizant of. Whether the earthquake-generating disturbance extended as far along the fault as it did in 1906, or even farther, we shall probably never know definitely, even though some note or record of its effects at Ross be some day found in the Russian archives; for, as is noted above, the territory traversed by the fault, for its complete known extent to the north of Ross, and for many miles to the south of the latitude of Mission Santa Clara, was uninhabited, except in part by scattered Indian tribes.

Brown told the reporter that "although he had felt many earthquakes since his arrival in California, he had experienced none which approached in violence the one of 1839." As he was not outlining the earthquake history of the region, it is evident why he mentions only one.

DATE OF BROWN'S "1839 EARTHQUAKE"

Brown tells, in his story, of the earthquake "which took place in 1839." He does not mention the day, the month, or even the season when it took place, but only that "it occurred shortly after mid-day." No one else has given a description or date of a violent earthquake in the region in 1839.

So far as I know, Allen¹⁸ was the first to question the year 1839, and believed it a misdating for 1838. Townley (*Catalog*, 1939) says: "It may be that this was the shock which occurred in June or July, 1838. It would be easy after a lapse of forty years for Mr. Brown to make a mistake of a year in the date, or the reporter may have done it. There is also some evidence on the point. Holden gives the Bancroft manuscript as one of the sources of information for this shock of 1839, yet in Bancroft's *History of California* 4: 78, where the

¹⁸ M. W. Allen, "Some Remarks Concerning Pacific Coast Earthquakes," *Bull. Seism. Soc. Am.*, 15:128-139 (1925).

earthquakes occurring in the interval 1836 to 1840 are described, no mention is made of any shock in 1839." Unfortunately for this latter argument, Bancroft did mention it in a later volume (*California*, VII: 685). He evidently had not consulted that late newspaper article in connection with the preparation of his earlier volume in which he made mention of the earthquakes of 1836 to 1840 (publ. 1886), but later supplied Holden with the reference and used it himself (publ. 1890).¹⁹

An earthquake of the violence inferred from Brown's description must have been severe, at least in the region from San Francisco to Monterey, the same area which suffered a severe shock in June, 1838. On theoretical grounds one would be disinclined to accept such a sequence unless the dates and the circumstances were established beyond a reasonable doubt.

It seemed desirable, therefore, to look up items of Brown's personal history or other statements he had made, in the hope of confirming or correcting his 1839 date. If it could be shown that he was not in the locality in 1838 or in 1839, the doubt about the year could be resolved. A number of statements have been published about Brown; he made a signed "Statement of Recollections of Early Events in California" for Bancroft, November 16, 1878; he also testified as a witness in many hearings of land-grant cases²⁰—so the outlook seemed promising. However, in all the testimony I have been able to find (nineteen cases), and in his statement to Bancroft, he never once mentioned any earthquake, nor did anyone writing about him mention his earthquake, except for an occasional reference to his newspaper account above quoted.

One very noticeable thing about Brown's career is that it is interspersed with confused dates, whether Brown himself gives them or whether they are made by persons writing about him. His descriptions of things, persons, and events appear to be reasonably reliable, but some of his dates are subject to doubt, and some can be shown to be incorrect, and he at different times assigns different dates to the same event.

The first questioned date is that of his arrival in California. Bancroft believed it was 1833. In his "Pioneer Register" he says, "In later years Brown always claimed to have come in '29; but the archive evidence is conclusive against the statement, both himself and his comrade deserters testifying in early years and in different doc. that they came in '33, to say nothing of the fact that the *Helvetius* does not appear in the lists of '29."

Brown says, in his written statement to Bancroft, "Besides in 1837 I mar-

¹⁹ Bancroft's statements in the later volume are so inconsistent with those in the earlier volume, and with the facts, as to be almost ridiculous. He speaks of the 1868 earthquake as "the most serious ever felt in San Francisco," and in a footnote says, "The earliest recorded earthquake here was a severe shock in 1839, as described by C. Brown, in S. F. Call, Dec. 21, 1877 [1879]." As said before, Bancroft's references are invaluable, but his statements are sometimes misleading.

²⁰ I am indebted to Dr. J. N. Bowman for supplying references to the cases in which Brown testified.

ried a daughter of Antonio Garcia of San José." But the records of Mission San Rafael show that he was married June 5, 1838.

Moore and de Pue's San Mateo County history (1878)²¹ states (p. 4): "Few arrivals in the county, or in California even, date earlier than that of Charles Brown, a native of New York, who came with Captain Brewster on the whale ship *Alvins*,²² in the year 1829. Ten years later he found his way to the redwoods near Woodside, where he settled the Mountain Home Ranch, and became the pioneer lumberman of San Mateo County. . . ." This would presumably make Brown settle there in 1839. The book gives no references or sources for its statements.

Alley's history of the same county (1883)²³ says (p. 120): "The next pioneer in the order of arrival was Charles Brown . . . In 1828 he sailed out of New York harbor on the whaling ship *Alvins*, Captain Brewster, and arrived in San Francisco bay in the spring of 1829. . . .²⁴ Harry Bee says that Brown was living at the Pueblo [San Jose] in 1833, and that two years thereafter—in 1835—he removed and settled near Copinger . . . Soon after 1835, Brown married Francesca Garcia . . . He put up on his ranch an adobe house near the present site of Searsville."

Townley (*Catalog*, 1939) directed attention to the fact that "Brown's adobe cabin still stands on the place now (1937) belonging to the John A. Hooper Co. . . . The date A.D. 1835 is on the front door." The Hoopers some years ago rehabilitated the old adobe and made it into a very attractive house. A fine polished redwood front door was installed, and the date 1835 inscribed. In reply to an inquiry, Mr. A. W. Hooper kindly sent me a typed excerpt from the *History of San Mateo County* (1878), with a correction of the years to conform with Alley's history (1883). He said that his father purchased this property in 1883 and "apparently felt certain that 1835 was the construction date." His father probably accepted, quite naturally, the date given in the county history. In the light of other evidence, however, it seems certain that, if the adobe was built in 1835, Brown did not build it, because he was busily engaged elsewhere in 1835, 1836, and the first part of 1837.

According to Brown's "Statement" (1878), he was in San Rafael with Padre Quijas in 1834, doing all the light work of the mission, and in charge of the boat. Early in 1835 he went to Sonoma with the colony of Híjar and Padréz. The history of this colony is well known and the time given is correct. But he stayed there only a few days because General Figueroa, then *gefe político*, called him aside and advised him to have nothing to do with the colonists, and "he

²¹ Moore and de Pue's *Illustrated History of San Mateo County, California, 1878*, San Francisco, G. T. Brown & Co., 1878.

²² Brown said in his Bancroft "Statement" that he came on the American ship "Helvevius," one of Stephen Girard's fleet.

²³ *History of San Mateo County, California*, San Francisco, B. F. Alley, Publisher, 1883.

²⁴ This is apparently taken from Moore and de Pue's history. No source is given.

would grant me a farm, which he did, and furnished me the stock and material to go on for the year, from the mission of San Francisco Solano." The farm was near Napa. He lived there scarcely a year when he sold out to Dr. Stokes because the place was too near Vallejo's, and if any of Vallejo's animals got on Brown's land he would send soldiers and have them carried away—too much military sway for Brown's taste. The active responsibility of a new ranch near Napa in 1835 is hardly consistent with Brown's living in the San Mateo redwoods and building an adobe residence there. Besides, about the fall of 1835 he joined a force of armed Californians, Mexicans, foreigners, and Indians under Vallejo on a three weeks' expedition against a hostile Indian tribe, in the course of which he was badly wounded.

After selling his ranch, he arranged with George Yount to manufacture shingles to shingle Vallejo's house in Sonoma. He must have been at this work for some time, since he was paid by the month. He also engaged in an otter-hunting expedition in skin boats in the vicinity of Suisun and elsewhere in the upper Bay region. Later on, he went into the shingle business on his own, and found it more profitable than working for Yount.

He was living at the landing of Sonoma in 1836 when Alvarado came to consult with his uncle Vallejo to upset Gutiérrez. In his "Statement" Brown makes no further mention of any events that occurred in the 1830's except that he was married in 1837, which, as shown above, is one year off the actual record of 1838.

In the Vallejo collection in the Bancroft Library (Vallejo Documentos, IV: 238) is a document in which General Vallejo grants permission to Carlos Brown and two other foreigners to cut redwood logs on the former Sonoma mission land upon payment of 10 per cent. It is signed May 26, 1837. Evidently Brown was still operating in Sonoma well along in the year 1837.

The next dated item in Brown's "Statement" reads: "In 1840 I bought the ranch of John Coppinger in what is now Searsville,²⁵ placed my stock on it, and carried on the lumber business there on the ranch." If this be taken to mean that Brown first came to live at this "Searsville" ranch in 1840, it would be meaningless to question whether the earthquake phenomena he described while he was living there occurred in 1838 or in 1839. But, as we have seen, one cannot accept too hastily Brown's dates.²⁶

²⁵ In 1889, land where remnants of Searsville stood was needed for water-supply development. A reservoir was constructed and named Searsville Lake in memory of the vanished but once flourishing lumbering center. The rewooded region between the sites of the original lumber camps of Woodside and Searsville in later years became the seat of attractive suburban homes, and the whole area is now usually referred to as Woodside.

²⁶ The worst confusion of memory of a date, which can be checked by the record, was that of Brown's naturalization. In his "Statement" (1878), in reference to the land grant which he said he received from Governor Figueroa in 1835, he said, "To secure the grant I applied for and obtained my naturalization as a Mexican." But the official permit issued by Vallejo in 1837, previously cited, calls him a foreigner, or alien (*extranjero*), a term that would not have been used of a Mexican citizen, and, further, the actual record of his petition for

John Coppinger (or Copinger) presented to Governor Alvarado, July 25, 1839, a petition soliciting a grant of a tract of land known as Cañada de Raimundo. The grant was made on August 4, 1840. It was part of this rancho which Coppinger sold to Charles Brown. A petition submitted by Coppinger's heirs (widow and daughter) at the land-title hearing under the American regime, May 19, 1852 (75 N.D.)²⁷ stated that "the said John Coppinger about four years previously to obtaining said grant, finding said land wholly unoccupied and unclaimed built a house thereon . . . in which he continued to reside till the time of his death, occupying said Cañada for grazing and other purposes, exercising complete and undisputed ownership over the whole tract thereof." It also asserted that he was married in 1838, and that his widow and his only child (Manuela) had continued to live there ever since. In September, 1850, the widow Coppinger married John Greer, and they continued to live in the Coppinger adobe until 1869, when they moved to a house in Palo Alto. This adobe had been built in 1840, Coppinger having previously lived on the ranch in a wooden house. The adobe was wrecked by the earthquake of 1906 and the ruins were removed. It was situated several miles from the Brown adobe.²⁸ It is the place of Mr. Lucas Greer's father [John Greer], referred to by Townley (*Catalog*, p. 25) in his discussion of the Brown story.

James W. Weeks testified in the Cañada de Raimundo case, May 19, 1852. He said that he was thirty-eight years old, that John Coppinger first settled on the property in 1835, and that he lived with Coppinger beginning at that time, was with him in 1838 when he married the present Mrs. Greer, and continued with him until 1840, and had visited the place at short intervals since. He further said that in 1835 Coppinger built a small frame dwelling house on the Cañada de Raimundo and a corral for cattle and horses, that he had a saw pit on it which he used for making lumber on the place, and that he had a stock of horses, sheep, hogs such as are usual upon ranchos—he cultivated about ten or twelve acres in wheat, barley, Indian corn, beans, etc. All those improvements existed at the rancho at the time the grant was obtained.

This testimony is included here to show that in those days a person could occupy, develop, operate, and exercise uncontested *de facto* ownership of a large property without benefit of a deed, grant, or other legal authority. In

naturalization and the granting thereof date them May 26, 1841. As another Brown variant, it may be further noted that in a deposition made May 10, 1854 (427 N.D.), in answer to the question, "Were you a naturalized citizen of Mexico?" he replied, "I was, and I think I became so naturalized in 1838."

²⁷ N.D. is the usual reference abbreviation for cases that came, usually on appeal, before the United States court for the Northern District of California; the accompanying number is the present reference number in the archives of the court. In the record of this case the original petition for the grant as copied is signed by Juan Copinger. In the petition made by the heirs in connection with the hearing he is called John Coppinger, and his daughter, Manuela Coppinger.

²⁸ The late history of the Coppinger adobe is taken from a letter to the editor by Guy C. Miller of Palo Alto which appeared in the San Francisco *Chronicle*, January 29, 1936.

fact, the showing that one had lived on the land and had properly developed and used it, and was a respectable member of the community, was an important factor in obtaining a formal legal grant. Hence, though Coppinger could not have sold any part of the Rancho to Brown as of legal record before he received the formal grant in August, 1840, he may well have entered into a personal agreement of sale, and of permission for Brown to occupy and use as his own a part of the property. As a matter of fact, the sale was not made of record until 1846, and even this belated formality may have been forced on Brown so that a mortgage might be placed on the property to cover an endorsement of a note, as a consequence of which, he said, he lost title to the property in 1849.

It will be recalled that Brown in his "Statement" made no reference to the years 1837, 1838, or 1839. In the hope of filling the gap I have gone over his testimony in the various land cases, with the following results.

On May 10, 1854 (427 N.D.), he testified that for the last twenty years he had resided in the county of San Francisco.²⁹ "I lived about 14 years ago at my farm in the Redwoods . . . and the balance of the time at the Mission." As to his occupation during these twenty years, he said, "I sawed lumber and made shingles in the Redwoods and have been ranching and had stock." Asked where he lived in 1833-34-35-36, he said: ". . . from that time to 1835 I was in Sonoma and Nappa Valley. I was after that a few months at Pueblo of San José and from that time to the present in this County, when I returned to this County from San José I do not recall where I first lived. I was part of the time at the Mission and here and at my place in the Redwoods."

On June 14, 1854, he testified (229 N.D.) that in 1841 he lived on the Pescadero Rancho adjoining the Rincón de la Ballena. These ranchos are across the mountains and along the coast to the southwest of Brown's farm.

In a deposition made October 29, 1855 (129 N.D.), he said he had known the Rancho Rinconada del Arroyo de San Francisquito since 1838. This ranch was situated three or four miles from Brown's; it is now the site of Stanford University. He also stated: "I lived in that neighborhood about 14 years. I went there in 1839, and lived there over fourteen years."

On February 21, 1857, he testified (304 N.D.), "I lived in San Antonio about half way from the town of San Antonio to the Rimero rancho during the years 1838 and 1839." This is on the east side of San Francisco Bay, in the Oakland region. Again, on August 12, 1862, he testified that he first became acquainted with the Mission Dolores "about 1832." Asked where he had resided from that time until 1840, he replied: "Most all of that time across the Bay in San Antonio. I came back to the Mission in 1838, and lived there and in the vicinity [that would be his ranch] ever since."

²⁹ Brown's house in the Mission Dolores district and the land where his ranch in the redwoods was situated were both, up to this time, within San Francisco County. The southern part of that County was cut off and San Mateo County was established in April, 1856.

These various testimonies are in the Brown manner and further illustrate his habit of giving inconsistent and confusing dates. From all Brown's available statements together it is impossible to derive directly the date when he first went to live on his ranch in the redwoods. Furthermore, at no time during the years 1837 to 1840 has he connected his location or his actions with any contemporaneous event the date of which could be substantiated by reliable evidence.

Let us try another tack. We have convincing evidence that there was a violent earthquake in the region in June, 1838. It is certain that Brown was at his ranch in the redwoods when he observed the phenomena he described, and his wife was there too. At no other place where Brown said he had been, or where it might seem reasonably possible that he could have been, could he have witnessed the group of phenomena which he described. Such phenomena in the vicinity of the San Andreas fault are perfectly consistent with the phenomena described in Monterey, Yerba Buena, and elsewhere for the earthquake of 1838. Is it possible that Brown could have been on the ranch with his wife in late June, 1838?

Let me try to reconstruct a short period of Brown's history after he left the country north of San Francisco Bay where he had lived and worked for several years. This is a piece of rationalization, but under the circumstances it seems called for as a last resort. I shall depend on Brown's statements of the things he did, but refuse to be bogged down by his confusing and inconsistent dates.

The last definite line we had on Brown north of the Bay was the formal permit that General Vallejo issued, on May 26, 1837, to cut redwood logs on a percentage basis on the former Sonoma mission lands. We do not know how long Brown was at that work. It may have been several months. He testified (1854) that after he came back from Sonoma he spent a few months at the Pueblo of San José. The idea that he spent several months in San Jose about that time seems quite essential for his personal history, for the next year he was to marry a San Jose woman. It seems reasonable to infer his belief that his suit was successful, and that he probably had the consent of the señorita, and the approval of her family, by the end of the year 1837. For it was surely in contemplation of marriage that he took the trip to San Rafael to be baptized. The church objected to marrying a Catholic to a non-Catholic. He went to San Rafael so that the rite could be performed by his old friend and former employer, Padre Quijas. According to the Mission record, he was baptized by Padre Quijas on January 27, 1838, and given the name Carlos de Jesús. For the same reason, he had his fiancée take the long trip to San Rafael, although Mission Santa Clara was very near her home, for the marriage ceremony, which according to the mission record was performed June 5, 1838.

Is it unreasonable to believe that also in contemplation of marriage, and probably with the approval or even at the suggestion of his fiancée's family, he

arranged to acquire a place in the redwoods where he could build a home and at the same time ply his trade? or that he took his wife there following their marriage? If the answer is No, then Señor and Señora Carlos de Jesús Moreno (he was often called by the Spanish-speaking people Carlos Moreno, Moreno being Spanish for Brown), may well have been at their ranch in the redwoods when the violent earthquake of late June, 1838, occurred. That is the ideal time of the year for living and working in the redwoods.

This is as far as the story goes. It is consistent with Brown's testimony (1854) that after a few months at San Jose he returned to San Francisco County, living part of the time at the mission and part of the time at his place in the redwoods, and also his testimony in 1857 that he came back to the mission in 1838 and had lived there and in the vicinity [i.e., in the redwoods] ever since.

Brown also testified on two occasions (1854, 1855) that he lived at the ranch fourteen years. It is evident that after he took up the ranch he lived there a number of years, but not continuously. He says several times that he lived part of the time at the mission. He apparently went back and forth from time to time.

Brown was an expert lumberman and shingle maker and I surmise that from time to time he was called to different ranchos, as the need arose, for temporary employment in connection with their building operations. On that basis, at land-title hearings he could testify that he lived on a certain ranch in certain years, knew the extent of the holding, the owner, etc. This would explain (it would, indeed, be the only reasonable explanation of) the apparent inconsistencies involved in his testimony (1857) that he lived in San Antonio during the years 1838 and 1839, or (1854) that in 1841 and 1842 he lived on the Pescadero Rancho.

Conclusions.—I conclude that the earthquake described by Charles Brown did not occur in 1839, but in late June, 1838, for the following reasons:

1. The violent earthquake of late June, 1838, is well authenticated.
2. No one besides Brown has given a description, and no one has given an approximately definite date, for a violent earthquake in 1839.
3. Brown, in general, was very uncertain in his dates, at one time giving one date and at another time another date for the same event, and sometimes giving only wrong dates (e.g., the date of his marriage, and the two different dates of his naturalization—one, three, and five years off, respectively).
4. Consideration of various lines of available evidence makes it appear reasonable that Brown was at his point of observation of the earthquake in late June, 1838.
5. A violent earthquake as adequately described by him must have been strong in the localities described as suffering severe shocks in 1838.
6. The data given by him for 1839 and the three accounts of the shock of

1838 are mutually consonant and complementary and could well be local aspects of one and the same violent earthquake.

7. William Heath Davis, who wrote so fully of this period, and who reported in some detail statements of others on the 1838 earthquake, which occurred just before he arrived in the region, and elaborated the descriptions in a second edition of his book, makes no mention of an earthquake in 1839 although he was living in the area at the time. Had an earthquake as violent as the one described by Brown occurred, it does not seem reasonable that Davis would not have mentioned it, and it would have been logical for him to have asked his business associate, who informed him about the 1838 earthquake, how it compared with that one which he himself did not experience.

EARTHQUAKES IN THE "ANNALS OF SAN FRANCISCO"

Holden made an entry in his catalogue, separate from the one taken from the *Call* (Brown's earthquake), as follows:

"1839. ?; VIII. A very severe earthquake in San Francisco, Cal.—*Annals of San Francisco.*"

To this is added in square brackets, in the Townley-Allen catalogue: "It is stated in the 'Annals' that the severity of this shock was equal to those of September 1829. If this and the one listed for Redwood City actually occurred in 1839, they were, in all probability, one and the same shock."

It seems desirable to quote the original in its context.³⁰

In September 1829, several severe shocks of an earthquake were experienced in San Francisco, which forced open lock-fast doors and windows. In 1839, an equally severe earthquake took place. In 1812, however, a much more serious convulsion had been felt. . . .

It may be mentioned, when on this subject, that since these dates, no serious occurrences of this nature have happened at San Francisco, although almost every year slight shocks, and occasionally smarter ones have been felt. God help the city if any great catastrophe of this nature should ever take place. Her huge granite and brick palaces, of four, five and six stories in height, would indeed make a prodigious crash, more ruinous both to life and property than even the dreadful fires of 1849, 1850 and 1851.

This is the complete story of earthquakes in the San Francisco area from the earliest days to 1855! It is certainly a strange list. It does not include a single one of the authenticated strong earthquakes in that region. Where was the information obtained? No hint is given. If the authors had consulted the archives, they would have found, for example, an official report of the earthquakes of 1808. If they canvassed the pioneers, they should have learned of the earthquakes of 1836 and 1838, for they occurred only seventeen to nineteen years before the book was published, and we know that there were persons still living years later who could and did describe these earthquakes. As to the

³⁰ Frank Soulé, John H. Gihon, M.D., and James Nisbet, *The Annals of San Francisco*, New York, San Francisco [etc.], D. Appleton & Company, 1855.

earthquakes listed in the book, it has not yet been definitely established that there was a strong earthquake in San Francisco in 1812; no other record has been found of an earthquake in 1829, and it seems certain that no violent one occurred; if the 1839 one is that described by Brown, it was treated with a remarkable lack of description for one so severe. None of the authors was in the region when any of these reputed earthquakes occurred. Bancroft makes no reference to these statements, and naturally so, for in doubtful or controversial matters of fact, secondhand statements which give neither definite dates, nor informative descriptions, nor sources of information, are practically worthless.

I have presented this material for the sake of completeness, because it appears in the catalogues of Holden and of Townley and Allen, but I cannot see that it throws any light on the subject under discussion.

SIR GEORGE SIMPSON'S REPORT

It may be of interest here to quote from the narrative of Sir George Simpson, who visited the Carmel mission in the course of a journey around the world,³¹ although the date of the earthquake referred to is not given. He visited the mission in January, 1842.

Near the mission there is a very distinct rent in the earth, of a mile or so in length, and of thirty or forty feet in depth, the result of one of the recent earthquakes. The mission itself, in addition to the hand of the spoiler, has also had this same subterranean enemy to encounter; for the beautiful church, which, as usual, superstition had wrested from rapacity, has had one side pretty severely shattered by a recent shock. (Vol. 1, p. 370)

His visit was made three and one-half years after the shock of 1838, but that may be looked upon as "recent," and we know of no other strong earthquake in that vicinity between 1838 and the end of 1841. It will be recalled that Captain du Petit-Thouars visited this same mission on October 30, 1837, and that, although he mentioned earthquake effects, he did not mention these easily observable phenomena. If we accept them as the result of the 1838 earthquake, they would confirm the account of Major Warren for Monterey, and indicate that in the Monterey-Carmel region the earthquake of 1838 was stronger than that of 1836 and also that of 1906.

FURTHER CONSIDERATION OF THE EARTHQUAKES OF 1838 AND 1836

I have already pointed out that the various descriptions assigned to 1838 and 1839 are perfectly complementary and consonant with the idea of a single shock, the Brown account being a description of phenomena along the generating fault line, and the other accounts descriptions of phenomena in various areas of rather high intensity. The fault-trace phenomena and the descriptions of phenomena in the settlements are all, in my opinion, as explained above,

³¹ Sir George Simpson, *Narrative of a Journey round the World during the years 1841 and 1842*, London, Henry Colburn, Publisher, 1847; 2 volumes.

consistent with the idea that an earthquake occurred which originated in movements along the San Andreas fault line and that it was in the general intensity class of the earthquake of April 18, 1906. The phenomena in Monterey, as described for 1838, were definitely more intense than those in 1906. An explanation that may be advanced for this is that the rupture along the fault extended farther south along the line in 1838 than it did in 1906, and that therefore the throw on the fault was greater opposite Monterey in 1838 than it was in 1906.

This study has convinced me that the earthquake of late June, 1838, was the next preceding earthquake corresponding to the earthquake of April 18, 1906, involving a major fault break with striking fault-trace phenomena along the central (and perhaps northern) Coast Range course of the San Andreas fault. The interval between these two events is sixty-eight years. If we go back a like interval before 1838 (though admittedly such a figure can have only speculative value, as earthquakes do not occur at regular intervals), it would carry us to a time before the white settlement of northern California and the founding of the northern missions.

The major earthquakes of the 1830's, even if the number is reduced to two in conformity with the conclusions of this paper, show relationships any theoretical explanation of which does not occur to me at the present time. The earthquake of June 10, 1836, apparently was a major earthquake originating on the Haywards fault, and not inferior in intensity to the earthquake produced by the same fault on October 21, 1868. The earthquake of late June, 1838, originated on the San Andreas fault and developed at least the intensity of the earthquake of April 18, 1906, on the same fault. The two early earthquakes were only 2 years apart, the Haywards fault action preceding that on the San Andreas fault. The next comparable earthquakes on these two faults (in this region) were 38 years apart, that on the Haywards fault following the earthquake of 1836 after 32 years, and that on the San Andreas fault following the 1838 earthquake after 68 years. There has not been a comparable earthquake on these respective faults since, the interval on the Haywards fault to this year (October, 1946) being 78 years, that on the San Andreas fault, 40 years.

Reid's discussion³² of the rate of development of the strain that gave rise to the earthquake of 1906, in accordance with his theory of elastic rebound, was based on the report of Hayford and Baldwin³³ on the displacement of triangulation stations between surveys carried out at different periods. He concluded that "two thirds of the stress which caused the rupture had already accumulated 25 years ago," and that "50 years ago the elastic strain, which

³² Harry Fielding Reid, "The Mechanics of Earthquakes," in Vol. 2 of the *Report of the State Earthquake Investigation Commission* (1910).

³³ *Ibid.*, Vol. 1, pp. 114-145.

caused the rupture in 1906, had already accumulated to nearly half its final amount. It seems not improbable, therefore, that the strain was accumulating for 100 years, altho there is no satisfactory reason to suppose that it accumulated at a uniform rate." (Pp. 18 and 19.) The results of the present study lead me to believe that the accumulation of strain must have taken place within the 68-year limit between 1838 and 1906, if indeed it took that long.

SUMMARY

The information and inferences therefrom concerning central California earthquakes reported as occurring in the 1830's, according to the conclusions reached in the foregoing discussion, may be summarized as follows.

1836—April 25, 5 A.M. A "strong" shock. Monterey. This may possibly be a foreshock of the June 10 earthquake. If so, it must have been felt at points around the Bay of San Francisco, but no reports are available.

1836—June 9, about 4 P.M. Monterey. Described as strong and short by Gomez; strong, and of about a half minute's duration, by Vallejo. It is probably a foreshock of the earthquake of the next morning, but no reports are available from other localities.

1836—June 10, 7:30 A.M. X. East of San Francisco Bay. An earthquake of great intensity comparable with and possibly stronger than that of October 21, 1868. Large fissures were formed and "innumerable" aftershocks occurred, decreasing in violence, but "continuous" for a month. The account stresses the effects along the foothill belt from San Pablo to Mission San Jose, which indicates an origin in the Haywards fault. The fissures were probably, at least in part, fault-trace phenomena. Reported by Gomez in Monterey as of more violence and duration than the shock of June 9. Described by Vallejo as strong, lasting close to a minute in Monterey, causing havoc in Monterey and Santa Clara, and arousing great fear among the people. Intensity apparently at least VII at Monterey and Mission Carmel.

1838—Late in June, just after noon. X. Comparable with the earthquake of April 18, 1906. Originated in the San Andreas fault, and violent fault-trace phenomena described by Charles Brown as observed in the hills behind Palo Alto near the present Searsville Lake: a great fissure which he describes as ten to twelve feet wide and running from near San Francisco to the latitude of Santa Clara; the ground cracked in all directions; thousands of trees broken off; water thrown from creek bed; adobe walls cracked. Violent at Yerba Buena (San Francisco), walls cracked at Presidio, a sand hill bodily shifted (according to Spear); house shaken down at San Jose (town), and walls badly injured at the San Francisco, Santa Clara, and San Jose missions (Captain Paty); crockery and glassware broken, walls of adobe buildings cracked, inhabitants "frightened out of their wits" in Monterey (Major Warren). Captain Paty reported aftershocks as "frequent since" (his ship left the coast September 19,

1838). The fault rupture may have occurred throughout all or most of the line active in 1906, but north and south beyond the limits indicated by Brown 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.