

EARTHQUAKES IN NORTHERN CALIFORNIA

AND

THE REGISTRATION OF EARTHQUAKES

AT

BERKELEY—MOUNT HAMILTON—PALO ALTO
SAN FRANCISCO—FERNDALE—FRESNO

FROM

July 1, 1939 to September 30, 1939

BY

PERRY BYERLY

AND

PHILLIP M. KLEIN

BULLETIN OF THE SEISMOGRAPHIC STATIONS

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EARTHQUAKE INTENSITY SCALE

Criteria of the Modified Mercalli Scale which were used to rate the intensities of the earthquakes registered were:

Intensity

- II Felt by a few people only. Duration or direction not appreciable.
 - III Duration or direction appreciable.
 - IV Rattling of doors and windows; swinging of suspended objects.
 - V Disturbance of movable objects; plaster cracked.
 - VI Overthrow of movable objects; cracking of chimneys and other brickwork.
 - VII Fall of some chimneys; some damage to buildings.
-

Epicenters located in the following list are plotted on the accompanying map. A number and a letter are given beside each epicenter. The number is that assigned to the earthquake in the list. Only those earthquakes are given numbers for which epicenters were located. The letter represents the excellence with which the epicenter has been located, a indicating excellent, b good, c fair, d poor.

EARTHQUAKES IN NORTHERN CALIFORNIA

(All intensities given on Modified Mercalli Scale)

1939 -- PACIFIC STANDARD TIME

- July 1, 06h 34m, p.m. Recorded at Palo Alto only; not reported felt; focus about 10 miles from Palo Alto station.
- July 2, 06h 51m, a.m. Recorded at Berkeley only; not reported felt; focus about 5 miles from University campus.
- July 4, 00h 47m, a.m. Recorded at Mount Hamilton and Palo Alto; not reported felt; no doubt a foreshock of earthquake at 02h 49m a.m.
- July 4, 02h 49m, a.m. Recorded at Berkeley, Mount Hamilton, Palo Alto, San Francisco, Fresno; VI at San Benito Winery (Cienega near Hollister), (reported for July 3, 2h 50m a.m. but day probably in error); IV at Hollister, Paicines, Salinas; epicenter just west of Tres Pinos. See map, epicenter 1a. The depth of focus was about 6 miles. This was an aftershock of the earthquake of June 24.
- July 4, 10h 46m, p.m. Recorded at Berkeley, Mount Hamilton, Palo Alto, Fresno; IV at Paicines, III at Hollister; epicenter about 6 miles southwest of Paicines; depth of focus about 6 miles. See map, epicenter 2c.
- July 8, 02h 42m, p.m. Recorded at Palo Alto only; not reported felt; focus about 12 miles from Palo Alto station.
- July 8, 08h 27m, p.m. Recorded at Mount Hamilton only; not reported felt; focus about 8 miles from Lick Observatory.
- July 8, 11h 37m, p.m. Recorded at Berkeley only; not reported felt; focus about 6 miles from University campus.
- July 10, 10h 17m, a.m. Recorded at Mount Hamilton, Palo Alto, Fresno; II at Pinnacles; epicenter very near Pinnacles. See map, epicenter 3c.
- July 11, 07h 45m, p.m. (ca.) Recorded at Mineral only; IV at Cassel; epicenter about 40 miles from the Mineral station.
- July 13, 09h 49m, a.m. Recorded at Palo Alto only; not reported felt; focus about 8 miles from Palo Alto station.
- July 16, 11h 07m, a.m. Recorded at Berkeley, Mount Hamilton, San Francisco, Fresno; III at a point 6 miles east of San Jose; epicenter about 9 miles east of Lick Observatory; depth of focus about 8 miles. See map, epicenter 4b.
- July 17, 01h 25m, a.m. Recorded at Berkeley, Mount Hamilton, Palo Alto, Fresno. Intensities:
 V Watsonville

1939 -- P.S.T.

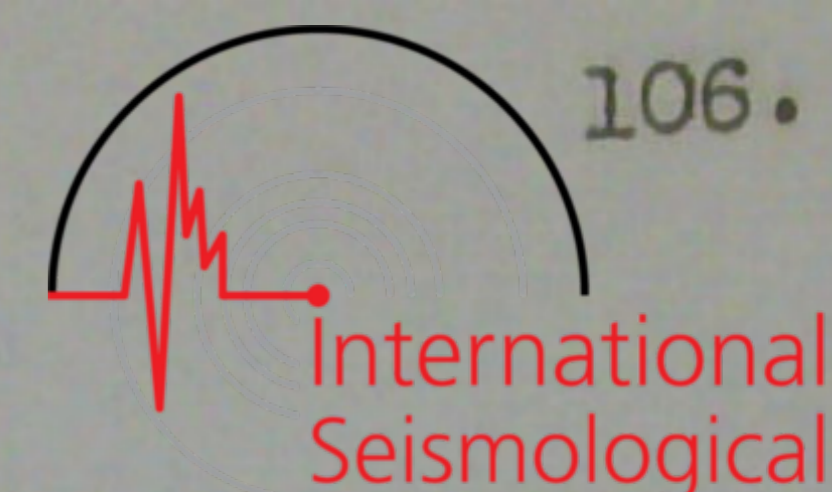
- IV Aptos, Big Basin, Blanco, Capitola, Carmel, Castroville, Felton, Gilroy, Hollister, King City, Laurel, Los Gatos, Marina, Monterey, Moss Landing, Olympia, Redwood City, San Benito Winery, San Francisco, San Jose, Seaside, Sunnyvale, Wrights.
- III Alviso, Brookdale, El Granada, Glenwood, Hollister, Holy City, Salinas, San Martin, SantaCruz, Spreckels, Tres Pinos.
- I-II Agnew, Almaden, Berkeley, Centerville, Chualar, San Simeon.

Epicenter about 4 miles southeast of Watsonville; depth of focus about 20 miles. See map, epicenter 5b.

- July 17, 01h 30m, a.m. Recorded at Berkeley, Mount Hamilton, Palo Alto, San Francisco, Fresno; felt in Gilroy, Salinas, Watsonville; aftershock of earthquake at 01h 25m, a.m.
- July 18, 05h 21m, p.m. Recorded at Berkeley, Mount Hamilton, Palo Alto, San Francisco, Fresno; III at Gilroy; epicenter about 3 miles west of Gilroy; depth of focus about 20 miles. See map, epicenter 6b.
- July 21, 08h 37m, p.m. Recorded at Ferndale only; not reported felt; epicenter about 50 miles from Ferndale.
- July 22, 05h 50m, a.m. Recorded at Berkeley, Mount Hamilton, Palo Alto; not reported felt; epicenter about 4 miles northwest of Boulder Creek. See map, epicenter 7b.
- July 27, 04h 43m, p.m. Recorded at Berkeley only; not reported felt; focus about 14 miles from University campus.
- July 28, 08h 38m, a.m. Recorded at Palo Alto only; not reported felt; focus about 12 miles from Palo Alto station.
- July 28, 08h 41m, a.m. Recorded at Palo Alto only; not reported felt; focus about 12 miles from Palo Alto station.
- July 29, 04h 32m, a.m. Recorded at Berkeley only; not reported felt; focus about 18 miles from University campus.
- July 30, 08h 33m, a.m. Recorded at Berkeley, Mount Hamilton, Palo Alto, San Francisco, Fresno; not reported felt; epicenter about 5 miles west of Hollister. See map, epicenter 8c.
- July 31, 09h 51m, p.m. Recorded at Berkeley, Mount Hamilton, Palo Alto; not reported felt; epicenter about 7 miles south of Gilroy. See map, epicenter 9d.
- August 1, 05h 59m, p.m. Recorded at Berkeley, Mount Hamilton, Palo Alto; not reported felt; epicenter about 9 miles northeast of Lick Observatory. See map, epicenter 10b.

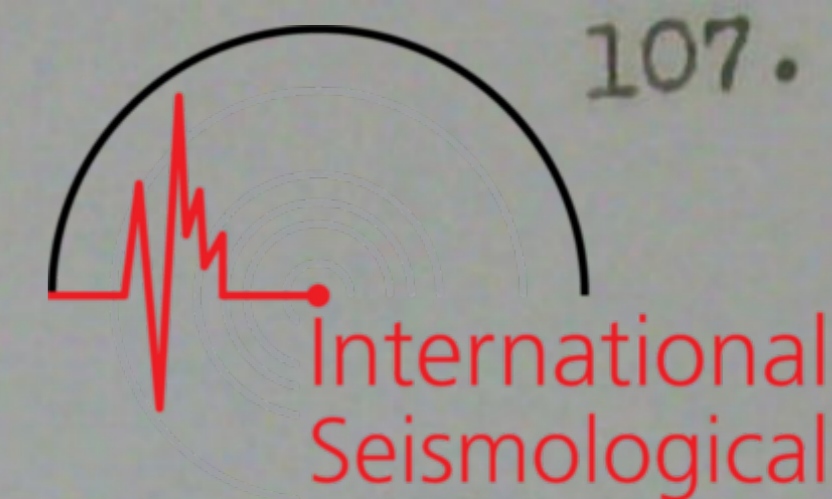
1939 -- P.S.T.

- August 7, 03h 30m, p.m. Recorded at Mineral only; not reported felt; epicenter about 20 miles from Mineral.
- August 8, 01h 53m, p.m. Recorded at Berkeley, Mount Hamilton, Palo Alto, Fresno; IV at San Benito Winery (Cienega); epicenter about 12 miles east of Spreckels. See map, epicenter 11c.
- August 12, 05h 14m, p.m. Recorded at Mount Hamilton only; not reported felt; focus about 15 miles from Lick Observatory.
- August 12, 09 21m, p.m. Recorded at Berkeley, Mount Hamilton, Palo Alto, Fresno; not reported felt; epicenter about 7 miles west of Hollister. See map, epicenter 12b.
- August 12, 11h 35m, p.m. Recorded at Mount Hamilton only; not reported felt; focus about 10 miles from Lick Observatory.
- August 13, 05h 29m, a.m. Recorded at Mineral only; not reported felt; epicenter about 17 miles from Mineral.
- August 13, 08h 57m, p.m. (ca.) Recorded at Mount Hamilton only; not reported felt; focus about 10 miles from Lick Observatory.
- August 14, 05h 44m, a.m. Recorded at Berkeley, Mount Hamilton, Palo Alto, Fresno, Mineral; felt in Grass Valley; epicenter between Tyler and North Columbia.
- August 15, 00h 57m, a.m. Recorded at Berkeley, Mount Hamilton, Palo Alto, Fresno; IV at Hollister; epicenter about 11 miles southwest of Hollister. See map, epicenter 13c.
- August 15, 00h 59m, p.m. Recorded at Berkeley, Mount Hamilton, Palo Alto, Fresno; not reported felt; an aftershock from epicenter 13c.
- August 15, 10h 21m, a.m. Recorded at Palo Alto only; not reported felt; focus about 11 miles from Palo Alto station.
- August 17, 06h 21m, a.m. Recorded at Berkeley, Mount Hamilton, Palo Alto, Fresno; not reported felt; epicenter about 3 miles west of Pinnacles. See map, epicenter 14d.
- August 19, 04h 29m, a.m. Recorded at Berkeley, Mount Hamilton, Palo Alto; not reported felt; epicenter about 2 miles southeast of Watsonville. See map, epicenter 15c.
- August 20, 05h 43m, p.m. Recorded at Berkeley, Mount Hamilton, Palo Alto, Fresno; not reported felt; epicenter 3 miles southeast of Spreckels. See map, epicenter 16c.
- August 20, 05h 54m, p.m. Recorded at Berkeley, Mount Hamilton, Palo Alto; not reported felt; an aftershock of epicenter 16.



1939 -- P.S.T.

- August 21, 05h 37m, a.m. Recorded at Berkeley and poorly at San Francisco; not reported felt; focus about 6 miles from University campus. (Blast?)
- August 21, 06h 00m, p.m. Recorded at Mount Hamilton, Palo Alto, Fresno; not reported felt; epicenter about 5 miles west of Soledad. See map, epicenter 17c.
- August 22, 10h 45m, a.m. Recorded at Berkeley only; not reported felt; focus about 6 miles from University campus. (Blast?)
- August 22, 03h 54m, p.m. Recorded at Berkeley, Mount Hamilton, Palo Alto; not reported felt; epicenter about 6 miles southeast of Watsonville. See map, epicenter 18c.
- August 22, 10h 44m, p.m. Recorded at Berkeley and very poorly at Palo Alto and Mount Hamilton; not reported felt; epicenter about 25 miles from Berkeley, northerly.
- August 24, 08h 07m, p.m. Not recorded; IV at Brokeoff Mountain Lookout (Lassen Park), III at Mineral.
- August 26, 07h 34m, p.m. Recorded at Berkeley only; not reported felt; focus about 5 miles from University campus.
- August 30, 02h 55m, p.m. Recorded at Berkeley only; not reported felt; focus about 8 miles from University campus. (Blast?)
- August 31, 07h 58m, p.m. Recorded at Berkeley and poorly at Palo Alto; not reported felt; epicenter about 40 miles from Berkeley, probably northerly.
- September 1, 08h 56m, a.m. Recorded at Berkeley, Mount Hamilton, Palo Alto; felt in San Jose; epicenter about 9 miles northwest of Lick Observatory; depth of focus about 6 miles. See map, epicenter 19b.
- September 1, 11h 18m, a.m. Recorded at Berkeley, Mount Hamilton, Palo Alto, Fresno; III at Hollister; epicenter about 11 miles southwest of Hollister. See map, epicenter 20c (same as 13c).
- September 10, 10h 14m, a.m. Recorded at Palo Alto only; not reported felt; focus about 7 miles from Palo Alto station.
- September 11, 01h 07m, p.m. Recorded at San Francisco and poorly at Berkeley; not reported felt; epicenter probably about 35 miles from University of San Francisco, no doubt northerly.
- September 14, 05h 38m, a.m. Recorded at Mineral only; not reported felt; focus about 20 miles from Mineral.
- September 17, 10h 27m, p.m. Recorded at Berkeley and poorly at Palo Alto; not reported felt; epicenter about 50 miles from Berkeley, probably northerly.



1939 -- P.S.T.

September 19, 06h 45m, p.m. Recorded at Berkeley, Mount Hamilton, Palo Alto, San Francisco, Fresno. Intensities:

IV Big Sur, Hollister, Salinas

III Castroville, Felton, Moss Landing, Pinnacles, San Jose, San Martin, Seaside.

Epicenter about 5 miles east of Salinas. See map, epicenter 21a.

September 21, 11h 35m, a.m. Recorded at Berkeley, Mount Hamilton, Palo Alto, Fresno; not reported felt; epicenter about 7 miles south of Gilroy. See map, epicenter 22c.

September 22, 02h 54m, a.m. Recorded at Berkeley, Mount Hamilton, Palo Alto, San Francisco; IV to V in San Francisco; IV in Oakland, III in Berkeley; epicenter on San Andreas Fault just off shore about 5 miles west southwest of University of San Francisco; depth of focus about 6 miles. See map, epicenter 23a.

September 22, 12h 26m, p.m. Recorded at Ferndale only; III at Bridgeville and Forest Glen; epicenter about 35 miles from Ferndale, probably between Bridgeville and Forest Glen.

September 22, 09h 37m, p.m. Recorded at Berkeley, Mount Hamilton, Palo Alto, Fresno; felt in Spreckels, III at Hollister; epicenter about 7 miles east of Spreckels; depth of focus about 20 miles. See map, epicenter 24b.

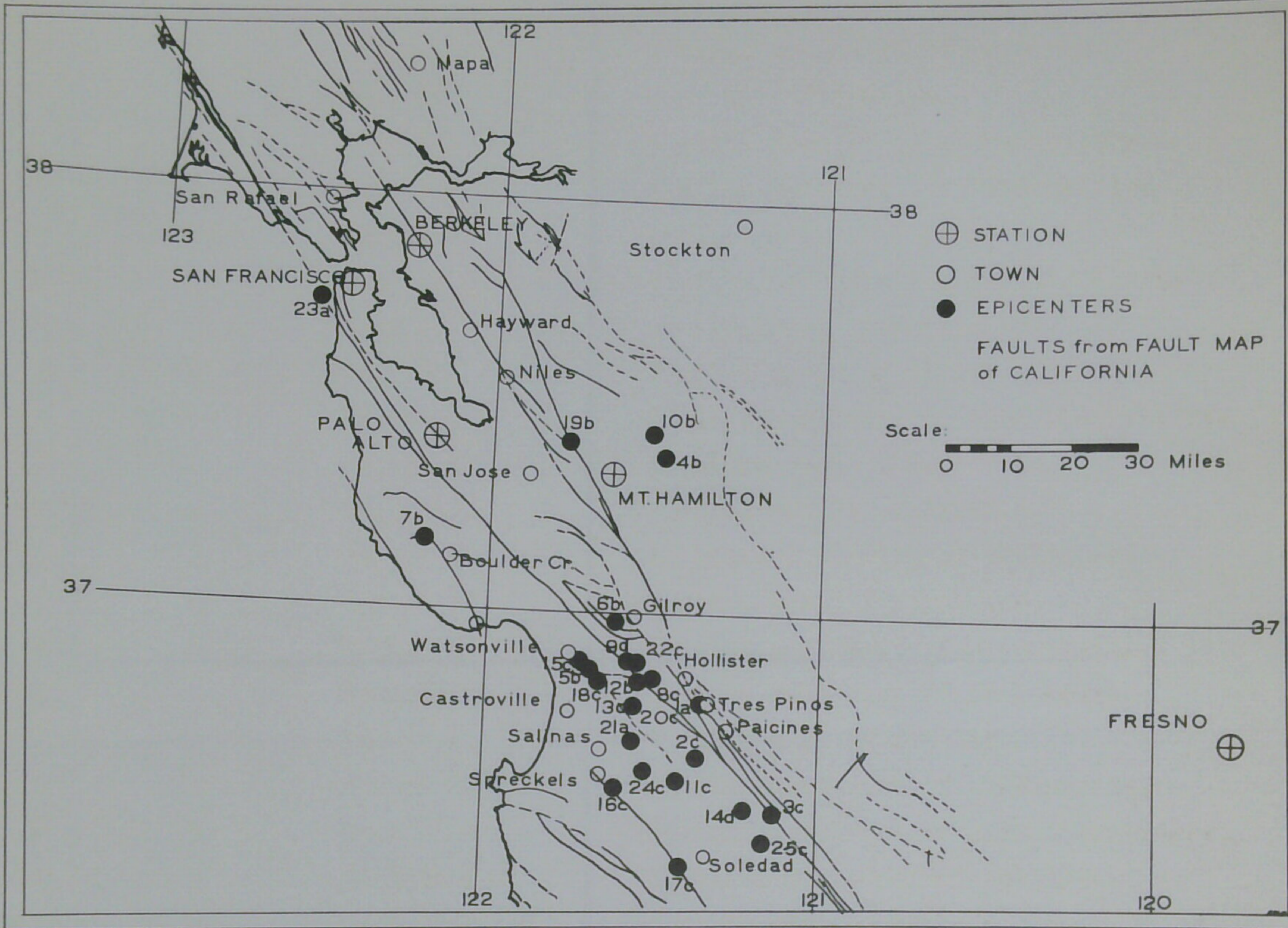
September 22, 10h 49m, p.m. Recorded at Berkeley, Mount Hamilton, Palo Alto; not reported felt; an aftershock from epicenter 24.

September 23, 02h 13m, a.m. Recorded at Berkeley, Mount Hamilton, Palo Alto; not reported felt; another aftershock from epicenter 24.

September 24, 03h 58m, a.m. Recorded at Berkeley, Mount Hamilton, Palo Alto, Fresno; not reported felt; epicenter about 6 miles south of Pinnacles. See map, epicenter 25c.

Summary of the Epicenters

No.	Rating	Date	Location
1	a	July 4	Just west of Tres Pinos.
2	c	July 4	6 miles southwest of Paicines.
3	c	July 10	Very near Pinnacles.
4	b	July 16	9 miles east of Lick Observatory.
5	b	July 17	4 miles southeast of Watsonville.
6	b	July 18	3 miles west of Gilroy.
7	b	July 22	4 miles northwest of Boulder Creek.
8	c	July 30	5 miles west of Hollister.
9	d	July 31	7 miles south of Gilroy.
10	b	August 1	9 miles northeast of Lick Observatory.
11	c	August 8	12 miles east of Spreckels.
12	b	August 12	7 miles west of Hollister.
13	c	August 15	11 miles southwest of Hollister.
14	d	August 17	3 miles west of Pinnacles.
15	c	August 19	2 miles southeast of Watsonville.
16	c	August 20	3 miles southeast of Spreckels.
17	c	August 21	5 miles west of Soledad.
18	c	August 22	6 miles southeast of Watsonville.
19	b	September 1	9 miles northwest of Lick Observatory.
20	c	September 1	11 miles southwest of Hollister.
21	a	September 19	5 miles east of Salinas.
22	c	September 21	7 miles south of Gilroy.
23	a	September 22	On San Andreas Fault just off shore about 5 miles west southwest of University of San Francisco.
24	b	September 22	7 miles east of Spreckels.
25	c	September 24	6 miles south of Pinnacles.



MAP SHOWING EPICENTERS, JULY 1, 1939 TO SEPTEMBER 30, 1939

THE REGISTRATION OF EARTHQUAKES

SYMBOLS AND NOTATIONS EMPLOYED

1. Character of the Earthquake--

	I. Perceptible.	II. Moderately Strong.	III. Strong
d (terrae motus domesticus)	Local shock (origin less than 100 kilometers distant).		
v (terrae motus vicinus)	Near shock (origin from 100 to 1,000 kilometers distant).		
r (terrae motus remotus)	Distant shock (origin from 1,000 to 5,000 kilometers distant).		
u (terrae motus ultimus)	Very distant shock or teleseism (origin more than 5,000 kilometers distant).		

2. Phases of the Seismogram--

P (undae primae)	Normal first phase, or first preliminary tremors (longitudinal).
P'	First preliminary tremors which have penetrated the core of the earth.
PR _n	Waves n times reflected at the earth's surface.
S (undae secundae)	Second phase, or second preliminary tremors (transverse).
SR _n	Waves n times reflected at the earth's surface.
PS	Waves changed from longitudinal to transverse oscillation or vice versa through reflection at the earth's surface.
PPS	Waves twice reflected at the earth's surface, having been longitudinal on two branches of the path and transverse on one branch.

In general a bar over two letters denoting types of waves indicates refraction. The subscript _c denotes the boundary at about 2900 km. depth between the core and the middle shell which surrounds it. Thus:

$\overline{S_c P_c S}$	Waves which have penetrated the core, having been transverse before entering and after leaving the core, and longitudinal within the core.
$\overline{P_c P_c} \overline{P_c P}$	Waves refracted at the core boundary into the core, reflected once at this boundary while within the core and again refracted out of the core, having remained longitudinal on all branches of the path.
L (undae longae)	Long waves of surface phase preceding M.
M (undae maximae)	Shorter and more regular waves of large amplitude in the surface phase.
M _n	Greatest motion in the surface phase.
C (coda)	Tail or end portion.
F (finis)	End of discernible movement.

For local earthquakes a special notation is used:

\overline{P}	The longitudinal wave which has traveled its whole path in the surface layer or crust of the earth.
\overline{S}	The transverse wave which has traveled its whole path in the surface layer of the earth.
P*	The longitudinal wave which has traveled the horizontal portion of its path in the intermediate layer.
S*	The corresponding transverse wave.



3. Nature of the Motion--

- i (impetus) Sudden beginning of the motion.
- e (emersio) Gradual beginning of the motion.
- T (period) Time of one complete oscillation.
- A Trace amplitude measured from the media line, + earth motion toward east, north, or zenith, - toward west, south, or nadir.
- AE E-W component of A.
- AN N-S component of A.
- AZ Vertical component of A.

4. Time--

- O (origin) Time of shock at point of origin.

BERKELEY

THE BERKELEY STATION, UNIVERSITY OF CALIFORNIA
BERKELEY, CALIFORNIA

CONSTANTS

CONSTANTS OF THE STATION

Latitude and longitude:

$$\begin{aligned} \varphi &= 37^{\circ} 52' 3 \text{ N.} \\ \lambda &= 122^{\circ} 15' 6 \text{ W.} \end{aligned}$$

Time.--All determinations are reduced to Universal Time.

Altitude.--81 meters (266 feet) above mean sea level.

CONSTANTS OF THE SEISMOGRAPHS

Apparatus	Component	V		T ₀	ε		$\frac{r}{T_0^2}$
Bosch-Omori 100 kg. ...	E	45		12	10		0.001
	N	45		12	10		0.001
Wiechert 80 kg.	Z	44		4	5		0.005
Wood-Anderson	E	3,000		0.9	15		
	N	3,000		0.9	15		
Galitzin		K	T	T ₁	μ ²	A ₁ (cm)	l (cm)
	E	112	12	11.8	0.00	100	11.3
	N	122	12	12.4	0.03	100	11.2
	Z	109	12	11.9	0.01	130	14.9
Benioff	Z	V		Coupled Period		ε	
				0.7		5	

The letter G before a reading designates that the seismogram was from the Galitzin instrument; W, Wiechert; B, Bosch-Omori; A, Wood-Anderson; H, Benioff.



BERKELEY

No.	Date	Char-acter	Phase	Time U.T.	Period	Amplitude			Remarks	
						AE	AN	AZ		
				h. m. s.	s.	mm.	mm.	mm.		
1	July 2	Id	iPz	H 14 50 40.2						See discussion, p. 103
			iSN	A 14 50 41.1						
			iSz	H 14 50 41.3						
			F	14 51						
2	July 4	Iv	iPnZ	H 10 49 33.1	0.3				+<.1	See discussion, p. 103
			iPz	H 10 49 34.8						
			ePN	A 10 49 35.0						
			iz	H 10 49 36.9						
			iN	H 10 49 52.4						
			F	10 53						
3	July 4	Iu	iPz	G 18 37 47						U.S.C. & G.S. epicenter: 23°S, 67°W. J.S.A. epicenter: 19°9 S., 67°3 W.
			ePNZ	A&H18 37 47.1						
			ePEN	G 18 37 51						
			iz	G 18 39 23						
			ez	G 18 41 51						
			eSEN	G 18 47 21						
			ez	G 18 48 49						
			eLEN	G 18 48 51						
			F	20.0						
				25						
	+3									
4	July 5	Iv	ePz	H 06 46 33.1						See discussion, p. 103
			F	06 48.0						
5	July 5	IIu	iPEZ	G 22 52 14						U.S.C. & G.S. epicenter: 24°S., 179°W. J.S.A. epicenter: 24°S., 180°W.
			iPN	A 22 52 15.7						
			iPz	H 22 52 16						
			iPR1Z	G 22 54 33						
			iN	G 22 55 30						
			eSN	A 23 01 32						
			iSEnz	G 23 01 38						
			iSR1EN	G 23 05 31						
			eSR1N	A 23 05 35						
			F	02.0						
				12						
	14 & 16									
	+12									
	-8									
	-15									
	+10									
6	July 6	Iu	ePN	A 01 17 07.3						Aftershock of #5.
			iPz	H 01 17 07.4						
			F	01 18.5						
7	July 9	Id	iPz	H 07 36 49.1						See discussion, p. 103
			iSN	A 07 36 50.3						
			iSz	H 07 36 50.4						
			F	07 37 10						



BERKELEY

No.	Date	Char-acter	Phase	Time U.T.	Period	Amplitude			Remarks
						AE mm.	AN mm.	AZ mm.	
	1939			h. m. s.	s.				
8	July 12	IIu	iPz iz eEN eN F	G 23 12 03 G 23 16 18 G 23 23 18 G 23 29.5 00.3	8			-2	New Zealand epicenter: 4°S., 140°E. Surface waves.
9	July 13	I	eEN F	G 17 38.5 18.5					Trace of distant shock.
10	July 14	Iu	ePz ePR ₁ Z eSN eN eN ez F	G 08 40 21 G 08 42 14 G 08 47 26 G 08 50 18 G 08 52 46 G 08 55 10.0					
11	July 16	I	eEN eEZ F	G 09 02 45 G 09 08.4 10.0					Trace of distant shock.
12	July 16	I	eEN eEZ F	G 13 57.4 G 14 00.4 14.8					Trace of distant shock.
13	July 16	Id	iPz iPN ePE iz iz iSN iSNZ F	H 19 06 52.5 A 19 06 52.6 A 19 06 52.9 H 19 06 59.9 H 19 07 01 A 19 07 03.9 A&H 19 07 05.4 19 08.5					See discussion, p. 103
14	July 17	IIv	iP*NZ iP*NZ iz eE eN iSNE iSNN F	A&H 09 25 12.5 G 09 25 13 H 09 25 13.9 A 09 25 14.3 A 09 25 17.0 G 09 25 28 A&G 09 25 29 09 30	4			-8	See discussion, p. 103
15	July 17	Iv	iPnz eN iN iN F	H 09 30 49.1 A 09 30 50.1 A 09 31 03.0 A 09 31 03.3 09 31.9					See discussion, p. 104

BERKELEY

No.	Date	Char-acter	Phase	Time U.T.	Period	Amplitude			Remarks
						A _E mm.	A _N mm.	A _Z mm.	
				h. m. s.	s.				
16	July 18	I	iz	H 00 24 30.2					
			e _N	A 00 24 30.6					
			F	00 24 40					
17	July 18	IIIr	iP _{EN}	G 03 29 35					U.S.C.&G.S. epicenter: 49°0 N., 130°5 W. J.S.A. epicenter: 49°2 N., 128°1 W. L. ?
			e _{PN}	A 03 29 35			- ?		
			iP _E	A 03 29 37					
			eP _Z	H 03 29 37	2			+ .1	
			e _N	A 03 31.9	23				
			F	07.0					
18	July 19	Iv	iP* _Z	H 01 21 04.9					See discussion, p. 104
			eP* _N	A 01 21 05					
			iS* _{EN}	A 01 21 19.2					
			i _N	A 01 21 20.5					
			F	01 21.9					
19	July 20	I	e _Z	G 00 12.4				Trace of distant shock.	
			F	01.0					
20	July 20	Iu	iP _Z	G 02 34 08	5			-3	J.S.A. epicenter: 22°6 S., 177°W.
			iP _Z	H 02 34 10.2	3			- .1	
			iP _N	A 02 34 10.3				- < .1	
			iP _{EN}	A 02 34 11	10 & 8	-4		-3	
			ipP _Z	G 02 36 24					
			iP _{R1Z}	G 02 37 24					
			e _N	A 02 42 23					
			iS _{EZ}	G 02 43 22	10	+12			
			iS _N	G 02 43 24	10			-10	
			F	06.0					
21	July 20	I	e _N	A 18 53 34					
			F	18 55					
22	July 22	Id	iP _Z	H 13 50 14.8				See discussion, p. 104	
			iS _N	A 13 50 24.9					
			iS _Z	H 13 50 25.2					
			F	13 50.8					
23	July 23	I	eS _{EN}	G 15 23 20				Distant. L ?	
			e _E	G 15 26 17					
			e _{EN}	G 15 29.5					
			e _Z	G 15 30.3					
			F	16.5					
24	July 29	Id	iP _Z	H 12 31 58.3				See discussion, p. 104	
			iS _{NZ}	A&H12 32 02.0					
			F	12 32.6					



BERKELEY

No.	Date	Char-acter	Phase	Time U.T.	Period	Amplitude			Remarks
						A _E mm.	A _N mm.	A _Z mm.	
				h. m. s.	s.				
25	July 30	Iv	iPnN iPnZ F	A 16 33 04.2 H 16 33 04.4 16 34.1					See discussion, p. 104
26	July 31	I	eENZ F	G 02 25.7 02 40					Trace of distant shock.
27	July 31	I	eEN F	G 07 15.2 08.0					Trace of distant shock.
28	Aug. 1	Iv	iPnZ F	H 05 51 10.7 05 52.2					See discussion, p. 104
29	Aug. 2	I	ePZ eEN ez F	G 01 07 41 G 01 42.2 G 01 47.2 02.5					Distant.
30	Aug. 2	Id	iPNZ iN iZ F	A&H01 58 46.6 A 01 58 57.5 H 01 58 57.7 01 59.7					See discussion, p. 104
31	Aug. 3	I	ePZ eSEN eLEN ez F	G 02 40 16 G 02 50 01 G 03 01 G 03 03 04.0	24				Distant.
32	Aug. 8	Iv	iPZ iPN iZ eE eSE iSN F	H 21 53 29.6 A 21 53 30.1 H 21 53 30.6 A 21 53 32 A 21 53 49 A 21 53 49.9 21 55.0					See discussion, p. 105
33	Aug. 12	IIu	ePNZ ePE ePNZ ipPZ ipPEZ iPR1Z iPR1ENZ eSEN	G 02 19 42 A 02 19 43.8 A&H02 19 45 G 02 20 25 A&H02 20 27 G 02 23 00 A&H02 23 01.8 G 02 29 45	6			-3	U.S.C.&G.S. epicenter: 13°S., 169°E. J.S.A. epicenter: 14°2 S., 168°9 E.

BERKELEY

No.	Date	Char-acter	Phase	Time U.T.	Period	Amplitude			Remarks	
						A _E	A _N	A _Z		
				h. m. s.	s.	mm.	mm.	mm.		
33	1939 Aug. 12 (cont.)	IIu	eSEN ePSN ePSE eLEN F	A 02 29 49 G 02 30 55 A 02 31 10 G 02 49.0 05.0	23					
34	Aug. 12	Iu	ePZ iSN iSE eLE F	G 10 00.5 G 10 08 22 G 10 08 35 G 10 17.0 11.0	12 25		+3		U.S.C.&G.S. epicenter: 45°N., 153°E. J.S.A. epicenter: 44°3 N., 152°5 E.	
35	Aug. 13	Iv	iPZ iz iSN F	H 05 21 13.4 H 05 21 14.4 A 05 21 30.6 05 22.0					See discussion, p. 105	
36	Aug. 14	Iv	iPnz iz iSN iSE F	H 13 44 15.4 H 13 44 29.9 A 13 44 46.3 A 13 44 47.1 13 46.0					See discussion, p. 105	
37	Aug. 15	Iv	ePnz iSnNZ F	H 08 57 45.3 A&H 08 58 03.4 08 58.9					See discussion, p. 105	
38	Aug. 15	Iv	iPZ iz iN F	H 08 59 00.8 H 08 59 19.0 A 08 59 19.5 09 00.0					See discussion, p. 105	
39	Aug. 16	Ir	iPZ iPEN iPEN iPZ eEN eLEN F	G 17 14 24 G 17 14 26 A 17 14 27 H 17 14 28 G 17 25.3 G 17 28.5 18.5	6 8 24	-3	+2	U.S.C.&G.S. epicenter: 13°N., 91°W. J.S.A. epicenter: 10°N., 93°W.		
40	Aug. 17	Iv	eSN F	A 14 21 36.5 14 22.3					See discussion, p. 105	
41	Aug. 18	IIu	iP'Z eSEN eEN eLEN eMN F	G 22 28 43 G 22 39 06 G 22 51.8 G 22 54.8 23 03 01.0	6 43 27		+3	U.S.C.&G.S. epicenter: 18°S., 168°E. J.S.A. epicenter: 18°0 S., 167°9 E.		



BERKELEY

No.	Date	Char-acter	Phase	Time U.T.	Period	Amplitude			Remarks
						A _E mm.	A _N mm.	A _Z mm.	
1939									
				h. m. s.	s.				
42	Aug. 19	I	ePE eEN eLEN F	G 01 00.0 G 01 29.8 G 01 34 02.5	40 24				Distant shock.
43	Aug. 20	I	iEZ F	A&HO7 23 53.1 07 25.7					Deep Focus.
44	Aug. 20	Iv	iPZ eSN F	H 12 29 44.0 A 12 30 58.8 12 30.4					See discussion, p. 105
45	Aug. 21	Iv	ePnz F	H 01 43 35.4 01 44.2					See discussion, p. 106
46	Aug. 21	Iv	iz F	H 01 54 50.6 01 55.6					See discussion, p. 106
47	Aug. 21	Id	iPZ iSN F	H 13 37 19.2 A 13 37 20.5 13 37.7					See discussion, p. 106
48	Aug. 21	I	ePZ eSE eLE	G 15 27 10 G 15 33 45 G 15 39.7	30				Distant. F lost in record change.
49	Aug. 22	Id	iPZ ePN iSZ F	H 18 44 38.0 A 18 44 38.1 H 18 44 38.9 18 45					See discussion, p. 106
50	Aug. 22	Iv	ePZ ePN iSN F	H 23 53 59.6 A 23 54 00.0 A 23 54 15.8 23 55.2					See discussion, p. 106
51	Aug. 23	I	eEN eEN F	G 04 57 39 G 05 07.7 05.5					
52	Aug. 23	Id	iPZ iSN iSZ F	H 06 44 08.1 A 06 44 13.1 H 06 44 13.6 06 44.8					See discussion, p. 106
53	Aug. 23	Iv	eN F	A 11 54 31.7 11 56					IV at Keeler.



BERKELEY

No.	Date	Char-acter	Phase	Time U.T.	Period	Amplitude			Remarks	
						A _E	A _N	A _Z		
				h. m. s.	s.	mm.	mm.	mm.		
54	Aug. 25	I	eN	G 04 11 15	30				Distant.	
			eE	G 04 11 31						
			eN	G 04 17 45						
			eN	G 04 24 43						
			eEZ	G 04 28.8						
			eLE	G 04 29.1						
		F	06.0							
55	Aug. 26	I	eE	G 08 28 02					Distant.	
			eEN	G 08 29 02						
			F	09.5						
56	Aug. 27	Id	iP _Z	H 03 34 03.7					See discussion, p. 106	
			iS _N	A 03 34 04.6						
			F	03 34.5						
57	Aug. 27	I	iPENZ	G 11 30 08	4			+3	Deep Focus.	
			iPNZ	A&H 11 30 08.2	1					
			F	11 45						
58	Aug. 27	I	eN	G 22 28.5	28				Trace of distant shock.	
			eLEN	G 22 29.5						
			F	23.0						
59	Aug. 28	I	eENZ	G 16 46.5					Trace of distant shock.	
			F	17.5						
60	Aug. 28	I	eNZ	A&H 19 31 26						
			eN	A 19 31 47.5						
			F	19 32.5						
61	Aug. 29	I	eENZ	G 08 49.0					Distant.	
			F	09.5						
62	Aug. 30	Id	iP _{NZ}	A&H 22 54 39.3					See discussion, p. 106	
			iS _Z	H 22 54 40.9						
			iN	A 22 54 41.3						
			F	22 55						
63	Sept. 1	Id	iPNZ	A&H 03 58 34.2					See discussion, p. 106	
			iZ	H 03 58 43.0						
			iN	A 03 58 43.2						
			F	03 59 06						
64	Sept. 1	Iv	iP _Z	H 16 56 35.5					See discussion, p. 106	
			iS _N	A 16 56 44.0						
			iZ	H 16 56 46.2						
			F	16 57.5						

BERKELEY

No.	Date	Char-acter	Phase	Time U.T.	Period	Amplitude			Remarks	
						A _E mm.	A _N mm.	A _Z mm.		
				h. m. s.	s.					
65	Sept. 1	Iv	iP _N	A 19 17 53.7					See discussion, p. 106	
			iP _Z	H 19 17 53.8						
			iz	H 19 18 09.0						
			F	19 18.5						
66	Sept. 2	IIu	eP _Z	G 09 11 11					New Zealand epicenter: 13°S., 167°E.	
			eEN	G 09 21.5						
			eN	G 09 32.7						
			eLE	G 09 36.4						30
			eLN	G 09 37.2						28
			F	11.0						
67	Sept. 8	IIIr	iP _Z	G 12 13 02	6				+4 U.S.C.&G.S. epicenter: 51°N., 175°E. J.S.A. epicenter: 53:7 N., 175:8 E.	
			eP _Z	H 12 13 02.7						
			eP _{EN}	G 12 13 05						
			iP _{NZ}	A&H 12 13 08						
			eS _N	A 12 19 33						
			eN	A 12 24 08						
			eLN	A 12 25 58						27
			F	15.0						
68	Sept. 11	I	eP _Z	G 08 00 26					Distant.	
			eS _N	G 08 08 46						
			eE	G 08 09						
			e _E F	G 08 12.2						
			F	09.0						
69	Sept. 11	Id	iP _Z	H 21 06 04.2					See discussion, p. 106	
			iN	A 21 06 47						
			iz	H 21 06 47.7						
			F	21 07.2						
70	Sept. 12	Iu	eP _Z	G 12 18 30	6				+2 Felt in Kermadec Isl. Δ = 85°	
			eEN	G 12 29.3						
			eZ	G 12 30.3						
			eEN	G 12 45.3						
			F	G 13.5						
71	Sept. 15	I	eN	G 12 09 39					Distant.	
			eENZ	G 12 18.3						
			F	13.0						
72	Sept. 16	I	iN	A 03 55 06						
			F	03 55.5						

BERKELEY

No.	Date	Char-acter	Phase	Time U.T.	Period	Amplitude			Remarks	
						AE	AN	AZ		
						mm.	mm.	mm.		
						h. m. s.	s.			
73	1939 Sept.16	I	eENZ F	G 22 11.1 23.8						
74	Sept.18	Id	iPZ iNZ F	H 06 26 42.5 A&H06 26 52.9 06 27.7					See discussion, p. 106	
75	Sept.20	IIv	iP̄NZ ePE iPNZ eN iE iSN F	A&H02 45 45.9 A 02 45 46 G 02 45 46 G 02 45 47.1 G 02 46 05 A 02 46 07.1 02 50	0.3		-.1	-.1	See discussion, p. 107	
76	Sept.20	I	eENZ F	G 08 21.1 09.0					Distant.	
77	Sept.21	I	eENZ F	G 13 15.1 14.0					Distant.	
78	Sept.21	Iv	ePnN iPZ iN F	A 19 35 49.0 H 19 35 49.7 A 19 35 50.0 19 37.0					See discussion, p. 107	
79	Sept.21	Ir	eENZ eEN eENZ eN eE ez F	G 21 30.0 A 21 30 16 G 21 32 14 A 21 32 26 A 21 33 14 G 21 33 44 22.2					U.S.C.&G.S. epicenter: 30°N., 114°W. J.S.A. epicenter: 30°N., 114°W.	
80	Sept.22	Iu	eENZ ez F	G 01 29.0 G 01 34.0 02.0	30(EN)				Damage in Smyrna, Turkey.	
81	Sept.22	IIId	iP̄N iP̄Z iSN iMN iE F	A 10 54 41.2 H 10 54 41.4 A 10 54 44.7 A 10 54 45.7 A 10 54 58 10 56.0					See discussion, p. 107	

BERKELEY

No.	Date	Char-acter	Phase	Time U.T.	Period	Amplitude			Remarks
						A _E	A _N	A _Z	
				h. m. s.	s.	mm.	mm.	mm.	
82	Sept.23	Iv	iPZ	H 05 37 05.4					See discussion, p. 107
			ePN	A 05 37 06					
			iP*Z	H 05 37 09.2					
			eS*N	A 05 37 26					
			F	05 38.4					
83	Sept.23	Iv	iPZ	H 06 49 08					See discussion, p. 107
			eN	A 06 49 08.7					
			iz	H 06 49 10.7					
			iSN	A 06 49 28					
			F	06 51.0					
84	Sept.23	Iv	iz	H 10 13 23					See discussion, p. 107
			eN	A 10 13 24					
			F	10 14					
85	Sept.24	Iv	eNZ	A&H11 58 07					See discussion, p. 107
			F	11 59.0					
86	Sept.26	I	eZ	H 10 43 15					
			F	10 44.0					

MOUNT HAMILTON

THE LICK OBSERVATORY STATION, UNIVERSITY OF CALIFORNIA
MOUNT HAMILTON, CALIFORNIA

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Latitude and longitude:

$$\begin{aligned} \varphi &= 37^{\circ} 20' 4'' \text{ N.} \\ \lambda &= 121^{\circ} 38' 6'' \text{ W.} \end{aligned}$$

Time--All determinations are reduced to Universal Time.

Altitude.--1281.7 meters (4205 feet) above mean sea level.

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Apparatus	Component	V	T ₀	ε
Wood-Anderson	E	3000	1	15
	N	3000	1	15

MOUNT HAMILTON

No.	Date	Char-acter	Phase	Time U.T.	Period	Amplitude			Remarks
						AE	AN	AZ	
	1939			h. m. s.	s.	mm.	mm.	mm.	
1	July 4	Id	iPN iE iSEN F	08 47 01.5 08 47 02.5 08 47 09.7 08 47.5					See discussion, p. 103
2	July 4	Id	iPE iPN iN iSN iSE F	10 49 22.6 10 49 22.8 10 49 27.3 10 49 31.4 10 49 31.6 10 52.5					See discussion, p. 103
3	July 4	Iu	ePN iE F	18 37 45.2 18 37 46.2 18 41.5					U.S.C. & G.S. epicenter: 23°S., 67°W. J.S.A. epicenter: 19°9 S., 67°3 W.
4	July 5	Id	ePE iE iSE iE F	06 46 19.8 06 46 20.8 06 46 30.1 06 46 32.8 06 47.7					See discussion, p. 103 N-S component failed July 5.
5	July 5	Iu	iPE iSE eSR1E F	22 52 17 23 01 40 23 05 39 23 10					U.S.C. & G.S. epicenter: 24°S., 179°W. J.S.A. epicenter: 24°S., 180°W.
6	July 9	Id	iPE ePN iSEN F	04 26 50.1 04 26 50.5 04 26 51.8 04 27.2					See discussion, p. 103
7	July 10	Iv	ePEN iSE iN F	18 17 31.0 18 17 43.9 18 17 45.1 18 19.0					See discussion, p. 103
8	July 14	Iu	ePE eN F	08 40 27 08 40 31 08 46					Distant. $\Delta = 50^\circ?$
9	July 16	Id	iPEN F	19 06 40.2 19 08.2					See discussion, p. 103
10	July 17	IIId	iP*E iP*N iN F	09 25 03.4 09 25 03.6 09 25 09.3 09 29.8					See discussion, p. 103

MOUNT HAMILTON

No.	Date	Char-acter	Phase	Time U.T.	Period	Amplitude			Remarks		
						A _E	A _N	A _Z			
						mm.	mm.	mm.			
						h. m. s.	s.				
11	July 17	Id	eP*N	09 30 38.7						See discussion, p. 104	
			iP*E	09 30 38.8							
			iS*N	09 30 45.3							
			iMN	09 30 45.9							
			F	09 31.8							
12	July 18	IIr	ePE	03 29 46	22				U.S.C.& G.S. epicenter: 49°N., 130°5 W. J.S.A. epicenter: 49°2 N., 128°1 W.		
			ePN	03 29 47							
			eSEN	03 32 16							
			eLE	03 33 37							
			eN	03 33 56							
			F	05.0							
13	July 19	Id	iP*EN	01 20 53.6	.3		-.1		See discussion, p. 104		
			iN	01 20 55.4							
			iE	01 20 58.6							
			iS*E	01 20 59.2							
			iS*N	01 20 59.6							
			F	01 22.3							
14	July 20	Iu	ePEN	02 34 12					J.S.A. epicenter: 22°6 S., 177°W.		
			eSN	02 43 25							
			eSE	02 43 26							
			F	02 48							
15	July 20	I	eN	18 53 22							
			iN	18 53 24.1							
			F	18 54							
16	July 22	Id	ePEN	13 50 09.6	0.2		-1.5		See discussion, p. 104		
			iSE	13 50 16.6							
			iSN	13 50 16.7							
			F	13 51.0							
17	July 30	Id		Ca 16 33					See discussion, p. 104 SN-PN = 8 ^s SE-PE = 7 ^s 2		
18	Aug. 1	Id		Ca 05 51					See discussion, p. 104 $\bar{S} - \bar{P} = 8^s$		
19	Aug. 2	Id		Ca 01 59					See discussion, p. 104 $\bar{S} - \bar{P} = 1^s8$		
20	Aug. 8	Id		Ca 21 53					See discussion, p. 105 $\bar{S} - \bar{P} = 10^s3$		

MOUNT HAMILTON

No.	Date	Char-acter	Phase	Time U.T.	Period	Amplitude			Remarks
						A _E	A _N	A _Z	
1939						mm.	mm.	mm.	
				h. m. s.	s.				
21	Aug. 13	Id		Ca 01 14					See discussion, p. 105 $\bar{S} - \bar{P} = 3^s$
22	Aug. 13	Id		Ca 05 21					See discussion, p. 105 $S - P = 7^s6^s$
23	Aug. 13	Id		Ca 07 35					See discussion, p. 105 $\bar{S} - \bar{P} = 1^s9$
24	Aug. 14	Id		Ca 04 57					See discussion, p. 105 $\bar{S} - \bar{P} = 2^s1$
25	Aug. 14	Iv		Ca 13 44					See discussion, p. 105 $S - P = 30^s$
26	Aug. 15	Id		Ca 08 57					See discussion, p. 105 $S - P = 8^s0$
27	Aug. 15	Id		Ca 08 59					See discussion, p. 105 $S - P = 8^s0$
28	Aug. 16	Ir	e \bar{P} EN eE F	17 14 22 17 31 17 40					U.S.C. & G.S. epicenter: 13° N., 91° W. J.S.A. epicenter: 10° N., 93° W.
29	Aug. 17	Id	e \bar{P} EN iEN F	14 21 05.8 14 21 15.5 14 22.5					See discussion, p. 105
30	Aug. 19	Id		10 30					See discussion, p. 105 $\bar{S} - \bar{P} = 6^s5$
31	Aug. 20	I	ePN ePE F	07 24 01.5 07 24 02 07 25.5					Deep Focus.
32	Aug. 21	Id	e \bar{P} EN e \bar{S} N e \bar{S} E F	01 43 24.8 01 43 35.4 01 43 36.0 01 44.5					See discussion, p. 106
33	Aug. 21	Iv	e \bar{P} N e \bar{P} E e \bar{S} N e \bar{S} E F	01 54 35.1 01 54 35.3 01 54 46.1 01 54 46.6 01 55.5					See discussion, p. 106



MOUNT HAMILTON

No.	Date	Char-acter	Phase	Time U.T.	Period	Amplitude			Remarks
						A _E	A _N	A _Z	
1939						mm.	mm.	mm.	
				h. m. s.	s.				
34	Aug. 22	Iv	e \bar{P} N	02 00 33					See discussion, p. 106
			i \bar{S} EN	02 00 46.8					
			F	02 01.5					
35	Aug. 22	Id	i \bar{P} E	23 52 47.9	0.4	+1			See discussion, p. 106
			e \bar{P} N	23 52 48.1					
			i \bar{S} N	23 52 55.2					
			i \bar{S} E	23 52 56.1					
			F	23 55.0					
36	Aug. 23	Iv	eE	06 44 22.6					See discussion, p. 106
			F	06 45.0					
37	Aug. 23	Iv	eN	11 53 40					IV at Keeler.
			eE	11 53 54.1					
			eEN	11 54 17					
			iN	11 54 19					
			F	11 55.5					
38	Aug. 27	I	i \bar{P} E	11 30 09.3					Deep Focus.
			e \bar{P} N	11 30 09.5					
			F	11 34					
39	Sept. 1	Id		Ca 16 56					See discussion, p. 106 $\bar{S} - \bar{P} = 2\text{S}5$
40	Sept. 1	Id		Ca 19 18					See discussion, p. 106 $\bar{S} - \bar{P} = 8\text{S}0$
41	Sept. 8	IIr	e \bar{P} N	12 13 13					U.S.C. & G.S. epicenter: 51°N., 175°E. J.S.A. epicenter: 53°7 N., 175°8 E.
			e \bar{P} E	12 13 15.1					
			e \bar{S} EN	12 20 01					
			e \bar{S} R ₁ N	12 23 07					
			eN	12 24 20					
			eLN	12 25 40					
F	14.5								
42	Sept. 16	I	e \bar{P} N	03 54 35					E-W component failed.
			eN	03 54 56					
			F	03 56					
43	Sept. 17	I	eN	11 02 19.5					
			iN	11 03 09					
			F	11 04					

MOUNT HAMILTON

No.	Date	Char-acter	Phase	Time U.T.	Period	Amplitude			Remarks
						A _E mm.	A _N mm.	A _Z mm.	
				h. m. s.	s.				
44	Sept.20	IIId	i \bar{P} N	02 45 35.5					See discussion, p. 107 E-W component failed.
			i _N	02 45 37.8					
			i _S N	02 45 44					
			F	02 49.0					
45	Sept.21	Iv	e _N	09 18 40					Pasadena says Esmeralda County, Nev. E-W component failed.
			e _N	09 19 18					
			i _S N	09 19 24					
			F	09 20.2					
46	Sept.21	Id	i \bar{P} N	19 35 37.5					See discussion, p. 107
			i _N	19 35 41.2					
			i _S N	19 35 44.0					
			F	19 37.0					
47	Sept.21	Ir	e _N	21 30 16	25				U.S.C.& G.S. epicenter: 30°N., 114°W. J.S.A. epicenter: 30°N., 114°W.
			eL?N	21 33 22					
			F	21 49					
48	Sept.22	Id	e \bar{P} N	10 54 51.7					See discussion, p. 107
			i _N	10 55 02.7					
			i _S N	10 55 03.2					
			F	10 56.1					
49	Sept.23	Id	i _P N	05 36 57.3					See discussion, p. 107
			i _S N	05 37 05.5					
			F	05 38.6					
50	Sept.23	Id	i _P N	06 48 58.6					See discussion, p. 107
			i _S N	06 49 07.8					
			F	06 51					
51	Sept.23	Id	i _P N	10 13 09.6					See discussion, p. 107
			i _S N	10 13 18.6					
			F	10 14.3					
52	Sept.24	Iv	i \bar{P} N	11 57 55.5					See discussion, p. 107
			i \bar{S} N	11 58 09.2					
			F	12 00					

PALO ALTO

THE BRANNER STATION, STANFORD UNIVERSITY
 PALO ALTO, CALIFORNIA

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Latitude and longitude:

$$\begin{aligned} \varphi &= 37^{\circ} 25'.1 \text{ N.} \\ \lambda &= 122^{\circ} 10'.8 \text{ W.} \end{aligned}$$

Time.--All determinations are reduced to Universal Time.

Altitude.-- 83 meters (272 feet) above mean sea level.

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Apparatus	Component	V	T ₀	ε
Wood-Anderson	E	3000	1	15
	N	3000	1	15

PALO ALTO

No.	Date	Char-acter	Phase	Time U.T.	Period	Amplitude			Remarks
						AE mm.	AN mm.	AZ mm.	
	1939			h. m. s.	s.				
1	July 2	Id	i \bar{P} E i \bar{P} N i \bar{S} N i \bar{S} E F	00 34 16.2 00 34 16.3 00 34 18.3 00 34 18.4 00 35.0					See discussion, p. 103
2	July 4	Iv	ePE eN eSE i \bar{S} N F	05 47 07 05 47 09.4 05 47 19.2 05 47 20.7 05 48.0					See discussion, p. 103
3	July 4	IIv	e \bar{P} N i \bar{P} E i \bar{N} i \bar{S} E i \bar{S} N i \bar{M} E F	10 49 27.6 10 49 28.1 10 49 28.8 10 49 38.3 10 49 38.8 10 49 42.5 10 55					See discussion, p. 103
4	July 4	Iu	eE eN F	18 37 46.6 18 37 46.9 18 44					U.S.C.& G.S. epicenter: 23°S., 67°W. J.S.A. epicenter: 19°9 S., 67°3 W.
5	July 5	Iv	e \bar{P} N i \bar{P} E i \bar{S} EN i \bar{N} i \bar{E} F	06 46 24.3 06 46 24.7 06 46 38.8 06 46 40.1 06 46 40.3 06 49					See discussion, p. 103
6	July 5	Iu	e \bar{P} EN e \bar{S} N e \bar{S} E e \bar{S} R ₁ E e \bar{S} R ₁ N F	22 52 16 23 01 36 23 01 38 23 05 33 23 05 36 23 08					U.S.C.& G.S. epicenter: 24°S., 179°W. J.S.A. epicenter: 24°S., 180°W.
7	July 8	Id	e \bar{P} N i \bar{P} E i \bar{E} i \bar{S} EN \bar{M} E F	22 42 32.3 22 42 32.5 22 42 34.1 22 42 34.8 22 42 35.6 22 43.0					See discussion, p. 103

PALO ALTO

No.	Date	Char-acter	Phase	Time U.T.	Period	Amplitude			Remarks
						A _E	A _N	A _Z	
				h. m. s.	s.	mm.	mm.	mm.	
8	July 10	Iv	ePN	18 17 35					See discussion, p. 103
			iPE	18 17 35.8					
			eN	18 17 54.1					
			iE	18 17 58.2					
			F	18 18.7					
9	July 13	Id	i \bar{P} EN	17 49 13.5					See discussion, p. 103
			i \bar{S} EN	17 49 15.2					
			F	17 50					
10	July 16	Id	i \bar{P} E	19 06 47.4					See discussion, p. 103
			i \bar{P} N	19 06 47.6					
			iN	19 06 53.1					
			i \bar{E}	19 06 53.6					
			i \bar{S} N	19 06 55.9					
			i \bar{E}	19 07 05.5					
			i \bar{N}	19 07 07.7					
F	19 08.8								
11	July 17	IIId	iP*E	09 25 07.4					See discussion, p. 103
			eP*N	09 25 07.4					
			iN	09 25 10.3					
			iS*EN	09 25 18					
			F	09 30					
12	July 17	Id	eP*E	09 30 43.6					See discussion, p. 104
			iS*E	09 30 52.7					
			iS*N	09 30 54.2					
			F	09 31.8					
13	July 18	IIr	ePN	03 29 47	27				U.S.C.& G.S. epicenter: 49°0 N., 130°5 W. J.S.A. epicenter: 49°2 N., 128°1 W.
			ePE	03 29 50					
			eSEN	03 32 11					
			eLEN	03 33 08					
			iME	03 34 12					
			F	05.1					
14	July 19	Id	eP*N	01 20 58.7					See discussion, p. 104
			iPE	01 20 58.9					
			iS*EN	01 20 07.7					
			F	01 22.0					
15	July 20	Iu	iPEN	02 34 09.8					J.S.A. epicenter: 22°6 S., 177°W.
			eSEN	02 43 22					
			F	02 48					
16	July 22	Id	e \bar{P} EN	13 50 06.0					See discussion, p. 104
			i \bar{S} N	13 50 09.4					
			i \bar{S} E	13 50 09.6					
			F	13 51.2					

PALO ALTO

No.	Date	Char-acter	Phase	Time U.T.	Period	Amplitude			Remarks
						A _E	A _N	A _Z	
				h. m. s.	s.	mm.	mm.	mm.	
17	July 28	Id	i \bar{P} E	00 42 33.0		+.1			See discussion, p. 104
			iN	00 42 34					
			i \bar{S} N	00 42 35.8					
			F	00 43.7					
18	July 28	Id	e \bar{P} EN	16 38 22.9					See discussion, p. 104
			i \bar{E} N	16 38 25.0					
			i \bar{S} E	16 38 25.4					
			F	16 38 50					
19	July 28	Id	e \bar{P} EN	16 40 34.9					See discussion, p. 104
			i \bar{S} EN	16 40 37.4					
			iE	16 40 38.9					
			F	16 41 00					
20	July 30	Id	i \bar{P} E	16 32 56.7					See discussion, p. 104
			e \bar{P} N	16 32 57					
			i \bar{S} E	16 33 08.0					
			i \bar{S} N	16 33 08.3					
			iE	16 33 09.7					
			iN	16 33 11.0					
			F	16 34.0					
21	Aug. 1	Id	e \bar{P} EN	05 51 03.7					See discussion, p. 104
			iE	05 51 11.9					
			i \bar{S} N	05 51 13.9					
			iE	05 51 17.9					
			F	05 52.0					
22	Aug. 2	Id	e \bar{P} N	01 58 41					See discussion, p. 104
			i \bar{P} E	01 58 41.3					
			i \bar{E} N	01 58 47.2					
			i \bar{S} N	01 58 49.0					
			iE	01 58 50.0					
			F	02 00.0					
23	Aug. 8	Iv	e \bar{P} N	21 53 20.8					See discussion, p. 105
			iP*EN	21 53 22.2					
			i \bar{S} EN	21 53 35.2					
			iS*N	21 53 38.3					
			F	21 55.0					
24	Aug. 12	Iu	ePE	02 19 34.4					U.S.C. & G.S. epicenter: 13°S., 169°E. J.S.A. epicenter: 14:2 S., 168:9 E.
			ePN	02 19 35					
			i \bar{S} N	02 29 38					
			i \bar{S} E	02 29 41					
			F	02 34					

PALO ALTO

No.	Date	Char-acter	Phase	Time U.T.	Period	Amplitude			Remarks
						A _E mm.	A _N mm.	A _Z mm.	
				h. m. s.	s.				
25	Aug. 13	Id	e \bar{P} EN	05 21 05.4					See discussion, p. 105
			i \bar{S} E	05 21 16.6					
			i \bar{N}	05 21 20.2					
			F	05 22.0					
26	Aug. 14	Iv	e \bar{P} N	13 44 26.5					See discussion, p. 105
			i \bar{S} N	13 44 56					
			i \bar{S} E	13 44 56.3					
			i \bar{E}	13 45 01.0					
			F	13 45.5					
27	Aug. 15	Id	e \bar{P} EN	08 57 37.5					See discussion, p. 105
			i \bar{S} EN	08 57 49.0					
			i \bar{E}	08 57 50.0					
			i \bar{N}	08 57 51.7					
			F	08 58.5					
28	Aug. 15	Id	e \bar{P} EN	08 57 53.8					See discussion, p. 105
			i \bar{S} E	08 58 05.0					
			i \bar{N}	08 58 07.0					
			i \bar{E}	08 58 08.5					
			F	08 59.5					
29	Aug. 15	Id	i \bar{P} EN	18 20 36.3					See discussion, p. 105
			i \bar{N}	18 20 37.5					
			i \bar{E}	18 20 37.7					
			i \bar{S} N	18 20 38.5					
			i \bar{S} E	18 20 39.0					
			F	18 21.0					
30	Aug. 17	Iv	i \bar{P} EN	14 21 10.7					See discussion, p. 105
			i \bar{S} E	14 21 26.5					
			i \bar{S} N	14 21 27.5					
			F	14 22.5					
31	Aug. 19	Id	e \bar{P} N	12 29 36.5					See discussion, p. 105
			e \bar{P} E	12 29 36.8					
			i \bar{S} N	12 29 45.7					
			e \bar{S} E	12 29 46					
			i \bar{E}	12 29 47.0					
			i \bar{E}	12 29 49.3					
			F	12 30.5					
32	Aug. 20	I	e \bar{E} N	07 23 58.0					Deep Focus.
			F	07 24					



PALO ALTO

No.	Date	Char-acter	Phase	Time U.T.	Period	Amplitude			Remarks
						A _E mm.	A _N mm.	A _Z mm.	
	1939			h. m. s.	s.				
33	Aug. 21	Iv	ePN ePE iE F	01 43 29.0 01 43 29.6 01 43 47 01 45.0					See discussion, p. 106
34	Aug. 21	Iv	ePEN eSN iEN F	01 54 40.0 01 54 55.5 01 55 00 01 57					See discussion, p. 106
35	Aug. 21	I	ePE ePN F	15 27 21 15 27 23 15 31.0					Distant.
36	Aug. 22	Iv	ePnN iNE iN F	02 00 39.6 02 00 59.6 02 00 59.9 02 01.5					See discussion, p. 106
37	Aug. 22	Id	ePN iPE iN iE F	23 53 51.5 23 53 52.2 23 54 03.5 23 54 04.5 23 55.5					See discussion, p. 106
38	Aug. 23	Id	eEN F	06 44 22.0 06 45.0					See discussion, p. 106
39	Aug. 23	Iv	eEN eE F	11 54 26 11 54 34 11 56					IV at Keeler.
40	Aug. 27	I	ePE ePN F	11 30 06.5 11 30 07.0 11 32					Deep Focus.
41	Aug. 28	I	iEN iEN F	19 31 41 19 32 03 19 33.0					
42	Sept. 1	Iv	eN iN F	03 58 54 03 58 58.5 04 00					See discussion, p. 106
43	Sept. 1	Id	ePEN iSEN iN F	16 56 29.4 16 56 34.0 16 56 46.0 16 58.0					See discussion, p. 106

PALO ALTO

No.	Date	Char-acter	Phase	Time U.T.	Period	Amplitude			Remarks
						A _E mm.	A _N mm.	A _Z mm.	
	1939			h. m. s.	s.				
44	Sept. 1	Id	e \bar{P} E e \bar{P} N i \bar{S} N i \bar{S} E iN iE F	19 17 46.0 19 17 46 19 17 57.3 19 17 58.0 19 18 01 19 18 01.6 19 18.7				See discussion, p. 106	
45	Sept. 8	IIr	ePE ePN eSEN eN eLEN F	12 13 07 12 13 08 12 19 32 12 24 27 12 25.8 14.0	25			U.S.C. & G.S. epicenter: 51°N., 175°E. J.S.A. epicenter: 53°7 N., 175°8 E.	
46	Sept. 10	Id	iPN iPE iSN iE iE F	18 13 16.9 18 13 17.6 18 13 18.4 18 13 19.1 18 13 20.8 18 13 50				See discussion, p. 106	
47	Sept. 16	I	eE iE iN F	03 54 37 03 55 08 03 55 10 03 56.0					
48	Sept. 17	I	eE eEN F	11 01 00.2 11 01 30.2 11 03					
49	Sept. 18	Iv	iPN ePE iE F	06 27 02 06 27 03 06 27 06.1 06 27.5				See discussion, p. 106	
50	Sept. 20	IIId	i \bar{P} N i \bar{P} E i \bar{S} E F					See discussion, p. 107	
51	Sept. 21	Id	i \bar{P} E i \bar{P} N i \bar{S} E i \bar{S} N F	19 35 43.9 19 35 44.2 19 35 54.5 19 35 55.4 19 37.0				See discussion, p. 107	

PALO ALTO

No.	Date	Char-acter	Phase	Time U.T.	Period	Amplitude			Remarks
						A _E	A _N	A _Z	
				h. m. s.	s.	mm.	mm.	mm.	
	1939								
52	Sept.21	Ir	ePE ePN eE eSN F	21 29 59 21 30 02 21 33 10 21 34 35 21 59					U.S.C.& G.S. epicenter: 30°N., 114°W. J.S.A. epicenter: 30°N., 114°W.
53	Sept.22	Id	i \bar{P} EN iEN iSEN F	10 54 45.9 10 54 51.3 10 54 53.3 10 56					See discussion, p. 107
54	Sept.23	Iv	ePN ePE iSE iSN iS*N iS*E F	05 37 00.3 05 37 00.4 05 37 12.0 05 37 12.9 05 37 15.5 05 37 16.0					See discussion, p. 107
55	Sept.23	Iv	ePEN iSE F	05 53 06 05 53 20 05 54.4					Probably an aftershock of previous earthquake.
56	Sept.23	Iv	ePN eSN iSN iS*N F	06 49 02.6 06 49 15.0 06 49 16.0 06 49 18.0 06 50.5					See discussion, p. 107
57	Sept.23	Iv	ePN iSN iN F	10 13 13.7 10 13 23.8 10 13 29.6 10 14.4					See discussion, p. 107
58	Sept.24	Iv	ePEN iSN iSE F	11 57 59.6 11 58 15 11 58 16 11 59.0					See discussion, p. 107

SAN FRANCISCO

 THE SAN FRANCISCO STATION, UNIVERSITY OF SAN FRANCISCO
 SAN FRANCISCO, CALIFORNIA

CONSTANTS

CONSTANTS OF THE STATION

Latitude and longitude:

$$\varphi = 37^{\circ} 46'.4 \text{ N.}$$

$$\lambda = 122^{\circ} 27'.2 \text{ W.}$$

Time.--All determinations are reduced to Universal Time.

Altitude.-- 100 meters (328 feet) above mean sea level.

CONSTANTS OF THE SEISMOGRAPHS

Apparatus	Component	V	T ₀	ε
Wood-Anderson	E 15°S	1500	1	15
	N	3000	1	15

SAN FRANCISCO

No.	Date	Char-acter	Phase	Time U.T.	Period	Amplitude			Remarks
						A _E	A _N	A _Z	
	1939			h. m. s.	s.	mm.	mm.	mm.	
1	July 4	Iv	iPN ePE iSN iE F	10 49 34.0 10 49 34.7 10 50 50.7 10 50 51.7 10 52					See discussion, p. 103
2	July 4	Iu	iN eE F	18 38 00.8 18 38 20 18 42					U.S.C.& G.S. epicenter: 23°S., 67°W. J.S.A. epicenter: 19°9 S., 67°3 W.
3	July 5	Iu	ePN eSN eN F	22 52 16.2 23 02 36 23 05 22 23 10					U.S.C. & G.S. epicenter: 24°S., 179°W. J.S.A. epicenter: 24°S., 180°W.
4	July 16	Id	eEN	19 07					See discussion, p. 103 S - P = 11 ^s
5	July 18	IIr	eEN	03 30					U.S.C.& G.S. epicenter: 49°0 N., 130°5 W. J.S.A. epicenter: 49°2 N., 128°1 W.
6	July 19	Iv	eP*N iS*EN F	01 21 05 01 21 19 01 22.0					See discussion, p. 104
7	July 30	Iv	eN	16 33					See discussion, p. 104 $\bar{S} - \bar{P} = 16^s$
8	Aug. 21	Id	iN	13 37	0.4		+2		
9	Aug. 28	I	eN eE F	08 32 04 08 32 09 08 33					Distant.
10	Sept. 8	IIr	ePN ePE iSN iSE eN eLN F	12 13 04 12 13 05 12 20 23 12 20 25 12 24 38 12 26 15 14.0					U.S.C.& G.S. epicenter: 51°N., 175°E. J.S.A. epicenter: 53°7 N., 175°8 E.

SAN FRANCISCO

No.	Date	Char-acter	Phase	Time U.T.	Period	Amplitude			Remarks
						A _E mm.	A _N mm.	A _Z mm.	
				h. m. s.	s.				
11	Sept.11	Id	i \bar{P} N	21 06 38.0					See discussion, p. 106 E-W record failed. S - P = 4.5 ^s
			i \bar{N}	21 06 40					
			i \bar{S} N	21 06 42.6					
			F	21 07					
12	Sept.21	Id	ePE	21 32 31					N-S component failed.
			iE	21 32 45					
			iE	21 32 47					
			F	21 34					
13	Sept.21	Ir	eE	21 29 06				U.S.C.& G.S. epicenter: 30°N., 114°W. J.S.A. epicenter: 30°N., 114°W.	
			F	21 36					
14	Sept.22	Id	ePE	10 55				$\bar{S} - \bar{P} = 1.5^s$ N-S component failed.	
			i \bar{S} E	10 55					

FERNDALE

 THE FERNDALE STATION
 FERNDALE, CALIFORNIA

CONSTANTS

CONSTANTS OF THE STATION

Latitude and longitude:

$$\varphi = 40^{\circ} 34' \text{ N.}$$

$$\lambda = 124^{\circ} 16' \text{ W.}$$

Time.--All determinations are reduced to Universal Time.

Altitude.-- 17 meters (55 feet) above mean sea level.

CONSTANTS OF THE SEISMOGRAPHS

Apparatus	Component	V	T ₀	ϵ
Bosch-Omori 25 kg.	E	12	11	5
	N	12	8	5

The station is operated by Mr. Joseph Bognuda, of Ferndale, in cooperation with the University of California.

FERNDALE

No.	Date	Char-acter	Phase	Time U.T.	Period	Amplitude			Remarks
						A _E mm.	A _N mm.	A _Z mm.	
				h. m. s.	s.				
1	July 5	Iu	eSEN	23 01 40					U.S.C.& G.S. epicenter: 24°S., 179°W. J.S.A. epicenter: 24°S., 180°W.
			eEN	23 05 40					
			F	23 20					
2	July 20	Iu	eEN	02 43 20					J.S.A. epicenter: 22°6 S., 177°W.
			F	02 55					
3	July 22	Id	iPE	04 37 09					See discussion, p. 104
			iPN	04 37 10					
			eSE	04 37 19					
4	Aug. 18	Iu	eEN	22 55.0					U.S.C.& G.S. epicenter: 18°S., 168°E. J.S.A. epicenter: 18°0 S., 167°9 E.
			F	23 20					
5	Aug. 27	I	eEN	22 27 44					Trace of distant shock.
			F	22 39					
6	Sept. 8	IIr	ePE	12 12 40					U.S.C.& G.S. epicenter: 51°N., 175°E. J.S.A. epicenter: 53°7 N., 175°8 E.
			eN	12 13 08					
			iE	12 13 10					
			eSEN	12 19 12					
			eN	12 22 40					
			F	14.0					
7	Sept. 21	Ir	eEN	21 34.0					U.S.C.& G.S. epicenter: 30°N., 114°W. J.S.A. epicenter: 30°N., 114°W.
			F	21 55					
8	Sept. 22	Id	ePE	20 26 21					See discussion, p. 107
			iSE	20 26 28					
			iSN	20 26 29					
			F	20 28					

FRESNO

THE FRESNO STATION, FRESNO STATE COLLEGE
FRESNO, CALIFORNIA

CONSTANTS

CONSTANTS OF THE STATION

Latitude and longitude:

$$\begin{aligned} \varphi &= 36^\circ 46'1 \text{ N.} \\ \lambda &= 119^\circ 47'8 \text{ W.} \end{aligned}$$

Time.--All determinations are reduced to Universal Time.

Altitude.-- 88.4 meters (290 feet) above mean sea level.

CONSTANTS OF THE SEISMOGRAPHS

Apparatus	Component	V	T ₀	ε
Wood-Anderson	N	3000	0.9	15

FRESNO

No.	Date	Char-acter	Phase	Time U.T.	Period	Amplitude			Remarks
						AE	AN	AZ	
				h. m. s.	s.	mm.	mm.	mm.	
1	July 4	Iv	ePnN	10 49 37.2					See discussion, p. 103
			iN	10 49 40.0					
			iN	10 49 53.1					
			iSnN	10 49 55.4					
			F	10 54.2					
2	July 4	Iu	ePN	18 37 34.8					U.S.C.& G.S. epicenter: 23°S., 67°W. J.S.A. epicenter: 19°9 S., 67°3 W.
			eN	18 49.2					
			F	18 55					
3	July 5	Iv	eN	06 46 34					See discussion, p. 103
			eSN	06 46 43.7					
			F	06 49					
4	July 5	Iu	iPN	22 52 21					U.S.C.& G.S. epicenter: 24°S., 179°W. J.S.A. epicenter: 24°S., 180°W.
			eSN	23 01 47					
			eN	23 03.9					
			F	23 12					
5	July 10	Iv	iSN	18 17 49.0					See discussion, p. 103
			F	18 20					
6	July 14	I	eN	08 40 43					
			F	08 43					
7	July 16	Iv	eN	19 07 24.7					See discussion, p. 103
			iSN	19 07 25.4					
			iN	19 07 34.5					
			F	19 08.8					
8	July 17	IIv	eP*N	09 25 22.0					See discussion, p. 103
			iSnN	09 25 37.6					
			iS*N	09 25 41.1					
			F	09 32					
9	July 17	Iv	eS*N	09 31 17.3					See discussion, p. 104
			F	09 31.8					
10	July 19	Iv	eN	17 21 25					See discussion, p. 104
			iS*N	17 21 32.1					
			F	17 22.3					
11	July 20	Iu	iPN	02 34 15.8	2				J.S.A. epicenter: 22°6 S., 177°W.
			ePR1N	02 36 59	4				
			eSN	02 43 33					
			F	02 50					

FRESNO

No.	Date	Char-acter	Phase	Time U.T.	Period	Amplitude			Remarks		
						AE	AN	AZ			
						mm.	mm.	mm.			
						h. m. s.	s.				
12	1939 July 20	I	eN F	18 52 26 18 54.1							
13	July 30	Iv	eN F	16 33 25 16 34						See discussion, p. 104	
14	Aug. 8	Iv	eP _N iS _N iN F	21 53 28 21 53 44.3 21 53 49 21 58.5						See discussion, p. 105	
15	Aug. 11	Iv	eP _N iS _N iN F	17 22 10.5 17 22 36 17 22 39.5 17 23						North end of Death Valley according to Pasadena.	
16	Aug. 12	Iu	eP _N iPR _{1N} eS _N eSR _{1N} F	02 19 50 02 23 07 02 30 08 02 31 30 02 40						U.S.C.& G.S. epicenter: 13°S., 169°E. J.S.A. epicenter: 14°2 S., 168°9 E.	
17	Aug. 14	Iv	eS _N iS* _N F	13 44 58 13 45 09.9 13 47						See discussion, p. 105	
18	Aug. 15	Iv	iS _N	08 58 06.2						See discussion, p. 105 ? F time.	
19	Aug. 15	Iv	iS _N F	08 59 21.9 08 59.5						See discussion, p. 105	
20	Aug. 15	Iv	eP _N iN iS _N F	15 48 57 15 49 04.6 15 49 19.8 15 51						Argus Mountains accord- ing to Pasadena.	
21	Aug. 16	Ir	eN F	17 14 08.1 17 16						U.S.C.& G.S. epicenter: 13°N., 91°W. J.S.A. epicenter: 10°N., 93°W.	
22	Aug. 17	Iv	iS _N F	14 21 28.8 14 22.4						See discussion, p. 105	

FRESNO

No.	Date	Char-acter	Phase	Time U.T.	Period	Amplitude			Remarks
						A _E mm.	A _N mm.	A _Z mm.	
	1939			h. m. s.	s.				
23	Aug. 21	Iv	e \bar{P} N eN iN F	01 43 40 01 43 45 01 43 51 01 44.9					See discussion, p. 106
24	Aug. 22	Iv	i \bar{P} N F	02 00 41.0 02 03					See discussion, p. 106
25	Aug. 23	IIv	ePN iSN F	11 53 08 11 53 29 11 55.0					IV at Keeler.
26	Aug. 27	I	ePN F	11 30 14 11 34					Deep Focus.
27	Aug. 28	I	eN F	16 45 34 16 55					
28	Aug. 28	I	eN F	19 32 43 19 34					
29	Sept. 1	Iv	iSnN F	19 18 14.6 19 19.0					See discussion, p. 106
30	Sept. 8	Ir	iPN iPR ₁ N eSN eN eLN F	12 13 25 12 15 14 12 20 22 12 26 19 12 27.6 13.5	24				U.S.C. & G.S. epicenter: 51°N., 175°E. J.S.A. epicenter: 53°7 N., 175°8 E.
31	Sept. 20	IIv	ePN eN eN i \bar{P} N eSN F	02 45 49 02 45 50 02 45 51 02 45 51.6 02 46 07 02 50					See discussion, p. 107
32	Sept. 20	Iv	ePN iN F	11 15 53 11 16 30 11 18					Nevada according to Pasadena.
33	Sept. 21	Iv	ePN eSN iSN F	09 17 17 09 17 38 09 17 39 09 19.8					Nevada according to Pasadena.

FRESNO

No.	Date	Char-acter	Phase	Time U.T.	Period	Amplitude			Remarks
						A _E	A _N	A _Z	
1939						mm.	mm.	mm.	
				h. m. s.	s.				
34	Sept.21	Iv	e \bar{S} _N F	19 36 16.5 19 36.5					See discussion, p. 107
35	Sept.21	Ir	eP _N i _N F	21 30.0 21 32 27 21 49					U.S.C.& G.S. epicenter: 30°N., 114°W; J.S.A. epicenter: 30°N., 114°W.
36	Sept.23	Iv	eS* _N F	05 37 27.3 05 38.5					See discussion, p. 107
37	Sept.23	I	i _N F	06 49 29 06 52					
38	Sept.24	Iv	iS _N F	11 58 14.0 11 58.5					See discussion, p. 107