THE REGISTRATION OF EARTHQUAKES AT THE BERKELEY STATION

AND

AT THE LICK OBSERVATORY STATION

FROM

October 1, 1922, to March 31, 1923

BY

JAMES B. MACELWANE
AND
WILLIAM L. APPLEFORD

BULLETIN OF THE SEISMOGRAPHIC STATIONS, VOL. 2, NO. 5

UNIVERSITY OF CALIFORNIA PRESS
BERKELEY, CALIFORNIA
1925

UNIVERSITY OF CALIFORNIA PUBLICATIONS
BULLETIN OF THE SEISMOGRAPHIC STATIONS
Vol. 2, No. 5, pp. 67–90. July 30, 1925

THE UNIVERSITY OF CALIFORNIA PRESS
BERKELEY, CALIFORNIA

THE CAMBRIDGE UNIVERSITY PRESS
LONDON, ENGLAND

THE REGISTRATION OF EARTHQUAKES AT THE BERKELEY STATION

AND

AT THE LICK OBSERVATORY STATION

FROM

OCTOBER 1, 1922, TO MARCH 31, 1923

BY

JAMES B. MACELWANE
AND
WILLIAM L. APPLEFORD

CONTENTS

Symbols and Notations

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.
$\bar{P}$	Individual, or upper first preliminary tremors.
PR_n	Waves n-times reflected at the earth's surface.
S (undae secundae)	Normal second phase, or second preliminary tremors.
$\bar{S}$	Individual, or upper second preliminary tremors.
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.
L (undae longae)	Long waves at the beginning of the surface phase.
M (undae maximae)	Shorter and more regular waves of large amplitude in the surface phase.
M_n	Greatest motion in the surface phase, usually in the group defined as M.
C (coda)	Tail or end portion.
F (finis)	End of discernible movement.

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	Amplitude of the earth motion, measured from the median line in microns (μ=1/1000 mm.), + toward the north, east, or zenith, − toward the south, west, or nadir.
A_E	E-W component of A.
A_N	N-S component of A.
A_Z	Vertical component of A.

4. *Time—*

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

THE BERKELEY STATION

CONSTANTS

Latitude and longitude of the center of the seismographic room:

φ=37° 52′ 15″.9 N. Lat.
λ=122° 15′ 36″.6 W. from Greenwich.

Time. All determinations are reduced to Greenwich mean civil time.

Altitude, 85.4 meters (280 feet) above mean sea level.

Constants of the Seismographs

Date	Apparatus	Component	V	T	ϵ
Oct. 5	Bosch-Omori 100 Kg.	E	46		
		N	52		
	Wiechert 80 Kg. V.	Z	42		
Nov. 3	Bosch-Omori	E	44	14.1	3.3
		N	47	12.7	6.3
	Wiechert	Z	43	5.5	6.7
Dec. 14	Bosch-Omori	E	47	14	3.4
		N	48	12.7	4.6
		changed			5.2
	Wiechert	Z	41	5.5	6.4
Jan. 18	Bosch-Omori	E	43	14	7.7
		N	44	12.5	
	Wiechert	Z	44	5.5	
Feb. 9	Bosch-Omori	E	44	14	7.9
		N	48	12.4	
	Wiechert	Z	43	5.4	
Mar. 21	Bosch-Omori	E	45	13.9	8.2
		N	55	12.2	5.5
	Wiechert	Z	43	5.4	5.2

Our thanks are hereby tendered to Dr. Perry Byerly, Jr., for the measurement of the Lick Observatory records for the months October-December and a part of the Berkeley records for January; and to Mr. Kyle J. Lutz for the measurement of the seismograms of the Berkeley station for the months October-December.

BERKELEY STATION

No.	Date	Character	Phase	Time G. M. C. T.	Period	Amplitude AE	Amplitude AN	Amplitude AV	Remarks
	1922			h. m. s.	s.	μ	μ	μ	
1	Oct. 6	Iv	ez	5 34 27					
			F	5 37					
2	Oct. 7	Id	ePE_{NZ}	19 08 06					Δ = 77 km. = 48 miles.
			iSE_{N}	19 08 16					Local quake, well defined on all components.
			iS_{Z}	19 08 17					
			L_{E}	19 08 22					
			L_{Z}	19 08 28					
			M_{E}	19 08 25	2	3			
			F	19 15					
3	Oct. 11	Iu	iP_{Z}	15 01 04					In Southern Peru. S-P=9-17; Δ=73.7°
			S_{E}	15 10 21					
			S_{N}	15 10 22					
			F	15 53					
4	Oct. 15	Ir	e_{E}	0 41 56					Trace of main phase of a distant earthquake registered on E only.
			F_{E}	1 02					
5	Oct. 24	Iu	ePE_{N}	21 31 13					S-P=8m 12s
			iP_{Z}	21 31 12					L-S=10m 56s
			eSE_{NZ}	21 39 25					Δ=6670 km.=4150 miles.
			eL_{E}	21 50 21	11				In Kuriles.
			eL_{N}	21 50 21	8				
			M_{E}	21 56 53	11	6			
			M_{N}	21 56 53		9			
			F	22 38					
6	Oct. 27	Iv	eP_{Z}	10 57 16					S-P=47 sec.
			ePE_{N}	10 57 18					Δ=3.8° approx.
			eS_{E}	10 58 03					Lick gives Δ=3.5°
			eS_{Z}	10 58 04					
			F	11 09					
7	Nov. 4	IIv	ePE_{NZ}	3 20 15					S-P=24s Δ=173 km.
			eSE_{NZ}	3 20 39					
			iL_{E}	3 21 19	5.7				Eureka, Calif., reports shock of intensity (R. F.) 2, at 7:18 Local or 3:18 Gr.
			eL_{N}	3 21 11					
			iL_{Z}	3 21 19	4.3	3			
			M_{E}	3 22 29	12	19			
			M_{N}	3 21 29	12		22		
			iL_{N1}	3 21 58	6.6				
			M_{N1}	3 22 23	10		25		
			iL_{N2}	3 23 27	6.6				
			M_{N2}	3 24 02	7		36		
			F	3 45					
8	Nov. 7	Iu	eP_{N}	23 12 45					Δ=81.9°
			iP_{E}	23 13 05					Epicenter: coast of Chile.
			iSR_{1EN}	23 29					
			iSR_{2E}	23 32 18					
			iL_{N}	23 40 48					
			F	0 46					

BERKELEY STATION

No.	Date	Character	Phase	Time G. M. C. T.	Period	Amplitude AE	Amplitude AN	Amplitude AV	Remarks
	1922			h. m. s.	s.	μ	μ	μ	
9	Nov. 11	IIIu	eP_{N}	4 44 54					Epicenter: coast of Chile.
			eP_{E}	4 44 57					
			eP_{Z}	4 45 12					
			iP_{Z}	4 45 20					
			iS_{NE}	4 59 09	N 18 E 15	+ 25	+ 66		
			S_{E}	4 55 21					
			$?PS_{N}$	4 55 47					
			PS_{E}	4 56 25					
			$?PS_{N}$	4 56 31					
			$?SR_{1N}$	5 00 34					
			SR_{1E}	5 00 39	30	+ 350			
			$?SR_{1N}$	5 00 56					
			SR_{2E}	5 04 21	24				
			SR_{2N}	5 04 23	29				
			eL_{E}	5 06 42	60				
			L_{N}	5 07 12	40		+ 900		
			iM_{N}	5 11 42	30		+ 470		
			iM_{E}	5 12 12	31	− 780			
			iM_{Z}	5 12 24	26			+1350	
			M_{N2}	5 17 06					
			$?Q_{EZ}$	5 17 18					
			F	8 30 00					
10	Nov. 11	Iu	eSE_{N}	18 32 04					Vertical component showed quake, but could not be measured because of defective record.
			eL_{E}	18 52 02	16.3				
			eL_{1E}	19 03 06	12.9				
			eL_{2E}	19 08 06	12.5				
			eL_{N}	18 53 54					
			eL_{1N}	19 00 46	13.5				
			FE_{N}	19 24 00					Origin: probably in Chile.
11	Nov. 16	Iv	iPE_{N}	11 21 11					S-P=43s
			iSE_{N}	11 21 54					Δ=350 km.
			eL_{N}	11 22 50					Very small amplitudes in all waves and no record on vertical component.
			FE_{N}	11 32 00					
12	Nov. 17	Iu	ePE_{NZ}	11 15 16					S-P=10m 12s
			eSE_{N}	11 25 28					Δ=9020 km.
			eL_{E}	11 45 07	16	+ 5			Origin: probably northern part of Chili.
			eL_{1E}	11 53 37					
			eL_{2E}	12 00 53					
			iL_{N}	11 43 31	16	+ 7			Secondary waves registered very poorly and were not distinct on vertical.
			eL_{1N}	11 52 35					
			eL_{2N}	11 54 46					
			eL_{Z}	11 43 01	14				
			eL_{1Z}	11 51 44	13 7				
			F	12 35 00					

BERKELEY STATION

No.	Date	Character	Phase	Time G. M. C. T.	Period	Amplitude AE	Amplitude AN	Amplitude AV	Remarks
	1922			h. m. s.	s.	μ	μ	μ	
13	Nov. 26	Iv	iP_{EN}	8 21 40					S-P = 40s
			eS_E	8 22 26					△ = 350 km.
			iS_N	8 22 20					
			eL_E	8 23 14					No vertical movement recorded.
			iL_N	8 23 16					
			F_{EN}	8 33 00					
14	Dec. 6	Iu	eP_E	14 17 53					
			eP_N	14 17 29					Very small amplitude and no L waves recognized. Strassburg reports origin in Turkestan.
			e_E	14 23 57					
			e_N	14 23 39					
			F	15 42					
15	Dec. 8	Iu	eP_{EZ}	22 44 35					S-P = 8m 51s
			eS_{EN}	22 53 26					△ = 7430 km.
			eS_Z	22 53 45					N-S component very poorly defined.
			eL_E	23 05 36					
			eL_Z	23 05 56					Origin: probably coast of Chile.
			F	23 56 00					
16	Dec. 14	Iv	eP_Z	3 26 41					
			e_E	3 37 14					
			F	4 16					
17	Dec. 18	Iu	eP_{ENZ}	12 43 58					
			eL_N	13 03 30					L-P = 19m 32s
			eM_{EZ}	13 10 10					△ = 6700 km.
			F	14 13 00					Origin: probably off West Indies.
18	Dec. 18	Id	e_Z	21 14 47					
			i_E	21 16 34					
			i_N	21 16 41	13	+	2		
			i_Z	21 17 00					
			F	21 28 00					
19	Dec. 19	Id?	e_E	18 16 05					
			e_N	18 16 51					
20	Dec. 21	Id	iP_{ENZ}	23 36 28					
			iS_{ZN}	23 36 35					S-P = 7s
			iL_N	23 36 42					△ = 54 km.
			F	23 39 05					Local shock, well defined on all components.
21	Dec. 23	Ir?	eL_N	22 27 44					
			F	23 19 00					
22	Dec. 31	Id	eP_Z	7 30 32					
			F_Z	7 31 29					Only on vertical.
23	Dec. 31	Ir	eP_{EN}	7 38 45					
			eL_{EN}	7 46 15					
			eM_N	7 50 45					
			F_E	9 27 00					

BERKELEY STATIONS

No.	Date	Character	Phase	Time G. M. C. T.	Period	Amplitude AE	Amplitude AN	Amplitude AV	Remarks
	1923			h. m. s.	s.	μ	μ	μ	
24	Jan. 2	Ir?	eP_Z	22 48 08					
			e_N	22 56 22			+ 7		
			e_E	22 58 08?					
			i_Z	23 00 17				+ 7	
			F	23 45 00					
25	Jan. 11	IId	eP_{NZ}	4 30 00					
			eP_E	4 30 05					
			i_N	4 30 45	3		+ 7		
			iS_{NE}	4 30 59	(N) 3		+ 20		
			iS_Z	4 31 01					
			i_E	4 31 28	5	+ 25			
			iL_E	4 31 40					
			M_E	4 31 57	10	+ 21			
			iL_N?	4 32 15	9		+ 9		
			M_Z	4 32 28	8			− 20	
			F	4 42 00					
26	Jan. 22	IIIv	i_{ENZ}	9 05 11					△ = 375 km. = 3.4°
			$\overline{P}_{ENZ}$	9 05 22					Epicenter: coast of California: λ = 124°.6, φ = 41°.0. (See note at end for details.)
			i_{N1}	9 05 11	12		− 640		
				9 05 23	12		+2440		
			i_{N2}	9 05 35	8		−1050		
				9 05 43	8		+1540		
			N_3	9 05 51	6		− 850		
				9 05 57	6		+ 910		
			N_4	9 06 03	2.5		− 460		
				9 06 05.5	2.5		+ 170		
			iE_N	9 05 11	12	+ 550			
				9 05 23	12	−1870			
			E_2	9 05 37	7.5	+1035			
				9 05 44.5	7.5	−1400			
			E_3	9 05 53	4	+1030			
				9 05 57	4	− 590			
			E_4	9 06 01	8	+ 930			
				9 06 09	8	−1310			
			Z_1	9 05 11	3	− 55			
				9 05 14	2	+ 22			
			Z_2	9 05 17	3.5	− 95			
				9 05 20.5	3.5	+ 95			
			Z_3	9 05 24	2.5	− 40			
				9 05 26.5	2.5	+ 130			
			Z_4	9 05 29	2.5	− 160			
				9 05 31.5	2.5	+ 20			
			Z_5	9 05 34	5	− 480			
				9 05 39	5	+ 800			
			Z_6	9 05 44	1.5	− 40			
				9 05 45.5	1	+ 30			
			Z_7	9 05 46.5	1	− 30			
				9 05 47.5	1	+ 10			
			Z_8	9 05 48.5	2	− 75			
				9 05 50.5	1.5	+ 65			
			Z_9	9 05 52	3.5	− 350			
				9 05 55.5	4	+ 525			

BERKELEY STATION

No.	Date	Character	Phase	Time G. M. C. T.	Period	Amplitude A_E	Amplitude A_N	Amplitude A_V	Remarks
	1923			h. m. s.	s.	μ	μ	μ	
26	Jan. 22 (contd.)	IIIv	Z_{10}	9 05 59.5	3.5	− 420			
				9 06 03	4	+ 560			
			Z_{11}	9 06 07	4	− 980			
				9 06 11	3.5	+ 400			
			Z_{12}	9 06 14.5	1	− 100			
				9 06 15.5	1.5	+ 380			
			Z_{13}	9 06 17	3	− 350			
				9 06 20	3	+ 300			
			Z_{14}	9 06 23	1	− 30			
				9 06 24	1	+ 105			
			Z_{15}	9 06 25	2	− 410			
				9 06 27	2	+ 100			
			Z_{16}	9 06 29	1	− 80			
				9 06 30	1.5	+ 360			
			Z_{17}	9 06 31.5	2.5	− 320			
				9 06 34	2.5	+ 250			
			Z_{18}	9 06 36.5	2.5	− 580			
				9 06 39	2.5	+			Machines dismantled.
27	Jan. 24	Id?	e_{ZN}	1 52 54	6				Obscured by microseisms.
			e_E	1 52 55	6				
			F_E	1 59 51					
28	Jan. 27	Ir	$?L_N$	20 05 46	16				
			L_E	20 05 46	14				
			L_Z	20 05 56	15				
			F	20 05 56					
29	Feb. 2	IIIu	P_Z	5 16 55					Epicenter: near southeastern coast of Kamchatka.
			P_N	5 17 04					
			PR_{1N1}	5 18 22	8				
			PR_{1N2}	5 19 30	8				
			S_Z	5 24 40					
			S_{NE}	5 24 30					
			S_{N1}	5 24 38	20				
			S_{N2}	5 24 58	20				
			S_{E1}	5 24 38	28				
			S_{E2}	5 25 06	12				
			SR_{1N1}	5 28 32	20				East-West seismogram damaged.
			SR_{1N2}	5 29 44	12				
			SR_{3N1}	5 30 58	14				
			SR_{3N2}	5 31 12	20				
			L_{Z1}	5 35 28	10			− 150	
				5 35 38	10			+ 150	
			L_{Z2}	5 35 48	10			− 150	
				5 35 58	10			+ 150	
30	Feb. 3	IIIu	P_{ENZ}	16 11 05					Epicenter: probably off southeastern coast of Kamchatka. △6000 k. from Berkeley.
			P_{N1}	16 11 35	3.5		− 9		
				16 11 38.5	3.5		+ 9		
			P_{N2}	16 11 54	5		− 17		
				16 11 59	5		+ 17		
			P_{E1}	16 11 28	10				

BERKELEY STATIONS

No.	Date	Character	Phase	Time G. M. C. T.	Period	Amplitude A_E	Amplitude A_N	Amplitude A_V	Remarks
	1923			h. m. s.	s.	μ	μ	μ	
30	Feb. 3 (contd.)	IIIu	P_{Z1}	16 11 33	3.5			− 70	
				16 11 36.5	3.5			+ 35	
			PR_{1N}	16 13 23					
			PR_{1N1}	16 13 23	13				
			PR_{1N2}	16 13 35	13				
			PR_{1E}	16 13 22					
			PR_{1Z}	16 13 17					
			PR_{1Z1}	16 13 26	5			− 40	
				16 13 31	5			+ 40	
			PR_{2E}	16 13 28					
			PR_{2Z}	16 14 25					East-West record rendered illegible by overlapping of succeeding lines.
			$?PR_{3E}$	16 14 56					
30	Feb. 3		$PR_{3Z}?$	16 14 54					
			PR_{3Z1}	16 14 57	5			− 40	
				16 15 02	5			+ 40	
			S_N	16 18 42					
			S_{N1}	16 18 42	9		− 18		
				16 18 51	9		+ 18		
			S_Z	16 18 43					
			PS_{NZ}	16 19 00					
			PS_{N1}	16 19 00	18		− 560		
				16 19 18	18		+1200		
			PS_{N2}	16 19 36	11		− 320		
				16 19 47	11		+ 350		
			PS_{N3}	16 19 58	13		− 450		
				16 20 11	13		+ 82		
			PS_{Z1}	16 19 00	13			− 270	
				16 19 13	13			+1080	
			PS_{Z2}	16 19 26	10			− 550	
				16 19 36	11			+ 740	
			SR_{1N}	16 22 44					
			SR_{1N1}	16 22 44	12		− 70		
				16 22 56	12		+ 420		
			SR_{1Z}	16 22 31					
			SR_{1Z1}	16 22 31	10			− 160	
				16 22 41	10			+ 160	
			SR_{2N}	16 24 30					Pen off sheet
			SR_{2Z}	16 24 36					
			SR_{2Z1}	16 24 46	10			− 640	
				16 24 56	10			+ 640	
			L_Z	16 27 03					
			L_{Z1}	16 27 03	20			−4120	
				16 27 23	20			+4120	
			M_Z	16 27 43					
			M_{Z1}	16 27 43	11			−2780	
				16 27 54	11			+2780	
			M_{Z2}	16 28 05	11			−3900	
					11			+2780	
			F	20 48 26					Grams taken off at this time.

BERKELEY STATION

No.	Date	Character	Phase	Time G. M. C. T.	Period	Amplitude AE	Amplitude AN	Amplitude AV	Remarks
	1923			h. m. s.	s.	μ	μ	μ	
31	Feb. 8	Ir?	L_N	44 05					
			L_{N1}	47 29		20			
			i_E	39 13					
			L_{E1}	47 23		20			
			L_{E2}	47 43		20			
			i_Z	39 23					
			F	1 00 13					
32	Feb. 9	Id	P_{NEZ}	12 14 05					Microseisms at 12: 13:45 may be P.
			S_{NEZ}	12 14 31					
			L_{EZ}	12 15 05					
			L_{N1}	12 14 57	6		− 9		
				12 15 03	6		+ 9		
			L_{N2}	12 15 09	4		− 10		
				12 15 13	4		+ 10		
			L_{E1}	12 15 09	4	+ 10			
				12 15 13	4	− 10			
			L_{Z1}	12 15 30	7				
			F	12 28 55					
33	Feb. 11	Ir	$L?_E$	23 02 00					N-S component obscured by microseisms. Vertical component overlapping.
			L_{E1}	23 12 40	20				
			L_{E2}	23 13 10	20				
			F	23 28 00					
34		Iv	$eP_E?_Z$	2 07 54					Beginning obscured by microseisms.
			L_{E1}	2 15 20	20				
			L_{E2}	2 15 40	20				
			L_{E3}	2 26 00	20				
			L_{N1}	2 15 40	20				
			L_{N2}	2 26 00	20				
			L_{Z1}	2 25 00	20				
			L_{Z2}	2 26 20	20				
			L_{Z3}	2 28 40	20				
			F	2 56 00					
35	Feb. 23	IIu	P_E	7 43 47					Epicenter: somewhere off eastern coast of Kamchatka.
			P_{E1}	7 44 42	4				
			P_{E2}	7 45 22	4				
			P_N	7 43 47					
			P_{N1}	7 44 42	4				
			P_Z	7 43 47					
			S_E	7 51 20					
			S_{E1}	7 51 20	11	+ 30			
				7 51 31	11	− 55			
			S_{E2}	7 51 42	10	+ 110			
				7 51 52	10	− 90			
			S_{E3}	7 52 02	11	+ 55			
				7 53 13	11	− 30			
			S_N	7 51 20					
			S_{N1}	7 51 20	10		− 25		
				7 51 30	10		+ 25		
			S_{N2}	7 51 40	9		− 35		
				7 51 49	9		+ 35		

BERKELEY STATIONS

No.	Date	Character	Phase	Time G. M. C. T.	Period	Amplitude AE	Amplitude AN	Amplitude AV	Remarks
	1923			h. m. s.	s.	μ	μ	μ	
35	Feb. 24	IIu	S_{N3}	7 51 58	10		− 25		
				7 52 08	10	+ 25			
			S_{N4}	7 52 18	10		− 25		
				7 52 28	10		+ 25		
			S_Z	7 51 27					
			S_{Z1}	7 51 27	20				
			S_{Z2}	7 51 47	20				
			e_E	7 52 24					
			e_{E1}	7 52 40	16				
			e_N	7 52 52					
			$_{N1}$	7 52 52	8				
			e_Z	7 52 39					
			$_{Z1}$	7 52 39	10				
			SR_{1E}	7 55 02					
			SR_{1E1}	7 55 10	20				
			SR_{1N}	7 55 02					
			SR_{1Z}	7 54 56					
			SR_{1Z1}	7 54 56	20				
			SR_{1Z2}	7 54 16	20				
			SR_{2E}	7 56 36					
			SR_{2E1}	7 56 36	20				
			SR_{2E2}	7 56 56	24				
			SR_{2N}	7 56 39					
			SR_{2Z}	7 56 02					
			SR_{3E}	7 57 27					
			SR_{3E1}	7 57 35	20				
			SR_{3N}	7 57 27					
			SR_{3Z}	7 57 02					
			L_E	7 59 52					
			L_{E1}	7 59 52	28				
			L_{E2}	7 00 20	28				
			L_N	7 59 52					
			L_{N1}	7 59 52	24				
			L_Z	7 59 32					
			L_{Z1}	7 59 32	30				
			e_E	7 01 22					
			e_N	7 01 06					
			$_{N1}$	7 01 56	24				
			e_Z	7 01 32					
			$_{Z1}$	7 01 32	20				
			$_{Z2}$	7 01 52	20				
			M_E	8 03 22					
			M_Z	8 03 34					
			M_Z	8 03 14					
			F	9 55 22					
36	Feb. 27	Ir	$P_E?$	20 37 59					Not recorded on vertical Epicenter: probably in peninsula of Lower California.
			P_N	20 38 12					
			P_{E1}	20 39 20	8				
			P_{N1}	20 38 40	6				
			S_{E1}	20 42 36	16				
			S_{N1}	20 42 50	16				
			F	20 56 09					

BERKELEY STATION

No.	Date	Character	Phase	Time G. M. C. T.	Period	Amplitude AE	Amplitude AN	Amplitude AV	Remarks
	1923			h. m. s.	s.	μ	μ	μ	
37	Mar. 1	Ir?	$eL?_N$	8 41 15	18				
			M_{EZ}	8 43 15					
			M_N	8 43 37					
			M_{Z1}	8 46 05	7				
			M_{Z2}	8 46 12	7				
			M_{Z3}	8 46 19	7				
			M_{N1}	8 43 37	8				
			M_{N2}	8 43 45	8				
			M_{N3}	8 43 53	8				
			F	9 45 35					
38	Mar. 2	Ir?	e_{EZ}	17 13 30					Obscured by microseisms on N-S.
			$?L_E$	17 36 30					
			L_{E1}	17 37 10	30				
			L_{E2}	17 37 40	28				
			L_{E3}	17 39 02	24				
			L_{E4}	17 39 26	24				
			L_Z	17 36 37					
			L_{Z1}	17 37 17	30				
			L_{Z2}	17 37 47	25				
			L_{Z3}	17 39 02	25				
39	Mar. 11	Iv	e	20 05 43					△ between 355 and 372 km. Phases indistinguishable.
			F	20 14 31					
40	Mar. 11	IIv	P_Z	23 07 46					
			P_{NE}	23 07 45					
			P_{N1}	23 07 47	4				
			P_{E1}	23 07 47	4				
			S_Z	23 08 26					
			S_{Z1}	23 08 26	5				
			S_E	23 08 29					
			S_{E1}	23 08 29	5				
			L_{N1}	23 08 55	8		− 70		
				23 09 03	8		+ 110		
			L_{E1}	23 08 45	11				
			M_{N1}	23 09 09	6		− 70		
					6		+ 70		
			M_{N2}	23 09 21	6		− 100		
				23 09 27	5		+ 50		
			M_{E1}	23 09 01	6	+ 60			
				23 09 07	6	− 60			
			F	23 22 31					
41	Mar. 16	Iu	PR_{1E}	22 18 06					N-S obscured by microseisms. Epicenter in sea off southeastern coast of Mindanao, Philippine Islands.
			PR_{1Z}	22 18 28					
			PR_{3EZ}	22 22 58					
			S_Z	22 25 58					
			S_E	22 26 02					
			S_{E1}	22 26 02	12				
			SR_{1E}	22 33 26					
			SR_{1E1}	22 34 06	20				
			SR_{2E}	22 38 02					
			SR_{2Z}	22 38 12					

No.	Date	Character	Phase	Time G. M. C. T.	Period	Amplitude AE	Amplitude AN	Amplitude AV	Remarks
	1923			h. m. s.	s.	μ	μ	μ	
41	Mar. 16 (contd.)	Iu	L_E	22 48 30					
			L_Z	22 49 48					
			L_{E1}	22 50 06	24				
			L_{Z1}	22 50 48	24				
			L_{Z2}	22 50 12	24				
			M_{EZ}	22 56 58					
			M_{E1}	22 56 58	16				
			M_{E2}	22 57 14	16				
			M_{Z1}	22 56 58	20				
			M_{Z2}	22 57 18	20				
			F	23 55 58					
42	Mar. 18	Ir	eL_E	20 35 14					Very faint on vertical and N-S.—Given as local by Tucson.
			L_{E1}	20 35 18	18				
			L_{E2}	20 36 18	8				
			F	20 36 18					
43	Mar. 24	Ir	e_E	13 06 47					
			e_N	13 04 47					
			$L?_N$	13 13 07					
			L_{E1}	13 13 15	28				
			L_{N1}	13 27 47	28				
			L_{N2}	13 28 15	28				
			L_{Z1}	13 31 47	30				
			L_{Z2}	13 34 42	20				
			L_{Z3}	13 35 02	28				
			M_{E1}	13 38 37	22				
			M_{E2}	13 38 59	15				
			M_{E3}	13 39 15	17				
			M_{E4}	13 39 32	16				
			F	14 26 47					
44	Mar. 28	Iv	$P_E?$	22 11 15					Reported felt at Eureka at 22:13.
			S_E	22 11 51					
			F	22 18 15					

THE LICK OBSERVATORY STATION

CONSTANTS

Constants of the Station

Latitude and longitude of the center of the seismographic room:

$\varphi = 37° 20' 24''.5$ N. Lat.

$\lambda = 121° 38' 34''$ W. from Greenwich.

Time. All determinations are reduced to Greenwich mean civil time.

Altitude, 1281.7 meters (4202.25 feet) above mean sea level.

Constants of the Seismographs

Date	Apparatus	Component	V	T_o	ϵ
Oct. 7	Wiechert 160 Kg. H.	E	85	9.6	5.9
		N	67	9.4	4.3
	Wiechert 80 Kg. V.	Z	51	3.2	9
Dec. 12	160 Kg. H.	E	90	8.3	3.3
		N	83	7.7	2.3
	80 Kg. V.	Z	70	3.1	5
Mar. 6	160 Kg. H.	E	96	9	1.3
		N	91	7.5	1.3
	80 Kg. V.	Z	62	3.0	6.3
Apr. 3	160 Kg. H.	E	86	9.3	3.8
	80 Kg. V.	Z	49	3.3	5.7

LICK OBSERVATORY STATION

No.	Date	Character	Phase	Time G. M. C. T.	Period	Amplitude A_E	Amplitude A_N	Amplitude A_V	Remarks
	1922			h. m. s.	s.	μ	μ	μ	
1	Oct. 2	IId	i_Z	20 39 30					One or two sharp impulses on N-S, dying off rapidly.
			i_{EN}	20 39 32					
			iSL_{EN}	20 39 33	<½		− 65		
				20 39 33.5	<½		+ 5		
			F	20 39 54					
2	Oct. 11	IIu	iP_{EN}	15 01 15					In Southern Peru, most of energy in S group.
			iS_{EN}	15 10 18					
			i_E	15 10 24	17	+ 30			
			iL_{EN}	15 20 36		+ 15			
			iM_N	15 27 36					
3	Oct. 13	Id	iP_{EN}	6 16 22					
			F	6 19					
4	Oct. 14	IId	iP_Z	5 39 55					
			iP_{EN}	5 39 56					
			iSL_{ZN}	5 39 57			+ 40		
			F	5 40 30					
5	Oct. 14	IId	iP_{ZEN}	6 58 31					Maximum follows iP at once.
			i_Z	6 58 32	<1			+ 20	
			i_E	6 58 32	<1	− 80			
			i_N	6 58 32	<1		+ 135		
			F	7 00 00	<1				
6	Oct. 17	Id	iP_{NZ}	5 30 57					Presumably two locals.
			i_E	5 31 02					
			i_E	5 31 08	4	+ 5			
			i_E	5 31 23	8	+ 5			
			L_Z	5 40 02					
			i_E	5 40 04					
			F	5 35					
7	Oct. 21	Id	iP_{EN}	8 05 58					
			F	8 06 10					
8	Oct. 24	Iu	eP_Z	21 31 12					Kurile ls.—S-P=8: 23. $\Delta = 63.3°$.
			eP_N	21 31 14					
			eP_E	21 31 20					
			i_Z	21 31 39					
			iS_{EN}	21 39 35					
			iL_N	21 49 30					
			iM_N	21 55 12					
			F	23 25 00					
9	Oct. 27	Id	iP_{EN}	00 09 18					
			F	00 09 28					
10	Oct. 27	Iv	eP_{EN}	10 56 32					S-P=44; $\Delta = 3.5°$ approx.
			iS_{EN}	10 57 16					
			iL_E	10 57 18	3	− 5			
			iQ_E	10 57 19					
			F	11 03 00					

LICK OBSERVATORY STATION

No.	Date	Character	Phase	Time G. M. C. T.	Period	Amplitude AE	Amplitude AN	Amplitude AV	Remarks
	1922			h. m. s.	s.	μ	μ	μ	
11	Oct. 29	Id	eP_E	11 23 20					
			iP_N	11 23 21					
			iSL_E	11 23 24					
			iSL_N	11 23 25					
			M_E	11 23 27	2	− 2			
			F	11 24 18					
12	Nov. 3	Id	iP_{ENZ}	2 25 30					
			iSL_{EN}	2 25 31					
			F	2 26 30					
13	Nov. 4	Id	iP_N	3 21 07					△=2.2° or 244 km. approx. Southern Mendocino County near Point Arena satisfies Berkeley and Lick.
			iP_E	3 21 10					
			iSL_N	3 21 34	16				
			M_N	3 22 19	11				
			M_E	3 25 06	9				
			F	7 38 00					
14	Nov. 5	Id	i_{EN}	18 21 39					A swarm of small shocks on this date.
			i_{EN}	18 21 43					
			F	18 21 51					
			i_{EN}	18 32 48					
			F	18 32 57					
			i_{EN}	19 51 47					
			F	19 52					
15	Nov. 7	Iu	eP_E	23 12 40					Coast of Chile. (See Berkeley report.)
			i_{EN}	23 22 34					
			i_E	23 34 30					
			iL_{EN}	23 39 30	18				
			iM_E	23 44 54	16				
			F	24 06 00					
16	Nov. 11	IIIv	eP_E	4 44 57					Coast of Chile. (See Berkeley report.)
			iP_{NE}	4 45 03					
			iPR_{INE}	4 48 27					
			eS_{NE}	4 55 08					
			S_{N1}	4 55 08				− 70	
			iPS_E	4 56 17					
			i?	4 59 17					
			iSR_{1E}	5 00 08	34	− 200			
			iSR_{1N}	5 00 50	25?			+ 180	
			iSR_{2E}	5 04 07					
			iSR_{2N}	5 04 50	26			− 200	
			iL_N	5 06 57	50			− 940	
			iL_E	5 07 08	42	− 720			
			iM_E	5 11 00					
			iM_N	5 11 12	29			− 225	
			iM_Z	5 11 48	29				
			M_{N2}	5 13 06	19			− 240	
			F	9 00 00					

LICK OBSERVATORY STATION

No.	Date	Character	Phase	Time G. M. C. T.	Period	Amplitude AE	Amplitude AN	Amplitude AV	Remarks
	1922			h. m. s.	s.	μ	μ	μ	
17	Nov. 11	Iu	eP_N	18 21 54					S-P=9:56, △=80.2° Chile.
			eP_E	18 21 56					
			eS_N	18 31 50					
			eS_E	18 31 54					
			iL_E	18 49 30					
			iM_E	18 54 15			+ 3		
			F	19 24 00					
18	Nov. 15	Id	iP_E	00 12 21					More shocks of swarm type.
			iP_N	00 12 22					
			F	00 12 29					
			iP_{EN}	2 24 04					
			F	2 24 12					
19	Nov. 16	Id	iP_{EN}	1 16 49					S-P=4s. △=0.3° or about 33 km. Stronger on E-W than on N-S.
			iSL_{EN}	1 16 53					
			F	1 16 58					
20	Nov. 16	Id	e_E	11 21 09					Two groups of waves—Strongest on E-W.
			e_N	11 21 14					
			i_{EN}	11 21 20					
			M_E	11 21 23	3	− 5			
			i_E	11 22 57					Perhaps another earthquake.
			i_E	11 28 00					
			i_N	11 28 04					
			F	11 29 18					
21	Nov. 17	Iv	eP_E	11 15 22					△=80.8°.—Chile. Strongest on E-W.
			eP_N	11 15 33					
			iS_{EN}	11 25 22		E 11	− 2		
			iL_{EN}	11 41 56		E 22	+ 6		
			iM_E	11 47 31		25	+ 15		
			F	12 22 00					
22	Nov. 25	Id	i_{NE}	10 58 22					Swarm type.
			i_{NE}	11 03 14					
23	Nov. 26	Iv	i_N	20 21 50					Beginning lost in microseisms.
			i_Z	20 21 53					
			i_E	20 21 13		4	− 5		
			F	20 24 00					
24	Nov. 28	Id	iP_{NE}	17 55 31					△ about 90 km.
			iSL_E	17 55 41					
			iSL_N	17 55 42					
			L_{NE}	17 55 52					
			F	17 58					
25	Dec. 6	Iu	i_{NE}	14 23 00					Beginning of motion cannot be determined because of microseisms.

LICK OBSERVATORY STATION

No.	Date	Character	Phase	Time G. M. C. T.	Period	Amplitude AE	Amplitude AN	Amplitude AV	Remarks
	1922			h. m. s.	s.	μ	μ	μ	
26	Dec. 18	Ir	i_E	21 17 03		+ 2			
			i_N	21 17 57			− 1		
			F	21 27 00					
27	Dec. 19	I?	i_E	18 14 50	12	− 4			
			F	18 17 00					
28	Dec. 21	Id	i_{NE}	23 36 33	E 3	− 3			
			iSL_{NE}	23 36 38	< N 2		− 5		
			F	23 38					
29	Dec. 23	Iu(?)	e_E	22 33 03					
			F	23 02 00					
30	Dec. 24	IId	i_{NE}	7 32 11					
			iSL_{NE}	7 32 12	1	+ 10	+ 25		
			F	7 33 00					
31	Dec. 29	Ir	eP_{NE}	12 11 37					Felt in Paso Robles, Calif. △=80 km.
			iSL_{NE}	12 11 46	E=2 N=3	+ 1	+ 1		
			F	12 14 00					
32	Dec. 31	Ir	eP_E	7 39 04					
				7 43 36					
				7 46 30					
				9 02 00					
	1923								
33	Jan. 11	IId	P_{ENZ}	3 30 08					
			S_{ENZ}	3 30 47					
			L_E	3 31 11	3	+ 25			
			F	3 39 17					
34	Jan. 22	IIIv	P_Z	9 05 18					△=435 km.=3.9° Epicenter: Coast of Calif. λ=124.6°, φ=41°.
			P_{EN}	9 05 20					
			P_{Z1}	9 05 18	1.5			− 5	
				9 05 19.5	1.5			+ 5	
			P_{Z2}	9 05 21	1.5			− 15	
				9 05 22.5	1.5			+ 30	
			P_{Z3}	9 05 24	1.5			− 40	
				9 05 25.5	1.5			+ 50	
			P_{Z4}	9 05 27	1.5			− 5	
				9 05 28.5	1.5			+ 20	
			P_{E1}	9 05 20	5	+ 35			
				9 05 25	5	− 45			
			P_{E2}	9 05 30	3	+ 15			
				9 05 33	3	− 110			
			P_{N1}	9 05 20	3		− 30		
				9 05 23	3		+ 5		
			P_{N2}	9 05 26	1.5		− 20		
				9 05 27.5	1.5		+ 40		
			P_{N3}	9 05 29	5.5		− 35		
				9 05 34.5	5.5		+ 180		

LICK OBSERVATORY STATION

No.	Date	Character	Phase	Time G. M. C. T.	Period	Amplitude AE	Amplitude AN	Amplitude AV	Remarks
	1923			h. m. s.	s.	μ	μ	μ	
34	Jan. 22 (contd.)	IIIv	$\bar{P}_{ENZ}$	9 05 32					
			$\bar{P}_{Z1}$	9 05 32	2.5			− 95	
				9 05 34.5	2.5			+ 80	
			$\bar{P}_{Z2}$	9 05 37	1.5			− 65	
				9 05 38.5	1.5			+ 60	
			$\bar{P}_{E1}$	9 05 36	2.5	+ 40			
				9 05 38.5	2.5	− 100			
			$\bar{P}_{N1}$	9 05 40	9		− 900		
				9 05 49	9		+ 815		
			S_N	9 06 16					
			S_E	9 06 18					
			S_Z	9 06 17					
			S_{N1}	9 06 16	2.25		− 135		
				9 06 18.25	2.25		+ 108		
			S_{N2}	9 06 20	1.5		− 100		
				9 06 21.5	1.5		+ 55		
			S_{E1}	9 06 18	3	+ 455			
				9 06 21	3	− 290			
			S_{Z1}	9 06 17	1			− 80	
				9 06 18	1			+ 60	
			S_{Z2}	9 06 19	2			− 65	
				9 06 21	2			+ 70	
			M_Z	9 07 09	5			−3750	
				9 07 14	5			+2630	
			F	9 37 44					
35	Jan. 27	Ir	L_E	8 08 09	9	+ 25			
				8 08 18	9	− 25			
			L_N	8 08 17	18				
			F	8 08 17					
36	Feb. 3	Iu	P_Z	16 15 20					N-S and E-W records damaged. S-P=7:42ˢ, △=55.3° This distance is probably unreliable because of a tendency of S to be recorded on vertical later than on horizontal components. Comparison with the Berkeley data shows this distance to be too great. * Series of short period waves with appearance of Pi. local. May be S. If above is S, this would be PS.
			P_{Z1}	16 15 47	8				
			P_{Z2}	16 15 55	4				
			PR_{1Z}	16 17 30					
			PR_{1Z1}	16 17 30					
			*e	16 22 35					
			*S_Z	16 23 02					
			S_{Z1}	16 23 02	40				
			S_{Z2}	16 23 42	18				
			M_Z	16 31 25					
			M_{Z1}	16 31 30	13				
				16 31 43	10				
			M_{Z2}	16 33 35	10				
				16 33 45	10				
			F	18 44 20					

LICK OBSERVATORY STATION

No.	Date	Character	Phase	Time G. M. C. T.	Period	Amplitude AE	Amplitude AN	Amplitude AV	Remarks
	1923			h. m. s.	s.	μ	μ	μ	
37	Feb. 8	Ir	e	43 19					Timing device out of order.
			F	1 07 31					
38	Feb. 9	Iv	ePN	12 18 31					△ in comparison with Berkeley shows epicenter to be located some 155 km. or 97 miles south of Lick Observatory.
			SN	12 18 49					
			LN	12 19 22					
			$LN1$	12 19 22	11				
			$LN2$	12 19 33	10				
			F	12 35 40					
39	Feb. 11	Ir	eLN	23 07 41					
			$LN1$	23 07 41	18				
			$LN2$	23 07 59	18				
			F	23 26 47					
40	Feb. 12	Ir	PZN	2 12 01					
			LN	2 25 47					
			$LN1$	2 25 47					
			F	2 56 47					
41	Feb. 24	Iu	PN	7 47 55					Kamchatka.
			$SN1$	7 55 28	15				
			$SN2$	7 55 43	17				
			$SN3$	7 56 00	15				
			$SR2N1$	8 00 59	20				
			$LN1$	8 03 13	18				
			F	10 52 22					
42	Feb. 27	Ir	eN	20 41 31					
			F	20 56 31					
43	Mar. 1	Ir	eN	8 43 12					Not on E-W or vertical.
			MN	8 51 32					
			$MN1$	8 51 32					
			$MN2$	8 51 41					
			F	9 31 32					
44	Mar. 2	Ir	eLZ	17 42 06					
			$LZ1$	17 42 06	24				
			$LZ2$	17 42 30	30				
			$LZ3$	17 46 40	24				
			F	17 51 38					
45	Mar. 11	Id	$PE1$	23 12 03	6				
			$PE2$	23 12 27	8				
			$SE1$	23 12 51	6				
				23 12 57	2				
			$SE2$	23 13 05	3				
				23 13 08	4				
			$LE1$	23 13 12	4				
				23 13 13	9				
			$LE2$	23 13 25	6				
				23 13 31	3				

LICK OBSERVATORY STATION

No.	Date	Character	Phase	Time G. M. C. T.	Period	Amplitude AE	Amplitude AN	Amplitude AV	Remarks
	1923			h. m. s.	s.	μ	μ	μ	
45	Mar. 11 (contd.)	Id	$ME1$	23 13 45	4				
				23 13 49	4				
			$ME2$	23 13 53	6				
				23 13 59	3				
			F	23 25 03					
46	Mar. 16	Ir	$M1E$	23 07 03	18				
			$M2E$	23 07 21	15				
			F	23 19 15					
47	Mar. 24	Ir	eE	13 17 35					
			1	13 17 35					
			2	13 17 50					
			$LE1$	13 26 53					
			$LE2$	13 31 50					
			$ME1$	13 38 05					
			F	14 37 35					
48	Mar. 28	Ir	eLE	22 16 29					
				22 16 29					
			F	22 18 39					

THE EARTHQUAKE OF JANUARY 22, 1923

By J. B. M.

A little after one o'clock in the morning of January 22, 1923, the whole of northern California, southern Oregon, and western Nevada was shaken by an earthquake, the total energy of which was so great that it recorded on seismographs over the whole of Europe and even apparently as far as Colombo, Ceylon, a distance of 127°. This places it in the class of world-shaking earthquakes.

The records obtained at Berkeley and at Mt. Hamilton are strikingly like those of the California earthquake, January 31, 1922, which was of equal violence. But the epicenter was not the same in the two cases. The epicenter of the latter shock (1922) was $\varphi = 41^{\circ}.1$ N., $\lambda = 125^{\circ}.5$ W. The best value of the coördinates for the epicenter of the earthquake of January 22, 1923, which can be got from the seismographic records is $\varphi = 41°$ N. and $\lambda = 124^{\circ}.6$ W. These points have special interest in view of the California earthquake of 1906. In that earthquake the fault trace could be followed from San Juan Bautista to Mussel Rock where it entered the Pacific Ocean, and from Bolinas Bay to Tomales Bay where it again entered the ocean. All this portion was in the well-known San Andreas rift. Directly in line with it was a smaller portion which traversed Bodega Head and, after crossing the intervening ocean stretch, cut into the land at Fort Ross, followed along the Gualala and the Garcia river valleys and entered the ocean north of Point Arena. So far there is little doubt that the observed trace was a continuation and therefore a part of the San Andreas fault. But in 1906 another fault trace appeared at Shelter Cove near Point Delgada running northwestward toward Petrolia. This line is roughly parallel to the other but farther northeast. Now the epicenter of the earthquake of 1922 is in the ocean almost directly in line with the part of the San Andreas fault which leaves the land at Point Arena. On the other hand the epicenter $\varphi = 41°$ N, $\lambda = 124^{\circ}.6$ W of this earthquake is in line with a prolongation of the Shelter Cove fault.

It is not possible to check this position of the epicenter with any assurance by means of the observed intensities because of

the unsymmetrical distribution of the observations. The shock was felt by a few people at Medford, Oregon. It stopped clocks in Reno, Nevada. It is said to have caused a landslide across the tracks of the Virginia-Truckee Railroad in Nevada. Many felt the shock in the region about the Bay of San Francisco. Light sleepers were awakened in Oakland and the shock there was accompanied by a swishing sound as if sandpaper were being rubbed. The three official clocks in the U. S. Weather Bureau office at the top of the Merchants Exchange Building in San Francisco were stopped. Clocks were also stopped at Santa Rosa. Throughout the Sacramento Valley the shock was strongly felt. Clocks were stopped in the city of Sacramento. The 150,000 cubic foot gas tank of the Pacific Gas and Electric Company at Chico was thrown from its supports; and another gas tank at Willows was damaged. But the violence of the shock and the damages caused by it were greatest of all in Humboldt County. All the towns along the Eel River and also the Northwestern Pacific Railway Company whose line traverses the Eel River valley suffered severe losses. South of the Eel River in the region along the Shelter Cove fault and especially at Upper Mattole the shock reached its greatest violence with an intensity IX Rossi-Forel. At sea the shock was felt by the steamer "President Hayes." The captain of the "El Segundo" reported that his ship "struck an object apparently dislodged by the earthquake" at 1:05 A. M. The U. S. S. "Texas" felt it strongly in latitude 44° N, longitude 124° 56′ W. Further details may be found in the Bulletin of the Seismological Society of America, vol. 13, pp. 76-77, and vol. 14, pp. 165-168. Taken as a whole the intensities may be said to agree much better with the location determined from the arrival times than with an epicenter at Upper Mattole as surmised in the article last quoted.

The records of the earthquake are of considerable importance, for they throw some light on the question of surficial structure of the California coast region. Two impulses are distinctly observable in the beginning of the record at both the Berkeley and the Lick Observatory stations. The first is the normal first preliminary P and it arrives at Berkeley 9:05:11 and at Mt. Hamilton at 9:05:18. The second is the phase called by A. Mohorovičić the individual first preliminary $\overline{P}$. It registered in Berkeley at 9:05:22 and at Mt. Hamilton at 9:05:32. The $\triangle$ for Berkeley is 375 km. and that for Mt. Hamilton is 435 km. Taking

the time of occurrence as 1h. 04m. 18s., P–O for the Lick Observatory is 1m. 14s., and for Berkeley it is 1m. 04s. We do not know either the focal depth or the depth of the layer as far as the discontinuity. However, we can form an estimate of both by trial. Let us assume the discontinuity to be about sixty kilometers below the surface of the earth and the focal depth to be twenty-five kilometers. Then we can use A. Mohorovičić's 1914 travel time curves for P_n and his 1919 curve for $\overline{P}$. By plotting the curves we see that the interval $\overline{P}$–P_n for Berkeley would be ten seconds. The observed interval is eleven seconds. For the Lick Observatory the interval $\overline{P}$–P_n would be thirteen seconds, while the observed interval is fourteen seconds. We conclude that the focus was a little shallower than twenty-five kilometers, for the discontinuity scarcely lies deeper than sixty kilometers in California.

It is noteworthy that no 'tidal' or seismic sea wave was caused by the earthquake, although the epicenter was submarine. It follows that the motion on the fault must have been purely horizontal, as it was in the earthquakes of 1906 and 1922. The absence of vertical movement seems to characterize the region at present.