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THE REGISTRATION OF EARTHQUAKES
AT THE BERKELEY STATION

AND

AT THE LICK OBSERVATORY STATION

FROM

OCTOBER 1, 1917, TO MARCH 31, 1918

BY

E. F. DAVIS

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SYMBOLS AND NOTATION

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) First phase, or first preliminary tremors.
 PR_n Waves n-times reflected at the earth's surface.
 S (undae secundae) Second phase, or 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, chief phase, or principal part.
 M (undae maximae) Greatest motion in the chief phase.
 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 motion, measured from the median line in microns ($\mu = 1/1000$ mm.).
 A_E E-W component of A.
 A_S N-S component of A.
 A_V 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:

$$\phi = 37^{\circ} 52' 15.9'' \text{ N. Lat.}$$

$$\lambda = 122^{\circ} 15' 36.6'' \text{ W. from Greenwich.}$$

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

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

CONSTANTS OF THE SEISMOGRAPHS

	Period	Magnif.	Damping
Bosch-Omori Seismograph N-S component	15s	80	8-1
Bosch-Omori Seismograph E-W component	15s	80	8-1
Weichert Seismograph Vertical component	6s	80	8-1
Omori Tromometer N-S component	2s	60	-----
Omori Tromometer E-W component	2.5s	60	-----
Marvin Strong-motion Seismograph—			
E-W component	6.5s	5.8	1.3-1
N-S component	6.5s	5.1	1.4-1

No.	Date	Charac.	Phase	Time G. M. C. T.	Period	Amplitude			Remarks
						A _E	A _N	A _V	
1	11 Oct. 1917	I _v	e P _V	21 26 13	2	6	6	4	Felt at Salinas and Spreckels.
			e P _{EN}	21 26 14					
			e L _E	21 26 28					
			e L _{NV}	21 26 29					
			M _{NV}	21 26 31					
			M _E	21 26 32					
C	indefinite								
F	21 29 10±								
2	19 Oct.	I?	e	16 53					Trace of a distant earthquake.
			F	17 13					
3	26 Oct.	I _a	i P _E	9 20 38.2	1-1½ 2	19	25	15	First shift of ground up, north and west. Registered by both components of Omori trometer. Marvin did not start. Δ = 70 km. Origin on Hayward's Rift just east of San José.
			e P _V	9 20 38.4					
			i P _N	9 20 38.6					
			e L _E	9 20 48.3					
			e L _N	9 20 49.3					
			e L _V	9 20 49.8					
			M _{EN}	9 20 50.2					
			M _V	9 20 51.7					
			C	indefinite					
			F	9 25 25					
4	27 Oct.	I _v	e	3 48 59					Trace of near shock visible on all components. The San Francisco Weather Bureau reports an earthquake felt in Eureka at 3 ^h 49 ^m .
			F	3 57 30±					
5	7 Nov.	I _a	e	1 36 05					Trace of a distant earthquake.
			F	1 56 10					
6	14 Nov.	I _a	e	9 30 23					Barely perceptible trace of a distant earthquake.
			F	10 13 28					
7	16 Nov.	I _a	O	3 19 42	18 19 18 17	61	86 108	25	Δ = 9300 km.
			e P _V	3 32 09					
			e P _E	3 32 12					
			e P _N	3 32 18					
			e S _V	3 42 34					
			e S _N	3 42 35					
			e S _E ?	3 42 47					
			e L _N ?	3 54 18					
			e L _E ?	3 54 24					
			M _E	4 04 40					
			M _V	4 05 25					
			M _{N1}	4 06 23					
M _{N2}	4 10 25								
C	4 12 44								
F	6 10±								
8	18 Nov.	I _a	e	3 19 32					Trace of a distant earthquake
			F	4 40±					

No.	Date	Charac.	Phase	Time G. M. C. T.	Period	Amplitude			Remarks
						A _E	A _N	A _V	
9	23 Nov. 1917	I _a	e P _N	0 26 09	2	5	4		Registered on vertical as a series of minute vibrations.
			e L	0 26 21					
			M _{EN}	0 26 23					
			C	indefinite					
			F	0 28 31					
10	12 Dec.	I _v	e	10 46 02	4	3	3		Trace of a near earthquake; visible on all components.
			M	10 56 18					
			F	10 59 40					
11	20 Dec.	I _a	e	2 30 30					Trace of a distant earthquake on all components.
			F	2 59 30					
12	21 Dec.	I _r	O	17 54 22	14 13½ 12	93	51 65		Δ = 3020 km. Fair record on vertical but most of it is illegible because of overscoring.
			e P _E	18 00 18					
			e P _{NV}	18 00 20					
			e S _{EN}	18 05 04					
			e L _E	18 07 23					
			e L _N	18 07 32					
			M _E	18 12 56					
			M _{N1}	18 14 35					
			M _{N2}	18 16 33					
			C	indefinite					
F	20 37±								
13	21 Dec.	I?	e	21 02 35					Trace of a distant earthquake on all components.
			F	21 57±					
14	23 Dec.	I?	e	14 20±					Faint trace of a distant earthquake on all components.
			F	14 43±					
15	23 Dec.	I?	e	15 47 49					Trace of a distant earthquake on all components.
			F	16 19±					
16	26 Dec.	I?	e	4 49 15±					Trace of a distant earthquake on horizontal components.
			F	5 07±					
17	26 Dec.	I?	e	5 35 45±					Trace of a distant earthquake on horizontal components.
			F	5 52±					
18	26 Dec.	I?	e	6 35 35±					Trace of a distant earthquake on horizontal components.
			F	6 47±					
19	26 Dec.	I?	e	13 48±					Trace of a distant earthquake on horizontal components.
			F	13 57±					

No.	Date	Charac.	Phase	Time G. M. C. T.			Period	Amplitude			Remarks				
				h	m	s		A _E	A _N	A _V					
20	1917 28 Dec.	I _r	O	21	14	17	s	μ	μ	μ	Δ = 3060 km.				
			e P _N	21	20	19									
			e P _E	21	20	21									
			e P _V	21	20	23									
			e S _N	21	25	05									
			e S _E	21	25	08									
			e L	indefinite											
			M _V	21	29	51						13	34	19	4
			M _E	21	32	46						14			
			M _{N₁}	21	33	18						14			
			M _{N₂}	21	45	49						11			
			C	indefinite											
			F	23	12	±									
21	1917 29/30 Dec.	I _r	O	22	50	22	s	μ	μ	μ	Δ = 3590. Considerable portions of the horizontal records of this earthquake were destroyed by the dragging of the time markers.				
			e P _{NV}	22	57	09									
			e S _N	23	02	32									
			M _V	23	12	18						12			
			F	0	37	±									
22	1917 31 Dec.	I _d	i P _N	6	29	35.8	< 1/2	5	5	5	Registered on east-west component by a thickening of the pen trace.				
			i LM _N	6	29	36.5									
			C	indefinite											
			F	6	29	41									
23	1918 4 Jan.	I?	e	4	40	34	20	20	10	10	Record of a distant earthquake. Phases not separable. Faint trace on vertical.				
			M _{EN}	4	53	44									
			F	5	18	±									
24	1918 4 Jan.	I?	e	16	19	04					Trace of a distant earthquake; record somewhat obscured by microseisms.				
			F	17	12	±									
25	1918 21 Jan.	I?	e	20	35	30±					Trace of a distant earthquake on horizontal components.				
			F	20	59	30±									
26	1918 25 Jan.	I?	e	1	31	57					Trace of a distant earthquake on all components.				
			F	2	13	±									
27	1918 30 Jan.	I _b	O	21	18	25	s	μ	μ	μ	Δ = 7380 km. Seismograms are unusual. P and S are sharply marked but no other phases are separable. The greater portion of the seismograms consists of waves of small amplitude in which there is no definite maximum.				
			i P _{EV}	21	29	18									
			e P _N	21	29	19									
			i S _N	21	38	04									
			i S _{EV}	21	38	06									
			F	22	38	±									

No.	Date	Charac.	Phase	Time G. M. C. T.			Period	Amplitude			Remarks
				h	m	s		A _E	A _N	A _V	
28	1918 3 Feb.	I?	e	14	25	±	s	μ	μ	μ	Trace of a distant earthquake on horizontal components.
			F	15	08	±					
29	1918 7 Feb.	I?	e	5	44	±					Trace of a distant earthquake on all components.
			F	6	38	±					
30	1918 12 Feb.	I?	e	1	28	±					Trace of a distant earthquake on all components.
			F	1	48	±					
31	1918 12 Feb.	I?	e	19	17	±					Trace of a distant earthquake; visible on all components.
			F	19	35	±					
32	1918 12 Feb.	I?	e	20	06	±					Trace of a distant earthquake on all components.
			F	20	27	±					
33	1918 13 Feb.	I?	e	6	33	±					Trace of a distant earthquake on all components.
			F	7	48	±					
34	1918 19 Feb.	I?	e	17	02	±					Trace of a distant earthquake on all components.
			F	17	38	±					
35	1918 3 Mar.	I _v	e	4	31	16					Trace of a near shock. A series of irregular vibrations of small amplitude; visible on all components. <i>Monthly Weather Review</i> reports an earthquake felt in Eureka at 4 ^h 30 ^m .
			F	4	35	26					
36	1918 19 Mar.	I?	e	6	32	21					Trace of a distant earthquake on all components.
			F	7	12	±					

THE LICK OBSERVATORY STATION

CONSTANTS

CONSTANTS OF THE STATION

Latitude and longitude of the center of the seismographic room :

$\phi = 37^{\circ} 20' 24.75''$ N. Lat.

$\lambda = 121^{\circ} 38' 34''$ 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

	Period	Magnif.	Damping
April 1, 1917, to June 6, 1917.			
Wiechert Seismograph N-S component	7.0	80	8:1
Wiechert Seismograph E-W component	6.0	80	8:1
Wiechert Seismograph Vertical component	3.0	80	8:1

No.	Date	Charac.	Phase	Time G. M. C. T.			Period	Amplitude			Remarks
				h	m	s		μ	μ	μ	
1	1 Oct.	I _a	e M _{EN} F	21	11	24	s				Strong thickening of pen traces on vertical component.
				21	11	27					
				21	11	34					
2	2 Oct.	I _a	i P _N i L _N M _N C F	3	53	16	$\frac{1}{2}$		9		Strong thickening of pen traces on east-west and vertical components.
				3	53	18					
				3	53	20					
				3	53	24					
				3	53	27					
3	3 Oct.	I _a	e M _N F	0	27	27	$\frac{1}{2}$		8		Registered on north-south and vertical components. Strong thickening of pen traces.
				0	27	31					
				0	27	34					
4	3 Oct.	I _a	i P _{EN} i L _{EN} M _{EN} F	16	03	42.7	$\frac{1}{2}$	5	7		Registered on vertical by a strong thickening of pen trace.
				16	03	46.2					
				16	03	49					
				16	03	55					
5	5 Oct.	I _a	e F	23	32	59					Marked thickening of pen traces on all components.
				23	33	10					
6	10 Oct.	I _a	i P _N i L _N M _N F	19	33	01.7	$\frac{1}{2}$		9		Registered on east-west and vertical components by a strong thickening of the pen traces.
				19	33	05.5					
				19	33	09.5					
				19	33	13					
7	11 Oct.	I _a	i P i LM C F	21	26	02.0	$\frac{1}{2}$	22	13	6	
				21	26	09.0					
				21	26	29					
				21	28	13					
8	16 Oct.	I _a	i P _{NV} i L _{NV} M _{NV} C F	0	56	21.0	$\frac{1}{2}$	6	16		Registered on east-west component by a strong thickening of the pen trace.
				0	56	26.6					
				0	56	28					
				0	56	31					
				0	56	35					
9	16 Oct.	I _a	e F	23	11	23					Registered by a thickening of pen traces.
				23	11	30					
10	19 Oct.	I _a	e M F	21	38	47	$\frac{1}{2}$	6	10	8	No phases discernible. A gradual increase in amplitude up to the maximum and then a gradual decrease.
				21	38	57					
				21	39	01					
11	20 Oct.	I _a	e M F	15	52	41	$\frac{1}{2}$	8	10	6	No phases discernible. A gradual increase in amplitude up to the maximum and then a gradual decrease.
				15	52	48					
				15	52	52					

No.	Date	Charac.	Phase	Time G. M. C. T.			Period	Amplitude			Remarks
				h	m	s		μ	μ	μ	
12	24 Oct.	I _a	e F	21	08	38	s				Marked thickening of pen traces on horizontal components.
				21	08	47					
13	26 Oct.	III _a	i P _V i LM _V C F	9	20	28.0	$\frac{1}{2}$?	?	236	First shift of ground up. Horizontal components were dismantled by force of the shock.
				9	20	29.3					
				9	20	49					
				9	23	31					
14	26 Oct.	I _a	i P _{EN} i LM _{EN} C F	15	52	25	$\frac{1}{2}$	7	8		A few minute vibrations on the vertical.
				15	52	27					
				15	52	30					
				15	52	37					
15	29 Oct.	II _a	e P i LM C F	12	30	52.0	$\frac{1}{2}$	40	31	6	
				12	30	54.5					
				12	30	56					
				12	31	22					
16	29 Oct.	II _a	i P i LM C F	12	44	47.0	$\frac{1}{2}$	29	29	6	
				12	44	48.5					
				12	44	57					
				12	45	24					
17	29 Oct.	I _a	e F	19	12	51					Marked thickening of pen traces on horizontal components.
				19	13	02					
18	30 Oct.	I _a	e F	0	43	57					Marked thickening of pen traces on all components.
				0	44	08					
19	1 Nov.	I _a	e F	1	01	51					Strong thickening of pen traces on all components.
				1	01	58					
20	1 Nov.	I _a	e P i LM C F	23	41	55.4	$\frac{1}{2}$	6	6	6	
				23	41	56.9					
				23	41	59					
				23	41	03					
21	1 Nov.	I _a	e F	23	45	52					Thickening of pen traces on all components.
				23	46	02					
22	2 Nov.	I _a	e F	16	07	32					Registered on all components by a strong thickening of the pen traces.
				16	07	40					
23	6 Nov.	I _a	e F	17	56	01					Strong thickening of pen traces on all components.
				17	56	10					
24	7 Nov.	I _a	e F	16	24	37					Strong thickening of pen traces on all components.
				16	24	46					

No.	Date	Charac.	Phase	Time G. M. C. T.	Period	Amplitude			Remarks
						A _E	A _N	A _V	
25	1917 8 Nov.	I _d	e F	h m s 16 11 32 16 11 41	s	μ	μ	μ	Strong thickening of pen traces on all components.
26	9 Nov.	I _d	e F	0 46 33 0 46 43					Thickening of pen traces on all components.
27	12 Nov.	I _d	e F	16 42 19 16 42 25					Strong thickening of pen traces on horizontal components.
28	13 Nov.	I _d	e F	0 15 55 0 16 03					Thickening of pen traces on horizontal components.
29	16 Nov.	I _d	e P i LM C F	0 22 23 0 22 25 indefinite 0 22 30	½	5	6	8	
30	16 Nov.	I _d	O e P _N e P _V e S _N e L M _N M _V C F	3 19 39 3 32 09 3 32 10 3 42 37 indefinite 4 05 12 4 06 38 indefinite 5 40±	22 18		200	60	Δ = 9360 km. Sinusoidal waves from 3 ^h 58 ^m 45 ^s to 4 ^h 16 ^m 25 ^s . East-west component of instrument not in adjustment.
31	23 Nov.	III _d	i P i LM C F	0 25 52.9 0 25 55.2 0 26 00 0 26 44	½	92	82	18	
32	27 Nov.	I _d	e F	22 41 31 22 41 39					Registered by a marked thickening of all pen traces.
33	3 Dec.	I _d	e F	16 02 57 16 03 02					A strong thickening of pen traces on all components.
34	4 Dec.	I _d	e F	11 51 41 11 51 48					A strong thickening of pen traces on all components.
35	18 Dec.	I _d	e F	0 23 10 0 23 18					A strong thickening of pen traces on all components.

No.	Date	Charac.	Phase	Time G. M. C. T.	Period	Amplitude			Remarks
						A _E	A _N	A _V	
36	1917 19 Dec.	I _d	i P _N i LM _N F	h m s 0 24 26.6 0 24 27.8 0 24 35	s	μ	μ	μ	Registered on east-west and vertical by a strong thickening of pen traces.
37	19 Dec.	I _d	e F	0 26 26 0 26 34					Registered on all components by a strong thickening of pen traces.
38	20 Dec.	I _d	e F	0 54 31 0 54 37					A thickening of the pen traces on all components.
39	20 Dec.	I _d	e F	1 00 03 1 00 12					A strong thickening of pen traces on all components.
40	21 Dec.	I _r	e M _E M _N F	17 59 35 18 12 05 18 13 22 19 40±	13 13	13	105		Record of a distant earthquake on horizontal components. Phases not separable.
41	21 Dec.	I _r	e F	21 04± 21 32±					Trace of a distant earthquake.
42	29/30 Dec.	I _r	O e P _{EN} e S _{EN} e L M _E M _N C F	22 50 18 22 56 58 23 02 15 indefinite 23 11 46 23 12 15 indefinite 0 40±	10 11	236	230		Δ = 3500 km. Vertical seismograph undergoing repairs.
43	31 Dec.	I _d	e M _N F	18 32 39 18 32 43 18 32 47	½			6	Registered on east-west component by a strong thickening of the pen trace.
44	1918 3 Jan.	I _d	e F	0 32 10 0 32 19					A strong thickening of pen traces on horizontal components.
45	4 Jan.	I _{r, u?}	e F	4 40 20 5 10±					Trace of a distant earthquake on horizontal components.
46	19 Jan.	II _d	i P i LM C F	12 07 35.0 12 07 36.6 12 07 40 12 08 14	½	33	36	6	
47	25 Jan.	I _{r, u?}	e F	1 34 10± 2 10±					Trace of a distant earthquake on horizontal components.

No.	Date	Charac.	Phase	Time G. M. C. T.	Period	Amplitude			Remarks
						A _E	A _N	A _V	
48	1918 26 Jan.	I _d	i P _N	h m s 0 19 48.0	$\frac{1}{2}$	μ	μ	μ	Thickening of pen traces on east-west and ver- tical components.
			i LM _N	0 19 49.5					
			C	indefinite					
			F	0 19 56					
49	27 Jan.	II _d	i P	20 07 32.6	$\frac{1}{2}$	41	46	10	
			i LM	20 07 34.8					
			C	20 07 38					
			F	20 08 03					
50	30 Jan.	I _u	O	21 18 29					$\Delta = 7490$ km. Registered only on horizontal com- ponents. P and S are sharply marked but the remainder of the rec- ords consists of vibra- tions of small ampli- tude in which there is no definite maximum.
			e P	21 29 23					
			e S	21 38 17					
			F	22 30 \pm					
51	1 Feb.	I _d	e P	22 48 49	$\frac{1}{2}$		7		Registered on east-west and vertical compon- ents by a strong thiek- ening of the pen traces.
			i LM _N	22 48 51					
			C	indefinite					
			F	22 48 58					
52	1 Feb.	I _d	e	23 14 56					Strong thickening of pen traces on all compon- ents.
			F	23 14 05					
53	14 Mar.	I _d	e	18 09 50					Strong thickening of pen traces on all compon- ents.
			F	18 09 57					
54	19 Mar.	I _{r-u?}	e	6 36					Trace of a distant earth- quake on horizontal components.
			F	7 11					