SEISMOLOGY.

W. J. HUMPHREYS, Professor in Charge.

[Dated: Weather Bureau, Washington, D. C., Dec. 3, 1919.]

TABLE 1.—*Noninstrumental earthquake reports, October, 1919.*

Day.	Approximate time, Greenwich civil.	Station.	Approximate latitude.	Approximate longitude.	Intensity Rossi-Forel.	Number of shocks.	Duration.	Sounds.	Remarks.	Observer.
		CALIFORNIA.								
1919.	*H. m.*		° ′	° ′			*Sec.*			
Oct. 1	18 42	Calexico	32 41	115 30	4	1	5	None	Felt by many	H. M. Rouse.
	21 46	do	32 41	115 30	3	1	2	Faint rumbling	Rapid vertical motion. Felt by many.	Do.
	23 50	do	32 41	115 30	5	1	1	do	Felt by many	Do.
2	7 31	do	32 41	115 30	5	1	70	do	do	Do.
4	6 15	do	32 41	115 30	3	1	8	Loud rumbling	do	Do.
	15 57	do	32 41	115 30	3	1	4	Faint rumbling	Felt by several	Do.
5	2 36	Eureka	40 45	124 15	3	1	2	None	do	L. B. Cooper.
13	20 35	Salinas	36 36	121 40	3	1		do	do	E. D. Eddy.
25	22 40	do	36 36	121 40	3	1		do	do	Do.
31	0 36	Lucerne Valley	34 27	116 57	3	1		do		J. M. Henry.

TABLE 2.—*Instrumental seismological reports, October, 1919.*

(Time used: Mean Greenwich, midnight to midnight. Nomenclature: International.)

[For significance of symbols see REVIEW for January, 1919, p. 59.]

Date.	Character.	Phase.	Time.	Period T.	Amplitude. A_E	Amplitude. A_N	Distance.	Remarks.

Alabama. *Mobile. Spring Hill College.* Earthquake Station. Cyril Ruhlmann, S. J.

Lat., 30° 41′ 44″ N.; long., 88° 08′ 46″ W. Elevation, 60 meters.

Instrument: Wiechert 80 kg.; astatic, horizontal pendulum.

(No earthquake recorded during October, 1919.)

Alaska. *Sitka. Magnetic Observatory.* U. S. Coast and Geodetic Survey. F. P. Ulrich.

Lat., 57° 03′ 00″ N.; long., 135° 30′ 03″ W. Elevation, 15.2 meters.

Instruments: Two Bosch-Omori, 10 and 12 kg.

Instrumental constants.. E: V 10, T_0 17; N: V 10, T_0 15

(No earthquake recorded during October, 1919.)

Arizona. *Tucson. Magnetic Observatory.* U. S. Coast and Geodetic Survey. Wm. H. Cullum.

Lat., 32° 14′ 48″ N.; long., 110° 50′ 06″ W. Elevation, 769.6 meters.

Instruments: Two Bosch-Omori, 10 and 12 kg.

Instrumental constants.. E: V 10, T_0 15; N: V 10, T_0 18

Date.	Character.	Phase.	Time.	Period T.	Amplitude. A_E	Amplitude. A_N	Distance.	Remarks.
1919.			*H. m. s.*	*Sec.*	μ	μ	*Km.*	
Oct. 1		P_E	18 43 15					N not in operation during October.
		M_E	18 44 13	2	5			
		F_E	18 45 ..					
1		iP_E	19 32 16	2				
		L_E	19 33 12					
		M_E	19 33 55		230			
		C_E	19 35 ..					
		F_E	19 45 ..	5				
1		eP_E	21 48 40					
		M_E	21 49 07	3	10			
		F_E	21 53 ..					
10		eP_E	2 11 09					P indefinite.
		L_E	2 17 30					
		M_E	2 17 38		20			
		F_E	2 27 ..					

California. *Berkeley. University of California.*

Lat., 37° 52′ 16″ N.; long., 122° 15′ 37″ W. Elevation, 85.4 meters.

(*See* Bulletin of the Seismographic Stations, University of California.)

California. *Mount Hamilton. Lick Observatory.*

Lat., 37° 20′ 24″ N.; long., 121° 38′ 34″ W. Elevation, 1,281.7 meters.

(*See* Bulletin of the Seismographic Stations, University of California.)

California. *Point Loma. Raja Yoga Academy.* F. J. Dick.

Lat., 32° 43′ 03″ N.; long., 117° 15′ 10″ W. Elevation, 91.4 meters.

Instrument: Two-component, C. D. West seismoscope.

Date.	Character.	Phase.	Time.	Period T.	Amplitude. A_E	Amplitude. A_N	Distance.	Remarks.
1919.			*H. m. s.*	Sec.	μ	μ	*Km.*	
Oct. 5					100	200		Tremors during 24 hours preceding 15 h.
7					200	200		Tremors during 24 hours preceding 15 h.
8					100	200		Tremors during 24 hours preceding 15 h.

Colorado. *Denver. Sacred Heart College.* Earthquake Station. A. W. Forstall, S. J.

Lat., 39° 40′ 36″ N.; long., 104° 56′ 54″ W. Elevation, 1,655 meters.

Instrument: Wiechert 80 kg., astatic, horizontal pendulum.

Date.	Character.	Phase.	Time.	Period T.	Amplitude. A_E	Amplitude. A_N	Distance.	Remarks.
1919.			*H. m. s.*	*Sec.*	μ	μ	*Km.*	
Oct. 1	Ii	L_E	19 36 30					P. not discernible. Distinct wavelets at intervals during day.
		L_N	19 36 30					
		M_E	19 37 ..	6	*2,000			
		M_N	19 37 ..	6		*2,800		
		F_E	19 38 ..					
		F_N	19 38 ..					
10	Ie	L_E	1 15 ..	12				Regular sinusoidal. P. and M. not discernible. Wavelets very clear at intervals during day.
		L_N	1 15 ..	?				
		F_E	1 35 ..					
		F_N	1 35 ..					
12–13								Distinct activity at intervals during day.
15–16								Wavelets visible at intervals during day.
20–21								Thickening of penmarks at intervals during day. Doubtful as to being seismic.

*Trace amplitude.

TABLE 2.—*Instrumental seismological reports, October, 1919*—Continued.

District of Columbia. *Washington. U. S. Weather Bureau.*

Lat., 38° 54′ 12″ N.; long., 77° 03′ 03″ W. Elevation, 21 meters.

Instrument: Marvin (vertical pendulum), undamped. Mechanical registration.

Instrumental constants.. V 110, T_0 6.4

Date.	Character.	Phase.	Time.	Period T.	Amplitude. A_E	Amplitude. A_N	Distance.	Remarks.
1919.			*H. m. s.*	*Sec.*	*μ.*	*μ.*	*Km.*	
Oct. 1		e	19 48 12					Heavy micros.
		L	19 49 12					
		F	20 *ca*					Lost in micros.
3		e	10 30 00					
		L	10 32 30	20				
		F	10 50 *ca*					Heavy micros.
10								Earthquake between 1 h. and 2 h. *ca.*; small disturbances lasting nearly an hour. Clock not working.
12		iP						Earthquake shortly after 22 h. L waves about one hour later. Whole disturbance lasting about 1 h. 20 m. Clock not working.
14								Earthquake between 17 h. and 18 h., lasting a half hour *ca.* Clock not working.
27		P	3 52 30?					Time uncertain.
		S	4 00 00?					
		eL	4 10 *ca*					
		F	4 20 *ca*					
28		P	7 29 15?					Time uncertain.
		S	7 33 45?					
		F	7 50 *ca*					

District of Columbia. *Washington. Georgetown University.*

F. A. Tondorf, S. J.

Lat., 38° 54′ 25″ N.; long., 77° 04′ 24″ W. Elevation, 42.4 meters. Subsoil: Decayed diorite.

Instruments: Wiechert 200 kg. astatic horizontal pendulum, 80 kg. vertical.

Instrumental constants.. V, T_0, ϵ: E 165 5.4 0; N 143 5.2 0; *Z* *80* *3.0* *0*

Date.	Character.	Phase.	Time.	Period T.	Amplitude. A_E	Amplitude. A_N	Distance.	Remarks.
1919.			*H. m. s.*	*Sec.*	*μ.*	*μ.*	*Km.*	
Oct 1[1]		e_E	19 48 23					Very heavy micros.
		e_N	19 48 00					
		F	20 10 ..					
3		e_E	10 07 33					Heavy micros.
		eL_N	10 30 24	11				
		L_E	10 34 16	21				
		F	11 *ca*					
10		eP_E	1 14 18					Heavy micros
		eP_N	1 14 18					
		L_E	1 28 28	14				
		L_N	1 28 28	14				
		F	2 15 ..					
			VERTICAL.					
10		*eP_Z*	*1 14 23*					
		L_Z	*1 30 32*	*14*				
		F_Z	*2 10* ..					
12		eP_E	22 08 14					Very heavy micros.
		iP_N	22 08 14					
		S_N?	22 11 34					F impossible.

[1] Because of repairs going on in cave, seismograms for the month are difficult to evaluate.

Hawaii. *Honolulu. Magnetic Observatory.* U. S. Coast and Geodetic Survey. Frank Neumann.

Lat., 21° 19′ 12″ N.; long., 158° 03′ 48″ W. Elevation, 15.2 meters.

Instrument: Mine seismograph of the Seismological Committee of the British Association.

T_0

Instrumental constant 18.4. Sensitivity, 0.40″.

(Report for October, 1919, not received.)

Illinois. *Chicago.* University of Chicago. U. S. Weather Bureau.

Lat., 41° 47′ N.; long., 87° 37′ W. Elevation 180.1 meters.

Instruments: Two Milne-Shaw horizontal pendulums, 0.45 kg.

Instrumental constants.. V, T_0, ϵ, Sensitivity.: E. 150 12 20:1 1″ arc tilt=26.6 mm.; N. 150 8 20:1 1″ arc tilt=13.2 mm.

Date.	Character.	Phase.	Time.	Period T.	Amplitude. A_E	Amplitude. A_N	Distance.	Remarks.
1919.			*H. m. s.*	*Sec.*	*μ.*	*μ.*	*Km.*	
Oct. 1		e	19 44 7					Heavy micros.
		M	19 45 00			11		
		F	19 55 *ca*					Lost in micros.
3		P	10 02 8					
		PR_1	10 04 38					
		S	10 10 6					
		L	10 25 00					
		L	10 30 00	15				
		F	12 20 *ca*					Heavy micros.
5		e	2 54 00					
		L	2 55 30	15				
		F	3 07 *ca*					Micros.
8		P?	5 09 48					
		L	5 37 00	30				
		L	5 42 00	22				
		L	5 53 00	18				
		F	7 10 *ca*					Micros.
8		P?	22 49 55					
		S?	22 53 25					
		L	22 56 10	22				
		F	23 15 *ca*					Heavy micros.
10		P	1 12 40				3,070	
		S	1 17 38					
		L	1 23 45	15				
		F	3 30 *ca*					Heavy micros.
12		iP	22 11 5					
		S?	22 20 25					
		L	22 54 00	40				
		L	23 00 00	25				
		L	23 15 00	22				
		L	23 36 00	18				
		L	23 52 00	15				
13		F	0 30 *ca*					
14		P	12 03 23					
		L	12 10 00	18				
		L	12 20 00	15				
		F	12 50 *ca*					
14		P	17 02 8					
		S?	17 05 12					
		L	17 07 00					
		F	18 *ca*					
21		eL	22 21 00					
		L	22 27 00	18				
		F	23 *ca*					
27		P	3 50 37				6,200	
		S	3 58 22					
		L	4 07 00					
		F	5 *ca*					
28			7 35 to 8 10 ..					Disturbances mixed with extremely heavy micros.

TABLE 2.—*Instrumental seismological reports, October, 1919.*—Continued.

Kansas. *Lawrence. University of Kansas.* Department of Physics and Astronomy. F. E. Kester.

Lat., 38° 57′ 30″ N.; long., 95° 14′ 58″ W. Elevation, 301.1 meters.

Instrument: Weichert.

Instrumental constants..		V	T_0	ε
	E	177	3.4	4:1
	N	205	3.4	4:1

(Report for October, 1919, not received.)

Maryland. *Cheltenham. Magnetic Observatory.* U. S. Coast and Geodetic Survey. George Hartnell.

Lat., 38° 44′ 00″ N.; long., 76° 50′ 30″ W. Elevation, 71.6 meters.

Instruments: Two Bosch-Omori, 10 and 12 kg.

Instrumental constants..		V	T_0
	E	10	14
	N	10	14

Date.	Character.	Phase.	Time.	Period T.	Amplitude. A_E	Amplitude. A_N	Distance.	Remarks.
			H. M. S.	*Sec.*	*μ*	*μ*	*Km.*	
1919. Oct. 10	.....	eP_E	1 16 00	.....	.....	.....	.....	Phases indefinite. P very faint.
		eP_N	1 19 45	.....	.....	.....	.....	
		L_E	1 28 50	.....	.....	.....	.....	
		L_N	1 28 10	.....	.....	.....	.....	
		M_E	1 33 50	8	20	.....	.....	
		M_N	1 29 10	14	.....	20	.....	
		C_E	1 35 ..	8	.....	.....	.....	
		C_N	1 32 ..	10	.....	.....	.....	
		F_E	2 04 ..	8	.....	.....	.....	
		F_N	2 13 ..	9	.....	.....	.....	
14	.....	P_E	17 01 58	.....	.....	.....	.....	
		P_N	17 02 01	.....	.....	.....	.....	
		L_E	17 07 00	.....	.....	.....	.....	
		L_N	17 07 10	.....	.....	.....	.....	
		M_E	17 17 25	8	10	.....	.....	
		M_N	17 09 10	12	.....	10	.....	
		F	17 22 ..	8	.....	.....	.....	

Massachusetts. *Cambridge. Harvard University Seismographic Station.* J. B. Woodworth.

Lat., 42° 22′ 36″ N.; long., 71° 06′ 59″ W. Elevation, 5.4 meters. Foundation: Glacia sand over clay.

Instruments: Two Bosch-Omori 100 kg. horizontal pendulums (mechanical registration).

Instrumental constants..		V	T_0	ε
	E	80	23	0
	N	50	25	4:1

(Report for October, 1919, not received.)

Missouri. *Saint Louis. St. Louis University.* Geophysical Observatory. J. B. Goesse, S. J.

Lat., 38° 38′ 15″ N.; long., 90° 13′ 58″ W. Elevation, 160.4 meters. Foundation: 12 feet of tough clay over limestone of Mississippi system, about 300 feet thick.

Instrument: Wiechert 80 kg. astatic, horizontal pendulum.

Instrumental constants..	V	T_0	ε
	80	7	5:1

Report for October, 1919, not received.)

New York *Ithaca. Cornell University.* Heinrich Ries.

Lat., 42° 26′ 58″ N.; long., 76° 29′ 09″ W. Elevation, 242.6 meters.

Instruments: Two Bosch-Omori 25 kg. horizontal pendulums (mechanical registration.)

Instrumental constants..		V	T_0	ε
	E	13	22	4:1
	N	14	25	4:1

(Report for October, 1919, not received.)

New York. *New York. Fordham University.* D. H. Sullivan, S. J.

Lat., 40° 51′ 47″ N.; long., 73° 53′ 08″ W. Elevation, 23.9 meters.

Instrument: Wiechert, 80 kg.

Instrumental constants..		V	T_0	ε
	E	72	5.0	0
	N	72	5.0	0

(Report for October, 1919, not received.)

Panama, Canal Zone. *Balboa Heights.* Governor, Panama Canal.

Lat., 8° 57′ 39″ N.; long., 79° 33′ 29″ W. Elevation, 27.6 meters.

Instruments: Two Bosch-Omori, 100 kg.

Instrumental constants..	V	T_0
	35	20

Date.	Character.	Phase.	Time.	Period T.	Amplitude. A_E	Amplitude. A_N	Distance.	Remarks.
			H. M. S.	*Sec.*	*μ.*	*μ.*		
1919. Oct. 9	.....	P_E	9 00 34	.....	.....	.....	183	Probably S. W.
		P_N	9 00 28	.....	.....	.....	.....	
		L_E	9 00 54	.....	.....	.....	.....	
		L_N	9 00 48	.....	.....	.....	.....	
		M_E	9 00 59	.....	*3,500	.....	.....	
		M_N	9 00 54	.....	.....	*3,000	.....	
		F_E	9 03 44	.....	.....	.....	.....	
		F_N	9 03 32	.....	.....	.....	.....	
27	.....	P_N	3 45 48	.....	.....	.....	2,776 ca	Record not clearly defined on the E. W. component.
		S_N	3 50 25	.....	.....	.....	.....	
		L_N	3 54 48	.....	.....	.....	.....	
		M_N	3 50 40	.....	.....	600	.....	
		F_N	4 17 00	.....	.....	.....	.....	

*Trace amplitude.

Porto Rico. *Viegues. Magnetic Observatory.* U. S. Coast and Geodetic Survey. W. M. Hill.

Lat., 18° 09′ N.; long. 65° 27′ W. Elevation, 19.8 meters.

Instruments: Two Bosch-Omori.

Instrumental constants..		V	T_0
	E	10	17
	N	10	19

(Report for October, 1919, not received.)

Vermont. *Northfield. U. S. Weather Bureau.* Wm. A. Shaw.

Lat., 44° 10′ N.; long., 72° 41′ W. Elevation, 256 meters.

Instruments: Two Bosch-Omri, mechanical registration.

Instrumental constants..		V	T_0
	E	10	15
	N	10	16

(No earthquake recorded during October, 1919.)

TABLE 2.—*Instrumental seismological reports, October, 1919*—Continued.

Canada. *Ottawa. Dominion Astronomical Observatory.* Earthquake Station. Otto Klotz.

Lat., 45° 23′ 38″ N.; long., 75° 42′ 57″ W. Elevation, 83 meters.

Instruments: Two Bosch photographic horizontal pendulums, one Spindler & Hoye 80 kg. vertical seismograph.

Instrumental constants. V 120, T_0 26

Date.	Character.	Phase.	Time.	Period T.	Amplitude. A_E	Amplitude. A_N	Distance.	Remarks.
1919.			*H. m. s.*	*Sec.*	*μ*	*μ*	*Km.*	
Oct. 1		i_N	19 49 11					Irregular waves mixed with heavy micros.
		F	19 54 ..					
3		e_E	10 06 30					Heavy micros.
		i_E	10 12 40					
		iL_N	10 30 23	11				
		eL_E	10 31 ..	24				
		L_E	10 35 ..	21				
		L	10 40 ..	15				
		L_E	10 49 ..	13				
		L_E	11 00 ..	13				
		L_E	11 11 ..	12				
		F	11 15 ..					
8		eL_E	5 40 ..					Very faint traces of sinusoidal L waves. Heavy micros.
		F	5 55 ..					
10		O	1 10 07				2,560	
		P_E	1 15 20					Heavy micros.
		S_E	1 19 30					
		eL	1 24 48					
		L	1 29 ..	12				
		L_E	1 30 ..					Very irregular and small L waves after 1 h. 30 m.
		L_E	2 15 ..					
		F	2 20 ..					
12		i_N	22 10 55					Heavy micros obscure all earlier phases.
		i_E	22 11 46					
		eL_E	22 55 ..	35				
		L_E	23 05 ..	20				
		F	23 40 ..					
14		e	17 13 ..					Irregular small waves.
		F	17 25 ..					
21		eL	22 25 ..					Very faint sinusoidal L waves. Barely discernible.
		F	22 50 ..					
27		O	3 40 47				6,560	
		P_N	3 50 50					Heavy micros prevent very accurate readings of initial impulses.
		S	3 58 56					
		eL_E	4 08 ..					
		L_E	4 10 ..					
		F	4 25 ..					
28		$e?_E$	7 36 24					Very faint record. Barely discernible.
		$eL?_E$	7 40 17					
		F	7 50 ..					

Canada. *Toronto. Dominion Meteorological Service.*

Lat., 43° 40′ 01″ N.; long., 79° 23′ 54″ W. Elevation, 113.7 meters. Subsoil: Sand and clay.

Instrument: Milne horizontal pendulum, North; in the meridian.

Instrumental constant T_0 18. Pillar deviation, 1 mm. swing of boom=0.45″.

Date.	Character.	Phase.	Time.	Period T.	Amplitude. A_E	Amplitude. A_N	Distance.	Remarks.
1919.			*H. m. s.*	*Sec.*	*μ*	*μ*	*Km.*	
Oct. 1								Micros on sheet when other station records quake.
3		E	10?02 00					Times doubtful, watch under repairs.
		E	10 06 24					
		S?	10 12 36					
		L	10 19 36					
		L	10 23 06					
		L	10 32 12					
		eL	10 33 36					
		M	10 39 42		*1,300			
		F						

Canada. *Toronto. Dominion Meteorological Service*—Continued.

Date.	Character.	Phase.	Time.	Period T.	Amplitude. A_E	Amplitude. A_N	Distance.	Remarks.
1919.			*H. m. s.*	*Sec.*	*μ*	*μ*	*Km.*	
Oct. 3		L	11 51 48					
		eL	11 59 18					
		M	12?05 54		*300			Marked thickening.
8		i	5 30 42					Times very doubtful, no cut-off.
		eL	5 43 48					
		eL	5 52 00					
		M	5 58 36		*300			
		L	6?27 36					
		L	6?55 06					
		F	6?58 00					
10		eL	1 25 54					Times very doubtful.
		iL	1 27 54					
		M	1 28 00		*1,300			
		F	2 12 00					
12		L	23 10 18					Times doubtful.
		M	23 14 36		*200?			
21		E	22 25 48					
		eL	22 32 54					
		M	22 35 30		*100			
		F						
27		i?	3?47 30					Isolated micros, render initial phases doubtful.
		P	3?51 06					
		S	3 59 18					
		eL	4 10 30					
		M	4 12 30		*300		6?680	
		F	4 36 30					
28		L	7 41 42					
		L	7 48 18					
		M	7 49 12		*200			
		F	7 54 42					

* Trace amplitude.

Canada. *Victoria B. C. Dominion Meteorological Service.*

Lat., 48° 24′ N.; long., 123 19′ W. Elevation, 67.7 meters. Subsoil: Rock.

Instrument: Wiechert, vertical; Milne horizontal pendulum, North; in the meridian.

Instrumental constant T_0 18. Pillar deviation, 1 mm. swing of boom=0.54″.

Date.	Character.	Phase.	Time.	Period T.	Amplitude. A_E	Amplitude. A_N	Distance.	Remarks.
1919.			*H. m. s.*	*Sec.*	*μ*	*μ*	*Km.*	
Oct. 1		P	19 40 25					
		M	19 42 33		*200			
		F	19 47 28					
3		P	10 00 29					
		S?	10?13 51					
		L	10 18 41					
		M	10 27 32		*400			
		F	11 11 18					
8		P?	5 04 53					
		L	5 23 34					
		M	5 35 22		‡800			
		F	7 14 43					
10		P	1 08 01					
		L	1 09 00					
		M	1 09 30		*1,000		450	
		F	2 54 14					
12		L	23?09 48					
		M	23 11 16		*200			
12		M	23 51 06		*200			
13		F	00 14 43					
14		M?	12 04 32		*50			May not be seismic.
21		L?	22 09 15					
		M	22 15 09		*400			
		F	22 32 51					
27		L	4 22 17					
		L	4 23 35					
		F	4 28 17		*100			Small but marked.

* Trace amplitude.