DEPARTMENT OF COMMERCE AND LABOR
COAST AND GEODETIC SURVEY
O. H. TITTMANN, SUPERINTENDENT

RESULTS OF OBSERVATIONS MADE AT THE COAST AND GEODETIC SURVEY MAGNETIC OBSERVATORY AT CHELTENHAM, MARYLAND 1905 AND 1906

BY

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WASHINGTON
GOVERNMENT PRINTING OFFICE
1909

CONTENTS.

ILLUSTRATIONS.

EARTHQUAKES.

In November, 1904, a Bosch-Omori seismograph made of nonmagnetic material and consisting of two horizontal pendulums, one recording north-south motion (N), and the other recording east-west motion (E), was mounted in the north room of the variation building. The following table is a register of the earthquakes recorded up to the end of 1906. The times are Greenwich mean time counted from midnight.

Period of pendulums: N. 25 sec., E. 18–20 sec.
Magnification: 10.
Steady mass: 10–12 kg.

Register of earthquakes recorded at Cheltenham.

No.	Comp.	Date	First P. T. begin	Second P. T. begin	Large waves begin	Maximum	End of principal portion	End	Maximum amp.
		1904.	*h m s*	*h m s*	*h m s*	*h m s*	*h m s*	*h m*	*mm*
1	N	Dec. 2	2 30 59	. . .	2 36 29	. . .	. . .	2 55	1.9
1	E	2	2 30 32	. . .	2 36 16	. . .	. . .	3 06	2.0
2	N	20	5 51 01	5 56 11	5 59 59	6 04 19	. . .	7 41	27.7
3	N	21	1 28 50	. . .	1 40 00	. . .	. . .	1 58	1.4
3	E	21	. . .	. . .	1 38 50	. . .	. . .	1 58	1.6
		1905.							
4	N	Jan. 20	18 06 19	18 11 15	18 14 15	18 16 15	. . .	18 30	0.5
4	E	20	. . .	18 12 55	18 16 00	18 17 15	. . .	. .	0.5
5	N	22	3 05 35	3 30 00	3 55 35	4 02 00	. . .	5 00	0.5
5	E	22	3 06 28	3 24 08	3 46 12	. . .	. . .	5 00	0.4
6	E	Feb. 13	5 54 00	. . .	. . .	6 28 30	. . .	6 58	...
7	N	14	9 09 06	. . .	9 22 00	9 33 00	. . .	10 46	2.5
7	E	14	9 07 00	. . .	9 22 00	9 27 50	. . .	10 58	4.0
8	N	17	12 34 20	. . .	12 46 20	. . .	. . .	13 12	...
8	E	17	12 30 33	. . .	12 45 33	. . .	. . .	13 11	...
9	N	19	5 26 00	. . .	5 37 00	. . .	. . .	6 20	0.3
9	E	19	5 05 20	. . .	5 38 20	. . .	. . .	5 58	0.5
10	E	26	3 26 10	. . .	. . .	. . .	. . .	3 59	...
11	N	Mar. 5	0 20 50	. . .	0 25 50	. . .	. . .	0 57	...
11	E	5	0 21 10	. . .	0 24 10	0 27 10	. . .	1 06	0.7
12	N	6	1 46 00	. . .	. . .	. . .	. . .	1 58	...
12	E	6	1 42 10	. . .	. . .	. . .	. . .	2 05	...
13	N	19	0 32 00	. . .	1 00 00	. . .	. . .	1 44	...
13	E	19	0 32 20	. . .	1 02 00	. . .	. . .	1 44	...
14	N	22	3 58 42	. . .	4 12 00	4 25 52	. . .	5 43	4.7
14	E	22	3 59 16	. . .	4 12 00	4 23 52	. . .	5 47	2.2
15	N	22	11 48 00	. . .	. . .	. . .	. . .	12 07	...
15	E	22	11 46 20	. . .	. . .	. . .	. . .	12 00	...
16	N	Apr. 4	1 08 45	1 18 10	1 35 00	1 52 05			10.6
	N					2 00 45	. . .	3 47	3.0
16	E	4	1 08 50	1 23 30	1 35 50	1 53 00			4.3
	E					1 58 40	. . .	3 58	...
17	N	19	13 19 00	. . .	. . .	. . .	. . .	13 40	...
17	E	19	13 20 20	. . .	. . .	. . .	. . .	13 42	...
18	N	26	21 53 00	22 01 00	. . .	. . .	. . .	22 37	...
18	E	26	21 54 00	22 01 00	. . .	. . .	. . .	22 37	...
19	N	May 9	6 51 24	6 53 52	6 56 25	6 58 24	. . .	7 21	1.6
19	E	9	6 51 43	. . .	6 57 43	6 58 03	. . .	7 17	0.8
20	N	18	. . .	. . .	14 37 00	. . .	. . .	15 32	...
20	E	18	. . .	. . .	14 37 00	. . .	. . .	15 32	...
21	N	June 9	. . .	. . .	13 30 00	. . .	. . .	13 53	...
21	E	9	. . .	. . .	13 26 00	. . .	. . .	14 04	...
22	E	12	. . .	. . .	6 19 00	. . .	. . .	6 36	...
23	N	14	12 12 14	. . .	. . .	. . .	. . .	13 38	...
23	E	14	. . .	. . .	12 24 30	. . .	. . .	17 14	...
24	N	30	17 48 40	. . .	. . .	. . .	. . .	20 09	...
24	E	30	17 32 40	. . .	18 05 40	. . .	. . .	20 02	...
25	N	30	20 17 14	. . .	. . .	20 24 00	. . .	20 54	2.5
25	E	30	20 23 14	. . .	. . .	20 26 45	. . .	20 49	1.5
26	N	July 6	0 50 00	. . .	. . .	1 31 00	. . .	2 08	0.4
26	E	6	. . .	. . .	. . .	1 31 00	. . .	2 04	0.5

Register of earthquakes recorded at Cheltenham—Continued.

No.	Comp.	Date	First P. T. begin	Second P. T. begin	Large waves begin	Maximum	End of principal portion	End	Maximum amp.
		1905.	*h m s*	*h m s*	*h m s*	*h m s*	*h m s*	*h m*	*mm*
27	N	July 9	10 04 22	.. .. ..	10 29 26	10 35 28	10 47 26	12 04	13.6
27	E	9	10 04 23	.. .. ..	10 24 28	10 33 36	10 44 34	12 02	22.0
28	N	14	9 07 17	.. .. ..	9 16 28	9 18 14	9 21 58	9 47	1.5
28	E	14	9 07 07	.. .. ..	9 16 56	9 18 20	9 21 53	10 02	9.2
29	N	23	3 00 00	3 10 03	3 33 14	3 47 08	4 02 22	5 48	39.4
29	E	23	.. .. ..	3 10 24	3 26 19	3 39 28	4 02 22	5 48	30.5
30	N	Aug. 22	5 10 31	.. .. ..	5 10 44	5 11 13	5 11 25	5 13	0.2
30	E	22	5 10 35	.. .. ..	5 10 48	5 11 08	5 11 48	5 13	0.2
31	N	Sept. 8	2 03 20	.. .. ..	.. .. ..	.. .. ..	.. .. ..	2 49	...
31	E	8	2 03 12	.. .. ..	.. .. ..	.. .. ..	.. .. ..	2 58	...
32	N	15	6 14 36	6 23 45	6 39 43	6 50 14	6 51 46	9 20	4.5
32	E	15	6 14 28	6 23 30	6 38 12	6 50 34	6 53 42	9 24	16.5
33	N	Oct. 14	14 41 09	14 44 40	14 48 10	14 51 17	14 53 37	15 12	0.5
33	E	14	.. .. ..	14 44 49	14 48 47	14 49 42	14 50 50	15 11	1.0
34	N	15	21 46 44	21 50 42	21 52 02	21 56 02	22 01 40	22 49	1.2
34	E	15	21 46 53	21 50 22	21 51 45	21 54 48	21 58 25	22 50	3.6
35	N	24	17 55 28	.. .. ..	18 00 19	18 01 58	18 03 08	18 40	1.8
35	E	24	.. .. ..	.. .. ..	18 01 35	18 03 39	18 03 46	.. ..	1.7
36	N	Nov. 8	22 26 36	.. .. ..	22 38 30	22 43 24	22 45 50	23 30	0.6
36	E	8	.. .. ..	.. .. ..	22 42 03	22 46 15	22 51 45	23 30	0.7
37	N	Dec. 17	5 41 42	5 44 24	5 47 24	5 48 23	5 52 34	6 35	14.8
37	E	17	5 37 48	5 42 46	5 47 40	5 50 48	5 52 44	6 46	12.7
38	N	17	9 46 00	.. .. ..	9 51 50	9 53 06	9 55 26	10 37	3.1
38	E	17	9 42 24	.. .. ..	9 52 58	9 55 34	10 00 04	10 54	4.5
39	N	17	11 36 27	.. .. ..	11 36 54	11 37 12	11 38 53	11 53	0.9
39	E	17	11 36 21	.. .. ..	11 38 24	11 39 30	11 39 58	11 52	0.7
		1906.							
40	N	Jan. 21	14 12 38	.. .. ..	.. .. ..	.. .. ..	.. .. ..	.. ..	...
40	E	21	14 13 42	.. .. ..	.. .. ..	.. .. ..	.. .. ..	.. ..	...
41	N	24	.. .. ..	.. .. ..	7 03 42	7 04 44	7 07 46	7 36	1.2
41	E	24	.. .. ..	.. .. ..	7 04 00	7 05 04	7 09 00	7 36	0.8
42	N	24	7 41 37	.. .. ..	7 42 12	7 43 40	7 48 38	8 00	0.8
42	E	24	7 41 40	.. .. ..	7 42 20	7 45 14	7 50 00	7 54	1.1
43	N	24	21 58 54	.. .. ..	21 59 22	22 01 32	22 04 30	22 20	0.5
43	E	24	21 58 56	.. .. ..	21 59 16	22 01 32	22 03 30	22 20	0.5
44	N	25	20 46 16	.. .. ..	20 46 56	20 47 42	20 49 52	20 57	0.5
44	E	25	20 46 48	.. .. ..	20 47 12	20 49 32	20 51 04	20 55	0.8
45	N	27	.. .. ..	.. .. ..	10 19 24	10 26 56	10 36 44	10 50	0.7
45	E	27	.. .. ..	.. .. ..	10 19 22	10 27 02	10 29 22	10 50	1.1
46	N	31	15 43 34	15 44 58	15 50 50	16 03 32	16 18 00	19 08	38.8
46	E	31	15 43 34	15 44 38	15 50 10	16 07 50	16 30 30	19 20	33.0
47	N	Feb. 1	23 38 28	.. .. ..	.. .. ..	.. .. ..	.. .. ..	24 03	...
47	E	1	23 38 34	.. .. ..	.. .. ..	23 45 00	.. .. ..	24 00	0.2
48	N	16	17 45 15	17 47 09	17 55 27	17 57 12	17 57 35	18 16	0.4
48	E	16	17 45 07	.. .. ..	17 51 53	17 56 23	17 58 30	18 14	0.9
49	N	19	2 30 36	.. .. ..	3 02 04	3 12 20	3 15 50	4 10	1.0
49	E	19	2 30 15	.. .. ..	3 01 54	3 09 44	3 16 54	4 04	4.8
50	N	Mar. 3	8 47 08	8 51 20	8 53 21	8 54 19	9 00 16	9 46	7.3
50	E	3	8 47 08	8 51 10	8 53 38	8 54 48	8 57 00	10 04	39.2
51	N	Apr. 10	21 34 14	.. .. ..	21 36 58	21 40 16	21 43 10	22 45	34.5
51	E	10	21 33 53	.. .. ..	21 38 15	21 42 29	21 45 58	22 53	18.5
52	N	18	13 19 26	13 25 01	13 30 08	13 34 20	13 42 00	16 42	42.3
52	E	18	13 19 04	13 25 00	13 29 24	13 35 54	13 45 30	17 12	36.9
53	N	18	18 23 46	.. .. ..	.. .. ..	.. .. ..	.. .. ..	18 28	...
53	E	18	18 23 30	.. .. ..	.. .. ..	.. .. ..	.. .. ..	18 30	...
54	N	19	0 45 14	.. .. ..	0 45 50	0 46 10	0 47 20	1 21	2.0
54	E	19	0 45 20	.. .. ..	0 46 02	0 48 36	0 52 04	1 24	0.8
55	N	19	7 54 16	.. .. ..	.. .. ..	8 03 48	.. .. ..	8 12	0.1
55	E	19	7 54 10	.. .. ..	.. .. ..	8 07 44	.. .. ..	8 30	0.2
56	N	23	9 28 54	.. .. ..	9 30 38	9 30 50	9 31 58	9 38	0.4
56	E	23	9 28 52	.. .. ..	9 30 25	9 33 02	.. .. ..	9 44	0.6
57	N	June 1	4 52 54	.. .. ..	5 33 30	5 40 02	5 45 42	6 50	0.8
57	E	1	4 52 47	.. .. ..	5 35 12	5 40 02	5 46 52	6 48	0.6
58	N	July 16	19 05 41	.. .. ..	19 05 55	19 06 11	19 06 13	19 12	0.2
58	E	16	19 05 46	.. .. ..	19 06 03	19 06 14	19 06 40	19 10	0.1
59	N	20	11 34 34	.. .. ..	.. .. ..	.. .. ..	.. .. ..	11 58	...
59	E	20	11 34 36	.. .. ..	11 41 32	11 44 48	11 45 20	11 54	0.1

Register of earthquakes recorded at Cheltenham—Continued.

No.	Comp.	Date	First P. T. begin	Second P. T. begin	Large waves begin	Maximum	End of principal portion	End	Maximum amp.
		1906.	*h m s*	*h m s*	*h m s*	*h m s*	*h m s*	*h m*	*mm*
60	N	Aug. 17	0 21 48	0 31 10	0 42 48	0 53 29	0 58 00	4 05	38.1
60	E	17	0 21 54	0 31 16	0 42 46	0 53 18	0 59 20	4 15	44.0
61	N	20	10 46 01	.. .. ..	.. .. ..	.. .. ..	.. .. ..	10 54	...
61	E	20	10 46 11	.. .. ..	.. .. ..	.. .. ..	.. .. ..	10 58	...
62	N	24	2 12 22	.. .. ..	2 16 29	2 18 17	2 18 37	2 28	0.4
62	E	24	2 12 08	.. .. ..	2 14 20	2 16 00	2 20 05	2 27	0.2
63	N	26	6 32 28	.. .. ..	7 07 00	7 12 00	.. .. ..	8 02	0.3
63	E	26	6 33 02	.. .. ..	7 07 23	7 10 24	.. .. ..	8 28	0.4
64	N	28	5 28 41	5 31 27	5 34 10	5 34 48	5 35 10	6 09	1.3
64	E	28	5 28 42	.. .. ..	5 35 44	5 36 50	5 37 08	6 24	1.0
65	N	30	2 48 33	2 56 21	3 07 04	3 14 20	3 24 46	4 12	0.5
65	E	30	2 48 35	2 56 28	3 06 18	3 13 04	3 23 27	4 14	0.4
66	N	Sept. 7	19 37 00	.. .. ..	.. .. ..	.. .. ..	.. .. ..	20 48	0.2
66	E	7	19 22 00	.. .. ..	.. .. ..	.. .. ..	.. .. ..	20 53	0.5
67	N	14	16 32 ?	16 38 52	17 00 00	17 04 17	17 26 13	18 49	1.0
67	E	14	16 24 48	16 38 39	16 59 33	17 17 33	17 51 28	19 02	3.0
68	N	27	14 45 56	.. .. ..	14 50 21	14 50 37	.. .. ..	15 05	0.1
68	E	27	14 46 05	.. .. ..	14 50 10	14 50 54	.. .. ..	15 14	0.2
69	N	28	15 32 25	15 38 32	15 43 28	15 38 41	.. .. ..	16 41	1.6
69	E	28	15 32 21	15 38 31	15 42 15	15 42 31	.. .. ..	16 38	0.9
70	N	Oct. 2	2 13 54	.. .. ..	.. .. ..	2 54 19	.. .. ..	4 24	0.3
70	E	2	2 13 15	2 25 26	2 35 00	3 06 03	.. .. ..	4 29	0.9
71	N	24	15 14 46	.. .. ..	15 28 54	.. .. ..	.. .. ..	16 19	0.3
71	E	24	15 23 23	.. .. ..	15 27 43	15 37 00	.. .. ..	16 21	0.4
72	N	31	2 36 29	.. .. ..	.. .. ..	.. .. ..	.. .. ..	2 48	0.1
72	E	31	2 35 32	.. .. ..	.. .. ..	.. .. ..	.. .. ..	2 52	0.3
73	N	Nov. 14	18 23 44	.. .. ..	18 25 41	18 38 14	.. .. ..	19 17	0.4
73	E	14	18 20 34	.. .. ..	18 33 56	18 40 46	.. .. ..	19 22	0.6
74	E	19	7 38 24	7 58 32	8 26 28	8 59 42	9 12 04	9 55	0.7
75	N	Dec. 3	23 04 51	.. .. ..	.. .. ..	.. .. ..	.. .. ..	.. ..	...
75	E	3	23 04 46	.. .. ..	.. .. ..	.. .. ..	.. .. ..	.. ..	...
76	N	8	21 35 03	.. .. ..	.. .. ..	21 35 50	.. .. ..	21 42	0.6
76	E	8	21 35 26	.. .. ..	.. .. ..	21 38 01	.. .. ..	21 42	0.3
77	N	16	23 54 10	.. .. ..	.. .. ..	23 55 17	.. .. ..	24 03	0.2
77	E	16	23 54 03	.. .. ..	.. .. ..	23 55 17	.. .. ..	24 03	0.2
78	N	19	1 40 53	.. .. ..	1 58 52	2 12 32	2 30 44	3 47	0.6
78	E	19	1 39 26	.. .. ..	2 08 04	2 12 27	2 33 20	3 54	2.0
79	N	22	18 38 17	.. .. ..	19 16 22	19 22 18	.. .. ..	20 53	7.3
79	E	22	18 37 38	.. .. ..	19 10 55	19 19 45	.. .. ..	20 34	2.2
80	N	23	7 12 03	.. .. ..	7 31 53	7 38 48	.. .. ..	8 54	0.5
80	E	23	7 12 40	.. .. ..	7 33 16	7 33 31	.. .. ..	8 01	0.5
81	N	23	.. .. ..	17 39 58	17 46 48	17 52 06	.. .. ..	18 53	5.8
81	E	23	.. .. ..	17 40 09	17 45 57	17 49 41	.. .. ..	18 35	15.2
82	N	26	6 03 21	6 11 10	6 22 33	6 29 18	.. .. ..	.. ..	1.5
82	E	26	6 03 47	6 11 13	.. .. ..	.. .. ..	.. .. ..	.. ..	?

REMARKS.

Nos. 8, 9, 11, 14, 15, 17, 20, 21, 22, and 23: Probably principal portion of distant earthquake.

No. 6: N — S pendulum out of adjustment.

Nos. 41, 45: Beginning obscured by wind disturbance.

No. 60: Aleutian Islands earthquake. At 0h. 58m. 44s. the larger waves on N show the smaller waves of the preliminary tremors of the Chilean earthquake, continuing up to about 1h. 33m.

Nos. 69, 70, 71: Phases uncertain.

No. 74: N — S pendulum out of adjustment.

Nos. 75, 81, 82: Phases obscured by wind disturbance.

No. 78: Beginning doubtful.

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CONTENTS.

ILLUSTRATIONS.

EARTHQUAKES.

A Bosch-Omori seismograph, made of nonmagnetic material, has been in operation since November, 1904. Up to October 5, 1907, it was mounted in the room with the Eschenhagen magnetograph. The record was seriously impaired, however, by the effect of wind pressure upon the broad sides of the variation building, and on the latter date the instrument was transferred to a separate building especially constructed for the purpose. This building is of concrete, with a light wooden roof. It consists of an inner room 10 feet square surrounded on the eastern half by a bank of earth and on the western half by a corridor 3 feet wide. The floors and walls of both the inner room and the corridor are of grouted concrete. The upper portion of the outside wall of the corridor is extended around the inner room as a support for the roof, which is firmly bolted to iron straps set in the concrete. The building is banked to the eaves on three sides, leaving only the west side and the roof exposed to the action of wind and sunshine.

The pier on which the seismograph is mounted is a single block of concrete extending 4 feet below the floor and 2 feet above. Its horizontal section is L-shaped, one arm pointing north, the other west. Each arm is 20 inches wide and about 6 feet long. The seismograph pedestals are fastened to the pier by heavy iron bolts set in the concrete. A space of 6 inches is left between the pier and the floor on all sides. The soil in which the pier rests is a mixture of clay and fine sand.

The seismograph consists of two horizontal pendulums, one recording north-south motion (N.) and the other recording east-west motion (E.).

In the following table the times are Greenwich mean time counted from midnight:

Period of pendulums.

N.	Seconds	E.	Seconds
1907.		1907.	
Jan. 1 to Apr. 1	20	Jan. 1 to Sept. 24	18
Apr. 1 to May 30	25	Oct. 16	25
June 1 to June 30	28	Dec. 30	24
July 1 to Sept. 2	27		
Sept. 23	20	1908.	
Oct. 16 to Dec. 31	27	Jan. 1 to June 30	24
		July 1 to Dec. 31	25
1908.			
Jan. 1 to June 30	27		
July 1 to Dec. 31	28		

Magnification: N. 10.
E. 10 up to June 30, 1908.
E. 15 after June 30, 1908.
Steady mass: 10-12 kg.

Register of earthquakes recorded at Cheltenham, Md.

No.	Date	Component	First P. T. begin	Second P. T. begin	Large waves begin	Maximum	End of principal portion	End	Maximum amplitude.
	1907.		*h m s*	*h m s*	*h m s*	*h m s*	*h m s*	*h m*	*mm*
83	Jan. 2	N	.. .. ..	.. .. ..	12 40 40	12 53 04	13 07 ..	14 06	1.4
83	2	E	12 14 40	12 24 10	12 48 50	12 54 32	13 19 50	15 16	3.5
84	4	N	5 41 34	5 51 16	5 59 56	6 45 13	6 57 20	8 00	5.5
84	4	E	5 42 ..	6 00 33	6 19 46	6 42 31	6 55 ..	8 00	2.0
85	14	N	20 42 46	20 46 40	20 47 54	20 54 10	20 55 00	21 30	0.8
85	14	E	20 42 54	20 46 34	20 47 56	20 51 16	20 52 40	21 40	3.0
86	Apr. 15	N	6 13 22	6 18 34	6 21 00	6 27 10	6 33 00	8 45	86.0
86	15	E	6 13 22	6 18 34	6 20 44	6 29 20	.. .. ..	.. ..	45.0
87	18	N	21 32 ..	.. .. ..	.. .. ..	22 17 20	.. .. ..	22 49	0.2
88	19	N	0 24 ..	.. .. ..	1 05 04	1 14 40	.. .. ..	1 52	0.5
89	June 1	N	8 47 28	8 53 40	8 56 26	9 04 15	9 10 43	10 33	1.2
89	1	E	8 47 36	8 53 33	8 56 30	9 06 32	9 10 20	10 30	0.8
90	5	N	3 29 00	3 34 48	3 43 36	3 47 10	3 52 00	23 38	1.2
90	5	E	3 29 24	3 34 52	3 41 00	3 48 06	3 50 43	23 40	1.4
91	13	N	9 30 10	9 39 54	9 55 20	9 40 00	10 08 ..	10 20	0.5
91	13	E	9 30 12	9 39 50	.. .. ..	9 40 30	.. .. ..	10 20	0.6
92	July 1	N	13 14 48	.. .. ..	13 22 08	13 25 08	13 28 38	14 15	6.6
92	1	E	13 14 54	13 19 32	13 22 50	13 26 40	13 28 40	14 15	4.8
93	5	N	.. .. ..	.. .. ..	7 17 24	7 21 20	7 22 30	.. ..	0.2
93	5	E	6 57 52	6 59 14	7 04 40	7 05 20	7 06 20	7 40	0.5
94	Sept. 2	N	16 12 44	.. .. ..	16 32 10	16 46 50	16 51 30	19 40	10.0
94	2	E	16 12 41	16 22 10	16 32 00	16 42 00	16 54 41	19 40	35.6
95	23	N	21 51 16	.. .. ..	21 57 01	21 57 19	.. .. ..	22 50	2.3
95	23	E	21 54 ..	.. .. ..	21 58 04	21 59 04	.. .. ..	22 50	2.1
96	Oct. 16	N	13 59 44	.. .. ..	14 13 50	14 14 30	.. .. ..	16 00	65.0
96	16	E	13 59 44	.. .. ..	14 13 56	14 16 50	.. .. ..	16 00	40.0
97	Dec. 30	N	5 32 52	5 37 44	5 38 28	5 43 54	5 49 44	6 50	35.0
97	30	E	5 32 58	5 37 43	5 38 34	5 44 39	5 48 46	7 00	64.0
	1908.								
98	Feb. 1	N	23 17 20	23 23 47	23 28 47	23 31 47	23 40 47	24 00	3.5
98	1	E	23 16 55	23 24 15	23 28 45	23 30 45	23 40 38	24 05	1.5
99	9	N	3 36 16	.. .. ..	3 42 30	3 43 08	3 45 50	4 01	1.5
99	9	E	3 35 56	.. .. ..	3 41 30	3 42 25	3 46 00	4 00	1.5
100	9	N	9 24 15	.. .. ..	9 25 15	9 26 00	.. .. ..	9 35?	0.5
100	9	E	9 21 00	.. .. ..	9 25 00	9 26 00	.. .. ..	9 35	0.2
101	14	N	9 00 00	.. .. ..	9 06 32	9 06 36	.. .. ..	9 25?	0.5
101	14	E	9 00 08	.. .. ..	9 07 32	9 11 02	.. .. ..	9 25	0.3
102	14	N	11 49 22	.. .. ..	.. .. ..	11 53 22	.. .. ..	11 57	0.1
102	14	E	11 49 20	.. .. ..	.. .. ..	11 53 12	.. .. ..	12 01	0.1
103	Mar. 1	N	20 40 ..	.. .. ..	.. .. ..	20 42 25	.. .. ..	20 50	0.4
103	1	E	20 40 ..	.. .. ..	.. .. ..	20 42 00	.. .. ..	20 53	0.2
104	3	N	23 51 30	.. .. ..	.. .. ..	.. .. ..	.. .. ..	23 57	...
104	3	E	23 49 20	.. .. ..	.. .. ..	.. .. ..	.. .. ..	24 01	...
105	5	N	2 39 11	.. .. ..	3 19 00	3 25 00	.. .. ..	4 00	0.3
105	5	E	2 39 10	.. .. ..	3 19 00	3 29 30	.. .. ..	4 00	0.2
106	25	N	19 01 15	19 06 03	19 09 30	19 13 45	19 17 15	19 50	0.9
106	25	E	19 01 15	19 06 05	19 10 00	19 12 55	19 18 10	19 50	0.3
107	26	N	23 09 36	23 14 08	23 19 58	23 22 38	23 31 00	1 22	55.5
107	26	E	23 09 34	23 14 08	23 19 52	23 26 06	23 30 30	1 15	21.0
108	27	N	3 52 54	3 58 08	4 03 23	4 06 43	.. .. ..	5 10	3.8
108	27	E	3 52 ?	.. .. ..	4 05 54	4 09 12	.. .. ..	4 50	1.2
109	Apr. 11	N	21 40 33	.. .. ..	.. .. ..	21 44 30	.. .. ..	21 48	0.3
109	11	E	21 43 20	.. .. ..	.. .. ..	21 43 25	.. .. ..	?	...
110	23	N	0 51 ?	.. .. ..	.. .. ..	1 05 00	.. .. ..	2 00	0.2
111	30	N	0 04 30	0 07 25	0 10 00	0 11 00	0 13 25	0 30	0.5
112	May 5	N	6 39 43	6 40 45	.. .. ..	7 40 35	.. .. ..	8 03	0.4
112	5	E	6 40 38	.. .. ..	.. .. ..	.. .. ..	.. .. ..	6 55	...
113	15	N	8 39 50	8 46 38	8 54 24	8 55 40	9 04 30	10 32	6.7
113	15	E	8 39 50	.. .. ..	8 54 48	8 55 40	.. .. ..	9 35	9.7
114	17	N	16 14 30	.. .. ..	.. .. ..	16 17 50	.. .. ..	16 22	0.1
115	June 14	N	6 11 38	.. .. ..	6 14 ..	.. .. ..	.. .. ..	6 25	0.1
115	14	E	6 11 43	.. .. ..	.. .. ..	6 11 58	.. .. ..	6 20	0.1
116	30	N	17 45 18	.. .. ..	17 52 ..	.. .. ..	.. .. ..	18 07	0.1
116	30	E	17 45 44	.. .. ..	17 54 ..	17 55 38	.. .. ..	18 07	0.2
117	Aug. 14	N	0 50 19	0 57 00	.. .. ..	1 01 17	.. .. ..	1 42	1.1
117	14	E	0 49 25	.. .. ..	.. .. ..	1 04 41	.. .. ..	1 43	0.2
118	17	N	10 56 00	.. .. ..	11 28 48	11 38 58	.. .. ..	12 19	0.5
118	17	E	10 56 00	.. .. ..	.. .. ..	.. .. ..	.. .. ..	11 53	0.1
119	19	N	23 49 49	.. .. .	.. . .	23 50 01	. .. ..	23 57	0.1

Register of earthquakes recorded at Cheltenham, Md.—Continued.

No.	Date	Component	First P. T. begin	Second P. T. begin	Large waves begin	Maximum	End of principal portion	End	Maximum amplitude.
	1907.		*h m s*	*h m s*	*h m s*	*h m s*	*h m s*	*h m*	*mm*
119	Aug. 19	E	23 49 52	.. .. .	. .. .	23 50 38	.. .. ..	23 57	0.1
120	20	N	10 45 35	.. . .	.. .. ..	10 59 15	.. .. ..	11 16	0.2
121	Sept. 21	N	6 46 04	6 55 59	7 08 36	7 10 26	.. .. ..	9 00	2.3
121	21	E	6 46 49	.. .. ..	7 11 33	7 16 01	.. .. ..	8 36	0.2
122	Oct. 13	N	5 12 36	5 17 30	5 22 36	5 36 14	5 42 41	7 45	1.4
122	13	E	5 12 33	5 17 26	5 24 57	5 30 17	5 39 31	?	0.2
123	Nov. 2	N	6 38 57	.. . ..	.. .. ..	6 45 37	.. .	7 03	0.2
124	6	N	7 22 09	7 32 34	8 02 25	8 11 35	8 18 04	8 37	0.5
124	6	E	7 22 19	7 42 47?	7 56 06	8 00 21	8 05 49	?	0.1
125	30	N	21 53 38	.. .. ..	21 59 56	22 00 34	.. .. ..	22 39	3.0
125	30	E	21 53 57	.. .. ..	21 59 56	22 00 41	.. .. .	22 28	2.5
126	Dec. 12	N	13 51 53	.. . ..	.. .. ..	14 02 13	.. . ..	14 28	0.4
127	28	N	4 30 37	4 41 17	4 51 17	5 00 52	.. .. ..	5 50	0.3
127	28	E	4 31 30	4 40 28	4 50 42	4 58 25	.. .. ..	5 50	0.7

REMARKS.

No. 83 N: Beginning uncertain.

Nos. 87 E and 88 E: Record indistinct.

No. 103: No distinct phases.

No. 104: Possibly artificial disturbance.

No. 107: The first and second phases begin with longer waves of large amplitude followed by shorter waves of small amplitude.

Nos. 110 and 114: No short waves. No record on E.

Nos. 112 and 115: Well-marked series of short waves followed on N by a few feeble long waves. No long waves on E.

Nos. 120, 123, 126: A series of long waves. Nothing on E.

No. 122: Possibly a second shock from 6.56 to 7.15.

Nos. 121, 124: Pulsatory tremors on E.

MAGNETIC STORMS.

Magnetic disturbances of considerable magnitude were recorded at the Cheltenham Observatory on the days tabulated below. The table gives the local mean time of the beginning of the disturbance, the approximate duration, and the magnitude, designated by the figures 1, 2, 3, 4. Where the storm began abruptly the time of beginning is given to the nearest minute.

On the succeeding pages will be found reproductions of the magnetograms showing the principal magnetic storms. The storms selected for reproduction are indicated in the table by an asterisk after the date. An upward motion of the curves corresponds to increasing west declination, increasing H and increasing Z.

For convenience in comparing with similar reproductions for other observatories, the time scale has been marked for *Greenwich mean time*.

DEPARTMENT OF COMMERCE AND LABOR
COAST AND GEODETIC SURVEY
O. H. TITTMANN, SUPERINTENDENT

RESULTS OF OBSERVATIONS MADE AT THE COAST AND GEODETIC SURVEY MAGNETIC OBSERVATORY AT CHELTENHAM, MARYLAND 1909 AND 1910

BY

DANIEL L. HAZARD
Computer, Division of Terrestrial Magnetism

WASHINGTON
GOVERNMENT PRINTING OFFICE
1912

CONTENTS.

ILLUSTRATIONS.

EARTHQUAKES.

A Bosch-Omori seismograph has been in operation at Cheltenham since November, 1904. It consists of two horizontal pendulums, one recording north-south motion (N.) and the other recording east-west motion (E.). In the following register of earthquakes the times are Greenwich mean time counted from midnight.

Constants of pendulums.

Date.	Period		Magnification		Steady mass	
	N.	E.	N.	E.	N.	E.
	s	*s*			*kg*	*kg*
Jan. 1 to July 7, 1909.....	28	25	10	15	10–12	10–12
July 30 to Dec. 31, 1909.....	36	25	10	10	10–12	10–12
Jan. 1 to Dec. 31, 1910.....	28	25	10	10	10–12	10–12

Register of earthquakes.

No.	Date	Component	First P. T. begin	Second P. T. begin	Large waves begin	Maximum	End of principal portion	End	Maximum amplitude
	1909.		*h m s*	*h m s*	*h m s*	*h m s*	*h m*	*h m*	*mm*
128	Jan. 12	N	0 05 47	.. .. ..	.. .. ..	0 06 24	.. ..	0 13	0.2
128	12	E	0 05 50	.. .. ..	.. .. ..	0 06 22	.. ..	0 15	0.3
129	12	N	10 22 30	.. .. ..	.. .. ..	.. .. ..	.. ..	10 41	0.1
130	12	N	12 22 20	.. .. ..	.. .. ..	12 31 ..	.. ..	12 52	0.1
130	12	E	12 22 30	.. .. ..	.. .. ..	12 30 ..	.. ..	12 55	0.1
131	21	N	21 44 50	.. .. ..	.. .. ..	21 48 50	.. ..	21 52	0.1
131	21	E	21 44 48	.. .. ..	.. .. ..	21 49 06	.. ..	21 52	0.1
132	23	N	3 12 13	.. .. ..	3 33 30	3 47 04	.. ..	4 29	1.1
132	23	E	3 12 11	.. .. ..	3 32 30	3 47 02	.. ..	4 35	0.4
133	Feb. 16	N	16 56 38	.. .. ..	.. .. ..	16 57 27	.. ..	17 16	0.5
133	16	E	16 56 38	.. .. ..	.. .. ..	16 55 00	.. ..	17 16	0.4
134	22	N	9 40 00	9 46 45	.. .. ..	9 46 52	.. ..	10 07	0.2
134	22	E	9 40 00	9 45 05	.. .. ..	9 49 18	.. ..	10 06	0.2
135	26	N	16 53 06	16 58 22	.. .. ..	17 02 ..	.. ..	17 24	0.2
135	26	E	16 52 50	16 58 24	.. .. ..	17 02 ..	.. ..	17 24	0.2
136	Mar. 8	E	.. .. ..	.. .. ..	12 24 ..	12 32 05	.. ..	12 45	0.2
137	12	N	.. .. ..	.. .. ..	23 41 20	.. .. ..	.. ..	23 48	0.1
138	13	N	0 07 53	.. .. ..	.. .. ..	0 18 41	.. ..	0 38	0.1
138	13	E	0 07 11	.. .. ..	.. .. ..	0 17 28	.. ..	0 38	0.2
139	13	N	14 46 46	.. .. ..	15 20 ..	15 23 47	.. ..	15 45	0.1
139	13	E	14 47 35	.. .. ..	15 20 ..	15 23 45	.. ..	16 05	0.3
140	Apr. 10	N	.. .. ..	5 52 25	6 12 49	6 24 06	.. ..	7 13	0.2
140	10	E	.. .. ..	.. .. ..	6 21 ..	.. .. ..	6 45	.. ..	0.1
141	10	N	18 57 40	19 05 56	19 19 06	19 24 04	19 35	19 47	0.5
141	10	E	18 55 29	.. .. ..	19 18 15	19 20 59	19 26	19 46	0.5
142	10	N	19 47 22	19 57 10	20 13 42	20 31 36	20 36	20 57	0.3
142	10	E	19 47 30	19 57 12	20 13 32	20 24 51	.. ..	20 57	0.2
143	14	N	20 44 24	.. .. ..	21 00 47	21 05 46	.. ..	21 15	0.1
144	25	N	.. .. ..	.. .. ..	1 28 26	1 29 54	1 33	1 48	0.3
144	25	E	.. .. ..	.. .. ..	1 28 33	1 29 44	1 33	1 47	0.2
145	May 5	N	2 50 25	.. .. ..	2 53 01	2 56 30	.. ..	3 05	0.2
145	5	E	2 49 27	.. .. ..	2 52 41	2 52 51	.. ..	3 05	0.2
146	12	N	0 04 17	.. .. ..	.. .. ..	0 20 38	.. ..	0 51	0.1
147	16	N	.. .. ..	.. .. ..	4 26 18	4 26 42	4 28	4 51	0.5
147	16	E	4 19 08	4 23 22	4 26 26	4 26 52	4 28	4 50	0.8
148	17	N	8 12 30	8 20 23	8 26 02	8 27 48	8 46	9 25	0.4
148	17	E	8 12 30	8 20 24	8 25 52	8 27 53	8 43	9 20	0.7
149	18	N	17 02 23	17 06 15	17 07 05.	17 07 56	17 16	17 37	0.5
149	18	E	17 02 04	17 05 58	17 06 46	17 07 20	17 14	17 36	0.4
150	18	N	18 31 59	.. .. ..	18 32 56	18 33 32	18 37	18 56	0.3
150	18	E	18 32 20	.. .. ..	.. .. ..	18 33 22	.. ..	18 56	0.1
151	26	N	14 41 41	.. .. ..	.. .. ..	14 42 11	.. ..	14 55	0.1
151	26	E	14 41 21	.. .. ..	.. .. ..	14 42 06	.. ..	14 58	0.1
152	June 3	N	18 59 58	.. .. ..	19 45 15	20 07 40	20 21	21 04	2.2
152	3	E	.. .. ..	.. .. ..	19 43 38	19 59 35	20 14	20 44	0.6
153	8	N	5 57 40	6 06 16	6 14 28	6 26 35	6 31	7 18	1.8

Register of earthquakes—Continued.

No.	Date	Component	First P. T. begin	Second P. T. begin	Large waves begin	Maximum	End of principal portion	End	Maximum amplitude
	1909.		*h m s*	*h m s*	*h m s*	*h m s*	*h m*	*h m*	*mm*
153	8	E	5 57 13	6 05 47	6 13 45	6 26 07	6 30	7 02	0.3
154	July 7	N	21 51 03	21 57 11	.. .. ..	22 05 31	.. ..	22 53	0.4
154	7	E	21 51 06	21 57 20	.. .. ..	22 01 08	.. ..	22 58	2.0
155	30	N	10 58 03	11 03 22	11 10 00	11 15 20	11 29	12 19	3.5
155	30	E	10 58 03	11 03 21	11 09 59	11 14 09	11 27	12 15	10.0
156	31	N	19 25 34	19 31 42	19 37 16	19 42 54	19 52	20 28	0.5
157	Aug. 16	N	7 05 26	7 11 08	7 15 24	7 17 48	7 20	8 09	1.3
157	16	E	7 05 27	7 10 41	7 14 47	7 16 27	7 19	7 55	0.5
158	31	N	12 07 14	.. .. ..	12 12 48	.. .. ..	.. ..	.. ..	0.2
158	31	E	12 07 14	.. .. ..	12 12 54	12 13 30	12 18	12 27	0.1
159	Sept. 8	N	17 00 00	17 08 18	17 20 28	17 20 42	17 22	17 52	0.4
159	8	E	17 00 02	17 08 18	17 18 50	17 20 42	17 23	17 54	0.4
160	19	N	.. .. ..	.. .. ..	.. .. ..	20 47 16	.. ..	21 03	0.2
160	19	E	20 29 38	.. .. ..	.. .. ..	20 47 04	.. ..	21 03	0.2
161	22	N	14 47 56	14 52 40	.. .. ..	14 59 40	.. ..	15 16	0.1
161	22	E	14 47 58	14 52 42	.. .. ..	15 01 08	.. ..	15 19	0.2
162	Oct. 18	N	8 37 22	.. .. ..	.. .. ..	8 42 00	.. ..	8 56	0.1
163	27	N	5 17 34	.. .. ..	.. .. ..	.. .. ..	.. ..	5 26	....
163	27	E	5 17 31	.. .. ..	.. .. ..	5 17 49	.. ..	5 26	0.2
164	29	N	7 04 51	.. .. ..	.. .. ..	7 08 20	.. ..	7 16	0.2
164	29	E	7 04 51	.. .. ..	.. .. ..	7 07 57	.. ..	7 14	0.2
165	31	N	10 02 21	.. .. ..	.. .. ..	10 05 27	.. ..	10 20	0.1
165	31	E	10 02 29	10 02 58	.. .. ..	10 04 38	.. ..	10 20	0.1
166	31	N	10 29 35	10 34 49	10 41 43	10 42 57	10 58	11 40	0.3
166	31	E	10 29 22	10 34 35	.. .. ..	10 43 32	.. ..	11 41	0.3
167	Dec. 9	N	16 40 ..	.. .. ..	.. .. ..	16 44 ..	.. ..	16 51	0.1
167	9	E	16 36 ..	.. .. ..	.. .. ..	16 40 ..	.. ..	16 51	0.3
	1910.								
168	Jan. 1	N	11 07 00	11 11 08	11 13 54	11 16 04	11 44	12 50	7.5
168	1	E	11 07 02	11 11 12	11 13 10	11 14 20	.. ..	12 50	25.5
169	22	N	8 56 21	9 05 18	9 09 18	9 13 18	9 18	10 11	10.3
169	22	E	8 57 57	9 05 13	9 09 18	9 13 18	9 18	.. ..	5.5
170	23	N	18 55 58	19 01 12	19 03 07	19 10 24	.. ..	15 00	0.5
170	23	E	18 55 57	19 01 10	19 03 15	19 08 10	.. ..	14 46	0.5
171	30	N	16 25 10	.. .. ..	.. .. ..	16 28 28	.. ..	16 38	0.2
171	30	E	16 25 10	.. .. ..	.. .. ..	16 26 08	.. ..	16 38	0.2
172	Feb. 4	E	.. .. ..	.. .. ..	15 07 ..	15 10 ..	15 33	19 10	0.2
173	21	N	3 53 01	.. .. ..	.. .. ..	3 53 18	.. ..	3 57	0.1
173	21	E	3 53 01	.. .. ..	.. .. ..	3 53 21	.. ..	3 57	0.1
174	28	N	21 16 36	21 21 30	21 28 28	21 31 22	21 48	22 30	0.7
174	28	E	21 16 32	21 21 42	21 28 26	21 32 18	21 48	22 30	1.2
175	Mar. 11	N	7 06 56	.. .. ..	.. .. ..	7 11 27	.. ..	7 32	0.2
175	11	E	7 06 56	.. .. ..	.. .. ..	7 14 06	.. ..	7 32	0.1
176	19	N	0 25 23	.. .. ..	0 30 48	0 31 23	0 34	0 54	0.5
176	19	E	0 25 23	.. .. ..	0 30 53	0 34 03	0 35	0 54	0.2
177	25	N	15 34 40	15 43 22	.. .. ..	15 45 50	.. ..	16 04	...
177	25	E	15 34 50	15 43 22	.. .. ..	15 50 30	.. ..	16 04	0.1
178	30	N	.. .. ..	.. .. ..	17 54 ..	18 06 ..	.. ..	18 38	0.2
178	30	E	.. .. ..	.. .. ..	17 55 ..	18 09 ..	.. ..	18 36	0.3
179	31	N	18 36 38	18 54 16	19 10 46	19 18 16	.. ..	19 44	0.2
179	31	E	.. .. ..	.. .. ..	19 10 36	19 18 06	.. ..	19 46	0.2
180	Apr. 12	N	0 41 07	0 47 15	.. .. ..	0 58 07	1.40	2 00	0.3
180	12	E	.. .. ..	0 46 54	1 08 00	1 17 20	1 33	1 53	0.2
181	27	N	1 36 58	.. .. ..	1 43 38	.. .. ..	.. ..	1 56	0.1
181	27	E	1 37 00	1 43 22	1 43 30	1 44 11	1 45	1 56	0.2
182	May 1	N	19 04 00	.. .. ..	19 35 ..	19 41 00	19 47	20 20	0.1
182	1	E	19 03 26	.. .. ..	19 33 ..	19 37 26	19 51	20 16	0.2
183	5	N	0 37 50	.. .. ..	0 44 04	0 45 50	0 52	1 16	0.3
183	5	E	0 37 50	.. .. ..	0 43 30	0 46 14	0 53	1 12	0.5
184	6	N	16 33 48	.. .. ..	.. .. ..	16 58 00	.. ..	17 29	0.1
184	6	E	16 32 20	.. .. ..	.. .. ..	16 58 50	.. ..	17 19	0.1
185	11	N	.. .. ..	.. .. ..	.. .. ..	7 34 38	.. ..	.. ..	0.1
185	11	E	7 31 00	.. .. ..	.. .. ..	7 34 30	.. ..	7 52	0.1
186	13	N	8 15 30	.. .. ..	8 26 20	8 28 08	8 49	10 17	1.0
186	13	E	8 15 30	.. .. ..	8 26 56	8 35 16	8 49	10 19	1.3
187	20	N	12 10 10	12 15 38	12 21 22	12 23 42	12 26	12 48	0.6
187	20	E	12 10 13	12 15 55	12 19 23	12 23 43	12 26	12 50	1.3
188	22	N	6 36 54	6 47 34	6 58 06	7 27 00	7 38	8 08	0.2
188	22	E	6 36 52	6 47 40	7 03 00	7 22 30	7 31	8 02	0.3
189	31	N	5 01 31	5 06 32	5 12 27	5 15 45	5 34	6 19	0.7

Register of earthquakes—Continued.

No.	Date	Component	First P. T begin	Second P. T. begin	Large waves begin	Maximum	End of principal portion	End	Maximum amplitude
	1910		*h m s*	*h m s*	*h m s*	*h m s*	*h m*	*h m*	*mm*
189	May 31	E	5 01 31	5 06 49	5 12 05	5 18 49	5 31	6 22	0.7
190	June 1	N	6 20 40	6 30 54	6 56 00	7 04 00	7 10	8 11	0.1
190	1	E	6 21 13	6 31 29	6 40 29	7 02 00	7 22	8 26	0.2
191	14	N	19 46 21	.. .. ..	19 58 00	20 01 00	20 04	20 25	0.1
191	14	E	19 46 23	.. .. ..	19 55 00	19 59 00	20 06	20 23	0.1
192	16	N	6 50 41	7 00 47	7 07 53	7 42 17	7 55	9 06	0.7
192	16	E	6 50 39	7 00 31	7 07 53	7 37 17	7 50	9 15	2.0
193	29	N	8 43 36	.. .. ..	8 50 00	8 57 36	9 10	10 00	0.2
193	29	E	8 44 17	.. .. ..	8 53 00	8 54 47	9 10	9 43	0.2
194	29	N	11 36 00	.. .. ..	11 42 30	11 50 30	12 10	13 10	0.3
194	29	E	11 39 00	.. .. ..	11 47 00	11 48 00	12 11	13 08	0.4
195	July 3	N	9 28 07	.. .. ..	9 29 07	9 30 18	9 34	9 39	0.1
195	3	E	9 29 03	9 29 33	9 30 16	9 32 45	9 33	9 40	0.2
196	7	N	4 57 46	4 59 18	5 01 08	5 01 46	5 03	5 30	1.5
196	7	E	4 57 57	4 59 17	5 00 44	5 01 52	5 03	5 22	2.5
197	10	N	15 08 07	.. .. ..	15 19 30	15 22 07	15 25	15 44	0.4
197	10	E	15 09 40	.. .. ..	15 20 30	15 23 36	15 24	15 37	0.1
198	29	N	10 49 10	.. .. ..	11 07 25	11 43 00	.. ..	12 00	0.1
198	29	E	10 49 33	.. .. ..	.. .. ..	11 43 00	.. ..	11 50	0.1
199	Aug. 5	N	1 38 58	.. .. ..	1 51 29	1 52 54	1 58	3 10	2.2
199	5	E	1 38 56	.. .. ..	1 51 19	1 55 30	1 58	2 45	1.5
200	11	N	16 35 36	16 39 55	16 42 40	16 43 21	16 46	17 53	1.0
200	11	E	16 35 26	16 39 44	16 42 32	16 43 28	16 45	17 53	2.2
201	21	N	5 56 14	.. .. ..	.. .. ..	6 11 41	.. ..	6 30	0.1
201	21	E	5 56 09	.. .. ..	.. .. ..	6 06 05	.. ..	6 30	0.2
202	Sept. 6	N	20 14 03	20 22 47	20 37 23	20 42 53	20 54	21 00	0.1
202	6	E	20 13 59	20 22 37	.. .. ..	.. .. ..	.. ..	21 00	0.1
203	7	N	8 08 50	.. .. ..	8 14 58	8 19 21	8 43	9 06	0.1
203	7	E	8 08 52	.. .. ..	8 17 48	8 28 18	8 35	9 06	0.2
204	7	N	10 58 35	.. .. ..	11 05 21	11 09 16	11 18	12 00	0.1
204	7	E	10 58 33	.. .. ..	11 00 13	11 02 ..	11 10	11 42	0.1
205	9	N	1 24 34	1 33 27	1 44 49	1 56 58	2 09	3 08	0.9
205	9	E	1 24 10	1 32 56	1 44 38	1 50 42	2 07	3 04	1.0
206	24	N	3 38 26	3 43 30	3 47 38	3 52 10	4 06	4 35	1.1
206	24	E	3 38 25	3 43 14	3 48 00	3 49 54	4 00	4 33	0.6
207	24	N	4 20 20	.. .. ..	.. .. ..	.. .. ..	.. ..	.. ..	0.1
207	24	E	4 20 00	.. .. ..	4 22 38	4 22 56	.. ..	.. ..	0.3
208	Oct. 4	N	23 10 18	.. .. ..	23 18 34	23 21 11	23 26	23 44	0.2
208	4	E	23 10 19	.. .. ..	23 17 47	23 20 21	23 26	23 56	0.4
209	Nov. 6	N	20 38 32	.. .. ..	20 51 32	20 52 22	20 58	21 49	5.1
209	6	E	20 38 36	.. .. ..	20 51 32	20 52 20	21 00	21 49	2.1
210	9	N	6 20 06	6 32 41	7 04 41	7 24 41	.. ..	.. ..	0.1
210	9	E	6 20 08	6 29 00	7 01 05	7 21 27	7 26	.. ..	0.8
211	9	N	7 50 45	7 57 48	8 02 32	8 12 33	8 28	8 58	0.1
211	9	E	7 51 10	7 57 50	8 03 50	8 18 00	8 29	8 59	0.2
212	10	N	13 09 15	.. .. ..	13 16 15	13 21 05	13 29	14 04	0.1
212	10	E	13 08 51	.. .. ..	13 20 00	13 21 10	13 42	14 07	0.2
213	26	N	5 17 16	.. .. ..	5 42 32	5 45 08	6 06	7 27	0.3
213	26	E	5 17 56	.. .. ..	5 41 00	5 42 56	6 04	7 44	0.8
214	Dec. 10	N	.. .. ..	9 57 10	10 22 00	10 28 30	11 01	11 45	0.2
214	10	E	9 46 52	9 57 18	10 22 50	10 30 00	11 01	11 50	0.3
215	13	N	12 02 31	12 12 34	12 22 32	12 31 40	12 41	13 55	1.3
215	13	E	12 02 27	12 12 12	12 21 02	12 37 05	12 44	.. ..	1.6
216	16	N	15 07 03	15 24 08	15 56 00	16 13 00	16 28	17 08	0.5
216	16	E	15 07 43	15 24 35	15 51 00	16 04 35	16 44	17 08	0.4
217	21	N	10 30 18	.. .. ..	10 43 46	10 44 16	10 45	11 00	0.3
217	21	E	10 30 58	.. .. ..	10 38 00	10 42 28	10 46	11 02	0.1
218	23	N	1 04 05	.. .. ..	1 08 45	1 16 25	1 18	1 31	0.2
218	23	E	1 04 10	.. .. ..	1 09 00	1 12 00	1 17	1 27	0.2

REMARKS.

Nos. 133, 135, 145, 147: Not very distant. Period of waves only 3–5 seconds.

No. 136: Probably principal portion of distant earthquake.

Nos. 141, 142: The end of No. 141 probably overlaps the beginning of No. 142. The beginning of No. 142 may be as early as $19^h\ 43^m\ 30^s$.

No. 146: Barely perceptible on E.

No. 148: Actual maximum on N, 0.7 mm at $8^h\ 22^m\ 05^s$; on E, 1.7 mm at $8^h\ 22^m\ 07^s$.

No. 152: A series of long waves, period about 40 seconds, occurs on each record from $19^h\ 47^m$ to $19^h\ 56^m$.

No. 154: Maximum of long waves occurred about $22^h\ 25^m$.

No. 156: Of same character as No. 155. E too faint to distinguish phases.

Nos. 158, 163: Record obscured by microseismic tremors.

No. 167: Long waves of a distant earthquake.

No. 207: A series of short waves showing on the longer waves of the end portion of No. 206.

Nos. 210, 211: Apparently two earthquakes overlapping.

No. 215: The preliminary phases are very indistinct. The paper on E was changed at $13^h\ 21^m$.

Microseismic tremors were recorded on July 1, 4; August 28, 31; September 7, 13, 17, 24, 26; October 11, 12, 15–17, 19, 24–29; November 4–6, 9–11, 13, 14, 17, 18, 22, 24–26, 29, 30; December 8, 13, 14, 16, 18, 26, 30, 1909; January 8, 10, 15, 29; February 5, 7, 8, 10, 12, 14, 18, 23; April 3, 13, 25; June 10, 12; October 15, 17, 19, 21, 22, 25, 26, 30; November 5, 26, 30; and December 6, 7, 16, 31, 1910.

MAGNETIC STORMS.

Magnetic disturbances of considerable magnitude were recorded on the days tabulated below. The relative magnitude of the disturbance is indicated by the figures 1, 2, 3, 4. Where the storm began abruptly the time of beginning is given to the nearest minute.

On the succeeding pages will be found reproductions of the magnetograms showing the principal magnetic storms. The storms selected for reproduction are indicated in the table by an asterisk after the date. An upward motion of the curves corresponds to increasing west declination, increasing H, and increasing Z.

For convenience in comparing with similar reproductions for other observatories, the time scale has been marked for Greenwich mean time.

Principal magnetic disturbances.

Date	L. M. T. of beginning	Duration in hours	Relative magnitude	Date	L. M. T. of beginning	Duration in hours	Relative magnitude
1909.	h m			1909.	h m		
Jan. 3	6	50	1	Nov. 29	18	62	1
13	1	48	1	Dec. 13	3	50	1
24*	16	176	3				
Feb. 1	20	37	1	1910.			
5	19 44	25	1	Jan. 24	18	62	1
20	20	96	1	Feb. 17	8	28	1
Mar. 3	7	25	1	20	5 06	40	1
5	6	24	1	Mar. 19	17	63	1
18*	4 23	45	2	26*	17	72	3
20	16	61	2	30*	10	90	2
26*	7 13	77	2	Apr. 17	15	38	1
Apr. 15	22	48	1	22	17	55	1
24	14	70	2	26*	23	96	2
May 13*	23	53	3	May 23	14	85	1
17*	23 58	42	2	June 19	17	100	1
June 21	0 22	72	1	July 4	14	96	1
27	22	70	1	Aug. 9*	20	30	2
July 21	3	94	1	17	14	62	1
28	8	48	1	21*	17	25	2
Aug. 1	20	52	1	27*	22	82	2
7	0 38	20	1	Sept. 24*	0	154	3
8	19	63	1	Oct. 1	16	33	1
28*	12	92	2	3	8	44	1
Sept. 2	17	53	1	5	13	30	1
21	6 11	18	1	11*	21	54	2
25	3	21	4	19	2 08	46	1
29	22 51	26	2	23	16	108	1
Oct. 1	17	27	1	Nov. 17	19	22	1
18*	0	59	2	Dec. 14	20	34	1
22*	18 51	60	2	28	0	48	1

DEPARTMENT OF COMMERCE
U. S. COAST AND GEODETIC SURVEY
O. H. TITTMANN, SUPERINTENDENT

RESULTS OF OBSERVATIONS MADE AT THE UNITED STATES COAST AND GEODETIC SURVEY MAGNETIC OBSERVATORY AT CHELTENHAM, MARYLAND 1911 AND 1912

BY

DANIEL L. HAZARD
Computer, Division of Terrestrial Magnetism

WASHINGTON
GOVERNMENT PRINTING OFFICE
1913

CONTENTS.

ILLUSTRATIONS.

EARTHQUAKES.

A Bosch-Omori seismograph has been in operation at Cheltenham since November, 1904. It consists of two horizontal pendulums, one recording north-south motion (N) and the other recording east-west motion (E). In the following table the times are Greenwich mean time counted from midnight.

Period of pendulums: N, 29s.; E, 25s. in 1911, 31s. in 1912.
Magnification: 10.
Steady mass: 10–12 kg.

Register of earthquakes.

No.	Date	Component	First P. T. begin	Second P. T. begin	Large waves begin	Maximum	End of principal portion	End	Maximum amplitude
	1911.		*h m s*	*h m s*	*h m s*	*h m s*	*h m*	*h m*	*mm*
219	Jan. 3	N	23 39 30	23 52 06	24 10 00	24 21 18	24 36	26 00	59. 0
		E	23 39 36	23 52 18	24 09 27	24 24 00	24 30	25 43	8. 8
220	Feb. 5	N	4 29 43	4 34 24	4 37 16	4 42 00	4 42	5 01	0. 1
		E	4 29 43	4 34 28	4 36 43	4 39 23	4 43	4 57	0. 2
221	7	N	.. .. ..	.. .. ..	2 35 58	.. .. ..	.. ..	2 52	0. 1
		E	2 27 57	.. .. ..	.. .. ..	2 33 42	2 36	2 49	0. 1
222	18	N	19 05 22	.. .. ..	19 32 36	19 40 00	19 52	20 11	0. 6
		E	.. .. ..	.. .. ..	19 32 25	19 39 57	19 52	20 09	0. 5
223	Apr. 7	N	6 55 22	7 04 43	7 21 43	7 32 40	7 35	7 49	0. 2
		E	6 55 24	7 05 04	7 21 08	7 36 04	7 40	.. ..	0. 1
224	10	N	18 48 21	.. .. ..	18 56 00	18 59 21	19 07	19 28	0. 3
		E	18 48 24	18 53 58	.. .. ..	18 55 30	19 03	19 17	0. 2
225	May 4	N	23 48 38	23 58 17	24 06 17	24 20 25	24 33	25 03	1. 1
		E	23 48 42	23 58 07	24 06 37	23 58 15	24 33	25 10	3. 3
226	June 7	N	11 09 15	11 14 20	11 19 24	.. .. ..	11 34	.. ..	65+
		E	11 09 09	11 14 05	11 17 05	11 26 41	11 36	13 16	11. 8
227	15	N	14 40 00	14 44 34	14 50 30	14 55 06	15 36	16 44	4. 5
		E	.. .. ..	14 44 33	14 52 08	15 16 48	15 34	16 44	1. 1
228	July 1	N	22 14 57	22 18 41	.. .. ..	22 19 23	.. ..	22 53	4. 5
		E	22 18 27	22 19 57	22 21 23	22 21 42	22 26	22 53	1. 0
229	4	N	13 50 45	13 59 42	14 08 30	14 09 49	.. ..	15 00	0. 2
		E	13 50 57	14 00 34	.. .. ..	14 22 21	.. ..	.. ..	0. 1
230	12	N	4 28 44	4 40 36	5 10 10	5 29 28	5 47	6 18	1. 1
		E	4 29 05	.. .. ..	5 09 ..	5 20 05	5 40	6 04	0. 6
231	Aug. 6	N	23 00 19	23 12 11	23 38 01	23 47 59	24 23	25 12	2. 6
		E	23 01 55	23 11 25	23 39 37	24 02 29	24 23	24 40	0. 5
232	21	N	.. .. ..	.. .. ..	16 54 51	17 02 51	17 23	.. ..	0. 2
		E	.. .. ..	.. .. ..	16 53 16	.. .. ..	16 57	.. ..	....
233	27	N	11 05 19	.. .. ..	11 10 14	11 10 30	11 21	11 31	0. 3
		E	11 06 08	.. .. ..	11 10 10	11 10 15	11 23	11 31	0. 2
234	Sept. 6	N	.. .. ..	.. .. ..	1 06 37	1 16 37	1 21	.. ..	0. 1
		E	.. .. ..	.. .. .	1 06 43	1 17 08	1 21	.. ..	0. 2
235	15	N	13 19 57	.. .. ..	13 38 ..	13 46 09	13 51	14 08	0. 4
		E	13 20 32	.. .. ..	.. .. ..	13 44 23	13 52	.. ..	0. 1
236	17	N	3 38 42	3 47 53	4 04 03	4 10 03	4 25	5 33	3. 0
		E	3 38 27	3 48 16	4 04 24	4 06 56	4 17	4 43	1. 1
237	22	N	5 10 04	5 23 21	5 26 21	5 30 38	5 33	6 00	1. 0
		E	5 10 06	5 23 16	5 26 30	5 27 10	5 31	5 56	1. 1
238	Oct. 6	N	10 20 39	.. .. ..	10 24 36	10 27 04	10 41	11 20	0. 8
		E	10 20 53	.. .. ..	10 24 43	10 32 51	10 44	11 20	1. 1
239	10	N	13 18 15	.. .. ..	.. .. ..	13 30 30	13 41	14 28	1. 7
		E	13 18 26	13 24 44	.. .. ..	.. .. ..	13 41	14 20	....
240	14	N	.. .. ..	.. .. ..	17 13 27	17 18 42	17 26	.. ..	0. 1
		E	. .. ..	.. . .	17 13 19	17 18 49	17 30	.. ..	0. 1
241	29	N	18 18 10	.. .. ..	18 22 36	18 22 50	.. ..	18 55	0. 1
		E	18 18 12	18 20 00	18 22 34	18 25 ..	.. ..	18 51	0. 1
242	Nov. 1	N	9 32 53	9 38 11	9 42 37	9 44 49	9 53	9 56	0. 5
		E	9 32 53	.. .. ..	9 44 00	9 44 41	9 52	9 56	0. 2
243	18	N	7 40 26	.. .. ..	.. .. ..	7 52 10	.. ..	8 06	0. 1
		E	7 40 23	.. .. ..	.. .. ..	7 51 50	.. ..	7 59	0. 1
244	20	N	13 56 01	14 00 04	.. .. ..	14 08 50	.. ..	14 21	0. 8
		E	13 56 02	14 00 16	14 04 44	14 08 45	14 12	14 25	0. 5
245	21	N	18 49 14	.. .. ..	18 51 34	18 52 00	18 54	18 55	0. 1
		E	18 50 ..	.. .. ..	18 51 34	.. .. ..	.. ..	19 00	0. 1
246	22	N	13 21 ..	.. .. ..	.. .. ..	13 28 22	.. ..	13 33	0. 2
		E	13 21 ..	.. .. ..	.. .. ..	13 28 04	.. ..	13 33	0. 1
247	Dec. 16	N	19 20 44	19 26 13	19 32 47	19 34 49	19 48	20 57	2. 1
		E	19 20 37	19 26 07	19 32 33	19 36 15	19 52	21 02	2. 1

Register of earthquakes—Continued.

No.	Date	Component	First P. T. begin	Second P. T. begin	Large waves begin	Maximum	End of principal portion	End	Maximum amplitude
	1911.		*h m s*	*h m s*	*h m s*	*h m s*	*h m*	*h m*	*mm*
248	Dec. 22	N	13 01 03	. . .	.. .. ..	13 16 21	.. ..	13 44	0.1
		E	13 06 26	.. . ..	.. .. ..	13 16 15	.. ..	14 01	0.5
249	23	N	21 11 14	21 16 52	21 21 20	21 24 11	21 30	21 46	0.2
		E	21 11 29	21 16 51	21 21 21	21 25 47	21 32	21 46	0.6
	1912.								
250	Jan. 4	N	16 06 46	.. .. ..	.. .. ..	.. .. ..	.. ..	.. ..	...
		E	16 06 42	.. .. .	16 20 45	16 26 35	16 54	17 24	0.3
251	31	N	20 20 23	20 27 26	20 35 53	20 47 47	20 48	21 28	2.5
		E	20 20 25	20 27 28	20 35 57	20 37 07	20 49	21 28	2.5
252	Feb. 19	N	. .. ..	.. .. ..	23 17 00	23 23 10	23 25	.. ..	0.1
253	Mar. 11	N	10 33 35	10 35 05	10 38 00	10 38 30	10 48	11 12	3.4
		E	10 33 52	.. .. ..	10 38 08	10 38 40	10 48	11 10	2.0
254	May 6	N	19 14 07	.. .. ..	19 19 04	19 23 03	19 30	20 05	2.0
		E	19 14 07	.. .. ..	19 19 56	19 23 25	19 28	19 58	0.5
255	23	N	2 45 16	.. .. ..	3 16 40	3 35 18	3 48	4 24	2.5
		E	2 46 07	3 01 03	3 13 50	3 37 55	3 46	4 18	0.5
256	June 7	N	.. .. ..	.. .. ..	8 29 ..	8 33 ..	8 45	.. ..	0.1
257	7	N	.. .. ..	.. .. ..	9 22 ..	9 28 ..	9 31	.. ..	0.1
258	7	N	.. .. ..	. .. ..	10 22 07	10 28 30	10 45	.. ..	0.4
		E	.. .. ..	.. .. ..	10 23 35	10 25 55	10 50	.. ..	0.1
259	7	N	.. .. ..	.. .. ..	11 01 53	11 03 53	11 15	.. ..	0.2
		E	.. .. ..	.. .. ..	11 00 03	11 04 23	11 15	.. ..	0.3
260	7	N	.. .. ..	.. .. ..	12 44 43	12 51 ..	13 00	.. ..	0.1
		E	.. .. ..	.. .. ..	12 44 31	12 51 45	13 06	. ..	0.1
261	7	N	.. .. ..	.. .. ..	18 51 ..	18 56 40	19 21	.. ..	0.4
		E	.. .. ..	.. .. ..	18 52 ..	18 54 .	19 03	..	0.1
262	8	N	.. .. ..	.. . ..	3 19 50	3 25 36	3 30	.. .	0.2
		E	.. . ..	.. .. ..	3 20 ..	.. .. ..	3 28	. ..	. .
263	June 8	N	.. .. ..	.. . ..	7 16 26	7 21 14	7 30	.. ..	0.5
		E	.. .. ..	.. .. ..	7 15 08	7 20 40	7 29	.. ..	0.1
264	8	N	7 51 08	.. . ..	8 03 04	8 08 17	8 29	.. ..	2.7
		E	7 52 14	.. .. ..	8 03 08	8 03 40	8 27	.. ..	1.0
265	8	N	.. .. ..	.. .. ..	9 13 50	9 18 00	9 25	9 34	1.1
		E	.. .. .	.. .. ..	9 12 15	9 17 32	9 23	9 37	0.3
266	8	N	.. .. .	.. .. ..	10 58 ..	11 00 .	11 05	.. ..	0.1
		E	.. .. ..	.. .. ..	10 58 ..	11 00 ..	11 07	.. ..	...
267	8	N	.. .. ..	.. .. ..	13 27 ..	13 29 ..	13 35	13 56	0.5
		E	. .. ..	.. .. ..	13 28 ..	13 29 ..	13 34	13 50	0.2
268	9	N	.. .. ..	.. .. ..	17 41 ..	17 46 ..	17 50	.. ..	0.2
		E	.. .. ..	.. .. ..	17 41 ..	17 44 ..	17 50	.. ..	0.1
269	June 10	N	16 15 19	16 26 56	16 34 07	16 38 30	16 47	17 18	2.0
		E	16 15 27	16 27 26	16 33 55	16 38 15	16 45	17 18	0.6
270	12	N	.. .. ..	.. .. ..	7 31 27	7 37 ..	7 39	.. .	0.1
		E	.. .. ..	.. .. ..	7 31 37	7 37 ..	7 38	.. ..	0.1
271	12	N	.. .. .	.. .. ..	10 32 30	10 33 08	10 35	.. .	0.1
		E	. .. .	.. .. ..	10 32 23	10 33 17	10 35	.. ..	0.1
272	12	N	12 49 11	.. .. ..	12 54 49	13 00 00	13 04	13 19	0.8
		E	12 49 07	.. .. ..	12 54 44	12 58 53	13 07	13 17	0.5
273	July 7	N	8 06 28	8 13 36	8 20 39	8 23 34	8 28	9 54	23.9
		E	8 06 25	8 13 48	8 20 38	8 23 26	8 29	9 21	23.9
274	8	N	22 02 51	.. .. ..	22 19 17	22 22 51	22 27	22 51	2.5
		E	22 02 53	.. .. ..	22 19 24	22 20 58	22 28	22 51	1.4
275	Aug. 9	N	1 41 05	1 50 26	2 01 45	2 12 14	2 20	3 04	1.9
		E	1 40 54	1 50 34	2 04 42?	2 12 24	2 21	2 29	0.2
276	17	N	19 34 35	19 51 39	20 11 ..	20 39 22	20 46	21 01	0.2
		E	19 34 40	.. .. ..	.. .. ..	.. .. ..	.. ..	.. ..	...
277	18	N	21 24 33	.. .. ..	.. .. ..	21 24 45	.. ..	21 30	0.5
		E	21 24 34	. .. ..	21 27 00	21 27 24	21 29	21 30	0.5
278	Sept. 10	N	16 20 10	.. .. ..	16 20 50	16 21 02	16 22	16 30	0.5
		E	16 20 08	.. .. ..	16 20 48	16 20 18	16 22	16 27	0.2
279	Oct. 12	N	15 54 00	.. .. ..	.. .. ..	16 04 03	.. ..	16 38	0.1
280	18	N	12 15 12	.. .. ..	12 29 ..	12 40 18	.. ..	12 51	0.3
		E	12 15 15	.. .. ..	12 29 ..	12 39 29	.. ..	12 50	0.1
281	Nov. 7	N	7 49 32	7 57 00	8 01 22	8 09 14	8 28	8 49	1.2
		E	7 49 30	7 57 30	.. .. ..	8 09 08	8 20	8 29	1.0
282	7	N	16 51 30	16 55 36	16 59 54	17 02 30	17 05	17 14	0.1
283	7	N	17 40 35	.. .. ..	17 44 35	17 47 35	17 49	18 10	0.4
284	19	N	14 05 34	14 07 56	14 11 54	14 20 21	.. ..	14 30	0.2
285	22	N	.. .. .	1 12 32	1 14 56	1 15 26	1 17	1 22	0.3
	22	E	1 10 20	1 12 44	1 15 11	1 15 28	1 17	1 21	0.2
286	Dec. 7	N	22 46 34	22 56 52	23 05 04	23 05 58	23 06	23 22	0.5

REMARKS.

No. 220: Small earthquake not far distant.
No. 221: Very small shock.
No. 223: Very small. Phases not well defined.
No. 226: N–S pen went off sheet; Mexican earthquake.
No. 228: Record indistinct; phases doubtful.
No. 229: Actual maximum on N, 0.4 mm, occurred at 14:00:41; E very faint.
No. 232: E very faint.
No. 233: Beginning and end obscured by microseismic tremors.
No. 235: Changing paper on N from 13:23:07 to 13:30:27; on E from 13:31:37 to 13:36:07.
No. 239: Changing paper on N from 13:23:50 to 13:27:20; on E from 13:27:30 to 13:38:30.
Nos. 240, 244: Beginning and end obscured by microseismic tremors.
No. 252: Record of E obscured by microseismic tremors. Phases not well defined on N.
No. 255: Phases not well defined.
No. 263: Beginning obscured by microseismic tremors.
No. 264: End doubtful.
No. 265: Beginning and end doubtful.

Microseismic tremors were present on January 12; February 11, 16, 19, 21, 22; March 6, 25, 31; April 3; June 8, 9, 1912.

E not in operation from 13:33 to 16:10 on November 19, and from December 3, 13^h to December 12, 18^h, 1912.

MAGNETIC STORMS.

Magnetic disturbances of considerable magnitude were recorded on the days tabulated below. Where the storm began abruptly the time of beginning is given to the nearest minute.

During the year 1911 there was an unusually large number of moderate storms of long duration, in several cases lasting for a week or more. The year 1912, on the other hand, was remarkably free from disturbance.

On the succeeding sheets will be found reproductions of the magnetograms showing the principal magnetic storms. A storm selected for reproduction is indicated in the table by an asterisk after the date. An upward motion of the curves corresponds to increasing west declination, increasing H, and increasing Z. For convenience in comparing with similar reproductions for other observatories the time scale has been marked for Greenwich mean time.

Principal magnetic disturbances.

Date	L. M. T. of beginning	Duration in hours	Relative magnitude	Date	L. M. T. of beginning	Duration in hours	Relative magnitude
1911.	*h m*			1911.	*h m*		
Jan. 1	20	50	2	Sept. 19*	12	65	2
8	12	72	1	Oct. 10*	6	24	2
15	1	34	1	16	20	48	1
24	4	116	2	Nov. 8	8 34	40	1
30	8	84	2	12	17	57	1
Feb. 4	21	91	1	Dec. 10*	10	34	2
12	17	59	2				
15	21	74	1	1912.			
20*	17	216	3	Jan. 12	17	28	1
Mar. 4	14	44	1	Feb. 25	20	20	1
13	12	37	1	Mar. 7	20	39	1
19*	19 41	220	3	April 9	17	19	1
April 8*	6 14	28	3	14*	14	63	2
9	17 14	28	1	May 4	15	24	1
15	17	165	2	11	17	58	1
May 6	8	48	1	June 7	16	80	1
14*	10	72	2	July 3	15	54	1
29	20	50	1	30	12	14	1
June 4	17	55	1	Aug. 5*	17	17	1
9	12	132	2	Sept. 17*	7	26	1
20	17	40	1	23	20	24	1
30	16 42	40	1	Oct. 13*	22	48	1
July 6	4	64	1	Nov. 9	22	38	1
17	6	70	1	Dec. 6*	17	24	1
27	17	60	1	22	8	39	1
Aug. 23*	3	52	2				

Serial No. 19

DEPARTMENT OF COMMERCE
U. S. COAST AND GEODETIC SURVEY
E. LESTER JONES, SUPERINTENDENT

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BY

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Assistant Chief, Division of Terrestrial Magnetism

WASHINGTON
GOVERNMENT PRINTING OFFICE
1915

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A Bosch-Omori seismograph has been in operation at Cheltenham since November, 1904. It consists of two horizontal pendulums, one recording north-south motion (N) and the other recording east-west motion (E). In the following table the times are Greenwich mean time counted from midnight.

Period of pendulums: N, 29 sec.; E, 31 sec.
Magnification: 10.
Steady mass: 10 to 12 kg.

Register of earthquakes.

No.	Date	Component	First P. T. begin	Second P. T. begin	Large waves begin	Maximum	End of principal portion	End	Maximum amplitude
	1913.		*h m s*	*h m s*	*h m s*	*h m s*	*h m*	*h m*	*mm*
287	Jan. 1	N	18 28 57	.. .. ..	18 30 05	18 30 35	18 31	18 37	0.5
		E	18 28 58	.. .. ..	18 30 06	18 30 36	18 31	18 35	0.4
288	15	N	.. .. ..	.. .. ..	18 58 18	19 03 22	19 30	.. ..	0 2
		E	.. .. ..	.. .. ..	18 53 11	18 53 24	19 11	.. ..	0.1
289	Mar. 14	N	9 04 34	9 07 40	.. .. ..	9 09 36	9 33	10 27	0.8
		E	9 04 34	9 07 26	.. .. ..	9 09 32	9 22	.. ..	0.5
290	31	N	.. .. ..	.. .. ..	4 14 ..	4 22 52	4 37	5 34	1.3
		E	.. .. ..	.. .. ..	4 19 ..	.. .. ..	4 34	.. ..	...
291	Apr. 29	N	12 54 33	.. .. ..	13 11 ..	13 15 50	13 30	.. ..	0.1
292	June 26	N	5 24 22	5 32 00	5 42 58	6 01 48	6 16	6 59	0.3
		E	5 16 15	5 23 07	5 50 10	6 02 05	6 15	6 32	0.2
293	July 9	N	0 24 26	.. .. ..	0 26 02	0 30 26	0 32	0 44	0.2
		E	0 24 03	.. .. ..	0 25 53	0 30 41	0 32	0 44	0.2
294	24	N	9 08 00	.. .. ..	.. .. ..	9 08 16	9 10	.. ..	0.1
		E	9 08 00	.. .. ..	.. .. ..	9 08 24	9 10	.. ..	0.1
295	25	N	.. .. ..	12 44 24	12 53 26	12 56 24	13 04	.. ..	0.2
		E	.. .. ..	.. .. ..	12 53 00	12 54 55	12 58	.. ..	0.2
296	Aug. 6	N	22 24 10	22 31 50	22 40 40	22 49 45	23 00	23 50	2.1
		E	22 24 18	22 31 45	22 41 33	22 44 05	23 00	23 30	0.8
297	Oct. 2	N	4 30 02	4 35 05	4 40 17	4 44 53	4 49	5 15	0.5
		E	4 30 14	4 35 04	4 40 15	4 42 28	4 47	5 07	0.5
298	11	N	.. .. ..	5 01 57	5 14 31	5 21 16	5 29	.. ..	0.2
		E	.. .. ..	5 03 00	5 13 08	5 20 23	5 26	.. ..	0.1
299	Nov. 10	N	.. .. ..	.. .. ..	22 13 ..	22 22 ..	.. ..	22 35	0.1
		E	.. .. ..	.. .. ..	22 12 ..	22 16 ..	.. ..	22 38	0.1
300	Dec. 6	N	0 29 26	.. .. ..	.. .. ..	.. .. ..	0 35	.. ..	0.1
		E	0 29 28	.. .. ..	.. .. ..	.. .. ..	0 34	.. ..	0.1
	1914.								
301	Jan. 30	N	3 47 20	3 56 46	4 12 ..	4 25 20	4 29	.. ..	0.1
		E	3 48 13	3 57 03	.. .. ..	.. .. ..	.. ..	.. ..	...
302	Feb. 10	N	18 33 55	18 34 27	18 34 45	18 34 59	18 36	18 38	0.5
		E	18 33 35	18 33 55	18 34 23	18 34 39	18 35	18 37	0.9
303	28	N	5 07 31	5 13 03	5 14 19	5 16 36	5 20	5 25	0.7
		E	5 07 27	5 13 03	5 14 23	5 16 29	5 22	5 28	0.7
304	Mar. 30	N	0 46 26	0 52 01	0 58 09	1 01 06	1 12	1 30	1.6
		E	0 46 32	0 52 00	0 57 07	1 01 27	1 27	1 57	3.6
305	Apr. 11	E	.. .. ..	.. .. ..	17 27 24	17 38 30	17 45	.. ..	0.3
306	20	N	13 36 42	.. .. ..	13 41 48	13 42 14	13 45	.. ..	0.2
		E	.. .. ..	.. .. ..	13 42 10	13 47 10	13 56	14 08	0.3
307	May 26	N	14 45 29	.. .. ..	.. .. ..	15 50 25	15 55	16 43	0.5
		E	14 45 22	.. .. ..	15 03 24	15 39 22	15 55	16 48	0.7
308	28	N	3 30 07	3 34 45	3 40 35	3 41 21	3 44	3 57	0.4
		E	3 29 55	3 34 17	3 39 17	3 40 35	3 42	3 56	0.4
309	June 25	N	19 27 07	.. .. ..	19 49 45	20 28 30	20 42	.. ..	0.4

Register of earthquakes—Continued.

No.	Date	Component	First P. T. begin	Second P. T. begin	Large waves begin	Maximum	End of principal portion	End	Maximum amplitude
	1914.		*h m s*	*h m s*	*h m s*	*h m s*	*h m*	*h m*	*mm*
310	July 21	N	22 48 46	22 52 02	22 55 03	22 55 54	22 59	23 06	0.5
		E	.. .. ..	22 52 04	22 55 00	22 55 06	22 58	23 10	0.2
311	Aug. 3	N	11 30 09	11 34 07	.. .. ..	11 39 25	11 43	12 04	0.1
		E	.. .. ..	11 34 12	11 38 08	11 38 48	11 41	11 55	0.2
312	4	N	.. .. ..	.. .. ..	23 31 22	23 45 21	23 58	24 12	0.4
		E	.. .. ..	.. .. ..	23 26 27	23 37 35	23 50	24 24	0.6
313	8	N	19 21 06	.. .. ..	19 27 14	19 29 45	19 39	20 00	0.3
		E	.. .. ..	.. .. ..	19 27 37	19 30 24	19 37	.. ..	0.2
314	22	N	5 35 27	5 41 20	5 48 28	5 52 06	5 55	6 10	0.4
		E	5 35 24	.. .. ..	5 48 24	5 51 56	5 56	6 10	0.6
315	Oct. 3	N	17 28 01	17 32 31	17 35 19	17 36 01	17 46	18 25	1.0
		E	17 28 05	17 32 33	17 34 33	17 35 33	17 43	18 21	2.0
316	23	N	7 41 28	.. .. ..	8 16 ..	8 29 00	8 32	8 57	0.1
		E	7 41 28	.. .. ..	8 14 18	8 28 10	8 36	8 54	0.5
317	Nov. 24	N	.. .. ..	.. .. ..	12 17 53	12 21 15	12 53	.. ..	0.5
		E	.. .. ..	.. .. ..	12 17 50	12 21 12	12 48	.. ..	0.6
318	Dec. 25	N	4 04 58	.. .. ..	4 07 41	4 08 27	4 13	4 18	0.1
		E	4 04 45	.. .. ..	4 07 31	4 08 11	4 12	4 17	0.2

REMARKS.

Nos. 288, 292. Phases doubtful.

No. 289. Phases doubtful. For three minutes after the beginning the waves are barely perceptible. Then there is a marked increase in amplitude without change of period, lasting about three minutes, the general appearance of the seismogram suggesting that possibly the record of a near-by shock is superposed upon that of a distant one.

No. 294. Near by; short period waves of very small amplitude.

No. 295. Phases indistinct; poor record.

No. 296. Earthquake in Peru, destroying towns of Caraveli and Quicacha.

No. 298. Preliminary phases doubtful.

No. 300. Apparently not far distant.

No. 305. Barely perceptible on E.

No. 306. Began on E while paper was being changed.

No. 309. E seismogram not legible.

Microseismic tremors were present on January 3, 4, 5, 8, 12, 18; February 3, 12, 13, 19, 20; March 2, 6, 7, 27; April 30; May 1, 3, 4, 5, 13, 14, 15, 17, 18, 19, 22; June 11, 1913; January 3, 4, 25; March 2, 20; and November 8, 1914.

MAGNETIC STORMS.

Magnetic disturbances of considerable magnitude were recorded on the days tabulated below. Where a storm began abruptly the time of beginning is given to the nearest minute.

On the succeeding sheets will be found reproductions of the magnetograms showing the principal magnetic storms. A storm selected for reproduction is indicated in the table by an asterisk (*) after the date. An upward motion of the curves corresponds to increasing west declination, increasing H and increasing Z. For convenience in comparing with similar reproductions for other observatories the time scale has been marked for Greenwich mean time.

Serial No. 94

DEPARTMENT OF COMMERCE
U. S. COAST AND GEODETIC SURVEY
E. LESTER JONES, SUPERINTENDENT

RESULTS OF OBSERVATIONS MADE AT THE UNITED STATES COAST AND GEODETIC SURVEY MAGNETIC OBSERVATORY AT CHELTENHAM, MARYLAND, 1915 AND 1916

By

DANIEL L. HAZARD
CHIEF, DIVISION OF TERRESTRIAL MAGNETISM

PRICE, 25 CENTS
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WASHINGTON
GOVERNMENT PRINTING OFFICE
1918

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Period of pendulums:
N-29 sec.; E-31 sec. to Feb. 27, 1916.
N-27 sec.; E-32 sec. after Feb. 27, 1916.
Magnification: 10.
Steady mass: 10 to 12 kg.

Register of earthquakes.

No.	Date	Component	P	S	L	M	C	F	Maximum amplitude
	1915.		*h m s*	*h m s*	*h m s*	*h m s*	*h m*	*h m*	*mm*
319	Jan. 5	N	23 46 07	.. .. ..	23 55 00	23 56 45	23 59	24 55	0.4
320	13	N	.. .. ..	.. .. ..	7 25	7 28 05	7 37	.. ..	0.2
321	Mar. 5	N	.. .. ..	.. .. ..	4 34 22	4 35 40	4 42	.. ..	0.3
		E	.. .. ..	.. .. ..	4 34 25	4 37 40	4 40	.. ..	0.1
322	May 1	N	5 12 29	5 22 42	5 39 21	5 45 40	6 06	7 04	1.5
		E	5 12 23	5 22 27	5 38 31	5 48 50	5 58	7 04	1.0
323	6	N	12 21 55	.. .. ..	12 29 12	12 30 12	12 37	12 41	0.5
		E	.. .. ..	.. .. ..	12 29	12 33	12 37	12 41	0.1
324	June 1	N	15 00 25	.. .. ..	15 09 44	15 14 03	15 20	15 40	0.2
		E	15 00 22	.. .. ..	15 09 25	15 10 42	15 17	15 45	0.9
325	6	N	21 39 20	21 47 08	21 54 22	21 58 52	22 15	22 31	0.5
		E	.. .. ..	21 47 02	21 54 22	21 54 45	.. ..	22 20	0.2
326	23	N	4 15 24	.. .. ..	4 15 53	4 16 18	4 17	4 25	0.5
		E	4 15 17	.. .. ..	.. .. ..	.. .. ..	.. ..	.. ..	....
327	23	N	5 11 54	.. .. ..	5 12 38	5 12 48	5 14	5 22	0.8
		E	5 11 55	.. .. ..	.. .. ..	.. .. ..	.. ..	.. ..	....
328	Sept. 7	N	1 26 40	1 31 23	1 35 01	1 37 14	1 57	3 05	76. +
		E	1 26 40	1 31 26	1 35 38	1 37 09	1 57	2 43	29.0
329	7	N	.. .. ..	.. .. ..	4 38 10	4 46 55	4 57	.. ..	0.1
330	Oct. 2	N	23 55 38	.. .. ..	23 56 43	23 56 51	24 00	24 02	0.1
		E	23 55 33	.. .. ..	23 56 49	23 56 51	24 00	24 02	0.1
331	3	N	.. .. ..	.. .. ..	2 04 57	2 05 41	2 20	.. ..	0.1
		E	.. .. ..	.. .. ..	2 04 44	2 06 56	2 20	.. ..	0.1
332	3	N	6 59 37	7 04 51	7 09 17	.. .. ..	.. ..	.. ..	55. +
		E	6 59 09	7 04 17	7 09 17	7 10 01	7 18	8 05	39.2
333	11	N	19 38 03	.. .. ..	19 41 51	19 48 33	19 49	20 05	0.4
		E	19 38 03	.. .. ..	19 41 51	19 42 00	19 49	20 01	0.4
334	Nov. 1	N	7 48 14	.. .. ..	8 10	8 26 22	8 39	9 11	0.6
		E	7 48 24	.. .. ..	8 08	8 22 50	8 30	8 48	0.4
335	21	N	0 29 10	.. .. ..	0 30 30	0 31 14	0 36	1 11	21.5
		E	.. .. ..	.. .. ..	0 33 09	0 34 30	0 37	1 04	9.0
336	Dec. 7	N	18 45 24	.. .. ..	18 45 36	18 45 42	18 47	18 49	0.2
		E	18 45 27	.. .. ..	.. .. ..	18 45 48	18 47	18 48	0.1
337	12	N	21 08 08	.. .. ..	21 15 14	21 16 57	21 19	21 31	0.6
		E	21 08 40	.. .. ..	21 14 37	21 17 40	21 18	21 23	0.5
338	31	N	.. .. ..	.. .. ..	12 41 09	12 41 24	12 46	13 05	0.6
		E	.. .. ..	.. .. ..	12 41 14	12 43 18	12 47	13 05	0.8
	1916.								
339	Jan. 1	N	.. .. ..	13 51 29	13 58 16	14 26 56	14 43	16 05	2.5
		E	13 46 32	13 51 10	13 58 34	14 35 10	14 43	15 54	1.5
340	13	N	.. .. ..	.. .. ..	7 30 16	7 38 ..	7 55	.. ..	0.2
		E	.. .. ..	.. .. ..	7 29 ..	7 35 ..	7 43	.. ..	0.2
341	13	N	8 44 20	.. .. ..	9 01 26	9 31 20	9 42	10 35	1.6
		E	8 44 11	.. .. ..	9 00 34	9 31 18	9 42	10 35	1.2
342	24	N	.. .. ..	.. .. ..	7 31 ..	7 48 ..	7 55	8 10	0.2
		E	.. .. ..	.. .. ..	7 32 ..	7 43 ..	7 59	8 14	0.3
343	Feb. 6	N	.. .. ..	22 11 46	22 25 30	22 34 49	22 43	23 45	1.4
		E	22 01 34	22 11 48	22 25 30	22 36 48	22 46	23 45	1.5
344	15	N	11 44 35	11 51 29	12 00 45	12 03 47	12 07	12 20	0.5
		E	.. .. ..	.. .. ..	12 00 50	12 03 34	12 07	12 29	0.5
345	20	N	.. .. ..	.. .. ..	18 17 48	18 32 24	.. ..	19 00	0.3
		E	.. .. ..	.. .. ..	18 17 34	18 24 40	.. ..	19 10	0.3
346	21	N	.. .. ..	.. .. ..	23 41 51	23 42 16	23 43	23 48	0.4
		E	.. .. ..	.. .. ..	23 42 06	23 42 40	23 43	23 47	0.3
347	27	N	20 27 12	20 32 27	20 36 32	20 39 20	20 41	22 01	22.0
		E	20 27 21	20 32 33	20 38 45	20 39 19	20 41	22 01	13.5

Register of earthquakes—Continued.

No.	Date	Component	P	S	L	M	C	F	Maximum amplitude
	1916.								
348	Mar. 12	N	.. .. ..	.. .. ..	7 41 40	7 49 10	7 57	.. ..	0.2
		E	7 33 20	.. .. ..	7 40 16	7 48 08	7 55	.. ..	0.1
349	31	N	.. .. ..	.. .. ..	11 30 15	11 35 28	11 39	.. ..	0.5
		E	.. .. ..	.. .. ..	11 30 10	11 34 20	11 39	.. ..	0.5
350	Apr. 18	N	4 11 52	4 20 08	4 32 ..	4 40 48	4 50	5 00	0.5
		E	4 11 46	4 20 06	4 33 ..	4 40 43	4 48	5 07	0.6
351	21	E	11 48 34	11 56 52	12 03 44	12 04 22	12 52	13 12	0.5
352	24	N	4 31 28	4 35 26	4 38 10	4 39 36	4 43	5 08	0.8
		E	4 31 30	4 35 22	4 38 02	4 41 50	4 48	5 26	0.4
353	24	N	8 08 17	8 13 16	8 18 40	8 20 58	8 25	9 20	23.1
		E	8 08 17	8 13 15	8 16 30	8 20 09	8 27	9 18	9.3
354	26	N	2 27 28	2 32 33	2 35 03	2 40 25	2 45	3 14	2.5
		E	2 28 36	2 32 36	2 34 52	2 36 48	2 42	3 32	31.4
355	26	N	6 30 55	.. .. ..	6 38 57	6 45 07	.. ..	7 04	0.4
		E	.. .. ..	.. .. ..	6 41 25	6 44 45	.. ..	7 00	0.1
356	27	N	.. .. ..	.. .. ..	7 33 15	7 35 25	.. ..	7 52	0.1
		E	7 28 17	.. .. ..	7 33 07	7 36 56	.. ..	7 54	0.3
357	May 10	N	.. .. ..	.. .. ..	21 50 52	21 55 13	.. ..	22 12	0.2
		E	.. .. ..	21 48 05	21 50 55	21 54 03	21 58	22 17	1.2
358	11	N	10 18 20	10 21 29	.. .. ..	.. .. ..	.. ..	10 29	0.2
		E	10 19 48	10 21 17	10 23 50	10 24 01	10 25	10 30	0.1
359	June 21	N	.. .. ..	.. .. ..	.. .. ..	21 51 06	.. ..	.. ..	0.2
		E	21 43 02	21 50 50	21 58 ..	.. .. ..	.. ..	22 06	1.0
360	25	N	.. .. ..	.. .. ..	18 37 45	.. .. ..	.. ..	18 45	0.1
		E	.. .. ..	.. .. ..	18 37 ..	.. .. ..	.. ..	18 44	0.1
361	30	N	.. .. ..	.. .. ..	.. .. ..	.. .. ..	.. ..	.. ..	...
		E	3 09 06	3 13 44	3 16 32	3 27 19	3 30	4 10	0.9
362	July 28	N	.. .. ..	.. .. ..	17 54 ..	17 57 ..	18 02	.. ..	0.1
		E	.. .. ..	.. .. ..	17 54 ..	.. .. ..	18 04	.. ..	...
363	Aug. 3	N	14 36 23	.. .. ..	14 39 29	.. .. ..	.. ..	14 42	0.1
		E	14 36 18	.. .. ..	14 39 40	14 40 16	.. ..	14 48	0.1
364	25	N	10 02 56	.. .. ..	10 13 56	10 14 40	.. ..	10 31	0.2
		E	10 02 44	.. .. ..	10 13 27	10 15 00	.. ..	10 24	0.1
365	28	N	7 27 05	.. .. ..	7 40 20	7 50 51	.. ..	8.04	0.3
		E	7 26 35	.. .. ..	7 38 50	7 48 45	.. ..	8.05	0.1
366	Sept. 23	N	5 49 09	5 53 23	5 58 59	6 01 31	6 06	6 23	0.9
		E	5 49 02	.. .. ..	.. .. ..	6 00 15	6 09	6 23	0.1
367	Oct. 3	N	1 36 04	1 43 24	1 52 24	2 02 40	.. ..	2 20	0.2
		E	.. .. ..	1 43 28	.. .. ..	1 58 40	.. ..	2 17	0.2
368	18	N	.. .. ..	.. .. ..	22 08 15	22 08 56	22 10	.. ..	0.1
		E	.. .. ..	.. .. ..	22 08 10	22 08 36	22 10	.. ..	0.1
369	31	N	15 53 11	16 01 17	.. .. ..	16 33 ..	.. ..	16 45	0.2
		E	15 53 05	.. .. ..	.. .. ..	16 23 ..	.. ..	16 35	0.3
370	Nov. 10	N	.. .. ..	.. .. ..	9 28 30	9 29 10	9 32	9 36	0.4
		E	.. .. ..	.. .. ..	9 28 07	9 31 53	9 33	9 40	0.4
371	21	N	6 31 13	.. .. ..	6 41 20	6 45 16	6 49	7 02	0.9
		E	.. .. ..	6 36 16	6 42 31	6 45 56	6 56	7 04	0.6
372	30	N	3 22 48	3 26 27	3 27 44	3 32 44	3 35	4 05	1.0
		E	3 22 32	3 26 22	3 27 30	3 32 35	3 35	4 08	0.8

REMARKS.

No. 319. No perceptible motion on E.

No. 320. No well-defined motion on E. Microseisms present for several hours before and after.

Nos. 326 and 327. Only a few waves of short period on E.

Microseisms on April 3 and 4.

No. 329. Shown only on N. Probably connected with No. 328.

Nos. 328 and 332. Stylus went off the sheet on N.

No. 337. Beginning and end obscured by wind tremors.

No. 338. Phases not well defined.

Microseismic tremors were present on December 13.

Nos. 339 and 340. Phases poorly defined.

No. 352. Actual maximums occurred during second preliminary tremors, 2.0 mm. on N at 4:35:38, 3.5 mm. on E. at 4:35:33.

No. 358. No well-defined phases. Actual maximum on N, 0.2 mm., at 10:21:39.

No. 359. Actual maximum on E, 1.0 mm., at 21:50:55.

Serial No. 170

DEPARTMENT OF COMMERCE
U. S. COAST AND GEODETIC SURVEY
E. LESTER JONES, SUPERINTENDENT

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By

DANIEL L. HAZARD
ASSISTANT CHIEF, DIVISION OF TERRESTRIAL MAGNETISM

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Period of pendulums:
N, 27 sec.; E, 32 sec., to March, 1917.
N, 25 sec.; E, 33 sec., May to August, 1917.
N, 15 sec.; E, 15 sec., after September, 1917.
Magnification, 10; steady mass, 10 to 12 kg.

Register of earthquakes.

No.	Date.	Component.	P	S	L	M	C	F	Maximum amplitude.
	1917.		*h. m. s.*	*h. m. s.*	*h. m. s.*	*h. m. s.*	*h. m.*	*h. m.*	*mm.*
373	Jan. 30	N	2 57 05	3 06 31	3 17 ..	3 31 10	3 46	4 50	21.5
		E	2 56 55	3 06 31	3 17 ..	3 26 41	3 44	4 56	19.3
374	Feb. 15	N	.. .. ..	.. .. ..	1 24 30	1 30 46	1 36	.. ..	0.1
375	Feb. 20	N	19 34 10	19 37 50	19 40 51	19 42 20	19 48	20 47	12.0
		E	19 34 14	19 37 53	19 40 11	19 41 16	19 46	20 41	31.8
376	Mar. 6	N	3 12 25	3 17 09	3 23 37	3 27 34	3 31	3 53	0.4
		E	.. .. ..	3 17 54	3 24 20	3 27 55	3 31	3 41	0.2
377	Mar. 26	N	14 17 05	.. .. ..	.. .. ..	.. .. ..	.. ..	14 24	....
		E	14 17 37	.. .. ..	.. .. ..	.. .. ..	.. ..	14 24	....
378	May 1	N	.. .. ..	18 56 28	19 02 32	19 34 20	19 47	20 33	4.5
		E	18 45 24	18 56 03	19 02 30	19 25 37	19 47	20 33	11.0
379	May 31	N	8 57 06	9 04 46	9 13 35	9 22 46	9 46	10 21	3.0
		E	8 57 03	9 04 49	9 13 24	9 20 27	9 39	10 26	5.0
380	June 1	N	17 06 14	.. .. ..	.. .. ..	17 07 42	.. ..	17 09	0.1
		E	17 06 07	.. .. ..	.. .. ..	17 07 12	.. ..	17 13	0.1
381	June 4	N	1 46 56	.. .. ..	.. .. ..	1 59 44	.. ..	2 25	0.1
		E	1 46 11	.. .. ..	.. .. ..	.. .. ..	.. ..	2 14	0.1
382	June 8	N	0 57 29	1 02 25	1 05 12	1 07 18	1 15	3 20	3.1
		E	0 57 35	1 02 27	1 05 11	1 07 12	1 16	3 30	5.5
383	June 10	N	4 39 54	4 47 04	4 53 44	4 56 19	5 00	5 31	0.4
		E	4 39 55	4 46 00	4 53 23	4 59 07	5 02	5 31	0.4
384	June 13	N	7 07 24	7 17 36	7 40 10	7 48 40	7 54	8 25	0.4
		E	7 07 22	.. .. ..	7 39 50	7 54 48	.. ..	8 30	0.2
385	June 24	N	.. .. ..	20 14 36	.. .. ..	.. .. ..	.. ..	20 35	....
		E	20 07 54	20 13 45	20 17 07	20 18 30	.. ..	20 35	0.1
386	June 26	N	6 03 06	6 14 29	6 38 13	6 44 42	7 01	8 51	33.0
		E	6 04 00	6 14 26	6 37 51	6 42 00	6 57	8 55	46.0
387	June 27	E	12 32 26	12 38 24	12 43 12	12 44 57	.. ..	13 02	0.1
388	June 29	N	16 22 06	.. .. ..	.. .. ..	16 30 49	.. ..	16 37	0.1
		E	16 22 49	.. .. ..	.. .. ..	16 27 43	.. ..	16 39	0.1
389	June 30	N	17 57 03	18 02 11	18 07 01	18 09 13	.. ..	18 28	0.1
		E	17 58 21	18 02 12	18 07 37	18 09 26	18 15	18 30	0.2
390	July 1	N	13 39 09	.. .. ..	.. .. ..	13 40 42	.. ..	13 46	0.1
		E	13 39 14	.. .. ..	.. .. ..	13 40 39	.. ..	13 49	0.1
391	July 25	N	2 42 38	.. .. ..	2 49 36	2 54 39	.. ..	3 03	0.2
		E	2 43 29	.. .. ..	2 49 22	2 53 28	2 55	3 07	0.1
392	July 27	N	1 06 12	1 10 00	.. .. ..	1 18 53	1 47	2 10	2.6
		E	1 06 12	1 10 00	1 12 09	1 19 10	1 47	2 20	3.0
393	July 27	N	3 02 40	3 11 54	3 33 ..	3 35 36	3 41	4 00	0.2
		E	3 02 38	3 11 52	.. .. ..	.. .. ..	.. ..	.. ..	....
394	July 29	N	22 13 50	22 23 35	22 49 ..	23 05 36	23 21	24 14	0.2
		E	22 13 54	22 23 58	22 55 ..	23 03 22	23 21	24 14	1.4
395	July 31	N	.. .. ..	.. .. ..	0 54 ..	1 04 ..	.. ..	1 15	0.2
		E	.. .. ..	.. .. ..	0 54 ..	.. .. ..	.. ..	1 08	....
396	Aug. 30	N	4 26 44	4 30 20	.. .. ..	.. .. ..	.. ..	6 10	....
		E	4 26 44	4 30 26	.. .. ..	4 36 28	4 40	.. ..	0.2
397	Aug. 31	N	11 43 19	11 48 52	11 54 ..	11 57 22	12 09	12 41	1.4
		E	11 43 18	11 48 53	11 53 25	11 58 01	12 07	12 41	0.8
398	Oct. 19	N	16 43 03	.. .. ..	.. .. ..	16 53 13	.. ..	.. ..	0.1
		E	16 44 00	.. .. ..	16 52 54	16 56 30	16 58	17 07	0.7
399	Nov. 16	N	.. .. ..	.. .. ..	.. .. ..	.. .. ..	.. ..	.. ..	...
		E	3 49 ..	.. .. ..	4 14 ..	4 27 ..	4 43	5 17	1.0
400	Dec. 12	E	.. .. ..	.. .. ..	11 04 40	.. .. ..	.. ..	11 08	...
401	Dec. 21	N	.. .. ..	18 11 06	18 20 30	18 27 57	18 32	19 02	5.8
		E	18 03 36	18 10 58	18 20 46	18 27 08	18 28	18 55	6.0
402	Dec. 26	N	.. .. ..	.. .. ..	5 33 ..	5 38 38	.. ..	5 47	0.1
		E	.. .. ..	.. .. ..	5 33 ..	5 39 ..	.. ..	5 54	0.1

Register of earthquakes—Continued.

No.	Date.	Component.	P	S	L	M	C	F	Maximum amplitude.
	1917.		*h. m. s.*	*h. m. s.*	*h. m. s.*	*h. m. s.*	*h. m.*	*h. m.*	*mm.*
403	Dec. 28	N	.. .. ..	21 30 57	21 41 48	21 53 25	21 59	22 22	1.4
		E	21 23 58	21 31 17	21 41 37	21 46 43	22 01	22 29	2.0
404	Dec. 29	N	22 56 27	23 01 27	23 04 50	23 15 08	23 28	23 45	1.0
		E	22 56 32	23 01 27	23 04 25	23 10 27	23 19	24 09	4.5
	1918.								
405	Jan. 4	N	.. .. ..	4 42 58	4 46 ..	4 47 08	.. ..	5 57	0.1
		E	.. .. ..	.. .. ..	4 46 38	4 47 44	.. ..	6 00	0.3
406	Jan. 25	N	1 31 49	.. .. ..	.. .. ..	1 39 10	.. ..	1 56	0.2
		E	1 32 10	.. .. ..	1 37 ..	1 38 20	.. ..	1 56	0.5
407	Jan. 30	N	21 31 06	.. .. ..	.. .. ..	21 41 10	.. ..	21 59	0.1
		E	21 31 06	.. .. ..	.. .. ..	21 44 14	.. ..	21 54	0.1
408	Feb. 12	N	1 40 39	.. .. ..	.. .. ..	1 41 49	.. ..	1 50	0.1
409	Feb. 12	N	19 33 52	.. .. ..	19 34 40	19 34 55	.. ..	19 37	0.1
410	Feb. 12	N	20 20 05	.. .. ..	.. .. ..	20 21 13	.. ..	20 27	0.6
		E	20 20 05	.. .. ..	.. .. ..	.. .. ..	.. ..	.. ..	...
411	Feb. 13	N	7 05 ..	.. .. ..	.. .. ..	7 23 28	.. ..	7 42	0.5
412	Apr. 10	N	1 09 12	.. .. ..	1 09 30	1 09 36	.. ..	1 18	0.5
		E	1 09 12	.. .. ..	1 09 30	1 09 32	.. ..	1 18	0.5
413	Apr. 21	N	22 39 12	22 44 29	22 47 20	22 50 28	22 55	23 49	24.0
414	May 20	N	14 44 54	14 51 55	14 58 40	14 59 50	15 06	15 54	1.1
		E	14 44 54	14 51 55	14 58 50	15 02 04	15 04	15 54	2.0
415	May 20	N	18 06 03	.. .. ..	.. .. ..	18 15 25	.. ..	18 23	0.1
		E	18 06 21	.. .. ..	.. .. ..	18 15 39	.. ..	18 20	0.6
416	May 23	N	12 09 14	.. .. ..	12 13 08	12 15 28	12 24	13 09	9.0
		E	12 09 ..	.. .. ..	12 13 08	12 17 08	12 24	13 09	1.5
417	May 25	N	19 40 39	.. .. ..	19 58 ..	.. .. ..	.. ..	.. ..	0.1
		E	19 40 39	19 48 35	19 58 ..	20 02 20	20 03	20 17	0.2
418	June 7	N	21 34 18	21 44 31	21 46 11	21 48 25	21 51	22 05	0.5
		E	21 34 06	21 44 21	21 47 25	21 48 10	21 53	22 06	0.6
419	June 11	N	12 41 41	12 45 54	12 48 37	12 55 09	.. ..	13 04	0.1
		E	12 41 43	12 45 53	12 49 ..	12 53 45	.. ..	12 57	0.1
420	June 12	N	.. .. ..	.. .. ..	4 47 03	.. .. ..	.. ..	4 54	0.1
		E	.. .. ..	4 44 09	4 48 09	4 48 23	.. ..	4 51	0.1
421	June 13	N	9 04 20	.. .. ..	.. .. ..	9 12 00	.. ..	9 30	0.2
		E	9 04 20	.. .. ..	.. .. ..	9 11 50	.. ..	9 31	0.1
422	June 17	N	16 46 02	.. .. ..	.. .. ..	16 46 46	.. ..	16 49	0.1
		E	16 46 00	.. .. ..	.. .. ..	16 46 47	.. ..	16 49	0.1
423	June 22	N	22 12 09	22 17 09	22 23 12	22 25 20	22 27	.. ..	0.1
424	July 3	N	7 13 31	7 30 21	7 55 45	8 06 42	8 26	9 16	0.3
		E	7 13 30	7 30 30	7 56 16	8 19 36	8 26	9 09	0.3
425	July 8	N	10 41 58	10 52 35	11 18 01	11 33 34	11 46	12 05	0.2
		E	10 41 46	.. .. ..	11 18 19	11 21 39	11 46	.. ..	0.3
426	July 15	N	0 30 29	0 36 17	0 42 ..	0 44 23	0 54	1 32	2.7
		E	0 30 24	0 36 12	0 41 42	0 46 26	0 54	1 19	1.9
427	July 21	N	.. .. ..	.. .. ..	7 11 45	7 21 ..	7 22	8 02	0.1
		E	.. .. ..	.. .. ..	7 12 49	7 19 ..	7 28	8 04	0.5
428	July 31	N	.. .. ..	14 48 12	14 52 43	14 55 51	14 59	15 12	0.6
		E	.. .. ..	14 48 08	14 52 34	14 54 08	14 59	15 10	0.5
429	Aug. 8	N	.. .. ..	.. .. ..	10 48 ..	10 55 ..	11 02	.. ..	0.1
		E	.. .. ..	.. .. ..	10 49 ..	10 55 ..	10 57	.. ..	0.1
430	Aug. 15	N	12 37 42	.. .. ..	13 20 ..	13 50 02	14 17	14 53	1.5
		E	12 37 35	.. .. ..	12 58 ..	13 41 53	14 01	14 34	3.2
431	Aug. 15	N	17 52 53	.. .. ..	.. .. ..	.. .. ..	.. ..	.. ..	...
		E	17 52 50	.. .. ..	.. .. ..	.. .. ..	.. ..	.. ..	...
432	Aug. 23	N	.. .. ..	.. .. ..	7 39 ..	7 53 ..	.. ..	7 56	0.1
		E	.. .. ..	.. .. ..	7 41 ..	7 45 ..	.. ..	7 57	0.1
433	Sept. 7	N	17 29 23	17 40 00	18 01 30	18 29 02	18 36	21 40	17.1
		E	17 29 23	17 40 11	18 01 30	18 24 31	18 53	20 35	12.0
434	Sept. 11	N	4 03 58	.. .. ..	.. .. ..	4 08 ..	4 12	.. ..	....
		E	4 04 04	.. .. ..	.. .. ..	.. .. ..	.. ..	.. ..	....
435	Sept. 12	N	.. .. ..	.. .. ..	18 29 48	18 30 25	18 31	18 38	0.1
		E	.. .. ..	.. .. ..	18 30 08	18 30 55	18 31	18 34	0.1
436	Sept. 30	N	14 12 25	.. .. ..	14 14 57	14 15 57	14 18	14 23	0.2
437	Oct. 4	N	9 27 29	.. .. ..	9 28 00	9 28 06	.. ..	9 29	0.2
		E	9 27 29	.. .. ..	9 27 48	9 28 06	.. ..	9 29	0.1
438	Oct. 11	N	14 19 29	14 23 45	14 26 08	14 30 33	14 41	16 42	52.0
		E	14 19 29	14 23 38	14 27 28	14 30 13	14 35	15 38	47.0
439	Oct. 11	N	17 08 40	17 12 44	17 16 20	17 18 42	17 21	17 51	0.4
		E	17 08 40	17 12 41	.. .. ..	.. .. ..	.. ..	17 21	...
440	Oct. 12	N	8 24 43	.. .. ..	8 34 19	8 34.50	.. ..	8 41	0.1
		E	8 24 43	.. .. ..	.. .. ..	.. .. ..	.. ..	8 31	...

Register of earthquakes—Continued.

No.	Date.	Component.	P	S	L	M	C	F	Maximum amplitude.
	1918.		*h. m. s.*	*h. m. s.*	*h. m. s.*	*h. m. s.*	*h. m.*	*h. m.*	*mm.*
441	Oct. 13	N	4 56 59	.. .. ..	5 06 35	5 07 20	.. ..	5 09	0.1
		E	4 57 02	.. .. ..	.. .. ..	.. .. ..	.. ..	5 05	...
442	Oct. 14	N	0 30 26	.. .. ..	0 39 30	0 40 17	0 41	0 38	0.1
		E	0 30 27	.. .. ..	.. .. ..	.. .. ..	.. ..	.. ..	...
443	Oct. 18	N	21 38 41	21 42 40	21 46 12	21 49 28	21 50	21 52	0.1
444	Oct. 19	N	3 28 42	3 33 27	3 39 01	3 42 18	3 44	4 05	1.5
		E	3 28 50	.. .. ..	.. .. ..	3 42 15	3 45	.. ..	0.3
445	Oct. 25	N	3 48 27	3 52 28	3 56 20	4 00 48	4 08	4 37	0.4
		E	3 48 28	3 52 28	.. .. ..	.. .. ..	4 09	.. ..	...
446	Oct. 27	N	.. .. ..	.. .. ..	16 35 ..	.. .. ..	.. ..	18 47	...
447	Oct. 29	N	12 33 55	.. .. ..	12 41 57	12 44 00	12 49	12 57	0.1
448	Nov. 2	N	.. .. ..	.. .. ..	10 38 30	10 40 30	10 42	10 43	0.1
449	Nov. 8	N	4 51 00	5 01 37	5 19 10	5 40 48	5 49	6 57	2.1
		E	4 51 00	.. .. ..	5 23 40	5 32 35	5 38	5 52	0.4
450	Nov. 12	N	21 49 37	21 53 42	21 55 46	21 59 52	22 04	22 36	0.6
		E	21 49 36	.. .. ..	.. .. ..	.. .. ..	.. ..	22 17	0.4
451	Nov. 18	N	19 01 07	19 04 53	19 15 ..	19 45 18	.. ..	20 55	0.4
		E	19 01 00	19 04 50	.. .. ..	.. .. ..	.. ..	20 06	....
452	Nov. 23	N	23 20 00	.. .. ..	24 12 30	24 17 ..	.. ..	24 27	0.1
		E	23 20 50	.. .. ..	.. .. ..	.. .. ..	.. ..	23 29	....
453	Dec. 1	N	.. .. ..	.. .. ..	3 33 30	3 34 10	3 35	3 46	0.1
		E	.. .. ..	.. .. ..	3 32 20	3 34 20	.. ..	3 46	0.1
454	Dec. 2	N	9 55 36	10 01 46	.. .. ..	10 02 00	.. ..	10 31	0.3
		E	9 55 36	10 01 55	.. .. ..	10 07 20	.. ..	10 38	0.2
455	Dec. 4	N	11 58 30	12 07 57	12 25 45	12 30 10	12 33	13 47	0.1
		E	11 58 30	12 07 00	12 28 40	12 30 30	12 33	13 45	0.5
456	Dec. 6	N	8 48 15	8 54 03	8 58 40	9 00 40	9 06	9 35	6.0
		E	8 48 18	8 54 06	9 00 06	9 01 02	9 07	9 35	5.5
457	Dec. 6	N	12 21 28	12 22 40	.. .. ..	.. .. ..	.. ..	12 31	....
		E	12 22 08	12 22 40	12 25 00	12 25 45	.. ..	12 31	0.2
458	Dec. 9	N	.. .. ..	.. .. ..	18 44 50	18 48 ..	.. ..	18 49	0.1
		E	.. .. ..	.. .. ..	18 44 30	.. .. ..	.. ..	18 47	0.1
459	Dec. 9	N	.. .. ..	.. .. ..	19 28 25	19 37 10	.. ..	19 51	0.1
		E	.. .. ..	.. .. ..	19 30 55	19 36 15	.. ..	19 52	0.1
460	Dec. 23	N	19 54 51	.. .. ..	19 59 24	20 00 18	20 01	20 13	0.2
		E	19 55 46	.. .. ..	19 59 54	20 00 18	20 03	20 10	0.2

REMARKS.

377. Barely perceptible.
378. Preliminary phases uncertain on both N and E.
380, 381, 383, 384, 385, 386, and 388. Phases uncertain.
387. Phases not well marked; nothing definite on N; microseismics March 27, April 9, and May 6.
390, 395, 399, 400, 402. No definite phases.
391, 398. Phases uncertain.
392. An amplitude of 9.8 mm. occurred during S at $1^h\ 10^m\ 32^s$.
399. No definite long waves.
406. Phases doubtful.
408, 409, 410, 411. E, trace defective.
412. Reported felt at Cheltenham and Croome, Md.; mechanical vibrations recorded by magnetograph No. 5 during the principal portion on *D* and *H*, but not by No. 1.
413. P, obscured; E, pen not recording.
414. Greater amplitudes during S waves at 14:52, 3.8 mm. on E and 3.3 mm. on N.
418. P and S doubtful, the waves beginning about 21:44:30 look more like P than S, and their period is only 4 sec.
420. Only a few long waves.
423. East-west motion barely discernible.
425. Time of L doubtful.
427. Phases very indefinite.
428. Microseisms present most of the day.
430. Changing paper from 12:47 to 13:07 on N and from 13:09 to 13:20 on E.
431. Possibly a few long waves on N about an hour later.
436. P doubtful because of presence of observer in room.
437. Local.
439, 440, 441, 442, 444, 445, 446, 450, 452. No long waves on E.
447. P uncertain because of microseisms.
450. Felt in Porto Rico.
454. Long waves not well defined; the tabulated maxima occur during what are probably S waves.
455. Actual maximum on E (1.0 mm.) occurs at 12:08:25.
456. Microseisms present on E.
457. The long waves are of small amplitude and are overlaid by waves of shorter periods. The actual maximum (0.4 mm.) occurs at 12:22:42 on both components.
460. Beginning faint; time of P uncertain.

Serial No. 214

DEPARTMENT OF COMMERCE
U. S. COAST AND GEODETIC SURVEY
E. LESTER JONES, Director

RESULTS OF OBSERVATIONS MADE AT THE UNITED STATES COAST AND GEODETIC SURVEY MAGNETIC OBSERVATORY AT CHELTENHAM, MARYLAND, 1919 AND 1920

BY

DANIEL L. HAZARD
ASSISTANT CHIEF DIVISION OF TERRESTRIAL MAGNETISM

PRICE, 30 CENTS
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CONTENTS.

ILLUSTRATIONS.

EARTHQUAKES.

A Bosch-Omori seismograph has been in operation at Cheltenham since November, 1904. It consists of two horizontal pendulums, one recording north-south motion (N) and the other recording east-west motion (E). In the following table the times are Greenwich mean time, counted from midnight.

Period of pendulums: 15 sec.; multiplication, 10; steady mass, 10 to 12 kg.

Register of earthquakes.

No.	Date.	Component.	P	S	L	M	C	F	Maximum.
	1919.		*h. m. s.*	*h. m. s.*	*h. m. s.*	*h. m. s.*	*h. m.*	*h. m.*	*mm.*
461	Jan. 1	N	1 56 55	.. .. ..	2 37 45	2 56 55	.. ..	.. ..	0.2
		E	1 56 59	.. .. ..	2 37 40	2 57 30	.. ..	.. ..	0.1
462	Jan. 1	N	3 19 53	3 26 59	.. .. ..	3 34 54	3 58	4 48	4.6
		E	3 19 20	3 25 12	3 29 09	3 35 19	4 17	5 10	2.5
463	Jan. 17	N	12 01 17	.. .. ..	.. .. ..	12 09 30	.. ..	12 33	0.1
		E	12 01 09	.. .. ..	.. .. ..	12 09 34	.. ..	12 31	0.2
464	Feb. 1	N	.. .. ..	.. .. ..	0 02 49	0 06 07	.. ..	0 28	0.2
		E	.. .. ..	.. .. ..	0 02 20	0 07 00	.. ..	0 22	0.2
465	Mar. 2	N	3 39 21	3 49 33	4 18 30	.. .. ..	.. ..	4 38	0.1
		E	3 40 01	3 49 33	.. .. ..	3 49 45	.. ..	.. ..	0.2
466	Mar. 2	N	12 07 45	.. .. ..	12 30 38	12 37 00	.. ..	12 45	0.2
		E	12 07 47	.. .. ..	12 28 39	12 31 54	.. ..	12 45	0.1
467	Mar. 9	N	3 38 47	.. .. ..	4 01 43	.. .. ..	.. ..	4 32	...
		E	3 38 44	.. .. ..	4 00 39	.. .. ..	.. ..	4 27	...
468	Apr. 17	N	20 58 55	21 03 44	21 09 42	21 12 27	21 16	22 12	18.0
		E	20 58 58	21 03 48	21 09 19	21 12 21	21 16	21 32	4.4
469	Apr. 18	N	21 08 39	21 13 13	21 19 17	21 20 31	21 21	22 07	5.7
		E	21 08 54	.. .. ..	21 20 20	.. .. ..	.. ..	21 33	0.2
470	Apr. 28	N	6 51 54	.. .. ..	7 00 59	7 03 44	7 13	7 27	0.3
		E	6 51 59	.. .. ..	.. .. ..	.. .. ..	.. ..	7 07	...
471	Apr. 30	N	7 35 54	7 44 00	8 17 ..	8 22 31	8 55	10 58	15.8
		E	7 35 51	.. .. ..	8 11 47	8 24 41	8 56	10 13	17.0
472	May 3	N	1 05 14	1 16 14	1 38 50	1 54 37	2 08	3 10	0.8
		E	1 05 25	1 16 19	1 42 00	1 54 00	.. ..	2 01	0.1
473	May 6	N	20 03 51	.. .. ..	20 34 ..	20 50 00	21 18	22 17	1.7
		E	20 02 45	.. .. ..	20 36 ..	21 01 20	21 11	21 39	0.4
474	May 18	N	10 45 12	.. .. ..	.. .. ..	10 46 02	.. ..	10 54	0.3
		E	10 45 16	.. .. ..	.. .. ..	10 45 40	.. ..	10 54	0.3
475	May 20	N	4 36 45	.. .. ..	4 41 ..	.. .. ..	.. ..	4 56	0.1
476	June 29	N	23 20 14	23 24 55	23 29 20	23 33 46	23 35	24 17	2.6
		E	23 20 14	23 24 54	23 31 20	23 30 47	23 44	24 18	2.8
477	July 6	N	7 10 30	7 15 00	7 20 56	7 22 30	7 24	7 35	0.5
		E	7 10 15	7 15 17	7 20 49	7 21 20	7 26	7 37	0.4
478	July 8	N	.. .. ..	.. .. ..	21 59 00	22 10 40	.. ..	22 21	...
		E	.. .. ..	.. .. ..	22 01 50	22 07 04	22 15	22 26	0.5
479	July 9	N	19 31 41	.. .. ..	19 38 17	19 39 00	19 40	19 58	0.8
480	July 17	N	16 31 11	.. .. ..	16 35 55	16 39 00	16 43	16 47	0.1
		E	16 30 42	.. .. ..	16 36 42	.. .. ..	.. ..	16 43	...
481	July 18	N	.. .. ..	.. .. ..	13 57 50	14 00 20	14 02	14 09	0.1
		E	.. .. ..	.. .. ..	13 58 35	.. .. ..	.. ..	14 07	0.1
482	July 22	N	22 07 21	22 11 57	22 14 00	22 23 45	.. ..	22 28	0.1
		E	22 07 25	22 11 57	22 14 06	22 14 36	22 16	22 25	0.3
483	July 31	N	22 12 45	.. .. ..	22 16 05	.. .. ..	.. ..	22 19	...
		E	22 12 43	.. .. ..	.. .. ..	.. .. ..	.. ..	22 17	0.1
484	Aug. 29	N	6 06 38	.. .. ..	6 55 20	7 06 25	7 18	7 50	0.1
		E	6 06 31	.. .. ..	6 56 20	.. .. ..	.. ..	7 05	...
485	Aug. 31	N	17 41 25	.. .. ..	18 12 30	18 39 00	.. ..	18 59	...
		E	17 40 53	17 50 33	18 27 40	18 31 35	.. ..	18 42	...
486	Sept. 6	N	9 34 45	9 38 48	9 42 00	9 49 15	9 50	10 14	0.2
		E	9 34 45	9 38 48	9 40 40	9 46 05	9 55	10 07	0.3
487	Sept. 15	N	17 47 31	.. .. ..	17 49 50	17 50 15	17 52	17 56	0.3
		E	17 47 31	.. .. ..	17 50 50	17 51 10	17 52	17 59	0.4
488	Sept. 27	N	11 34 28	.. .. ..	.. .. ..	.. .. ..	.. ..	11 38	0.1
		E	11 34 03	.. .. ..	.. .. ..	.. .. ..	.. ..	11 39	0.1
489	Sept. 30	N	7 53 42	.. .. ..	7 54 40	7 54 45	.. ..	8 03	0.3
		E	7 53 46	.. .. ..	7 57 40	7 59 05	.. ..	8 03	0.1
490	Oct. 10	N	1 19 45	.. .. ..	1 28 10	1 29 10	1 32	2 13	0.2
		E	1 16 00	.. .. ..	1 28 50	1 33 50	1 35	2 04	0.2
491	Oct. 14	N	17 02 01	.. .. ..	17 07 10	17 09 10	.. ..	17 22	0.1
		E	17 01 58	.. .. ..	17 07 00	17 17 25	.. ..	17 22	0.1

Register of earthquakes—Continued.

No.	Date.	Component.	P	S	L	M	C	F	Maximum.
	1920.		*h. m. s.*	*h. m. s.*	*h. m. s.*	*h. m. s.*	*h. m.*	*h. m.*	*mm.*
492	Jan. 4	N	4 27 44	4 32 23	4 38 47	4 42 30	4 54	5 05	0.4
		E	4 27 37	4 32 36	.. .. ..	4 32 50	.. ..	5 01	0.1
493	Feb. 2	E	.. .. ..	.. .. ..	12 35 26	.. .. ..	.. ..	12 42	0.1
494	Feb. 2	E	.. .. ..	.. .. ..	13 29 19	.. .. ..	.. ..	13 35	0.1
495	Feb. 10	N	22 12 56	22 17 00	22 20 20	22 27 20	22 37	22 54	8.3
		E	22 12 56	22 17 00	22 20 20	22 24 22	22 38	23 03	0.6
496	Feb. 22	N	17 58 09	.. .. ..	.. .. ..	17 58 27	.. ..	18 02	0.3
		E	17 58 10	.. .. ..	.. .. ..	17 58 27	.. ..	18 00	0.8
497	Mar. 20	N	.. .. ..	18 08 00	.. .. ..	.. .. ..	.. ..	18 14	0.2
		E	17 57 36	.. .. ..	.. .. ..	.. .. ..	.. ..	18 13	0.1
498	Mar. 20	N	18 43 52	18 53 50	19 12 15	19 15 48	19 19	19 43	0.8
		E	.. .. ..	18 53 45	.. .. ..	.. .. ..	.. ..	19 07	0.1
499	Mar. 23	N	15 28 12	15 33 09	15 37 20	.. .. ..	15 42	15 55	0.2
		E	15 27 49	15 33 00	15 37 17	.. .. ..	15 40	15 45	0.1
500	Mar. 29	N	5 15 15	5 24 07	5 28 20	5 31 50	5 37	6 08	4.0
		E	5 15 13	.. .. ..	5 28 58	5 31 48	5 37	5 51	1.0
501	Apr. 18	N	21 31 42	.. .. ..	21 40 46	.. .. ..	21 42	22 19	0.1
		E	21 31 11	21 33 28	.. .. ..	.. .. ..	.. ..	22 20	0.1
502	Apr. 19	N	21 12 12	21 16 50	21 24 01	21 30 39	21 32	21 40	0.1
		E	21 12 12	.. .. ..	21 26 45	21 30 22	.. ..	21 40	0.1
503	May 7	N	22 14 00	.. .. ..	22 29 48	.. .. ..	22 48	23 19	0.1
		E	21 53 48	22 01 31	22 31 20	22 41 45	23 06	23 59	0.4
504	May 13	N	.. .. ..	.. .. ..	2 55 12	3 03 12	3 06	3 12	0.1
		E	.. .. ..	.. .. ..	3 01 40	3 04 00	.. ..	3 13	0.1
505	May 20	E	.. .. ..	.. .. ..	8 22 10	.. .. ..	.. ..	8 35	...
506	May 30	N	21 04 48	.. .. ..	.. .. ..	21 06 22	.. ..	21 09	0.2
		E	21 05 16	.. .. ..	21 07 10	.. .. ..	.. ..	21 10	0.2
507	June 2	N	22 18 57	.. .. ..	.. .. ..	.. .. ..	.. ..	22 28	0.2
		E	22 18 56	.. .. ..	.. .. ..	22 30 39	.. ..	22 40	0.1
508	June 4	N	10 46 56	.. .. ..	.. .. ..	.. .. ..	.. ..	11 01	0.1
		E	10 47 42	.. .. ..	.. .. ..	10 58 23	.. ..	11 04	0.1
509	June 5	N	4 40 58	4 48 10	5 16 45	5 39 36	5 48	6 07	1.9
		E	4 41 17	4 48 10	5 17 35	5 38 23	5 43	6 04	0.5
510	June 22	N	3 05 14	.. .. ..	3 06 05	3 06 24	3 09	3 13	0.1
511	July 7	N	19 00 00	.. .. ..	19 04 35	19 05 40	19 09	19 27	2.0
		E	18 56 24	19 01 17	19 04 05	19 05 35	19 10	19 30	2.2
512	July 8	N	1 02 07	.. .. ..	.. .. ..	.. .. ..	.. ..	1 11	0.2
		E	1 02 12	.. .. ..	.. .. ..	.. .. ..	.. ..	1 09	0.1
513	Aug. 3	N	20 08 05	20 16 49	20 31 33	20 38 07	20 47	21 03	0.2
		E	20 08 10	20 16 59	.. .. ..	.. .. ..	.. ..	20 25	...
514	Aug. 20	N	16 27 29	16 37 16	17 03 58	.. .. ..	.. ..	17 21	0.1
515	Aug. 26	N	23 10 17	23 18 38	23 31 00	23 31 45	23 41	24 01	0.1
		E	23 10 15	.. .. ..	.. .. ..	.. .. ..	.. ..	23 16	...
516	Sept. 8	N	2 10 44	2 20 45	.. .. ..	.. .. ..	.. ..	2 42	0.5
517	Sept. 20	N	15 04 55	15 16 09	15 39 49	15 51 27	16 00	17 21	2.9
		E	14 53 05	.. .. ..	15 38 11	15 46 36	15 50	16 24	0.9
518	Sept. 27	N	5 42 28	.. .. ..	5 42 43	5 43 46	5 46	5 58	0.4
		E	5 42 35	.. .. ..	.. .. ..	.. .. ..	.. ..	5 48	...
519	Oct. 1	N	19 01 05	19 09 35	19 12 05	19 14 30	.. ..	19 40	0.1
520	Oct. 8	N	16 56 48	17 01 04	.. .. ..	17 06 33	17 18	17 29	0.3
		E	16 56 48	.. .. ..	.. .. ..	.. .. ..	.. ..	17 18	...
521	Oct. 18	N	8 24 21	8 34 49	9 02 45	9 09 30	.. ..	9 35	0.1
		E	8 24 21	8 34 45	.. .. ..	.. .. ..	.. ..	8 55	...
522	Oct. 22	N	12 20 02	12 28 10	12 39 40	.. .. ..	.. ..	13 09	...
		E	12 20 04	12 28 18	.. .. ..	.. .. ..	.. ..	12 35	...
523	Oct. 26	N	19 19 20	.. .. ..	19 26 32	19 28 12	.. ..	19 55	0.1
524	Oct. 28	N	13 00 55	13 10 03	.. .. ..	.. .. ..	.. ..	13 36	...
		E	13 01 00	13 10 18	.. .. ..	.. .. ..	.. ..	13 17	...
525	Nov. 16	N	8 39 05	.. .. ..	8 53 41	8 53 48	.. ..	9 05	0.3
		E	8 39 03	8 47 51	8 53 00	8 53 52	8 55	9 02	0.5
526	Dec. 16	N	12 24 14	.. .. ..	13 02 38	13 10 10	13 22	14 08	21.5
		E	12 25 00	.. .. ..	12 51 20	13 11 40	13 27	14 25	21.0

REMARKS.

461. End covered by beginning of next quake.
462. The phases are not well defined and it may be that there are two quakes overlapping. The times given for S and M on N are the abrupt beginnings of two single isolated waves.
463. Phases obscured by tremors.
466. L uncertain on both components.
467. Entire record very faint except P.
469. No well defined long waves or maximum on E.
471. Times given as P may be P once reflected. What is probably S once reflected occurs on N at 7:51:24.
472. L and following phases very faint on E.
473. Phases not well defined.
476. L uncertain; it may come earlier.
484. Phases uncertain. L may come 3^m earlier on N.
486. Actual maximum occurred at 9:39:00 on N (0.6 mm.) and at 9:39:05 on E (0.8 mm.).
487. P uncertain on account of microseisms.
488. Possibly not seismic.
490. Phases indefinite.
495. Felt in Porto Rico. L uncertain.
496. This may be an unusually large microseism, as the waves all have a period of about 5 sec.
497, 498, 499. Record faint; phases not well defined.
501. At 21:32:12 on both components there is a fresh impulse, which may be PR. Another point of fresh activity occurs at 21:35:02 on N and 21:35:28 on E.
502. L uncertain.
507. Other phases indeterminate.
509. Reported from Formosa. For this distance the phase tabulated as P would be PR. A secondary phase occurred at 4:50:45 on N and 4:50:53 on E.
510. Reported from Los Angeles, Calif.
511. Preliminary phases uncertain.
512. No distinct phases.
513, 515. Preliminary tremors only on E.
514. No distinct maximum.
517, 518, 519. Preliminary phases uncertain.
521, 522. No long waves on E.
523, 525. Phases not well defined.
526. The phases recorded as P are probably PR.

MAGNETIC STORMS.

Magnetic disturbances of considerable magnitude were recorded on the days tabulated below. Where a storm began abruptly, the time of beginning is given to the nearest minute.

On the succeeding sheets will be found reproductions of the magnetograms showing the principal magnetic storms. A storm selected for reproduction is indicated in the table by an asterisk after the date. An upward motion of the curves corresponds to increasing west declination, increasing H and increasing Z. For convenience in comparing with similar reproductions for other observatories the time scale has been marked for Greenwich mean time.

Serial No. 275

DEPARTMENT OF COMMERCE
U. S. COAST AND GEODETIC SURVEY
E. LESTER JONES, Director

RESULTS OF OBSERVATIONS MADE AT THE UNITED STATES COAST AND GEODETIC SURVEY MAGNETIC OBSERVATORY AT CHELTENHAM, MD., IN 1921 AND 1922

BY

DANIEL L. HAZARD
Assistant Chief, Division of Terrestrial Magnetism

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CONTENTS

INTRODUCTION

[Latitude, 38° 44′.0; longitude, 76° 50′.5; elevation, 72 meters (235 feet)]

The magnetic observatory at Cheltenham was put in operation in April, 1901. For a general description of the buildings and instruments see "Results of Observations Made in 1901–1904." The methods employed are explained in "Directions for Magnetic Measurements," published in 1911 (second edition in 1921).

The division of terrestrial magnetism of the United States Coast and Geodetic Survey, of which N. H. Heck, hydrographic and geodetic engineer, is chief, includes both the office and field work. The work of the Cheltenham Observatory during 1921 and 1922 was in charge of George Hartnell, assisted by S. G. Townshend, jr., magnetic observers. The office reductions and preparation of the results for publication were in charge of D. L. Hazard, assisted by Frank Neumann, O. S. Hill, J. B. Goldsmith, and I. I. Kaplan, computers.

Up to the end of 1914 each hourly value of declination (D), horizontal intensity (H), or vertical intensity (Z) in the monthly tabulations represented the momentary value of the quantity for the specified hour, local mean time. Beginning with 1915 the published hourly values are average values for successive periods of an hour, beginning at midnight of the specified standard meridian (seventy-fifth in the case of Cheltenham). Thus a value in the column headed 1 represents the average value for the hour beginning at midnight and ending at 1 a. m., seventy-fifth meridian time.

EARTHQUAKES

A Bosch-Omori seismograph has been in operation at Cheltenham since November, 1904. It consists of two horizontal pendulums, one recording north-south motion (N) and the other recording east-west motion (E). In the following table the times are Greenwich mean time, counted from midnight.

Period of pendulums, 15 seconds.
Multiplication, 10.
Steady mass, 10 to 12 kg.

Register of earthquakes

No.	Date	Component	P	S	L	M	C	F	Maximum amplitude
	1921		h. m. s.	h. m. s.	h. m. s.	h. m. s.	h. m.	h. m.	mm.
527	Feb. 4	E	8 28 12	8 33 20	8 37 04	8 39 01	8 48	9 04	7.7
		N	8 28 14	8 33 21	8 37 51	8 38 21	8 47	8 59	1.3
528	Mar. 6	E	7 41 15	.....	.....	7 44 30	.....	7 52	.4
		N	7 41 10	.....	.....	7 44 05	.....	7 52	.4
529	Mar. 25	E	0 48 53	.....	.....	0 49 18	.....	0 56	.2
		N	0 48 53	.....	0 49 30	0 49 41	.....	0 56	.5
530	Mar. 28	E	.....	7 59 55	8 03 07	8 06 30	8 14	8 28	5.7
		N	7 54 48	7 59 49	8 02 40	8 05 35	8 14	8 40	4.3
531	Apr. 10	E	14 01 44	.....	14 05 15	14 05 45	14 07	14 12	1.1
		N	13 59 25	.....	14 04 50	14 05 18	14 11	14 25	1.0
532	Apr. 12	E	7 50 36	.....	.....	7 52 39	.....	7 59	.2
		N	7 50 03	.....	.....	7 52 33	7 56	8 02	.4
533	May 1	E	5 46 19	.....	5 59 49	6 00 17	.....	6 11	1.1
		N	5 46 19	.....	5 56 49	5 59 23	6 14	6 43	.6
534	May 14	E	22 16 39	22 21 24	.....	22 27 49	22 34	22 42	.1
		N	22 16 34	.....	22 23 14	22 30 10	22 33	22 40	.2
535	May 28	E	21 12 37	.....	.....	21 13 54	.....	21 33	.1
		N	21 10 55	.....	.....	21 14 08	.....	21 34	.4
536	June 25	E	2 25 32	.....	.....	2 28 40	.....	2 33	.1
		N	2 25 29	.....	.....	2 29 11	2 30	2 36	.2
537	Aug. 19	E	.....	.....	8 39 05	.....	.....	8 41	.....
		N	8 38 10	.....	8 38 44	8 39 26	8 40	8 46	.1
538	Aug. 23	E	.....	.....	20 42 35	.....	20 45	20 50	.1
		N	20 37 05	.....	20 41 28	20 42 15	20 43	20 57	.3
539	Sept. 5	N	.....	.....	20 36 16	20 58 31	.....	21 20	.1
540	Sept. 11	N	4 21 29	.....	4 50 53	5 34 57	.....	6 29	1.0
541	Sept. 19	N	.....	.....	4 37 52	4 46 30	.....	5 05	.1
542	Oct. 15	E	.....	5 32 11	.....	6 10 15	6 15	6 30	.1
		N	.....	.....	5 47 29	6 10 49	6 13	6 33	.1
543	Oct. 20	E	.....	6 21 06	6 28 36	.....	.....	.....	.....
		N	6 13 17	6 21 15	6 28 46	6 41 42	6 43	6 50	.2
544	Nov. 11	E	.....	.....	.....	20 00 40	.....	20 31	.2
		N	.....	19 07 27	19 34 09	20 08 37	.....	20 33	.2
545	Nov. 13	E	.....	8 52 15	8 54 54	8 55 37	.....	9 08	.3
		N	8 47 36	8 51 55	8 53 53	8 54 07	.....	9 15	.1
546	Nov. 15	E	.....	.....	21 02 38	.....	.....	21 38	.....
		N	20 49 50	.....	21 00 06	21 03 50	.....	21 40	.2
547	Dec. 18	E	15 36 42	15 42 22	.....	15 42 34	.....	16 07	2.1
		N	15 36 42	15 42 13	.....	15 42 46	.....	16 15	1.5
	1922								
548	Jan. 6	E	.....	14 28 39	14 36 34	14 45 19	.....	15 06	.2
		N	14 20 56	14 28 19	14 38 36	14 46 41	.....	15 15	.1
549	Jan. 9	E	5 15 45	5 20 48	5 23 46	5 24 38	5 32	5 47	.1
		N	5 15 52	.....	5 22 19	5 23 14	5 24	5 56	.2
550	Jan. 17	E	3 57 55	.....	4 03 31	4 07 07	4 08	4 44	3.8
		N	3 57 43	.....	4 03 31	4 07 07	4 08	4 42	1.5
551	Jan. 22	E	4 17 16	.....	.....	4 20 52	4 25	4 41	.2
		N	4 17 59	.....	4 23 45	.....	.....	4 30	.1
552	Jan. 26	E	.....	.....	9 51 02	9 54 20	9 55	10 03	.3
		N	9 41 39	.....	9 51 02	9 51 58	9 55	10 00	.2
553	Jan. 31	E	13 24 32	13 30 20	13 36 41	13 41 14	13 44	15 25	16.0
		N	13 24 37	13 30 20	13 34 41	.....	13 44	15 12	41+
554	Feb. 16	E	3 25 05	3 27 23	3 30 17	3 31 06	3 33	3 50	.5
		N	3 21 52	.....	3 41 34	3 55 08	.....	4 05	.7
555	Mar. 10	E	.....	.....	.....	11 43 22	11 45	11 53	.2
		N	.....	.....	11 35 29	11 43 02	.....	11 57	1.5
556	Mar. 28	E	.....	4 15 49	.....	4 16 52	.....	4 28	.1
		N	4 07 47	4 15 49	4 25 41	4 36 43	4 37	4 45	.1
557	Apr. 2	E	.....	.....	19 46 51	19 51 20	.....	20 14	.1
		N	.....	.....	19 36 03	19 54 26	.....	20 30	.3

Register of earthquakes—Continued

No.	Date	Component	P	S	L	M	C	F	Maximum amplitude
	1922		*h. m. s.*	*h. m. s.*	*h. m. s.*	*h. m. s.*	*h. m.*	*h. m.*	*mm.*
558	Apr. 5	E			11 00 21	11 06 48		11 29	.1
		N			11 03 40	11 10 33		11 29	.1
559	Apr. 8	E		20 57 55	21 07 51	21 08 54		21 22	.9
		N	20 51 02	20 57 41	21 07 51	21 11 00		21 47	.4
560	Apr. 11	E			1 20 24	1 22 05		1 38	.1
561	Apr. 13	E	15 22 55		15 24 48	15 25 29		15 37	.1
		N	15 23 32		15 25 03	15 25 08		15 33	.2
562	Apr. 25	E			22 41 50	22 45 30		23 06	.1
563	June 12	E		4 59 11	5 04 18	5 07 18	5 06	5 40	4.1
		N		4 58 43	5 01 51	5 04 52		5 29	11.5
564	June 12	E			11 04 29			11 16	
		N	10 57 19		11 00 15	11 01 27		11 14	.5
565	June 16	N		21 11 51	21 15 56	21 17 29		21 24	.2
566	July 2	E	21 28 36			21 29 35		21 31	.1
		N	21 28 36			21 29 35		21 31	.1
567	Sept. 1	E		19 44 22	20 11 50	20 12 20		20 51	.1
		N		19 45 32	20 12 00	20 27 56		20 51	.1
568	Nov. 11	E	4 43 47	4 52 16	5 06 50	5 10 15	5 14	7 21	2.3
		N	4 43 31	4 52 16	5 07 34	5 14 31		7 28	3.8
569	Dec. 18	E		12 43 57	12 55 26			13 04	
		N	12 39 52	12 43 57	12 49 04	12 49 48		12 58	.1
570	Dec. 31	E	7 42 46	7 43 34	8 01 46			8 06	

REMARKS

527. Phases well marked on E with the exception of P. PR_1 is shown on both components at 8 : 28 : 34 and SR_1 on E at 8 : 34 : 29. Δ=3,860 km.
528. Microseisms obscure beginning; phases uncertain.
530. A distinct impetus on both components at 7 : 55 : 05. Δ=3,260 km.
531. Phases uncertain; beginning probably later than S; impetus on N at 14 : 02 : 08.
532. 535. No distinct phases.
533. Phases P_N and L_N are well defined but L_N has some of the characteristics of S.
536. Phases poorly defined; on both components there is a distinct phase at 2 : 26 : 21.
537, 538. Phases ill defined.
539, 540, 541. Nothing recorded on E.
542. PR_1 on E at 5 : 25 : 45.
544. PR_1 on N at 18 : 57 : 39. Beginning of E at 19 : 15 : 20.
546. No definite phase on E; record begins at 20 : 59 : 04.
549. O at 5 : 09 : 20; distance 3,400 km.
550. Recorded on magnetograph (D) from 4 : 03 to 4 : 21. Actual maximum at 4 : 03 : 44, 9.6 mm. on E and 3.4 mm. on N.
551. Beginning indefinite.
552. Preliminary phases hidden by microseisms.
553. N stylus off the sheet from 13 : 38 : 30 to 13 : 39 : 00. O at 13 : 17 : 13, distance 4,010 km.
555. E emerges at 11 : 40 : 00.
556. SR_2 on E at 4 : 21 : 33. O at 3 : 57 : 49; distance 6,480 km.
559. PR_1 on N at 20 : 52 : 51; SR_1 at 21 : 01 : 10.
563. SR_1 on E at 5 : 00 : 41; on N at 5 : 00 : 26. Times on N are somewhat uncertain because the time marker was not operating.
564. No definite phases.
567. Phases poorly defined. PR_1 on E at 19 : 36 : 00; SR_1 at 19 : 51 : 58 on E and 19 : 52 : 58 on N.
568. Chilean earthquake. O at 4 : 32 : 46, distance 7,320 km. PR_1 on N at 4 : 46 : 34; PR_2 on N at 4 : 48 : 00 SR_1 at 4 : 57 : 39; SR_2 at 4 : 59 : 53 on E and 5 : 00 : 18 on N. Actual M_E occurs at 4 : 53 : 20, 3.5 mm.
569. O at 12 : 34 : 45, distance 2,500 km.
570. Record very faint.

MAGNETIC STORMS

Magnetic disturbances of considerable magnitude were recorded on the days tabulated below. Where a storm began abruptly, the time of beginning is given to the nearest minute.

On the succeeding sheets will be found reproductions of the magnetograms showing the principal magnetic storms. A storm selected for reproduction is indicated in the table by an asterisk after the date. An upward motion of the curves corresponds to increasing west declination, increasing H and increasing Z. For convenience in comparing with similar reproductions from other observatories the time scale has been marked for Greenwich mean time.

Principal magnetic disturbances

Date	75th meridian time of beginning	Duration in hours	Relative magnitude
1921	*h. m.*		
Jan. 3	20	42	1
Jan. 9	1	48	1
Jan. 11	17	32	1
Jan. 15	6	72	1
Jan. 19	21	56	1
Jan. 23	16	20	1
Jan. 25	16	18	1
Jan. 30	15	83	1
Feb. 4	13	35	1
Feb. 12	21	32	1
Feb. 16	18	12	1
Feb. 18	19	20	1
Feb. 20	16	17	1
Feb. 27	16	68	1
Mar. 9	12	17	1
Mar. 14	16	44	2
Mar. 21	8	44	2
Mar. 24	14	128	3
Apr. 3	4	16	1
Apr. 7	18	56	1
Apr. 11	14	135	2
Apr. 18	9 32	19	2
Apr. 19	23	101	2
Apr. 28*	14 26	38	2
May 3	3	26	1
May 7	19	71	1
May 11*	12	279	4
May 26	8	64	1
June 3	5	43	1
June 6	1	127	2
June 13	12	36	1
June 16	17	29	1
June 21	12	24	1
June 23	4	29	1
June 28	17	30	1
July 6	9	91	1
July 12	4	116	1
July 22	16	41	1
July 29	1	48	1
Aug. 2	11	25	1
Aug. 4	6	72	2
Aug. 7	22	22	1
Aug. 10	20	26	1
Aug. 14	12	54	1
Aug. 25	20	48	1
Aug. 30	0	30	1
Sept. 1*	16	25	2
Sept. 3	21	33	1
Sept. 6	23	53	1
Sept. 22	19	19	1
Sept. 28	11	38	2
Sept. 30	17	16	1
Oct. 7	11	45	2
Oct. 10	16	37	1
Oct. 20	16	26	1
Oct. 26	20	62	1
Nov. 5	10	41	1
Nov. 9	16	22	1
Nov. 15*	17	91	2
Dec. 1	17	35	1
Dec. 11	11	71	2
Dec. 15	19	50	1
Dec. 22	4	24	1
Dec. 27	18	57	1
1922			
Jan. 6	11	21	1
Jan. 8	9	71	1
Jan. 16	7	41	1
Jan. 23*	18	64	2
Jan. 30	18 31	30	1
Feb. 3	2	91	1
Feb. 8	6	44	2
Feb. 11	17	41	1
Feb. 14	8	89	2
Feb. 19	16	58	1
Feb. 25	20	47	1
Feb. 28	13	57	2
Mar. 3	12	17	1
Mar. 5	2	24	1
Mar. 9	20 36	48	1
Mar. 12*	7	70	2
Mar. 17	2	08	1
Mar. 24	21	33	1
Mar. 28	12	125	2
Apr. 7	16	82	2
Apr. 11	14	88	1
Apr. 16	16	32	1
Apr. 20	13	43	2
Apr. 22	22	191	2
May 5	12	132	1
May 15	16	41	2
May 20	13	93	1
May 25	2	48	1
June 1	1	147	2
June 11	19	56	1
June 16	11	115	1
June 27	0	168	2
July 13	7	164	1
July 23	15	20	1
July 26	7	145	2
Aug. 4	23	29	1
Aug. 9	10	149	2
Aug. 20	0	104	2
Aug. 25	12	56	1
Aug. 29	17	48	1
Sept. 6	3	125	1
Sept. 12*	22	50	2
Sept. 19	20	44	1
Sept. 27	8	22	1
Oct. 2	14	32	1
Oct. 4*	13	133	2
Oct. 17	1	24	1
Oct. 19	20	30	1
Oct. 23	17	55	1
Oct. 30	12	116	2
Nov. 9	12	33	1
Nov. 27	12	72	1
Dec. 1	4	22	1
Dec. 4	0	28	1
Dec. 9	16 52	34	1
Dec. 13	22	36	1
Dec. 25	8	33	1

Serial No. 394

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Reports of earthquakes recorded in years subsequent to 1924 are being published in the Seismological Report issued quarterly by this bureau.

Period of pendulums, 15 seconds.
Multiplication, 10.
Steady mass, 10 to 12 kg.

Register of earthquakes

No.	Date	Component	P	S	L	M	C	F	Maximum amplitude
	1923		h. m. s.	h. m. s.	h. m. s.	h. m. s.	h. m.	h. m.	mm.
571	Jan. 22	E	9 11 24	9 17 12	9 23 53	9 27 37	9 29	10 00	9.0
		N	9 11 24	9 17 12	9 22 39	9 25 ..	9 27	10 11	52+
572	Jan 27	N			8 13 50	8 15 36		8 22	.2
573	Feb. 2	E	5 19 45	5 29 14	5 46 42	5 51 35		6 40	.2
		N	5 19 52	5 29 22	5 46 26			6 40	.1
574	Feb. 3	E	16 13 36	16 23 08	16 37 54		16 58	20 09	45+
		N	16 13 36	16 23 20	16 39 44		16 58	19 27	54+
575	Feb. 24	E		7 55 34	8 10 57	8 19 35		8 57	.5
		N	7 46 14	7 55 26	8 13 08	8 18 49		9 12	.5
576	Mar. 24	E		13 40 04	13 46 07	13 47 58		14 01	.2
		N		13 38 22	13 45 43	13 46 53		13 59	.1
577	Apr. 13	E	16 00 31		16 09 27	17 20 14		17 30	.1
578	Apr. 24	E	23 07 08			23 07 22		23 13	.2
		N	23 07 08			23 07 22		23 13	.2
579	Apr. 25	E	19 54 18			19 55 02		20 02	.2
		N	19 54 01		19 54 47	19 55 06		20 02	.2
580	May 4	E	16 37 28	16 43 49	16 52 49	16 57 25	17 02	17 43	1.2
		N		16 43 45	16 50 36	16 57 55	17 02	17 40	.8
581	June 1	E		17 53 31	18 17 30	18 23 15		18 42	.1
		N		17 51 27	18 14 06	18 26 43		18 48	.1
582	June 19	E		22 59 46	23 06 39	23 10 39		23 22	.3
		N	22 52 32		23 08 47	23 10 22		23 25	.2
583	June 22	E	7 49 19					8 03	
		N	7 47 02		7 58 13	8 00 15		8 08	.1
584	July 16	E			0 57 31			1 23	.1
		N			0 57 36			1 25	.1
585	July 22	E	14 28 40	14 37 54	14 51 30	15 03 28		15 10	.1
		N	14 29 23	14 38 16	14 50 19			15 30	
586	July 23	E	7 47 11			7 47 55	7 49	7 58	.4
		N	7 46 33		7 47 33	7 47 56	7 49	7 58	1.0
587	Aug. 28	E	23 25 11	23 26 27	23 31 07	23 34 30	23 36	24 05	.9
		N	23 24 06		23 30 52	23 32 44	23 36	24 08	10.0
588	Sept. 1	E	3 12 43	3 23 59	3 42 19	4 00 20	4 31	5 33	2.0
		N		3 23 45	3 42 12	4 05 10	4 32	6 15	3.0
589	Sept. 2	E		3 11 45	3 35 28	3 57 20		4 30	.1
		N		3 11 14	3 35 44	3 55 51		4 24	.1
590	Sept. 30	E	1 27 43	1 32 52	1 37 30	1 40 34	1 45	2 21	6.0
		N	1 27 37	1 32 53	1 37 23	1 41 20	1 45	2 26	9.0
591	Oct. 7	E			4 43 17	4 45 49		5 00	.1
		N			4 30 31	4 51 24		5 23	.2
592	Oct. 10	E			7 36 41	7 37 36		7 53	.2
		N	7 19 40	7 26 39	7 36 41	7 37 56		7 58	.1
593	Nov. 1	E	20 15 39		20 17 03			20 20	.1
		N	20 15 29			20 17 20		20 22	.1
594	Nov. 2	E	22 00 16		22 05 57	22 23 11		22 45	.5
		N	22 00 06		22 06 06	22 21 58		22 57	.2
595	Nov. 3	E	8 45 48			9 04 05		9 14	.1
		N	8 42 56		8 48 25	8 53 17		9 14	.1
596	Nov. 4	E	0 42 07		1 05 09	1 08 12		1 22	.1
		N	0 58 07			1 07 00		1 39	.2
597	Nov. 5	E		22 21 47	22 28 42	22 30 38		22 50	.1
		N	22 16 56		22 27 52	22 38 27	22 42	23 17	.1
598	Nov. 8	N	0 13 14			0 14 09		0 18	.2
599	Nov. 16	E	4 36 24			4 37 18		4 41	.2
		N	4 36 24			4 37 18		4 43	.2

Register of earthquakes—Continued

No.	Date	Component	P	S	L	M	C	F	Maximum amplitude
	1924		*h. m. s.*	*h. m. s.*	*h. m. s.*	*h. m. s.*	*h. m.*	*h. m.*	*mm.*
600	Jan. 30	E	21 04 24		21 07 16	21 07 54	21 08	21 11	0.3
		N	21 04 47	21 05 14			21 08	21 14	.3
601	Mar. 4	E	10 14 15		10 21 50	10 24 40	10 26		5.5
		N	10 14 03	10 18 49	10 21 56	10 26 08	10 35		2.0
602	Mar. 4	E	11 51 50	11 55 18	11 59 05	12 01 03		12 15	.7
		N			12 01 05			12 15	
603	Mar. 11	E	10 55 18		10 57 46	10 58 47		11 15	.2
		N			10 57 33	11 01 08		11 10	.1
604	Mar. 30	E			0 29 29			0 38	.1
		N			0 29 37	0 30 16		0 38	.5
605	Apr. 14	E	16 40 12		17 23 03	17 38 46		18 00	.2
		N	16 39 54		17 23 03	17 28 44	17 42	18 22	.6
606	Apr. 21	E	20 07 24					20 30	.1
		N	20 07 40	20 12 11	20 14 18			20 35	.1
607	May 1	E	20 00 35		20 13 21	20 13 32		20 31	.2
		N	20 00 34		20 12 07	20 15 04		20 31	1.0
608	June 26	E			2 44 43	2 47 03		3 49	.2
		N			2 44 19	2 45 19		3 55	.4
609	June 30	E	15 57 02	16 07 16				16 40	
		N	15 57 02	16 07 16				16 55	
610	July 3	E	5 28 53		5 36 00	5 39 18		5 49	.1
		N	5 26 30		5 35 55	5 42 00		5 58	.5
611	July 6	E			14 35 56	14 37 21		14 45	.1
612	July 11	E	20 30 25		20 43 06	20 49 55		20 53	.1
		N	20 34 36		20 43 56	20 52 11		21 25	1.0
613	Aug. 14	N			18 50 53			19 35	.1
614	Aug. 30	N			4 00 ..			4 40	.1
615	Sept. 30	E			8 58 04	8 58 14		9 01	.3
		N			8 58 16	8 58 40		9 02	.1
616	Oct. 14	N	5 06 35		5 13 10	5 19 25		5 30	.1
617	Oct. 17	E	4 44 01		4 44 44		4 46	4 48	.2
		N			4 44 31	4 44 54		4 48	.2
618	Oct. 20	E			20 34 00			20 42	.1
		N			20 33 30	20 38 55		20 42	.1
619	Dec. 28	E		23 18 38	23 36 06	23 49 00		24 12	.1
		N		23 18 59	23 45 08	23 46 12		23 58	.1

REMARKS

571. Maximum on N off the sheet. O at 9:04:04; distance 4,020 km. L_2 on E at 9:27:06, on N at 9:24:27. Recorded on magnetograph.

572. Nothing definite on E.

573. O at 5:08:15; distance 8,180 km. Additional phases on E, PR_1 at 5:22:43, L_2 at 5:49:02; on N. PR (?) at 5:24:13 and 5:25:26, PS at 5:30:11, SR_1 at 5:34:14, SR_2 at 5:38:05, L_2 at 5:49:48.

574. O at 16:02:02, distance 8,240 km. Both styluses off the sheet at 16:49. Recorded on the magnetograph. Additional phases on E, PR_1 at 16:17:08, PS at 16:23:47, SR_1 at 16:28:15, L_2 at 16:41:08; on N, PS at 16:23:39, SR_1 at 16:28:27, SR_2 at 16:31:33, L_2 at 16:41:03.

575. O at 7:34:15, distance 8,370 km. SR_2 on E at 8:04:33, L_2 on E at 8:13:16.

576, 577. Preliminary phases uncertain.

578, 579. Characteristics of a near-by earthquake, but reported local at Sitka.

580. P doubtful. Additional phases on E at 16:46:06, 16:55:52, 16:57:13; on N at 16:46:36, 16:55:02, 16:56:18. Tremors of 3 seconds period superimposed on the long waves.

581. S doubtful. L_2 on N at 18:21:25.

582. Motion very irregular. O at 22:43:27, distance 5,580 km. L_2 on E at 23:08:33, on N at 23:09:29.

585. O at 14:17:25, distance 7,880 km. L_2 on N at 14:52:51.

586. First phase uncertain.

587. Preliminary phases barely perceptible. SR_1 on E at 23:28:09, on N at 23:28:20. Another phase on N at 23:31:16.

588. O at 2:58:36, distance 10,750 km., derived from S and PR_1 on N. PR_1 on both components at 3:16:20. Other phases on E at 3:23:09 and 3:32:29; on N at 3:23:02 and 3:31:46.

589. O at 2:46:12, distance 11,200 km. Other phases, PR_1 on both at 3:04:25, PR_2 on E at 3:07:15, SR_1 on both at 3:18:53.

590. O at 1:21:06, distance 3,420 km. Other phases on E at 1:31:04, 1:34:15, 1:34:48 and on N at 1:34:23 and 1:34:55.

591. Other phases on N, PR_2 at 3:53:07, one at 4:03:50, L_2 at 4:43:57.

592. O at 7:10:52, distance 5,310 km. PR on E at 7:22:04, SR on E at 7:30:03 and on N at 7:30:07.

593, 594, 596, 599. Preliminary phases uncertain.

595. Nothing definite on E.

600. No well-defined phases.

601. O at 10:07:48, distance 3,200 km. Tremors continue to the beginning of the next earthquake.

602. First two phases very weak. SR on E at 11:57:00.

605. O at 16:20:29, distance 14,300 km. Other phases on E, PR_1 at 16:43:08, SR_2 at 17:04:31, L_2 at 17:28:28 on N, PR_2 at 16:43:02, SR_1 at 16:59:25, SR_2 at 17:04:35, a phase at 17:17:21 and L_2 at 17:27:40.

606. O at 20:01:22, distance 3,060 km. No definite maxima.

607. Record faint and phases not well defined. A movement on N, possibly seismic, occurred at 20:00:14. Another phase occurred at 20:04:50 on E and at 20:04:52 on N.

608. Other phases, PR_1 on E at 1:57:15 and on N at 1:57:11; PR_2 at 2:00:38; SR_2 at 2:18:19; and a phase on N at 2:06:49.

609. O at 15:44:45; distance 9,060 km.

610, 612. Beginning indefinite.

616–618. Marking clock out of order during October; times doubtful.

619. L_2 on E at 23:41:09.