

THE PANAMA CANAL
DEPARTMENT OF OPERATION AND MAINTENANCE
SECTION OF SURVEYS

MR 56851—Panama Canal—11-13-37—100



SEISMOLOGICAL RECORD AT BALBOA HEIGHTS, CANAL ZONE

Lat. 8° 57' 39" N.

Long. 79° 33' 29" W.

h = 36 meters.

Lithologic foundation: Basalt.

Time Correction: Within 1.0 sec.

INSTRUMENTS—FIXED CONSTANTS

INSTRUMENTS	SYMBOL	REGISTRATION	DAMPING	PAPER SPEED	MASS
Wood-Anderson	I	Photographic	Magnetic	60 mm. per min.	1.3 gr.
Bosch-Omori	II	Smoked Sheet	Air	15 mm. per min.	100 kg.

INSTRUMENTS—DETERMINED CONSTANTS

INSTRUMENTS	COMPONENT	T _c	v	h	DETERMINED
Wood-Anderson	E - W	0.8	1370	Critical	July 18, 1934
Wood-Anderson	N - S	0.8	1370	Critical	July 18, 1934
Bosch-Omori	- - -	Not Operating	- -	- -	- -
Bosch-Omori					

Month January, 1938

Page No. 1

No. and Date	Phase	Time G. M. T.			Period s	AMPLI- TUDE mm	REMARKS
		h	m	s			
#1 Jan. 1		11	24				Faint tremors from distant disturbance
		to					
		11	43				
#2 Jan. 2		22	31	54			Tremors from distant disturbance
		to					
		23	07	00			
#3 Jan. 3	1PNE	4	43	10			Distance, 45 miles
	1SN	4	43	18		8.0	
	1SE	4	43	19		6.5	
	MN	4	43	21.5			
	ME	4	43	21.5			
	CN	4	43	56			
	CE	4	43	44			
	FNE	4	45	34			
#4 Jan. 4	oPNE	00	27	25			Distance, 30 miles
	oSNE	00	27	30			
	LNE	00	27	40			
	MN	00	27	41.5		5.0	
	ME	00	27	44		4.0	
	FNE	00	29	00			
#5 Jan. 4		11	08	41			Very weak
		to					
		11	10	00			
#6 Jan. 4	oPNE	11	41	20			Weak
	MN	11	42	11			
	ME	11	42	14			
	FNE	11	44	00			
#7 Jan. 5		3	16	56			Very weak
		to					
		3	17	23			

SEISMOLOGICAL RECORD AT BALBOA HEIGHTS, CANAL ZONE

Month January, 1958.Page No. 2

No. and Date	Phase	Time G. M. T.			Period s	AMPLI- TUDE mm	REMARKS
		h	m	s			
#8 Jan. 5		12 : 28 : 51 to 12 : 29 : 27				Very weak	
#9 Jan. 5		22 : 14 : 30 to 22 : 14 : 15				Very weak	
#10 Jan. 6		14 : 29 : 00 to 14 : 31 : 00				Very weak	
#11 Jan. 6		19 : 24 : 35 to 19 : 26 : 00				Faint tremors distant disturbance	
#12 Jan. 6		20 : 05 : 45 to 20 : 06 : 52				Very weak	
#13 Jan. 7		13 : 32 : 47 to 13 : 33 : 04				Brief & sharp. Ampl. N3.5 ^m - S9.0 ^m	
#14 Jan. 7	ePNE oSNE LNE MN ME CNE FNE	14 : 09 : 00 14 : 09 : 12 14 : 09 : 18 14 : 09 : 20 14 : 09 : 20 14 : 09 : 27 14 : 11 : 00			4.7 2.8	Distance about 80 miles	
#15 Jan. 7		17 : 38 : 21 to 17 : 38 : 55				Very weak	
#16 Jan. 7		21 : 44 : 26 to 21 : 44 : 50				Very weak	
#17 Jan. 8		3 : 47 : 29 to 3 : 47 : 57				Very weak	
#18 Jan. 10		21 : 06 : 44 to 21 : 07 : 19				Very faint	

SEISMOLOGICAL RECORD AT BALBOA HEIGHTS, CANAL ZONE

Month January, 1938.Page No. 3

No. and Date	Phase	Time G. M. T.			Period s	AMPLI- TUDE mm	REMARKS
		h	m	s			
#19 Jan. 11		1	52	49			Very weak
			to				
		1	54	08			
#20 Jan. 11		16	18	08			Weak
			to				
		16	18	24			
#21 Jan. 11		18	33	00			Very faint
			to				
		18	33	30			
#22 Jan. 12	ePNE	13	33	26			Distance about 70 miles
	eSNE	13	33	33			
	LNE	13	33	55			
	MNE	14	00	00			
	ONE	14	00	10			
	FNE	14	35	30			
#23 Jan. 12		19	29	19			Very weak
			to				
		19	30	00			
#24 Jan. 13		7	58	19			Weak
			to				
		8	01	00			
#25 Jan. 13		19	48	33			Very weak
			to				
		19	49	00			
#26 Jan. 14		6	55	43			Weak
			to				
		6	57	00			
#27 Jan. 16		00	51	29			Faint
			to				
		00	52	00			
#28 Jan. 16		21	44	00			Faint tremors from distant disturbance
			to				
		21	50	00			
#29 Jan. 18		20	35	15			Sharp
			to				
		20	35	30			

SEISMOLOGICAL RECORD AT BALBOA HEIGHTS, CANAL ZONE

Month January, 1938Page No. 4

No. and Date	Phase	Time G. M. T.			Period s	AMPLI- TUDE mm	REMARKS
		h	m	s			
#30 Jan. 19		17	05	15			Very weak
			to				
		17	05	30			
#31 Jan. 19		19	40	51			Very weak
			to				
		19	41	12			
#32 Jan. 19	ePNE	23	09	09			Weak - Distance about 65 miles.
	eSN	23	09	16			
	eSE	23	09	21			
	LN	23	09	33			
	LE	23	09	32			
	MN	23	09	35	5.0		
	ME	23	09	53	4.0		
	CN	23	09	48			
	CE	23	09	55			
	FNE	23	10	56			
#33 Jan. 20		22	28	35			Very weak
			to				
		22	29	05			
#34 Jan. 21		03	07	18			Very weak
			to				
		03	07	50			
#35 Jan. 22		03	01	55			Very weak
			to				
		03	02	30			
#36 Jan. 22		19	59	:			Very faint
			to				
		20	02	:			
#37 Jan. 24		10	43	:			Very faint trace
			to				
		11	30	/			
#38 Jan. 24	ePNE	15	06	58			Weak - Distance about 60 miles
	ISNE	15	07	06			
	FNE	15	08	:			

G. E. MATTHEW,
Acting Chief of Surveys.

THE PANAMA CANAL
DEPARTMENT OF OPERATION AND MAINTENANCE
SECTION OF SURVEYS



SEISMOLOGICAL RECORD AT BALBOA HEIGHTS, CANAL ZONE

Lat. 8° 57' 39" N.

Long. 79° 33' 29" W.

h = 36 meters.

Lithologic foundation: Basalt.

Time Correction: Within 1.0 sec.

INSTRUMENTS—FIXED CONSTANTS

INSTRUMENTS	SYMBOL	REGISTRATION	DAMPING	PAPER SPEED	MASS
Wood-Anderson	I	Photographic	Magnetic	60 mm, per min.	1,3 gr.
Bosch-Omori	II	Smoked Sheet	Air	15 mm, per min.	100 kg.

INSTRUMENTS—DETERMINED CONSTANTS

INSTRUMENTS	COMPONENT	T ₀	V	h	DETERMINED
Wood-Anderson	E - W	0.8	1370	Critical	July 18, 1934
Wood-Anderson	N - S	0.8	1370	Critical	July 18, 1934
Bosch-Omori)	Not Operating.				
Bosch-Omori)					

Month FEBRUARY 1938Page No. 5

No. and Date	Phase	Time G. M. T.			Period s	AMPLI- TUDE mm	REMARKS
		h	m	s			
39 Feb. 1	e P E	19:	24:	05			
	e P N	19:	24:	03			
	e E	19:	25:	31			
	e N	19:	25:	43			
	e E	19:	28:	32			
	e N	19:	28:	32			
40 Feb. 1	P E	20:	09:	35			Superposed.
	P N	20:	09:	35			
41 Feb. 4		10:	30				From distant disturbance.
		10:	44				
42 Feb. 5	1 P N E	02:	25:	00			Distance about 365 miles. Intensity II. Slight damage in Cali, Colombia.
	1 E	02:	25:	10			
	1 S N	02:	26:	04			
	1 S E	02:	26:	02			
	M N	02:	26:	27		57.5	
	M E	02:	26:	31		48.8	
	C N	02:	27:	43			
	C E	02:	27:	32			
F N E	02:	51:	00				
43 Feb. 7	c P N E	13:	25:	53			Very weak. 250 miles.
	e S N	13:	26:	37			
	e S E	13:	26:	38			
	F N E	13:	29:	00			
44 Feb. 8	e P N	05:	40:	54			Distance 650 miles. Very weak.
	e P E	05:	40:	53			
	e S N E	05:	40:	46			
	F N E	05:	50:	00			

SEISMOLOGICAL RECORD AT BALBOA HEIGHTS, CANAL ZONE

Month FEBRUARY 1938.Page No. 6.

No. and Date	Phase	Time G. M. T.			Period s	AMPLI- TUDE mm	REMARKS
		h	m	s			
45 Feb. 8	• P N	07:	18:	47			650 miles. Very weak.
	• P E	07:	18:	45			
	• S N	07:	20:	40			
	e S E	07:	20:	30			
	• N	07:	21:	36			
	F N E	07:	33:	00			
46 Feb. 8		08:	03:	14			Very faint.
			to				
47 Feb. 8		10:	59:				Very faint.
			to				
		10:	03				
48 Feb. 8	• P N	14:	24:	07			Distance 650 miles. Very weak.
	• P E	14:	24:	04			
	• S N	14:	25:	59			
	• S E	14:	25:	54			
	F N E	14:	37:	00			
49 Feb. 8		16:	03				Very faint trace.
			to				
		16:	08				
50 Feb. 9		02:	26:	00			Very faint trace.
			to				
		02:	29:	00			
51 Feb. 9	1 N E	12:	29:	10			Impulsive beginning of one sec. period. Wavef.
	F N E	12:	32:	00			
52 Feb. 14	• P N E	05:	29:	09			Distance about 60 miles.
	1 S N E	05:	29:	20			
	F N E	05:	31:	00			
53 Feb. 16		18:	38:				Very weak.
			to				
		18:	41:				

SEISMOLOGICAL RECORD AT BALBOA HEIGHTS, CANAL ZONE

Month FEBRUARY 1938.

Page No. 7

No. and Date	Phase	Time G. M. T.			Period s	AMPLI- TUDE mm	REMARKS
		h	m	s			
54 Feb. 18	1 P N E	12	33	13			Distance about 65 miles. Very weak.
	1 S N E	12	33	21			
	F N E	12	24	00			
55 Feb. 27		08	25	00			Very weak.
			to				
		08	28	00			

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SECTION OF SURVEYS



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INSTRUMENTS—DETERMINED CONSTANTS

INSTRUMENTS	COMPONENT	T ₀	V	h	DETERMINED
Wood-Anderson	E - W	0.8	1370	Critical	July 18, 1934
Wood-Anderson	N - S	0.8	1370	"	" " "
Bosch-Omori)	Not Operating ---	---	---	---	---
Bosch-Omori)					

Month MARCH 1938

Page No. 8

No. and Date	Phase	Time G. M. T.			Period	AMPLI- TUDE mm	REMARKS
		h	m	s			
56 March 1	1 P N E	14:	02:	33	changing records.	Distance about 250 miles. Weak.	
	1 S N	14:	03:	13			
	S E	Lost	in				
	F N E	14:	12:	00			
57 March 4	o P N E	18:	23:	33	Faint. Distance about 90 miles.		
	o S N E	18:	23:	50			
	F N E	18:	25:	00			
58 March 9	1 P N E	05:	18:	06	Distance about 260 miles. Weak.		
	1 S N	05:	18:	53			
	1 S E	05:	18:	54			
	F N E	05:	31:	00			
59 March 11	P N E	05:	17:		Lost in following shock.		
	F N E	Lost	in				
60 March 11	o P N E	05:	18:	52	Distance about 320 miles. Faint.		
	o S N E	05:	19:	49			
	F N E	05:	24:	00			
61 March 11		02:	11		Very faint trace.		
		to					
		02:	15				
62 March 20		00:	11		Very faint trace.		
		to					
		00:	33				

SEISMOLOGICAL RECORD AT BALBOA HEIGHTS, CANAL ZONE


Month MARCH 1938Page No. 9.

No. and Date	Phase	Time G. M. T.			Period s	AMPLI- TUDE mm	REMARKS
		h	m	s			
63 March 25	1 P N E	04:	07:	48		Weak. Distance about 230 miles.	
	1 S N E	04:	08:	29			
	F N E	04:	13:				
64 March 31	1 P N E	05:	26:	53		Weak. Distance about 260 miles.	
	• S N	05:	27:	39			
	• S E	05:	27:	40			
	F N E	05:	30:				

R. Z. KIRKPATRICK,
Chief of Surveys.

THE PANAMA CANAL
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MR 56851—Panama Canal—11-13-37—100



International
Seismological
Centre

SEISMOLOGICAL RECORD AT BALBOA HEIGHTS, CANAL ZONE

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INSTRUMENTS—DETERMINED CONSTANTS

INSTRUMENTS	COMPONENT	T _c	V	h	DETERMINED
Wood-Anderson	N-S	0.8	1370	Critical	July 18, 1934
Wood-Anderson	E-W	0.8	1370	"	"
Bosch-Omori)	Not operating				
Bosch-Omori)					

Month APRIL 1938Page No. 10

No. and Date	Phase	Time G. M. T.			Period s	AMPLI- TUDE mm	REMARKS
		h	m	s			
65 Apr. 2		21:32	to	21:57			Very faint trace
66 Apr. 8	1PNE 1SNE FNE	21:42:57		21:43:21			Distance about 135 miles. Very weak
67 Apr. 14		01:36	to	01:59			Very faint trace.
68 Apr. 17		02:56:00	to	02:58:00			Very faint trace
69 Apr. 17		05:41:00	to	05:42:30			Very faint
70 Apr. 17		14:45:00	to	14:58:00			Faint trace from distant disturbance
71 Apr. 17		15:03:06	to	15:08:00			Weak
72 Apr. 19		03:29:59	to	03:30:40			Very faint
73 Apr. 20		02:20:37	to	02:22:00			Very faint
74 Apr. 21		03:13:49	to	03:14:30			Faint trace
75 Apr. 21		17:42:00	to	17:43:00			Faint trace
76 Apr. 24		19:17:32	to	19:18:00			Faint trace
77 Apr. 24		20:24	to	20:27			Barely discernible waves, apparently from distant disturbance

SEISMOLOGICAL RECORD AT BALBOA HEIGHTS, CANAL ZONE

Month APRIL 1938Page No. 11

No. and Date	Phase	Time G. M. T.			Period s	AMPLI- TUDE mm	REMARKS
		h	m	s			
78 Apr. 25	ePN	17	09	53			Distance about 570 miles E. W. record not very clear
	eSN	17	11	52			
	eN	17	12	22			
	JN	17	28				
79 Apr. 30		17	00	58			Weak
			to				
		17	02	00			

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INSTRUMENTS—FIXED CONSTANTS

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Wood-Anderson	I	Photographic	Magnetic	60 mm. per min.	1.3 gr.
Bosch-Omori	II	Smoked Sheet	Air	15 mm. per min.	100 kg.

INSTRUMENTS—DETERMINED CONSTANTS

INSTRUMENTS	COMPONENT	T.	V	h	DETERMINED
Wood-Anderson	N-S	0.8	1370	Critical	July 18, 1934.
Wood-Anderson	E-W	0.8	1370	Critical	July 18, 1934.
Bosch-Omori)	Not operating				
Bosch-Omori)					

Month May, 1938.Page No. 12

No. and Date	Phase	Time G. M. T.			Period s	AMPLI- TUDE mm	REMARKS
		h	m	s			
80 May 2	1PN eSN LN MN CN FN	23:41:37 23:41:58 23:42:27 23:42:43 23:43:00 23:51:00				10.0	Distance about 120 miles. No E-W record.
81 May 3		2:20:17 to 2:45:00					U. S. Coast and Geodetic Survey reports on this quake as follows: Time at origin 2:15:36 G.M.T. Approximate epicenter 18° N. Lat. 99° W. Long., probably about 100 km deep.
82 May 3		3:14:57 to 3:15:40					Faint.
83 May 3		3:19:00 to 3:23:00					Very faint.
84 May 4		2:56:52 to 2:58:00					Very faint.
85 May 4		19:29:00 to 19:30:00					Faint.
86 May 5		3:19:56 to 3:21:00					Faint

SEISMOLOGICAL RECORD AT BALBOA HEIGHTS, CANAL ZONE

Month May 1938Page No. 13

No. and Date	Phase	Time G. M. T.			Period s	AMPLI- TUDE mm	REMARKS
		h	m	s			
87 May 5		22:02:00					Barely discernible trace from distant disturbance.
		to					
		22:04:00					
88 May 5		23:06:00					Faint trace from a distant disturbance.
		to					
		23:10:00					
89 May 6	ePNE eN iN eE iE PNE	18:19:00					The U. S. Coast and Geodetic Survey reports as follows: Time at origin, 18:17:24 G.M.T. Approximate epicenter, 13°N.Lat., 87°W.Long.
		18:20:53					
		18:21:19					
		18:21:24					
		18:22:02					
		18:37:00					
90 May 6		21:56:00					Weak.
		to					
		21:59:00					
91 May 7		3:06:34					Very weak.
		to					
		3:08:00					
92 May 7		21:50:00					Faint trace from distant disturbance.
		to					
		21:53:00					
93 May 8		3:52:14					Very faint.
		to					
		3:53:00					
94 May 9		10:21:44					Faint.
		to					
		10:26:00					
95 May 10		3:26:58					Faint.
		to					
		3:27:30					
96 May 11		14:49:00					Distant disturbance.
		to					
		15:30:00					
97 May 11		18:54:09					Very faint.
		to					
		18:55:00					

SEISMOLOGICAL RECORD AT BALBOA HEIGHTS, CANAL ZONE

Month May 1938Page No. 14

No. and Date	Phase	Time G. M. T.			Period s	AMPLI- TUDE mm	REMARKS
		h	m	s			
98 May 12	1PNE	7	36	54		10.5 9.5	Probably just below Intensity I. Distance about 140 miles.
	1SNE	7	37	19			
	MN	7	37	25			
	ME	7	37	26			
	CNE	7	37	46			
	FNE	Lost in #99					
99 May 12		7	40	29			Superimposed on No. 98 but very faint.
			to				
		7	44	00			
100 May 12	1PNE	7	45	41		0.6 0.6	Weak; distance about 150 miles.
	1SNE	7	46	08			
	MN	7	46	16			
	ME	7	46	14			
	CN	7	46	23			
	CE	7	46	27			
FNE	7	49	00				
101 May 12		8	03	48			Very faint.
			to				
		8	06	00			
102 May 12		10	31	41			Very weak.
			to				
		10	34	00			
103 May 13		3	54	36			Very faint.
			to				
		3	55	10			
104 May 13		15	28	00			Very weak.
			to				
		15	31	00			
105 May 14		2	45	50			Very faint.
			to				
		2	47	00			
106 May 15		16	02	28			Very faint.
			to				
		16	04	00			
107 May 15		16	13	40			Very faint.
			to				
		16	16	00			

SEISMOLOGICAL RECORD AT BALBOA HEIGHTS, CANAL ZONE

Month May 1938Page No. 15

No. and Date	Phase	Time G. M. T.			Period s	AMPLI- TUDE mm	REMARKS
		h	m	s			
108 May 16		18:22:40 to 18:25:00				Faint.	
109 May 18		2:18:27 to 2:21:00				Faint.	
110 May 19		3:48:40 to 3:49:10				Very faint.	
111 May 19		6:03:37 to 6:07:00				Very weak.	
112 May 20	oPNE SNE MNE N E CN CE FNE	9:06:40 9:07:17 9:07:20 9:07:28 9:07:39 9:07:45 9:07:47 9:12:00		MN = 11.4 ME = 6.3		Weak; distance about 200 miles.	
113 May 21	1PNE 1SNE MN ME LN LE CN CE FNE	7:44:30 7:44:51 7:44:51 7:44:53 7:45:12 7:45:11 7:45:57 7:46:05 7:48:00			33.0 30.0	Intensity III; felt by residents of Canal Zone and Panama, no damage reported. Epicentral distance about 120 miles.	
114 May 22		21:16:00 to 21:20:00				Faint.	
115 May 23	oPNE SN SE FN FE ONE	00:18:47 00:19:12 00:19:13 00:19:35 00:19:32 00:21:00				Weak; distance about 145 miles.	
116 May 23		8:41:30 to 8:46:00				Faint trace from a distant disturbance.	
117 May 26		22:01:08 to 22:02:00				Very faint.	
118 May 28		11:05:00 to 11:18:00				Faint trace from a distant disturbance.	

 R. Z. KIRKPATRICK,
Chief of Surveys.

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DEPARTMENT OF OPERATION AND MAINTENANCE
SECTION OF SURVEYS



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Bosch-Omori	II	Smoked Sheet	Air	15 mm. per min.	100 kg.

INSTRUMENTS—DETERMINED CONSTANTS

INSTRUMENTS	COMPONENT	T ₀	V	h	DETERMINED
Wood-Anderson	E-W	0.75	2740	Critical	June 21, 1938
Wood-Anderson	N-S	0.75	1370	Critical	June 21, 1938
Bosch-Omori	Not operating.				
Bosch-Omori					

Month June 1938

Page No. 16

No. and Date	Phase	Time G. M. T.			Period	AMPLITUDE	REMARKS
		h	m	s			
119 June 4		4:55:00					Faint
		to					
		5:00:00					
120 June 7		4:56:00					Faint trace from a distant disturbance.
		to					
		5:00:00					
121 June 9		18:45:00					Faint
		to					
		18:49:00					
122 June 11		15:04					Weak
		to					
		15:08					
123 June 14		03:55					Weak
		to					
		03:59					
124 June 18	ePNE eSNE FNF	10:12:26 10:13:04 10:16					Distance about 215 miles. Weak.
125 June 19	ePN ePE eSN ese MN ME FN	17:13:00 17:12:59 17:13:40 17:13:42 17:13:56 17:14:05 17:19	0.4 0.4 0.5 0.5		15.6 10.6		Distance about 230 miles.

SEISMOLOGICAL RECORD AT BALBOA HEIGHTS, CANAL ZONE

17

Month June 1938

Page No. _____

No. and Date	Phase	Time G. M. T.			Period s	AMPLI- TUDE mm	REMARKS
		h	m	s			
126 June 20	ePNE eSNE FNE	01:35:37 01:35:51 01:38				Distance about 80 miles.	
127 June 20	ePNE eSNE FNE	05:49:38 05:49:50 05:51				Distance about 60 miles.	
June 21,	"v" on	E-W Component changed to 2740.					
128 June 23		01:11 to 01:14				Very faint trace.	
129 June 23	ePE ePN FNE	07:38:38 07:38:36 07:41				Weak.	
130 June 25		18:23 to 18:24				Very faint trace.	
131 June 26		03:11:53 to 03:55				Faint.	
132 June 28		03:23 to 03:25				Very faint trace.	
133 June 28		11:18 to 11:21				Very faint trace.	
134 June 28		19:22 to 19:31				Distant disturbance, probably Mexico.	

R. Z. KIRKPATRICK,
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SEISMOLOGICAL RECORD AT BALBOA HEIGHTS, CANAL ZONE

Lat. 8° 57' 39" N.

Long. 79° 33' 29" W.

h = 36 meters.

Lithologic foundation: Basalt.

Time Correction: Within 1.0 sec.

INSTRUMENTS—FIXED CONSTANTS

INSTRUMENTS	SYMBOL	REGISTRATION	DAMPING	PAPER SPEED	MASS
Wood-Anderson	I	Photographic	Magnetic	60 mm. per min.	1.3 gr.
Bosch-Omori	II	Smoked Sheet	Air	15 mm. per min.	100 kg.

INSTRUMENTS—DETERMINED CONSTANTS

INSTRUMENTS	COMPONENT	T _c	V	h	DETERMINED
Wood-Anderson	E - W	0.75	2740	Critical	June 21, 1938
Wood-Anderson	N - S	0.75	1370	"	June 21, 1938
Bosch-Omori)	Not	Operating			
Bosch-Omori)					

Month JULY 1938Page No. 18

No. and Date	Phase	Time G. M. T.			Period s	AMPLI- TUDE mm	REMARKS
		h	m	s			
135 July 1		18: 25:					Very faint.
		to					
		18: 28:					
136 July 2	1PNE	21: 05: 26			0.44		Distance about 265 miles.
	i NE	21: 05: 54					
	1SNE	21:06:13			0.55		
	eN	21:06:24					
	eE	21:06:26					
	e LN	21:06:39			0.50		
	e LE	21:06:42			0.50		
	FNE	21:14					
137 July 3		02: 47: 55					Very faint trace.
		to					
		02: 48: 30					
138 July 3	ePN	03: 38: 20			0.37		Distance about 270 miles - Weak
	1 PE	03: 38: 21			0.40		
	e SN	03: 39: 08			0.44		
	1 SE	03: 39: 09			0.40		
	FNE	03: 41					
139 July 3		09: 33:					Very faint
		to					
		09: 36					
140 July 5	ePNE	20: 42: 20					Distance about 50 miles.
	1SNE	20:42:39					
	FNE	20: 44:					
141 July 5		02: 49: 16					Very faint trace.
		to					
		02: 50					
142 July 7		03: 17: 43					Very faint trace.
		to					
		03: 18: 30					

SEISMOLOGICAL RECORD AT BALBOA HEIGHTS, CANAL ZONE

Month JULY 1938Page No. 19

No. and Date	Phase	Time G. M. T.			Period s	AMPLI- TUDE mm	REMARKS
		h	m	s			
143 July 8		02: 58: 19 to 02: 59: 00				Very faint trace.	
144 July 9	ePNE eSNE FNE	03: 19: 36 03: 20: 00 03: 21				Very faint - Distance about 135 miles.	
145 July 10	ePNE 1 PE FNE	23: 11: 29 23: 12: 11 23: 15:	0.34 0.44			Distance about 240 miles.	
146 July 11	ePNE FNE	02: 21: 55 02: 25				Very faint	
147 July 13	1PNE 1 SN 1 SE FNE	03: 00: 07 03: 00: 36 03: 00: 34 03: 04:	0.45 0.45 0.45			Distance about 150 miles.	
148 July 13	ePNE FNE	03: 30: 38 03: 31: 30				Very faint	
149 July 13	ePNE 1SNE FNE	06: 47: 31 06: 47: 52 06: 48:				Weak. Distance 120 miles.	
150 July 16	ePNE e E FNE	19: 10: 18 19: 11: 34 19: 15:				Very faint.	
151 July 16		05: 58: to 06: 04:				Barely discernible.	
152 July 16	1 FN 1 PE 1 SN 1 SE FNE	08: 01: 38 08: 01: 36 08: 02: 00 08: 02: 01 08: 05:	0.40 0.40 0.45 0.46			Distance 130 miles.	
153 July 20	ePNE FNE	02: 17: 16 02: 21:	0.46			Weak.	

SEISMOLOGICAL RECORD AT BALBOA HEIGHTS, CANAL ZONE

Month JULY 1938.Page No. 20.

No. and Date	Phase	Time G. M. T.			Period s	AMPLI- TUDE mm	REMARKS
		h	m	s			
154 July 22	eFNE	07:	54:	08	2.1	Waves from distant disturbance.	
	e PE	07:	54:	07			
	e N	07:	58:	26	6.0		
	FNE	08:	15:				

R. Z. KIRKPATRICK,
Chief of Surveys.

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SEISMOLOGICAL RECORD AT BALBOA HEIGHTS, CANAL ZONE

Lat. 8° 57' 39" N.

Long. 79° 33' 29" W.

h = 36 meters.

Lithologic foundation: Basalt.

Time Correction: Within 1.0 sec.

INSTRUMENTS—FIXED CONSTANTS

INSTRUMENTS	SYMBOL	REGISTRATION	DAMPING	PAPER SPEED	MASS
Wood-Anderson	I	Photographic	Magnetic	60 mm, per min.	1.3 gr.
Bosch-Omori	II	Smoked Sheet	Air	15 mm, per min.	100 kg.

INSTRUMENTS—DETERMINED CONSTANTS

INSTRUMENTS	COMPONENT	T _c	V	h	DETERMINED
Wood-Anderson	E - W	0.75	2740	Critical	June 21, 1938
Wood-Anderson	N - S	0.75	1370	"	" " "
Bosch-Omori) Not operating				
Bosch-Omori					

Month AUGUST 1938Page No. 21

No. and Date	Phase	Time G. M. T.			Period s	AMPLI- TUDE mm	REMARKS
		h	m	s			
155 Aug. 4	1PNE	09:01:26			0.7	Weak. Onset of new shock ?	
	eN	09:06:42					
	eE	09:06:43					
	eE	09:10:22					
	eN	09:10:13					
	eN	09:11:22					
	FNE	09:25					
156 Aug. 5	1PNE	16:07:06			0.37	Felt distinctly in Cristobal Intensity II Distance about 55 miles	
	1SNE	16:07:16					
	FNE	16:09					
157 Aug. 10	1PNE	01:20:34			0.36	Intensity I Distance about 55 miles	
	1SNE	01:20:44					
	FNE	01:23					
158 Aug. 10		02:04 to 02:10				Weak. From distant disturbance.	
159 Aug. 12	ePN	16:42:48			0.36	Distance about 130 miles. Weak	
	ePE	16:42:47					
	eSNE	16:43:11					
	FNE	16:45					

SEISMOLOGICAL RECORD AT BALBOA HEIGHTS, CANAL ZONE

Month AUGUST 1938Page No. 22

No. and Date	Phase	Time G. M. T.			Period s	AMPLI- TUDE mm	REMARKS
		h	m	s			
160 Aug. 14	ePN	14:27:11			0.44	8.2 21.9	Distance 250 miles.
	ePE	14:27:12			0.44		
	eSN	14:27:55			0.71		
	eSE	14:27:57			0.71		
	MN	14:28:02					
	ME	14:28:02					
	CE	14:28:30					
	CN	14:28:35					
	FNE	14:33					
161 Aug. 16	ePNE FNE	04:47:42 04:56			0.44		Very weak.
162 Aug. 17	ePNE FNE	00:58:20 01:01					Very faint
163 Aug. 18		09:50 to 10:08					Very faint trace from distant disturbance. Not discernible on N - S.
164 Aug. 18		11:56 to 11:58					Very faint trace. Not discernible on N - S.
165 Aug. 22	1PNE 1SN MN ME CN CE FNE	16:30:10.5 16:30:28 16:30:33 16:30:31 16:30:51 16:30:56 16:35			0.43	30.0 55.5	Distance about 100 miles. Intensity II. Felt by people on the Pacific side.
166 Aug. 23	1PNE 1SNE MN ME FNE	14:43:01.5 14:43:19 14:43:25 14:43:24 14:46			0.40	8.6 23.7	Distance about 100 miles. Not reported felt.

SEISMOLOGICAL RECORD AT BALBOA HEIGHTS, CANAL ZONE

Month AUGUST 1938Page No. 23

No. and Date	Phase	Time G. M. T.			Period s	AMPLI- TUDE mm	REMARKS
		h	m	s			
167 Aug. 25	ePN	00	06	08	0.43	Distance about 285 miles.	
	ePE	00	06	07	0.45		
	iSNE	00	06	58	0.43		
	FNE	00	12				
168 Aug. 25		01:48 to 02:07				Very faint trace. Not discernible on N - S.	
169 Aug. 31	ePNE iSNE FNE	11:54:54 11:55:02 11:56				Distance about 45 miles. Very weak.	
170 Aug. 31		19:13 to 19:16				Barely discernible.	

G. E. MATTHEW
Acting Chief of Surveys

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SEISMOLOGICAL RECORD AT BALBOA HEIGHTS, CANAL ZONE

Lat. 8° 57' 39" N.

Long. 79° 33' 29" W.

h = 36 meters.

Lithologic foundation: Basalt.

Time Correction: Within 1.0 sec.

INSTRUMENTS—FIXED CONSTANTS

INSTRUMENTS	SYMBOL	REGISTRATION	DAMPING	PAPER SPEED	MASS
Wood-Anderson	I	Photographic	Magnetic	60 mm. per min.	1.3 gr.
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INSTRUMENTS—DETERMINED CONSTANTS

INSTRUMENTS	COMPONENT	T.	V	h	DETERMINED
Wood-Anderson	E - W	0.75	2740	Critical	June 21, 1938
Wood-Anderson	N - S	0.75	1370	"	" " "
Bosch-Omori	Not Operating		--	--	-
Bosch-Omori					

Month SEPTEMBER, 1938Page No. 24

No. and Date	Phase	Time G. M. T.			Period s	AMPLI- TUDE mm	REMARKS
		h	m	s			
171 Sept. 1	1PNE	04:20:52			0.45	31.5 45.4	Distance 65 miles. Generally felt throughout the Canal Zone. Intensity III
	1SNE	04:21:04			--		
	MN	04:21:11					
	ME	04:21:09					
	ON	04:21:35			0.45		
	OE	04:21:36			0.45		
	FNE	04:25					
172 Sept. 1	1PN	22:50:55			1.0 1.0 2.2	Distance about 880 miles. Press reports quake off the coast of Guatemala. U. S. C. & G. S. reports epicenter Lat. 13° 6" N., Long. 89° 24' W. Time at origin 22:54:24 G.M.T.	
	1PE	22:50:56					
	1P*N	22:51:32					
	1SN	22:53:22					
	1SE	22:53:23					
	Looks like "L" E	22:54:12					
LE?	22:54:59						
FNE	23:14						
173 Sept. 2		04:42 to 04:45				Barely discernible.	
174 Sept. 3	oP FNE	08:36:36 08:39				Very faint.	
175 Sept. 6		00:56:27 to 00:58:00				Very faint.	
176 Sept. 6		18:05:53 to 18:07:00				Very faint.	

SEISMOLOGICAL RECORD AT BALBOA HEIGHTS, CANAL ZONE

Month SEPTEMBER, 1938Page No. 25

No. and Date	Phase	Time G. M. T.			Period s	AMPLI- TUDE mm	REMARKS
		h	m	s			
177 Sept. 9		17:30:57 to 17:38:00					Very faint; from a distant disturbance.
178 Sept. 12		20:07:05 to 20:09:00					Very weak.
179 Sept. 18	ePNE eSNE LN ME CNE FNE	8:46:22 8:47:03 8:47:11 8:47:06 8:47:20 8:50:00			5.0 2.5		Distance about 230 miles.
180 Sept. 19	ePNE eSN eSE LN ME CN CE FNE	00:46:39 00:47:30 00:47:31 00:47:52 00:47:42 00:48:18 00:48:24 00:57:00			5.0 8.0		Distance about 280 miles.
181 Sept. 20	ePNE eSN eSE LN LE MN ME CN CE FNE	3:06:11 3:06:31 3:06:33 3:06:52 3:06:50 3:07:09 3:07:04 3:07:33 3:07:25 3:19:00			12.0 10.3		Distance about 120 miles.
182 Sept. 20		8:38:20 to 8:44:00					Very weak.
183 Sept. 22		6:14:55 to 6:19:00					Very faint.
184 Sept. 22		14:12:00 to 14:20:00					Very faint; from a distant disturbance.

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Lat. 8° 57' 39" N.

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INSTRUMENTS	SYMBOL	REGISTRATION	DAMPING	PAPER SPEED	MASS
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Bosch-Omori	Not Operating	-	-	-	-
Bosch-Omori					

Month October 1938

Page No. _____

No. and Date	Phase	Time G. M. T.			Period s	AMPLI- TUDE mm	REMARKS
		h	m	s			
185 Oct. 1		19:59	to	20:01			Very faint trace
186 Oct. 2	ePNE eSNE PNE	11:05:17 11:05:52 11:08					Weak Distance about 200 miles.
187 Oct. 3	ePNE PNE	20:14:17 20:17					Very weak
188 Oct. 8	ePNE iSNE PNE	04:09:54 04:10:07 04:11					Distance about 75 miles. Very weak
189 Oct. 8	iPNE iSNE PNE	09:21:12 09:21:25 09:21:00					Distance about 75 miles.
190 Oct. 8	ePNE eSNE PNE	15:28:23 15:28:36 15:29:30					Distance about 75 miles.. Faint
191 Oct. 10	ePNE PNE	21:08:04 to 21:17					Very weak
192 Oct. 11		00:28 to 00:30					Very faint trace, barely discernible.

SEISMOLOGICAL RECORD AT BALBOA HEIGHTS, CANAL ZONE

Month October 1938.Page No. 27

No. and Date	Phase	Time G. M. T.			Period s	AMPLI- TUDE mm	REMARKS
		h	m	s			
193 Oct. 17	ePNE iSNE FNE	11:40:57 11:41:10 11:45				Distance about 75 miles. Very faint.	
194 Oct. 20	ePE ePN eE eN FNE	02:39:16 02:39:15 02:41:17 02:41:30 03:08				Very weak.	
195 Oct. 20		11:22 to 11:34				Very faint. Not discernible on N-S.	
196 Oct. 21	iPNE iSNE FNE	19:19:56 19:20:17 19:27				Distance about 120 miles. Light weak. - Record blurred. Intensity II	
197 Oct. 23	iPNE iSNE FNE	23:05:48 23:06:10 23:09				Distance about 125 miles.	
198 Oct. 27	iPNE iSNE MN ME FNE	18:13:33 18:13:48 18:13:52 18:13:50 18:18			11.0 19.5	Intensity I to II. Distance approximately 85 miles.	
199 Oct. 27		18:38:46 to 18:41:00				Very faint.	
200 Oct. 29	ePNE FNE	13:16:27 13:20				Weak.	

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SEISMOLOGICAL RECORD AT BALBOA HEIGHTS, CANAL ZONE

Lat. 8° 57' 39" N.

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INSTRUMENTS—DETERMINED CONSTANTS

INSTRUMENTS	COMPONENT	T.	V	h	DETERMINED
Wood-Anderson	E-W	0.75	2740	Critical	June 21, 1938.
Wood-Anderson	N-S	0.75	1370	Critical	June 21, 1938.
Bosch-Omori) Not operating				
Bosch-Omori					

Month November 1938

Page No. 28

No. and Date	Phase	Time G. M. T.			Period s	AMPLITUDE mm	REMARKS
		h	m	s			
201 Nov. 2	ePN	5	45	57		Weak	
	ePE	5	45	55			
	FNE	5	54	00			
202 Nov. 2	ePNE	20	01	37		Very faint Distance about 80 miles	
	eSNE	20	01	51			
	FNE	20	03	00			
203 Nov. 5		9	03	00		Very faint U.S.C. & G.S. provisional epicenter: 38° N. Lat., 141° E. Long., which is in Japanese Islands.	
		13	15	00			
204 Nov. 10		15	26	34		Very faint	
		15	31	00			
205 Nov. 10	ePE	20	30	49		Epicenter about <u>5320</u> miles, (8560 km.) distant and located near the Aleutian Islands west of Alaska. Apparently no tidal effect at Balboa. U.S.C. & G.S. Provisional epicenter: 56° N. Lat., 159° W. Long.	
	ePN	20	30	52			
	ePRE	20	34	20			
	ePRN	20	34	10			
	eE	20	36	08			
	eN	20	36	19			
	eSE	20	40	16			
	eSN	20	40	15			
	eSRE	20	46	13			
	eSRN	20	46	25			
	eE	20	49	22			
	eN	20	49	17			
	LE	20	50	33			
	LN	20	50	28			
E	20	56	26				
N	20	56	20				
FNE	23	26					

SEISMOLOGICAL RECORD AT BALBOA HEIGHTS, CANAL ZONE

Month November

Page No. 29

No. and Date	Phase	Time G. M. T.			Period s	AMPLI- TUDE mm	REMARKS
		h	m	s			
206 Nov. 11		1:19:00 to 1:24:00				Very weak	
207 Nov. 13		5:13:15 to 5:18:00				Very weak	
208 Nov. 16		2:59:56 to 3:01:00				Very faint	
209 Nov. 17		4:06:29 to 5:18:00				Very weak	
210 Nov. 29	ePNE SN SE MN ME FNE	5:34:09 5:34:22 5:34:21 5:34:26 5:34:26 5:38:00			9.0 13.0	Weak; distance about 75 miles.	
211 Nov. 29		9:47:00 to 9:49:00				Very faint	

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Wood-Anderson	I	Photographic	Magnetic	60 mm. per min.	1.3 gr.
Bosch-Omori	II	Smoked Sheet	Air	15 mm. per min.	100 kg.

INSTRUMENTS—DETERMINED CONSTANTS

INSTRUMENTS	COMPONENT	T ₀	V	h	DETERMINED
Wood-Anderson	E - W	0.76	2740	12 to 1	Dec. 21, 1938
Wood-Anderson	N - S	0.74	1570	9 to 1	Dec. 21, 1938
Bosch-Omori) --	Not Operating			
Bosch-Omori					

Month **DECEMBER 1938**

Page No. **30**

No. and Date	Phase	Time G. M. T.			Period s	AMPLI- TUDE mm	REMARKS
		h	m	s			
212 Dec. 5	e P N E	22	56	35		8.5 15.0	Weak; distance about 260 miles
	i S N E	22	57	22			
	M N	22	57	28			
	M E	22	57	29			
	C N	22	57	55			
	C E	22	57	54			
	F N E	23	05	00			
213 Dec. 5		9	25	00			Very faint
		to					
		9	30	00			
214 Dec. 6		14	20	00			Very faint
		to					
		14	25	00			
215 Dec. 7		16	45	38			Very weak
		to					
		16	51	00			
216 Dec. 8		6	09	57			Very faint
		to					
		6	12	00			
217 Dec. 9		00	42	05			Very weak
		to					
		00	49	00			
218 Dec. 12	e P N E	22	03	47		6.5 11.0	Weak; distance about 240 miles
	i S N E	22	04	29			
	M N	22	04	53			
	M E	22	04	33			

SEISMOLOGICAL RECORD AT BALBOA HEIGHTS, CANAL ZONE

Month DECEMBER 1938Page No. 31

No. and Date	Phase	Time G. M. T.			Period s	AMPLI- TITUDE mm	REMARKS
		h	m	s			
218 Dec. 18 (Continued)	C N C E F N E	22	05	36 33 00			
219 Dec. 18		20	58	14 to 21 : 11 : 00			Very weak
220 Dec. 19		2	06	22 to 2 : 11 : 00			Very faint
221 Dec. 19		10	22	00 to 10 : 27 : 00			Weak
222 Dec. 20		22	17	42 to 22 : 20 : 00			Faint

G. E. MATTHEW,
Actg. Chief of Surveys.