

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 0.5 sec.

INSTRUMENTS—FIXED CONSTANTS

INSTRUMENTS	SYMBOL	REGISTRATION	DAMPING	PAPER SPEED		MASS
				60 mm. per min.	15 mm. per min.	1.5 gr. 100 kg.
Wood-Anderson	I	Photographic	Magnetic	60 mm. per min.		
Bosch-Omori	II	Smoked Sheet	Air	15 mm. per min.		

INSTRUMENTS—DETERMINED CONSTANTS

INSTRUMENTS	COMPONENT	T.				DETERMINED		
		T.		V		h		DATE
Wood-Anderson	N-S	1370		0-8		Critical		July 18, 1936
Wood-Anderson	E-W	"		"		"		" " "
Bosch-Omori)		-		-		-		
Bosch-Omori)		-		-		-		

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Month JANUARY - 1937Page No. 1

No. and Date	Phase	Time			Period	Amplitude		REMARKS
		G. M. T.				E	N	
		h	m	s		mm	mm	
1 Jan. 2	ePNE iSNE FNE	12:52:35 12:53:11 12:54						Weak. Distance about 210 miles.
2 Jan. 5								Faint seismic activity from 18:46 to 18:49.
3 Jan. 6								Faint seismic activity from 10:57 to 11:00.
	NOTE:	There were no records from 13:38 Jan. 10 to 13:28 Jan. 11						
4 Jan. 13								Faint seismic activity from 14:11 to 14:14.
5 Jan. 14								Faint seismic activity from 17:01 to 17:03 - (See No. 6 below - May be from same cause)
6 Jan. 14		18:54:25 to 18:55:00						Caused by a large rock slide in Gaillard Cut, bearing N. 47° W. 7.95 miles from Balboa Hts.
7 Jan. 16	ePNE eN eE FNE	17:45:34 17:46:24 17:46:26 17:51						Weak
8 Jan. 25								Faint seismic activity from 16:39 to 16:41.
9 Jan. 26								Very faint seismic activity from 03:10 to 03:13.
10 Jan. 27								Faint seismic activity from 11:06 to 11:10.
11 Jan. 28								Seismic activity from 03:56 to 03:59.

R. Z. KIRKPATRICK,
Chief of Surveys.

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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	N-S	0.8	1370	Critical	July 18, 1934
Wood-Anderson	E-W	"	"	"	" " "
Bosch-Omori	Not operating				
Bosch-Omori					

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Month FEBRUARY, 1937Page No. 2

No. and Date	Phase	Time G. M. T.			Period s	Amplitude		REMARKS
		h	m	s		E mm	N mm	
12 Feb. 4		Seismic activity from 12:37 to 12:39						
13 Feb. 4	1PNE 1SNE MN ME FNE	13:49:26 13:49:40 13:49:43 13:49:42 13:51				7.2	10.0	Distance about 80 miles.
14 Feb. 5	oPN oPE 1SN 1SE MN ME FNE	19:14:57 19:14:58 19:15:24 19:15:25 19:15:36 19:15:35 19:17				6.6	4.8	Distance about 150 miles.
15 Feb. 9		Seismic activity from 19:42 to 19:44						
16 Feb. 12		Faint seismic activity from 14:52 to 14:55						
17 Feb. 18		Faint seismic activity from 07:40 to 07:43						
18 Feb. 28	1PNE 1SNE MN ME CN CE FNE	03:43:42 03:43:48 03:44:05 03:44:04 03:45:09 03:44:58 03:48				120.5	126.6	Distance about 35 miles. Intensity III - IV.

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

INSTRUMENTS—DETERMINED CONSTANTS

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

Month MARCH, 1937Page No. 3

No. and Date	Phase	Time G. M. T.			Period s	Amplitude		REMARKS
		h	m	s		E	N	
						mm	mm	
19 March 1	1FNE	05:01:45						Distance approximately 65 miles. Intensity II
	1SNE	05:01:57						
	1NE	05:02:04						
	MN	05:02:09				9.5		
	ME	05:02:07				9.9		
	FNE	05:05						
20 March 6	eFNE	12:58:06						Weak. Distance approximately 250 miles.
	eN	12:58:32						
	eE	12:58:30						
	1SN	12:58:50						
	1SE	12:58:51						
	MNE	12:58:58				9.7	8.1	
	FNE	13:02						
21 March 9	1FN	15:41:20						Intensity II-III Distance approximately 250 miles. Felt generally throughout the Pacific section of the Canal.
	1PE	15:41:22						
	1N	15:41:46						
	1E	15:41:49						
	1SN	15:42:05						
	1SE	15:42:06						
	MN	15:42:29				34.6	35.4	
	ME	15:42:27						
FNE	16:00							
22 March 9		15:49:06 to 15:52						Superposed. Faint.
23 March 10	eFNE	00:55:21						Distance approximately 260 miles Weak.
	1N	00:55:46						
	1E	00:55:47						
	eSN	00:56:08						
	eSE	00:56:07						
	FNE	01:00						
24 March 10		03:21 to 03:24						Aftershock. Very faint.
		11:50 to 11:53						Very faint trace barely discernible
26 March 10		12:48 to 12:51						Very faint, but certainly seismic.
								Faint seismic activity from 15:27 to 15:30.

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SEISMOLOGICAL RECORD AT BALBOA HEIGHTS, CANAL ZONE

Month MARCH, 1937Page No. 4

No. and Date	Phase	Time G. M. T. h m s	Period s	Amplitude		REMARKS
				E mm	N mm	
28 March 11		00:18:34 to 00:19:30				Very faint. Local.
29 March 11		01:52:49 to 01:53:30				Probably same origin as preceding.
30 March 16		22:12:26 to 22:14				Very faint. Local.
31 March 17	ePN ePE 1SN 1SE LN LE GN GE FNE	14:00:57 14:00:58 14:02:00 14:02:02 14:02:57 14:02:59 14:04:11 14:04:13 14:16				Distance about 360 miles.
32 March 20		02:51:21 to 02:54				Faint. Local
33 March 20	1PNE 1SNE LNE MN ME FNE	17:57:29 17:57:34 17:57:39 17:57:41 17:57:40 18:01		51.8	45.0	Distance approximately 30 miles. Intensity III-IV Some people slightly alarmed.
34 March 20	1PNE SNE LNE FNE	23:41:25 23:41:30.5 23:41:34 23:44				Aftershock. Weak. Distance approximately 30 miles. Not reported felt.
35 March 21	1PNE 1SNE LNE MN FNE	03:00:27 03:00:31.5 03:00:37 03:00:38 03:03		16.9	15.6	Aftershock. Distance approximately 30 miles. Intensity II Felt by several people.
36 March 21		Seismic activity from 16:28 to 16:31				
37 March 22	ePNE eSNE LNE FNE	08:49:50 08:49:55 08:49:59 08:51				Very weak. Distance about 30 miles.
38 March 22		20:44 to 20:46				Very faint, but certainly seismic.
39 March 22		23:59 to 00:01				Barely discernible
40 March 23	ePN ePE eN eE FNE	19:37:09 19:37:11 19:37:53 19:37:51 19:41				Weak.

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SEISMOLOGICAL RECORD AT BALBOA HEIGHTS, CANAL ZONE

Month MARCH, 1937Page No. 5

No. and Date	Phase	Time G. M. T.			Period s	Amplitude		REMARKS
		h	m	s		E mm	N mm	
41 March 24		03:35						Very weak
		to 03:36						
42 March 24		06:18						Very faint trace.
		to 06:20						
43 March 24	ePN ePR eN iE iSN iSE MN ME FNE	13:58:46 13:58:47 13:59:16 13:59:16 13:59:26 13:59:28 13:59:41 13:59:43 14:06					26.7 28.5	Distance approximately 230 miles. Intensity II. Felt by several
44 March 24		Seismic activity from 16:30 to 16:33.						
45 March 24		19:58:37						Very faint Local.
		to 20:00						
46 March 25		21:35						Very faint trace.
		to 21:35						
47 March 26	iPN ePR iSN <u>iSE</u> iNE FNE	06:07:05 06:07:16 06:07:43 06:08:23 06:12		06:07:44				Weak. Distance about 220 miles.
48 March 26		06:10:53						Superposed. Very faint.
		to 06:15						
49 March 26		06:59:27						Very faint.
		to 07:02						
50 March 26		08:58						Very faint trace.
		to 09:00						
51 March 26		16:25:46						Weak. Evidently same epicenter as No. 47.
		to 16:29						
52 March 27		20:05						Very faint trace. Barely discernible.
		to 20:08						
53 March 27		20:41						Very faint trace Barely discernible.
		to 20:43						
54 March 27		21:08:21						Probably 220 miles. Not recorded on E-W as E-W clock had stopped for about 10 minutes and then started again.
		to 21:11						



SEISMOLOGICAL RECORD AT BALBOA HEIGHTS, CANAL ZONE

Month MARCH, 1937Page No. 6

No. and Date	Phase	Time G. M. T.	Period	Amplitude		REMARKS
				E mm	N mm	
55 March 27		h m s 21:18:23 to 21:20	s			Very faint trace.
56 March 27		21:34 to 21:36				Very faint trace
57 March 27		21:50 to 21:53				Very faint trace.
58 March 28		02:02 to 02:04				Very faint, but certainly seismic.
59 March 29		05:17:43 to 05:21				W e a k . Distance about 240 miles.
60 March 29		05:48:55 to 05:52				Very faint trace.
61 March 29		06:01 to 06:04				Barely discernible.
62 March 29	1PNE 1SN 1SE LN LE FNE	06:19:42 06:20:24 06:20:25 06:21:08 06:21:05 06:29				Intensity II. Distance 240 miles. Felt in David, Republic of Panama.
63 March 29		06:29 to 06:31				Superposed. Very faint.
64 March 29		07:00 to 07:03				Very faint.
65 March 29		07:55 to 07:59				F a i n t .
66 March 29		09:59 to 10:02				Barely discernible.
67 March 29	1FN ePE eSN eSE LN LE FNE	12:08:57 12:08:58 12:09:42 12:09:41 12:10:17 12:10:18 12:16				Distance about 240 miles. Felt in David, Republic of Panama.

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SEISMOLOGICAL RECORD AT BALBOA HEIGHTS, CANAL ZONE

Month MARCH, 1937Page No. 7

No. and Date	Phase	Time G. M. T. h m s	Period s	Amplitude		REMARKS
				E mm	N mm	
68 March 29	ePW	15:19:35				Weak. Distance about 240 miles.
	ePE	15:19:36				
	eSNE	15:20:18				
	LN	15:21:00				
	LE	15:20:56				
	FNE	15:24				
69 March 29		15:21 to 15:23				Superposed. Very weak.
		15:35 to 15:38				Very faint; barely discernible.
71 March 30	1PNE	14:17:11		9.5	11.2	Distance about 45 miles
	1SNE	14:17:19				
	MNE	14:17:20				
	FNE	14:19				
72 March 30		17:34 to 17:35				Barely discernible.
		23:14 to 23:17				Very faint trace.



G. E. MATTHEW
Acting Chief of Surveys.

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

INSTRUMENTS—DETERMINED CONSTANTS

INSTRUMENTS	COMPONENT	T ₀	V	h	DETERMINED
					July 18, 1934
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 APRIL - 1937Page No. 8

No. and Date	Phase	Time G. M. T.			Period s	Amplitude		REMARKS
		h	m	s		E	N	
						mm	mm	
74 April 2		02:23						Very faint trace.
		to 02:25						
75 April 2		21:22						Very faint trace.
		to 21:25						
76 April 3	ePNE eSN eSE FNE	20:35:50 20:36:33 20:36:32 20:39						Distance about 225 miles. Very weak.
77 April 3		20:48 to 20:51						Very faint trace.
78 April 3		22:18 to 22:24						Very faint trace.
79 April 4	ePN ePE FNE	06:04:30 06:04:31 06:09						Very weak.
80 April 4		06:24:14 to 06:27						Very weak.
81 April 4		16:58 to 17:01						Very faint trace.
82 April 4	ePNE ISNE FNE	05:13:33 05:13:39 05:14						Distance approximately 30 miles. Very faint.
83 April 5	ePN ePE eSNE FNE	06:41:43 06:41:44 06:42:27 06:46						Distance about 240 miles. Weak.
84 April 5		07:16 to 07:19						Very faint trace.
85 April 8		02:14:41 to 02:18						Weak.
86 April 10		17:24 to 17:26						Very faint trace.

SEISMOLOGICAL RECORD AT BALBOA HEIGHTS, CANAL ZONE

Month APRIL - 1957

Page No. _____

No. and Date	Phase	Time G. M. T.			Period s	Amplitude		REMARKS
		h	m	s		E mm	N mm	
87 April 11		18:44 to 18:47						Faint.
88 April 11		23:53 to 23:57						Faint.
89 April 12	1PN ePE 1SN 1SE MN ME FNE	05:09:24 05:09:25 05:10:05 05:10:06 05:10:17 05:10:25 05:17					25.9 20.7	Distance about 230 miles.
90 April 14	ePN ePE 1SN 1SE MN ME FNE	16:33:29 16:33:30 16:34:11 16:34:10 16:34:25 16:34:24 16:36					2.5 2.5	Distance about 230 miles.
91 April 14		16:37:51 to 16:38:20						Faint
92 April 15		15:24 to 15:26						Very faint.
93 April 15		17:11 to 17:13						Very faint.
94 April 15		19:26:50 to 19:27:20						Faint
95 April 16	3:19	3:19 to 3:35						Faint tremors from distant disturbance.
96 April 16		4:27 to 4:28						Very faint.
97 April 16		4:47:17 to 4:48:11						Faint.
98 April 16		16:54 to 16:55						Very faint.
99 April 17		21:58:50 to 22:00						Faint.
100 April 17		22:51 to 22:53						Very faint.
101 April 18		10:27 to 10:28						Faint.

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Month APRIL - 1937

Page No. _____

No. and Date	Phase	Time G. M. T.			Period	Amplitude		REMARKS
		h	m	s		E mm	N mm	
102 April 18		23:15 to 23:17						Faint.
103 April 19		4:26 to 4:28						Very faint.
104 April 19		15:43 to 15:44						Faint.
105 April 19		17:11 to 17:13						Faint.
106 April 20		2:42 to 2:43						Faint.
107 April 20		14:32:49 to 14:33:33						Faint.
108 April 22		17:36:59 to 17:37:28						Faint.



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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	N - S	0.8	1370	Critical	July 18, 1934
Wood-Anderson	E - W	"	"	"	" " "
Bosch-Omori)		Not Operating			
Bosch-Omori)					

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Month May 1937Page No. 11

No. and Date	Phase	Time G. M. T.			Period s	Amplitude		REMARKS
		h	m	s		E mm	N mm	
109 May 8		15:22	to	15:28				Very faint trace.
110 May 11	ePNE 1SNE FNE	12:01:30		12:01:40				Very faint. Distance about 30 miles
111 May 12		19:17	to	19:19				Very faint trace. Barely discernible.
112 May 13		03:04	to	03:07				Very faint trace.
No record from 13:31 May 13 to 13:35 May 14, 1937.								
113 May 18		20:00:54	to	20:01:22				Faint trace.
114 May 21	e PN e PE e SN e SE LNE M N M E FNE	13:13:57		13:13:56			10.4	Distance about 250 miles.
115 May 26		16:47	to	16:48				Weak
116 May 27		17:38	to	17:43				Weak
117 May 28		15:39	to	15:45				Very weak
118 May 29		8:45	to	8:48				Very weak.

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Wood-Anderson	E - W	"	"	"	"
Bosch-Omori)		NOT OPERATING			
Bosch-Omori)		NOT OPERATING			

Month JUNE - 1937Page No. 12

No. and Date	Phase	Time G. M. T.	Period	Amplitude		REMARKS
				E	N	
		h m s	s	mm	mm	
119 June 4		19:44 to 19:47				Faint Trace.
120 June 7		04:03 to 04:08				Weak.
121 June 7	ePN ePE eSN eSE FNE	18:57:14 18:57:13 18:57:46 18:57:45 19:00				Distance about 180 miles.
122 June 8		03:10 to 03:12				Very weak.
123 June 8		22:35 to 22:36				Very faint trace
124 June 15	1PNE 1SNE FNE	19:24:27 19:24:40 19:27				Weak. Distance approximately 75 miles.
125 June 21	ePN ePE 1N eSN eSE eN eE FNE	15:17:08 15:17:06 15:17:24 15:20:26 15:20:28 15:21:10 15:21:20 15:39				Distance about 1300 miles. Cable despatches state that this shock caused some damage in Trujillo, Peru.
126 June 24	ePNE eSN SE FNE	10:05:51 10:06:41 ? 10:10				Distance about 280 miles. Very faint.
127 June 24	1PN ePE eSN eSE MN Tail	13:12:48 13:12:50 13:13:38 13:13:39 13:14:00 portion lost		12.0	10.0	Distance about 280 miles. in following shock.
128 June 24	MN ME FNE	13:15:50 13:15:53 13:33		20.9	25.3	Superposed. P & S indistinguishable.

NOTE: The following is a report received from the master of the U.S. Army Transport "ST. MICHEL":

"1. At 7:10 a.m. and 7:12 a.m. at ship, 13 hours 10 minutes Greenwich civil time, June 24, 1937, in Latitude 8-13-00 N, Longitude 84-08-00 W, 35 miles off Cano Island, and in 1000 fathoms of water, the U.S. Army Transport "ST. MICHEL" experienced two distinct and very severe earthquake shocks one minute apart.

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No. and Date	Phase	Time G. M. T.			Period	Amplitude		REMARKS
		h	m	s		E mm	N mm	
								<p>"2. The vessel shook violently each time from stem to stern, causing windows to rattle, loose gear to jump up and down and rigging to vibrate. The shocks were about ten seconds in duration.</p> <p>"3. Our radio operator contacted the S.S. NEVADAN and the S.S. CHATTANOOGA CITY who were in the same vicinity and they reported that they had felt the shocks.</p> <p>(Sgd) C. A. McMULLEN, Master."</p>
129 June 27		15:44 to 15:46						Very faint trace.
130 June 29		Very faint seismic activity from 01:56 to 01:58						
131 June 29	1PN 1PE 1SNE MN ME CN CE FNE	15:19:10 15:19:09 15:19:45 15:19:50 15:19:51 15:20:20 15:20:18 15:23				19.6	26.9	Distance about 200 miles. Intensity II. Felt by few people on Pacific Side.
132 June 30	ePNE 1SE FNE	14:13:28 14:13:33 14:14						Very faint. Distance 25 miles.
133 June 30	ePNE 1SNE FNE	14:28:03.5 14:28:08 14:29						Very faint. Distance 25 miles.
134 June 30		17:03:41 to 17:05						Very faint trace.
135 June 30	ePNE 1SNE FNE	17:46:38.5 17:46:43 17:47:30						Very faint. Distance 25 miles.
136 June 30	ePNE eSE FNE	23:09:27 23:09:32 23:10						Very faint. Distance 25 miles.

R. Z. KIRKPATRICK,
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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
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Wood-Anderson	E-W	"	"	"	"
Bosch-Omori	Not Operating.				
Bosch-Omori					

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Month July 1937Page No. 14

No. and Date	Phase	Time G. M. T.			Period s	Amplitude		REMARKS
		h	m	s		E mm	N mm	
137 July 1	1PNE 1SNE FNE	10:	56:	50				Very faint Distance approximately 80 miles.
138 July 1	ePNE eSNE FNE	10:	39:	56				Very faint Distance 25 miles
139 July 1	1PE 1SE ME FNE	14:	54:	13			9.0	Distance 210 miles N-S record not clear. Sheet was placed on drum with sensitive side reversed.
140 July 1	1PE 1SE ME FNE	16:	37:	29			4.6	Distance about 20 miles.
141 July 4	ePN 1SN FNE	06:	04:	03				Distance about 250 miles Weak. E-W clock stopped.
142 July 4		11:	40:	42				Very faint.
143 July 9		17:	32:	58				Very faint.
144 July 11		17:	34:					Very faint
145 July 11		18:	46:					Very faint, barely discernible.
146 July 12		04:	45:					Faint.
147 July 12		16:	38:					Very faint trace.

SEISMOLOGICAL RECORD AT BALBOA HEIGHTS, CANAL ZONE

Month July 1937Page No. 15

No. and Date	Phase	Time G. M. T.			Period s	Amplitude		REMARKS
		h	m	s		E mm	N mm	
Note: No record from 18: 16 to 20: 33 July 12; repairing drive clocks, and no record from 13: 17 July 13 to 13: 26 July 14.								
148 July 16	1PNE 1SNE MNE FNE	05: 59: 09 05: 59: 28 05: 59: 30 06: 02				3.0	3.3	Weak Distance 105 miles.
149 July 17		08: 58 to 09: 01						Very weak.
150 July 19	ePNE 1SNE 1N 1E FNE	19: 38: 06 19: 40: 11 19: 40: 39 19: 40: 42 19: 53						Weak. Distance 725 miles. ✓
151 July 20		05: 24: 41 to 05: 27						Very faint trace.
152 July 21								Very faint seismic activity from 16:37 to 16: 40
153 July 22		17: 20 to 18: 51						A very faint suggestion of long period waves appear intermittently, the period of the waves in the first part are much shorter than the ending portion. Might be two quakes superposed.
154 July 26	1PN 1PE 1N 1E 1N eE FNE	03: 51: 23 03: 51: 24 03: 51: 57 03: 51: 56 03: 52: 45 03: 52: 47 04: 11						Weak.
155 July 30	ePN ePE eSE eSN FNE	02: 08: 44 02: 08: 45 02: 09: 31 02: 09: 30 02: 13						Weak. Distance about 260 miles.
156 July 31		22: 25 to 22: 28						Very faint trace.

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THE PANAMA CANAL
DEPARTMENT OF OPERATION AND MAINTENANCE
SECTION OF SURVEYS

SEISMOLOGICAL RECORD AT BALBOA HEIGHTS, CANAL ZONE

Lat. 8° 57' 39" N.

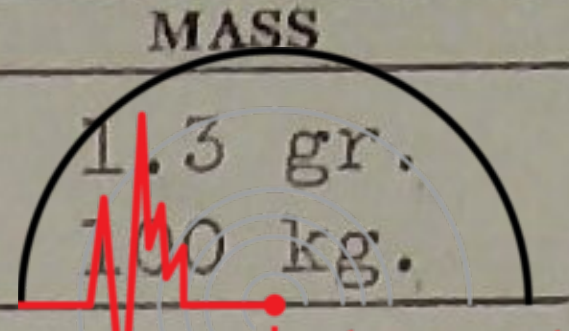
Long. 79° 33' 29" W.

h = 36 meters.

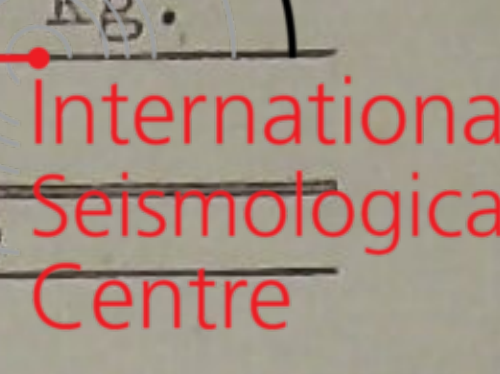
Lithologic foundation: Basalt.

Time Correction: Within 0.5 sec.

INSTRUMENTS—FIXED CONSTANTS

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

INSTRUMENTS—DETERMINED CONSTANTS

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

Month AUGUST - 1937Page No. 16

No. and Date	Phase	Time G. M. T.			Period	Amplitude		REMARKS
		h	m	s		E	N	
						mm	mm	
157 Aug. 3		Faint seismic activity from 03:08 to 03:11						
158 Aug. 10		16:07 to 12:12						Very faint, barely discernible
159 Aug. 11		01:14 to 01:23						Very faint trace
160 Aug. 15	1PNE 1SNE MNE FNE	04:33:47 04:33:55 04:33:56 04:35				6.0	4.4	Distance about 45 miles
161 Aug. 15		04:46 to 04:49						Very faint trace, barely discernible
162 Aug. 16	ePN ePE eSNE FNE	23:58:49 23:58:48 23:59:29 00:03						Weak
163 Aug. 18	ePE eSE FE	19:01:40 19:02:24 19:06						Very weak. N-S clock stopped
164 Aug. 19		08:14 to 08:17						Very faint trace. N-S clock stopped
165 Aug. 20	ePE eSE FNE	20:53:32 20:54:31 20:58						Weak. Distance about 340 miles
166 Aug. 21		17:11 to 17:12						Weak
167 Aug. 22		02:04 to 02:05						Weak
168 Aug. 22		14:52 to 14:54						Weak
169 Aug. 24	ePNE eSNE LNE FNE	20:15:57 20:18:07 20:19:07 20:30:00						Distance about 730 miles
Aug. 24		16:19 to 16:20						Dynamite explosion
Aug. 24		18:49 to 18:50						Dynamite explosion
170 Aug. 25		02:42:55 to 02:43:39						Weak

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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 0.5 sec.

INSTRUMENTS—FIXED CONSTANTS

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

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					

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Month SEPTEMBER 1937

Page No. 17

No. and Date	Phase	Time G. M. T.			Period	Amplitude		REMARKS	
		h	m	s		E	N		
					s	mm	mm		
#171 Sept. 1		11:59						Weak.	
		to							
		12:02							
#172 Sept. 2		16:06:55						Faint	
		to						Local	
		16:08							
#173 Sept. 3		08:37:00						Faint	
		to						Local	
		08:38							
#174 Sept. 3	ePN	19:00:56						Weak	
	ePF	19:00:58							
	eN	19:11:10							
	eF	19:11:09							
	FN	19:21							
#175 Sept. 4	ePNE	09:18:48						Distance about 20 miles.	
	1SNE	09:18:51.5						Faint.	
	FNE	09:20							
#176 Sept. 4		17:06:03						Faint	
		to						Distance probably 15 miles.	
		17:07							
#177 Sept. 4	ePNE	23:22:44						Probably same epicenter as above.	
	1SNE	23:22:47							
	FNE	23:24							
#178 Sept. 5	ePNE	10:53:05.5						Probably same epicenter as preceding.	
	1SNE	10:53:08							
	FNE	10:54							
#179 Sept. 6		04:40						Very faint trace; barely discernible	
		to							
		04:45							
#180 Sept. 8		00:51						Very faint trace.	
		to							
		00:56							
#181 Sept. 9		23:21						Very faint trace.	
		to							
		23:24							

SEISMOLOGICAL RECORD AT BALBOA HEIGHTS, CANAL ZONE

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Month _____

Page No. _____

No. and Date	Phase	Time G. M. T.	Period	Amplitude		REMARKS
				E	N	
		h m s	s	mm	mm	
#182 Sept. 12	ePNE 1SNE FNE	15:44:15 15:45:00 15:48				Distance about 250 miles. Weak.
#183 Sept. 15		00:53 to 00:58				Very faint trace of 4 second period waves.
#184 Sept. 15	ePN ePE eN FNE	23:51:57 23:52:00 23:56:10 00:11	10.0			Very faint.
#185 Sept. 21		09:59 to 10:02				Very faint trace.
#186 Sept. 22		15:36 to 15:38				Very faint trace.
#187 Sept. 22	ePNE 1SNE FNE	20:20:31 20:20:43 20:22				Distance about 65 miles.
#188 Sept. 23		13:24 to 13:28				Very faint trace, barely discernible.
#189 Sept. 24	1PNE SNE FNE	01:20:23 01:21:06 01:28				Distance about 240 miles. Weak.
#190 Sept. 24	ePNE 1SNE FNE	02:41:02 02:41:45 02:49				Distance about 240 miles Weak.
#191 Sept. 25		07:29 to 07:35				Weak.
#192 Sept. 26		08:54 to 08:56				Faint trace.
#193 Sept. 28		06:23 to 06:30				Faint.

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THE PANAMA CANAL
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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 0.5 sec.

INSTRUMENTS—FIXED CONSTANTS

INSTRUMENTS	SYMBOL	REGISTRATION	DAMPING	PAPER SPEED	MASS
Wood-Anderson	I	Photographic	Magnetic	60 mm. per min.	13 gr.
Bosch-Omori	II	Smoked Sheet	Air	15 mm. per min.	100 kg.

INSTRUMENTS—DETERMINED CONSTANTS

INSTRUMENTS	COMPONENT	T.	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 October - 1937Page No. 19

No. and Date	Phase	Time G. M. T.			Period s	Amplitude		REMARKS
		h	m	s		E mm	N mm	
194 Oct. 2		10:04						Very faint trace
195 Oct. 12		16:02						Weak Distant
196 Oct. 12	eNE eNE FNE	20:57 21:04:35 21:07						Very faint May be two quakes superposed.
197 Oct. 13		15:15:27 to 15:19						Weak.
198 Oct. 13		15:47:37 to 15:52						Weak.
199 Oct. 14	ePN eSN FNE	06:35:49 06:36:10 06:37						Distance about 115 miles
200 Oct. 14	ePN ePE eSN eSE FNE	16:49:51 16:49:52 16:50:28 16:50:27 16:52						Distance about 210 miles. Very faint.
201 Oct. 14	1PNE 1SNE MN ME FNE	18:00:44 18:00:525 Blurred 18:00:54 18:03			18.0			Intensity II Distance about 45 miles. Felt by many on the Pacific Side.
202 Oct. 15		03:07:45 to 03:09						Very faint trace.
203 Oct. 16		22:16 to 22:18						Very faint trace.
204 Oct. 20	ePNE eSN eSE FNE	20:40:59 20:41:43 20:41:42 20:44						Very faint trace Distance about 250 miles.
205 Oct. 21		15:13 to 15:15						Very faint trace.

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SEISMOLOGICAL RECORD AT BALBOA HEIGHTS, CANAL ZONE

Lat. 8° 57' 39" N.

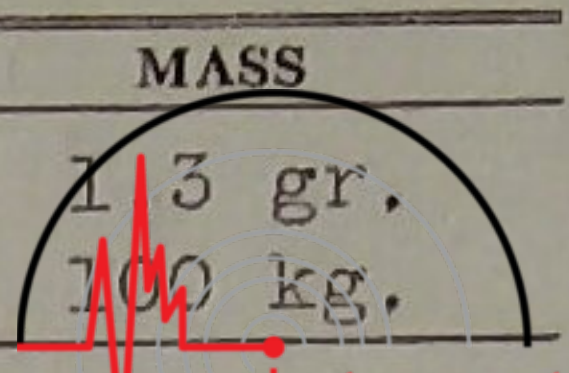
Long. 79° 33' 29" W.

h=36 meters.

Lithologic foundation: Basalt.

Time Correction: Within 0.5 sec.

INSTRUMENTS—FIXED CONSTANTS

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

INSTRUMENTS—DETERMINED CONSTANTS

INSTRUMENTS	COMPONENT	T ₀	V	h	DETERMINED
					July 18, 1934
Wood-Anderson	E - W	0.8	1370	Critical	July 18, 1934
Wood-Anderson	N - S	0.8	1370	Critical	July 18, 1934
Bosch-Omori	---	No operating	--	--	--
Bosch-Omori					

Month NOVEMBER, 1937Page No. 20

No. and Date	Phase	Time G. M. T.			Period s	Amplitude		REMARKS
		h	m	s		E	N	
						mm	mm	
206 Nov. 3		17:40						Faint trace.
207 Nov. 7		09:13						Very faint.
208 Nov. 15	ePNE eSNE 1LNE MNE FNE	14:57:22 14:58:14 14:58:26 14:58:32 15:00:00				6.0	7.0	Slight Distance about 310 miles
209 Nov. 15		16:52:54 to 16:55:00						Weak trace - possibly same origin at #208.
210 Nov. 16		3:00:46 to 3:01:16						Faint confused trace.
211 Nov. 18		3:06:34 to 3:07:00						Faint trace.
212 Nov. 18		11:31:23 to 11:32:12						Very faint trace.
213 Nov. 19		3:07:25 to 3:07:55						Faint trace.
214 Nov. 19	ePN ePE eSN eSE 1LNE MN ME FNE	3:39:54 3:39:55 3:40:35 3:40:37 3:41:00 3:41:06 3:41:07 3:41:18				2.0	2.5	Slight Distance about 240 miles, probably in Chiriqui.
215 Nov. 20	ePNE eSNE 1LN 1LE FNE	15:03:39 15:03:46 15:03:53 15:03:54 15:04:50				2.0	1.5	Very slight. Distance about 40 miles.
216 Nov. 20		17:21:08 to 17:21:45						Faint trace.
217 Nov. 20		23:10:06 to 23:10:30						Faint trace.

SEISMOLOGICAL RECORD AT BALBOA HEIGHTS, CANAL ZONE

Month NOVEMBER, 1937.Page No. 21

No. and Date	Phase	Time G. M. T.			Period s	Amplitude		REMARKS
		h	m	s		E mm	N mm	
218 Nov. 21		6:08:09 to 6:09:30						Very faint trace.
219 Nov. 21	ePNE eSN eSE 1LN 1LE FNE	8:32:32 8:32:49 8:32:48 8:33:06 8:33:05 8:34:35				2.0	1.5	Very slight Distance about 90 miles
220 Nov. 21	ePN ePE eSN eSE 1LNE MN ME FNE	20:53:38 20:53:40 20:54:00 20:54:01 20:54:28 20:54:32 20:54:33 20:55:40				2.0	2.8	Very slight Distance about 115 miles
221 Nov. 22		16:58:07 to 17:00:20						Very faint trace.
222 Nov. 24		3:18:23 to 3:19:40						Very faint trace.
223 Nov. 27		10:03:56 to 10:08:00						Very faint trace.
Nov. 27		16:14:40 to 16:14:50						Sharp and abrupt seismic activity.



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Lat. 8° 57' 39" N.

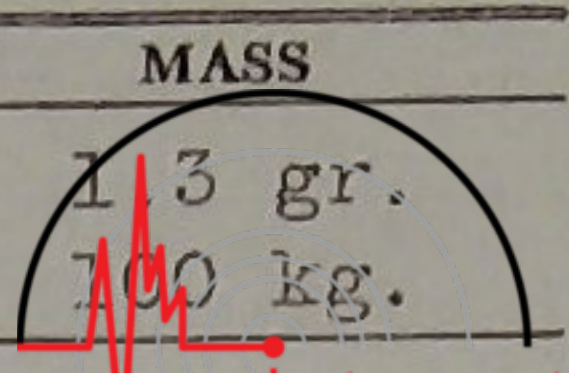
Long. 79° 33' 29" W.

h=36 meters.

Lithologic foundation: Basalt.

Time Correction: Within 0.5 sec.

INSTRUMENTS—FIXED CONSTANTS

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

INSTRUMENTS—DETERMINED CONSTANTS

INSTRUMENTS	COMPONENT	T ₀	V	h	DETERMINED
					July 18, 1934
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	--	Not operating	--	--	--

Month DECEMBER 1937Page No. 22

No. and Date	Phase	Time G. M. T.			Period s	Amplitude		REMARKS
		h	m	s		E	N	
						mm	mm	
Dec. 1		16: 13: 30						Sharp and abrupt Seismic Activity
		to						
224		3: 23: 10						Very faint trace
Dec. 2		to						
		3: 25: 00						
225		11: 44: 47						Very faint trace
Dec. 2		to						
		11: 47: 00						
226		5: 44: 16						Very faint and far away
Dec. 5		to						
		5: 48: 00						
227		12: 01: 03						Very faint trace
Dec. 6		to						
		12: 02: 15						
228	ePNE	21: 08: 44						Very slight Distance about 240 miles X The end of this Quake is lost in the beginning of the after shock.
Dec. 6	eSN	21: 09: 19						
	eSE	21: 09: 18						
	iLN	21: 09: 42						
	iLE	21: 09: 41						
	MN	21: 10: 02				2.0		
	ME	21: 09: 55				2.0		
	FNE	21: X :						
229	iMNE	21: 12: 50						Very slight
Dec. 6	FNE	21: 18: 50						The P and S waves were lost in the end of Quake No. 228
230	ePN	21: 44: 28						Slight Distance about 160 miles
Dec. 6	ePE	21: 44: 27						
	eSN	21: 44: 56						
	eSE	21: 44: 55						
	iLN	21: 45: 24						
	iLE	21: 45: 23						
	MN	21: 45: 32				3.5		
	ME	21: 45: 40			4.0			
	FNE	21: 55: 00						
231	ePNE	18: 01: 59						Slight Distance about 185 miles
Dec. 7	eSN	18: 02: 29						
	eSE	18: 02: 26						
	iLNE	18: 02: 58						
	MN	18: 03: 02				7.0		
	ME	18: 03: 03				4.8		
	FNE	18: 12: 00						
232	ePNE	2: 26: 37						Slight Same source as No. 231
Dec. 8	eSNE	2: 27: 12						
	iLN	2: 27: 35						
	iLE	2: 27: 36						
	MN	2: 27: 50				3.0		
	ME	2: 27: 53				3.8		
	FNE	2: 38: 00						
233		8: 29: 29						Weak
Dec. 11		to						
		8: 31: 00						
234		12: 04: 00						Weak
Dec. 11		to						
		12: 06: 00						
235		18: 51: 40						Weak
Dec. 11		to						
		18: 54: 00						

SEISMOLOGICAL RECORD AT BALBOA HEIGHTS, CANAL ZONE

Month December 1937Page No. 23

No. and Date	Phase	Time G. M. T.			Period s	Amplitude		REMARKS
		h	m	s		E mm	N mm	
236 Dec. 15		16: 11: 54						Sharp and abrupt
		to 16: 12: 08						
237 Dec. 15		10: 29: 10						Weak
		to 10: 31: 00						
238 Dec. 16		23: 03: 05						Weak
		to 23: 24: 10						
239 Dec. 18		5: 00: 30						Faint trace
		to 5: 01: 40						
240 Dec. 18	1PNE 1SNE 1LN 1LE MN ME CN CE FNE	19: 17: 48 19: 18: 01 19: 18: 19 19: 18: 18 19: 18: 27 19: 18: 22 19: 19: 27 19: 19: 26 19: 25: 00					29.0 30.0	Intensity I to II. Distance about 75 miles. Felt by many people
241 Dec. 18	1PNE 1SN 1SE 1LNE MN ME CN CE FNE	20: 45: 22 20: 45: 35 20: 45: 37 20: 45: 53 20: 45: 58 20: 46: 01 20: 46: 32 20: 46: 28 20: 49: 00					19.0 17.0	Distance about 75 miles. Felt.
242 Dec. 18	1PNE 1SN 1SE LN LE MN ME CNE FNE	20: 49: 41 20: 49: 54 20: 49: 51 20: 50: 08 20: 50: 11 20: 50: 24 20: 50: 27 20: 51: 50 21: 00: 00					56.0 72.0	Intensity II to III. Distance 75 miles Felt by many people
243 Dec. 18		21: 14: 00 to 21: 15: 30						Weak
244 Dec. 18		21: 15: 30 to 21: 17: 00						Very weak
245 Dec. 18		22: 06: 00 to 22: 08: 00						Very weak
246 Dec. 18	1PNE 1SNE LN LE MN ME CN CE FNE	22: 10: 18 22: 10: 35 22: 10: 50 22: 10: 48 22: 10: 53 22: 10: 55 22: 11: 31 22: 11: 28 22: 14: 30					17.0 21.5	Felt by a few people
247 Dec. 18		22: 13: 00 to 22: 14: 00						Weak; superposed on end portion of No. 246. Weak
248 Dec. 18		22: 45: 00 to 22: 46: 00						Very faint



SEISMOLOGICAL RECORD AT BALBOA HEIGHTS, CANAL ZONE

Month December 1937Page No. 24

No. and Date	Phase	Time G. M. T.			Period s	Amplitude		REMARKS
		h	m	s		E mm	N mm	
249 Dec. 18	ePNE	23	46	56	-----	3.0	4.5	Distance about 75 miles. Slight
	eSN	23	47	06				
	eSE	23	47	10				
	LN	23	47	30				
	LE	23	47	27				
	MNE	23	47	51				
	CN	23	47	45				
	CE	23	47	49				
FNE	23	49	00					
250 Dec. 19		2	58	00				Faint trace
			to					
251 Dec. 19		4	57	55				Faint trace
			to					
252 Dec. 19		20	52	43				Faint trace
			to					
253 Dec. 20		4	14	24				Faint trace
			to					
254 Dec. 20	iPNE	6	51	11	-----	2.5	3.0	Distance about 75 miles. Slight
	iSN	6	51	27				
	iSE	6	51	25				
	iLN	6	51	42				
	iLE	6	51	43				
	MN	6	51	45				
	ME	6	51	49				
	CN	6	52	03				
CE	6	52	05					
FNE	6	54	00					
255 Dec. 21		3	25	45				Very faint trace
			to					
256 Dec. 21		9	56	55				Weak
			to					
257 Dec. 22		22	05	20				Sharp
			to					
258 Dec. 22		22	07	00				Faint
			to					
259 Dec. 23		3	03	00				Very weak
			to					
260 Dec. 23	ePNE	13	22	30	-----	-----	-----	Approximate distance about 1600 miles. Newspaper reports indicate that this quake was destructive in the vicinity of Mexico City.
	eSNE	13	26	22				
	LN	13	29	12				
	LE	13	28	47				
	MN	13	31	23				
	ME	13	31	47				
	CN	13	35	55				
	CE	13	36	00				
FNE	14	15	00					
261 Dec. 23		17	18	00				Faint
			to					
262 Dec. 23	iPNE	20	15	00	-----	16.5	16.0	Distance approximately 80 miles.
	iSN	20	15	13				
	iSE	20	15	18				
	LN	20	15	28				
	LE	20	15	31				
	MN	20	15	36				
	ME	20	15	44				
	CNE	20	15	58				
FNE	20	18	00					
263 Dec. 23		23	25	00				Very faint trace
			to					
264 Dec. 24		2	22	29				Very weak
			to					
		2	22	30				



SEISMOLOGICAL RECORD AT BALBOA HEIGHTS, CANAL ZONE

Month December 1937Page No. 25

No. and Date	Phase	Time G. M. T.			Period s	Amplitude		REMARKS
		h	m	s		E mm	N mm	
265 Dec. 24		6: 25: 15						All American Cables Co. informs of an earthquake about 1:30 a.m. 50 miles of "Perene" at colony of Peruvian Corp. Injured 15, killed 25, 200 shops broken down. <i>Peru S.A.</i>
		to 6: 44: 00						
266 Dec. 24		13: 56: 53						Weak
		to 13: 59: 00						
267 Dec. 26		12: 16: 19						Very faint
		to 12: 17: 17						
268 Dec. 27		19: 04: 45						Very weak
		to 19: 05: 30						
269 Dec. 28		3: 35: 37						Very weak
		to 3: 37: 00						
270 Dec. 28		6: 28: 00						Very faint trace distant disturbance
		to 6: 33: 00						
271 Dec. 28		23: 11: 07						Sharp
		to 23: 11: 20						
272 Dec. 29		2: 47: 09						Very weak
		to 2: 48: 00						
273 Dec. 30		3: 48: 06						Very weak
		to 3: 49: 00						
274 Dec. 30		16: 28: 17						Sharp
		to 16: 28: 28						
275 Dec. 31		3: 17: 00						Very weak
		to 3: 17: 29						
276 Dec. 31		7: 29: 27						Faint
		to 7: 29: 48						
277 Dec. 31		16: 14: 52						Short and abrupt
		to 16: 15: 04						
278 Dec. 31		17: 45: 50						Tremors from distant disturbance
		to 18: 03: 00						
279 Dec. 31		20: 52: 22						Weak
		to 20: 53: 00						

R. Z. KIRKPATRICK,
Chief of Surveys.