



SEISMOLOGICAL RECORD AT BALBOA HEIGHTS, CANAL ZONE

Month January 1939

Page No. 2

| No. and Date | Phase | Time G. M. T. | | | Period s | AMPLI- TUDE mm | REMARKS |
|--------------------------|-------|--------------------------------|---|---|---|--|---------|
| | | h | m | s | | | |
| 6 Jan. 25 (Cont'd) | 1E | 03:49:07 | | | (Zone of L-waves with velocity about 4.5 Km/sec.) | | |
| | 1E | 03:51:12 | | | | | |
| | 1N | 03:54:46 | | | | | |
| | 1E | 03:54:30 | | | | | |
| | FNE | 05:05 | | | | | |
| 7 Jan. 27 | ePN | 10:41:22 | | | | Very slight. Distance about 265 miles. | |
| | ePE | 10:41:24 | | | | | |
| | eSNE | 10:42:10 | | | | | |
| | FNE | 10:48 | | | | | |
| 8 Jan. 27 | ePNE | Confused due to passing train. | | | | Very faint trace. | |
| | eSNE | 14:14:32 | | | | | |
| | FNE | 14:23 | | | | | |
| 9 Jan. 27 | ePN | 14:58:35 | | | | Slight. Distance about 205 miles. | |
| | ePE | 14:58:34 | | | | | |
| | 1SN | 14:59:11 | | | | | |
| | 1SE | 14:59:10 | | | | | |
| | FNE | 14:05 | | | | | |
| 10 Jan. 27 | ePN | 20:37:43 | | | | Very slight. Distance about 235 miles. | |
| | ePE | 20:37:41 | | | | | |
| | eSNE | 20:38:32 | | | | | |
| | FNE | 20:43 | | | | | |
| 11 Jan. 29 | ePNE | 18:53:04 | | | | Very slight. Distant quake. | |
| | eN | 18:57:06 | | | | | |
| | eE | 18:57:04 | | | | | |
| | FNE | 19:11 | | | | | |
| 12 Jan. 30 | | 02:37:29 | | | | Faint tremors at a great distance. Probably same source as No. 6. | |
| | | to 04:38 | | | | | |
| 13 Jan. 31 | | 00:09:27 | | | | Very faint distant tremors. | |
| | | to 00:22 | | | | | |
| 14 Jan. 31 | | 15:44 | | | | Very faint - barely discernible. | |
| | | to 15:47 | | | | | |

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DEPARTMENT OF OPERATION AND MAINTENANCE
SECTION OF SURVEYS

MR 58704—Panama Canal—3-16-38—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. | V | h | DETERMINED |
|---------------|-----------|------------|------|---------|---------------|
| Wood-Anderson | N - S | 0.76 | 2740 | 12 to 1 | Dec. 21, 1938 |
| Wood-Anderson | E - W | 0.74 | 1370 | 9 to 1 | " " " |
| Bosch-Omori) | Not | Operating. | | | |
| Bosch-Omori) | | | | | |

Month FEBRUARY, 1939Page No. 3

| No. and Date | Phase | Time G. M. T. | | | Period | AMPLI- TUDE mm | REMARKS |
|----------------|---------|---------------------------------------|----|----|--------------------------|----------------------|---------------------------|
| | | h | m | s | | | |
| #15 Feb. 1 | | 1 | 59 | 07 | | | Very Faint. |
| | | | to | | | | |
| | | 2 | 04 | | | | |
| #16 Feb. 7 | | 13 | 03 | | | | Very Faint. |
| | | 13 | to | | | | |
| | | 13 | 05 | | | | |
| Feb. 7 | | Instruments stopped for clock repairs | | | | | |
| | | 13 | 55 | to | 14:11 and 15:22 to 15:54 | | |
| #17 Feb. 9 | 1 P N E | 15 | 17 | 22 | | | Distance about 500 miles. |
| | e S N | 15 | 18 | 50 | | | |
| | e S E | 15 | 18 | 44 | | | |
| | L N | 15 | 19 | 17 | | | |
| | L E | 15 | 19 | 20 | | | |
| | F N E | 15 | 32 | 00 | | | |
| #18 Feb. 17 | 1 P N | 8 | 05 | 30 | | | Distance about 95 miles. |
| | 1 P E | 8 | 05 | 29 | | | |
| | 1 S N | 8 | 05 | 57 | | | |
| | 1 S E | 8 | 05 | 56 | | | |
| | L N E | 8 | 06 | 05 | | | |
| | M N | 8 | 06 | 26 | | | |
| | M E | 8 | 06 | 11 | | | |
| | C N | 8 | 06 | 38 | | | |
| | C E | 8 | 06 | 42 | | | |
| | F N E | 8 | 10 | 00 | | | |

SEISMOLOGICAL RECORD AT BALBOA HEIGHTS, CANAL ZONE

Month FEBRUARY, 1939.Page No. 4.

| No. and Date | Phase | Time G. M. T. | | | Period s | AMPLI- TUDE mm | REMARKS |
|----------------|---------|------------------|----|----|-------------|----------------------|---------------------------|
| | | h | m | s | | | |
| #19 Feb. 19 | 1 P N E | 17 | 11 | 11 | | | Distance about 95 miles. |
| | L N | 17 | 11 | 36 | | | |
| | L E | 17 | 11 | 55 | | | |
| | M N | 17 | 11 | 44 | | | |
| | M E | 17 | 11 | 37 | | | |
| | C N | 17 | 11 | 53 | | | |
| | C E | 17 | 11 | 52 | | | |
| | F N E | 17 | 14 | 00 | | | |
| #20 Feb. 20 | 1 P N E | 21 | 29 | 41 | | | Distance about 95 miles |
| | S N E | 21 | 29 | 56 | | | |
| | L N E | 21 | 30 | 04 | | | |
| | M N E | 21 | 30 | 05 | | | |
| | C N | 21 | 30 | 24 | | | |
| | C E | 21 | 30 | 28 | | | |
| | F N E | 21 | 32 | 00 | | | |
| #21 Feb. 21 | | 19 | 29 | | | | Weak. |
| | | | to | | | | |
| | | 19 | 31 | | | | |
| #22 Febr 23 | e P N E | 23 | 07 | 57 | | | Distance about 95 miles. |
| | e S N | 23 | 08 | 14 | | | |
| | e S E | 23 | 08 | 17 | | | |
| | L N | 23 | 08 | 23 | | | |
| | L E | 23 | 08 | 20 | | | |
| | M N | 23 | 08 | 32 | | | |
| | M E | 23 | 08 | 25 | | | |
| | C N | 23 | 08 | 43 | | | |
| | C E | 23 | 08 | 54 | | | |
| | F N E | 23 | 12 | 00 | | | |
| #23 Feb. 24 | 1 P N E | 2 | 16 | 10 | | | Distance about 110 miles. |
| | S N | 2 | 16 | 31 | | | |
| | S E | 2 | 16 | 30 | | | |
| | L N | 2 | 16 | 35 | | | |
| | L E | 2 | 16 | 33 | | | |
| | M N E | 2 | 16 | 37 | | | |
| | F N E | 2 | 22 | 00 | | | |
| #24 Feb. 24 | | 6 | 37 | 24 | | | Very Faint. |
| | | | to | | | | |
| | | 6 | 39 | 00 | | | |

SEISMOLOGICAL RECORD AT BALBOA HEIGHTS, CANAL ZONE

Month FEBRUARY, 1959.Page No. 5.

| No. and Date | Phase | Time G. M. T. | | | Period s | AMPLI- TUDE mm | REMARKS |
|----------------|-------|------------------|----|----|-------------|----------------------|-------------|
| | | h | m | s | | | |
| #25 Feb. 24 | | 8 | 54 | 27 | | | Very Faint. |
| | | | to | | | | |
| | | 8 | 57 | 00 | | | |
| #26 Feb. 24 | | 23 | 56 | | | | Weak. |
| | | | to | | | | |
| | | 23 | 58 | | | | |
| #27 Feb. 25 | | 5 | 09 | | | | Weak. |
| | | | to | | | | |
| | | 5 | 12 | | | | |
| #28 Feb. 25 | | 9 | 05 | | | | Weak |
| | | | to | | | | |
| | | 9 | 05 | | | | |
| #29 Feb. 26 | | 6 | 14 | | | | Weak. |
| | | | to | | | | |
| | | 6 | 17 | | | | |

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Lat. 8° 57' 39" N.

Long. 79° 33' 29" W.

h=36 meters.

Lithologic foundation: Basalt.

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

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| Wood-Anderson | N - S | 0.74 | 1370 | 9 to 1 | Dec. 21, 1938 |
| Wood-Anderson | E - W | 0.76 | 2740 | 12 to 1 | " " " |
| Bosch-Omori | | Not Operating | | | |
| Bosch-Omori | | Not Operating | | | |

Month March, 1939

Page No. 6

| No. and Date | Phase | Time | Period | AMPLI- | REMARKS |
|---------------|---|--|--------|--------|------------------------------|
| | | G. M. T. | | TUDE | |
| | | h m s | | mm | |
| #30 Mar. 1 | | 3:27 to 3:31 | | | |
| #31 Mar. 3 | | 16:56 to 16:59 | | | |
| #32 Mar. 4 | ePNE eLN eLE CNE FNE | 17:16:32 17:16:39 17:16:36 17:16:46 17:19 | | | Close, Poorly defined quake. |
| #33 Mar. 4 | | 20:23 to 20:23 | | | |
| #34 Mar. 5 | | 15:15:39 to 15:26 | | | |
| #35 Mar. 8 | ePNE eLNE MN ME ON OE FNE | 5:55:36 5:56:21 5:56:26 5:56:31 5:56:46 5:56:43 6:00 | | | |

SEISMOLOGICAL RECORD AT BALBOA HEIGHTS, CANAL ZONE

Month March, 1939.

Page No. 7

| No. and Date | Phase | Time G. M. T. | | | Period s | AMPLI- TUDE mm | REMARKS |
|----------------|--|--|---|---|-------------|----------------------|--|
| | | h | m | s | | | |
| Mar. 9-10 | | Time Marker stopped between 17:40 GMT Mar. 9, and 19:15 GMT Mar. 10, 1939. | | | | | |
| #36 Mar. 10 | | 4:37 to 4:44 | | | | | Time Marker stopped - Beginning and ending given only to nearest minute. |
| #37 Mar. 12 | | 21:16 to 21:20 | | | | | |
| #38 Mar. 13 | 1PNE 1SNE LNE MN ME ONE FNE | 15:05:49 15:05:58 Indistinct 15:06:00 15:06:01 15:06:24 15:10 | | | | | Distance about 50 miles. Intensity III Modified Mercalli scale. Felt by local residents. |
| #39 Mar. 14 | ePNE eSNE LN LE MN ME ONE FNE | 12:58:38 12:59:18 12:59:50 12:59:49 12:59:52 13:00:01 13:00:06 13:05 | | | | | Distance about 225 miles. |
| #40 Mar. 14 | | 17:56 to 17:58 | | | | | |
| #41 Mar. 16 | ePNE eSN eSE LNE MN ME ON OE FNE | 6:08:06 6:08:35 6:08:34 6:09:00 6:09:03 6:09:07 6:09:08 6:09:11 6:12 | | | | | Distance about 165 miles. |

SEISMOLOGICAL RECORD AT BALBOA HEIGHTS, CANAL ZONE

Month March, 1939.

Page No. 8

| No. and Date | Phase | Time G. M. T. | | | Period s | AMPLI- TUDE mm | REMARKS |
|----------------|--|-------------------------|---|---|-------------|--------------------------|---------|
| | | h | m | s | | | |
| #42 Mar. 16 | ePNE | 10:31:18 | | | | Distance about 60 miles. | |
| | eSNE | 10:31:29 | | | | | |
| | LN | 10:31:39 | | | | | |
| | LE | 10:31:38 | | | | | |
| | MN | 10:31:40 | | | | | |
| | ME | 10:31:41 | | | | | |
| | CN | 10:31:44 | | | | | |
| | CE | 10:31:49 | | | | | |
| | FNE | 10:35 | | | | | |
| #43 Mar. 20 | | 12:59:58 to 13:10 | | | | Distant Quake. | |
| Mar. 21 | Instruments stopped between 13:45 and 20:54 GMT for maintenance & testing. | | | | | | |
| #44 Mar. 22 | | 18:21 to 18:23 | | | | | |
| Mar. 23 | Instruments stopped between 15:24 and 16:59 GMT. | | | | | | |
| #45 Mar. 23 | | 17:30 to 17:32 | | | | | |
| Mar. 23 | Instruments stopped between 18:10 and 19:25 GMT for testing. | | | | | | |

Newly determined Constants.

| Instrument | Component | T _c | V | h | Determined |
|---------------|-----------|----------------|------|--------|----------------|
| Wood-Anderson | N - S | 0.79 | 2740 | 7 to 1 | Mar. 23, 1939. |
| Wood-Anderson | E - W | 0.79 | 2740 | 6 to 1 | Mar. 23, 1939. |

SEISMOLOGICAL RECORD AT BALBOA HEIGHTS, CANAL ZONE

Month March, 1939.Page No. 9

| No. and Date | Phase | Time G. M. T. | | | Period s | AMPLI- TUDE mm | REMARKS |
|----------------|-------|----------------------|----|----|-------------|----------------------|---------------------------|
| | | h | m | s | | | |
| #46 Mar. 25 | ePNE | 3 | 24 | 06 | | | Distance about 135 miles. |
| | eSN | 3 | 24 | 33 | | | |
| | eSE | 3 | 24 | 30 | | | |
| | eLN | 3 | 24 | 48 | | | |
| | eLE | 3 | 24 | 49 | | | |
| | LN | 3 | 24 | 51 | | | |
| | ME | 3 | 24 | 52 | | | |
| | CNE | 3 | 25 | 03 | | | |
| FNE | 3 | 28 | | | | | |
| #47 Mar. 26 | ePNE | 17 | 48 | 50 | | | Distance about 45 miles. |
| | eSNE | 17 | 48 | 53 | | | |
| | FNE | 17 | 50 | | | | |
| #48 Mar. 29 | 1PNE | 11 | 25 | 11 | | | Distance about 90 miles. |
| | eSN | 11 | 25 | 27 | | | |
| | 1SE | 11 | 25 | 26 | | | |
| | LN | 11 | 25 | 29 | | 20mm. | |
| | ME | 11 | 25 | 32 | | 21mm. | |
| | CN | 11 | 26 | 07 | | | |
| | CE | 11 | 26 | 03 | | | |
| FNE | 11 | 30 | | | | | |
| #49 Mar. 30 | | 10:22 to 10:26 | | | | Confused Record. | |

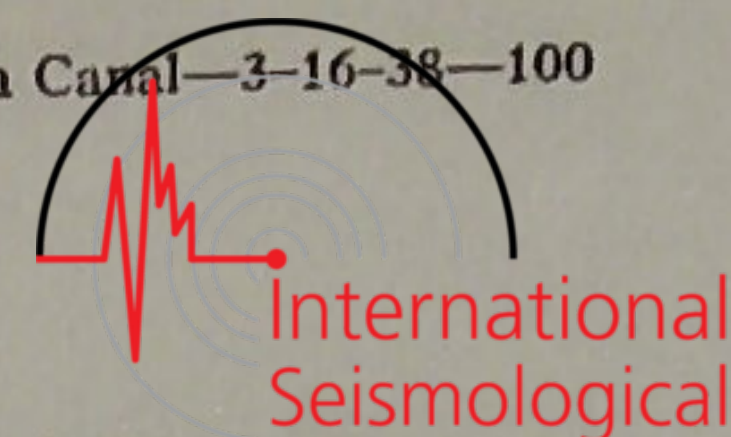
Errata

Jan. 1939, Page 1 - Under Determined Constants, the N - S constants should read $T_0 = 0.74$, $V = 1370$ and $h = 9$ to 1. The E - W constants should read $T_0 = 0.76$, $V = 2740$ and $h = 12$ to 1.

Feb. 1939, Page 3 - Under Determined Constants, the N - S constants should read $T_0 = 0.74$, $V = 1370$ and $h = 9$ to 1. The E - W constants should read $T_0 = 0.76$, $V = 2740$ and $h = 12$ to 1.

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International
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Centre

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Lat. 8° 57' 39" N.

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| Bosch-Omori | | | | | |

Month April 1939Page No. 10

| No. and Date | Phase | Time G. M. T. | | | Period | AMPLI- TUDE mm | REMARKS |
|-------------------|-------|------------------|----|----|--------|----------------------|--------------------------|
| | | h | m | s | | | |
| No. 50 April 1 | ePN | 7 | 03 | 49 | | | Distance about 105 miles |
| | 1PE | 7 | 03 | 48 | | | |
| | eSNE | 7 | 04 | 08 | | | |
| | MN | 7 | 04 | 09 | | 11 | |
| | ME | 7 | 04 | 10 | | 12 | |
| | CN | 7 | 04 | 27 | | | |
| | CE | 7 | 04 | 25 | | | |
| | FNE | 7 | 07 | | | | |
| No. 51 April 1 | | 17 | 12 | to | | | |
| | | 17 | 13 | | | | |
| No. 52 April 2 | ePNE | 5 | 18 | 49 | | | Distance about 210 miles |
| | eSN | 5 | 19 | 26 | | | |
| | eSE | 5 | 19 | 28 | | | |
| | LNE | 5 | 19 | 55 | | | |
| | MN | 5 | 20 | 01 | | 9 | |
| | ME | 5 | 20 | 03 | | 13 | |
| | CNE | 5 | 20 | 19 | | | |
| | FNE | 5 | 25 | | | | |
| No. 53 April 3 | | 17 | 45 | to | | | Very Confused |
| | | 17 | 47 | | | | |
| No. 54 April 5 | ePN | 2 | 24 | 18 | | | Distance about 110 miles |
| | ePE | 2 | 24 | 20 | | | |
| | eSN | 2 | 24 | 38 | | | |
| | eSE | 2 | 24 | 39 | | | |
| | LN | 2 | 24 | 59 | | | |
| | LE | 2 | 25 | 00 | | | |
| | MN | 2 | 25 | 06 | | 13 | |
| | ME | 2 | 25 | 08 | | 24 | |
| | CN | 2 | 25 | 28 | | | |
| | CE | 2 | 25 | 25 | | | |
| | FNE | 2 | 30 | | | | |

SEISMOLOGICAL RECORD AT BALBOA HEIGHTS, CANAL ZONE

Month April 1939Page No. 11

| No. and Date | Phase | Time G. M. T. | | | Period s | AMPLI- TUDE mm | REMARKS |
|--------------------|--|---|---|--------------|-------------|----------------------|--------------------------|
| | | h | m | s | | | |
| No. 55 April 6 | | 4: 58 | | to 5: 02 | | | Distant Activity |
| No. 56 April 6 | | 14: 41 | | to 14: 43 | | | |
| No. 57 April 7 | | 2: 07 | | to 2: 09 | | | |
| No. 58 April 7 | ePNE LN LE MN ME CNE FNE | 3: 09: 38 3: 10: 10 3: 10: 09 3: 10: 12 3: 10: 11 3: 10: 32 3: 13: | | | 5 5 | | Distance about 90 miles |
| April 8 - 9 | A faint seismic activity started at 23:35 GMT, April 8 and continued until 2:34 GMT, April 9 with an average period of 1.12 sec. | | | | | | |
| No. 59 April 9 | ePNE eSNE LNE MN ME CN CE FNE | 1: 18: 12 1: 18: 37 1: 18: 57 1: 19: 06 1: 19: 08 1: 19: 18 1: 19: 17 1: 22 | | | 6 6 | | Distance about 140 miles |
| No. 60 April 9 | ePNE LNE FNE | 13: 57: 35 13: 58: 20 14: 01 | | | | | Same source as No. 59 |
| No. 61 April 12 | ePNE eSNE LN LE MN ME CN CE FNE | 1: 16: 11 1: 16: 30 1: 16: 47 1: 16: 48 1: 16: 49 1: 16: 54 1: 17: 07 1: 17: 02 1: 21 | | | 4 6 | | Distance about 105 miles |

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Month April 1939Page No. 12

| No. and Date | Phase | Time G. M. T. | | | Period s | AMPLI- TUDE mm | REMARKS |
|--------------------|--|---|----|---|-------------|--|---------|
| | | h | m | s | | | |
| No. 62 April 12 | | 17: 27 | to | | | | |
| | | 17: 29 | | | | | |
| No. 63 April 14 | ePNE LN LE MN ME FNE | 1: 59: 00 1: 59: 23 1: 59: 24 1: 59: 29 1: 59: 25 1: 41: | | | 4 3 | | |
| No. 64 April 15 | ePNE ePR, NE iSNE eSR, N eSR, E LN LE FNE | 6: 29: 50 6: 31: 13 6: 35: 34 6: 38: 11 6: 38: 05 6: 42: 11 6: 41: 26 6: 49 | | | | Distance about 2560 miles Epicenter in Northern Chile | |
| No. 65 April 20 | | 17: 50 to 17: 53 | | | | | |
| No. 66 April 21 | | 10: 57 to 11: 00 | | | | | |
| No. 67 April 25 | iPNE eSN eSE MN ME CN CE FNE | 12: 58: 23 12: 58: 34 12: 58: 35 12: 58: 40 12: 58: 39 12: 59: 40 12: 59: 37 13: 12: | | | | Distance about 65 miles | |
| No. 68 April 25 | iPNE eSNE eLNE MN ME CNE FNE | 13: 16: 00 13: 16: 14 13: 16: 34 13: 16: 45 13: 16: 46 13: 18: 03 13: 23 | | | | Distance about 75 miles | |

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|--------------------|-------|------------------|----|--------------|-------------|----------------------|--|
| | | h | m | s | | | |
| No. 69 April 30 | | 3 | 16 | to 5: 30 | | | Very distant disturbance apparently of destructive nature |
| No. 70 April 30 | | 10 | 05 | to 10: 06 | | | |
| No. 71 April 30 | | 10 | 37 | to 10: 38 | | | |

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| Bosch-Omori) | | Not | operating | | |

Month May 1939

Page No. 14

| No. and Date | Phase | Time | Period | AMPLI- | REMARKS |
|---|-----------------------------------|--|--------|--------|--|
| | | G. M. T. | | TUDE | |
| | | h m s | | mm | |
| #72 May 1 | | 16:54 to 16:55 | | | |
| #73 May 1 | ePN eSN FNE | 17:14:59 17:15:32 17:19 | | | E-W trace very poorly defined Distance about 185 miles |
| #74 May 2 | | 2:19 to 2:21 | | | |
| #75 May 2 | ePNE eSNE MNE FNE | 13:23 13:28 13:38 14:12 | | | Distance about 2100 miles Poorly defined trace, only approximate time given (Cable reports quake in Gulf of Lower California) |
| No record from 13:28 GMT May 5 to 13:43 GMT May 6 | | | | | |
| #76 May 7 | | 19:16 to 19:18 | | | |
| #77 May 7 | | 21:14 to 21:17 | | | |
| #78 May 8 | ePNE eSNE LNE MNE FNE | 1:56:37 2:01:28 2:04:30 2:10:50 2:27 | | | Distance about 2100 miles |
| #79 May 8 | ePN ePS ISN eSE | 13:04:02 13:04:05 13:04:17 13:04:20 | | | Distance about 85 miles |

SEISMOLOGICAL RECORD AT BALBOA HEIGHTS, CANAL ZONE

Month _____

Page No. _____

| No. and Date | Phase | Time G. M. T. | | | Period s | AMPLI- TUDE mm | REMARKS |
|--------------------------|-------|------------------|---|---|-------------|----------------------|---|
| | | h | m | s | | | |
| #89 May 8 (cont'd) | 1LNE | 13:04:27 | | | | | |
| | MN | 13:04:50 | | | | | |
| | ME | 13:04:51 | | | | | |
| | CN | 13:05:27 | | | | | |
| | CE | 13:05:13 | | | | | |
| | FNE | 13:09 | | | | | |
| #80 May 8 | | 14:14 | | | | | |
| | | to | | | | | |
| | | 14:15 | | | | | |
| #81 May 9 | | 13:04:53 | | | | | |
| | | to | | | | | |
| | | 13:05:30 | | | | | |
| #82 May 9 | | 16:40:08 | | | | | |
| | | to | | | | | |
| | | 16:40:34 | | | | | |
| #83 May 10 | | 7:14:12 | | | | | Distant disturbance. Very faint activity showing at 8:08 probably maximum waves; end of disturbance undetermined. |
| | | | | | | | |
| #84 May 13 | | 3:27:31 | | | | | |
| | | to | | | | | |
| | | 3:28 | | | | | |
| #85 May 14 | | 1:01 | | | | | |
| | | to | | | | | |
| | | 1:02 | | | | | |
| #86 May 16 | | 2:24 | | | | | |
| | | to | | | | | |
| | | 2:30 | | | | | |
| #87 May 16 | ePNE | 4:10:34 | | | | | Distance about 245 miles |
| | eSNE | 4:11:37 | | | | | |
| | LNE | 4:12:05 | | | | | |
| | MN | 4:12:08 | | | 2.0 | | |
| | ME | 4:12:07 | | | 2.5 | | |
| | CN | 4:12:22 | | | | | |
| | CE | 4:12:24 | | | | | |
| | FNE | 4:15 | | | | | |
| #88 May 17 | 1PNE | 10:01:38 | | | | | Distance about 65 miles |
| | eSN | 10:01:51 | | | | | |
| | eSE | 10:01:49 | | | | | |
| | LN | 10:02:02 | | | | | |
| | LE | 10:02:01 | | | | | |

SEISMOLOGICAL RECORD AT BALBOA HEIGHTS, CANAL ZONE

Month May 1939Page No. 16

| No. and Date | Phase | Time G. M. T. | | | Period s | AMPLI- TUDE mm | REMARKS |
|---------------------------|---------------------------------|--|---|---|-------------|----------------------|-------------------------|
| | | h | m | s | | | |
| #88 May 17 (cont'd) | MN ME ONE FNE | 12:02:14 10:02:16 10:03:12 10:08 | | | | 29 17 | |
| #89 May 17 | | 10:05:52 to 10:08 | | | | | |
| #90 May 18 | | 5:36:52 to 5:09 | | | | | |
| #91 May 18 | EPNE MNE FNE | 13:04:55 13:05:48 13:08 | | | | | |
| #92 May 18 | | 15:19 to 15:20 | | | | | |
| #93 May 18 | ePNE eSNE MN ME FNE | 16:35:53 16:35:58 16:36:02 16:36:00 16:36:26 | | | | | Distance about 25 miles |
| #94 May 19 | | 3:49:24 to 3:50 | | | | | |
| #95 May 19 | ePN ePE MN ME FNE | 13:09:16 13:09:15 13:09:19 13:09:18 13:10:30 | | | | | |
| #96 May 19 | | 18:31 to 18:36 | | | | | |
| #97 May 19 | ePNE MN ME FNE | 20:18:34 20:18:39 20:18:41 20:19:10 | | | | | |
| #98 May 19 | | 23:09:48 to 23:12 | | | | | |

SEISMOLOGICAL RECORD AT BALBOA HEIGHTS, CANAL ZONE

Month May 1939

Page No. 17

| No. and Date | Phase | Time G. M. T. | | | Period s | AMPLI- TUDE mm | REMARKS |
|----------------|-------|------------------|---|---|-------------|----------------------|---------------------------------------|
| | | h | m | s | | | |
| #99 May 20 | | 3:09:11 | | | | | |
| | | to | | | | | |
| | | 3:10 | | | | | |
| #100 May 21 | | 2:45:43 | | | | | |
| | | to | | | | | |
| | | 2:44:20 | | | | | |
| #101 May 24 | | 3:07:24 | | | | | |
| | | to | | | | | |
| | | 5:08 | | | | | |
| #102 May 25 | | 3:06:43 | | | | | |
| | | to | | | | | |
| | | 3:07:20 | | | | | |
| May 25 | | 21:29 | | | | | Sharp, apparently dynamite explosion. |
| | | to | | | | | |
| | | 21:30 | | | | | |
| #103 May 26 | | 3:31:57 | | | | | |
| | | to | | | | | |
| | | 3:32:20 | | | | | |
| #104 May 27 | | 4:05:19 | | | | | |
| | | to | | | | | |
| | | 4:09 | | | | | |
| #105 May 27 | | 16:22 | | | | | |
| | | to | | | | | |
| | | 16:22:30 | | | | | |
| #106 May 28 | 1PNE | 2:33:02 | | | | | Distance 180 miles |
| | 1SN | 2:33:33 | | | | | |
| | 1SE | 2:33:32 | | | | | |
| | eLNE | 2:34:59 | | | | | |
| | MNE | 2:34:01 | | | | | |
| | CNE | 2:34:49 | | | | | |
| | FNE | 2:36:00 | | | | | |
| #107 May 28 | ePNE | 2:35:19 | | | | | Distance about 580 miles |
| | eSNE | 2:36:59 | | | | | |
| | MNE | 2:39:19 | | | | | |
| | FNE | 2:45:00 | | | | | |

SEISMOLOGICAL RECORD AT BALBOA HEIGHTS, CANAL ZONE

Month May 1939Page No. 18

| No. and Date | Phase | Time G. M. T. | | | Period s | AMPLI- TUDE mm | REMARKS |
|----------------|-------|------------------|----|----|-------------|----------------------|--------------------------|
| | | h | m | s | | | |
| #108 May 28 | 1PNE | 11 | 27 | 04 | | | Distance about 160 miles |
| | 1PE | 11 | 27 | 05 | | | |
| | 1SN | 11 | 27 | 32 | | | |
| | 1SE | 11 | 27 | 35 | | | |
| | 1LN | 11 | 27 | 56 | | | |
| | 1LE | 11 | 28 | 02 | | | |
| | MN | 11 | 28 | 20 | | | |
| | ME | 11 | 28 | 13 | | | |
| | CN | 11 | 29 | 08 | | | |
| | CE | 11 | 28 | 53 | | | |
| FNE | 11 | 31 | 00 | | | | |

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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 | N-S | 0.79 | 2740 | 7 to 1 | Mar. 23, 1939 |
| Wood-Anderson | E-W | 0.79 | 2740 | 6 to 1 | " " " |
| Bosch-Omori) | | Not - Operating. | | | |
| Bosch-Omori) | | | | | |

Month June 1939

Page No. 19

| No. and Date | Phase | Time G. M. T. | | | Period | AMPLI- TUDE mm | REMARKS |
|-----------------|-------|------------------|-------|---|--------|----------------------|---------------|
| | | h | m | s | | | |
| # 109 June 1 | | 13 | 56:48 | | | | |
| | | | to | | | | |
| | | 13 | 59 | | | | |
| # 110 June 2 | | 3 | 53:12 | | | | |
| | | | to | | | | |
| | | 3 | 57 | | | | Very Confused |
| # 111 June 2 | | 3 | 57:42 | | | | |
| | | | to | | | | |
| | | 3 | 58 | | | | |
| # 112 June 2 | | 22 | 42:12 | | | | |
| | | | to | | | | |
| | | 22 | 44 | | | | |
| # 113 June 3 | | 1 | 38:33 | | | | |
| | | | to | | | | |
| | | 1 | 41 | | | | |
| # 114 June 3 | | 4 | 09:34 | | | | |
| | | | to | | | | |
| | | 4 | 14 | | | | |
| # 115 June 3 | | 9 | 54:14 | | | | |
| | | | to | | | | |
| | | 9 | 58 | | | | |
| # 116 June 5 | | 8 | 36:44 | | | | |
| | | | to | | | | |
| | | 8 | 37:32 | | | | |

SEISMOLOGICAL RECORD AT BALBOA HEIGHTS, CANAL ZONE

Month June 1939Page No. 20

| No. and Date | Phase | Time G. M. T. | | | Period s | AMPLI- TUDE mm | REMARKS |
|------------------|--|------------------|----------------|--|-------------|----------------------|---|
| | | h | m | s | | | |
| # 117 June 7 | ePNE e SN e SE * LN * LE MN ME CNE FNE | 6: | 03: | 28 35 36 46 43 58 00 31 00 | | | Distance about 40 miles. |
| # 118 June 7 | ePNE eSN eSE *LNE MNE CNE FNE | 22: | 19: | 00 19 18 50 58 56 00 | | | Distance about 110 miles. |
| # 119 June 8 | | 21: | 10 to 14 | | | | Maximum phase of apparently distant disturbance. Preliminary determination of epicenter places it at Lat 15°S, Long 175°W, Depth 100Km. |
| # 120 June 8 | | 24: | 20 to 22 | | | | Same as above. |
| # 121 June 9 | | 00: | 55 to 58 | | | | Same as above. |
| # 122 June 9 | | 19: | 28 to 30 | | | | |
| # 123 June 10 | iPNE eSNE LNE MNE CNE FNE | 2: | 34: | 10 25 43 53 03 38 | | | Distance about 85 miles. |

SEISMOLOGICAL RECORD AT BALBOA HEIGHTS, CANAL ZONE

Month June 1939Page No. 21

| No. and Date | Phase | Time G. M. T. | Period | AMPLI- TUDE | REMARKS |
|----------------------|-------|--|---------|----------------|----------------------------|
| # 124 June 12 | i FN | 4 ^h 09 ^m 22 ^s | s | mm | Distance about 1100.miles. |
| | e PE | 4: 09: 21 | | | |
| | e N | 4: 10: 01 | | | |
| | e E | 4: 10: 13 | | | |
| | e SN | 4: 12: 24 | | | |
| | e SE | 4: 12: 25 | | | |
| | LN | Obscured | | | |
| | LE | Obscured | | | |
| | MN | 4: 15: 13 | | | |
| | ME | 4: 15: 05 | | | |
| | FNE | 4: 21 | | | |
| # 125 June 13 | e FN | 5: 38: 20 | | | Distance about 85 miles. |
| | e PE | 5: 38: 19 | | | |
| | eSNE | 5: 38: 35 | | | |
| | LN | 5: 38: 46 | | | |
| | LE | 5: 38: 44 | | | |
| | MN | 5: 38: 52 | | 2.0 | |
| | ME | 5: 38: 49 | | 2.5 | |
| | CNE | 5: 39: 03 | | | |
| | FNE | 5: 41 | | | |
| # 126 June 13 | ePNE | 13: 59: 26 | | | Distance about 115 miles |
| | eSN | 13: 59: 45 | | | |
| | eSE | 13: 59: 48 | | | |
| | LN | 13: 59: 59 | | | |
| | LE | 14: 00: 01 | | | |
| | MN | 14: 00: 12 | | 2.5 | |
| | ME | 14: 00: 18 | | 3.0 | |
| | CN | 14: 00: 29 | | | |
| | CE | 14: 00: 31 | | | |
| | FNE | 14: 03 | | | |
| # 127 June 14 | ePNE | 17: 53: 30 | | | Distance about 65 miles. |
| | eSNE | 17: 53: 42 | | | |
| | LNE | 17: 53: 50 | | | |
| | MNE | 17: 53: 51 | | 2.0 | |
| | CNE | 17: 53: 58 | | | |
| | | FNE | 17: 56: | | |
| # 128 June 15 | ePNE | 5: 25: 03 | | | Distance about 115 miles. |
| | eSN | 5: 25: 23 | | | |
| | eSE | 5: 25: 22 | | | |
| | LNE | 5: 25: 44 | | | |
| | MN | 5: 25: 47 | | 2.5 | |
| | ME | 5: 25: 50 | | 2.0 | |
| | CN | 5: 25: 53 | | | |
| | CE | 5: 25: 55 | | | |
| | FNE | 5: 25 8 | | | |

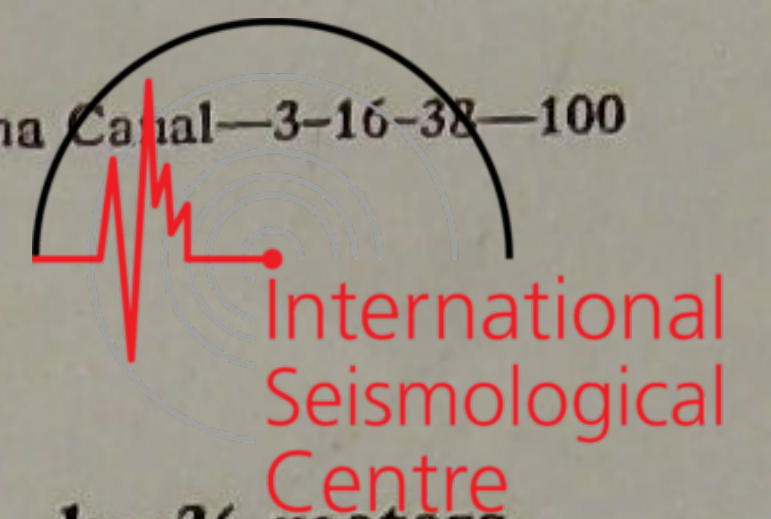
SEISMOLOGICAL RECORD AT BALBOA HEIGHTS, CANAL ZONE

Month June 1939Page No. 22

| No. and Date | Phase | Time G. M. T. | | | Period s | AMPLI- TUDE mm | REMARKS |
|------------------|--|------------------|--------------------|----------------------------------|-------------|----------------------|---------------------------|
| | | h | m | s | | | |
| # 129 June 18 | | 16 | 47 | 24 to 17: 08 | | | Light weak - phases lost. |
| # 130 June 18 | | 20 | 36 | 46 to 20: 45 | | | Light weak - phases lost. |
| # 131 June 24 | ePNE eSNE LNE MNE CNE FNE | 10 | 52 | 07 58 34 35 48 57 | | | Distance about 290 miles. |
| # 132 June 25 | ePNE eSNE LNE MNE FNE | 2 | 12 | 14 26 36 38 14 | | | Distance about 65 miles. |
| # 133 June 27 | | 23 | 24 to 23: 29 | | | | |

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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 ₀ | V | h | DETERMINED |
|---------------|-----------|----------------|------|--------|---------------|
| Wood-Anderson | N-S | 0.79 | 2740 | 7 to 1 | Mar. 23, 1939 |
| Wood-Anderson | E-W | 0.79 | 2740 | 6 to 1 | Mar. 23, 1939 |
| Bosch-Omori) | | Not Operating | | | |
| Bosch-Omori) | | | | | |

Month July 1939Page No. 23

| No. and Date | Phase | Time G. M. T. | | | Period | AMPLI- TUDE mm | REMARKS |
|----------------|---------|------------------|-----|----|--------|----------------------|---|
| | | h | m | s | | | |
| #154 July 1 | P N E | 15: | 33: | 26 | | | Distance about 95 miles |
| | i S N E | 15: | 33: | 43 | | | |
| | L N E | 15: | 33: | 49 | | | |
| | M N | 15: | 33: | 57 | | | |
| | M E | 15: | 33: | 55 | | | |
| | C N | 15: | 34: | 33 | | | |
| | C E | 15: | 34: | 28 | | | |
| | F N E | 15: | 37 | | | | |
| #155 July 2 | | 15: | 53: | 03 | | | |
| | | to | | | | | |
| | | 15: | 56: | 00 | | | |
| #156 July 4 | | 18: | 33: | 32 | | | TREMOR from distant disturbance. Provisional epicenter by U.S.C.G.S. 23°S 67°W, Time of origin 18h 26.3m. |
| | | to | | | | | |
| | | 19: | 00 | | | | |
| #157 July 4 | | 21: | 05: | 43 | | | |
| | | to | | | | | |
| | | 21: | 07 | | | | |
| #158 July 8 | | 21: | 34 | | | | |
| | | to | | | | | |
| | | 21: | 41 | | | | |

SEISMOLOGICAL RECORD AT BALBOA HEIGHTS, CANAL ZONE

Month July 1939Page No. 24

| No. and Date | Phase | Time G. M. T. | | | Period s | AMPLI- TUDE mm | REMARKS |
|-----------------|--|--------------------------|-----|----|-------------|----------------------|---------|
| | | h | m | s | | | |
| #139 July 18 | | 6: | 00: | 12 | | | |
| | | | to | | | | |
| | | 6: | 01: | 30 | | | |
| #140 July 19 | | 12: | 55: | 39 | | | |
| | | | to | | | | |
| | | 12: | 57 | | | | |
| #141 July 20 | | 19: | 41 | | | | |
| | | | to | | | | |
| | | 19: | 42 | | | | |
| #142 July 21 | | 22: | 58: | 53 | | | |
| | | | to | | | | |
| | | 23: | 02 | | | | |
| #143 July 22 | <ul style="list-style-type: none"> • P N • P E • S N • S E LN LE M N E C N C E F N E | 17: | 18: | 24 | | | |
| | | 17: | 18: | 26 | | | |
| | | 17: | 18: | 55 | | | |
| | | 17: | 18: | 56 | | | |
| | | 17: | 19: | 29 | | | |
| | | 17: | 19: | 28 | (N-S | 10.0 | |
| | | 17: | 19: | 35 | (E-W | 14.0 | |
| | | 17: | 20: | 01 | | | |
| | | 17: | 20: | 00 | | | |
| | | 17: | 24 | | | | |
| | | Distance about 175 miles | | | | | |
| #144 July 24 | | 2: | 15: | 43 | | | |
| | | | to | | | | |
| | | 2: | 17 | | | | |
| #145 July 24 | | 3: | 50: | 56 | | | |
| | | | to | | | | |
| | | 3: | 55 | | | | |
| #146 July 23 | | 3: | 05: | 42 | | | |
| | | | to | | | | |
| | | 3: | 08 | | | | |

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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

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

INSTRUMENTS—DETERMINED CONSTANTS

| INSTRUMENTS | COMPONENT | T. | V. | h | DETERMINED |
|---------------|----------------------|------|------|--------|---------------|
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| Wood-Anderson | E - W | 0.79 | 2740 | 6 to 1 | Mar. 23, 1939 |
| Bosch-Omori) | ----- Not Operating. | | | | |
| Bosch-Omori) | | | | | |

Month AUGUST, 1939.Page No. 25

| No. and Date | Phase | Time G. M. T. | | | Period | AMPLI- TUDE mm | REMARKS |
|------------------|--|------------------|------|--|--------|----------------------|--|
| | | h | m | s | | | |
| #147 August 1 | | 1 | : 25 | | | | Principal phase of distant disturbance |
| | | | to | | | | |
| | | 1 | : 31 | | | | |
| #148 Aug. 8 | e P N E e S N E L N L E M N M E C N E F N E | 16 | : 46 | : 05 : 23 : 37 : 39 : 47 : 53 : 01 : 49 | | | Distance about 100 miles |
| # 149 Aug. 13 | | 8 | : 14 | : 40 to : 17 | | | |
| #150 Aug. 15 | | 3 | : 55 | : 46 to : 58 | | | |
| #151 Aug. 16 | e P N E e S N E L N E M N E F N E | 7 | : 09 | : 56 : 34 : 00 : 00 : 00 | | | Approximate distance about 950 miles |
| #152 Aug. 18 | | 3 | : 06 | to : 09 | | | |
| #153 Aug. 18 | e P N E e S N E M N M E C N E F N E | 4 | : 18 | : 44 : 55 : 07 B l u r r e d : 34 : 00 | | | Approximate distance about 60 miles. |

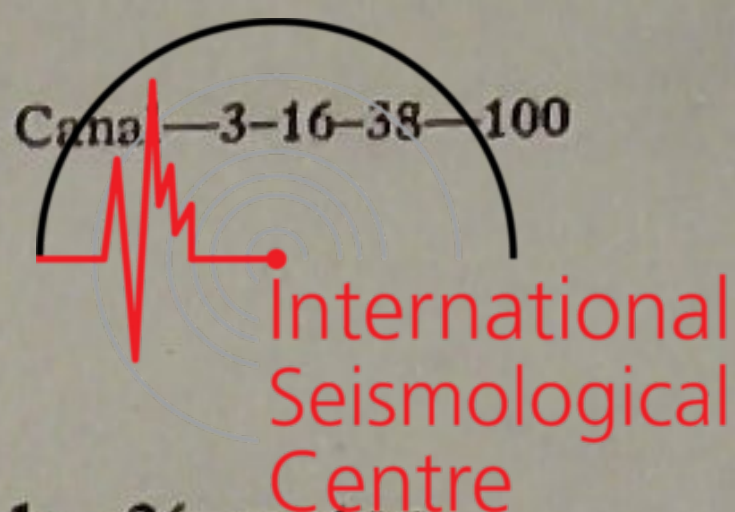
SEISMOLOGICAL RECORD AT BALBOA HEIGHTS, CANAL ZONE

Month August, 1939.Page No. 26

| No. and Date | Phase | Time G. M. T. | | | Period s | AMPLI- TUDE mm | REMARKS |
|--------------------------|--|----------------------------|------|------|-------------|----------------------|---------------------------------------|
| | | h | m | s | | | |
| #154 | P N E | 20 | 50 | 43 | | | |
| | S N E | 20 | 51 | 26 | | | |
| Aug. 18 | L N | 20 | 51 | 32 | | | |
| | L E | 20 | 51 | 34 | | | |
| | M N E | 20 | 51 | 49 | | | Approximate distance about 245 miles. |
| | C N E | 20 | 52 | 23 | | | |
| | F N E | 20 | 56 | 00 | | | |
| # 155 | | 22 | 03 | | | | |
| | | | to | | | | |
| Aug. 19 | | 22 | 07 | | | | Confused due to passage of train. |
| Aug. 23 to Aug. 24 | Both components were out of operation for one hour 19 minutes at 19 : 46 G.M.T. for maintenance. N - S component was out of operation till 20:19 G.M.T. on Aug. 24. A new suspension wire was installed on the N - S component. New constants were determined for both components. | | | | | | |
| | | Newly Determined Constants | | | | | |
| | Instrument | Component | To | V | h | Determined | |
| | Wood-Anderson | N - S | 0.80 | 2740 | 8 to 1 | Aug. 24, 1939 | |
| | Wood-Anderson | E - W | 0.80 | 2740 | 12 to 1 | Aug. 24, 1939 | |
| #156 | | 11 | 05 | 33 | | | |
| | | | to | | | | |
| Aug. 27 | | 11 | 06 | 30 | | | |
| #157 | | 4 | 33 | 23 | | | |
| | | | to | | | | |
| Aug. 29 | | 4 | 34 | | | | |

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SEISMOLOGICAL RECORD AT BALBOA HEIGHTS, CANAL ZONE

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|---------------|----------------|----------------|------|---------|-----------------|
| Wood-Anderson | N - S | 0.80 | 2740 | 8 to 1 | August 24, 1939 |
| Wood-Anderson | E - W | 0.80 | 2740 | 12 to 1 | August 24, 1939 |
| Bosch-Omori | Not operating. | | | | |
| Bosch-Omori | | | | | |

Month SEPTEMBER 1939Page No. 27

| No. and Date | Phase | Time G. M. T. | Period | AMPLI- TUDE mm | REMARKS |
|------------------|---|--|--------|----------------------|--|
| #158 Sept. 8 | | 7 ^h : 52 ^m : 42 ^s to 7 : 54 | | | |
| #159 Sept. 8 | e P N E e S N E F N E | 12 : 18 : 03 12 : 28 : 24 13 : 19 | | | P and S well defined. Distance about 5800 miles. |
| #160 Sept. 9 | 1 P N E 1 S N E L N E M N M E C N E F N E | 13 : 21 : 08 13 : 21 : 16 13 : 21 : 17 13 : 21 : 18 Blurred 13 : 21 : 49 13 : 23 | | 55+ | Sharp. Distance about 45 miles. Felt by few local residents. Intensity II. |
| #161 Sept. 11 | | 11 : 08 : 16 to 11 : 09 : 06 | | | |
| #162 Sept. 11 | | 13 : 36 : 29 to 13 : 37 : 12 | | | |
| #163 Sept. 16 | | 1 : 48 to 1 : 55 | | | Faint Trace. |
| #164 Sept. 16 | | 7 : 36 to 7 : 40 | | | Faint Trace. |
| #165 Sept. 17 | e P N E e S N e S E M N F N E | 20 : 59 : 29 20 : 59 : 44 20 : 59 : 43 20 : 59 : 48 21 : 01 | | | Distance about 85 miles. |

SEISMOLOGICAL RECORD AT BALBOA HEIGHTS, CANAL ZONE

Month SEPTEMBER 1939Page No. 28

| No. and Date | Phase | Time G. M. T. | | | Period s | AMPLI- TUDE mm | REMARKS |
|------------------|---|---|----|--|-------------|----------------------|---------------------------|
| | | h | m | s | | | |
| #166 Sept. 18 | | 19 | 17 | 09 to 24 | | | |
| #167 Sept. 19 | | 23 | 08 | 12 to 12 | | | |
| #168 Sept. 20 | | 6 | 58 | 01 to 06 | | | |
| #169 Sept. 21 | <ul style="list-style-type: none"> • P N E • S N E L N E M N M E C N C E F N E | 11 | 37 | 53 06 13 18 15 21 35 40 | | | Distance about 70 miles. |
| #170 Sept. 23 | | Faint principal phases of distant disturbance evident at 17 : 48 and 17 : 52 | | | | | |
| #171 Sept. 23 | | 19 | 21 | to 25 | | | |
| #172 Sept. 26 | <ul style="list-style-type: none"> 1 P N E 1 S N E L N L E M N M E C N C E F N E | 12 | 54 | 56 16 28 26 45 40 50 56 02 | | 15.8 15.0 | Distance about 110 miles. |
| #173 Sept. 26 | | 17 | 38 | to 40 | | | |
| #174 Sept. 27 | | 23 | 16 | 13 to 19 | | | |
| #175 Sept. 28 | | 15 | 01 | 31 to 11 | | | Faint tremors. |

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 | N - S | 0.80 | 2740 | 8 to 1 | August 24, 1939 |
| Wood-Anderson | E - W | 0.80 | 2740 | 12 to 1 | August 24, 1939 |
| Bosch-Omori) | Not | operating. | | | |
| Bosch-Omori) | | | | | |

Month OCTOBER 1939

Page No. 29

| No. and Date | Phase | Time G. M. T. | | | Period | AMPLI- TUDE mm | REMARKS |
|-----------------|---------|------------------|----|----|--------------------|----------------------|---------------------------|
| | | h | m | s | | | |
| #176 Oct. 5 | | 3 | 06 | 03 | | | |
| | | | to | | | | |
| | | 3 | 09 | | | | |
| #177 Oct. 5 | | 8 | 05 | | | | |
| | | | to | | | | |
| | | 8 | 08 | | | | |
| #178 Oct. 7 | e P N E | 11 | 39 | 09 | | | Distance about 135 miles. |
| | e S N | 11 | 39 | 34 | | | |
| | e S E | 11 | 39 | 33 | | | |
| | L N | 11 | 39 | 49 | | | |
| | L E | 11 | 39 | 47 | | | |
| | C N | 11 | 40 | 01 | | | |
| | C E | 11 | 40 | 03 | | | |
| | F N E | 11 | 43 | | | | |
| #179 Oct. 7 | | 21 | 03 | | | | |
| | | | to | | | | |
| | | 21 | 06 | | | | |
| #180 Oct. 8 | | 15 | 52 | | | | |
| | | | to | | | | |
| | | 15 | 54 | | | | |
| #181 Oct. 10 | i P N E | 21 | 42 | 48 | | | Distance about 45 miles |
| | e S N E | 21 | 42 | 56 | | | |
| | L N E | 21 | 42 | 57 | | | |
| | M N E | 21 | 42 | 58 | --{ N - S E - W | 13.3 7.0 | |
| | C N | 21 | 43 | 25 | | | |
| | C E | 21 | 43 | 22 | | | |
| | F N E | 21 | 44 | | | | |

SEISMOLOGICAL RECORD AT BALBOA HEIGHTS, CANAL ZONE

Month OCTOBER, 1939Page No. 30

| No. and Date | Phase | Time G. M. T. | | | Period s | AMPLI- TUDE mm | REMARKS |
|-----------------|---------|------------------|----|----|-------------|----------------------|---|
| | | h | m | s | | | |
| #182 Oct. 13 | i P N E | 15 | 23 | 28 | | 44.5 30.0 | Distance about 55 miles. Intensity I Modified Mercalli Scale. |
| | i S N E | 15 | 23 | 38 | | | |
| | L N E | 15 | 23 | 40 | | | |
| | M N | 15 | 23 | 43 | | | |
| | M E | 15 | 23 | 45 | | | |
| | C N E | 15 | 24 | 27 | | | |
| | F N E | 15 | 26 | | | | |
| #183 Oct. 14 | i P N E | 13 | 47 | 10 | | 51+ 41 | Distance about 95 miles Intensity II Modified Mercalli Scale |
| | i S N | 13 | 47 | 26 | | | |
| | i S E | 13 | 47 | 27 | | | |
| | L N | 13 | 47 | 40 | | | |
| | L E | 13 | 47 | 43 | | | |
| | M N | 13 | 47 | 47 | | | |
| | M E | 13 | 47 | 46 | | | |
| | C N | 13 | 48 | 28 | | | |
| | C E | 13 | 48 | 23 | | | |
| F N E | 13 | 54 | | | | | |
| #184 Oct. 15 | e P N | 11 | 03 | 40 | | | Distance about 115 miles. |
| | e P E | 11 | 03 | 41 | | | |
| | e S N | 11 | 04 | 01 | | | |
| | e S E | 11 | 04 | 02 | | | |
| | L N E | 11 | 04 | 19 | | | |
| | M N | 11 | 04 | 33 | | | |
| | M E | 11 | 04 | 40 | | | |
| | C N E | 11 | 04 | 43 | | | |
| F N E | 11 | 08 | | | | | |
| #185 Oct. 17 | | 6 | 41 | | | | Very faint traces of distant disturbance |
| | | 7 | 06 | | | | |
| #186 Oct. 19 | i P N E | 13 | 55 | 21 | | 34 | Distance about 25 miles |
| | i S N | 13 | 55 | 26 | | | |
| | i S E | 13 | 55 | 25 | | | |
| | L N | 13 | 55 | 29 | | | |
| | L E | 13 | 55 | 28 | | | |
| | M N | 13 | 55 | 30 | | | |
| | M E | Indistinct | | | | | |
| | C N E | 13 | 55 | 48 | | | |
| F N E | 13 | 58 | | | | | |

SEISMOLOGICAL RECORD AT BALBOA HEIGHTS, CANAL ZONE

Month OCTOBER, 1939

Page No. 31

| No. and Date | Phase | Time G. M. T. | | | Period s | AMPLI- TUDE mm | REMARKS |
|-----------------|--|------------------|----|--|-------------|----------------------|--|
| | | h | m | s | | | |
| #187 Oct. 20 | 1 P N E 1 S N L N M N C N F N E | 20 | 06 | 58 20 35 48 08 30 | | 76 | E - W Trace lost due to poor developing Distance about 120 miles. Intensity IV Modified Mercalli Scale. Widely felt but no damage reported. |
| #188 Oct. 21 | 1 P N E 1 S N E L N E M N M E C N C E F N E | 23 | 30 | 54 07 18 20 23 35 37 33 | | 5 5 | Distance about 75 miles. |
| #189 Oct. 27 | | 21 | 12 | to 21:24 | | | |
| #190 Oct 28 | | 19 | 07 | 37 to 19 : 10 | | | |
| #191 Oct. 29 | | 19 | 49 | 04 to 19 : 52 | | | |
| #192 Oct. 31 | P N E M N M E F N E | 16 | 22 | 05 30 31 24 | | 5 5 | |

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

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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 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. |

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| INSTRUMENTS | COMPONENT | T ₀ | V | h | DETERMINED |
|---------------|-----------|----------------|------|---------|-----------------|
| Wood-Anderson | N - S | 0.80 | 2740 | 8 to 1 | August 24, 1939 |
| Wood-Anderson | E - W | 0.80 | 2740 | 12 to 1 | August 24, 1939 |
| Bosch-Omori | Not | operating. | | | |
| Bosch-Omori | | | | | |

Month ~~NOVEMBER~~ 1939

Page No. 32

| No. and Date | Phase | Time G. M. T. | | | Period | AMPLI- TUDE mm | REMARKS |
|-----------------|--|---|----|---|--------------|---|---------|
| | | h | m | s | | | |
| #193 Nov. 2 | | 4 | 28 | | | | |
| | | | to | | | | |
| | | 4 | 30 | | | | |
| #194 Nov. 7 | | 15 | 46 | | | | |
| | | | to | | | | |
| | | 15 | 52 | | | | |
| #195 Nov. 7 | | 15 | 57 | | | | |
| | | | to | | | | |
| | | 16 | 00 | | | | |
| #196 Nov. 10 | P N E M N M E F N E | 9 : 51 : 27 9 : 51 : 53 9 : 51 : 55 9 : 54 | | | 3.5 3.0 | | |
| #197 Nov. 13 | P N E S N E | 7 : 55 : 12 8 : 02 : 33 | | | | Only P & S waves appear. Distance about 3200 miles. | |
| #198 Nov. 14 | P N E S N E L N L E M N M E C N E F N E | 1 : 49 : 29 1 : 49 : 42 1 : 49 : 52 1 : 49 : 51 1 : 49 : 56 1 : 50 : 03 1 : 50 : 48 1 : 54 | | | 48.0 28.0 | Distance about 75 miles. Intensity II Modified Mercalli Scale. | |
| #199 Nov. 14 | | 21 : 00 to 21 : 03 | | | | | |
| #200 Nov. 16 | P N P E M N M E C N E F N E | 1 : 14 : 06 1 : 14 : 09 1 : 14 : 57 1 : 14 : 51 1 : 14 : 22 1 : 18 | | | 5 4 | | |

SEISMOLOGICAL RECORD AT BALBOA HEIGHTS, CANAL ZONE

Month ~~NOVEMBER~~ 1939

Page No. 33

| No. and Date | Phase | Time G. M. T. | | | Period s | AMPLI- TUDE mm | REMARKS |
|-----------------|---|------------------|----|---|-------------|----------------------|---|
| | | h | m | s | | | |
| #201 Nov. 20 | | 18 | 57 | 48 to 19 : 00 | | | |
| #202 Nov. 24 | P N E M N M E F N E | 18 | 28 | 00 52 54 31 | | 2.5 3.0 | |
| #203 Nov. 28 | P N E S N E L N L E M N M E C N C E F N E | 2 | 10 | 22 33 40 41 30 32 06 43 Confused by aftershock. | | 60+ 53 | Distance about 65 miles Intensity III - IV Modified Mercalli Scale. Generally felt throughout Isthmus of Panama. |
| #204 Nov. 28 | e P N E e S N E L N E M N M E C N E F N E | 2 | 17 | 22 33 41 43 44 05 20 | | | Distance about 65 miles After shock to No. 203 |

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.

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Time Correction: Within 1.0 sec.

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| INSTRUMENTS | COMPONENT | T. | V | h | DETERMINED |
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| Wood-Anderson | E-W | 0.80 | 2740 | 12 to 1 | August 24, 1939 |
| Bosch-Omori | | | | | |
| Bosch-Omori | | | | | |

Month December 1939

Page No. 34

| No. and Date | Phase | Time G. M. T. | | | Period | AMPLI- TUDE mm | REMARKS |
|------------------|-------|------------------|---|---|--------|--------------------------|---|
| | | h | m | s | | | |
| # 205 Dec. 2 | | 11:57 | | | | | Distance about 85 miles |
| | | to | | | | | |
| | | 12:03 | | | | | |
| # 206 Dec. 2 | | 13:16 | | | | | Distance about 85 miles |
| | | to | | | | | |
| | | 13:21 | | | | | |
| # 207 Dec. 2 | | 21:42:23 | | | | | |
| | | to | | | | | |
| | | 21:45 | | | | | |
| # 208 Dec. 5 | eFN | 8:33:07 | | | | | Distance about 1000 miles C. & G.S. Epicenter 14.5 N. Lat., 92.5 W. Long (in Guatemala) |
| | eSN | 8:35:49 | | | | | |
| | LN | 8:38:19 | | | | | |
| | MN | 8:41:00 | | | | | |
| | FN | 9:15 | | | | | |
| # 209 Dec. 6 | | 18:28:53 | | | | | |
| | | to | | | | | |
| | | 18:30 | | | | | |
| # 210 Dec. 8 | | 22:56 | | | | | |
| | | to | | | | | |
| | | 22:59 | | | | | |
| # 211 Dec. 18 | | 5:38 | | | | | |
| | | to | | | | | |
| | | 5:40 | | | | | |
| # 212 Dec. 19 | | 19:51:32 | | | | | Distance about 780 miles. |
| | | to | | | | | |
| | | 19:59 | | | | | |

SEISMOLOGICAL RECORD AT BALBOA HEIGHTS, CANAL ZONE

Month December 1939Page No. 35

| No. and Date | Phase | Time G. M. T. | | | Period s | AMPLI- TUDE mm | REMARKS |
|------------------|--|--|---|---|-------------|----------------------|--|
| | | h | m | s | | | |
| # 213 Dec. 21 | i PNE e SN e SE LNE MN ME ONE PNE | 20:56:09 20:57:15 20:57:17 20:57:24 20:57:52 20:58:2 21:01:00 23:30 | | | | 55.0 57.0 | Distance about 375 miles. Minor Quake, aftershock, Superposed. Beginning at 21:20:23 |
| # 214 Dec. 22 | | 3:56 to 3:58 | | | | | |
| # 215 Dec. 22 | i PNE e SNE LNE MN ME ONE PNE | 4:45:19 4:46:17 4:46:30 4:47:16 Blurred 4:50:50 6:15 | | | | 63.0 | Distance about 375 miles. Slight tremors superposed Beginning at 5:10:49 — |
| # 216 Dec. 22 | | 11:20 to 11:24 | | | | | |
| # 217 Dec. 22 | | 11:41 to 11:45 | | | | | |
| # 218 Dec. 23 | | 1:35 to 1:41 | | | | | |
| # 219 Dec. 23 | | 4:24 to 4:28 | | | | | |
| # 220 Dec. 23 | | 8:09 to 8:22 | | | | | |
| # 221 Dec. 23 | e PN SN MN CN FN | 17:12:25 17:13:28 17:14:07 17:14:50 17:27:00 | | | | 7.0 | Distance about 360 miles E-W sheet gave poor results because of defective light |

SEISMOLOGICAL RECORD AT BALBOA HEIGHTS, CANAL ZONE

December 1939

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Month -----

Page No. -----

| No. and Date | Phase | Time G. M. T. | | | Period s | AMPLI- TUDE mm | REMARKS |
|------------------|-------|------------------|---|---|-------------|----------------------|--------------------------|
| | | h | m | s | | | |
| # 222 Dec. 26 | | 11:57:42 | | | | | |
| | | to | | | | | |
| | | 12:15:00 | | | | | |
| # 223 Dec. 26 | • PHE | 21:51:11 | | | | | Distance about 375 miles |
| | • SN | 21:52:17 | | | | | |
| | • SE | 21:52:20 | | | | | |
| | • ME | 21:52:48 | | | 8.0 | | |
| | • NE | 21:53:04 | | | 8.0 | | |
| | • CN | 21:54:11 | | | | | |
| | • CE | 21:54:42 | | | | | |
| | • PE | 22:10:00 | | | | | |
| # 224 Dec. 27 | | 00:15 | | | | | Distant disturbance. |
| | | to | | | | | |
| | | 2:45 | | | | | |
| # 225 Dec. 27 | | 2:52 | | | | | |
| | | to | | | | | |
| | | 3:00 | | | | | |
| # 226 Dec. 27 | | 3:22:07 | | | | | |
| | | to | | | | | |
| | | 3:27:00 | | | | | |
| # 227 Dec. 28 | | 1:26 | | | | | |
| | | to | | | | | |
| | | 1:32 | | | | | |
| # 228 Dec. 29 | | 17:29 | | | | | Very faint tremors |
| | | to | | | | | |
| | | 17:40 | | | | | |
| # 229 Dec. 29 | | 20:07 | | | | | |
| | | to | | | | | |
| | | 20:14 | | | | | |
| # 230 Dec. 31 | | 18:09 | | | | | |
| | | to | | | | | |
| | | 18:12 | | | | | |
| # 231 Dec. 31 | | 20:11:31 | | | | | |
| | | to | | | | | |
| | | 20:14:00 | | | | | |