

ANTARTIC SEISMOLOGICAL BULLETIN

Palmer Land Peninsula, Antarctica
South Latitude 68° - 12'
West Longitude 67° - 00'

in Operation from
18 May 1947 through 15 February 1948

Compiled by
RONNE ANTARCTIC RESEARCH EXPEDITION

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Prepared by
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National Oceanic and Atmospheric Administration

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FOREWORD

Submitted herewith is Technical Report No. 9 of the Ronne Antarctic Research Expedition, entitled "Antarctic Seismological Bulletin," which is mainly the interpreted phases of seismograms made on Palmer Land Peninsula, Antarctica. Since seismological data of the Antarctic region are rare, this report should be of interest to investigators in this field.



W. H. Leahy
Captain, USN
Assistant Chief of Research

6 January 1950

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PREFACE

Technical Report No. 9 is one in a series completed by members of the Ronne Antarctic Research Expedition, 1946-1948. This report was prepared by Andrew A. Thompson, geophysicist, who was in charge of the geophysical research investigations for the expedition.

This report presents the interpreted phases of the temporary seismological station located on Palmer Land Peninsula, Antarctica, 68° 12' South Latitude, and 67° West Longitude. The station was in operation from 18 May 1947 through 15 February 1948.

The project would not have been possible without the valuable assistance and cooperation received from the Office of Naval Research, the Jesuit Seismological Association, the U. S. Coast and Geodetic Survey, and Columbia University. Another report will contain such information as installation and operational difficulties.

A handwritten signature in black ink, appearing to read 'Finn Ronne', with a stylized flourish at the end.

Finn Ronne
Commander, USNR, Inactive
Expedition Leader

ANTARCTIC SEISMOLOGICAL BULLETIN

INSTRUMENTS

Neumann-Labarre

- To = 2" (May 18, 1947 through June 10, 1947).
- To = 3.5" (June 11, 1947 through November 30, 1947) ¹
- To = 2" (December 1, 1947 through February 15, 1948).

f = Damping, just under critical

Orientation - To measure motion along a line 37°E of true north or 15°E of magnetic north.

V = 5000

Sprengnether, Series H ²

- To = 6 1/2" (May 24, 1947 through November 23, 1947)
- To = 20" (November 24, 1947 through December 13, 1947)
- To = 22" (December 14, 1947 through February 15, 1948)

f = Damping, near critical

Orientation -

May 24, 1947 through November 23, 1947 - To measure motion along a line 62°E of true north or 40°E of magnetic north.

November 24, 1947 through December 13, 1947 - To measure motion along a line 48°W of true north or 70°W of magnetic north.

December 14, 1947 through February 15, 1948 - To measure motion along a line 2°E of true north or 20°W of magnetic north.

V = 2000 to 3000

POSITION OF STATION - Latitude 68° 11' 40" South
Longitude 67°00' West

ELEVATION OF STATION - 24 feet above mean sea level

FOUNDATION OF STATION - Granite bed rock

RATE OF RECORDING COMPONENT - 15 mm /minute

¹ Large weight used.

² Natural period of seismometer was adjusted to be the same as natural period of galvanometer in each case.

TIME MARKS - Navy chronometer checked to at least nearest half second against radio time signals. Checks were made once or twice a week and are included in Appendix A.

SEISMOGRAM AVAILABILITY - The operations of this temporary station were incorporated as part of the activity of the Geophysics Laboratory, Department of Geology of Columbia University, and the seismograms and other original data are available in the archives of that laboratory.

SEISMOGRAM INTERPRETATION

Notes -

A lack of i or e before a phase indicates a phase half way between impulsive and emergent.

Amplitudes are measured from the Sprengthener unless not operating or unless otherwise specified. They are measured from crest to trough.

Local disturbances due to near earthquakes, ice falls, and so forth are classified as large, medium or small, according to amplitudes of about 1/2 inch, 1/4 inch, and just noticeable, respectively. Small local disturbances are omitted except when of long duration, or when accompanied by an ice fall that was recorded when heard.

For phases so gradual that the beginning is difficult to pick, an estimate of the probable error of the pick is sometimes given in "Remarks."

J.S.A. indicates data taken from the Jesuit Seismological Association.

B.C.I.S. indicates data taken from the British Committee International Seismology.

U.S.C.G.S. indicates data taken from the United States Coast and Geodetic Survey.

Notation - (From Macelwane, J.B., and Sohon, F. W. "Introduction to Theoretical Seismology." p. 258. Wiley, 1936.

Δ meas.	Indicates the degrees that the preliminary epicenter location of the earthquake is from the antarctic station measured along a great circle.
P	Normal first preliminary tremor; condensation-rarefaction or longitudinal waves that have passed below the subcrustal or Mohorovičić discontinuity.
K	The symbol employed to indicate a leg of a composite path, which lies within the core and is traversed as a P-wave.
PKP (or P')	P-waves that have traversed the earth's core.
PR ₁ (or PP)	P-waves reflected once at the earth's surface.
PR ₂ (or PPP)	P-waves reflected twice at the earth's surface.
pP	P-waves from a deep focus, reflected near the epicenter.

§	Normal second preliminary tremors; transverse or shear waves which have passed below the Mohorovičić discontinuity.
PS (and SP)	Waves transformed from P to S, and (or) vice versa, on reflection at the earth's surface. SP arrives before PS if the depth of focus differs appreciably from zero.
PPS	P-waves reflected twice at the earth's surface, once without and once with transformation to S.
sS	S-type waves from a deep focus, reflected near the epicenter.
SR₁ (or SS)	S-type waves reflected once at the earth's surface.
SR₂ (or SSS)	S-type waves reflected twice at the earth's surface.
SKS (or $\overline{S_c P_c S}$)	S-waves transformed to P-waves on refraction into the core and back to S-waves when leaving the core.
PKS (or $\overline{P_c P_c S}$)	P-waves refracted through the core but transformed to S on leaving the core.
SKKS (or $\overline{S_c P_c P_c S}$)	S-waves in the mantle refracted and internally reflected as P-waves in the core.
L	Long surface waves of irregular form at the beginning of the "principal phase."
M	Shorter and more regular surface waves of large amplitude which follow the L-waves.

<u>Date</u>	<u>Phase</u>	<u>h</u>	<u>m</u>	<u>s</u>	<u>Remarks</u>
18 May 1947	i	19	39	55	Local
19 May	e	3	23	13	S or L type phase of earthquake
22 May	e	3	40	51	Error $\pm 4^S$, local, small
22 May	i	4	42	27	Local, strong
24 May	i	4	47	30	Local, strong, 8 ^m duration.
27 May	eP	6	14	05	H=5 59 14 J.S.A.
	PR ₁	6	17	49	Epicenter 2°4S, 141°E
	e	6	24	00	Δ meas. = 108°0
	$\overline{eS_cP_cP_cS}$	6	25	23	Depth of focus normal
	eSR ₁	6	33	11	PR ₁ , fairly distinct
	eL	6	46	11	Amplitude of M = 1 in.
	eM	6	55	53	
28 May	iP	14	59	03	H=14 47.9 B.C.I.S.
	e	15	08	19	24° S 179° E
	eS	15	09	11	Depth of focus \pm 70 km
					Δ meas. = 77°5
					iP very distinct
					Surface waves practically absent.
					Not sure which of the emergent waves are S. Both somewhat distinct
30 May	i(P?)	13	05	32	L, 1/2 ^h duration. Amplitude of L, 1/4 in.
	i	13	06	22	Slight.
	eL	13	10	10	Possibility of two superimposed quakes.
					Pasadena iP 13 12 07
					Stuttgart e 13 19 02 e 13 27 50
					Roma e (PKP) 13 22 13 e(PP) 13 27 15

<u>Date</u>	<u>Phase</u>	<u>h</u>	<u>m</u>	<u>s</u>	<u>Remarks</u>
30 May (continued)					Roma $\Delta = 156^\circ$
5 June	i	01	01	50	Local, rather strong
7 June	iP	11	00	08	Error in beginning of $S + 3^S$
	S	11	00	10	
7 June	e	19	09	00	Quake very weak and indistinct
	eL	19	48		
10 June	i	09	32	51	Local, medium strength
12 June	eP'	09	20	40	H = 09 02 34 J. S. A.
	iPR ₁	09	21	52	1° 0N 126° 5E
	eS	09	29	32	Depth of focus = 100 \pm km
	PH	09	31	24	
	eL	09	51	24	
13 June	Pn	15	05	33	Possible local quake
	iP	15	05	38	$\Delta_{P-S} = 84$ to 85 km
	iS	15	05	41	
	eS	15	05	48	
13 June	iP'	20	44	08	H = 20 24 51 J. S. A.
	iPR ₁	20	46	16	21° 7N 145° 0E
	$\overline{S_c P_c P}$	20	47	27	Mag. 7 1/4 Pasadena & Strasbourg
	ePR ₂	20	49	00	Δ meas. = 129°
	$\overline{S_c P_c S}$	20	51	16	Large quake, noticeable for 2 1/2 ^h
	$\overline{S_c P_c P_c S}$	20	53	04	Amplitude of $\overline{S_c P_c P}$ = 5/16 in.
	eS	20	54	28	" " $\overline{S_c P_c S}$ = 1/4 in.
	ePS	20	56	41	" " $\overline{S_c P_c P_c S}$ = 3/8 in.
	eSR ₁	21	03	26	" " L = 1/4 in.
	eL max	21	31		

<u>Date</u>	<u>Phase</u>	<u>h</u>	<u>m</u>	<u>s</u>	<u>Remarks</u>	
13 June	eP'	21	19	49	Aftershock	
	ePR ₁	21	21	50	H = 21 00 36	B.C.I.S.
	$\overline{eS_cP_cP}$	21	23	08	21° 7N 145° 0E	B J.S.A.
	i	21	20	57	Pasadena iP 21 13 00	
					Stuttgart eP 21 14 18 ePP 21 18 25	
					Δ meas. = 129°	
					All phases weak	
13 June	eP'	24	09	46	Aftershock	
	$\overline{S_cP_cP}$	24	13	04	H = 23 50 25	J.S.A.
	$\overline{eS_cP_cP_cS}$	24	18	35	21° 7N 145° 0E	
					Δ meas. = 129°	
14 June	eP'	00	50	20	Aftershock	
	ePR ₁	00	52	20	H = 00 30 48	B.C.I.S.
	$\overline{eS_cP_cP}$	00	53	16	21° 7N 145° 0E	J.S.A.
	$\overline{eS_cP_cP_cS}$	00	59	02	Δ meas. = 129°	
16 June	i	11	57	31	Local, medium	
19 June	eP'	07	53	50	Aftershock	
	ePR ₁	07	56	02	H = 7 34 36	U.S.C.G.S.
	$\overline{S_cP_cP}$	07	57	16	21° 7N 145° 0E	J.S.A.
	e	07	58	26	Δ meas. = 129°	
	$\overline{iS_cP_cP_cS}$	08	02	47		
	i	08	03	07		
	eS	08	04	08		
	e	08	04	44		
	e	08	08	04		
	eL	08	37			

<u>Date</u>	<u>Phase</u>	<u>h</u>	<u>m</u>	<u>s</u>	<u>Remarks</u>
23 June	e	17	58	30	Very weak
	i	18	01	29	
26 June	iP	17	29	56	Local, strong, 3 ^m duration
	iS	17	29	58	
26 June	iP	17	44	52	Local, strong 2 ^m duration
	iS	17	44	54	
26 June	P or P'	23	46	59	Error in arrival of 1st phase + 3 secs.
	i or iS	23	47	13	
29 June	i	02	32	53	Local, fairly strong.
30 June	e(P or P')	23	53	35	First phase doubtful, second definite
	i(P or P')	23	54	27	Wellington P 23 46 11 S 23 50 06 (21°)
	ep ^P	23	54	37	Pasadena iP 23 53 47
	iS	24	03	39	Stuttgart i 24 00 42 e 24 01 50
					Strasbourg i 24 00 44 e 24 02 03
					Uccle e 24 00 41
					Roma e 24 00 44
2 July	i	12	36	44	Local, medium, short duration
2 July	i(P or P')	17	04	03	Definite phase
3 July	P or P'	12	24	44	Error in arrival + 2 ^S
4 July	e	22	44	47	P or P' type phase
9 July	i	05	19	50	Local, medium, short duration
12 July	iP	12	41	37	H = 12 29 36
	eS	12	51	22	20°0S 176°3W
	eL	13	10	38	Mag. 6 3/4 after Pasadena
					Δ meas. = 79°8
12 July	i	15	35	31	
	e	15	47	08	e phase P or P' type

<u>Date</u>	<u>Phase</u>	<u>h</u>	<u>m</u>	<u>s</u>	<u>Remarks</u>
13 July	iP	13	09	24	H = 12 57 30 J. S. A.
	i	13	09	55	19°7S 178°8W
	ePR ₁	13	12	31	h = 150+km ca
	ePR ₂	13	13	51	Δ meas. = 81°0
	iS	13	19	12	Surface waves practically absent
16 July	i(P or P')	15	35	19	Pasadena P 15 38 11 pP 15 38 39
	ep ^P	15	36	10	St. Louis Un. eP 15 37 04 ep ^P 15 37 59
	i	15	37	43	With Antarctic phases, located some place in Bolivia or Peru, S. A. Need report from Bolivia, since inconsistency.
	iS ?	15	42	01	
16 July	i	22	39	17	Local, small, 3 ^m duration
18 July	iP	18	04	27	Deep focus
	ip ^P	18	04	49	Second phase fairly sharp
	iS	18	08	27	
	e	18	46	15	
	e	18	49	37	
20 July	e	03	21	24	Local, large, 4 ^m duration
20 July	e	10	30	38	Others such as Granada
	e	10	38	38	Zurich, Malaga, picked
	e	10	41	26	up quake
23 July	iP	17	18	16	H = 17 13 22 J. S. A.
	iS	17	22	18	53°3S 28°5W
					Δ meas. = 21°0, Δ P-H = 21°0 phases strong
					Amplitude of iP = 2 1/4 in.
					Amplitude of iS = 2 1/2 in.

<u>Date</u>	<u>Phase</u>	<u>h</u>	<u>m</u>	<u>s</u>	<u>Remarks</u>
24 July	iP	08	44	46	H = 08 39 58 J. S. A.
	e	08	45	37	54°8S 29°8W
	iS	08	48	49	Δ meas. = 21.2°, Δ P-H=21.4° i phases very strong Amplitude of iP = 1 3/8 in. Amplitude of iS = 1 1/4 in.
24 July	iP	12	29	26	H = 12 16 57 J. S. A.
	e	12	29	49	19°1S 170°2E
	iS	12	39	49	Δ meas. = 84°2 Δ P-H=82.2°
	e	12	41	28	
	e	12	42	11	
	e	12	42	45	
	eL	12	57	26	
25 July	i(P or P')	19	16	22	Second phase sharp, L weak.
	iS?	19	21	48	Ottawa P 19 19 11 S 19 27 42 (61°9)
	eL	19	46	22	Seven Falls P 19 19 18 S 19 27 52 (62°5) Alicanti P 19 20 01 S 19 30 03 (85°5) Kew i 19 21 06 e 19 23 13
26 July	iP	23	05	32	H = 22 58 42 B. C. I. S.
	eS	23	11	00	vers 50°S 10°W
	eL	23	16	30	In South Atlantic Δ meas. = 33° quake weak
28 July	i	21	27	16	Local, large, 1/2 ^m duration
29 July	P'	14	02	53	H = 13 43 24 J. S. A.
	eP'	14	03	02	28°2N 93°2E

<u>Date</u>	<u>Phase</u>	<u>h</u>	<u>m</u>	<u>s</u>	<u>Remarks</u>
29 July (continued)	ePR ₁	14	05	39	Δ meas. = 138°4 Δ SKS-H = 137°
	e $\overline{S_c P_c P}$	14	06	11	Amplitude of M = 2 1/4 inches
	e	14	06	26	
	e	14	08	04	
	eSKS	14	09	48	
	eSKKS	14	12	30	
	e $\overline{P S_c P_c S}$	14	15	45	
	ePPS	14	17	55	
	eSR ₁	14	23	52	
	eSR ₂	14	29	02	
	eL	14	47	28	
	eM	14	55		
31 July	e(P)	14	24	44	H = 14 13 11 2° N 84° W J. S. A.
31 July	e(P or P')	18	45	21	
	e	18	45	33	
1 August	iP	00	56	57	Quake weak but distinct, iP and iS
	i	00	57	15	especially distinct.
	i	00	57	36	Bogota eP 00 55 55 e 01 03 24
	i	00	58	40	Pasadena iP 01 01 20 pP 01 02 01
	iS	01	02	56	Strasbourg e 01 07 16 e 01 13 26 Stuttgart e 01 07 17 e 01 13 34 Ksara e 01 09 43 e 01 18 33
					From Antarctic phases plus above H = 00 49 29

<u>Date</u>	<u>Phase</u>	<u>h</u>	<u>m</u>	<u>s</u>	<u>Remarks</u>
1 August (continued)					276°S 64°W h = 180 km Δ meas. = 40°+
1 August	iP	03	39	45	Probably from Sandwich Islands Surface waves negligible
	iS	03	43	48	
1 August	e(P or P')	04	36	02	
5 August	eP'	14	43	23	H = 14 24 14 J.S.A.
	e	14	52	30	21°2N. 61°2E
	e	14	57	14	Δ meas. = 125°8
	eSR ₁	15	03	00	
	eM	15	36	24	
6 August	iP	05	56	05	H = 05 47 03 J.S.A.
	iPR ₁	05	56	20	8°6S 70°3W
	i	05	59	50	h = 600 ± km
	iS	06	03	31	Δ meas. = 59°6, Δ P-H = 59°4
	iSR ₁	06	03	51	iP and iS, very distinct No surface waves
7 August	iP	11	29	03	Fairly weak, but P distinct
	S	11	32	53	
7 August	P	14	04	28	Probable aftershock
	S	14	08	24	
7 August	iP	16	54	34	Stuttgart eP 17 17 39 eL 17 ^h 47 ^m
	i	16	54	57	Strasbourg eL 17 ^h 47 ^m
	ePP	16	58	34	Interpretation not too reliable
	eS	17	05	58	First phase sharp
	e(S or PPS)	17	06	11	

<u>Date</u>	<u>Phase</u>	<u>h</u>	<u>m</u>	<u>s</u>	<u>Remarks</u>
7 August	i(P or P')	22	29	55	Bogota eP 22 20 42 Stuttgart eP 22 28 26 eL 22 ^h 54 ^m
9 August	iP	02	59	58	H = 2 48 28 J.S.A.
	eS	03	09	34	1°5N 29°7W Δ meas. 73°8, Δ P-H = 73°7
10 August	i(P or P')	04	07	59	Other emergent phases within previous and following few hours
13 August	i(P or P')	05	38	18	Possibly local.
15 August	iP	14	30	33	
	i	14	33	32	
15 August	e(P or P')	15	36	33	Weak
16 August	iP	07	07	40	iP very strong, iS rather weak
	iS	07	17	46	Surface waves practically absent Pasadena iP 07 06 47 ipP 07 07 22 Strasbourg ePKP 07 15 00 e(pPKP) 07 15 35 Stuttgart e 07 15 01 e 07 15 34 Ksara e 07 15 06 e 07 18 28 Roma e 07 15 25 e 07 29 25 From Antarctic phases with above located at Region Samoa 16°S 173°W H = 6 55 36 h = 150 <u>+</u> km
16 August	e	22	45	28	P type, weak
17 August	i	00	01	05	Local, strong
17 August	i	05	24	28	Large local disturbance lasting for over 13 ^m

<u>Date</u>	<u>Phase</u>	<u>h</u>	<u>m</u>	<u>s</u>	<u>Remarks</u>
18 August	i	18	31	56	Large local disturbance lasting for over 6 ^m
22 August	i(P or P')	02	44	39	Very distinct. Other phases lost while changing paper Brisbane iP 02 35 56 iS 02 39 43 Riverview iP 02 37 18 eS 02 41 48 Pasadena eP 02 43 56 Stuttgart ePKP 02 50 41 iPP 02 53 28 From Antarctic phases with above located near 164°E 10°S H = 02 31 18
24 August	eP'	11	56	51	Error in beginning of phase $\pm 3^S$ H = 11 37 00 B.C.I.S. Vers 43°N 82°E Δ meas. = 149°2
26 August	eP	04	53	25	H = 04 42 24 B.C.I.S.
	ePR ₂	04	56	58	34°5S 46°E
	e	05	00	52	Δ meas. = 66°2
	eSR ₁	05	06	47	All phases very weak
	eSR ₂	05	08	58	eP most prominent
27 August	iP	10	55	28	Possible local quake
	iS	10	55	32	Amplitude of iS to inch
27 August	eS	13	57	34	H = 13 37 48 J.S.A.
	ePS	13	57	58	37°8S 179°1E
	eSR ₁	14	02	16	Δ meas. = 64°5
	eL	14	08	40	P lost with changing paper Amplitude of eL = 1/2 in.

<u>Date</u>	<u>Phase</u>	<u>h</u>	<u>m</u>	<u>s</u>	<u>Remarks</u>
28 August	iP'	07	10	11	H = 06 50 36 J. S. A.
	ePR ₁	07	14	04	51°:3N 156°:6E
	$\overline{iS_c P_c P_c S}$	07	20	37	h = 60 <u>+</u> km
	e	07	21	03	Δ meas. = 154°:7
					Surface waves slight
					$\overline{iS_c P_c P_c S}$ fairly strong
28 August	eP'	14	49	27	H = 14 29 43 J. S. A.
					54°:0N 160°:1E
					h = 50 <u>+</u> km
					Δ meas. = 156°:1 Δ P-H = 156°:1
28 August	iP	19	55	27	H = 19 48 13 J. S. A.
	iS	20	01	19	29°:9S 70°:8W
	eSR ₁	20	03	20	h = 100 <u>+</u> km
	eSR ₂	20	04	12	Δ meas. = 38°:3 Δ P-H = 38°:3
					Amplitude of iS = 3/8 in.
					Amplitude of eSR ₂ = 1/4 in.
					No surface waves
2 September	i	03	07	32	Local, medium
2 September	iP	14	44	14	H = 14 32 40 J. S. A.
	ipP	14	45	18	23°:3S 175°:4W, h=250 <u>+</u> km.
	S	14	53	57	Δ meas. = 79°, Δ P-H = 79°
	eSS	14	55	05	L waves negligible
					Amplitude of P = 1/4 in.
					Amplitude of S = 1/2 in.
3 September	e	02	50	57	Local, medium small
3 September	iP	19	09	41	H = 18 56 30 J. S. A.

<u>Date</u>	<u>Phase</u>	<u>h</u>	<u>m</u>	<u>s</u>	<u>Remarks</u>
3 September (continued)	iPR ₁	19	13	28	11°7S 164°0E
	eSKS	19	20	13	Δ meas. = 93°7 Δ PR ₁ -H=93°7
	e	19	20	35	Phases weak but distinct
	eL	19	42		
	eM	19	49		
4 September	iP	00	42	35	H = 00 30 14 J. S. A.
	e	00	43	30	15°7S 173°4W
	ePR ₁	00	45	42	Δ meas. = 82°7 Δ P-H = 82°7
	iS	00	52	54	P and S distinct but not large
	eL	01	12		Amplitude of S = 3/16 in. Evidence of possible aftershocks
4 September	e	14	20	38	
	eL	14	36		
4 September	e	15	23	44	
5 September	i(P or P')	04	54	51	
5 September	i	14	52	00	
11 September	i	11	18	56	Local, medium
11 September	i	18	47	30	
12 September	P or P'	02	43	46	
12 September	e	05	16	58	
12 September	e	07	18	16	
12 September	P	10	30	42	Error in beginning of P = + 2 ^s
	iS	10	37	18	Stuttgart e(P) 10 35 25 eL(M) 11 07 Ksara e 10 40 36 L 11 04
14 September	e	02	11	46	

<u>Date</u>	<u>Phase</u>	<u>h</u>	<u>m</u>	<u>s</u>	<u>Remarks</u>
19 September	iP	10	30	38	iP very definite or sharp, S fairly definite
	pP	10	30	58	Bogota iP 10 29 25 eS 10 34 48 (32°4)
	pP	10	31	36	Morned Cadets e 10 30 49
	S	10	37	07	Pasadena iP 10 35 04 pP 10 35 30
					With above data and with Antarctic phases located near Ascension, Paraguay, S. A.
					Deep
					H = 10 22 46
21 September	e	19	35	09	Indistinct e phases during next few minutes
22 September	e	19	22	57	
23 September	i	06	40	55	Local, strong
23 September	i(P or P')	07	26	57	
23 September	eP'	12	47	19	H = 12 28 22 J.S.A.
	ePR ₁	12	50	03	34°1N 57°6E
	$\overline{eS_c P_c P}$	12	50	54	Δ meas.=133°5, SKKS-H=133°5
	eSKKS	12	56	48	All phases weak
	eSR ₁	13	07	55	
	eSR ₂	13	12	31	
	eL	13	36		
	eM	13	43		
	M max	13	51		
24 September	e	07	09	12	
25 September	i	23	50	32	First phase S type
	e	23	57	30	
	eL	24	16	30	

<u>Date</u>	<u>Phase</u>	<u>h</u>	<u>m</u>	<u>s</u>	<u>Remarks</u>
26 September	i	00	43	39	Local, strong, 7 ^m duration
26 September	iP	02	53	59	Local, medium small
	iS	02	54	03	
26 September	eP'	16	21	08	H = 16 01 52 J. S. A.
	iP'	16	21	21	21°7N 122°4E
	i	16	23	50	h = 150 ± km
	i	16	25	17	Δ meas. = 153°.9, Δ P'-H = 154°.0
	e	16	25	37	
	eSKS	16	28	13	
	e	16	30	35	
	e*	16	33	01	*Aftershock
	eS	16	34	08	
	i	16	42	29	
	eL	16	59	30	
27 September	e	05	45	56	P type
28 September	i(P or P')	03	15	58	Other phases lost in changing paper
29 September	i	08	27	16	Local, possible ice fall
1 October	iP	12	44	35	H = 12 31 36 B. C. I. S.
	i	12	46	43	vers 13°S 167°E
	eS	12	55	26	h = 100 ± km
	i	13	01	47	Δ meas. = 91°.5 iP very distinct
2 October	e	03	09	20	
2 October	i	14	28	11	
3 October	i	09	16	26	Local, medium, 6 ^m duration

<u>Date</u>	<u>Phase</u>	<u>h</u>	<u>m</u>	<u>s</u>	<u>Remarks</u>
3 October	iP	23	45	12	H = 23 32 15 J. S. A.
	iS	23	55	38	18°6N, 101°5W
	ePR ₁	23	49	00	h = 100 ± km Δ meas. = 91°2
3 October	e	24	38	30	Possible aftershock
5 October	i	05	17	56	Local, medium small
5 October	ePR ₁	18	59	20	H = 18 40 42 J. S. A.
	ePS	19	08	30	4°0S 133°7E
	eSR ₁	19	14	42	Δ meas. = 107°2 Δ PR-H = 107°2
	eL	19	30		All phases very weak except L
6 October	e	16	56	33	
6 October	eP	20	11	47	H = 19 55 40 J. S. A.
	P'	20	14	35	36°9N 21°7E
	e	20	21	23	Δ meas. = 123°8
	ePPS	20	28	05	All phases weak
	eL	20	55		P' strongest
7 October	iP'	02	12	57	H = 01 53 23 J. S. A.
	eS _C P _C P	02	16	38	64°0N 148°6W Δ meas. = 144°9 P' very distinct. Other phases obscured by microseisms
7 October	e	03	04	12	
7 October	P'	03	17	04	H = 02 57 30 J. S. A. 64°0N 148°6W Aftershock, P' weak but fairly distinct. Error = + 2 ^S
7 October	e	13	03	06	

<u>Date</u>	<u>Phase</u>	<u>h</u>	<u>m</u>	<u>s</u>	<u>Remarks</u>
7 October (continued)	e	13	05	11	
	e	13	09	29	
8 October	P	00	41	42	Δ P-S = 11° 51'
	iS	00	43	55	Error in P = \pm 2 ^S
8 October	eP	00	48	25	Probable aftershock
	eS	00	50	31	
8 October	iP	09	18	44	Deep focus
	iS	09	22	59	
10 October	i(P or P')	02	49	58	
10 October	P'	07	52	03	H = 07 32 47 44°3N 145°9E h = 300 \pm km Δ meas. = 151°6 Error in P' = \pm 2 ^S
					J. S. A.
10 October	iP	13	53	49	H = 13 42 52
	eS	14	02	55	31°0S 177°8W
	eSR ₁	14	07	49	Δ meas. = 69°8, Δ P-H = 69°8
	L	14	15		
	M	14	21		
					J. S. A.
11 October	e	14	26	29	First phase P type
	e	14	27	45	Possible quake at 640 km dist.
12 October	i(P or P')	20	53	45	
	i	20	54	27	
13 October	iP	07	41	33	H = 07 31 24
	eS	07	50	18	44°2S 169°0E
	eL	08	01	48	Magnitude 6 to 6 1/2
					Wellington

<u>Date</u>	<u>Phase</u>	<u>h</u>	<u>m</u>	<u>s</u>	<u>Remarks</u>
13 October (continued)					Based on Riverview, Brisbane, Ksara, Roma, Stuttgart, Cartuja iP strong Amplitude of L = 5/16 in.
14 October	iP	01	52	10	H = 01 41 14 J.S.A.
	eL	02	14	39	32°8S 178°4E Δ meas. = 68°2, Δ P-H = 68°2 Amplitude of L = 1/4 in.
16 October	iP'	02	29	19	H = 02 09 50 J.S.A.
	iP'	02	29	23	63°8N 148°1W
	i	02	33	03	Δ meas. = 145°
	$\overline{eS_c P_c P_c S}$	02	39	28	P' very distinct with 1/2 in.
	e	02	44	30	Amplitude on Neumann-Labarre.
	eSR ₁	02	51	33	Sprengnether not operating.
	eL	03	09		eL visible for 1 1/2 ^h
17 October	eP'	13	45	04	H = 13 25 30 B.C.I.S.
	iPPS	13	59	36	45°9N 26°6E
	e	14	08	56	h = 150 km ca
	e	14	14	26	Δ meas. = 37°2 No surface waves coming in where they should. Last phase has slight resemblance to L but does not last long.
18 October	i(P or P')	01	11	53	Second phase S type
	e	01	21	02	
18 October	i	11	36	03	Local, medium
19 October	e(P or P')	18	41	00	
	eL	19	41	00	

<u>Date</u>	<u>Phase</u>	<u>h</u>	<u>m</u>	<u>s</u>	<u>Remarks</u>
20 October	iP'	02	02	51	H = 01 43 17 J.S.A.
	iP'	02	02	57	64°N 147°9W
	i	02	03	02	Δ meas. = 145° Δ P-H = 145°
	i	02	11	06	P' very strong, Amplitude 1/8 in.
	L	02	52		L for 1 ^h duration
20 October	e	16	51	54	S or L type
22 October	e(P)?	17	36	13	
	eL	18	12		
27 October	e	11	18	59	H = 10 ^h 30 ^m B.C.I.S.
	eL	11	27	34	38°N 8°E
					Δ meas. = 120°
27 October	e	12	04	56	
1 November	i(P or P')	05	03	32	Weak
1 November	eP'	06	18	36	H = 05 59 33 J.S.A.
	eL	06	54	30	06°S 102°E
1 November	iP	12	52	39	Deep
	iS	12	56	33	
1 November	P	15	08	41	H = 14 58 54 J.S.A.
	P	15	08	48	10.8S 44.5W
	iS	15	16	41	Probably deeper than normal
	eL	15	26	41	Δ meas. = 57°6 Δ P-H = 58°2
					Amplitude of S and L = 2 in.
4 November	iP'	00	29	02	H = 00 09 14 J.S.A.
	i	00	29	10	44.8N 139.6E
	ePR ₁	00	32	57	Δ meas. = 154°1 Δ P'-H = 154°1
	eL	01	20		P' very strong, all other phases weak

<u>Date</u>	<u>Phase</u>	<u>h</u>	<u>m</u>	<u>s</u>	<u>Remarks</u>
7 November	iP	23	10	16	H = 23 00 29 J.S.A. 10°8S 74°5W Probably deeper than normal Δ meas. = 57°6 Δ P-H = 57°7
8 November	i	03	45	11	Local, smallish, 6 ^m duration
8 November	P or P'	09	27	00	
9 November	iP	05	09	59	H = 04 57 51 J.S.A.
	iP	05	10	01	23°4S 170°4E
	iS	05	20	07	Δ meas. = 80°2 Δ P-H = 80°2
	eL	05	39		
12 November	eP	10	40	40	H = 10 28 48 B.C.I.S.
	eS	10	51	05	23°4S 170°4E J.S.A. Aftershock S wave strongest
12 November	iP	16	31	07	H = 16 18 58 J.S.A.
	iS	16	41	13	25°5S 170°5E Δ meas. = 80°2 Δ P-H = 80°4
25 November	iP	18	24	54	H = 18 15 10 J.S.A.
	e	18	31	02	10°8S, 74°5W
	eS	18	32	56	h = 50 <u>+</u> km
	eL	18	40		Δ meas. = 57°7 Δ P-H = 57°7
29 November	i	13	08	03	Local, medium
30 November	eP	18	32	15	Error in P = <u>+</u> 2 ^S
	eS	18	36	50	
2 December	iP	21	48	09	iP <u>very sharp</u>
	iS	21	57	24	Pasadena iP 21 48 09

<u>Date</u>	<u>Phase</u>	<u>h</u>	<u>m</u>	<u>s</u>	<u>Remarks</u>
2 December (continued)					Ksara i 21 55 40 i 21 58 03 Stuttgart e 21 55 43.5 e 21 58 17 Paris e 21 55 46 i 21 56 04 Wellington iP 21 41 14 S 21 44 29 (16°9) Zurich eP 21 55 44°8 Jena e 21 55 46 Above data doesn't check for location with Antarctic data More data needed
8 December	e(P or P')	17	31	55	
	eL	18	02		
15 December	iP	19	27	45	H = 19 20 17 J.S.A.
	ip ^P	19	29	17	60°3S 166°8W
	iS	19	33	34	h = 100 + km
	e	19	36	53	Δ meas. = 40°1 Δ P-H = 40°1
	e	19	37	48	Strong quake
	eL	19	38	23	First three phases very strong
	eM	19	40		especially ip ^P
16 December	e(P or P')	21	11	03	
17 December	e	06	13	41	
	e	06	15	02	
	eL	06	25		
17 December	i	21	51	06	
	eL	22	02	30	
19 December	iS ?	16	59	03	Ksara eP 16 48 15 eS 16 58 (51) Stuttgart eP 16 49 23 eS 17 00 06 (86°4)

<u>Date</u>	<u>Phase</u>	<u>h</u>	<u>m</u>	<u>s</u>	<u>Remarks</u>
19 December (continued)					Zurich eP 16 49 27.5
					Basel eP 16 49 29.0
					Trieste eP 16 49 57 e(S) 16 59 57
					Kew e(PP) 16 52 46 eS 17 00 10 (103.5)
					Clermont e16 53 44 L 17 31
24 December	iP	05	31	37	H = 05 21 48 J.S.A.
	e	05	33	46	54°S 110°E
	ePR ₂	05	34	58	Δ meas. = 58.1, Δ P-H = 58.1
	iS	05	39	32	Amplitude of M = 1/2 in.
	iS _c S	05	41	26	
	eSR ₁	05	43	30	
	eL	05	50	58	
	eM	05	53	58	
26 December	iP	16	56	29	H = 16 44 02 J.S.A.
	e	17	00	06	20°S 169.7 E
	eS	17	06	52	Δ meas. = 83.8 Δ P-H = 83.8
	eSR ₁	17	12	34	
	eL	17	23		
30 December	eP	02	07	20	H = 01 55 18 J.S.A.
	iS	02	17	14	9.5N 84.0W
	eL	02	28		h = 50 ± km
	eM	02	33		Δ meas. = 80.0 Δ P-H = 80.3
					Δ S-H = 78.8
					S phase very definite
31 December	iP	15	18	54	H = 15 06 36 J.S.A.
	S	15	29	08	16°S 173.4W

<u>Date</u>	<u>Phase</u>	<u>h</u>	<u>m</u>	<u>s</u>	<u>Remarks</u>
31 December (continued)	i	15	29	31	$h = 60 \pm \text{km}$
	eSR ₁	15	34	57	$\Delta \text{ meas.} = 82^\circ.7 \Delta \text{ P-H} = 82^\circ.8$
	eM	15	57		
31 December	i	20	39	55	Local, small, checked with ice fall
1 January 1948	e	20	32	26	Pasadena, first motion 20 29 23
	L	20	37		pP 20 31 23
2 January	e	03	27	05	Pasadena iP 03 27 09 i 03 27 23
	eL	03	38	05	Brisbane e 03 21 40
					Riverview e(S) 03 21 52 eL 03 28 06
					Trieste e(P) 03 25 15
				Ksara e 03 26 34 M 03 58	
4 January	eP	09	07	41	H = 08 56 40 J.S.A.
	ipP	09	09	44	21°3S 178°5W
	iS	09	16	52	$h = 600 \pm \text{km}$
	e	09	28	52	$\Delta \text{ meas.} = 78^\circ.9 \Delta \text{ pP-H} = 78^\circ.9$
				S and pP strong	
				L waves weak	
6 January	iP	17	36	17	H = 17 23 26 J.S.A.
	ePR ₁	17	39	42	16°9N 98°8W
	$\overline{S_c P_c S}$ or S	17	46	35	$h = 60 \pm \text{km}$
	e	17	48	07	$\Delta \text{ meas.} = 88^\circ.5 \Delta \text{ P-H} = 88^\circ.6$
	e	17	49	02	$\overline{S_c P_c S}$ and SR ₁ strong
	eSR ₁	17	52	50	Amplitude of L = 1/2 in and
	eL	18	05	20	very regular lasting for 1 1/2 ^h
				Looks like M came in one minute after L.	

<u>Date</u>	<u>Phase</u>	<u>h</u>	<u>m</u>	<u>s</u>	<u>Remarks</u>
10 January	P	05	27	11	H = 05 14 45 J.S.A.
	iS or iSKS	05	37	24	19°6S 170°3E
	e	05	38	08	Δ meas. = 84° Δ P-H = 83°9
	eL	05	53	00	Amplitude of L = 1/4 in. L regular, lasting for 1 ^h
10 January	i	18	55	32	Local, medium
11 January	i	17	45	06	Local, noticeable only on Sprengnether. Small. Checked with ice fall.
12 January	i	01	52	17	Local, medium, 8 ^m duration
14 January	iS	02	45	08	H = 02 25 36 J.S.A.
	e	02	48	48	8°9S 108°7W
	eSR ₂	02	52	32	Δ meas. = 66°1 Δ S-H = 65°8
	eL	02	55	45	
16 January	eP'	11	28	18	H = 11 09 00 J.S.A.
	e	11	46	50	52°5N 177°7E
	eL	12	21	50	h = 100 <u>+</u> km
16 January	eS	22	00	53	
	eL	22	03	11	
17 January	eS	02	19	23	
	eL	02	34	26	
17 January	ePR ₁	07	31	48	H = 7 11 30 J.S.A.
	PS	07	41	50	14°N 152°E
	eL	08	06	00	Probably deep.
	eM	08	14	30	Δ meas. = 121°4 Δ PR ₁ -H = 121°8 PS most distinct
18 January	eP	13	52	47	H = 13 ^h 40°0 ^m B.C.I.S.

<u>Date</u>	<u>Phase</u>	<u>h</u>	<u>m</u>	<u>s</u>	<u>Remarks</u>
18 January (continued)	eS	14	03	11	vers 19°S, 170°E
	eL	14	26	41	Δ meas. = 84.8 eS fairly distinct
19 January	e	16	15	16	
	eL	16	17	04	
20 January	iP	09	54	57	H = 09 44 08 J.S.A.
	iPR ₁	09	57	26	34.0S 178.3W
	iS	10	03	51	Δ meas. = 67.1 Δ P-H = 67.1
	eSR ₁	10	09	09	
	eL	10	11	25	
	eM	10	17	30	
21 January	e	08	49	09	
	e	08	58	33	
	e	09	00	09	
	e	09	04	27	
	eL	09	07	21	
21 January	i	22	04	32	i very weak
	eL	22	16	40	Pasadena, first motion 22 07 01
22 January	i	02	27	25	Local, medium
22 January	iP	14	06	58	H = 13 55 23 J.S.A.
	ip ^P	14	07	34	22.8S 177.1W
	iPR ₁	14	09	50	h = 150 \pm km
	iS	14	16	31	Δ meas. = 77.1 Δ P-H = 77.1
	esS	14	17	31	iP and iS are strong
	e	14	19	56	
	eSR ₁	14	21	38	

<u>Date</u>	<u>Phase</u>	<u>h</u>	<u>m</u>	<u>s</u>	<u>Remarks</u>
22 January (continued)	eL	14	30	30	
22 January	eP	20	17	30	Pasadena iP 20 21 45 ipP 20 22 02
	ePPP	20	19	25	La Paz iP 20 12 43 iS 20 15 25
	e	20	20	16	Bogota eP 20 16 25
	eS	20	23	37	Temiskaming iP 20 21 37
	eG	20	26	49	Mornedes Cadets e 20 18 16
	eL	20	29		Istanbul e(P) 20 23 19 eL 21 ^h 07 ^m
					Ksara eP or PR ₁ 20 29 58 eS 20 40 05
					H = 20 09 54 J.S.A.
					Region 28°S 76°W
					West Argentina Δ P-H = 40°1
24 January	eP (?)	18	02	08	H = 17 46 46 J.S.A.
	iP'	18	05	44	10°8N 121°9E
	e	18	07	00	Δ meas. = 122°8 Δ P'-H = 122°8
	ePR ₁	18	07	06	Δ PS-H = 122°8
	iPR ₂	18	09	55	Very large quake
	$\overline{eS_c P_c P_c S}$	18	14	18	
	eS	18	15	30	
	iPS	18	17	18	
	e	18	27	05	
	eSR ₂	18	28	37	
	eL	18	45	30	
	eM	18	55		
25 January	e	06	30	51	Brisbane eP 06 06 40 e 06 13 42
	eL	07	00	00	Riverview e(P) 06 08 41 e(S) 06 15 50

<u>Date</u>	<u>Phase</u>	<u>h</u>	<u>m</u>	<u>s</u>	<u>Remarks</u>
25 January (continued)					Strasbourg e 06 10 30 e 06 29.0 Stuttgart e(P) 06 11 28 eL 06 50 Pasadena first motion 06 12 28
25 January	iP	22	33	49	Surface waves slight
	iS	22	37	52	Probably in Shetland Islands
26 January	ePR ₁	14	31	14	H = 14 10 43 J.S.A.
	eSKKS	14	38	11	10° 8N 121° 9E
	eL	15	09	30	Δ meas. = 122° 8 Δ PR ₁ -H = 122° 9
	eM	15	17	30	Surface waves lasting 1 1/2 ^h
27 January	iP	12	09	31	H = 11 58 26 J.S.A.
	eP	12	09	36	20° 3S 178° 4W
	iPR ₁	12	11	45	h = 600 ₊ km
	iS	12	18	42	Δ meas. = 79° 8 Δ P-H = 79° 8
	eS	12	18	48	
	ePS	12	19	36	
	e	12	23	09	
28 January	ePR ₁	04	06	43	H = 03 47 26 J.S.A.
	eSKS	04	12	33	2° N 127° E
	eS	04	13	34	h = 100 ₊ km
	ePS	04	16	46	Δ meas. = 114° 0 Δ PR ₁ -H = 114° 0
	ePPS	04	18	14	
	eSR ₁	04	22	52	
	eSR ₂	04	26	58	
	eL	04	43		
	M	04	52		
28 January	ePR ₁	16	14	00	H = 15 51 37 J.S.A.

<u>Date</u>	<u>Phase</u>	<u>h</u>	<u>m</u>	<u>s</u>	<u>Remarks</u>
28 January (continued)	eSR ₁	16	32	09	38°1N 65°2E
	eSR ₂	16	37	51	Δ meas. = 139°7
	e	16	54	41	All phases weak
	eL	17	00		
	eM	17	14		
29 January	i	11	45	51	Local, medium
2 February	iP	20	40	04	Possible error of - 1 minute on all phases
	eS	20	49	12	
	eL	21	01	30	
2 February	iP	13	48	58	Possible error of - 1 minute on all phases
	ipP	13	49	18	
	eS	13	56	48	L slight
3 February	i	12	05	32	Local, medium
3 February	e	12	15	48	
	eL	14	03	30	
4 February	i	11	23	24	Local, medium
5 February	i	11	57	09	Local, large
5 February	e	17	04	50	Local, Sprengnether only, large
6 February	iP	22	56	32	
	i	22	57	59	
	iS	23	00	31	
9 February	ePR ₁	13	18	47	H = 12 58 23 J. S. A.
	e $\overline{S_c P_c P}$	13	20	21	35°8N 27°3E
	e	13	26	16	h = 50 <u>+</u> km
	i(PS)	13	28	13	Δ meas. = 123°6 Δ PR ₁ -H = 123°6

<u>Date</u>	<u>Phase</u>	<u>h</u>	<u>m</u>	<u>s</u>	<u>Remarks</u>
9 February (continued)	eSR ₁	13	34	49	
	eL	13	55		
	eM	14	04		
10 February	i	15	39	54	Local, medium
10 February	e	18	32	32	
	e	18	38	26	
	eL	18	43	20	
14 February	eP	00	55	30	
	S	01	05	16	
	eL	01	11		
14 February	eP ?	10	56	51	H = 10 52 50
	iS	11	06	39	27°0S 62°3W
	e	11	09	57	h = 600 <u>+</u> km L slight
14 February	eP	22	11	48	H = 22 00 37
	iS	22	20	02	8°2S 76°8W
	eL	22	26	20	

NOTE: In regards to local shocks, the large ice falls, whose times of occurrence were recorded, correlated only with small disturbances, on the seismograms. This fact may indicate the larger local seismogram disturbance to be the effect of a different cause, namely local earthquakes.

APPENDIX

TIME CORRECTIONS FOR CHRONOMETER

Corrections were made on the break circuit chronometer at various intervals by a radio time signal from WWV in Washington, D. C. This break circuit chronometer applied fiducial marks directly to the seismograms. The corrections as listed below were added algebraically to the time indicated on the seismograms when listing the phase arrival times. A negative correction, thus, would indicate the chronometer was fast. The corrections, listed below, were made at approximately 2300 GMT in each case.

<u>Date</u>	<u>Correction</u>
May 24, 1947	- 48 "
28	- 49 "
<hr/>	
June 13, 1947	- 58 "
20	- 64.5"
25	- 68.2"
<hr/>	
July 6, 1947	- 80 "
9	- 80 "
10	- 80.5"
12	- 81 "
14	- 82 "
19	- 84.2"
23	- 88 "
24	- 89 "
29	- 92.3"
<hr/>	
August 3	- 1'35 "
8	- 1'37 "
11	- 1'40 "
15	- 1'44 "
18	- 1'46.5"
20	- 1'47.5"
24	- 1'53 "
29	- 1'58 "
31	- 2' 0.5"
<hr/>	
September 1	- 2' 1.5"
5	- 2' 5.5"
6	- 2' 6.5"
10	- 2'11 "
15	- 2'15 "
20	- 2'21 "
25	- 2'45.5"
<hr/>	
October 1	- 2'28 "
5	chronometer stopped +1 ^h 54' 6 "
6	+1 ^h 54' 5.5"
9	+1 ^h 54' 4 "
10	changed chronometer + 0.5"
15	- 3 "
17	- 4 "

<u>Date</u>	<u>Correction</u>
October 20	- 6 "
24	- 10 "
25	- 10.5"
28	- 14 "
29	- 14.5"
29	- 15 "
<hr/>	
November 1	- 18.5"
2	- 20.0"
8	- 25 "
17	- 32 "
23	- 38 "
28	- 43 "
<hr/>	
December 5	- 48 "
15	- 55 "
18	- 57.5"
26	- 1' 3.5"
<hr/>	
January 5, 1948	- 1' 9.5"
11	- 1'14 "
20	- 1'21 "
28	- 1'26.6"
<hr/>	
February 5	- 32.5"
12	- 37.5"
12	- 38 "
17	- 44 "
<hr/>	