COMMONWEALTH OF THE PHILIPPINES
DEPARTMENT OF AGRICULTURE AND COMMERCE

WEATHER BUREAU

MANILA CENTRAL OBSERVATORY

SEISMOLOGICAL BULLETIN FOR 1940
JANUARY–JUNE

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MANILA
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INTRODUCTION

SEISMIC STATIONS

The following is the list and data of stations equipped with seismographs.

Name	Islands	North latitude	East longftude	Elevation	Equipment	Substructure
		° ′	° ′	*m*		
Manila	Luzon	14 35	120 59	3.0	Galitzin-Wilip, 3 components. Wiechert inverted pendulum, 955 kg. Two horizontal pendulums, 118 kg. each.	Alluvium and pyroclastics to unknown depth
Baguio	----do	16 25	120 35	1,512	Vicentini vertical. Wiechert inverted pendulum, 200 kg.	Limestone.
Ambulong	----do	14 05	121 03	10.5	Wiechert inverted pendulum, 200 kg.	Soil underlaid by tuff.
Tagaytay	----do	14 06	120 55	696.0	----do	Compact ash and soil.
Butuan	Mindanao	8 56	125 32	2.0	----do	Alluvium.
Agana	Guam	13 28	144 45	5.0	----do	Coral.

All meteorological stations, official and coöperative, have instructions to report all perceptible earthquakes.

SEISMIC RECORDS

The instrumental record is that obtained from the seismographs in the Manila Observatory. It is that of the Galitzin-Wilip instruments except when stated otherwise.

The time of occurrence given in the macroseismic records is that indicated by the seismographs of the Manila Observatory whenever the disturbance has been recorded by them. This fact is denoted by an asterisk in the macroseismic record. Otherwise the time is that given by the meteorological observer who reports the earthquake. Greenwich mean time is given and insular time is added in brackets.

Intensity is given according to the Rossi-Forel scale as adapted by Rev. W. C. Repetti, S. J., Chief of the Seismic Division, for use in the Philippine Islands.

ROSSI-FOREL SCALE OF EARTHQUAKE INTENSITIES (Adapted)

I. *Microseismic shock.*—Felt only by an experienced observer under favorable conditions.

II. *Extremely feeble shock.*—Felt by a small number of persons at rest.

III. *Very feeble shock.*—Felt by several persons at rest. Duration and direction may be perceptible. Sometimes dizziness or nausea experienced.

IV. *Feeble shock.*—Felt generally indoors; outdoors by a few. Hanging objects swing slightly. Creaking of frames of houses.

V. *Shock of moderate intensity.*—Felt generally by everyone. Hanging objects swing freely. Overturn of tall vases and unstable objects. Light sleepers awakened.

VI. *Fairly strong shock.*—General awakening of those asleep. Some frightened persons leave their houses. Stopping of pendulum clocks. Oscillation of hanging lamps. Slight damage in very old or poorly built structures.

VII. *Strong shock.*—Overturn of movable objects. General alarm, all run outdoors. Damage *slight* in well-built houses, *considerable* in old or poorly built structures, old walls, etc. Some landslides from hills and steep banks. Cracks in road surfaces.

VIII. *Very strong shock.*—People panicky. Trees shaken strongly. Changes in flow of springs and wells. Sand and mud ejected from fissures in soft ground. Small landslides. Slides in river banks.

IX. *Extremely strong shock.*—Panic general. Partial or total destruction of some buildings. Fissures in ground. Landslides and rock falls.

SYMBOLS AND ABBREVIATIONS

P	Normal first preliminary tremors; longitudinal waves which have passed below the continental layer.
$\overline{P}$	Upper first preliminary tremors whose path lies wholly in the continental layer.
P'	Longitudinal waves that have traversed the earth's core.
PRn	Longitudinal waves reflected "n" times at the earth's surface.
PcP	Longitudinal waves reflected from the outer surface of the earth's core.
S	Normal second preliminary tremors; transverse waves that have passed below the continental layer.
$\overline{S}$	Second preliminary tremors whose path lies entirely in the continental layer.
PS	Waves transformed from longitudinal to transverse oscillations or vice versa through one reflection at the earth's crust.
SRn	Normal transverse waves reflected "n" times at the earth's surface.
$\overline{ScS}$	Normal transverse waves reflected from the outer surface of the earth's core.
SKP	Waves which start with transverse vibrations but on refraction into the core are changed to longitudinal, or starting as longitudinal are refracted out as transverse.
L	Long waves of irregular form at the beginning of the surface or main phase.
M	Shorter and more regular waves of large amplitude in the surface group which travel more slowly than the L waves.
Mn	Individual waves of relatively large amplitude in the surface phase and usually in the M group.
F	Finis. End discernible movement.
i	Impetus. Impulsive and sharply defined beginning of a phase.
e	Emersio. Poorly defined emergency of a phase.
m	Maximum wave in any phase.
T	Period of waves.
O	Time of earthquake at the epicenter.
H	Time of earthquake at focus.
h	Focal depth.
Δ	Arcual distance from station to epicenter.
To	Free or undamped period of the seismograph.
V	Static magnification.
e	Ratio of successive damped amplitudes.
r	Friction constant.
J. S. A.	Jesuit Seismological Association. Central Office at St. Louis University, St. Louis, Missouri, U. S. A.
U. S. C. G. S.	United States Coast and Geodetic Survey, Washington, D. C., U. S. A.
C. M. O.	Central Meteorological Observatory, Tokyo, Japan.

CONSTANTS OF THE WIECHERT INVERTED PENDULUM

1940	N–S component				E–W component			
	T_o	V	E	$\frac{r}{T_o^2}$	T_o	V	E	$\frac{r}{T_o^2}$
January	4.2	211	2.4	0.087	4.2	268	2.8	0.086
February	4.3	203	2.4	0.088	4.2	268	2.6	0.099
March	4.3	202	2.5	0.079	4.2	275	2.4	0.093
April	4.4	202	2.5	0.081	4.2	280	2.6	0.118
May	4.3	205	2.6	0.085	4.2	252	2.7	0.108
June	4.4	195	2.6	0.079	4.2	257	2.8	0.105

SEISMOLOGICAL BULLETIN FOR JANUARY, 1940

MACROSEISMIC RECORD

3, 11h 42m [3, 7:42 P. M.] **Butuan, Agusan.** Very feeble and very short earthquake. Lamps and hanging objects moved slightly.

8, 13h 20m [8, 9:20 P. M.] **Pamplona, Cagayan.** Light earthquake.

10, 16h 00m [10, Midnight] **Gonzaga, Cagayan.** Light earthquake. Another light shock at 8:00 P. M. on the 11th.

12, 4h 00m [12, Noon] **Cape Bojeador, Ilocos Norte.** Light earthquake.

13, 1h 24m 42s [13, 11:24:42 A. M.] **Agaña, Guam.** Light earthquake recorded and felt.

15, 21h 25m [16, 5:25 A. M.] **Tacloban, Leyte.** Earthquake of intensity II and duration of one second.

17, 1h 20m 34s * [17, 11:20:34 A. M.] **Agaña, Guam.** Earthquake recorded and felt. Epicenter about 300 miles northeast of Guam.

20, ——— [20, 5:00 to 8:00 A. M.] **Gonzaga, Cagayan.** Six earthquake shocks felt. Thirteen other light shocks during the day.

20, 1h 06m 26s [20, 11:06:26 A. M.] **Agaña, Guam.** Earthquake recorded and felt.

23, 3h 46m [23, 11:46 A. M.] **Calayan, Cagayan.** Very feeble earthquake of five seconds duration. The motion was vertical.

23, 11h 30m 14s * [23, 7:30:14 P. M.] **Luzon.** Epicenter in Lamon Bay. Felt with intensity IV and with a duration of five seconds in Infanta where the motion was partly vertical. Creaking of houses. Intensity III in Manila, Atimonan, Santa Cruz, and Tagaytay. Light in Lukban and Matatio, Tayabas and at San Antonio, Laguna.

28, 5h 44m [28, 1:44 P. M.] **Butuan, Agusan.** Extremely feeble shock of very short duration.

28, ———. **Hinatuan, Surigao.** Light earthquake. Time not reported.

INSTRUMENTAL RECORD

No.	Date	Phase	Time			▽	Remarks
			h.	*m.*	*s.*	*Km.*	
1	1	ePNEZ	0	22	22	135	Deeper than normal.
		SNEZ			39		
		F		25			
2	1	iPZ	12	25	20	2,700?	Dilatation.
		ePNE			20		
		S?NE		29	31		
		F	13	03			
3	2	eP?NE	5	05	25	1,700?	
		SNE		08	20		
		F		30			
5	2	ePPNE	11	29	36	14,710±	31°±S: 108°±W; H=11:07.6 by U. S. C. G. S.
		LNE	12	08	ca		
		F	13	36			
8	6	ePNEZ	0	29	59	740	
		SNEZ		31	21		
		F		55			
9	6	iPZ	8	23	16	3,965	Dilatation.
		ePE			16		
		SN		28	50		
		LN		33	25ca		
		F	9	35			
10	6	ePNEZ	10	46	30	1,670	
		SNE		49	23		
		LNE		50	45ca		
		MN		52	ca		
		F	11	50			
12	6	iPZ	14	13	34	6,620	Dilatation. Deep focus. Between New Hebrides and New Caledonia by Riverview and Manila. 22° S; 170° E by U. S. C. G. S. 21.5° S 169° E by Wellington.
		iPE	21	44	36		
		iSNE		21	44		
		LNE		32	20ca		
		MN		37	25ca		
		F	17	30			
14	7	ePNEZ	3	28	24	3,490	
		SNE		33	28		
		LNE		37	10ca		
		F	5	25			
17	9	iPZ	6	36	18	1,835?	Dilatation.
		ePNE			18		
		S?E		39	26		
		F		55			
19	10	ePZ	11	23	33	3,640	Disturbed by microseisms.
		ePN			37		
		SNE		28	47		
		LNE		32	30ca		
		MN		35	05ca		
		F	12	46			
20	11	ePNE	10	30	48	440	
		SN		31	42		
		F		44			
21	12	ePZ	17	16	32	480	Deeper than normal. Baguio, 150 km.
		ePNE			34		
		SNEZ		17	29		
		F		37			
24	14	ePNEZ	8	03	37	2,200?	Disturbed by another movements.
		S?NE		07	14		
		F	9	40			
25	14	eP?NE	9	51	16	7,750?	Do.
		SN	10	00	33		
		F	11	25			
27	14	eP?N	13	35	25	4,180?	
		SNE		41	13		
		F	14	17			
29	15	iPZ	11	11	04	2,190	Dilatation. Deep focus.
		ePNE			04		
		SNE		14	40		
		F		33			
33	16	ePNEZ	5	05	40	340	
		SNEZ		06	31		
		F		16			
36	17	iPZ	1	20	31	3,020	Dilatation. 18° N: 148.2° E by Manila, Hong Kong, and Riverview. S-P at Guam, 50 seconds. Data after P from the Wiechert and Horizontals. 17° N: 148° E, by U. S. C. G. S. 17.2° N: 147.3° E by J. S. A.
		PNE			34		
		SNE		25	16		
		LE		39	55ca		
		F	5	00			

INSTRUMENTAL RECORD—Continued

No.	Date	Phase	Time	△	Remarks
			h. *m.* *s.*	*Km.*	
38	17	PNEZ	12 12 43	3,530	
		SNE	17 50	----------	
		F	58	----------	
43	19	ePz	0 49 58	1,935	
		SE	53 14	----------	
		F	1 04	----------	
44	19	ePNEZ	5 34 38	2,655	
		SNE	38 47	----------	
		ME	43 25ca	----------	
		F	6 46	----------	
45	20	ePNEZ	10 17 31	7,530?	
		S?NE	26 35	----------	
		F	12 30	----------	
46	21	iPz	2 48 42	1,655	Compression. Deep focus.
		ePN	43	----------	
		iPE	44	----------	
		iSNEZ	51 34	----------	
		F	3 22	----------	
47	21	ePNEZ	4 39 18	1,390	
		SNE	41 42	----------	
		F	5 00	----------	
48	21	iPz	23 50 15	2,220	
		ePNE	15	----------	
		SNE	53 54	----------	
		F	0 20	----------	
49	23	$\overline{\text{iP}}$NEZ	11 30 14	110	Dilatation. Data after $\overline{\text{P}}$ from the Wiechert. Felt in Manila and east central Luzon.
		$\overline{\text{S}}$NE	28	----------	
		F	44	----------	
52	25	ePz	6 51 11	6,010	Deep focus. 15° S: 167° E, by Wellington.
		ePNE	13	----------	
		SNE	58 45	----------	
		F	7 42	----------	
53	26	iPz	17 08 10	4,255	Dilatation.
		iPE	11	----------	
		iPN	12	----------	
		iSNE	14 01	----------	
		LNE	19 20ca	----------	
		F	19 25	----------	
54	27	ePNEZ	14 54 56	4,690	
		SE	15 01 14	----------	
		F	40	----------	
55	27	eP'NEZ	23 05 36	1,080	
		SE	07 30	----------	
		F	20	----------	
57	28	ePNEZ	11 10 44	1,070	
		SN	12 37	----------	
		F	21	----------	

Twenty-eight insignificant or undecipherable disturbances on the following days of January: 2nd, 3rd, 4th, 6th(2), 7th(2), 9th, 14th(3), 15th(2), 16th(4), 17th(3), 18th, 19th, 24th, 25th, 27th, 29th, 30th, and 31st.

FEBRUARY, 1940

MACROSEISMIC RECORD

7, 14h 40m [7, 10:40 P. M.] **Cagayan and Ilocos Norte.** Light earthquake felt at Cape Bojeador, Claveria, and Pamplona.

7, 16h 00m [7, Midnight] **Tupi, Cotabato.** Light earthquake.

8, 4h 45m [8, 2:45 P. M.] **Agaña, Guam.** Light earthquake recorded and perceived.

10, ———. **San Teodoro, Mindoro.** From the 10th to the 13th five or six earthquake shocks were felt daily, with explosives sounds accompanying them. Probably collapse earthquakes as on January 29–30, 1939.

10, 22h 44m 08s * [11, 6:44:08 A. M.] **Dumaguete, Negros Oriental.** Earthquake of intensity III and of twenty-two seconds duration.

11, 7h 00m [11, 3:00 P. M.] **Halcon Rubber, Mindoro.** Light earthquake. Another shock at 8:00. Another shock at 11:52 A. M. on the 13th was recorded in Manila.

14, 9h 29m 02s * [14, 5:29:02 P. M.] **Bayokan,** Tayabas. Light earthquake.

14, 11h 04m 40s [14, 9:04:40 P. M.] **Agaña, Guam.** Earthquake recorded and perceived.

14, 20h 30m [15, 4:30 A. M.] **Yakan, Basilan.** Light earthquake.

15, 21h 08m [16, 5:08 A. M.] **Dapitan, Zamboanga.** Light earthquake. Another shock at 5:15 A. M.

22, 13h 32m 06s* [22, 9:32:06 P. M.] **N. Luzon.** Epicenter in Babuyan Islands. Felt with intensity V and oscillatory motion in Calayan, Babuyan Islands, where the duration was about twenty seconds. Creaking of houses. Two light aftershocks. Intensity IV and eight seconds duration in Aparri, and intensity III in Laoag and Basco. Felt slightly in the provinces of Ilocos Norte, Mountain Province, Cagayan, and Isabela.

24, 23h 10m [25, 7:10 A. M.] **Mainit, Surigao.** Light earthquake.

25, 14h 12m [25, 10:12 P. M.] **Dapitan, Zamboanga.** Light earthquake. Another shock at 10:18 P. M.

25, 19h 40m 01s* [26, 3:40:01 A. M.] **Romblon.** Strong earthquake.

26, ———. **Gonzaga, Cagayan.** Two light shocks in the morning and two in the afternoon.

27, ———. **Gonzaga, Cagayan.** Light shock in the afternoon and another at night. Shocks at 4:30 A. M. and 8:45 A. M. on the 28th.

28, 16h 15m [29, 0:15 A. M.] **Hinatuan, Surigao.** Light earthquake.

29, 22h 45m [March 1, 6:45 A. M.] **San Fernando, Ticao.** Light earthquake.

INSTRUMENTAL RECORD

No.	Date	Phase	Time	△	Remarks
			h. *m.* *s.*	*Km.*	
61	1	ePNE	18 24 02	135	
		SNEZ	19		
		F	29		
62	1	ePN	20 48 54	135	
		SNEZ	49 11		
		F	52		
64	5	iPZ	6 34 01	2,635	
		SNE	38 04		
65	5	eP?Z	7 07 48	3,510?	No. 64 still recording.
		iSNE	12 53		
		F	37		
71	7	iPEZ	17 25 40	6,500	Dilatation. 52°N: 174.5°E, by U. S. C. G. S. 52°N: 177.1°E by J. S. A.
		ePN	40		
		iSNE	33 49		
		LNE	43 30ca		
		MNE	48 ca		
		F	19 28		
73	8	ePNEZ	15 13 40	1,445	
		SNE	16 10		
		F	40		
74	9	ePNEZ	8 06 56	1,445	
		SNEZ	09 27		
		F	25		
77	10	ePNE	22 44 08	680	Felt at Dumaguete.
		SNE	45 24		
		F	57		
81	11	iPEZ	21 30 28	1,690	Compression.
		ePN	28		
		iSNEZ	33 22		
		LNE	34 50ca		
		MN	36 25ca		
		F	22 08		
82	12	P′1	0 21 30	18,220	26°S: 71°W; H=O:01:32 by J. S. A.
		SKKS	32 39		
		PSKS	36 29		
		L	1 19 39		
83	12	iPZ	8 31 59	7,480	Dilatation. 22.6°S: 177.5°W; h=200, by J. S. A.
		ePNE	59		
		SNE	41 00		
84	12	ePNEZ	9 29 03	7,920	No. 83 still recording. 54°N: 160°W, by J. S. A.
		SNE	38 24		
		F	10 30		
85	12	iPZ	16 36 44	2,265	Dilatation.
		ePNE	44		
		SNE	40 24		
		LNE	42 35ca		
		F	17 22		
88	14	ePNE	2 20 14	2,365?	No records on Z component throughout the 14th.
		S?N	24 03		
		F	3 12		
90	14	ePNE	11 54 29	2,655	
		SE	58 38		
		F	12 20		
93	16	ePNEZ	1 14 11	1,530	
		SNE	16 50		
		MNE	19 35ca		
		F	38		
95	17	ePNEZ	1 06 54	1,845	
		SNE	10 03		
		F	42		
96	18	ePNEZ	10 43 30	2,010	
		SNE	46 52		
		F	55		
99	20	iPZ	2 27 26	5,610	Compression. 12°S:167°E, by U. S. C. G. S. 14°S: 167° 15′E; h=200 Km, by Wellington.
		iPNE	28		
		iNEZ	28 30		
		iSNE	34 45		
		LNE	41 30ca		
		MNE	45 45ca		
		F	4 40		
100	20	ePNE	13 06 16	6,000	
		SN	13 52		
		LNE	22 ca		
		F	14 40		

INSTRUMENTAL RECORD—Continued

No.	Date	Phase	Time	△	Remarks
			h. *m.* *s.*	*Km.*	
102	21	ePNEZ	13 28 41	2,665	Deep focus.
		iSN	32 51		
		F	14 02		
103	22	iPNEZ	13 32 06	510	Compression. Felt in northern Luzon, Batan, and Babuyan Islands, About 19° 10′N: 121° 15′E, by Manila and Hong Kong.
		iSNEZ	33 09		
		F	14 37		
104	24	ePNEZ	12 05 52	3,065	
		SNE	10 28		
		iNE	12 13		
		LNE	13 05		
		F	14 10		
109	27	ePNEZ	19 15 23	2,490	
		SNEZ	19 20		
		iE	20 40		
		iN	54		
		LNE	21 40ca		
		F	20 45		
110	28	ePNEZ	13 13 23	880	
		SNEZ	14 57		
		F	22		
111	28	ePNEZ	19 37 09	1,630	
		SNE	40 10		
		LN	41 15		
		F	50		
112	29	PNEZ	16 20 25	9,460	Turkey.
		iSN	30 57		
		eSE	57		
		iN	31 23		
		MN	54 30ca		
		ME	58 00 ca		
		F	17 45		

Twenty-five insignificant or undecipherable disturbances on the following days of February: 4th, 5th(2), 6th(2), 7th, 8th, 9th(2), 10th, 11th(2), 13th, 14th(3), 15th, 16th, 18th, 19th. 20th, 25th(2), 26th, and 27th.

MARCH, 1940

MACROSEISMIC RECORD

1, $2^h\ 15^m$ [1, 10:15 A. M.] **Danao, Cebu.** Light earthquake lasting one minute and forty seconds.

1, $20^h\ 09^m\ 30^{s*}$ [2, 4:09:30 A. M.] **Lobo, Batangas.** Light earthquake.

2, $6^h\ 35^m\ 21^{s*}$ [2, 2:35:21 P. M.] **Samar and Leyte.** Intensity IV and twelve seconds duration in Tacloban, where the motion was oscillatory, first NNE–SSW and then E–W. Intensity IV in Guiuan; III in Borongan; and light in Oras, Bobon, Maasin, Abuyog, Burawen, and Sogod.

3, $21^h\ 42^m\ 06^s$ [4, 7:42:06 A. M.] **Agaña, Guam.** Earthquake recorded and perceived.

5, $5^h\ 20^m$ [5, 1:20 P. M.] **Bobon, Samar.** Light earthquake.

10, $16^h\ 00^m$ [10, Midnight] **Butuan, Agusan.** One momentary shock felt by a few persons.

12, $22^h\ 19^m\ 44^{s*}$ [13, 6:19:44 A. M.] **N. Luzon.** Epicenter in the Balintang Channel. Intensity IV, oscillatory and of eleven seconds duration in Calayan. Felt slightly at Cape Bojeador and Pamplona.

12, $23^h\ 56^m\ 36^{s*}$ [13, 7:56:36 A. M.] **Prieto–Diaz, Sorsogon.** Light earthquake.

13, $1^h\ 00^m$ [13, 9:00 A. M.] **Gonzaga, Cagayan.** Light earthquake.

15, $23^s\ 05^m$ [16, 7:05 A. M.] **Mainit, Surigao.** Slight earthquake.

16, $17^h\ 29^m\ 25^{s*}$ [17, 1:29:25 A. M.] **Iba, Zambales.** Oscillatory earthquake of intensity II and about two seconds duration.

19, $14^h\ 15^m\ 38^{s*}$ [19, 10:15:38 P. M.] **Samar and Leyte.** Oscillatory earthquake of intensity III and four second duration in Borongan. Felt by a few persons with intensity II in Tacloban.

22, $11^h\ 56^m$ [22, 7:56 P. M.] **Tacloban, Leyte.** Sharp shock of intensity II; one second duration.

25, $21^h\ 18^m\ 00^{s*}$ [26, 5:18:00 A. M.] **Igdalaguit, Antique.** Light earthquake.

28, $14^h\ 18^h\ 26^{s*}$ [28, 10:18:26 P. M.] **SE Luzon.** Oscillatory earthquake of intensity IV and about three seconds duration in Virac. Felt lightly in Naga and Libmanan.

28, $15^h\ 49^m\ 22^{s*}$ [28, 11:49:22 P. M.] **Luzon and Mindoro.** Epicenter in the China Sea. Oscillatory, with intensity IV–V in Manila and about fifty seconds duration. Intensity V in Capas, Tarlac, and at Iba where it was preceded by a roaring noise. Felt slightly in all the provinces of northwest, central and southern Luzon, Mindoro, Marinduque, and Catanduanes, which indicate a macroseismic area of about 400-kilometer radius. No damage was reported.

29, $4^h\ 37^m\ 54^s$ [29, 2:37:54 P. M.] **Agaña, Guam.** Earthquake recorded and perceived.

30, $8^h\ 42^m\ 51^s$ [30, 4:42:51 P. M.] **N. Luzon.** Rotatory motion of intensity III and one minute duration felt in Laoag. Also felt lightly in the provinces of Ilocos Norte, Cagayan, and the northern part of the Mountain Province.

INSTRUMENTAL RECORD

No.	Date	Phase	Time	△	Remarks
			h. *m.* *s.*	*Km.*	
113	1	ePNEZ	10 43 47	520	
		SNE	44 48		
		F	11 08		
116	2	ePNEZ	6 35 21	580	Felt in Samar and Leyte. Epicenter probably in Samar.
		SNE	36 27		
		F	7 10		
117	3	ePN	0 15 31	6,320	Near 17°S: 165°E, by Riverview and Manila. P in E and Z components lost in changing records.
		iSNE	23 13		
		F	1 40		
119	3	iPz	12 03 26	3,250	
		ePNE	26		
		iSN	08 15		
		LN	11 45ca		
		F	13 13		
121	4	iPz	15 49 48	2,545	
		ePNE	48		
		SNEZ	53 49		
		F	16 13		
125	6	iPz	18 34 30	8,220	Dilatation.
		ePNE	30		
		SN	44 06		
		LNE	59 ca		
		F	19 45		
127	9	iPz	10 51 22	1,810	Do.
		ePNE	22		
		SNE	54 27		
		F	12 10		
130	10	ePNEZ	10 12 28	630	
		SNE	13 29		
		F	32		
132	12	ePNEZ	22 19 44	600	Approximately 20°N: 121°E, by Manila and Hong Kong. Felt in northern Luzon, and Calayan.
		SNEZ	20 52		
		F	23 19		
133	12	ePNEZ	23 56 36	420	Felt at Prieto-Diaz, Sorsogon. Epicenter in the neigborhood of 13°10′N: 124°30′E.
		SNEZ	57 27		
	13	F	0 10		
137	14	ePEZ	18 34 14	8,190	56°S; 145°E by Wellington.
		ePN	18		
		iSNE	43 52		
		LNE	58 40ca		
		MNE	19 05 ca		
		F	21 15		
139	15	ePNEZ	5 33 23	2,880	
		SN	37 47		
		LE	40 30ca		
		ME	43 ca		
		F	7 10		
141	16	ePEZ	17 29 25	150	Felt at Iba, Zambales.
		SNE	44		
		F	38		
146	19	iPEZ	4 44 44	5,520	
		iSN	51 50		
		LE	5 00 ca		
		F	52		
147	19	ePNEZ	10 52 25	3,365?	
		S?NE	57 33		
		F	12 10		
150	21	iPEZ	13 58 45	3,720	Compression.
		ePN	45		
		iSNE	14 04 04		
		LNE	08 05ca		
		MNE	11 05ca		
		F	16 00		
151	22	ePNEZ	20 31 32	8,980	
		SN	41 40		
		LN	52 30ca		
		MNE	59 ca		
		F	22 00		
153	27	iPz	12 41 20	6,620	Compression. 51°N: 180° by U. S. C. G. S. 51.5°N: 177.5°W, by J.S.A.
		ePNE	22		
		iSNE	49 34		
		LNE	13 00 ca		
		ME	04 50		
		F	14 38		

INSTRUMENTAL RECORD—Continued

No.	Date	Phase	Time	△	Remarks
			h. *m.* *s.*	*Km.*	
155	28	ePNEZ	14 18 28	390	Compression. Probably deeper than normal. Felt in Catanduanes and Camarines Sur, SE Luzon.
		SNEZ	19 17		
		F	47		
156	28	iPNEZ	15 49 22	175	Compression. 14°N: 119°30′E. Felt in Luzon, Mindoro, Marinduque, and Catanduanes. S from Horizontal Pendulums.
		S	44		
		F	18 20		
161	29	ePNEZ	21 43 12	3,920	
		SNE	48 43		
		LNE	53 50		
		F	22 25		
162	30	$e\overline{P}z$	4 18 59	175	
		$e\overline{P}NE$	59		
		$\overline{S}NE$	19 21		
		F	27		
163	30	iPz	6 26 50	2,630	
		ePNE	50		
		SNE	31 06		
		LNE	33 20		
		F	7 43		
164	30	ePNE	8 42 51	350	Felt in northern Luzon. Z cylinder stopped at 7:38. Center probably in mountains of N. Luzon.
		SNE	43 36		
		F	9 13		
165	30	$e\overline{P}NE$	13 00 51	175	
		$\overline{S}NE$	01 13		
		F	07		
167	30	$e\overline{P}NE$	21 36 37	180	
		$\overline{S}NE$	37 00		
		F	44		

Thirty insignificant or undecipherable disturbances on the following days of March: 1st(2), 3rd, 4th(2), 5th, 6th, 7th, 9th(2), 11th, 13th, 14th(2), 15th(2), 17th(2), 18th(2), 19th, 21st, 25th, 27th 29th(4), 30th, and 31st.

APRIL, 1940

MACROSEISMIC RECORD

3, 11h 10m [3, 7:10 P. M.] **Juban, Sorsogon.** Light earthquake.

5, 9h 22m 34s* [5, 5:22:34 P. M.] **SE Luzon.** Oscillatory motion, S–N, with intensity IV felt at Virac. Felt lightly at Naga, Tiwi, Libog, and Mayon Rest House.

6, 0h 41m 21s* [6, 8:41:21 A. M.] **Surigao, Surigao.** Extremely feeble shock lasting four seconds.

7, 8h 55m [7, 4:55 P. M.] **Carigara, Leyte.** Slight earthquake.

8, 2h 50m 29s* [8, 10:50:29 A. M.] **SE Luzon and Samar.** Epicenter in the Philippine Deep. Felt with intensity V at Laoang. Oscillatory, with intensity IV and duration of forty seconds at Legaspi. Felt lightly in the provinces of southeast Luzon, throughout Samar, and at Abuyog in Leyte.

8, 3h 15m [8, 11:15 A. M.] **Mindanao.** Light earthquake felt at Pantao, Lanao, and at Libay, a barrio of Dapitan in the Province of Zamboanga.

8, 17h 52m 07s * [9, 1:52:07 A. M.] **Luzon.** Earthquake felt very lightly in Calayan, with vertical motion lasting ten seconds. Also felt at Claveria and Laoag.

8, 20h 00m [9, 4:00 A. M.] **Kabugao, Mountain.** Light earthquake.

10, 11h 11m [10, 7:11 P. M.] **Kaatoan, Bukidnon.** Earthquake lasting five seconds.

12, 3h 05m [12, 11:05 A. M.] **Ormoc, Leyte.** Oscillatory motion of intensity II lasting fifteen seconds.

12, 20h 15m 08s * [13, 4:15:08 A. M.] **Port Lamon, Surigao.** Light earthquake of three seconds duration.

14, 10h 55m [14, 6:55 P. M.] **Cantilan, Surigao.** Light earthquake.

14, ——— [P. M.] **Oras, Samar.** Light earthquake; exact time not reported.

14, 14h 35m 48s* [14, 10:35:48 P. M.] **NE Mindanao.** Epicenter in the Philippine Deep. Felt with intensity IV at Butuan for a duration of about forty seconds. Pendulum clock stopped; houses creaked; sleeping persons awakened. Felt lightly at Surigao, Dapa, Cantilan and Cabadbaran.

15, 06h 30m 27s* [15, 2:30:27 P. M.] **Butuan, Agusan.** Earthquake of intensity II and duration of twenty seconds.

18, 8h 00m [18, 4:00 P. M.] **San Jose, Nueva Ecija.** Light earthquake.

19, 8h 50m [19, 4:50 P. M.] **Laoag, Ilocos Norte.** Earthquake of intensity II and duration of five seconds.

20, 15h 37m [20, 11:37 P. M.] **E Mindanao.** Earthquake of short duration felt at Baganga, Port Lamon, and Talacogon.

22, 0h 30m [22, 8:30 A. M.] **Baguio City.** Light earthquake.

23, 4h 53m 49s* [23, 12:53:49 P. M.] **Central Luzon.** Felt with intensity III and oscillatory motion at Cabanatuan. Also felt in Manila, Baler and Baguio.

26, ——— [4:30 A. M.?] **Cape Bojeador, Ilocos Norte.** Light earthquake.

28, 17h 47m 00s* [29, 1:47:00 A. M.] **Baler, Tayabas.** Very feeble earthquake lasting five seconds with oscillatory motion.

INSTRUMENTAL RECORD

No.	Date	Phase	Time			△	Remarks
			h.	*m.*	*s.*	*Km.*	
169	1	iPNEZ	11	24	31	3,090	Dilatation from SE. In the region of New Guinea, by Manila and Riverview.
		iSNE		29	09		
		F	14	05			
170	1	ePNE	16	15	10	1,020	
		SNE		16	58		
		F		33			
174	4	ePNEZ	7	12	20	1,380	
		SNE		14	43		
		F		42			
176	5	ePNEZ	9	22	34	325	Felt in southeastern Luzon. Epicenter in the Pacific Ocean.
		$\overline{S}$NEZ		23	17		
		F		35			
177	5	iPZ	16	40	01	2,350	Compression.
		ePNE			01		
		SNE		43	49		
		F	17	12			
179	6	ePNEZ	5	20	34	1,930	
		SNEZ		23	50		
		F		42			
181	6	ePZ	13	47	32	2,555	Compression. 27°N: 105°E, provisional by Bombay.
		ePNE			33		
		iSNE		51	34		
		iN		52	03		
		LN		53	50ca		
		F	14	56			
183	6	PNZ	18	59	29	1,565?	
		S?N	19	02	12		
		MN		05	12		
		F		33			
185	8	iPZ	2	50	29	590	Dilatation. Near 12° 30′N: 125°50′E. Felt in southeastern Luzon and in northern Samar.
		ePNE			29		
		iSNE		51	36		
		F	4	14			
187	8	ePNEZ	11	31	55	435	Dilatation.
		SNEZ		32	48		
		F	12	35			
188	8	ePNEZ	17	52	07	590	Felt in northern part of Luzon.
		SNZ		53	14		
		F	18	27			
190	11	ePNEZ	9	12	10	4,920?	
		S?NE		18	42		
		F	10	20			
197	14	ePNEZ	8	31	37	1,190	
		SNE		33	40		
		F		47			
198	14	iPZ	9	44	22	3,600	
		ePNE			22		
		SE		49	33		
		LNE		53	29		
		F	10	27			
199	14	ePNEZ	12	04	59	1,530	
		SNE		07	38		
		F	13	15			
200	14	iPZ	14	35	48	890	Compression. 9°N: 126° 50′E, by Butuan and Manila. Felt in northeastern Mindanao.
		iPNE			51		
		iSZ		37	23		
		F	16	40			
201	14	ePNEZ	17	48	08	1,570	
		SNE		50	52		
		F	18	50			
203	15	ePNEZ	3	56	47	2,490	
		SN	4	00	44		
		F		22			
204	15	ePNEZ	6	30	27	890	Probably 9°N: 126° 59′E, by Manila and Butuan.
		iSNE		32	07		
		F	7	00			
205	15	ePNEZ	17	34	13	2,530	
		SNE		38	13		
		F	18	10			

INSTRUMENTAL RECORD—Continued

No.	Date	Phase	Time			△	Remarks
			h.	*m.*	*s.*	*Km.*	
207	16	iPEZ	6	17	23	6,245	Compression. 52.6°N: 173.8°E, by U. S. C. G. S. 53.7°N: 175.3°E,by J. S. A.
		PN			26	----------	
		SNE		26	13	----------	
		LNE		35	ca	----------	
		F	10	35		----------	
208	17	iPZ	20	12	09	1,410	
		ePNE			11	----------	
		SN		14	35	----------	
		LN		15	40ca	----------	
		F	21	22		----------	
209	17	iPZ	21	42	39	3,000	Dilatation.
		ePNE			39	----------	
		SN		47	11	----------	
		F	22	50		----------	
210	18	ePNEZ	19	50	38	4,345	
		SNE		56	47	----------	
		F	20	40		----------	
211	18	ePEZ	23	19	03	2,500	
		iN		21	58	----------	
		SE		23	01	----------	
		F		52		----------	
214	19	iPZ	14	48	07	5,060	
		ePNE			07	----------	
		SE		54	47	----------	
		F	16	10		----------	
216	20	iPZ	15	48	33	1,190	Compression. Probably deeper than normal In the Philippine Deep.
		ePNE			33	----------	
		SNEZ		50	36	----------	
		F	17	10		----------	
222	23	i$\overline{P}$NEZ	4	53	49	140	Compression. 15° 52′N: 121° 15′E, by Baguio and Manila. Felt at Baler, Manila, Cabanatuan, and Baguio. $\overline{S}$ from the Wiechert.
		$\overline{S}$NE		54	06	----------	
		F	5	22		----------	
223	23	ePEZ	7	06	14	690	N–S cylinder stopped at 4:56.
		SE		07	31	----------	
		F		25		----------	
227	24	ePNEZ	10	28	37	3,920	
		SNE		34	18	----------	
		LN		38	50ca	----------	
		MN		41	50ca	----------	
		F	11	54		----------	
232	27	ePNEZ	9	44	38	5,940	
		SNE		52	08	----------	
		LNE	10	01	25ca	----------	
		MNE		04	40ca	----------	
		F	13	45		----------	
233	27	ePNEZ	10	51	25	6,540	
		SNE		59	30	----------	
		LE	11	10	10ca	----------	
		MNE		14	40ca	----------	
234	27	ePNEZ	18	13	56	6,020?	
		S?NE		21	31	----------	
		F	20	15		----------	
235	28	e$\overline{P}$NEZ	17	16	49	150	
		i$\overline{S}$NEZ		17	08	----------	
		F		26		----------	
236	28	e$\overline{P}$NEZ	17	47	00	150	Felt at Baler.
		i$\overline{S}$NEZ			19	----------	
		F		58		----------	

Thirty-six insignificant or undecipherable disturbances on the following days of April: 2nd, 3rd(2), 4th, 6th(3), 7th, 8th, 10th, 11th, 12th, 13th(3), 14th(2). 15th, 19th(2), 20th(3), 22nd(3), 23rd(3), 25th, 26th(2), 27th, 28th, 29th, and 30th.

MACROSEISMIC RECORD

1, 6h 01m 56s* [1, 2:01:56 P. M.] **Lobo, Batangas.** Light earthquake.

4, 17h 17m 33s* [5, 1:17:33 A. M.] **Ormoc, Leyte.** Oscillatory earthquake of intensity II, lasting twenty seconds.

5, 8h 45m [5, 4:45 P. M.] **Claveria, Cagayan.** Light earthquake.

8, ——— [6:00 P. M.] **Itogon, Mountain.** Light earthquake.

17, 0h 24m 13s* [17, 8:24:13 A. M.] **Baganga, Davao.** Light earthquake with vertical motion, lasting, but a few seconds.

21, 4h 18m [21, 12:18 P. M.] **SW Mindanao.** Oscillatory earthquake of intensity III and two seconds duration felt in Zamboanga. Felt lightly at San Ramon and Yakan.

22, 13h 00m [22, 9:00 P. M.] **Alang-Alang, Leyte.** Light earthquake.

23, 20h 36m 50s* [24, 4:36:50 A. M.] **SE Luzon and Marinduque.** Oscillatory earthquake of intensity III and four seconds duration felt at Capalonga. Felt slightly at Boac, Libmanan, Naga, and Masbate.

26, 23h 48m [27, 7:48 A. M.] **NE Mindanao.** Earthquake felt slightly at Butuan, Cantilan, Mainit, and Bucas Island.

28, 14h 10m [28, 10:10 P. M.] **Matatio, Tayabas.** Light earthquake.

30, 19h 46m [31, 3:46 A. M.] **Naga, Camarines Sur.** Light, oscillatory earthquake of short duration.

31, 0h 53m 41s [31, 10:53:41 A. M.] **Agaña, Guam.** Light earthquake recorded and perceived.

31, 22h 35m 57s* [June 1, 6:35:57 A. M.] **SE Visayas and N Mindanao.** Epicenter probably in Bohol Strait. Oscillatory with intensity IV and eight seconds duration at Dumaguete. Oscillatory with intensity III and five seconds duration at Maasin. Felt lightly at Jagna, Clarin, Butuan, and Abuyog.

INSTRUMENTAL RECORD

No.	Date	Phase	Time			△	Remarks
			h.	*m.*	*s.*	*Km.*	
240	1	i$\overline{P}$Z	6	01	56	125	Slightly felt at Lobo, Batangas. Baguio, 325km.
		e$\overline{P}$NE			56		
		$\overline{S}$NEZ		02	12		
		F		27			
241	1	ePNZ	7	57	16	2,030	
		ePE			19		
		iSN	8	00	40		
		LNE		02	20ca		
		MN		04	20ca		
		F	9	20			
243	2	iPZ	5	49	59	4,645	
		ePNE			59		
		SNE		56	24		
		F	6	40			
244	2	ePNEZ	8	33	19	6,090	
		SNE		41	05		
		F	9	10			
245	3	eP?NEZ	4	00	29	2,020?	
		SNE		03	36		
		F		45			
246	3	ePNEZ	5	13	54	1,550	
		SNE		16	35		
		F		37			
249	4	iPZ	7	33	47	6,430	Dilatation. 53°N: 173°E, by U. S. C. G. S.
		ePNE			47		
		iSNE		41	46		
		LNE		50	05ca		
		F	9	47			
251	4	ePNEZ	21	12	02	6,940	Compression.
		SNE		20	31		
		LNE		31	20ca		
		MNE		36	30ca		
		F	23	25			
252	5	P_1'	2	23	45		Long distance.
		PPZ		28	00		
		F	4	40			
253	6	e$\overline{P}$NEZ	10	46	02	110	
		$\overline{S}$NE			16		
		F		52			
255	7	iPZ	22	35	04	7,700	
		ePNE			06		
		SN		44	20		
		F	23	58			
257	8	ePNZ	8	41	08	2,740	
		SNE		45	23		
		F	9	11			
260	9	ePNZ	0	36	32	2,220	
		SNEZ		40	11		
		F	1	32			
262	10	i$\overline{P}$Z	6	45	15	125	
		e$\overline{P}$NE			15		
		i$\overline{S}$NE			31		
		F		52			
263	10	iPZ	19	05	20	3,190	
		ePNE			20		
		SNE		10	05		
		LE		12	55ca		
		F	20	20			
264	11	ePNEZ	7	47	42	4,600	
		eSNEZ		53	55		
		F	8	25			
265	11	iPZ	14	04	18	6,340	Compression. 53.2°N: 172°E, by U. S. C. G. S.
		ePNE			18		
		iSNE		12	11		
		MNE		26	40ca		
		F	15	37			
266	11	ePNEZ	21	06	01	5,390	
		SN		12	59		
		F	22	20			
269	13	ePNEZ	22	42	18	1,245	
		SNE		45	27		
		LN		46	45ca		
		F	23	17			

INSTRUMENTAL RECORD—Continued

No.	Date	Phase	Time	△	Remarks
			h. *m.* *s.*	*Km.*	
271	14	ePNEZ	16 07 17	2,300	
		SE	11 01		
		F	55		
275	16	ePNEZ	15 45 21	3,390	
		SNE	50 18		
		F	16 10		
277	17	iZ	2 19 34	16,435	7.9°N: 81.8°W, by U. S. C. G. S.
		iE	23 10		
		F	49		
278	17	ePNEZ	8 02 47	680	
		SEZ	04 03		
		F	12		
279	17	$\overline{e}$PNEZ	13 52 02	175	
		$\overline{S}$NEZ	24		
		F	59		
280	18	ePNEZ	5 08 21	4,290	
		SNE	14 15		
		F	6 20		
281	19	ePNEZ	4 51 11	12,015	Near 32.8°N: 115.6°W, by U. S. C. G. S. 0=4:36:46.
		PPZ	55 38		
		SKSNE	5 01 47		
		S	03 20		
		PSN	04 47		
		L	27 ca		
		F	8 35		
282	19	iPZ	15 25 04	4,700	Dilatation. 51°N: 148°E, h= about 600 km., by U. S. C. G. S.
		ePNE	04		
		SNE	30 31		
		iNE	34 00		
		F	17 03		
283	19	iPZ	18 29 52	8,140	
		SE	39 28		
		F	21 00		
284	20	ePNEZ	11 28 20	1,290	
		SN	30 34		
		F	55		
287	21	ePNEZ	7 27 11	1,755	
		SNE	30 15		
		F	52		
289	21	iPEZ	18 59 32	7,800	Dilatation. Region 23°S: 178°W; h about 400 km., by U. S. C. G. S.
		PN	35		
		iZ	19 01 32		
		LNE	08 31		
		F	20 20		
292	23	ePZ	6 11 40	4,300	
		ePNE	41		
		SNE	17 35		
		LE	22 10ca		
		MNE	26 15ca		
		F	7 37		
293	23	$\overline{e}$PNEZ	12 18 42	145	
		$\overline{S}$NEZ	19 00		
		F	28		
295	23	ePNEZ	20 36 50	230	Felt in southeastern Luzon and in Marinduque. Epicenter in the Pacific.
		$\overline{S}$NEZ	37 21		
		F	21 00		
296	24	iP$_1$′EZ	16 53 57	17,990	Compression .Near 11.9°S: 77.4°W, 0=16:33:40, by U. S. C. G. S. Destructive in Peru. Phases after P$_1$′ from Wiechert
		eP$_1$′N	54 00		
		SSS	17 25 10ca		
		L	51 00ca		
		M	18 03 00ca		
		F	22 08		
297	24	iP$_1$′Z	22 17 49	17,990	Aftershock of No. 296. 9=21:57:40, by U. S. C. G. S.
	25	F	0 50		
298	26	ePNEZ	4 12 20	580	
		$\overline{S}$NE	13 52		
		F	27		
299	26	ePNEZ	6 51 50	210	
		$\overline{S}$NE	52 19		
		F	59		
300	27	ePEZ	4 19 08	6,310	Deep focus.
		iSNE	26 59		
		F	56		

INSTRUMENTAL RECORD—Continued

No.	Date	Phase	Time	△	Remarks
			h. *m.* *s.*	*Km.*	
303	28	iPz	9 46 04	3,000	Dilatation. Provisional 2°S: 136°E, by U. S. C. G. S. L from the Wiechert.
		PNE	06		
		iSE	50 35		
		LNE	53 30		
304	28	ePNEZ	13 06 22	2,980	No. 303 still recording.
		SN	10 52		
		F	14 22		
305	28	iPz	14 28 41	3,020	
		iSN	33 14		
		F	15 02		
307	28	ePNEZ	21 33 40	2,910	
		SN	38 06		
		F	22 25		
308	29	iPz	1 03 33	3,790	Compression. Deep focus?
		ePNE	33		
		SN	08 56		
		LE	13 10ca		
		MNE	17 30ca		
309	29	ePz	2 10 14	9,100	No. 308 still recording. 68°N: 148°W, by U. S. C. G. S.
		SNE	29 29		
		LNE	35 50ca		
		MN	43 20ca		
		F	4 40		
310	29	ePNEZ	8 03 29	3,080	
		SN	08 06		
		F	32		
311	29	$e\overline{P}$NEZ	19 15 22	145	
		$\overline{S}$NEZ	40		
		F	31		
313	31	ePNEZ	0 52 30	8,140	
		SNE	1 02 06		
		F	54		
315	31	Pz	23 35 57	630	Felt at Cebu, at points around the Mindanao Sea, and at Abuyog Leyte.
		SNEZ	37 07		
		F	23 27		

Twenty-seven insignificant or undecipherable disturbances on the following days of May: 1st, 3rd(2), 4th, 6th, 8th(2), 9th(2), 12th(2), 14th, 15th, 16th(2), 17th, 20th(2), 21st(2), 22 nd, 23rd, 27th(2), 28th, 30th, and 31st.

JUNE, 1940

MACROSEISMIC RECORD

2, 12h 55m [2, 8:55 P. M.] **NE Mindanao.** Sharp shock of intensity III and short duration at Dapa. Felt lightly at Mainit and Butuan.

5, 14h 48m 51s* [5, 10:48:51 P. M.] **NW Luzon.** Felt with intensity III and eighteen seconds duration at Vigan. Felt lightly at Batac, Lepanto, Pamplona, and Baguio.

6, 11h 30m [6, 7:30 P. M.] **Cotabato.** Light earthquake felt at **Kling** and **Tupi.**

6, 13h 20m [6, 9:20 P. M.] **San Fernando, Masbate.** Light earthquake.

7, 8h 30m [7, 4:30 P. M.] **Mainit, Surigao.** Light earthquake.

10, ——— [P. M.] **Upi, Cotabato.** Light earthquake.

10, 17h 10m [11, 1:10 A. M.] **Palanas, Masbate.** Light earthquake.

23, 17h 48m [24, 1:48 A. M.] **Davao, Davao.** Earthquake of intensity II.

26, 22h 11m 29s [27, 8:11:29 A. M.] **Agaña, Guam.** Earthquake recorded and perceived.

INSTRUMENTAL RECORD

No.	Date	Phase	Time	△	Remarks
			h. *m.* *s.*	*Km.*	
317	2	iPZ	12 13 41	2,630	Dilatation.
		iPNE	43		
		iNEZ	17 14		
		iSNE	50		
		F	13 58		
318	2	PZ	19 30 09	5,255	
		iSNE	37 08		
		F	20 20		
319	3	P′Z	18 25 12	13,000	Provisional, 25°N: 110°W; 0=18:05:22, by U. S.. C. G S.
		LNE	50 00		
		F	20 30		
320	4	iPZ	0 06 05	2,240	
		ePNE	07		
		SNE	09 45		
321	4	ePN	0 11 33	1,010	No. 320 still recording.
		SNE	13 20		
		F	32		
323	4	$e\overline{P}$NEZ	17 55 28	135	
		$i\overline{S}$NE	45		
		F	18 05		
324	5	ePZ	11 13 35	9,110	68°N: 38°W; by U. S. C.G S.
		SN	23 56		
		LN	40 50ca		
		MN	47 10ca		
		F	13 55		
325	5	iPNZ	14 48 51	550	Compression. Felt in northern Luzon.
		SNE	49 55		
		F	16 15		
326	6	ePZ	11 05 41	1,930?	
		ePNE	42		
		SNE?	08 57		
		F	51		
327	7	iPZ	7 24 42	4,390	Compression.
		ePNE	43		
		iSNE	30 41		
		LNE	36 20ca		
		F	8 55		
328	8	iPZ	4 11 23	8,680	Dilatation?
		ePNE	29		
		SNE	21 26		
		F	5 25		
331	10	$e\overline{P}$NEZ	11 41 56	150	
		$\overline{S}$NEZ	42 15		
		F	46		
332	11	iPZ	8 47 19	2,780	Compression (?).
		iPN	21		
		ePE	21		

INSTRUMENTAL RECORD—Continued

No.	Date	Phase	Time			Δ	Remarks
			h.	*m.*	*s.*	*Km.*	
		iSNE		51	36	----------	
		MNEZ		56	30ca	----------	
		F	10	15		----------	
333	12	ePNEZ	5	45	36	4,790	
		SNE		52	00	----------	
		F	6	35		----------	
334	12	ePz	11	59	46	7,400	
		SNE	12	08	48	----------	
		F	13	20		----------	
335	12	ePNEZ	14	06	09	3,680	
		SNE		11	25	----------	
		LNE		15	30ca	----------	
		F	17	00		----------	
336	12	iPz	18	42	25	4,000	Compression?
		ePNE			25	----------	
		iSN		48	03	----------	
		LN		51	15ca	----------	
		F	19	50		----------	
339	15	ePNEZ	6	17	15	230	
		SNE			47	----------	
		F		25		----------	
342	17	ePEZ	10	38	55	9,150	21°N: 155.3°W, by U. S. C. G. S.
		SNE		49	13	----------	
		LNE	11	05	30ca	----------	
		ME		13	30ca	----------	
		F	13	04		----------	
343	17	iPz	14	40	06	1,370	Compression?
		ePNE			06	----------	
		iSN		42	29	----------	
		MN		45	54ca	----------	
		F	15	42		----------	
344	17	ePNZ	20	23	39	1,360?	
		iS?N		26	01	----------	
		F	21	05		----------	
346	18	iPEZ	13	54	46	1,010	Compression from SE. Deeper than normal.
		ePN			46	----------	
		iSNE		56	33	----------	
		F	16	00		----------	
347	18	ePz	18	48	40	6,200	54°N: 173° ±E, by U. S. C. G. S.
		ePNE			41	----------	
		SNE		56	33	----------	
		MN	19	10	30ca	----------	
		F	20	15		----------	
351	19	ePNEZ	23	12	56	320	
		SNEZ		13	38	----------	
		F		26		----------	
355	22	iPNEZ	11	40	04	1,700	Dilatation from SE. ~~In region of 11°N; 186°E, by Manila and Butuan.~~ S from the Wiechert and Horizontals.
		SNE		43	00	----------	
		F	14	22		----------	
356	22	ePNEZ	23	17	17	1,690	Dilatation from SE.
		SNE		20	12	----------	
		F		41		----------	
360	24	ePNEZ	2	39	19	4,190	
		SNE		45	07	----------	
		F	3	30		----------	
361	25	ePNEZ	2	24	18	4,240?	
		S?E		30	09	----------	
		LN		34	18ca	----------	
		F	3	25		----------	
363	26	iPz	8	05	45	3,090	Compression.
		ePNE			45	----------	
		iSNE		10	35	----------	
		LNE		13	20ca	----------	
		MNE		15	35ca	----------	
		F	9	30		----------	
364	27	ePNEZ	6	56	44	2,430?	
		S?N	7	00	37	----------	
		F		19		----------	

Twenty insignificant or undecipherable disturbances on the following days of June: 2nd, 4th, 9th, 10th, 13th, 14th, 15th(2), 17th, 18th, 19th(2), 21st(3), 23rd(3), 26th, and 27th.

PHILIPPINE EARTHQUAKE EPICENTERS, 1933–1934

By W. C. Repetti, S. J.
Manila Observatory

In this issue of the Seismological Bulletin we give the Philippine earthquake epicenters for the years 1933 and 1934, continuing the lists published in previous bulletins. The reasons for publishing these epicenters are the same as those in the preceding bulletin (July–Dec., 1939), viz., the probability that the International Summary will fall still farther into arrears because of the war, and the fact that many of the determinations made here are more accurate than those of the Summary.

The earthquake of particular interest in this present series is that of February 14, 1934, at 3:59:34 G. M. T. The records of this earthquake obtained throughout the world show that it was the strongest earthquake in the Philippines of which we have definite evidence. The famous Manila earthquakes of 1645, 1658, 1863 and 1880 were far more destructive but we are of the opinion that the destruction was due to a very great extent to the type of weakness of construction and to deterioration, thus giving an exaggerated estimate of the severity of the earthquakes. In the case of the 1934 earthquake, which was under the China Sea and not very destructive on land, we have the more reliable evidence of seismic records over the whole world.

EPICENTERS

	Δ ° ′	P h. m. s.	O–C s	Remarks
FEBRUARY 19, 1933				
14° 10′ N: 122° 40′ E: H = 04h 35m 30s				
Manila	01 45	4 36 01	0	Destructive near the epicenter. This position adopted by the International Summary.
Miyazaki	19 28	40 00	— 1	
Hukuoka	20 39	13	— 2	
Koti	21 42	18	— 4	
FEBRUARY 22, 1933				
5° 18′ N: 125° 00′ E; H = 3h 48m 02s				
Manila	10 06	3 50 29	0	Not reported as felt in southern Mindanao. The erroneous arrival time of P given in the Observatory Bulletin for 1933 was due to microseisms and a spurious oscillation between 3:48:00 and 3:49:00. The International Summary gives a position only slightly different from the above, viz: 5° 24′N: 125° 12′E.
Hong Kong	20 00	52 35	0	
Batavia	21 28	54	+ 2	
PhuLien	23 37	53 08	— 5	
Zikawei	26 06	36	— 2	
Medan	26 08	45	+ 7	
Chiufeng	35 42	55 06	+ 3	
Baku	75 18	59 50	+ 8	
Tifiis	79 06	4 00 10	+ 6	
MARCH 3, 1933				
15° 35′ N: 120° 10′ E: H = 2h 19m 43s; h = 75–100 Km.				
Manila	1 15	2 20 01	0	Felt moderately in western Luzon. The International Summary gives 15°N: 120°E and normal depth, but this position does not agree with the macroseismic reports. Moreover, a residual of +13 seconds is found for Manila, which can not be admitted.
Hong Kong	8 48	21 49	+ 3	
Taihoku	9 32	22 00	+ 5	
PhuLien	13 52	(23) 00	+ 4	
Zikawei	15 39	16	— 1	
Palau	16 17	18	— 8	
Nanking	16 31	32	+ 4	
Nagasaki	19 17	49	— 9	
Koti	21 39	24 26	+ 5	
Zinsen	22 38	2 24 27	— 2	
Keizyo	22 48	34	+ 3	
Sumoto	22 58	58	+ 5	
Kobe	23 22	41	+ 4	
Osaka	23 32	32	— 6	
Toyooka	23 51	47	+ 8	
Heizyo	23 58	50	+ 7	
Medan	24 18	50	+ 4	
Chiufeng	24 41	53	+ 3	
Batavia	25 28	25 06	+ 6	
Kodaikanal	41 54	27 24	+ 1	
Bombay	45 13	28 00	+10	
Almata	45 57	05	+ 9	

EPICENTERS—Continued

	Δ °	Δ ′	P h.	P m.	P s.	O–C s	Remarks
MARCH 3, 1933							
15° 35′ N: 120° 10′ E: H = 2h 19m 43s; h = 75–100 Km.							
Andijan	48	12			12	— 1	Felt moderately in western Luzon. This International Summary gives 15° N: 120° E and normal depth, but this position does not agree with the macroseismic reports. Moreovcr. a residual of + 13 seconds is found for Manila, which can not be admitted.
Tashkent	59	39		28	32	+ 1	
Tcimkent	50	42			30	— 2	
Samarkand	51	59			32	— 9	
Sverdlovsk	60	30		29	42	— 1	
Baku	65	06		30	14	+ 1	
Theodosia	75	24		31	16	+ 3	
Simferopol	76	18			21	+ 3	
Yalta	76	21			19	+ 1	
Pulkovo	76	30			20	0	
Sebastopol	76	46			25	+ 4	
Copenhagen	87	00		32	15	0	
Zagreb	88	24			22	0	
Chur	92	06			39	— 2	
Zurich	92	25			41	— 2	
MARCH 17, 1933							
6° 30′ N: 127° 00′ E; H = 19h 32m 29s							
Palau	7	26	19	34	14	— 5	
Manila	10	00			56	0	
Amboina	10	15		35	00	+ 2	
Hong Kong	20	04		37	00	— 2	
Batavia	23	48			36	— 6	
Phu-Lien	24	04			44	— 3	
Titizima	25	08			54	— 1	
Zikawei	25	15			50	— 6	
Miyazaki	25	45			59	— 2	
Nagasaki	26	24		38	03	— 5	
Nanking	26	40			07	— 4	
Koti	27	44			18	— 3	
Medan	28	18			31	+ 5	
Sumoto	28	48			25	— 6	
Kobe	29	12			30	— 4	
Taikyu	29	24			41	+ 5	
Kameyama	29	40			35	— 4	
Toyooka	29	54			38	— 3	
Nagoya	30	06			39	— 3	
Keizyo	31	06		(39)	01	+10	
Chiufeng	34	57			15	— 9	
Mizusawa	35	02			25	+ 1	
Morioka	35	33			27	— 1	
Vladivostok	36	54			39	— 1	
Perth	39	54		40	00	— 4	
Calcutta	40	36			19	+10	
Ootomari	42	24			30	+ 6	
Colombo	46	48	19	41	00	+ 2	
Melbourne	47	18		(41)	00	— 2	
Hyderabad	48	36			14	+ 3	
Kodaikanal	49	06			11	— 6	
Agra	50	48			25	— 3	
Bombay	54	06			51	0	
Almata	57	12		42	20	+ 7	
Andijan	59	24			33	+ 5	
Tashkent	61	45			50	+ 7	
Samarkand	63	00		43	00	+ 9	
Wellington	64	42			12	+10	
Sverdlovsk	71	48			50	+ 2	
Baku	76	00		44	15	+ 2	
Tiflis	79	54			35	— 1	
Tananarive	82	12			51	+ 3	
Kucino	84	06			58	+ 1	
Theodosia	86	30		45	11	+ 2	
Ksara	87	18			13	0	
Simferopol	87	27			13	— 1	
Yalta	87	27			15	+ 1	
Pulkovo	87	48			17	+ 1	
Sebastopol	87	54			20	+ 4	
Helwan	91	42			37	+ 2	
Stuttgart	102	48		46	26	— 2	
Chur	103	24			32	+ 1	
De Bilt	103	30			34	+ 3	
Florence	103	30			36	+ 5	
Strasbourg	103	42	19	46	35	+ 3	
La Plata	151	18		52	20	+ 7	P_1'
San Juan	151	54			20	+ 6	P_1'
Huancayo	157	18			29	+ 8	P_1'
La Paz	162	06			28	+ 2	P_1'
APRIL 1, 1933							
6° 20′ N: 127° 00′ E; H = 08h 07m 33s							
Manila	10	09	8	10	10	0	The International Summary puts the epicenter at 5° 06′N:127° 18′E.
Hong Kong	20	12		12	10	+ 1	
Batavia	23	43			51	+ 6	
Phu-Lien	24	18		(13)	00	+ 9	
Medan	28	28			35	+ 3	
Chiufeng	35	08		(14)	36	— 3	
Vladivostok	37	02			50	+ 6	
Sverdlovsk	71	57		19	00	+ 7	
Tiflis	79	48			47	+ 8	

EPICENTERS—Continued

	Δ	P	O–C	Remarks
	° ′	h. m. s.	s	
MAY 19, 1933				
10° 06′ N: 126° 30′ E; H = 12h 16m 03s				
Manila	7 00	12 17 37	0	The International Summary adopted this position.
Hong Kong	17 00	20 10	+10	
Irkutsk	45 09	24 23	— 2	
MAY 27, 1933				
11° 45′ N: 126° 00′ E; H = 4h 41m 53s				
Manila	5 39	4 43 18	0	Very strong at Borongan, Samar. The International Summary gives 8° 00′N: 123° 00′E by this affords no agreement whatever with the macroseismic data which indicate an epicenter in the Philippine Deep.
Tashkent	57 24	51 32	— 6	
Sverdlovsk	66 48	52 40	+ 2	
JUNE 6, 1933				
14° 00′ N: 120° 20′ E; H = 02h 28m 39s; h = 75 Km.				
Manila	0 58	2 28 54	0	Somewhat destructive on the west coast of Cavite Province, Luzon. The International Summary gives 13° 18′N: 120° 24′E and normal depth. This position does not agree with the macroseismic reports. The residual of +8 seconds at Manila can not be admitted. Satisfactory residuals were not obtained until a depth of 75 km was assumed.
Hong Kong	10 12	31 00	+ 1	
Taihoku	11 06	16	+ 4	
Phu-Lien	14 45	59	— 2	
Palau	15 24	32 03	— 7	
Zikawei	17 12	34	+ 2	
Nanking	18 07	42	— 1	
Miyazaki	20 28	33 11	+ 5	
Nagasaki	20 40	12	+ 4	
Hukuoka, B.	21 33	19	— 1	
Koti	22 56	33	+ 5	
Taikyu	23 06	32	+ 3	
Medan	23 46	36	— 1	
Siomisaki	23 57	41	+ 2	
Zinsen	24 09	44	+ 4	
Batavia	24 12	35	— 6	
Sumoto	24 15	44	+ 2	
Keizyo	24 18	46	+ 4	
Kobe	24 39	47	+ 1	
Osaka	24 45	38	— 8	
Toyooka	25 09	53	+ 3	
Heizyo	25 30	56	+ 2	
Nagoya	25 55	34 02	+ 5	
Chiufeng	26 20	03	+ 2	
Nagano	27 44	17	+ 4	
Mizusawa	31 16	49	+ 2	
Irkutsk	40 21	36 07	+ 1	
Colombo	40 22	2 36 02	— 4	
Agra	41 30	12	— 4	
Kodaikanal	42 00	17	— 3	
Bombay	45 42	49	— 1	
Andijan	49 24	37 19	+ 1	
Tashkent	51 50	45	+ 9	
Riverview	56 06	(38) 00	— 8	
Sverdlovsk	61 57	46	— 1	
Tiflis	70 00	39 43	+ 5	
Kucino	74 09	40 06	+ 7	
Theodosia	76 36	19	+ 3	
Simferopol	77 30	21	+ 1	
Yalta	77 33	24	+ 3	
Ksara	77 42	20	— 2	
Sebastopol	77 57	26	+ 3	
Pulkovo	77 57	24	+ 5	
Helsingfors	80 27	45	+ 9	
Helwan	82 14	48	+ 2	
Upsala	84 09	54	— 2	
Copenghagen	88 10	41 17	0	
Potsdam	89 07	22	0	
Hamburg	90 20	27	— 1	
Treist	91 10	30	— 3	
Stuttgart	92 45	39	— 2	
Coir	93 24	37	— 6	
Florence	93 32	43	— 2	
Prato	93 32	48	+ 3	
De Bilt	93 34	44	— 2	
Strasbourg	93 43	43	— 3	
Zurich	93 45	42	— 4	
Piacenza	94 00	44	— 4	
Neuchatel	94 54	48	— 5	
Uccle	95 12	48	— 3	
Paris	96 42	56	— 6	
JUNE 2, 1933				
9° 35′ N: 128° 20′ E; H = 17h 11m 34s				
Palau	6 30	16 13 06	— 5	We first put the epicenter at 10°N: 127° 30′E and this was adopted by the International Summary. A later examination of the Manila seismograms forced us to adopt the position given above.
Manila	8 45	13 43	0	
Nanking	24 08	16 57	+ 7	
Batavia	26 36	17 22	+ 7	
Chiufeng	32 22	18 10	+ 2	
Sverdlovsk	69 54	22 50	+ 8	

EPICENTERS—Continued

	Δ ° ′	P h. m. s.	O–C s	Remarks
AUGUST 7, 1933				
10° 00′ N: 126° 35′ E; H = 12h 34m 45s				
Manila	7 09	12 36 31	0	The International Summary gives 10°N: 127° 30E′, but this is too far east.
Nanking	23 12	39 53	+ 1	
Batavia	25 26	(40) 17	+ 3	
Chiufeng	31 28	41 03	— 8	
Tashkent	59 03	44 36	— 6	
Sverdlovsk	68 36	45 41	— 3	
Tiflis	77 15	46 44	+ 8	
AUGUST 20, 1933				
13° 37′N: 124° 50′ E; H = 11h 45m 12s				
Manila	3 52	11 46 12	0	Felt very strongly in the island of Catanduanes. The International Summary gives 13°N: 124° 42′E, but this does not agree well with the macroseismic reports.
Palau	11 24	47 49	— 8	
Hong Kong	13 24	48 20	— 4	
Naze	15 28	51	0	
Zikawei	17 51	49 26	+ 6	
Phu-Lien	18 48	29	— 2	
Nanking	19 15	41	+ 4	
Miyazaki	19 18	36	— 1	
Nagasaki	19 48	43	0	
Simidu	20 42	54	+ 1	
Muroto	21 24	56	— 5	
Koti	21 27	50 08	+ 6	
Taikyu	22 30	08	— 4	
Sumoto	22 39	13	0	
Kobe	23 03	14	— 3	
Toyooka	23 42	27	+ 3	
Nagoya	24 02	30	+ 1	
Oiwake	25 44	50	+ 6	
Batavia	26 42	(51) 04	+10	
Medan	27 42	50 58	— 6	
Mizusawa	29 18	51 19	+ 1	
Irkutsk	42 00	53 02	— 1	
Kodaikanal	46 24	36	— 2	
Bombay	50 03	54 08	+ 3	
Frunse	52 24	29	+ 7	
Tashkent	55 24	42	— 1	
Sverdlovsk	64 39	55 46	+ 1	
Tiflis	73 34	56 43	+ 1	
Theodosia	80 03	57 23	+ 4	
Pulkovo	80 30	22	0	
Simferopol	80 54	24	0	
Ksara	81 36	33	+ 5	
Helwan	86 12	49	— 2	
Copenhagen	90 48	58 18	+ 4	
Vienna	91 36	17	— 1	
Triest	94 21	37	+ 8	
Florence	96 46	38	— 5	
Prato	97 26	49	+ 3	
Huancayo	160 18	12 05 06	— 1	P_1'
AUGUST 20, 1933				
13° 37′ N: 124° 50′ E; H = 12h 06m 19s; h = 75 Km.				
Manila	3 54	12 07 16	0	The only macroseismic report was from Catanduanes Island. Not felt strongly. Lost on the Galitzin-Wilip records by change of seismograms. Lost on the Wiechert by dislocation of pens. Data from the Horizontal Pendulums. On these records the gram had more of the appearance of abnormal depth than in the preceding earthquake. Hence travel times for h=75 km were used.
Nanking	19 15	10 29	— 4	
Nagasaki	19 48	39	0	
Taikyu	22 30	11 09	+ 4	
Sumoto	22 39	11	+ 5	
Kobe	23 03	02	— 7	
Toyooka	23 42	18	+ 2	
Hamamatu	24 00	29	+10	
Nagoya	24 02	27	+ 8	
Mizusawa	29 18	12 16	+ 7	
Tiflis	73 34	17 36	— 5	
Simferopol	80 54	18 21	+ 2	
AUGUST 22, 1933				
13° 37′ N: 124° 50′ E; H = 13h 13m 02s				
Manila	3 52	13 14 02	— 0	
Hong Kong	13 24	16 11	— 4	
Phu-Lien	18 48	17 20	— 1	
Nanking	19 15	34	+ 7	
Nagasaki	19 48	36	+ 3	
Koti	21 27	54	+ 2	
Kobe	23 03	18 11	+ 3	
Osaka	23 06	(18) 17	+ 9	
Kameyama	24 00	21	+ 4	
Nagoya	24 00	19	+ 2	
Oiwake	25 44	43	+ 9	
Chiufeng	27 36	46	— 7	
Irkutsk	42 00	20 50	— 2	
Frunse	52 24	22 10	— 2	
Tashkent	55 24	33	0	
Sverdlovsk	64 39	23 37	+ 2	
Tiflis	73 34	24 34	+ 2	
Pulkovo	80 30	25 11	— 1	

EPICENTERS—Continued

	Δ ° ′	P h. m. s.	O–C s	Remarks
AUGUST 26, 1933				
20° 30′ N: 121° 00′ E; H = 3h 06m 15s; h = 150 Km.				
Taihoku	4 35	3 07 31	— 1	Felt slightly at Basco, Batan Islands. The Manila seismograms indicated abnormal depth. Calculated travel times from the curve of the earthquake of April 13, 1927. The International Summary gives 20° 30′N: 124°E, with normal depth, but this gives a residual of –43s at Hong Kong.
Manila	5 56	51	0	
Hong Kong	6 38	08 01	+ 1	
Nagoya	20 18	10 34	+ 2	
Sverdlovsk	56 52	15 50	— 3	
SEPTEMBER 7, 1933				
5° 30′ N: 126° 30′ E; H = 17h 53m 16s				
Manila	10 35	17 55 50	0	Felt slightly in Mindanao. The International Summary gives 6° 30′N: 126° 30′E, In this position it would have been felt more strongly in Davao.
Hong Kong	20 36	58 06	+10	
Batavia	22 51	25	+ 6	
Nanking	27 34	59 06	— 1	
Gihu	31 36	40	— 3	
Nagano	32 57	54	— 1	
Sendai	35 16	18 00 15	+ 2	
Vladisvostok	37 55	35	— 1	
Tiflis	80 09	05 23	— 2	
SEPTEMBER 20, 1933				
13° 18′ N: 120° 24′ E; H = 23h 33m 43s				
Manila	1 24	23 34 07	0	Felt in southern Luzon and in the island of Marinduque. The International Summary gives the position "as on June 6, 1933". The latter earthquake was further north. The International Summary assumes normal depth with residuals of +7 seconds at Manila and Hong Kong. Some other solution should be found to eliminate these residuals, especially since the time at Manila is known to be correct. Using Macelwane's travel times and H=23:33:43 the residuals are reduced satisfactorily. The prevalence of negative residuals suggests that the focal depth was lightly greater than normal.
Hong Kong	10 48	36 19	— 1	
Phu-Lien	15 06	37 14	— 3	
Zikawei	17 54	48	— 3	
Nanking	18 48	38 00	— 2	
Nagasaki	21 18	25	— 6	
Medan	23 30	47	— 6	
Koti	23 36	45	— 9	
Sumoto	24 48	58	— 8	
Chiufeng	27 02	39 18	—10	
Mizusawa	31 36	40 01	— 9	
Bombay	46 00	42 03	— 3	
Tashkent	52 24	48	— 5	
Sverdlovsk	62 36	44 04	+ 2	
Tiflis	70 30	51	— 3	
Kucino	74 48	45 15	— 5	
Simferopol	78 00	36	— 3	
Yalta	78 00	36	— 3	
Ksara	78 06	40	— 0	
Sebastopol	78 30	36	— 6	
Pulkovo	78 36	37	— 5	
Vienna	89 06	46 33	— 3	
Stuttgart	93 24	48	— 9	
Strasbourg	94 18	47 00	— 1	
La Paz	171 12	53 44	— 4	
SEPTEMBER 25, 1933				
5° 30′ N: 126° 30′ E; H = 13h 45m 45s				
Amboina	9 22	13 48 03	+ 8	Same epicenter as on May 26, 1925. In the Observatory bulletin for 1933 a very great error was made in the distance of this earthquake owing to the extremely slight change at the entrance of the S phase.
Manila	10 35	19	0	
Hong Kong	20 36	50 19	— 6	
Batavia	22 51	51	+ 3	
Zikawei	26 12	51 18	— 3	
Nanking	27 34	(51) 31	— 5	
Vladivostok	37 55	53 03	— 1	
Adelaide	42 00	44	+ 8	
Riverview	45 44	54 09	+ 3	
Kodaikanal	48 45	31	+ 2	
Agra	50 54	41	— 4	
Bombay	53 56	55 07	+ 1	
Sverdlovsk	72 24	57 10	+ 2	
Tiflis	80 09	56 10	+ 3	
Pulkovo	88 30	58 36	+ 1	
Copenhagen	98 33	59 26	+ 1	
SEPTEMBER 28, 1933				
6° 00′ N: 127° 15′ E; H = 0h 27m 51s				
Manila	10 33	0 30 25	0	The International Summary gives 7°N: 127° 30′E
Hong Kong	20 36	32 31	0	
Batavia	23 45	33 11	+ 7	
Medan	29 06	48	— 7	
Sverdlovsk	72 21	39 13	0	

EPICENTERS—Continued

	Δ ° ′	P h. m. s.	O–C s	Remarks
SEPTEMBER 28, 1933				
13° 15′ N: 121° 00′ E; H = 18h 57m 17s; h = 150 Km.				
Manila	1 21	18 57 48	0	Felt lightly in southern Luzon. The International Summary gives 13° 18′N: 120° 24′E, as on June 6, 1933. We have seen that the latter earthquake was further north. Satisfactory residuals can not be obtained by assuming normal depth and this earthquake showed characteristics of abnormal focal depth. The Manila seismograms indicated that the epicenter was almost due south of Manila. The distance indicated by the S-P interval was 150 km. The epicenter 13° 15′ N: 121° E was adopted and distances calculated. Corrections for various depth values were tried and the above residuals resulted from using a depth of .02 (Geophy. Supp. M. N. R. A. S. vol. I, No. 1). Other values gave less satisfactory residuals.
Amboina	18 23	19 01 29	+ 6	
Nanking	18 54	35	+ 6	
Nagasaki	21 07	59	+ 6	
Koti	23 18	02 23	+ 8	
Batavia	24 00	(02) 32	+10	
Medan	24 04	33	+10	
Chiufeng	27 12	54	+ 2	
Tashkent	52 48	06 26	+15	
Sverdlovsk	63 00	07 39	+12	
NOVEMBER 9, 1933				
6° 50′ N: 127° 45′ E; H = 7h 31m 40s				
Palau	6 42	7 33 18	— 2	Felt slightly in southeastern Mindanao.
Manila	10 12	34 08	0	
DECEMBER 2, 1933				
20° 13′ N: 121° 55′ E; H = 8h 43m 08s				
Taihoku	4 51	8 44 19	— 3	Felt with intensity VII in Basco, Batan Islands.
Manila	5 42	34	0	
Hong Kong	7 32	59	0	
Zikawei	11 00	45 43	— 5	
Nanking	12 12	58	— 6	
Phu-Lien	14 19	46 29	— 3	
Nagasaki	14 24	25	— 9	
Sumoto	18 12	47 18	— 2	
Kobe	18 36	18	— 7	
Osaka	18 48	8 47 20	— 7	
Chiufeng	20 28	43	— 4	
Tyosi	22 46	(48) 12	+ 1	
Vladivostok	24 24	25	— 2	
Medan	28 06	49 06	+ 3	
Tashkent	49 00	51 52	— 1	
Sverdlovsk	57 36	52 57	+ 3	
Tiflis	67 16	54 01	+ 2	
JANUARY 16, 1934				
5° 36′ N: 128° 18′ E; H = 18h 39m 31s				
Manila	10 24	18 42 02	0	The International Summary gives 6° 06′N: 124° 48′E, but this is not an earthquake region. There would have been more macro reports had the earthquake occurred here.
Hong Kong	20 24	44 06	— 3	
Batavia	22 42	40	+ 7	
Naze	23 00	44	+ 8	
Phu-Lien	24 24	49	— 1	
Zikawei	25 54	45 10	+ 5	
Nanking	27 24	24	+ 4	
Medan	27 42	22	— 1	
Miyasaki	26 48	23	+ 9	
Chiufeng	35 36	46 34	+ 3	
Kodaikanal	48 30	48 18	+ 5	
Agra	50 40	29	0	
Bombay	53 42	54	+ 4	
Frunse	58 48	49 35	+ 9	
Tashkent	61 52	52	+ 6	
Baku	76 03	51 24	+ 9	
Tiflis	79 56	46	+ 8	
Yalta	87 36	52 27	+10	
Simferopol	87 36	25	+ 8	
Sebastopol	88 02	29	+10	
Pulkovo	88 12	26	+ 6	
FEBRUARY 14, 1934				
17° 20′ N: 119° 20′ E; H = 3h 59m 34s				
Manila	3 12	4 00 33	0	De Bilt and Bombay adopt the Manila position of this epicenter. The International Summary gives 17.4°N: 119bE. Hokoto, Zinsen, and Honolulu gives position differing little from that of the International Summary. St. Louis gives a position which is one degree too far north. The macroseismic evidence confirms the Manila position. Felt very strongly on the northwest coast of Luzon. Perceptible over the whole of Luzon except in the southeast peninsula. Small sea wave opposite the epicenter. Manila-Shanghai cable broken at the epicenter. Many small aftershocks felt by the cable ship. Apparent drop of 600 feet in the sea bottom. The instrumental reception of this earthquake over the whole world; the reception of the P-phase on the small seismographs in Spain; and the penetration of the P-phase into the shadow zone, to an epicentral distance of 117°, indicate that this earthquake was the strongest Philippine earthquake of which we have definite quantitative evidence.
Takao	5 19	54	0	
Taito	5 48	01 03	+ 2	
Tainan	5 54	00	— 3	
Arisan	6 21	11	+ 2	
Hong Kong	6 51	13	— 3	
Taityu	6 57	1 17	0	
Taihoku	7 59	38	+ 6	
Isigakizima	8 20	39	+ 1	
Phu-Lien	12 30	02 34	— 1	
Zikawei	14 00	56	+ 2	
Naze	14 29	03 11	0	
Nanking	14 42	03 00	— 3	
Palau	17 51	47	+ 6	
Nagasaki	18 06	50	+ 5	
Miyazaki	18 14	48	+ 2	
Kumamoto	18 34	4 03 56	+ 5	
Saga	18 44	58	+ 6	
Hukuoka	19 03	04 01	+ 5	

EPICENTERS—Continued

	Δ ° ′	P h. m. s.	O–C s	Remarks
FEBRUARY 14, 1934.—Continued				
17° 20′ N: 119° 20′ E; H = 3h 59m 34s				
Ituhara	19 05	01	+ 4	De Bilt and Bombay adopt the Manila position of this epicenter. The International Summary gives 17.4°N: 119°E. Hokoto, Zinsen, and Honolulu gives position differing little from that of the International Summary. St. Louis gives a position which is one degree too far north. The macroseismic evidence confirms the Manila position. Felt very strongly on the northwest coast of Luzon. Perceptible over the whole of Luzon except in the southeast peninsula. Small sea wave opposite the epicenter. Manila-Shanghai cable broken at the epicenter. Many small aftershocks felt by the cable ship. Apparent drop of 600 feet in the sea bottom. The instrumental-reception of this earthquake over the whole world; the reception of the P-phase on the small seismographs in Spain; and the penetration of the P-phase into the shadow zone, to an epicentral distance of 117°, indicate that this earthquake was the strongest Philippine earthquake of which we have definite quantitative evidence.
Simidu	19 45	08	+ 3	
Taikyu	20 17	14	+ 3	
Koti	20 36	14	0	
Muroto	20 47	15	— 1	
Niihama	20 47	19	+ 3	
Zinsen	21 09	21	0	
Tadoto	21 18	27	+ 5	
Keizyo	21 19	24	+ 2	
Dairen	21 40	33	+ 7	
Siomisaki	21 51	32	+ 5	
Sumoto	21 58	32	+ 3	
Wakayama	22 03	34	+ 4	
Kobe	22 24	34	+ 1	
Heizyo	22 25	39	+ 6	
Osaka	22 34	41	+ 6	
Amboina	22 46	43	+ 6	
Toyooka	22 49	45	+ 8	
Chiufeng	22 54	41	+ 3	
Kyoto	22 56	44	+ 7	
Miyadu	23 01	42	+ 3	
Titizima	23 15	46	+ 5	
Hikone	23 25	48	+ 5	
Ibukisen	23 34	50	+ 5	
Gihu	23 48	52	+ 5	
Nagoya	23 54	53	+ 3	
Medan	24 38	57	+ 3	
Mizima	24 54	05 05	+ 7	
Toyama	24 58	04	+ 5	
Oiwake	25 29	08	+ 4	
Tokyo Met. Ob.	25 48	11	+ 4	
Tokyo Univ.	25 48	03	— 4	
Takada	25 51	14	+ 7	
Kumagaya	25 52	12	+ 5	
Maebasi	26 12	10	— 1	
Tukubasen	26 21	13	+ 1	
Kakioka	26 25	14	+ 2	
Batavia	26 34	16	+ 1	
Tyosi	26 36	16	+ 1	
Mito	26 41	22	+ 6	
Hukusima	27 35	25	0	
Vladivostok	27 48	28	+ 1	
Sendai	28 09	31	+ 1	
Akita	28 44	39	+ 4	
Mizusawa	28 54	38	+ 1	
Morioka	29 17	43	+ 3	
Sapporo	31 48	06 04	+ 1	
Asahigawa	32 49	17	+ 5	
Nemuro	34 11	14	— 9	
Hyderabad	38 38	07 04	+ 6	
Agra	39 34	05	— 1	
Colombo	39 56	07	— 2	
Kodaikanal	41 08	4 07 20	+ 2	
Bombay	44 07	49	+ 7	
Frunse	45 36	48	— 6	
Andijan	46 30	08 04	+ 3	
Tashkent	48 54	25	+ 6	
Perth	49 24	26	+ 4	
Samarkand	50 18	33	+ 4	
Adelaide	55 24	09 11	+ 6	
Riverview	59 30	40	+ 7	
Sydney	59 30	30	— 3	
Melbourne	60 12	46	+ 8	
Grozny	66 24	10 19	— 1	
Tiflis	67 10	32	+ 8	
Kucino	70 54	54	+ 6	
Theodosia	73 42	11 10	+ 6	
Yalta	74 36	15	+ 5	
Pulkovo	74 36	17	+ 7	
Apia	74 46	21	+10	
Sebastopol	75 00	19	+ 7	
Ksara	75 09	21	+ 8	
Helsingfors	77 09	29	+ 4	
Honolulu	77 21	27	+ 1	
Wellington	77 52	37	+ 7	
Christchurch	77 57	36	+ 6	
Tananarive	79 18	44	+ 7	
Helwan	79 51	44	+ 3	
Lemberg	80 09	51	+ 9	
Upsala	80 52	52	+ 6	
Sitka	83 31	12 08	+ 9	
Belgrade	83 57	03	+ 1	
Budapest	83 57	05	+ 3	
Lund	84 27	10	+ 6	
Copenhagen	84 52	12	+ 6	
Vienna	85 27	14	+ 5	
Prague	85 58	14	+ 2	
Bergen	86 10	22	+ 9	
Zagreb	86 34	21	+ 6	
Leipzig	86 40	20	+ 5	
Hamburg	87 03	23	+ 6	
Cheb	87 10	22	+ 4	
Jena	87 15	23	+ 5	

EPICENTERS—Continued

	Δ ° ′	P h. m. s.	O–C s	Remarks
FEBRUARY 14, 1934.—Continued				
17° 20′ N: 119° 20′ E; H = 3h 59m 34s				
Hof	87 22	21	+ 2	De Bilt and Bombay adopt the Manila position of this epicenter. The International Summary gives 17.4°N: 119°E. Hokoto, Zinsen, and Honolulu gives position differing little from that of the International Summary. St. Louis gives a position which is one degree too far north. The macroseismic evidence confirms the Manila position. Felt very strongly on the northwest coast of Luzon. Perceptible over the whole of Luzon except in the southeast peninsula. Small sea wave opposite the epicenter. Manila-Shanghai cable broken at the epicenter. Many small aftershocks felt by the cable ship. Apparent drop of 600 feet in the sea bottom. The instrumental-reception of this earthquake over the whole world; the reception of the P-phase on the small seismographs in Spain; and the penetration of the P-phase into the shadow zone to an epicentral distance of 117°, indicate that this earthquake was the strongest Philippine earthquake of which we have definite quantitative evidence.
Laibach	87 28	25	+ 6	
Taranto	87 36	23	+ 3	
Gottingen	87 58	25	+ 3	
Triest	88 04	27	+ 4	
Scoresby-Sund	88 10	27	+ 3	
Trent	88 42	35	+10	
Trevise	89 01	33	+ 6	
Venice	89 02	35	+ 3	
Padua	89 24	36	+ 7	
Stuttgart	89 36	34	+ 4	
Karlsruhe	59 56	35	+ 4	
Catania	90 10	41	+ 7	
Chur	90 13	39	+ 6	
De Bilt	90 17	4 12 38	+ 5	
Rome	90 24	42	+ 8	
Prato	90 24	37	— 2	
Florence	90 26	37	+ 3	
Strasbourg	90 30	38	+ 4	
Zurich	90 34	40	+ 5	
Sienna	90 35	30	— 5	
Piacenza	90 55	40	+ 4	
Basle	91 00	37	— 4	
Livorno	91 10	40	+ 2	
Uccle	91 21	43	+ 5	
Neuchatel	91 44	44	+ 4	
Edinburgh	92 26	44	0	
Stonyhurst	93 15	53	+ 5	
Grenoble	93 19	38	—10	
Paris	93 24	54	+ 6	
Kew	93 30	54	+ 6	
Bidston	93 50	50	0	
Oxford	93 50	47	— 3	
Victoria	93 54	40	—10	
Marseilles	94 36	13 00	+ 7	
Barcelona	97 28	09	+ 1	
Bagneres	97 51	10	+ 3	
Ukiah	97 48	22	+ 7	
Tortosa	98 50	16	+ 1	
Algiers	99 09	19	+ 2	
Berkeley	100 06	24	+ 4	
Branner	100 24	29	+ 7	
Alicante	100 48	32	+ 8	
Toledo	102 16	31	0	
Bozeman	102 36	36	+ 4	
Almeria	102 54	39	+ 6	
Granada	103 30	28	— 8	
Haiwee	103 55	43	+ 5	
Malaga	104 18	49	+ 9	
Pasadena	104 54	46	+ 3	
Mt. Wilson	104 57	46	+ 2	
Riverside	105 32	44	— 2	
La Jolla	106 15	52	+ 3	
Toronto	116 38	14 40	+ 2	
Florissant	117 21	38	— 3	
St. Louis	117 33	18 26	+ 8	P_1'
Oak Ridge	119 30	27	+ 4	P_1'
Little Rock	119 48	32	+ 8	P_1'
Georgetown	121 42	35	+ 7	P_1'
San Juan	143 52	19 12	+ 4	P_1'
Huancayo	164 51	43	+ 9	P_1'
La Paz	172 48	50	+ 9	P_1'
Sucre	175 16	47	+ 5	P_1'
FEBRUARY 14, 1934				
17° 20′ N: 119° 20′ E; H = 17h 14m 44s; h = 200 Km.				
Manila	3 12	17 15 40	0	By way of exception, all residuals have been retained. Same epicenter as the preceding earhquake. The large negative residuals resulting from normal travel times and the form of the Manila records indicated abnormal focal depth. The value h=200 km has been adopted as a suggestion; the residuals are too discordant to establish a definite value. The calculated distances, given above, were reduced for h=0.03 before using the travel times.
Hong Kong	6 51	16 11	—17	
PhuLien	12 31	17 38	+ 2	
Ziikawei	14 00	48	— 7	
Nanking	14 44	18 09	+ 6	
Amboina	22 46	19 38	+ 5	
Chiufeng	22 54	42	— 8	
Medan	24 28	(19) 44	— 4	
Batavia	26 34	(20) 35	+28	
Vladivostok	27 54	32	+12	
Tashkent	48 54	23 28	+17	
MARCH 18, 1934				
11° 30′ N: 124° 20′ E; H = 7h 13m 15s; h = 150 Km.				
Manila	4 30	7 14 30	0	Not reported as felt, which may possibly be due to the fact that there were no meteorological stations operating in the immediate vicinity at this time. The International Summary gives the epicenter as 10.7°N: 124.7°E. This position does not satisfy the distances from Manila and Butuan derived from the S-P intervals. Placing the epicenter in the position given above and assuming a depth of focus greater than normal, which has some confirmation in the appearance of the records, we obtain the residuals given in the table. These are quite satisfactory. The travel times used were those derived from the earthquake of April 13, 1927, at 15° 12′N: 119° 40′E.
Hong Kong	14 30	16 33	+ 2	
Batavia	24 48	18 20	+ 1	
Medan	26 36	34	— 2	
Tashkent	56 12	22 49	0	

EPICENTERS—Continued

	Δ ° ′	P h. m. s.	O–C s	Remarks
APRIL 1, 1934				
17° 20′ N: 119° 20′ E; H = 21h 55m 32s				
Manila	3 12	21 56 22	0	Same epicenter as February 14, 1934.
Hong Kong	6 51	57 15	+ 1	
APRIL 12, 1934				
21° 10′ N: 122° 15′ E; H = 3h 20m 23s				
Manila	6 42	3 22 03	0	Not reported as felt.
Hong Kong	7 36	22 13	— 2	
PhuLien	14 36	23 50	— 1	
Medan	28 54	26 25	— 1	
Batavia	31 15	44	— 2	
APRILL 15, 1934				
7° 15′ N: 127° 05′ E; H = 22h 15m 10s				
Palau	7 21	22 17 04	+ 5	
Manila	9 28	29	0	
Amboina	11 00	57	+ 7	
Ishigakizima	17 19	19 12	+ 1	
Taihoku	18 36	30	+ 3	
Hong Kong	19 32	38	+ 1	
Naze	21 16	59	+ 1	
PhuLien	23 59	20 26	+ 1	
Titizima	24 28	33	+ 3	
Zikawei	24 31	30	0	
Batavia	25 06	36	0	
Nagasaki	25 37	41	0	
Nanking	25 58	42	— 3	
Simidu	26 00	47	+ 2	
Hukuoka B	26 31	52	+ 2	
Hukuoka A	26 31	48	— 2	
Koti	26 58	55	0	
Matuyama	27 05	56	0	
Niihama	27 18	58	0	
Tadotu	27 46	21 05	+ 2	
Husan	27 55	02	— 2	
Wakayama	28 00	01	— 3	
Sumoto	28 03	04	0	
Kobe	28 26	08	0	
Osaka	28 29	04	— 5	
Medan	28 30	14	+ 5	
Taikyu	28 39	11	+ 1	
Kameyama	28 55	14	+ 1	
Toyooka	29 10	13	— 2	
Zinsen	30 13	22	— 2	
Kohu	30 18	25	0	
Keizyo	30 19	24	— 1	
Kumegaya	31 02	25	— 6	
Nagano	31 07	31	— 1	
Kakioka	31 20	33	— 1	
Wazima	31 25	34	— 1	
Heizyo	31 48	43	+ 4	
Dairen	32 03	38	— 2	
Hukusima	33 22	46	— 7	
Chiufeng	34 16	56	— 4	
Mizusawa	34 18	22 01	+ 1	
Morioka	34 49	06	+ 2	
Sapporo	37 57	25	— 4	
Perth	40 39	22 23 00	+10	
Melbourne	48 04	45	— 4	
Sydney	48 27	58	+ 6	
Tashkent	62 06	25 30	+ 5	
Sverdlovsk	72 12	26 26	— 5	
Baku	76 18	27 02	+ 6	
Tiflis	79 42	21	+ 6	
Kucino	84 30	40	0	
Theodosia	86 36	55	+ 4	
Simferopol	86 58	58	+ 5	
Ksara	86 58	28 01	+ 8	
Yalta	87 00	00	+ 7	
Sebastopol	87 24	02	+ 7	
Sitka	88 00	06	+ 8	
Pulkovo	88 09	27 48	0	
Helsingfors	89 04	28 12	+ 8	
Budapest	96 34	46	+ 6	
Vienna	98 01	51	+ 4	
Scoresby-Sund	98 30	57	+ 7	
Hamburg	98 30	58	+ 8	
Prague	98 32	46	— 3	
Zagreb	99 08	56	+ 4	
Gottinghen	100 30	29 01	+ 3	
Triest	100 37	01	+ 2	
Trevise	101 35	28 55	— 9	
Padua	101 56	29 06	+ 1	
Stuttgart	102 12	10	+ 3	
De Bilt	102 51	13	+ 4	
Florence	102 59	10	0	
Strasbourg	103 06	14	+ 4	
Prato	103 47	10	— 4	

EPICENTERS—Continued

	Δ ° ′	P h. m. s.	O–C s	Remarks
APRIL 15, 1934.—Continued				
7° 15′ N: 127° 05′ E; H = 22h 15m 10s				
Uccle	103 57	17	+ 3	
Neuchatel	104 20	18	— 2	
Haiwee	105 16	30	+ 9	
Mt. Wilson	105 54	28	+ 5	
Paris	106 00	26	+ 2	
Riverside	106 30	32	+ 6	
Algiers	111 40	29 50	— 1	
Buffalo	124 33	34 16	+ 5	P_1'
Harvard	127 40	23	+ 6	P_1'
Fordham	128 12	25	+ 7	P_1'
Georgetown	128 42	27	+ 9	P_1'
APRIL 16, 1934				
7° 15′ N: 127° 05′ E; H = 3h 59m 10s				
Manila	9 28	4 01 29	0	Felt in eastern Mindanao. Same epicenter as preceding earthquake.
Hong Kong	19 32	03 33	— 4	
Naze	21 16	59	+ 1	
Zikawei	24 31	04 29	— 1	
Batavia	25 06	37	+ 1	
Nagasaki	25 37	40	— 2	
Nanking	25 58	52	+ 7	
Koti	26 58	4 04 56	+ 1	
Chiufeng	34 16	05 56	— 4	
Vladivostok	36 06	06 16	— 4	
Tashkent	62 06	07 32	+ 6	
Baku	76 18	11 04	+ 8	
Tiflis	79 42	24	+ 9	
Pulkovo	88 09	12 03	+ 3	
MAY 7, 1934				
9° 00′ N: 126° 45′ E; H = 4h 06m 41s				
Manila	7 50	4 08 38	0	Felt in eastern Mindanao. Same epicenter as June 10, 1920; December 25, 1925; November 18, 1927; April 8, 1929; September 24, 1930; and January 24, 1931.
Hong Kong	17 45	10 49	0	
Zikawei	21 55	11 42	+ 1	
Batavia	25 00	12 08	+ 2	
Sverdlovsk	69 33	17 39	— 7	
JULY 21, 1934				
16° 45′ N: 121° 00′ E; H = 4h 37m 30s				
Manila	2 06	4 38 05	0	Very strong in the epicentral section.
Phu-Lien	14 12	40 53	0	
Nanking	15 26	(41) 16	+ 8	
Sumoto	21 34	42 27	+ 6	
Kobe	21 58	33	— 7	
Osaka	22 12	21	— 6	
Tashkent	50 22	46 29	+ 3	
Sverdlovsk	60 00	47 38	+ 6	
Pulkovo	75 58	49 16	+ 2	
JULY 31, 1934				
15° 08′ N: 119° 47′ E; H = 5h 58m 42s; h = 65 Km.				
Manila	1 15	5 59 06	0	Felt strongly in western Luzon. Perceptible over all of central Luzon. Residuals from normal travel times indicated abnormal focal depth. Distances were corrected for h=.01 and the residuals given above were obtained.
Takao	7 30	6 00 36	+ 4	
Arisan	8 26	49	+ 3	
Taihoku	10 02	01 15	+ 7	
Naze	16 00	02 23	— 2	
Zikawei	16 08	25	— 1	
Nanking	16 56	37	+ 2	
Nagasaki	19 50	03 09	+ 1	
Miyazaki	19 52	15	+ 7	
Itusan	21 38	26	— 3	
Zinsen	23 12	44	0	
Sumoto	23 16	47	— 1	
Medan	23 48	54	+ 5	
Kobe	24 06	54	+ 1	
Osaka	24 10	55	+ 1	
Chiufeng	25 08	04 03	0	
Oiwake	27 00	15	— 9	
Midusawa	30 27	50	— 5	
Sapporo	33 28	05 24	+ 5	
Tashkent	50 42	6 07 36	+ 3	
Sverdlovsk	60 45	08 48	+ 4	
Baku	65 02	09 02	—10	
Yalta	76 21	10 28	+ 5	
Simferopol	76 21	28	+ 5	
Theodosia	76 38	21	— 4	
Pulkovo	76 41	28	+ 2	
Copenhagen	86 57	11 23	+ 3	
Hamburg	89 05	33	+ 2	
Stuttgart	91 33	45	+ 2	
Chur	92 11	48	+ 1	
De Bilt	92 21	48	+ 1	
Strasbourg	92 30	47	— 1	
La Paz	172 12	18 48	— 1	

EPICENTERS—Continued

	Δ ° ′	P h. m. s.	O–C s	Remarks
AUGUST 12, 1934				
8° 20′ N: 126° 50′ E; H = 23h 49m 23s				
Palau	7 40	23 51 12	— 4	
Manila	8 24	28	0	
Amboina	12 06	52 15	— 3	
Karenko	16 26	53 18	— 5	
Taihoku	17 27	28	+ 2	
Naha	17 54	35	+ 4	
Hong Kong	18 36	36	— 4	
Naze	20 12	54	— 5	
PhuLien	23 09	54 21	— 8	
Zikawei	23 24	25	— 7	
Titizima	23 43	37	+ 2	
Miyazaki	23 58	33	— 5	
Nagasaki	24 32	39	— 4	
Batavia	24 42	41	— 4	
Nanking	24 52	42	— 5	
Hukuoka A	25 27	50	— 2	
Hukuoka B	25 27	45	— 3	
Koti	25 57	52	— 5	
Hirosima	26 32	55 00	— 3	
Husan	26 50	02	— 4	
Sumoto	27 00	01	— 7	
Hamada	27 00	05	— 3	
Kobe	27 25	08	— 4	
Oosaka	27 30	09	— 4	
Taikyo	27 36	09	— 5	
Toyooka	28 09	19	0	
Omaesaki	28 16	16	— 4	
Medan	28 24	18	— 3	
Zinsen	29 09	23	— 4	
Keizyo	29 15	23	— 5	
Nagano	30 09	34	— 2	
Mito	30 40	40	— 2	
Heizyo	30 43	36	— 6	
Hukusima	31 54	44	— 9	
Sendai	32 30	23 55 48	—10	
Mizusawa	33 22	56 03	— 3	
Sapporo	37 00	39	+ 5	
Perth	41 36	57 15	+ 4	
Adelaide	44 40	46	+ 9	
Tashkent	60 18	59 28	+ 1	
Sverdlovsk	70 06	24 00 31	— 1	
Honolulu	73 21	48	— 3	
Tananarive	82 40	44	0	
Theodosia	85 08	02 00	+ 4	
Simferopol	86 03	01	0	
Yalta	86 06	04	+ 2	
Pulkovo	86 06	01 59	— 2	
Ksara	86 12	02 08	+ 6	
Sitka	87 18	12	+ 5	
Victoria	87 58	(02) 13	+ 2	
Budapest	96 10	52	+ 1	
Copenhagen	96 22	52	0	
Vienna	97 03	56	+ 1	
Zagreb	98 10	03 05	+ 4	
Gottingen	99 28	08	+ 1	
Triest	99 39	10	+ 2	
Stuttgart	101 10	08	— 7	
De Bilt	101 48	24	+ 6	
Florence	102 00	19	0	
Strasbourg	102 06	17	— 2	
Zurich	102 09	35	+10	
Basle	102 42	16	— 6	
Uccle	102 55	27	+ 5	
Neuchatel	103 20	25	+ 1	
Paris	105 12	32	— 2	
Kew	105 18	36	+ 2	
Georgetown	127 54	08 38	+ 8	P_1'
San Juan	150 24	09 20	+ 5	P_1'
SEPTEMBER 6, 1934				
6° 30′ N; 126° 00′ E; H = 2h 16m 51s; h = 100 Km.				
Manila	9 30	2 19 08	0	
Batavia	22 54	21 48	— 2	
PhuLien	23 06	45	— 5	
Nanking	26 25	(22) 13	— 9	
Medan	27 20	30	0	
Tashkent	61 06	26 47	— 2	
Baku	75 12	28 22	+ 4	
Tiflis	79 08	23 36	— 5	
Theodosia	85 48	29 13	— 4	
Ksara	86 30	19	— 2	
Yalta	86 42	14	— 8	
Simferopol	86 48	17	— 5	
Pulkovo	87 12	14	—10	
De Bilt	102 54	30 33	— 9	
Uccle	104 00	36	—10	

The distances given above are the actual distances. They were corrected for depth before travel times were used to obtain the residuals given in the last column.

EPICENTERS—Continued

	Δ ° ′	P h. m. s.	O–C s	Remarks
OCTOBER 30, 1934				
7° 40′ N: 127° 05′ E; H = 20h 52m 48s				
Palau	7 21	20 54 47	+10	
Manila	9 12	55 04	0	
Hong Kong	19 12	57 09	— 3	
Batavia	24 30	58 05	— 3	
Chiufeng	33 51	59 41	+ 6	
NOVEMBER 26, 1934				
14° 10′ N: 120° 10′ E; H = 12h 09m 22s; h = 75 Km.				
Manila	0 50	12 09 35	0	Slightly destructive in Manila
Arisan	9 23	11 34	+ 1	
Karenko	9 55	40	0	
Hong Kong	9 56	40	0	
Isigakizima	10 51	51	— 1	
Taihoku	10 57	57	+ 4	
PhuLien	14 30	12 46	+ 4	
Palau	15 38	51	— 5	
Naze	16 39	13 06	— 2	
Zikawei	17 04	13	— 1	
Nanking	17 56	20	— 4	
Amboina	19 33	30	— 9	
Nagasaki	20 35	49	— 1	
Hukuoka A	21 30	14 02	+ 3	
Hukuoka B	21 30	01	+ 2	
Husan	22 24	09	+ 2	
Koti	22 52	15	+ 5	
Taikyu	23 00	18	+ 6	
Siomisaki	23 55	24	+ 4	
Zinsen	24 03	25	+ 2	
Keizyo	24 10	27	+ 3	
Titizima	24 15	23	— 1	
Batavia	24 16	27	+ 2	
Sumoto	24 24	26	0	
Kobe	24 36	31	+ 3	
Oosaka	24 45	30	0	
Toyooka	25 00	38	+ 6	
Kameyama	25 24	37	+ 1	
Chiufeng	26 09	46	+ 4	
Nagano	27 39	15 02	+ 6	
Mizusawa	31 03	30	+ 3	
Colombo	40 15	16 54	+ 6	
Bombay	45 30	17 35	+ 4	
Perth	46 18	31	— 6	
Tashkent	51 36	18 13	— 4	
Adelaide	52 09	18	— 3	
Baku	65 57	20 01	+ 5	
Tiflis	69 48	22	+ 2	
Christchurch	74 57	58	+ 8	
Theodosia	76 24	21 02	+ 4	
Simferopol	77 18	08	+ 6	
Yalta	77 20	08	+ 6	
Pulkovo	77 44	07	+ 2	
Sebastopol	77 44	12 21 11	+ 6	
Helwan	82 00	24	+ 4	
Vienna	88 21	22 02	+ 1	
Zagreb	89 27	10	+ 3	
Triest	90 57	13	— 2	
Gottingen	92 15	15	— 6	
Stuttgart	92 33	22	— 1	
De Bilt	93 21	29	+ 2	
Strasbourg	93 30	28	0	
Zurich	93 33	27	— 1	
Basel	94 06	29	— 2	
Uccle	94 25	28	— 5	
Neuchatel	94 42	31	— 3	
Paris	96 28	39	— 1	
NOVEMBER 27, 1934				
13° 10′ N: 124° 25′ E; H = 1h 14m 38s; h = 100 Km.				
Manila	3 36	1 15 37	0	Felt in southeastern Luzon
Hong Kong	13 15	17 42	— 2	
Chiufeng	27 50	20 19	— 1	
Sverdlovsk	64 43	25 04	+ 9	
DECEMBER 27, 1934				
14° 05′ N: 121° 30′ E; H = 17h 43m 11s; h = 100 Km.				
Manila	0 42	17 43 28	0	
Nanking	18 16	47 12	— 5	
Chiufeng	26 24	48 38	— 3	
Sverdlovsk	62 30	53 21	+ 4	

No. 1. January, 1940

M A N I L A , P . I .

SEISMOLOGICAL BULLETIN OF THE OBSERVATORY

ϕ=14° 34' 42" N. λ=120° 58' 41" E. h=3 m. Alluvium.

CONSTANTS OF THE GALITZIN-WILIP

	T_1	T	ρ^2	V_s
N-S	12.6	12.9	0	400
E-W	11.8	11.9	.08	229
Z	11.6	9.0		

Cf. Theoretical Seismology.
Sohon. S.J.

CONSTANTS OF THE WIECHERT INVERTED PENDULUM. M 955 Kg.
January 1, 1940.

	T_o	V	ε.	$\frac{r}{T_o^2}$
N-S	4.2	211	2.4	0.087
E-W	4.2	268	2.8	0.086

No. and Date	Phase	Greenwich Time h. m. s.	Dist. Km.	Remarks
Jan. 1940				
#1	ePNEZ	0 22 22	135	Deeper than normal.
1st	SNEZ	39		
	F	25		
#2	iPZ	12 25 20	2,700?	Dilatation.
1st	ePNE	20		
	S?NE	29 31		
	F	13 03		
#3	eP?NE	5 05 25	1,700?	
2nd	SNE	08 20		
	F	30		
#5	ePPNE	11 29 36	14,710±	31°±S: 108°±W; H=11:07.6 by USCGS.
2nd	LNE	12 08 ca		
	F	13 36		
#8	ePNEZ	0 29 59	740	
6th	SNEZ	31 21		
	F	55		
#9	iPZ	8 23 16	3,965	Dilatation.
6th	ePE	16		
	SN	28 50		
	LN	33 25ca		
	F	9 35		
#10	ePNEZ	10 46 30	1,670	
6th	SNE	49 23		
	LNE	50 45ca		
	MN	52 ca		
	F	11 50		
#12	iPZ	14 13 34	6,620	Dilatation. Deep focus. Between New
6th	iPE	36		Hebrides and New Caledonia by
	iSNE	21 44		Riverview and Manila.
	LNE	32 20ca		22°S: 170°E by USCGS.
	MN	37 25ca		
	F	17 30		

M A N I L A , P . I .

SEISMOLOGICAL BULLETIN OF THE OBSERVATORY.--Continued.

No.and Date	Phase.	Greenwich Time h. m. s.	Dist. Km.	Remarks.
Jan. 1940				
#14 7th	ePNEZ	3 28 24	3,490	
	SNE	33 28		
	LNE	37 10ca		
	F	5 25		
#17 9th	iPZ	6 36 18	1,835?	Dilatation.
	ePNE	18		
	S?E	39 26		
	F	55		
#19 10th	ePZ	11 23 33	3,640	Disturbed by microseisms.
	ePN	37		
	SNE	28 47		
	LNE	32 30ca		
	MN	35 05ca		
	F	12 46		
#20 11th	ePNE	10 30 48	440	
	SN	31 42		
	F	44		
#21 12th	ePZ	17 16 32	480	Deeper than normal. Baguio 150 Km.
	ePNE	34		
	SNEZ	17 29		
	F	37		
#24 14th	ePNEZ	8 03 37	2,200?	Disturbed by another movemwnts.
	S?NE	07 14		
	F	9 40		
#25 14th	eP?NE	9 51 16	7,750?	Disturbed by another movements.
	SN	10 00 33		
	F	11 25		
#27 14th	eP?N	13 35 25	4,180?	
	SNE	41 13		
	F	14 17		
#29 15th	iPZ	11 11 04	2,190	Dilatation. Deep focus.
	ePNE	04		
	SNE	14 40		
	F	33		
#33 16th	ePNEZ	5 05 40	340	
	SNEZ	06 31		
	F	16		

M A N I L A , P . I .

SEISMOLOGICAL BULLETIN OF THE OBSERVATORY.--Continued.

No. and Date	Phase.	Greenwich Time h. m. s.	Dist. Km.	Remarks.
Jan. 1940				
36	iPZ	1 20 31	3,020	Dilatation. 18°N: 148.2°E by Manila,
17th	PNE	34		Hong Kong and Riverview.
	SNE	25 16		S-P at Guam 50 seconds.
	LE	39 55ca		Data after P from the Wiechert and
	F	5 00		Horizontals.
				17°N: 148°E by USCGS.
38	PNEZ	12 12 43	3,530	
17th	SNE	17 50		
	F	58		
43	ePZ	0 49 58	1,935	
19th	SE	53 14		
	F	1 04		
44	ePNEZ	5 34 38	2,655	
19th	SNE	38 47		
	ME	43 25ca		
	F	6 46		
45	ePNEZ	10. 17: 31	7,530?	
20th	S?NE	26 35		
	F	12 30		
46	iPZ	2 48 42	1,655	Compression. Deep focus.
21st	ePN	43		
	iPE	44		
	iSNEZ	51 34		
	F	3 22		
47	ePNEZ	4 39 18	1,390	
21st	SNE	41 42		
	F	5 00		
48	iPZ	23 50 15	2,220	
21st	ePNE	15		
	SNE	53 54		
22nd	F	0 20		
49	iP̄NEZ	11 30 14	110	Dilatation. Felt at Infanta and in
23rd	S̄NE	28		Manila. Data after P̄ from the
	F	44		Wiechert.
52	ePZ	6 51 11	6,010	Deep focus.
26th	ePNE	13		
	SNE	58 45		
	F	7 42		

M A N I L A , P . I .

SEISMOLOGICAL BULLETIN OF THE OBSERVATORY.--Continued.

No. and Date	Phase.	Greenwich Time h. m. s.	Dist. Km.	Remarks.
Jan. 1940				
53	iPZ	17 08 10	4,255	Dilatation.
26th	iPE	11		
	iPN	12		
	iSNE	14 01		
	LNE	19 20cu		
	F	19 25		
54	ePNEZ	14 54 56	4,690	
27th	SE	15 01 14		
	F	40		
55	ePNEZ	23 05 36	1,080	
27th	SE	07 30		
	F	20		
57	ePNEZ	11 10 44	1,070	
28th	SN	12 37		
	F	21		

Twenty-eight insignificant or undecipherable disturbances on the following days of January: 2nd, 3rd, 4th, 6th(2), 7th(2), 9th, 14th(3), 15th(2), 16th(4), 17th(3), 18th, 19th, 24th, 25th, 27th, 29th, 30th, and 31st.

No. 5. February, 1940.

M A N I L A , P . I .

SEISMOLOGICAL BULLETIN OF THE OBSERVATORY.

ϕ=14° 34' 42" N. λ=120° 58' 41" E h=3 m. Alluvium.

CONSTANTS OF THE GALITZIN-WILIP

	T_1	T	μ^2	V_s
N-S	12.6	12.9	0	400
E-W	11.8	11.9	.08	229
Z	11.6	9.0		

Cf. Theoretical Seismology.
Sohon S.J.

CONSTANTS OF THE WIECHERT INVERTED PENDULUM. M=955 Kg.
February 1, 1940

	T_o	V	ε	$\frac{\Gamma}{T_o^2}$
N-S	4.3	205	2.4	0.088
E-W	4.2	268	2.6	0.099

No.	Date	Phase	Greenwich Time h. m. s.	Dist. Km.	Remarks.
61	1st	ePNE	18 24 02	135	
		SNEZ	19		
		F	29		
62	1st	ePN	20 48 54	135	
		SNEZ	49 11		
		F	52		
64	5th	iPZ	6 34 01	2,635	
		SNE	38 04		
65	5th	eP?Z	7 07 48	3,510?	No. 64 still reconding.
		iSNE	12 53		
		F	37		
71	7th	iPEZ	17 25 40	6,500	Dilatation. 52°N: 174.5°E by U.S.C.G.S.
		ePN	40		
		iSNE	33 49		
		LNE	43 30ca		
		MNE	48 ca		
		F	19 28		
73	8th	ePNEZ	15 13 40	1,445	
		SNE	16 10		
		F	40		
74	9th	ePNEZ	8 06 56	1,455	
		SNEZ	09 27		
		F	25		
77	10th	ePNE	22 44 08	680	Felt at Dumaguete.
		SNE	45 24		
		F	57		
81	11th	iPEZ	21 30 28	1,690	Compression.
		ePN	28		
		iSNEZ	33 22		
		LNE	34 50ca		
		MN	36 25ca		
		F	22 08		
82	12th	ePNEZ	0 21 27	3,120	Disturbed by microseisms.
		SNE	26 07		
		LE	30 35ca		
		MNE	32 40ca		
		F	1 17		

M A N I L A , P . I .

SEISMOLOGICAL BULLETIN OF THE OBSERVATORY.--Continued.

No.	Date	Phase.	Greenwich Time h. m. s.	Dist. Km.	Remarks
	Feb. 1940				
83	12th	iPZ	8 31 59	8,710	Dilatation. Disturbed by microseisms
		ePNE	59		
		LNE	41 00		
84	12th	ePNEZ	9 29 03	7,920	No. 83 still recording. Disturbed by microseisms.
		SNE	38 24		
		F	10 30		
85	12th	iPZ	16 36 44	2,265	Dilatation.Disturbed by microseisms.
		ePNE	44		
		SNE	40 24		
		LNE	42 35ca		
		F	17 22		
88	14th	ePNE	2 20 14	2,365?	No records on Z Component throughout the 14th.
		S?N	24 03		
		F	3 12		
90	14th	ePNE	11 54 29	2,655	
		SE	58 38		
		F	12 20		
93	16th	ePNEZ	1 14 11	1,530	
		SNE	16 50		
		MNE	19 35ca		
		F	38		
95	17th	ePNEZ	1 06 54	1,845	
		SNE	10 03		
		F	42		
96	18th	ePNEZ	10 43 30	2,010	
		SNE	46 52		
		F	55		
99	20th	iPZ	2 27 26	5,610	Compression. 12°S: 167°E by USCGS.
		iPNE	28		
		iNEZ	28 30		
		iSNE	34 45		
		LNE	41 30ca		
		MNE	45 45ca		
		F	4 40		
100	20th	ePNE	13 06 16	6,000	
		SN	13 52		
		LNE	22 ca		
		F	14 40		
102	21st	ePNEZ	13 28 41	2,665	Deep focus.
		iSN	32 51		
		F	14 02		
103	22nd	iPNEZ	13 32 06	510	Compression. Felt in northern Luzon. About 19° 10' N: 121° 15' E by Manila and Hong Kong.
		iSNEZ	33 09		
		F	14 37		

M A N I L A , P . I .

SEISMOLOGICAL BULLETIN OF THE OBSERVATORY.--Continued.

No.	Date	Phase.	Greenwich Time h. m. s.	Dist. Km.	Remarks.
	Feb. 1940				
104	24th	ePNEZ	12 05 52	3,065	
		SNE	10 28		
		iNE	12 13		
		LNE	13 05		
		F	14 10		
109	27th	ePNEZ	19 15 23	2,490	
		SNEZ	19 20		
		iE	20 40		
		iN	54		
		LNE	21 40ca		
		F	20 45		
110	28th	ePNEZ	13 13 23	880	
		SNEZ	14 57		
		F	22		
111	28th	ePNEZ	19 37 09	1,630	
		SNE	40 01		
		IN	41 15		
		F	50		
112	29th	PNEZ	16 20 25	9,460	
		iSN	30 57		
		eSE	57		
		iN	31 23		
		MN	54 30ca		
		ME	58 ca		
		F	17 45		

Twenty-five insignificant or undecipherable disturbances on the following days of February: 4th, 5th(2), 6th(2), 7th, 8th, 9th(2), 10th, 11th(2), 13th, 14th(3), 15th, 16th, 18th, 19th, 20th, 25th(2), 26th, and 27th.

No. 8.

March, 1940.

M A N I L A , P . I .

SEISMOLOGICAL BULLETIN OF THE OBSERVATORY.

φ=14° 34' 42" N. λ=120° 58' 41" E. h=3 m. Alluvium.

CONSTANTS OF THE GALITZIN-WILIP

	T_1	T
N-S	12.6	12.9
E-W	11.8	11.9
Z	11.6	9.0

CONSTANTS OF THE WIECHERT INVERTED PENDULUM. M 955 Kg. March 1, 1940.

	T	V	ε	$\frac{I}{T_o}z$
N-S	4.3	202	2.5	0.079
E-W	4.2	275	2.4	0.093

No.	Date	Phase.	Greenwich Time h. m. s.	Dist. Km.	Remarks.
113	1st	ePNEZ	10 43 47	520	
		SNE	44 48		
		F	11 08		
116	2nd	ePNEZ	6 35 21	580	Felt in the eastern part of Visayas
		SNE	36 27		
		F	7 10		
117	3rd	ePN	0 15 21	6,320	Near 17°S: 165°E by Riverview and Manila.
		iSNE	23 13		P in E and Z components lost in changing records.
		F	1 40		
119	3rd	iPZ	12 03 26	3,250	
		ePNE	26		
		iSN	08 15		
		LN	11 45ca		
		F	13 13		
121	4th	iPZ	15 49 48	2,545	
		ePNE	48		
		SNEZ	53 49		
		F	16 23		
125	6th	iPZ	18 34 30	8,220	Dilatation.
		ePNE	30		
		SN	44 06		
		LNE	59 ca		
		F	19 45		
127	9th	iPZ	10 51 22	1,810	Dilatation.
		ePNE	22		
		SNE	54 27		
		F	12 10		
130	10th	ePNEZ	10 12 28	630	
		SNE	13 29		
		F	32		
132	12th	ePNEZ	22 19 44	600	Approx. 20°N: 121°E by Manila and Hong Kong. Felt in northern Luzon.
		SNEZ	20 52		
		F	23 19		
133	12th	ePNEZ	23 56 36	420	Felt at Prieto-Diaz, Sorsogon.
		SNEZ	57 27		
	13th	F	0 10		

M A N I L A , P . I .

SEISMOLOGICAL BULLETIN OF THE OBSERVATORY.--Continued.

No.	Date	Phase.	Greenwich Time h. m. s.	Dist. Km.	Remarks.
	Mar. 1940				
137	14th	ePEZ	18 34 14	8,190	In region of New Zealand by Riverview and Manila.
		ePN	18		
		iSNE	43 52		
		LNE	58 40ca		
		MNE	19 05 ca		
		F	21 15		
139	15th	ePNEZ	5 33 23	2,880	
		SN	37 47		
		LE	40 30ca		
		ME	43 ca		
		F	7 10		
141	16th	ePEZ	17 29 25	150	Felt at Iba, Zambales.
		SNE	44		
		F	38		
146	19th	iPEZ	4 44 44	5,520	
		iSN	51 50		
		LE	5 00 ca		
		F	52		
147	19th	ePNEZ	10 52 25	3,365?	
		S?NE	57 33		
		F	12 10		
150	21st	iPEZ	13 58 45	3,730	Compression.
		ePN	45		
		iSNE	14 04 04		
		LNE	08 05ca		
		MNE	11 05ca		
		F	16 00		
151	22nd	ePNEZ	20 31 32	8,980	
		SN	41 40		
		LN	52 30ca		
		MNE	59 ca		
		F	22 00		
153	27th	iPZ	12 41 20	6,620	Compression. 51°N: 180° by U.S.C.G.S
		ePNE	22		
		iSNE	49 34		
		LNE	13 00 ca		
		ME	04 50		
		F	14 38		
155	28th	ePNEZ	14 18 26	410	Felt at Virac, Catanduanes and Naga, Camarines Sur.
		SNEZ	19 17		
		F	47		
156	28th	iPNEZ	15 49 22	175	Compression. Epicenter probably to the SW. Felt in southwestern Luzon, Mindoro, Culion and Marinduque. S from Horizontal Pendulums.
		S	44		
		F	18 20		
161	29th	ePNEZ	21 43 12	3,920	
		SNE	48 43		
		LNE	53 50		
		F	22 25		

M A N I L A , P . I .

SEISMOLOGICAL BULLETIN OF THE OBSERVATORY.--Continued.

No.	Date	Phase.	Greenwich Time h. m. s.	Dist. Km.	Remarks.
	Mar. 1940				
162	30th	ePZ	4 18 59	175	
		ePNE	59		
		SNE	19 21		
		F	27		
163	30th	iPZ	6 26 50	2,630	
		ePNE	50		
		SNE	31 06		
		LNE	33 20		
		F	7 43		
164	30th	ePNE	8 42 51	350	Felt in northern part of Luzon.
		SNE	43 36		Z cylinder stopped at 7:38.
		F	9 13		
165	30th	ePNE	13 00 51	175	
		SNE	01 13		
		F	07		
167	30th	ePNE	21 36 37	180	
		SNE	37 00		
		F	44		

Thirty insignificant or undecipherable disturbances on the following days of March: 1st(2), 3rd, 4th(2), 5th, 6th, 7th, 9th(2), 11th, 13th, 14th(2), 15th(2), 17th(2), 18th(2), 19th, 21st, 25th, 27th, 29th(4), 30th, and 31st.

February 12th, 8:31:59
Near 22°S: 176°E by Riverview and Manila.

February 20th, 2:27:26
13°S: 162°E by Riverview and Manila.