THE GOVERNMENT OF THE PHILIPPINE ISLANDS
DEPARTMENT OF AGRICULTURE AND COMMERCE

International Seismological Centre

WEATHER BUREAU

MANILA CENTRAL OBSERVATORY

SEISMOLOGICAL BULLETIN FOR 1934
JANUARY–JUNE

By REV. WILLIAM C. REPETTI, S. J.
CHIEF OF THE SEISMIC AND MAGNETIC DIVISION

PREPARED UNDER THE DIRECTION OF

REV. MIGUEL SELGA, S. J.
DIRECTOR OF THE WEATHER BUREAU

MANILA
BUREAU OF PRINTING
1934

287746

International Seismological Centre

INTRODUCTION

SEISMIC STATIONS

The following is the list of official seismic stations. Moreover, all the meteorological stations, official and coöperative, have instructions to report all perceptible earthquakes.

Name	Province	North latitude	East longitude	Elevation	Equipment
		° ′	° ′	*m.*	
Manila	Manila	14 35	120 59	2.5	Galitzin-Wilip seismographs, 3 components. Wiechert inverted pendulum, mass 1,000 kg. Two horizontal pendulums, mass 118 kg. each.
Baguio	Mountain	16 25	120 35	1,512.0	Vicentini seismograph, 3 components. Wiechert inverted pendulum, mass 200 kg.
Ambulong	Batangas	14 05	121 03	10.5	Vicentini seismograph, 3 components.
Butuan	Agusan	8 56	125 32	2.0	Wiechert inverted pendulum, mass 200 kg.
Agaña	Guam	13 28	144 45	5.0	Do.

NOTE.—The subsoil of Manila is alluvium.

The time of occurrence is that indicated by the seismographs at the Central Observatory, Manila, whenever the disturbance has been recorded by them. This fact is denoted by an asterisk(*). Otherwise the time is that noted by the meteorological observers who report them. All time indications are in Greenwich Mean Time, insular time being added in brackets for the convenience of Philippine readers.

The intensity of macroseisms is given according to the Rossi-Forel scale.

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

ROSSI-FOREL SCALE

I. *Microseismic shock:* recorded by a single seismograph or by seismographs of the same model but not by several seismographs of different kinds; the shock felt by an experienced observer.

II. *Extremely feeble shock:* recorded by several seismographs of different kinds; felt by small number of persons at rest.

III. *Very feeble shock:* felt by several persons at rest; strong enough for the direction or duration to be appreciable.

IV. *Feeble shock:* felt by persons in motion; disturbances of movable objects, doors, windows; creaking of ceilings.

V. *Shock of moderate intensity:* felt generally by everyone; disturbance of furnitures, beds, etc., ringing of swinging bells.

VI. *Fairly strong shock:* general awakening of those asleep; general ringing of house bells; oscillation of chandeliers; stopping of pendulum clocks; visible agitation of trees and shrubs; some startled persons leave their dwellings.

VII. *Strong shock:* overthrow of movable objects; fall of plaster; ringing of church bells; general panic, without damage to buildings.

VIII. *Very strong shock:* fall of chimneys, cracks in walls of buildings.

IX. *Extremely strong shock:* partial or total destruction of some buildings.

X. *Shock of extreme intensity:* great disaster, buildings ruined, disturbance of the strata, fissures in the ground, rock-fall from mountains.

International Seismological Centre

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.
P_cP	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.
S_cS	Normal transverse waves reflected from the outer surface of the earth's core.
$\overline{S_cP_cP}$	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 of 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.
A	Amplitude of earth motion measured in microns from position of equilibrium. One micron equals .001 mm.
μ	Micron.
A_E	E–W component of A.
A_N	N–S component of A.
A_Z	Vertical component of A.
T	Period of waves.
O	Time of earthquake at the epicenter.
Δ	Arcual distance from station to epicenter.
T_O	Free or undamped period of the seismograph.
V	Static magnification.
ϵ	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

Date	N–S component.				E–W component.			
	T_o	V	ϵ	$\frac{r}{T_o^2}$	T_o	V	ϵ	$\frac{r}{T_o^2}$
1934								
January	4.5	193	2.3	0.026	4.8	203	2.7	0.029
February	4.4	192	2.3	0.031	4.9	202	2.7	0.030
March	4.4	192	2.3	0.031	4.8	206	2.7	0.034
April	4.5	181	2.3	0.035	4.8	209	2.7	0.036
May	4.4	192	2.4	0.030	4.8	203	2.7	0.034
June	4.4	189	2.4	0.035	4.8	202	2.7	0.035

International Seismological Centre

CONSTANTS OF THE GALITZIN-WILIP INSTRUMENTS

	N-S	E-W	Z
PERMANENT CONSTANTS			
Galvanometer periods	12.3s.	11.8s.	11.0s.
Galvanometers to drums	100.5 cm.	100.5 cm.	100.5 cm.
Telescope to seismographs	500 cm.	492 cm.	450 cm.
Reduced pendulum lengths	11.52 cm.	11.40 cm.	14.82 cm.
TEMPORARY CONSTANTS			
Seismograph period, T^1	12.59	11.90	9.0
Coefficient of damping			
Transmission factor, k			

International Seismological Centre

SEISMOLOGICAL BULLETIN FOR 1934

JANUARY, 1934

MACROSEISMIC RECORD

4, 19h 45m [5, 3:45 A. M.] **Glan, Cotabato.** Feeble earthquake.

8, 22h 33m [9, 6:33 A. M.] **Basco, Batan Islands.** Earthquake of intensity II and five seconds duration.

9, 8h 00m [9, 4:00 P. M.] **Lubuagan, Mountain.** Slight earthquake.

15, 18h 40m [16, 2:40 A. M.] **Lamitan, Basilan Island.** Light earthquake.

15, 21h 04m [16, 5:04 A. M.] **Baguio, Mountain.** Earthquake felt by a few persons.

16, 19h 40 [17, 3:40 A. M.] **Cotabato, Cotabato.** Earthquake of intensity III.

16, 23h 03m 45s* [17, 7:03:45 A. M.] **Davao, Davao.** Light earthquake.

17, 4h 40m [17, 12:40 P. M.] **Haight's Place, Mountain.** Light earthquake.

19, 20h 15m [20, 4:15 A. M.] **Siukun Farm, Zamboanga.** Light earthquake.

25, 18h 21m 22s* [26, 2:21:22 A. M.] **W Luzon.** Moderate earthquake with center in the Lingayen Gulf, felt with intensity III at Dagupan and San Fernando. Also felt at Baguio and Vigan.

26, 0h 43m 52s [26, 10:43:52 A. M.] **Agaña, Guam.** Light earthquake recorded and felt.

29, 5h 29m 41s* [29, 1:29:41 P. M.] **Daet, Camarines Norte.** Earthquake of intensity VI and three seconds duration.

INSTRUMENTAL RECORD

No.	Date	Phase	Time			△	Remarks
			h.	m.	s.	Km.	
1	1	iPz	6	21	40	2,535	In region of Flores, N. E. I., by Manila, Pelew, Hong Kong, Chiufeng.
		ePNE		21	41	----------	
		iE		21	44	----------	
		iN		21	45	----------	
		iSNEZ		25	42	----------	
		F	7	20		----------	
2	2	PNE	3	14	09	395	
		$\overline{S}$NE		15	09	----------	
		F		23		----------	
6	2	iPNEZ	17	29	49	2,980	
		iSNE		34	19	----------	
		LN		37	09	----------	
		MN		39	44	----------	
		F	18	00		----------	
7	2	ePNEZ	19	11	34	2,745	
		SNE		15	49	----------	
		LNE		18	25	----------	
		F		35		----------	
9	2	iPNE	21	05	21	7,165	
		SNE		14	03	----------	
		LNE		25	50cs	----------	
		MNE		31	cs	----------	
		F	22	20		----------	
10	3	iPz	9	50	42	4,948	Dilatation. Disturbed by microseisms. Kamtchatka. 53.8° N; 157.3° E by J. S. A. 53° N; 155° E by U. S. C. G. S. 52.2° N: 157° E, h=280, by Koti.
		ePNE		50	42	----------	
		iSNE		57	16	----------	
		F	11	20		----------	
13	8	PNEZ	19	53	54	320	17° 50′ N: 122° 15′ E by Manila and Baguio.
		$\overline{S}$NE		54	41	----------	
		F	20	06		----------	
14	8	PNEZ	23	12	18	2,435	34° N: 133.8° E according to Koti. Felt in Koti, Japan.
		SNEZ		16	11	----------	
		F		26		----------	
15	9	PNEZ	21	43	04	215	
		$\overline{S}$NE		43	32	----------	
		F		47		----------	

International Seismological Centre

INSTRUMENTAL RECORD—Continued

No.	Date	Phase	Time	△	Remarks
			h. *m.* *s.*	*Km.*	
16	10	PNEZ	3 36 58	390	
		SNEZ	37 46		
		F	55		
18	11	PNEZ	8 24 37	1,150	
		SNE	26 36		
		F	50		
19	11	P?NEZ	10 31 40	5,720?	
		SNE	38 57		
		LN	47 02		
		F	11 30		
20	12	PNEZ	13 36 21	2,435	L from the Wiechert. 23° N: 103° E according to Chiufeng. 25.4^{h} N: 103° E by Hong Kong, Karenko, Manila, Chiufeng, according to Taihoku.
		SNE	40 14		
		LNE	42 30ca		
		F	45		
23	13	PNE	22 16 01	1,845	
		SNE	19 10		
		LNE	20 36		
		F	35		
28	15	iPZ	8 50 08	3,845	Compression. Data after P from the Wiechert. Valley of the Ganges, India. 25° N: 86° E by U. S. C. G. S. 25.6° N: 85.7° E by J. S. A 27.5° N: 86.5° E by Strasbourg.
		iPE	50 09		
		PN	50 10		
		iN	51 55		
		SNE	55 33		
		MN	9 02 50ca		
		F	12 30		
32	15	$\overline{P}$NEZ	21 34 51	215	Felt at Baguio with intensity I. Approximately 16° 30′ N: 121° E by Manila and Baguio.
		$\overline{S}$NEZ	35 18		
		F	39		
33	16	iPNEZ	18 42 02	1,420	Felt at Davao, Mindanao. In region of north Celebes by Manila, Pelew, Hong Kong, Zikawei.
		SNE	44 30		
		F	20 20		
34	16	ePNE	23 03 45	1,200	Felt at Davao, Mindanao, with intensity I.
		SNE	05 50		
		LNE	06 44		
		F	50		
38	19	ePZ	12 38 26	2,990	In region of 27° N: 98° E by Hong Kong, Manila, Chiufeng.
		iNE	38 32		
		SNE	42 57		
		LNE	45 50		
		F	13 40		
39	19	PNE	17 59 27	1,435	
		SNE	18 01 56		
		LN	03 12		
		F	19 19		
40	20	PNE	18 02 03	3,310	Felt at Tai-Yuan, Shansi. Disturbed by microseisms.
		SNE	06 55		
		LE	10 13		
		F	19 10		
41	20	SN	22 06 51		P lost in microseisms.
		F	26		
43	21	ePZ	6 57 37	2,200?	26.5° N: 131° E according to Taihoku.
		S?EZ	7 01 14		
		F	8 30		
47	25	iPZ	18 21 22	215	16° 23′ N: 120° 08′ E by Manila and Baguio. Dilatation at Manila and Baguio. Felt at Baguio and along the coast of Lingayen Gulf.
		ePNE	21 24		
		i$\overline{S}$NEZ	21 50		
		F	31		
48	28	PR1E	19 31 33	14,345	Disturbed by strong microseisms. 17° N: 100° W by U. S. C. G. S.
		LNE	20 11 14		
		MNE	21 ca		
		F	21 40		
49	29	ePNEZ	5 29 41	220	Felt at Daet with intensity VI.
		$\overline{S}$NEZ	30 11		
		F	35		
50	29	ePNE	12 55 07	2,710	Deep focus. Felt at Kisar and Tanimbar Islands according to Batavia. Butuan, △=16.1°.
		SNEZ	59 19		
		F	13 22		
52	31	PNE	10 17 56	7,765?	
		iPZ	17 56		
		S?N	27 13		
		F	11 15		

In addition to the above there were twenty-four insignificant or undecipherable disturbances on the following days of January; 2nd(4), 6th, 7th, 10th, 13th(2), 14th(4), 15th(3), 17th(2), 18th, 20th, 22nd, 23rd(2), and 30th.

MACROSEISMIC RECORD

1, 13h 45m [1, 9:45 P. M.] **Upi Agricultural High School, Cotabato.** Light earthquake.

3, 13h 44m 57s* [3, 9:44:57 P. M.] **Davao, Davao.** Earthquake felt in Davao with intensity II.

4, 12h 00m [4, 8:00 P. M.] **Siukun Farm, Zamboanga.** Light earthquake.

6, 20h 09m 29s* [7, 4:09:29 A. M.] **NE Mindanao.** Light earthquake felt at Butuan and Hinatuan.

7, 9h 55m 09s* [7, 5:55:09 P. M.] **Manila.** Earthquake of intensity II felt in the Observatory.

14, 4h 00m 32s* [14, 12:00:32 P. M.] **Luzon.** Strong earthquake in the China Sea at 17° 30′ N; 119° 25′ E. Felt throughout all of Luzon, except the southeast peninsulas, in Formosa and Hong Kong. See special account.

14, 17h 15m 40s* [15, 1:15:40 A. M.] **West Luzon.** Aftershock of the midday earthquake felt at Vigan and Baguio with intensity III at Vigan.

16, 6h 18m 51s* [16, 2:18:51 P. M.] **Baguio, Mountain.** Light earthquake probably an aftershock of the earthquake of the 14th.

INSTRUMENTAL RECORD

No.	Date	Phase	Time			△	Remarks
			h.	*m.*	*s.*	*Km.*	
53	2	iPz	15	10	28	2,710	Compression. Data after P from the Wiechert. 6° S: 135° E by Amboina, Manila, Batavia, Hong Kong, Chiufeng.
		ePNE		10	28	----------	
		iE		10	33	----------	
		iN		10	40	----------	
		iSNE		14	40	----------	
		LNE		17	19	----------	
		ME		19	29	----------	
		F	16	50		----------	
56	3	P?NEZ	13	44	57	970?	Felt in Davao, Mindanao, with intensity II. Disturbed by microseisms.
		SN		46	40	----------	
		F		56		----------	
57	3	iPEZ	14	40	14	4,535	Compression. Data after S from the Wiechert. Eastern New Guinea by Manila, Hong Kong, Chiufeng, Wellington, Batavia, Christchurch.
		ePN		40	15	----------	
		SNE		46	23	----------	
		LNE		52	05ca	----------	
		F	15	45		----------	
58	4	P?E	3	14	26	----------	P doubtful because of microseisms. Deep focus. Butuan, △=16.5.°
		SNEZ		17	57	----------	
		F		58		----------	
59	4	PE	13	46	04	75,555?	Disturbed by microseisms. In region of 35° N: 54° E according to Strasbourg.
		S?NE		54	09	----------	
		L?NE	14	05	30ca	----------	
		F		43		----------	
60	4	iPNEZ	22	06	06	2,490	Dilatation from the SE. SE Band Neira according to Batavia.
		SNEZ		10	04	----------	
		F	23	42		----------	
61	6	P?E	20	09	29	930	Felt at Butuan. N–S recording lamp burned out.
		SE		11	08	----------	
		F		23		----------	
62	7	$\overline{\text{i}}$PNEZ	9	55	09	175	Dilatation from the NE. Felt in Manila Observatory.
		$\overline{\text{S}}$NEZ		55	31	----------	
		mZ		55	41	----------	
		F	10	15		----------	
64	9	iPz	9	34	51	3,100?	
		ePNE		34	51	----------	
		SNE		39	30?	----------	
		F	10	30		----------	
68	11	iPEZ	9	07	01	4,410	Compression. In region of 9° S: 153° E by Manila, Hong Kong, Riverview, Wellington, Batavia.
		SNE		13	03	----------	
		LNE		16	20	----------	
		F		50		----------	
73	12	iPz	11	35	24	2,380	Compression. 19° N: 99° E by Hong Kong, Manila, Zikawei, Chiufeng.
		PNE		35	26	----------	
		SNE		39	14	----------	
		LNEZ		41	14	----------	
		MNE		43	20ca	----------	
		F	13	20		----------	
76	14	iPz	1	26	07	2,710	Felt in Soemba, Timor, Flores according to Batavia.
		ePNE		26	08	----------	
		SNE		30	19	----------	
		F		54		----------	

International Seismological Centre

INSTRUMENTAL RECORD—Continued

No.	Date	Phase	Time	△	Remarks
			h. *m.* *s.*	*Km.*	
77	14	iPNZ	4 00 32	345	Dilatation at Manila and Baguio. 17° 20′ N: 119° 20′ E by Manila and Baguio. At about 4:01 the Manila–Shanghai cable broke near this location. Surge of the sea observed south of Vigan. Seventeen aftershocks until No. 95. See special article.
		iPE	00 33		
95	14	PNE	17 15 40	345	Compression at Manila and Baguio. Epicenter at 17° 15′ N: 119° 12′ by Manila and Baguio. Followed by eight aftershocks until No. 104.
		SNE	16 24		
		F	54		
104	15	PNEZ	3 12 06	8,690	Distance subject to correction for depth of focus.
		SNE	22 09		
		F	55		
					No. 105 to No. 112 and No. 114 to No. 117 are aftershocks of No. 77.
113	16	PNE	6 38 34	1,190	In the region of Sakishima Islands by Manila and Baguio. From the Wiechert.
		SNE	40 38		
		F	7 40		
118	17	PNEZ	21 06 34	2,300	Dilatation. 4° S: 130° 20′ E by Pelew, Manila, Amboina, Batavia.
		SNE	10 18		
		F	22 15		
124	18	PNEZ	20 16 33	895	
		SNE	18 09		
		F	35		
126	19	iPZ	10 30 28	4,140	10° S: 92° 30′ E by Medan, Batavia, Manila, Hong Kong.
		ePNE	30 28		
		SNE	36 13		
		LNE	41 05		
		F	12 40		
128	20	PNEZ	4 15 05	680	
		SE	16 21		
		F	33		
129	20	PNEZ	15 11 22	630	
		SNEZ	12 33		
		F	31		
130	21	PNE	3 35 44	985	
		SNEZ	37 29		
		F	51		
132	21	$\overline{\text{i}}$PZ	18 49 25	160	Dilatation.
		e$\overline{\text{P}}$NE	49 25		
		iNE	49 26		
		$\overline{\text{S}}$NE	49 45		
		F	56		
133	22	PNEZ	8 12 38		
		iNE	16 34		
		iNE	27 43		
		F	10 25		
137	24	iPNEZ	6 28 53	2,765	Compression from the NE. SSE of Ogasawara Island according to Hukuoka.
		iSNE	33 09		
		LNE	35 45		
		MNE	38 ca		
		F	9 50		
138	25	iPNEZ	16 23 52	370	Compression from the NW. Aftershock of No. 77.
		iSNE	24 39		
		F	17 52		
139	25	$\overline{\text{P}}$NEZ	19 10 52	235	
		$\overline{\text{S}}$NEZ	11 24		
		F	26		
142	27	iPZ	21 36 47	4,200	Compression. Approximately 10° S: 150° E by Pelew, Manila, Hong Kong, Chiufeng.
		ePNE	36 47		
		SNE	42 30		
		MN	50 37		
		F	22 40		
143	28	$\overline{\text{P}}$NEZ	8 38 02	120	
		$\overline{\text{S}}$NEZ	38 17		
		F	46		
144	28	PNEZ	9 38 35	2,180	Felt at Geser, Ceram, according to Batavia.
		iSNEZ	38 09		
		F	56		
145	28	PNEZ	14 28 37	4,055	In region of 3° S: 152° E by Manila, Riverview, Hong Kong, Wellington Pelew, Koti, Batavia.
		SNE	34 17		
		LN	39 ca		
		MNE	43 ca		
		F	16 20		

In addition to the above there were sixty-two insignificant or undecipherable disturbances on the following days of February; 2nd(2), 7th, 9th, 10th(2), 11th(3), 12th(3), 14th(22), 15th(11), 16th(4), 18th(5), 19th(2), 21st, 22nd, 23rd(2), 25th, and 26th.

International Seismological Centre

MARCH, 1934

MACROSEISMIC RECORD

7, 10h 59m [7, 6:59 P. M.] **Butuan, Agusan.** Feeble earthquake of short duration.

10, 7h 40m [10, 3:40 P. M.] **Davao, Davao.** Light earthquake.

11, 10h 44m 36s* [11, 8:44:36 P. M.] **Agaña, Guam.** Earthquake recorded and felt.

20, 20h 54m 17s* [21, 4:54:17 A. M.] **NE Mindanao and Leyte.** Earthquake in the Philippine Deep at 9° 20′ N; 126° 30′ E. Felt with intensity V in Butuan and with decreasing intensity to Talisayan, Oriental Misamis, 200 kilometers to the southwest, and to Palo, Leyte, 250 kilometers to the northwest.

29, 15h 29m 36s [30, 1:29:36 A. M.] **Agaña, Guam.** Earthquake recorded and felt.

INSTRUMENTAL RECORD

No.	Date	Phase	Time			△	Remarks
			h.	*m.*	*s.*	*Km.*	
146	1	PNEZ	3	55	11	4,210?	
		S?E	4	01	00	----------	
		LNE		05	50	----------	
		ME		09	ca	----------	
		F	5	10		----------	
148	1	PNEZ	19	48	03	4,045	In region of New Britain by Manila, Hong Kong, Chiufeng, Batavia.
		SNE		53	42	----------	
		LNEZ		58	30	----------	
		MNE	20	01	30	----------	
		F	21	30		----------	
149	1	iPZ	22	05	04	13,980	Dilatation. 39.7° S: 72.5° W by J. S. A. 39° S: 73° W by U.S.C.G.S.
		ePNE		05	04	----------	
		iN		06	05	----------	
		iEZ		28	10	----------	
		iN		29	09	----------	
		LE		45	ca	----------	
	2	F	0	10	ca	----------	
151	2	ePNEZ	19	57	29	2,465?	
		S?NE	20	01	24	----------	
		MN		06	05ca	----------	Continues into the following quake.
154	3	PNE	0	38	42	2,135	
		SNE		42	14	----------	
		LN		44	05	----------	
		MN		45	ca	----------	
		F	1	15		----------	
155	3	eNEZ	16	16	05	----------	Conspicuous group of 19s period waves on E–W component from 16:36 to 16:41.
		iE		27	42	----------	
		iE		28	00	----------	
		F	17	10		----------	
156	3	PNEZ	18	38	27	435?	Baguio, △=175 km.
		S?NEZ		39	20	----------	
		F		50		----------	
157	4	PNEZ	6	04	44	6,080	Compression. In region of 17° S: 160° E by Manila, Hong Kong, Riverview, Chiufeng, Pelew, Batavia, Amboina.
		SNEZ		12	22	----------	
		LNE		21	36	----------	
		F	7	30		----------	
158	4	iPZ	11	26	50	5,925	Compression.
		ePNE		26	50	----------	
		SNEZ		34	19	----------	
		LE		42	ca	----------	
		ME		47	ca	----------	
		F	13	05		----------	
161	5	PNE	0	01	29	220	From the Wiechert.
		SNE		01	59	----------	
		F		09		----------	
163	5	iPZ	11	57	56	8,065	Compression from the SE. Data after P from the Wiechert. 41° S: 176.5° E according to Wellington. Felt over greater part of New Zealand.
		PNE		57	57	----------	
		SNE	12	07	28	----------	
		LNE		21	30	----------	
		MNE		26	40	----------	
		F	14	50		----------	
165	6	PNEZ	4	39	01	400	
		SNE		40	02	----------	
		F		50		----------	

International Seismological Centre

INSTRUMENTAL RECORD—Continued

No.	Date	Phase	Time			△	Remarks
			h.	*m.*	*s.*	*Km.*	
173	11	ePNEZ	10	44	36	3,110	Epicenter in the Nero Deep, SE of Guam. Felt at Guam, △=135 km.
		iSNE		49	15	----------	
		iE		50	13	----------	
		LE		52	24	----------	
		F	11	20		----------	
174	11	PNEZ	19	20	18	2,810	
		SNE		24	37	----------	
		LNE		27	40ca	----------	
		F		59		----------	
177	12	ePNE	15	20	00	11,685	Interpretation by Macelwane's New Tables. 41.7° N: 113° W by J.S.A. 41.7° N: 112.6° W by U. S. C. G. S.
		PR_1Z		24	10	----------	
		PSNE		33	30	----------	
		LNE		55	00	----------	
		MNE	16	04	00	----------	
		PPSS'?		09	00	----------	
		F	17	40		----------	
179	13	iPZ	13	20	48	7,060	Compression from the SE. 12° S: 163° E according to Wellington.
		ePE		20	49	----------	
		SNE		29	24	----------	
		LNE		41	00ca	----------	
		F	15	25		----------	
181	15	iPZ	10	58	17	8,080	Compression. 39.6° S: 177.4° E according to Wellington.
		ePNE		58	17	----------	
		iSNEZ	11	07	51	----------	
		LNE		21	05ca	----------	
		MNE		27	ca	----------	
		F	12	25		----------	
183	16	PNEZ	8	47	21	390	Baguio, △=200 km.
		SNEZ		48	09	----------	
		F		56		----------	
184	16	iPZ	14	20	02	3,490	L and M not distinguishable. 5° S: 145° 45′ E by Amboina, Manila, Batavia, Hong Kong.
		ePNE		20	04	----------	
		SNE		25	06	----------	
		F	15	34		----------	
186	18	ePNEZ	0	34	44	1,165	
		SNE		25	45	----------	
		LNE		26	40ca	----------	
		MNE		28	ca	----------	
		F		46		----------	
187	18	iPZ	4	41	30	5,065	In the region of 50° N: 150° E by Chiufeng and Manila. 50° N; 158° E by J. S. A. 49° N: 156° E by U. S. C. G. S.
		ePNE		41	30	----------	
		SNE		48	10	----------	
		F	5	55		----------	
188	18	PNEZ	7	14	30	525	Butuan, △=325 Km.
		SNEZ		15	32	----------	
		F	8	07		----------	
189	18	PEZ	12	35	56	1,590	Felt at Minahasa, Ternate, Halmahera, according to Batavia. In the Molukka Passage, 1° 30′ N; 127° E, by Pelew, Manila, Batavia.
		SNEZ		38	43	----------	
		F	13	16		----------	
192	20	PNEZ	2	45	21	3,810	From the SE. 5° S: 150° E according to Wellington.
		iSNE		50	45	----------	
		LNE		55	20	----------	
		MNE		58	40	----------	
		F	4	40		----------	
193	20	PNEZ	20	54	17	835	9° 20′ N: 126° 30′ E by Manila and Butuan. Felt in eastern and central Mindanao.
		SNEZ		55	47	----------	
		F	21	33		----------	
196	21	PN	9	14	11	250	
		$\overline{S}$NEZ		14	16	----------	
		F		24		----------	
199	24	PNEZ	12	12	58	5,400	L from the Wiechert. 12° S: 162° E according to Wellington. 10° S: 161° E by U. S. C. G. S. 9.3° S: 161.5° E by J. S. A.
		SNE		19	56	----------	
		LNE		27	40	----------	
		F	15	20		----------	

In addition to the above there were twenty-nine insignificant or undecipherable disturbances on the following days of March: 1st, 2nd(3), 4th(2), 5th(2), 6th, 7th(2), 9th(2), 10th(2), 12th(3), 14th, 16th(2), 18th, 19th, 21st(2), 22nd, 23rd, 28th, and 29th.

International Seismological Centre

APRIL, 1934

MACROSEISMIC RECORD

1, 2h 49m 04s* [1, 10:49:04 A..M.] **Iloilo, Panay.** Light earthquake felt at Central Santos–Lopez and in Iloilo.

2, 15h 52m 45s [3, 1:52:45 A. M.] **Guam, Marianas Islands.** Earthquake recorded and felt at Agaña.

9, 23h 14m [10, 7:14 A. M.] **Mindanao.** Earthquake of intensity III felt at Butuan and Tagoloan.

11, 3h 16m [11, 11:16 A. M.] **Samar.** Earthquake of intensity II and twenty seconds duration felt at Guiuan.

15, 22h 17m 29s* [16, 6:17:29 A. M.] **Mindanao and SE Visayas.** Earthquake in the Philippine Deep at 6° N; 127° E. Felt at Cotabato 350 kilometers to the west of the epicenter and at Catbalogan, Samar, 670 kilometers to the north-northwest. In many places in Mindanao the people were in church at this time and considerable alarm was aroused by the long duration of the motion. Ormoc in Leyte reported a duration of thirty-eight seconds. In Butuan the people left the church and their homes until the movement subsided. Five aftershocks were reported from Compostela in the Province of Davao.

15, 22h 02m 50s [16, 8:02:50 A. M.] **Guam, Marianas Islands.** Earthquake recorded and felt at Agaña.

16, 4h 01m 29s* [16, 12:01:29 P. M.] **Mindanao.** An aftershock of the earthquake at 6:17 A. M. Reported from Davao, Hinatuan, and Tagoloan.

17, 17h 25m [18, 1:25 A. M.] **Panay.** Extremely feeble earthquake felt at Capiz.

19, 7h 50m 33s* [19, 3:50:33 P. M.] **Luzon.** Earthquake in the mountains of Ifugao subprovince. Felt throughout northern Lu zon. Duration of one minute at Vigan and Sagada.

22, 9h 52m 28s* [22, 5:52:28 P. M.] **Baguio, Mountain.** Light earthquake felt by a few persons.

22, 20h 16m 09s* [23, 4:16:09 A. M.] **Vigan, Ilocos Sur.** Earthquake of intensity III and ten seconds duration.

INSTRUMENTAL RECORD

No.	Date	Phase	Time			△	Remarks
			h.	m.	s.	Km.	
202	1	PNEZ	2	49	04	470	Dilatation. Felt at Iloilo, Panay.
		SNE		50	00	----------	
		F	3	02		----------	
203	1	iPNEZ	21	56	22	320	Compression from the NW.
		SNEZ		57	04	----------	
		F	22	35		----------	
204	2	iPZ	5	01	25	1,880?	Dilatation.
		ePNE		01	25	----------	
		S?NE		04	36	----------	
		F		45		----------	
206	3	PNEZ	8	36	35	4,880	
		SNEZ		43	04	----------	
		MNE		54	ca	----------	
		F	9	48		----------	
207	3	iPZ	22	37	02	2,645	Compression. Felt in Hukushima according to Koti.
		ePNE		37	03	----------	
		SNE		41	10	----------	
	4	F	0	05		----------	
208	4	PNEZ	21	31	21	215	
		$\overline{S}$NE		31	50	----------	
		F		39		----------	
209	4	$\overline{P}$NE	21	42	35	195	
		$\overline{S}$NE		43	00	----------	
		F		53		----------	

International Seismological Centre

INSTRUMENTAL RECORD—Continued

No.	Date	Phase	Time			△	Remarks
			h.	*m.*	*s.*	*Km*	
211	6	PNEZ	19	15	30	3,165	Dilatation. Japan.
		SNEZ		20	13		
		LE		23	40		
		F	20	30			
216	10	iPZ	10	27	56	2,635	Compression. Deep focus. Data after P from the Wiechert. Probably in Netherlands, East Indies.
		iPNE		27	57		
		PR_1		28	26		
		PR_2		28	36		
		iSNE		32	03		
		F	12	20			
218	11	ePNEZ	21	21	37	6,490	Deep focus. 21° S: 168° E by Wellington.
		iNE		22	32		
		iSNEZ		29	34		
219	11	PNEZ	22	01	00	2,535	No. 218 still recording. Deep focus. P and S in minute gaps.
		SNEZ		05	00		
		F	23	10			
220	12	iPZ	3	22	03	450	From the north. S from the Wiechert. Baguio, △=270 km.
		ePNE		22	05		
		SNE		22	58		
		F	4	30			
221	12	PNEZ	9	15	37	3,310	
		SNE		20	29		
		ME		26	ca		
		F	10	05			
224	13	iPNZ	22	06	36	1,390	Compression.
		ePE		06	36		
		SNE		09	00		
		F		32			
225	15	PNEZ	10	38	46	3,440?	From the NE.
		S?N		43	47		
		iE		44	34		
		LE		46	55		
		F	11	30			
227	15	iPNEZ	22	17	29	1,090	Compression. S from the Wiechert. Felt in central and eastern Mindanao and southeastern Visayas. 6° N: 127° E by Manila and 15 other observatories giving residuals of 10s or less.
		iSNEZ		19	24		
	16	F	1	20			
229	16	PNEZ	4	01	29	1,100	Compression. S from the Wiechert. Felt at Davao. Aftershock of No. 227.
		SNE		03	25		
		F	5	55			
231	16	PNEZ	13	42	05	1,100	In region of Formosa.
		SNEZ		44	01		
		F	15	00			
232	17	PNEZ	4	10	08	1,100	
		SNEZ		12	03		
		F		50			
236	18	PNEZ	5	22	10	370	Felt at Capiz, Panay.
		SNEZ		22	57		
		F		41			
238	18	PNEZ	21	32	47	1,030	
		SNEZ		34	36		
		MNE		38	20		
		F	22	28			
239	19	iPNEZ	7	50	33	250	Compression. S from the Horizontal pendulums. Approximately 121° 30′ E: 16° 50′ N by Manila and Baguio. Felt in northern Luzon.
		SNE		51	07		
		F	8	30			
240	19	ePNEZ	16	17	59	1,580?	30.5° N: 140° E by Koti.
		S?NE		20	43		
243	20	PNEZ	17	55	38	1,510	
		SNEZ		58	14		
		F	18	25			
246	22	PNEZ	9	52	28	190	Compression. Felt at Baguio. Baguio, △=100 km.
		SNEZ		52	52		
		F	10	20			
247	22	PNEZ	20	16	09	290	Felt at Vigan, Luzon.
		SNEZ		16	48		
		F		29			
248	24	iPZ	2	04	15	2,560	Compression. Deep focus.
		ePNE		04	15		
		iSNEZ		08	17		
		F		45			

International Seismological Centre

INSTRUMENTAL RECORD—Continued

No.	Date	Phase	Time	△	Remarks
			h. *m.* *s.*	*Km.*	
249	24	iPz	17 47 54	6,490	
		ePNE	47 57	----------	
		eSE	55 56	----------	
		LNE	18 06 ca	----------	
		MNE	10 20	----------	
		F	19 45	----------	
250	25	ePNEZ	5 07 54	1,820	Compression.
		SEZ	11 00	----------	
		F	50	----------	
252	26	iPz	5 42 14	6,790	Compression. 21° S: 168° E by Wellington.
		ePNE	42 14	----------	
		SNE	50 32	----------	
		LNE	6 01 30	----------	
		MN	06 00	----------	
		F	7 15	----------	
253	26	ePNE	8 07 33	6,710	P on Z-component lost in local disturbance.
		SNE	15 48	----------	
		F	9 40	----------	
254	26	iPz	13 42 52	2,020	Dilatation. Approximately 4° S: 122° 30′ E by Manila, Hong Kong, Zikawei.
		iPNE	42 54	----------	
		SNE	46 14	----------	
		F	15 20	----------	
255	26	iPz	21 09 42	6,155	Dilatation. In region of New Hebrides by Manila and Riverview.
		iPNE	09 43	----------	
		SNE	17 26	----------	
		LNE	27 ca	----------	
		MNE	31 ca	----------	
		F	23 15	----------	
256	27	PNEZ	3 15 35	2,635	Compression. Deep focus.
		SNEZ	19 42	----------	
		F	40	----------	
258	27	PNEZ	11 35 16	295	
		SNE	35 56	----------	
		F	54	----------	
259	27	iPz	20 57 22	7,055	Dilatation. 23° S: 173° E by Riverview, Manila, Hong Kong, Chiufeng, Zikawei. 22° S: 170° E by Wellington.
		ePNE	57 22	----------	
		SNE	21 05 58	----------	
		iN	06 14	----------	
		iE	06 23	----------	
		iN	13 14	----------	
		LNE	17 30	----------	
		MNE	22 30	----------	
	28	F	0 15	----------	
260	28	ePNEZ	15 15 07	4,575	Compression.
		SNE	21 19	----------	
		LNE	27 20	----------	
		F	17 05	----------	
264	29	PNEZ	4 43 02	1,620	
		SNE	45 30	----------	
		F	5 40	----------	
266	29	PNEZ	12 35 00	1,600?	
		S?NE	37 46	----------	
		LNE	39 ca	----------	
		F	13 40	----------	
268	30	PNEZ	15 24 36	2,435	Compression.
		SNEZ	28 29	----------	
		F	16 40	----------	

In addition to the above there were twenty-eight insignificant or undecipherable disturbances on the following days of April: 2nd, 4th, 8th(3), 9th, 10th, 13th(2), 15th, 16th(2), 17th(2), 18th(2), 19th, 20th, 21st(2), 25th, 27th, 28th(3), 29th, 30th(2).

International Seismological Centre

MAY, 1934

MACROSEISMIC RECORD

6, 18h 24m 17s* [7, 2:24:17 A. M.] **Butuan, Agusan.** Feeble earthquake of seven seconds duration. Motion was NNE–SSW.

6, 21h 30m [7, 5:30 A. M.] **Hinatuan, Surigao.** Slight earthquake perceived. A second shock was felt at 8:35 A. M.

7, 1h 57m 06s* [7, 9:57:06 A. M.] **Butuan, Agusan.** Feeble earthquake of about seven seconds duration. Center in the Philippine Deep.

7, 4h 08m 38s* [7, 12:08:38 P. M.] **NE Mindanao.** Light earthquake felt at Butuan and Hinatuan. From same center as preceding shock.

7, 7h 28m 12s* [7, 3:28:12 P. M.] **Butuan, Agusan.** Another light shock from same center as the preceding.

9, 15h 39m 21s* [9, 11:39:21 P. M.] **S Luzon.** Earthquake of intensity III and thirteen seconds duration in Canlubang, Laguna, and intensity II in Manila. Center probably in Laguna Bay.

10, 17h 05m [11, 1:05 A. M.] **Lubuagan, Mountain.** Light earthquake.

11, 1h 55m [11, 9:55 A. M.] **Surigao, Surigao.** Earthquake of intensity II and four seconds duration.

13, 17h 03m 49s* [14, 1:03:49 A. M.] **N Luzon.** Earthquake of moderate intensity felt throughout northern Luzon. Intensity IV at Tuguegarao and Aparri, and intensity III at Laoag, Vigan, Echague, Baguio. Center in mountains of northern Luzon.

17, 20h 19m [18, 4:19 A. M.] **Butuan, Agusan.** Feeble earthquake with motion SE–NW.

19, 8h 57m 11s* [19, 4:57:11 P. M.] **Aparri, Cagayan.** Earthquake of intensity IV and five seconds duration.

21, 0h 53m [21, 8:53 A. M.] **Cebu, Cebu.** Earthquake of intensity III and four seconds duration.

31, 8h 45m [31, 4:45 P. M.] **Masbate, Masbate.** Light earthquake.

International Seismological Centre

INSTRUMENTAL RECORD

No.	Date	Phase	Time	△	Remarks
			h. m. s.	*Km.*	
271	1	iPEZ	3 49 58	5,540?	Conspicuous group of 22s period waves on E component from 4:13 to 4:16.
		SNE?	57 05		
		F	4 34		
272	1	iPNEZ	7 10 12	3,790	Compression from the SW. 6° 30′ S: 94° E by Hong Kong, Manila, Chiufeng, Osaka, Zikawei.
		SNE	15 30		
		ME	22 30		
		F	8 40		
275	3	PNEZ	1 36 25	3,325	27° 45′ N: 145° E by Osaka, Manila, Chiufeng, Hong Kong, Zikawei.
		SNZ	41 18		
		LE	44 30		
		ME	47 30		
		F	3 17		
277	4	iPNEZ	4 48 04	8,450	Dilatation from the NE. 61° N: 145.1° W by J.S.A. 61° N: 148° W by U. S. C. G. S. Strong at Seward, Alaska.
		iSNE	57 55		
		LE	5 12 40		
		MN	20 30		
		F	7 40		
279	5	ePN	14 43 33	8,345	30° S: 177° 30′ W by Riverview, Manila, Chiufeng, Christchurch. Deep focus, 37° S: 175° W by Wellington.
		iz	43 54		
		SNE	53 19		
		F	16 10		
280	5	iPZ	16 47 38	2,200	Dilatation.
		ePNE	47 38		
		iSNEZ	51 15		
		F	17 40		
284	6	PNEZ	21 57 12	1,000	
		SNE	58 58		
		F	22 35		
286	7	PNE	1 57 06	870	10° N: 127° 30′ E. Felt at Butuan, Mindanao.
		SNE	58 39		
		LNE	59 39		
		F	3 30		
287	7	iPNEZ	4 08 38	870	Dilatation. Felt at Butuan. 10° N: 127° 30′ E by Manila, Hong Kong, Zikawei as on April 13th 1922.
		SNE	10 13		
		LNE	11 18		
		F	5 40		
289	7	PNEZ	7 28 12	870	Felt at Butuan. 10° N: 127° 30′ E. Epicenters of No. 286 and No. 289 based on No. 287.
		SNE	29 45		
		F	59		
290	8	PNEZ	1 02 27	500	
		SNEZ	03 26		
		F	42		
295	9	$i\overline{P}$NEZ	15 39 21	50	Compression from the SE. Felt at Canlubang with intensity III and at Manila with intensity II.
		$i\overline{S}$NEZ	39 28		
		F	52		
301	11	PNEZ	9 06 31	2,645	
		SNE	10 39		
		F	45		
304	11	ePNE	18 28 48	7,655?	
		S?NE	38 00		
		F	19 15		
305	12	iPZ	10 39 53	970	Compression. Deep focus.
		ePNE	39 53		
		iSNEZ	41 36		
306	12	PNEZ	10 56 52	2,465	No. 305 still recording.
		SNE	11 00 47		
		F	12 06		
308	12	ePEZ	20 32 10	3,710	
		iz	33 00		
		SNE	37 28		
		LNE	42 ca		
		MNE	44 ca		
		F	21 20		
312	13	iPEZ	9 09 23	4,520	Compression from the SSE. 5° S: 154° E by U. S. C. G. S.
		ePN	09 23		
		SNE	15 13		
		LNE	21 25ca		
		F	11 45		
313	13	PNEZ	14 37 29	2,655	A second earthquake about 14:54.
		SNE	41 38		
		F	15 40		

International Seismological Centre

INSTRUMENTAL RECORD—Continued

No.	Date	Phase	Time	△	Remarks
			h. *m.* *s.*	*Km.*	
314	13	iPz	17 03 49	400	Compression. Felt throughout N. Luzon. Epicenter in the mountains of north Luzon. S from the Wiechert and Horizontals.
		ePNE	03 49	----------	
		SNE	04 45	----------	
		F	18 15	----------	
317	14	$\overline{P}$NEZ	10 48 20	180	
		$\overline{S}$NEZ	48 43	----------	
		F	54	----------	
319	14	iPz	22 24 35	8,300	Compression. Deep focus. 59° N: 159° W by U. S. C. G. S. 56.2° N: 150.7° W by J. S. A.
		ePNE	24 35	----------	
		iSNE	34 18	----------	
		LNE	49 30ca	----------	
		F	23 35	----------	
322	16	PNEZ	3 42 19	325	
		$\overline{S}$NEZ	43 07	----------	
		F	49	----------	
325	16	PNEZ	23 10 32	520	
		SNE	11 34	----------	
		mNE	13 30ca	----------	
		F	33	----------	
326	17	$\overline{P}$NEZ	9 21 31	135	
		$\overline{S}$NEZ	21 48	----------	
		F	31	----------	
329	17	PNEZ	22 16 14	2,725	
		SNE	20 27	----------	
		MNE	25 ca	----------	
		F	55	----------	
330	19	PNEZ	8 57 11	515?	Felt in Aparri, intensity IV.
		$\overline{S}$NEZ?	58 32	----------	
		F	9 15	----------	
331	19	PNEZ	10 49 38	2,755	
		SNEZ	53 54	----------	
		F	12 30	----------	
332	21	P?NEZ	4 39 22	2,210?	P doubtful; disturbed by microseisms.
		SNEZ	43 00	----------	
		LNE	44 40ca	----------	
		F	5 50	----------	
333	22	P?NEZ	1 28 43	3,030?	P disturbed by wind.
		SNEZ	33 17	----------	
		LNE	36 20ca	----------	
		ME	38 ca	----------	
		F	2 20	----------	
336	23	$\overline{i}$PNEZ	15 33 34	90	
		$\overline{S}$NEZ	33 46	----------	
		F	36	----------	
342	27	PNEZ	6 56 30	400	
		SNE	57 20	----------	
		F	7 28	----------	
344	27	PNEZ	20 20 54	575	
		$\overline{S}$NE	22 25	----------	
		F	35	----------	
347	31	$\overline{P}$NEZ	5 08 42	165	
		$\overline{S}$NEZ	09 03	----------	
		F	12	----------	

In addition to the above there were forty-four insignificant or undecipherable disturbances on the following days of May: 1st, 2nd(2), 4th, 5th, 6th(3), 7th(2), 8th(2), 9th(3), 10th(2), 11th(4), 12th(2), 13th(2), 14th(3), 15th, 16th(3), 17th(2), 22nd(2), 23rd, 24th(2), 25th, 26th, 27th, 28th, and 30th.

International Seismological Centre

JUNE, 1934

MACROSEISMIC RECORD

6, $9^h\ 43^m\ 54^{s*}$ [6, 5:43:54 P. M.] **Borongan, Samar.** Earthquake of intensity VII and eight seconds duration.

6, $7^h\ 55^m\ 41^{*s}$ [6, 5:55:41 P. M.] **Agaña, Guam.** Earthquake recorded and felt.

9, $2^h\ 27^m\ 45^{s*}$ [9, 10:27:45 A. M.] **Aparri, Cagayan.** Earthquake of intensity IV and five seconds duration. Also felt in Ilagan, Isabela.

16, $13^h\ 57^m\ 46^{s*}$ [16, 9:57:46 P. M.] **Surigao, Surigao.** Earthquake of intensity III and three seconds duration.

16, $18^h\ 48^m\ 30^{s*}$ [17, 2:48:30 A. M.] **Panay.** Moderate earthquake felt in Iloilo and other parts of southeast of Panay.

18, $8^h\ 10^m\ 24^{s*}$ [18, 4:10:24 P. M.] **Mindanao.** Light earthquake reported from Hinatuan, Surigao and Compostela, Davao.

21, $8^h\ 28^m$ [21, 4:28 P. M.] **Ormoc, Leyte.** Leyte earthquake of intensity II and twenty-seven seconds duration.

23, $4^h\ 03^m$ [23, 12:03 P. M.] **Hinatuan, Surigao.** Slight earthquake.

International Seismological Centre

INSTRUMENTAL RECORD

No.	Date	Phase	Time	△	Remarks
			h. *m.* *s.*	*Km.*	
349	2	PNEZ	6 00 02	3,635	Region of Bengal, India.
		SN	05 15		
		LN	09 15ca		
		F	55		
350	2	PEZ	13 56 02	10,570	Iceland. 65° N: 20° W by J. S. A.
		PR_2	59 52		
		S_cP_cS	14 06 35		
		LNE	28 00		
		MNE	36 00		
		F	15 40		
352	2	iPZ	21 05 30	5,645	Dilatation. In region of New Hebrides by Manila and Riverview.
		ePNE	05 30		
		SNE	12 43		
353	2	eP?NE	21 33 42	2,335?	No. 352 still recording.
		SNEZ	37 29		
		F	22 35		
355	3	ePNE	16 25 02	5,980	Deep focus. Z component not recording.
		iSNE	32 34		
		F	17 20		
356	3	ePNE	21 07 22	3,180	
		SNE	12 06		
		LNE	15 30ca		
		F	22 40		
364	6	iPZ	9 43 54	595	Dilatation. Felt in Borongan.
		ePE	43 54		
		SNEZ	45 04		
		$\overline{S}$N	45 27		
		F	10 05		
365	6	PNEZ	10 17 53	7,350	Deep focus.
		SN	26 46		
		F	11 00		
369	7	iPZ	20 22 52	2,545	Compression. Deep focus.
		ePNE	22 52		
		iSNEZ	26 53		
		F	21 07		
370	8	PEZ	18 34 41	8,010	Felt in Apia, Samoa.
		SNE	44 10		
		F	19 20		
372	9	PNE	2 27 45	470	Felt at Aparri with intensity IV. S from the Wiechert. Epicenter in the Babuyan Channel by Manila and Baguio.
		SNE	28 41		
		F	3 25		
373	9	PEZ	13 05 13	3,570	Dilatation. 6° 30′ S: 145° 30′ E by Riverview, Adelaide, Manila, Chiufeng, Wellington, Zikawei, Christchurch.
		SNE	10 21		
		F	15 00		
375	12	$\overline{P}$NEZ	7 44 50	150	Epicenter in Caraballo Mountains by Manila and Baguio.
		$\overline{S}$NEZ	45 09		
		F	50		
376	13	iPNEZ	1 58 02	4,055	Dilatation from the NE. 45° N: 149.5° E by J. S. A. h=95 km. 48° N: 148° E by Strasbourg.
		iSNEZ	2 03 42		
		LNE	08 27		
		F	4 00		
378	13	iPZ	22 19 59	6,200	Dilatation. Afghanistan. Approximately 32° N: 61° 30′ E by Manila, Chiufeng, Hong Kong. 29.5° N: 63.5° E by J. S. A.
		iPN	20 00		
		PR_1	22 24		
		SNEZ	27 44		
		LNE	37 30ca		
		MNE	41 30ca		
	14	F	0 30		
379	14	PNEZ	19 11 43	1,520	
		SNE	14 20		
		F	20 20		
380	15	PEZ	2 59 02	3,235	Compression.
		SE	3 03 49		
		LN	07 25ca		
		F	57		
382	15	PNEZ	21 36 51	1,520	
		SNE	39 29		
		F	22 25		
386	16	$\underline{P}$NEZ	18 48 30	390	Felt in southeastern Panay.
		$\overline{S}$NEZ	49 18		
		SNZ	49 28		
		F	19 30		

International Seismological Centre

INSTRUMENTAL RECORD—Continued

No.	Date	Phase	Time	△	Remarks
			h. *m.* *s.*	*Km.*	
387	17	P̄NEZ	1 43 47	195	Compression.
		S̄NEZ	44 12		
		F	55		
391	18	PNEZ	9 25 34	8,290	62° N: 150° W by U. S. C. G. S. 59.2° N: 149.5° W by J. S. A.
		iz	25 53		
		SE	35 17		
		iE	36 58		
		iN	37 16		
		F	10 30		
392	19	PNEZ	2 50 12	1,635	
		SNEZ	53 02		
		LNE	43 30ca		
		F	3 25		
393	19	PNEZ	3 55 41	2,890	16° N: 147° 30′ E by Guam and Manila.
		iz	55 47		
		SNEZ	4 00 06		
		iN	00 54		
		F	50		
394	19	PNEZ	15 51 26	1,345	
		SN	53 45		
		F	16 42		
400	22	PNZ	18 02 18	6,490	Compression from the north.
		PE	02 19		
		iE	07 50		
		iSNE	10 20		
		F	19 50		
403	23	PNEZ	5 26 20	3,735	32° 30′ N: 90° 12′ E by Manila Hong Kong, Chiufeng.
		PR_1	27 22		
		SNE	31 39		
		SR_1	33 44		
		LNE	36 19		
		iMN	37 36		
		iME	38 00		
		iME	39 10		
		F	7 00		
404	23	P̄NEZ	9 39 21	200	
		S̄NEZ	39 47		
		F	44		
406	24	iPz	6 19 31	18,800?	Dilatation. Argentina. 23° S: 68° W by U. S. C. G. S. 22° S: 68° W by J. S. A.
		iPE	19 33		
		iPN	19 34		
		LNE	7 19 ca		
		F	9 25		
417	28	iPz	1 05 17	5,890	Dilatation. 16° 30′ S: 165° E by Manila, Hong Kong, Chiufeng, Zikawei.
		ePNE	05 17		
		iNE	10 30		
		SNE	12 44		
		LNE	21 30ca		
		ME	26 ca		
		F	2 50		
421	29	iPz	8 29 21	1,825	Compression from the SE. 8° 30′ N; 137° 30′ E by Manila, Chiufeng.
		iPNE	29 22		
		SNE	32 29		
		F	10 30		
422	29	iPEZ	12 38 42	1,690	
		ePN	38 42		
		iN	38 47		
		SE	41 36		
		MN	44 40ca		
		F	13 50		
426	30	PNEZ	17 12 30	3,945	Disturbed by microseisms.
		iN	17 11		
		SNE	18 02		
		LE	23 10		
		F	57		

In addition to the above there were forty-nine insignificant or undecipherable disturbances on the following days of June: 2nd(2), 3rd, 4th(3), 5th(2), 6th(3), 7th(2), 8th, 10th, 13th, 15th, 16th(3), 17th, 18th(2), 20th, 21st(4), 23rd(2), 24th(3), 25th(3), 26th(3), 27th(2), 28th(3), 30th(5).

International Seismological Centre

THE CHINA SEA EARTHQUAKE OF FEBRUARY 14TH, 1934

By Rev. W. C. Repetti, S. J.
Chief, Seismic and Magnetic Division
Weather Bureau, P. I.

On February 14th, 1934 a strong earthquake occurred in the China Sea off the west coast of Luzon. It was perceptible over all of Luzon, except the southern peninsulas, in southern Taiwan and in Hong Kong. Consequently, the shaken area was approximately 1,885,900 sq. km. or 723,400 sq. m.

In the coast towns nearest the center of the earthquake the motion was perceptible from 90 to 120 seconds, while in Manila, some 350 kilometers from the epicenter, the motion lasted about 60 seconds.

Although the earthquake caused considerable alarm the damage done on land was negligible. The wall of a public school in Manila was cracked and a portion of a pier settled a few inches, but these effects were due, no doubt, to defective or weakened material, and should not be taken as a criterion of intensity.

A feature of much greater importance and interest was the rupture of the Manila–Shanghai cable of the Commercial Pacific Cable Company. This will be dealt with later.

THE EPICENTER. As soon as the seismograms could be developed and examined a statement was given to the Press that the earthquake center was about 350 kilometers to the northwest of Manila, off the west coast of Luzon. This was misinterpreted in some press reports to mean 350 kilometers from the west coast of Luzon, and consequently some central seismic associations gave the epicenter as 18° N; 118° E.

A preliminary report on this earthquake was issued with the seismic bulletin of the Manila Observatory for May, 1934. The epicenter was given as 17° 30′ N: 119° 25′ E. A redetermination has since been made, based on the seismograms of Manila and Baguio and on a report from the cable repair ship. The epicenter is now given as

17° 20′ N: 119° 20′ E,

and the time at origin as

$3^h\ 59^m\ 38^s$ G. M. T.

This position is 115 kilometers due west of San Esteban where a sea disturbance was observed.

THE EPICENTRAL MOVEMENT AND CABLE FRACTURE. At San Esteban the first movement of the sea was reported to have been a recession, and to such a noticeable extent that the people hurried out on the exposed shore to gather fish which had been left stranded. Some persons narrowly escaped drowning when the water returned.

This phenomenon, combined with the fact that the first motion at Manila was a dilatation, prompted the writer to express the opinion to the manager of the cable company that there had been a drop in the sea bottom. The Manila–Shanghai cable break occurred at 4: 01: 00, G. M. T. (12: 01 P. M., 120th meridian time). The cable ship came from Shanghai and in reply to a request from the writer, through the Manila manager of the Company, Mr. Morgan, it was stated that no change of depth had

International Seismological Centre

been found. On March 2nd the cable again became interrupted but no earthquake was recorded at Manila or in Baguio.

A report from the cable company after this occurrence stated that the breaks had been located in a depth of 1,355 fathoms and that there were indications of a change of depth. Soundings were made with a view to finding a level path for the cable. Going south for a distance of 2.25 miles from the break the depth was found to decrease to 1,300 fathoms. Continuing south for another mile and a quarter the depth increased to 1,408 fathoms. The attempt to find a level path was apparently abandoned. It will be of interest to insert here the report received from Shanghai.

"Following details are from the Cableship Pacific's reports on the two repairs. On February 14, at 12.02 Shanghai time, the Manila–Shanghai cable became interrupted. Two breaks had occurred at the following positions; northerly break 17 26 24 North 119 16 50 East. Southerly break 17 25 45 North 119 16 50 East. During the repair which was carried out from February 23 to 25, shocks were felt through the ship three times. Each shock lasted only a short time perhaps from 5 to 10 seconds but they were felt by all on board. The first shock was felt on the 23, at 22.05, and the second which by far was the heaviest, came on the 24, at about 8.30, and the last the same day at about 12.25. On March 2, at 19.45, the cable was again interrupted at a place very close to or actually between the two former breaks. During the repairs, the cable was found to be buried at the place where the break had occurred."

We can not be certain that the entire reported change of depth occurred suddenly. The changes in sea bottom conditions as given in the various reports of the cable ship and the shocks felt while repairing the cable suggest that the cable break of March 2nd was due to slumping set up by the earthquake of February 14th.

The writer wishes to express his thanks to Mr. Pagh, chief engineer, Great Northern Telegraph Co., Shanghai, and to Mr. Morgan, manager, Commercial Pacific Cable Co., Manila, for their kindness in furnishing information regarding the cable break.

SURFACE WAVE. We refer here to a long period wave that appeared on some seismograms, calling it a surface wave because of its similarity to the usual wave of that name. The long duration of the perceptible motion, even at great distances from the epicenter, was an unusual feature of this earthquake. The duration of the microseismic motion can not be stated because of the numerous aftershocks which kept the seismographs in motion. At Hong Kong, 6° 51′ from the epicenter, a 22^s period wave, with short period impulses superimposed, appears about 12 seconds after P. After two or three oscillations it becomes indistinguishable because of the rapidity of motion of the light spot caused by the entrance of the S wave.

Seismograms for the interval from Hong Kong to Phu Lien are lacking, hence the waves can not be followed continuously.

At Phu Lien, 12° 31′ from the epicenter, a 26^s period wave entered at 4: 02: 47, thirteen seconds after P. It was extraordinarily large on the E–W component and gave three complete oscillations, ending at 4: 04, one minute before the beginning of S.

There is some evidence of a similar wave on the Weichert seismograms of Zikawei. It enters on the E–W component at 4: 05: 25 and was interpreted as S by Zikawei. The S phase was not due until 4: 05 43 and appeared one second late. If these waves at Phu Lien and Zikawei were identical they would indicate a travel through 1° 29′ in an interval of 2^m 38^s, and this after a travel through 12° 31′ at a velocity approximately the same as that of the P wave.

At Koti, 20° 36′, a 13s wave comes in at 4: 08: 35, which is 27 seconds after S. At Chiufeng, 22° 54′, the seismograms are of normal appearance.

These waves are not the PL waves of Sommville and Landsberg (Gerl. Beitr. z. Geophysik, Vol. 27, p. 437; Vol. 29, pp. 64 and 247; Vol. 33, p. 31). According to the

International Seismological Centre

travel times of PL by Landsberg the wave would be due at Phu Lien at 4:03:33 and at Zikawei at 4:04:03. At present we can merely state that there was a complicated phenomenon, probably superficial, whose exact nature we do not know, over a large epicentral area.

THE $\overline{S_cP_cS}$ WAVE. In calculating the residuals of the various phases it was noticed that there were persistent positive residuals for $\overline{S_cP_cS}$, or negative residuals for S and $\overline{S_cP_cP_cS}$. In order to investigate these residuals, curves for S, $\overline{S_cP_cP_cS}$, and $\overline{S_cP_cS}$, between 86° and 100°, were drawn from Macelwane's New Tables, November, 1933. Observed arrivals, from Bergen to Alicante, were plotted on the same sheet as shown in Figure 1. It is seen that they indicate a curve later than $\overline{S_cP_cS}$ and having a slightly greater slope. The slope is 5.7s/deg. Lehmann and Plett (Gerl. Beitr. z. Geophy., Vol. 36, pp. 38–77) found different slopes and travel times for $\overline{S_cP_cS}$ in three earthquakes from different regions. This suggested a comparison with other Philippine earthquakes.

On March 19th, 1931, there was a strong earthquake from an epicenter only 10 kilometers distant from this one of February 14th, 1934. Moreover, the arrival times of P have been found to agree satisfactorily with those of Macelwane's New Tables, thus indicating a depth of focus substantially the same as that of February 14th. Following the same procedure in this earthquake as in that of February 14th we obtained the results shown in Figure 2. The stations used were from Beograd, 83° 48′, to Plaisance, 97° 21′. The distances and arrival times of $\overline{S_cP_cS}$ are given in Table 1. Again we obtain an indicated curve for $\overline{S_cP_cS}$ later than Macelewane's and with a slightly greater slope, viz. 6^s/degree. In this case the difference from Macelwane's curve is not quite as much as in the case of February 14th by 2–4 seconds roughly. This difference in absolute times is ascribed to a slightly deeper focus on March 19th, 1931, than on February 14th, 1934.

TABLE 1

Observatory	°	′	h. m. s.	Observatory	°	′	h. m. s.
Beograd	83	48	6:47:47	Coire	90	02	6:48:27
Budapest	83	48	53	De Bilt	90	06	31
Copenhagen	84	30	55	Strasbourg	90	12	30
Vienna	85	12	48:00	Catania	90	15	38
Zagreb	86	22	06	Rome	90	16	35
Hamburg	86	39	10	Zurich	90	18	29
Jena	86	57	12	Stuttgart	90	42	24
Scoresby–Sund	87	20	14	Prato	90	57	30
Tarente	87	33	14	Uccle	91	00	37
Gottingen	87	34	17	Neuchatel	91	27	36
Triest	87	51	08	Stonyhurst	92	45	47
Trevise	88	52	25	Kew	93	06	48
Frankfort	89	03	25	Paris	93	06	47
Padua	89	10	24	Barcelona	97	16	49:09
Messina	89	38	40	Plaisance	97	21	48:34

International Seismological Centre

We next took the earthquake of November 13th, 1925, one of the three used by Lehmann and Plett, since it also is a Philippine earthquake. The epicenter had already been determined (Philippine Earthquake Epicenters, South of Manila, Seis. Bull., Jan.–June, 1931, Manila Observatory) as 13° N: 125° E, and in a recent revision of the data of this earthquake we changed from 0=12: 14: 48, G. M. T., to H=12: 14: 49, G. M. T., with more satisfactory results. Observed arrival times as given by Lehmann and Plett, Table 2 below, were compared with calculated values obtained by the use of Macelwane's New Tables. The residuals were plotted in Figures 1 and 2, and are distinguished by small crosses. It is to be regretted that the principal range of distance covered is 91° to 99°, a range which is not well represented in the earthquakes of March 19th, 1931 and February 14th, 1934. However, in spite of diversity of range, it is seen that the $\overline{S_cP_cS}$ values of November 13th, 1925 suggest a curve between that of February 14th, 1934 and that of March 19th, 1931. It is believed that this diversity of $\overline{S_cP_cS}$ curves is due to slight differences in depth of focus.

TABLE 2

Observatory	°	h m s	Residuals
Upsala	87.1	12:37:56	+10s
Beograd	90.7	38:27	+16
Vienna	92.1	32	+12
Zagreb	93.2	36	+10
Leipzig	93.2	39	+13
Hamburg	93.5	34	+ 6
Gottingen	94.4	39	+ 5
Munich	95.0	46	+11
Nordlingen	95.4	46	+ 6
Innsbruck	95.5	42	+ 2
Hohenheim	96.2	50	+ 6
Ravensburg	96.4	53	+ 7
De Bilt	96.8	57	+ 9
Strasbourg	97.1	54	+ 4
Firenze	97.1	57	+ 7
Zurich	97.2	55	+ 5
Dyce	97.3	59	+ 8
Uccle	97.8	39:01	+ 7
Edinburgh	98.6	03	+ 4
Stonyhurst	99.5	13	+ 9
Paris	99.9	14	+ 8
Oxford	100.2	15	+ 8

FIRST MOTION. It was hoped that complete data on the first motion would be available, but it was not so. Many reports indicated that a sharp first motion was not recorded. Table 3 shows the available data with stations arranged in azimuth from the epicenter, from north through east. If we suppose a distribution of impulses by sectors there will be at least three sectors of dilatation. It seems more consistent with the epicentral phenomena to call this a collapse earthquake and make a zonal distribution of first motions. As far as 14° there are dilatations, beyond this, compressions. Amboina is doubtful. Hyderabad was read from horizontal component copies with interpretation as given on the seismograms.

International Seismological Centre

TABLE 3

Observatory	Distance	Azimuth from epicenter	First motion
Zikawei	14° 00′	N 7° 11′ E	Dilatation.
Nagasaki	18° 06′	N 26° 03′ E	Dilatation.
Kobe	22° 24′	N 36° 16′ E	Compression.
Pelew	17° 51′	N 139° 53′ E	Dilatation.
Riverview	59° 30′	N 144° 20′ E	Compression.
Manila	3° 12′	N 152° 18′ E	Dilatation.
Amboina	22° 46′	N 157° 02′ E	Dilatation?
Batavia	26° 34′	N 151° 12′ W	Compression.
Hyderabad	38° 28′	N 90° 00′ W	Dilatation.
Bombay	44° 07′	N 80° 20′ W	Compression.
Phu Lien	12° 31′	N 72° 40′ W	Dilatation.
Hong Kong	6° 51′	N 44° 06′ W	Dilatation.
Triest	88° 04′	N 42° 30′ W	Compression.
Scoresby–Sund	88° 10′		Compression.
De Bilt	90° 17′		Compression.
Florence	90° 26′	to	Compression.
Strasbourg	90° 30′		Compression.
Uccle	91° 21′		Compression.
Paris	93° 24′		Compression.
Kew	93° 30′	N 32° 30′ W	Compression.
Chiufeng	22° 54′	N 6° 34′ W	Compression.
Nanking	14° 44′	N 2° 11′ W	Compression.

Table 4 is a compilation of phase residuals. The observed times, in a large majority of instances, were taken from observatory reports. In some instances they were read from original records or contact copies. The tables used were, as has been said, Macelwane's New Tables, November, 1933. We wish to express our appreciation of the coöperation of other observatories in supplying contact copies of their seismograms or lending original records.

International Seismological Centre

TABLE 4

Observatory	°	′	P	PR_1	PR_2	S	SR_1	$\overline{S_cP_cS}$	PS	$\overline{S_cP_c\overline{P_cS}}$	P′
Manila	3	12									
Hong Kong	6	51									
Taihoku	7	59									
Phu Lien	12	31	— 5			— 2					
Zikawei	14	00	— 2	— 7		+ 1					
Nanking	14	44	[a]	[a]	[a]	[a]	[a]	[a]	[a]	[a]	[a]
Pelew	17	51	+ 2			0					
Nagasaki	18	06	+ 1			— 2					
Hukuoka	19	03	+ 1			— 1					
Koti	20	36	— 4			+ 2					
Kobe	22	24	— 3			0					
Osaka	22	34	+ 2			+ 4					
Amboina	22	46	+ 2			— 6					
Chiufeng	22	54	— 1			— 3					
Medan	24	28	— 1								
Batavia	26	34	— 3			— 1					
Malabar	27	09	+ 9			+11					
Hyderabad	38	28	+ 3			0					
Bombay	44	07	+ 3	— 2		+ 7	—13				
Perth	49	24	0	+ 7		+ 1	+ 9				
Adelaide	55	24	+ 2			— 8					
Riverview	59	30	+ 3			— 2	— 2				
Sydney	59	30	— 7			+ 8					
Melbourne	60	12	+ 4			— 6					
Apia	74	48	+ 8			+12					
Arapuni	76	32	+35			—15					
Helsingfors	77	09	0			+ 5					
Honolulu	77	21	+12			— 2					
Wellington	77	52	+ 4			— 4					
Christchurch	77	57	+ 2			— 1					
Tananarive	79	18	+ 3			— 1					
Sitka	83	31	+ 7			+ 3					
Lund	84	27	+ 2			+ 8					
Copenhagen	84	52	+ 2			+ 5					
Bergen	86	10	+ 5					+14			
Zagreb	86	34	+ 2					+14			
Hamburg	87	03	+ 2			+ 3		+15			
Triest	88	04	+ 1			— 7					
Scoresby-Sund	88	10	0					+15			
Trevise	89	01	+ 2			— 3					
Padua	89	24	+ 3					+14			
Chur	90	13	+ 2	+ 6				—15			
De Bilt	90	17	+ 1	+ 3							
Florence	90	26	— 1					+12			
Strasbourg	90	30	0	+ 2	+12		— 2	+ 9	+ 4	— 2	
Zurich	90	34	+ 1	+ 6				+10			
Prato	91	10	— 3					+ 9			
Uccle	91	21	+ 1	— 1	+ 8	+ 1	+ 7	+15	+15	— 6	
Neuchatel	91	44	0	+ 5				+10			
Stonyhurst	93	15	+ 1	+ 7							
Grenoble	93	19	—14	— 9						— 9	
Paris	93	24	+ 2	+ 6				+10		—11	
Kew	93	30	+ 1	+ 4		— 7		+11	— 1	— 8	
Victoria	93	54	—14								
Tunis	94	10	+ 9								
Marseilles	94	26	+ 3								
Toledo	97	00	+23								
Barcelona	97	28	— 3	+ 5							
Tortosa	98	50	— 3								
Algiers	99	14	+13	+ 7							
Berkeley	100	06	0					+ 8			
Alicante	100	48	— 5					— 5			
Bozeman	102	36	—16			+18			+ 1		
Tinemaha	103	10	+10					+ 6			
Granada	103	30	—12					— 2			
Santa Barbara	103	40	+ 7								
Haiwee	103	55	+ 1								
Coimbra	104	44	+10						— 7		
Pasadena	104	54	— 1	+ 4		— 7		— 5	0		
Mt. Wilson	104	57	— 2								
Riverside	105	32	— 6								
San Fernando	105	33		+ 2							
La Jolla	106	15	— 1					+ 8			
Tucson	111	00		+ 6			+21		+ 2		
Madison	114	04		+ 7			— 7		+ 3		
Chicago	115	50		+ 3					+ 6		
Toronto	116	38	— 2	— 4			— 8		— 3		+1
Florissant	117	21	— 7	+ 8	+ 9	— 3	+ 3	— 2	+ 8	+ 3	+3
St. Louis	117	33		+ 6		—12	— 1	— 5	0	— 5	+4
Buffalo	117	30		+ 7							
Ottawa	117	32		—11							
Little Rock	119	48		+ 6							+4
Fordham	120	31		+ 2				+ 1			
Georgetown	121	42		+ 4					— 2		+3
San Juan	143	52		+ 4						— 3	—2
La Paz	172	48									+5

[a] No time marks.

International Seismological Centre

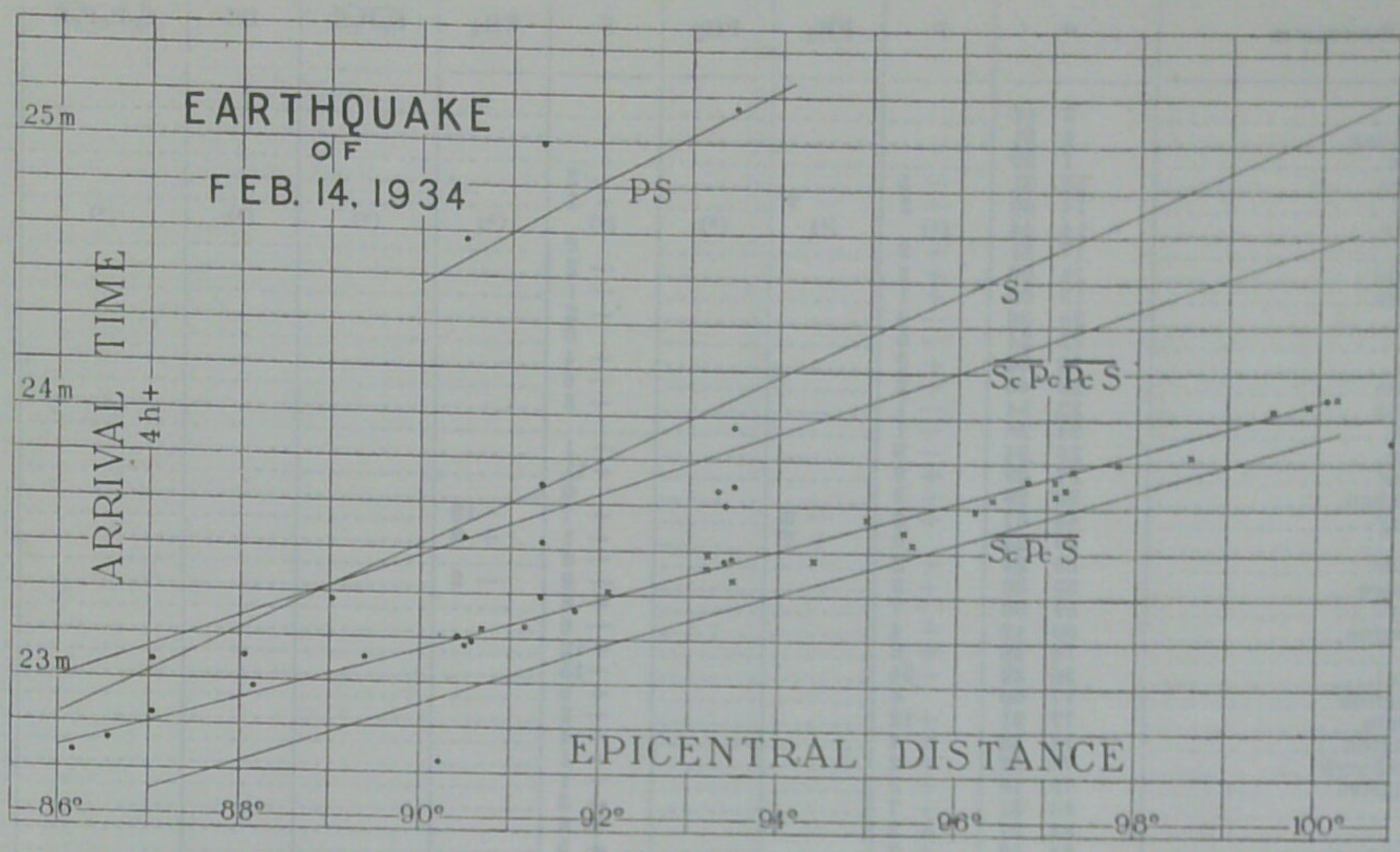


FIGURE 1

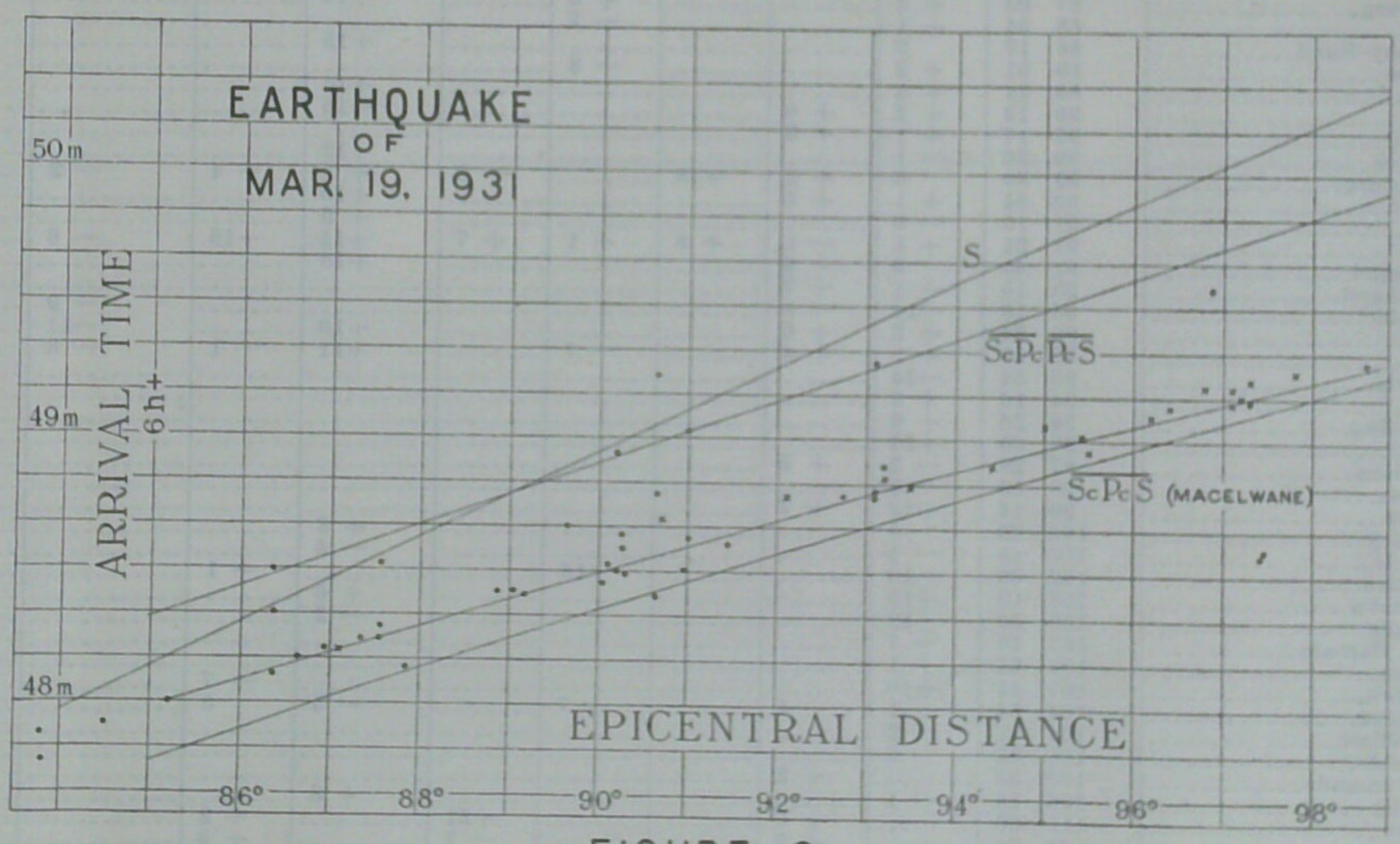


FIGURE 2

International Seismological Centre

AFTERSHOCKS. The principal shock was recorded at Manila at 4: 00: 32, G. M. T. February 14th. Then followed a series of aftershocks at the following times:

February 14th	5: 49: 47	February 14th	19: 07: 27
	6: 21: 06		19: 51: 34
	6: 30: 21		23: 06: 50
	6: 45: 32		23: 32: 21
	7: 13: 23	February 15th	1: 07: 00
	7: 45: 39		1: 56: 36
	7: 51: 40		3: 05: 24
	8: 03: 06		10: 58: 57
	8: 28: 36		11: 23: 09
	8: 40: 09		12: 56: 30
	8: 49: 35		13: 12: 37
	8: 52: 45		14: 02: 29
	9: 26: 56		19: 08: 49
	11: 02: 47	February 16th	6: 18: 51
	11: 18: 52		12: 08: 44
	11: 27: 36		12: 22: 03
	11: 51: 03		13: 52: 22
	17: 15: 40		22: 48: 41
	18: 56: 42		

The shock at 17: 15: 40 on the 14th showed a compression at Manila and Baguio. The cable ship reports having felt one shock on the 23rd and two on the 24th. No doubt there were many others too feeble to affect the seismographs in Manila and Baguio.

International Seismological Centre

SEISMOLOGICAL BULLETIN FOR 1934
JULY—DECEMBER

293092

Ack'd
DOMINION OBSERVATORY
RECEIVED
26 NOV. 1935
236
WELLINGTON, N.Z.

International Seismological Centre

INTRODUCTION

SEISMIC STATIONS

The following is the list of official seismic stations. Moreover, all the meteorological stations, official and coöperative, have instructions to report all perceptible earthquakes.

Name	Province	North latitude	East longitude	Elevetion	Equipment
		° ′	° ′	*m.*	
Manila	Manila	14 35	120 59	2.5	Galitzin-Wilip seismographs, 3 components. Wiechert inverted pendulum, mass 1,000 kg. Two horizontal pendulums, mass 118 kg. each.
Baguio	Mountain	16 25	120 35	1,512.0	Vicentini seismograph, vertical component. Wiechert inverted pendulum, mass 200 kg.
Ambulong	Batangas	14 05	121 03	10.5	Vicentini seismograph, 3 components.
Butuan	Agusan	8 56	125 32	2.0	Wiechert inverted pendulum, mass 200 kg.
Agaña	Guam	13 28	144 45	5.0	Do.

NOTE.—The subsoil of Manila is alluvium.

The time of occurrence is that indicated by the seismographs at the Central Observatory, Manila, whenever the disturbance has been recorded by them. This fact is denoted by an asterisk(*). Otherwise the time is that noted by the meteorological observers who report them. All time indications are in Greenwich Mean Time, insular time being added in brackets for the convenience of Philippine readers.

The intensity of macroseisms is given according to the Rossi–Forel scale.

The intrumental record is that obtained from the seismographs in the Manila Observatory. It is that of the Galitzin-Wilip instruments except where noted otherwise.

ROSSI-FOREL SCALE

I. *Microseismic shock:* recorded by a single seismograph or by seismographs of the same model but not by several seismographs of different kinds; the shock felt by an experienced observer.

II. *Extremely feeble shock:* recorded by several seismographs of different kinds; felt by small number of persons at rest.

III. *Very feeble shock:* felt by several persons at rest; strong enough for the direction or duration to be appreciable.

IV. *Feeble shock:* felt by persons in motion; disturbances of movable objects, doors, windows; creaking of ceilings.

V. *Shock of moderate intensity:* felt generally by everyone; disturbance of furnitures, beds, etc., ringing of swinging bells.

VI. *Fairly strong shock:* general awakening of those asleep; general ringing of house bells; oscillation of chandeliers; stopping of pendulum clocks; visible agitation of trees and shrubs; some startled persons leave their dwellings.

VII. *Strong shock:* overthrow of movable objects; fall of plaster; ringing of church bells; general panic, without damage to buildings.

VIII. *Very strong shock:* fall of chimneys, cracks in walls of buildings.

IX. *Extremely strong shock:* partial or total destruction of some buildings.

X. *Shock of extreme intensity:* great disaster, buildings ruined, disturbance of the strata, fissures in the ground, rock-fall from mountains.

International Seismological Centre

SYMBOLS AND ABBREVIATIONS

P	Normal first preliminary tremors; longitudinal waves which have passed below the continental layer.
$\bar{P}$	Upper first preliminary tremors whose path lies wholly in the continental layer.
P′	Longitudinal waves that have traversed the earth's core.
PP	Longitudinal waves reflected 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.
$\bar{S}$	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.
SS	Normal transverse waves reflected at the earth's surface.
ScS	Normal transverse waves reflected from the outer surface of the earth's core.
ScPcP	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 of 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.
A	Amplitude of earth motion measured in microns from position of equilibrium. One micron equals .001.
μ	Micron.
A_E	E–W component of A.
A_N	N–S component of A.
A_Z	Vertical component of A.
T	Period of waves.
O	Time of earthquake at the epicenter.
Δ	Arcual distance from station epicenter.
T_o	Free or undamped period of the seismograph.
V	Static magnification.
ϵ	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

Date	N–S component				E–W component			
	T_o	V	ϵ	$\frac{r}{T_o^2}$	T_o	V	ϵ	$\frac{r}{T_o^2}$
1934								
July	4.4	194	2.4	0.046	4.8	199	2.7	0.038
August	4.6	190	2.3	0.045	4.9	202	2.7	0.032
September	4.6	183	2.3	0.032	4.9	201	2.8	0.030
October	4.6	191	2.3	0.046	4.8	205	2.6	0.030
November	4.4	192	2.3	0.035	4.8	198	2.7	0.036
December	4.5	197	2.2	0.040	4.6	196	2.7	0.036

International Seismological Centre

CONSTANTS OF THE GALITZIN-WILIP INSTRUMENTS

PERMANENT CONSTANTS			
	N–S	E–W	Z
Galvanometer periods	12.3s	11.8s	11.0s
Galvanometers to drums	100.5 cm	100.5 cm	100.5 cm
Telescope to seismographs	500 cm	492 cm	450 cm
Reduced pendulum lengths	11.52 cm	11.40 cm	14.82 cm
TEMPORARY CONSTANTS			
Seismograph period, T^1	12.59	11.90	9.0
Coefficient of damping			
Transmission factor, k			

International Seismological Centre

SEISMOLOGICAL BULLETIN FOR 1934

JULY, 1934

MACROSEISMIC RECORD

2, 10h 59m [2, 6:59 P. M.] **Surigao, Surigao.** Earthquake of intensity III and six seconds duration.

4, 6h 15m [4, 2:15 P. M.] **Cotabato, Cotabato.** Light earthquake of intensity I.

7, 8h 30m [7, 4:30 P. M.] **Janiuay, Iloilo.** Slight earthquake.

8, 16h 05m 34s* [9, 0:05:34 A. M.] **Baguio, Mountain.** Earthquake felt by a few persons. Probably on Mount Pulog.

13, 8h 00m [13, 4:00 P. M.] **Haight's Place, Mountain.** Light earthquake.

14, 16h 06m [15, 0:06 A. M.] **Baler, Tayabas.** Earthquake of intensity II.

18, 4h 00m [18, Noon] **Lubuagan, Mountain.** Light earthquake.

18, 21h 00m [19, 5:00 A. M.] **Siukun, Zamboanga.** Light earthquake with repetition at 9.30 A. M.

19, 1h 33m [19, 9:33 A. M.] **Baguio, Mountain.** Earthquake felt by a few persons.

21, 4h 38m 05s* [21, 12:38:05 P. M.] **N Luzon.** Earthquake felt over all of northern Luzon and as far south as Manila. The center was in the immediate vicinity of Mount Pulog. At Haight's Place it was felt with violence preceded by a rapid, violent sound. Trees threshed about, dead branches were shaken off and it was impossible to keep one's feet. The oscillations seemed to be east and west and lasted for a long time.

At Bayombong, 30 kilometers to the southeast, the motion was horizontal and roofs rattled. A missionary reported that it was the strongest shock in that section in 12 years. In Baguio, the motion was perceptible for about forty seconds. Some landslides were caused near Bokod.

29, 5h 33m 05s* [29, 1:33:05 P. M.] **Baguio, Mountain.** Earthquake of intensity II felt by some persons.

29, 5h 42m 04s* [29, 3:42:04 P. M.] **Agaña, Guam.** Earthquake recorded and felt.

31, 5h 59m 06s* [31, 1:59:06 P. M.] **Central Luzon.** Earthquake in the China Sea off the west coast of Luzon. Felt with intensity VI at Iba. A strong sound was heard shortly before the shock was perceived. Some damage in stores. It was perceptible over a radius of about 200 kilometers throughout central and southern Luzon. Intensity V in Manila.

31, 8h 12m [31, 4:12 P. M.] **Basco, Batan Islands.** Earthquake of intensity II and of short duration.

International Seismological Centre

INSTRUMENTAL RECORD

No.	Date	Phase	Time	△	Remarks
			h. *m.* *s.*	*Km.*	
432	3	iPz	3 48 36	2,210	Disturbed by microseisms.
		PNE	36		
		SNZ	52 14		
		LNE	54 15		
		F	4 45		
433	3	PNEZ	17 53 52	200	
		SNE	54 18		
		F	58		
434	4	PNEZ	2 04 51		15° W; 53° S by URSS.
		iNEZ	08 41		
		F	3 30		
435	4	PNEZ	13 24 40	2,700	
		iE	24 46		
		SNE	28 51		
		F	14 05		
436	6	PNEZ	23 02 30	10,800	41.5° N: 124.9° W by J. S. A. 41.3° N: 125.3° W by U. S. C. G. S.
		PP	06 27		
		SKS	13 10		
		PS	15 18		
		LNEZ	34 ca		
		MNEZ	41 ca		
	7	F	1 52		
438	8	iPNEZ	0 11 34	195	Compression from the SE.
		iSNEZ	59		
		F	25		
439	8	PNEZ	14 32 15	245	
		SNEZ	49		
		F	48		
440	8	PNEZ	16 05 34	210	Baguio, 35 km. Probably south of Mount Pulog.
		SNEZ	06 01		
		F	20		
442	10	PNEZ	21 21 17	5,765	Disturbed by microseisms.
		SNE	28 37		
		F	22 05		
444	11	PNEZ	4 01 26	780	
		SNEZ	02 52		
		F	15		
446	12	PNEZ	8 05 46	190	Dilatation. Bagujo, 35 km. 16° 20′ N: 120° 57′ E by Baguio and Manila.
		SNEZ	06 10		
		F	26		
447	12	P?	9 58 14	3,735	38.6° N: 143.9° E according to Zinsen.
		SNE	10 03 33		
		ME	10 40ca		
		F	55		
448	12	PNEZ	14 30 40	3,745	Compression. Region of 16° S: 113° E by Manila, Batavia, Amboina.
		SNE	36 49		
		F	15 30		
450	12	PNEZ	19 30 13	2,145	Felt in Amboina, N. E. I.
		SNE	33 47		
		F	20 08		
451	12	PNEZ	21 14 58	165	
		SNE	15 19		
		F	18		
452	12	PNEZ	21 36 46	215	Compression.
		SNEZ	37 14		
		F	46		
457	18	P′NEZ	1 56 11	16,410	Compression. P strong. L from the Wiechert. No other definite phases. Disturbed by microseisms. 8.2° N: 82.5° W by J. S. A.
		LE	2 50 00		
		F	4 15		
459	18	PNEZ	19 49 33	6,060	Data after P from the Wiechert. 12° S: 169° E by Manila, Hong Kong, Adelaide, Chiufeng, Wellington, Christchurch. H-19:40:08.
		SNE	57 09		
		LNE	20 05 00		
		MNE	08 ca		
		F	22 00		
460	19	PNEZ	0 16 01	5,880	13° 15′ S; 166° 30′ E.
		SNE	23 27		
		F	1 07		
461	19	iPNEZ	1 31 57	2,310	S from the Wiechert. 1° 20′ S: 133° 40′ E. H-1:27:21. Felt in Ceamr and NW New Guinea.
		iSNE	35 42		
		F	3 40		

International Seismological Centre

INSTRUMENTAL RECORD—Continued

No.	Date	Phase	Time	△	Remarks
			h. *m.* *s.*	*Km.*	
462	19	PNEZ	5 54 43	6,630	15° S: 173° 30′ E by Manila, Batavia, Adelaide, Riverview, Chiufeng, Hong Kong.
		SN	6 02 53		
		F	7 00		
463	19	PNEZ	7 46 13	6,060	13° 45′ S: 168° E by Adelaide, Manila, Hong Kong, Chiufeng, Christchurch, Zikawei, Riverview, Batavia.
		SNE	53 49		
		LE	8 02 50		
		ME	08 20		
		F	9 50		
467	20	PEZ	16 57 31	5,945	11° 30′ S: 167° 30′ E by Batavia and Manila.
		SNE	17 05 01		
		F	35		
468	20	PNZ	18 19 28	4,945	
		SNE	26 01		
		LNE	31 00		
		MN	35 30		
469	20	P?	18 56 12	6,700?	No. 468 still recording.
		SNE	19 04 26		
		LNE	15 00		
		MNE	19 00		
		F	20 40		
470	21	iPNEZ	4 38 05	230	Compression from the NE. Felt in northern and central Luzon.
		$\overline{S}$NE	38 36		
		F	5 20		$\overline{S}$ from the Wiechert and Horizontals.
471	21	iPZ	6 27 19	5,380	Dilatation. 12° 15′ S: 161° 30′ E by Manila, Hong Kong, Chiufeng, Zikawei, Christchurch.
		PNE	27 21		
		SNE	34 20		
		LNE	42 ca		Data after P from the Wiechert.
472	21	PNE	7 31 48	6,155	No. 471 still recording. From the Wiechert.
		SNE	39 28		
		F	8 50		
473	21	iPZ	10 58 54	16,410	Compression. Panama. 7.8° N: 82.5° W by U. S. C. G. S. 8.2° N: 82.5° W by J. S. A.
		iNE	59 00		
		F	14 15		
474	21	PZ	20 20 31	5,925	Disturbed by microseisms.
		PNE	36		
		SNE	28 00		
		ME	41 20		
		F	21 35		
475	22	iPZ	3 06 55	6,500	12° 30′ S: 173° 30′ E by Riverview, Melbourne, Manila.
		PNE	57		
		SNE	14 55		
		LN	21 30		
		F	4 40		
476	22	$\overline{P}$NEZ	10 30 18	150	
		$\overline{S}$NE	37		
		F	36		
477	22	P?	18 47 08	2,210?	
		SNE	50 46		
		LN	52 40		
		F	19 55		
478	22	PNEZ	20 05 20	5,355	37° 36′ N: 71° 48′ E by Tashkent.
		iNE	06 51		
		iSNEZ	12 16		
		iE	33		
		iN	16 44		
		LN	19 52		
		F	21 30		
488	25	$\overline{P}$NEZ	20 40 01	150	16° 20′ N: 121° 22′ E by Manila and Baguio.
		SNE	25		
		F	50		
491	27	PNEZ	12 34 52	5,890	Region of 13° S: 166° E by Manila, Riverview, Melbourne.
		SNE	42 19		
		F	14 30		
492	28	iPZ	2 14 51	5,110	Central Asia.
		iSNE	21 34		
		LN	28 30		
		F	3 15		
493	28	iPZ	21 48 34	8,080	Compression. 55.1° N: 154.8° W by J. S. A. 56° N: 157° W by U. S. C. G. S.
		PNE	34		
		PPE	51 38		
		iSNE	58 07		
		LNE	22 12 30		
		MNE	18 20		
	29	F	0 50		

International Seismological Centre

INSTRUMENTAL RECORD—Continued

No.	Date	Phase	Time			Δ	Remarks
			h.	*m.*	*s.*	*Km.*	
494	29	$\overline{P}$NEZ	5	33	05	150	Felt in Baguio.
		$\overline{S}$NE			24		
		F		41			
495	29	$\overline{P}$NEZ	5	50	05	185	Compression. 16° 15′ N: 120° 50′ E by Baguio and Manila.
		$\overline{S}$NE			28		
		F	6	00			
498	30	PNEZ	3	41	07	2,700	
		SNE		45	18		
		LNE		47	30		
		F	4	20			
500	30	PNEZ	14	37	03	440	
		SNEZ		38	57		
		F		51			
501	31	$\overline{P}$NEZ	5	59	06	140	Dilatation. 15° 08′ N: 119° 47′ E by Manila and Baguio. $\overline{S}$ from the Horizontals.
		$\overline{S}$NE			24		
		F	7	20			
502	31	PNEZ	11	05	21	2,780	Felt in Medan, Sumatra.
		SNE		09	38		
		F		35			
503	31	PEZ	11	55	01	3,745	P in minute gap, probably dilatation. Region of 4° N: 96° E by Batavia, Manila, Hong Kong, Zikawei, Chiufeng.
		PN			01		
		SNE	12	00	21		
		LNE		05	ca		
		MNE		08	ca		
		F	13	12			

In addition to the above there were thirty-two insignificant or undecipherable disturbances on the following days of July; 1st, 2nd (2), 7th, 9th, 11th, 12th (2), 13th, 14th, 16th (2), 18th, 19th, 20th (2), 23rd (6), 24th, 25th (2), 26th (2), 29th, 30th (2), and 31st (2).

International Seismological Centre

AUGUST, 1934

MACROSEISMIC RECORD

6, 20h 00m [7, 4:00 A. M.] **Cotabato, Cotabato.** Earthquake of intensity III with a light repetition at 4.40 A. M.

7, 7h 15m [7, 3:15 P. M.] **Occidental Negros.** Slight earthquake of three seconds duration felt at La Carlota and at San Jose.

7, 9h 23m 20s* [7, 5:23:20 P. M.] **Manila.** A light earthquake of intensity II and three seconds duration.

8, 21h 34m [9, 5:34 A. M.] **Compostela, Davao.** Light earthquake of nine seconds duration.

11, 18h 32m 45s [12, 4:32:45 A. M.] **Agaña, Guam.** Earthquake recorded and perceived.

12, 7h 20m [12, 3:20 P. M.] **Pontevedra, Occidental Negros.** Slight earthquake.

12, 17h 26m 11s [13, 3:26:11 A. M.] **Agaña, Guam.** Earthquake recorded and felt.

12, 23h 51m 28s* [13, 7:51:28 A. M.] **Mindanao.** Earthquake felt over all of Mindanao, except the southwest section, and in the central and eastern Visayas. The center was in the Philippine Deep at 8° 20′ N; 126° 50′ E as on June 13, 1929. The intensity was VI–VII in Butuan, Surigao and other places in eastern Mindanao. The water of the Agusan River was strongly agitated. The shock was recorded all over the world.

13, 18h 54m [14, 2:54 A. M.] **Borongan, Samar.** Earthquake of intensity VI.

13, 23h 19m 10s* [14, 7:19:10 A. M.] **Mindanao.** Earthquake of light intensity felt in the provinces of eastern Mindanao. Probably an aftershock of the earthquake of the 12th.

16, 0h 59m 26s [16, 10:59:26 A. M.] **Agaña, Guam.** Earthquake recorded and felt.

16, 17h 11m 36s* [17, 1:11:36 A. M.] **Naga, Camarines Sur.** Earthquake of intensity II and short duration.

19, 17h 41m 13s [20, 3:41:13 A. M.] **Agaña, Guam.** Earthquake recorded and felt. Another shock occurred at 11:05:00 P. M.

22, 8h 37m [22, 4:37 P. M.] **Hinatuan, Surigao.** A slight earthquake.

23, 19h 00m [24, 3:00 A. M.] **Cauayan, Occidental Negros.** Earthquake felt.

27. 20h 28m 06s* [28, 4:28:06 A. M.] **Naga, Camarines Sur.** Earthquake of intensity II and of short duration.

International Seismological Centre

INSTRUMENTAL RECORD

No.	Date	Phase	Time			△	Remarks
			h.	*m.*	*s.*	*Km.*	
512	2	iPz	7	00	42	3,780	Dilatation. Felt in Hollandia, New Guinea.
		PE			42	----------	
		PN			45	----------	
		SNE		06	04	----------	
		F	8	32		----------	
520	4	iPEZ	13	14	23	3,700	6° S: 147° E by Manila, Pelew, Hong Kong, Chiufeng, Zikawei, Batavia, Riverview, Victoria.
		PN			25	----------	
		SNE		19	35	----------	
		LNE		22	01	----------	
		iN			12	----------	
		LN		23	40	----------	
		F	15	10		----------	
521	7	PNEZ	3	49	23	5,860	Compression. 13° 45′ S: 166° E by data of ten stations.
		SNE		56	48	----------	
		LE	4	04	10	----------	
		MNE		09	00	----------	
		F	5	55		----------	
522	7	$\overline{\text{i}}$PNEZ	9	23	20	135	Compression from the southwest. Felt in Manila, intensity II.
		i$\overline{\text{S}}$NZ			37	----------	
		F		40		----------	
523	7	P?	11	59	31	5,610?	Disturbed by microseisms. 42° 30′ N: 87° 30′ E by URSS.
		SN	12	06	42	----------	
		LNE		13	38	----------	
		iN		15	39	----------	
		iME		17	20	----------	
		F	13	02		----------	
525	8	PNEZ	21	45	10	2,600	Dilatation.
		iN		48	48	----------	
		SNE		49	14	----------	
		LNE		51	20	----------	
		ME		54	ca	----------	
		F	22	37		----------	
527	9	PNEZ	13	20	12	4,610	Region of 18° S: 97° E by Manila, Amboina, Chiufeng.
		SNE		26	24	----------	
		LNE		32	30	----------	
		MN		36	ca	----------	
		F	14	50		----------	
528	9	PNEZ	19	41	02	4,020	
		SNE		46	40	----------	
		LN		51	ca	----------	
		MN		55	ca	----------	
		F	21	30		----------	
529	9	$\overline{\text{P}}$NEZ	20	03	21	150	No. 528 still recording.
		$\overline{\text{S}}$NEZ			40	----------	
533	10	PNE	22	43	48	3,690	
		SN		49	05	----------	
		LNE		53	00	----------	
		F	23	45		----------	
534	11	$\overline{\text{P}}$NEZ	0	49	50	190	
		$\overline{\text{S}}$NEZ		50	14	----------	
		F		56		----------	
535	11	PNEZ	8	20	49	1,120	Dilatation. Data after P from the Wiechert. Felt at Giran, Taihoku Perfecture, Taiwan. 24° 40′ N: 121° 45′ E.
		SNE		23	17	----------	
		LE		25	ca	----------	
		MNE		27	ca	----------	
		F	10	40		----------	
536	11	iPz	12	04	48	4,420	Dilatation. 4° S: 155° 30′ E by Manila, Hong Kong, Riverview.
		PNE			49	----------	
		SNE		10	49	----------	
		LNE		14	20ca	----------	
		MN		18	ca	----------	
		F	14	10		----------	
541	12	PNEZ	13	49	33	4,045	Compression.
		SNE		55	13	----------	
		LN		59	ca	----------	
		MNE	14	03	ca	----------	
		F	15	00		----------	
542	12	iPNEZ	23	51	28	940	Compression from southeast. Dilatation from east at Butuan. Felt over central and eastern Mindanao and southeastern Visayas. Epicenter at 8° 20′ N: 126° 50′ E by Manila and Butuan, as on April 29th 1932 and June 13th 1929.
		iSNEZ		53	08	----------	
		F	2	30		----------	
544	13	iPz	10	46	44	4,080?	
		PNE			44	----------	
		S?		52	25	----------	
		LN		57	ca	----------	
		MN	11	01	ca	----------	
		F	12	00		----------	
545	13	$\overline{\text{P}}$NEZ	16	47	09	195	
		$\overline{\text{S}}$EZ			34	----------	
		F	17	01		----------	

International Seismological Centre

INSTRUMENTAL RECORD—Continued

No.	Date	Phase	Time			Δ	Remarks
			h.	*m.*	*s.*	*Km.*	
546	13	PNEZ	23	19	10	985	Felt in Davao and Butuan, Mindanao.
		SNEZ		20	55	----------	
		F		40		----------	
548	14	iPz	8	59	47	6,910	19° 30′ S: 174° 30′ E by Wellington, Manila, Batavia, Chiufeng, Melbourne.
		PNE			47	----------	
		SNE	9	08	14	----------	
		LN		19	15ca	----------	
		MNE		24	20ca	----------	
		F	10	25		----------	
550	15	PNEZ	15	12	36	390	Baguio, 230 km. Probably in northeast Luzon.
		SNEZ		13	24	----------	
		$\overline{S}$NE		13	35	----------	
		F		30		----------	
552	16	PE	17	11	36	290	Felt at Naga with intensity II.
		$\overline{S}$NEZ		12	18	----------	
		F		30		----------	
553	17	PEZ	1	38	53	670	
		SNE		40	08	----------	
		F		53		----------	
554	18	PNEZ	2	44	20	2,855	Felt strongly in Nagoya and central Japan. 35° 30′ N: 137° E by Manila, Osaka, Chiufeng.
		SNE		48	42	----------	
		F	3	25		----------	
559	21	PNEZ	19	31	58	3,420	Compression. In region of 2° S: 94° 30′ E by Manila, Hong Kong, Medan, Batavia, Zikawei.
		SNE		36	58	----------	
		L?		40	35	----------	
		MNE		43	42	----------	
		F	20	40		----------	
563	22	PNEZ	18	42	42	3,035	
		SNE		47	16	----------	
		LNE		50	15	----------	
		MN		52	42	----------	
		F	20	15		----------	
564	23	PNEZ	22	39	49	6,065	14° S: 167° E by Riverview, Manila, Chiufeng.
		SNEZ		47	26	----------	
		LE		56	51	----------	
		MN	23	01	51	----------	
		F		20		----------	
565	23	PNEZ	23	39	44	5,065	Same epicenter as No. 564. Continues into following record.
		SNEZ		47	21	----------	
566	23	{PNZ	23	58	08	6,065	Same epicenter as preceding earthquakes. P at Batavia in agreement.
		PE		58	08	----------	
	24	{SNEZ	0	05	41	----------	
		LNEZ		14	15	----------	
		MNE		19	00	----------	
		F	1	25		----------	
572	28	PNEZ	18	27	05	2,255?	
		S?		30	46	----------	
		MN		41	14	----------	
		ME		42	09	----------	
		F	19	40		----------	
575	30	$\overline{P}$NEZ	12	04	38	195	
		$\overline{S}$NEZ		05	03	----------	
		F		11		----------	
579	30	PNEZ	16	31	22	2,500	
		SE		35	20	----------	
		LNE		37	30ca	----------	
		MN		39	30ca	----------	
		F	17	25		----------	
582	31	PEZ	5	16	00	10,345	Compression. Baffin Bay.
		PN			01	----------	
		PPEZ		19	41	----------	
		SNE		27	05	----------	
		PSN		28	08	----------	
		SSN		33	25	----------	
		LNE		46	30	----------	
		MNE		54	ca	----------	
		F	7	40		----------	
583	31	iPz	15	06	41	5,745	39° N: 70° 30′ E by URSS.
		PNE			41	----------	
		iSNEZ		14	00	----------	
		LNE		22	15ca	----------	
		MNE		26	45ca	----------	
		F	17	10		----------	

In addition to the above there were forty-five insignificant or undecipherable disturbances on the following days of August: 1st (3), 2nd (4), 3rd (5), 8th, 9th, 10th (3), 12th (4), 13th, 14th, 15th, 16th, 18th (2), 21st (2), 22nd (3), 24th, 25th, 26th, 27th, 28th, 29th (2), and 30th (5).

International Seismological Centre

SEPTEMBER, 1934

MACROSEISMIC RECORD

1, ... **Hinatuan, Surigao.** Earthquake felt at night. Time not reported.

4, 22h 10m [5, 6:10 A. M.] **Ormoc, Leyte.** Earthquake of intensity II and fifteen seconds duration.

5, 18h 00m [6, 2:00 A. M.] **Cateel, Davao.** Earthquake felt.

6, 2h 19m 08s* [6, 10:19:08 A. M.] **Mindanao.** Light earthquake felt in the provinces of eastern Mindanao. The center was south of the Davao Gulf.

9, 1h 30m [9, 9:30 A. M.] **Hinatuan, Surigao.** Slight earthquake felt. Another shock felt at 4:45 A. M. on the 10th.

15, 19h 47m [16, 3:47 A. M.] **Lubuagan, Mountain.** Light earthquake felt.

18, 11h 40m [18, 7:40 P. M.] **Iloilo, Iloilo.** Very light earthquake of two seconds duration. Another shock of intensity IV at 10:40 P. M. This was also reported from Janiuay.

20, 12h 00m [20, 8:00 P. M.] **Cateel, Davao.** Earthquake felt.

24, 15h 27m 39s* [24, 11:27:39 P. M.] **Samar and Leyte.** Earthquake from the Philippine Deep off Samar. Felt at Borongan with intensity VI and at Tacloban with intensity IV.

25, 13h 30m 10s [25, 11:30:10 P. M.] **Agaña, Guam.** Earthquake recorded and felt.

30, 12h 10m [30, 8:10 P. M.] **Hinatuan, Surigao.** Slight earthquake felt.

INSTRUMENTAL RECORD

No.	Date	Phase	Time h.	Time m.	Time s.	△ Km.	Remarks
586	1	iPEZ	8	15	52	1,700	Dilatation. Butuan, 8°. 1° 10′ N: 128° 20′ E.
		PN			52		
		iSNEZ		18	48		
		LN		20	35ca		
		F	9	30			
591	2	P?	11	35	09	6,880?	
		SNE		43	34		
		F	12	30			
592	4	PNEZ	16	44	57	6,900	23° S: 171° 30′ E by Riverview, Manila, Hong Kong, Chiufeng, Wellington, Christchurch, Chatham I.
		SNE		53	20		
		F	17	40			
593	5	$\overline{P}$NEZ	0	45	26	150	Probably in the Caraballo Mountains.
		$\overline{S}$NEZ			45		
		F		57			
594	6	PNEZ	2	19	08	1,120	5° 50′ N: 126° E. Felt in eastern Mindanao.
		SNEZ		21	05		
		F	3	15			
595	6	i$\overline{P}$NEZ	7	07	16	135	Dilatation.
		i$\overline{S}$NEZ			33		
		F		12			
598	11	iPNZ	8	17	11	1,690	Do.
		PE			11		
		SNEZ		20	06		
		LNE		21	30		
		F	9	50			
600	12	$\overline{P}$Z	9	37	23	175	
		$\overline{P}$NE			25		
		$\overline{S}$NEZ			45		
		F		43			

INSTRUMENTAL RECORD—Continued

No.	Date	Phase	Time	Δ	Remarks
			h. *m.* *s.*	*Km.*	
601	12	PNEZ	14 31 17	2,075	Region of Iwo Island, Kagoshima, according to Zinsen.
		iSNEZ	34 44		
		LEZ	36 30		
		MN	38 25ca		
		F	16 10		
602	12	PZ	17 47 09	2,065	
		SNE	50 35		
		F	18 50		
605	13	PNZ	14 22 41	1,980	
		SNZ	26 00		
		F	15 03		
609	15	eNZ	7 16 13	12,580	19.9° N: 104.7° W by J.S.A. 20° N: 105° W by U.S.C.G.S. Group of long waves from 7:56 to 8:10.
		LNE	54 ca		
		F	9 20		
611	15	PNEZ	17 50 17	2,355	
		SNEZ	54 05		
		F	18 03		
612	16	PNEZ	13 19 40	2,090	Dilatation. Same epicenter as No. 601 according to Zinsen.
		SNE	23 08		
		ME	27 30ca		
		F	14 20		
614	17	$\overline{P}$NE	6 13 03	125	
		$\overline{S}$NE	19		
		F	17		
619	21	iPZ	12 44 18	3,510	Compression. Felt in Tapanoeli, Sumatra. 1° N: 92° E by Batavia and Manila.
		PNE	18		
		SNEZ	49 23		
		LNE	53 10ca		
		MNE	57 ca		
		F	13 30		
625	23	PNEZ	16 49 12	235	
		$\overline{S}$NEZ	44		
		F	58		
628	24	PNEZ	15 27 18	650	Felt at Borongan with intensity VI. Epicenter in Philippine Deep at 11° 30′ N: 127° E approximately by Manila and Butuan.
		SNE	28 30		
		F	36		
632	25	iPEZ	19 21 29	3,045?	Compression.
		PN	29		
		S?	26 04		
		F	20 20		
633	26	iPE-	7 47 30	660	
		PN	30		
		SE	48 44		
		F	8 18		

In addition to the above there were thirty-two insignificant or undecipherable disturbances on the following days of September; 1st (3), 2nd (3), 8th, 9th, 11th, 13th (2), 14th (2), 15th (2), 16th, 17th (2), 21st (3), 22nd (2), 23rd (2), 24th (3), 25th (2), 27th and 28th.

International Seismological Centre

International Seismological Centre

OCTOBER, 1934

MACROSEISMIC RECORD

1, 16h 00m [2, 0:00 A. M.] **Hinatuan, Surigao.** Slight earthquake.

1, 21h 54m 34s* [2, 5:54:34 A. M.] **Manila.** Earthquake in the Caraballo Mountain 16° 20′ N; 121° 15′ E. Felt slightly in Manila.

3, 14h 30m [3, 10:30 P. M.] **Hinatuan, Surigao.** Light earthquake.

4, ... **Cateel, Davao.** Earthquake felt at night. Time not reported.

6, 12h 55m [6, 8:55 P. M.] **Hinatuan, Surigao.** Slight earthquake.

13, 12h 45m [13, 8:45 P. M.] **Hinatuan, Surigao.** Slight earthquake. Another shock on the 14th at 5:40 P. M.

18, 7h 01m 56s* [18, 3:01:56 P. M.] **Manila.** Very light earthquake.

21, 21h 10m [22, 5:10 A. M.] **Cateel, Davao.** Slight earthquake.

22, 5h 00m [22, 1:00 P. M.] **Mindanao.** Light earthquake felt at Hinatuan, Surigao and in the Province of Davao.

22, 16h 45m [23, 0:45 A. M.] **Cateel, Davao.** Light earthquake.

22, 20h 02m [23, 4:02 A. M.] **Tacloban, Leyte.** Earthquake of intensity II and ten seconds duration.

22, 23h 15m [23, 7:15 A. M.] **Davao, Davao.** Light earthquake.

23, 4h 30m [23, 12:30 P. M.] **Hinatuan, Surigao.** Light earthquake.

27, 15h 29m 26s [28, 1:29:26 A. M.] **Agaña, Guam.** Earthquake recorded and felt.

30, 13h 00m [30, 9:00 P. M.] **Cateel, Davao.** Strong earthquake felt.

30, 20h 55m 04s* [31, 4:55:04 A. M.] **Mindanao.** Earthquake felt in eastern Mindanao. The center was in the Philippine Deep. Intensity III at Davao. Large oscillations of light intensity at Butuan.

31, 5h 14m 24s [31, 3:14:24 P. M.] **Agaña, Guam.** Earthquake recorded and felt.

31, ... **Cateel, Davao.** Earthquaque felt at night. Time not reported. Another shock felt at 6:00 A. M. of November 1st.

International Seismological Centre

INSTRUMENTAL RECORD

No.	Date	Phase	Time			Δ	Remarks
			h.	*m.*	*s.*	*Km.*	
636	1	$\overline{P}$NEZ	18	25	20	160	
		$\overline{S}$NEZ			40		
		F		32			
637	1	$\overline{P}$NEZ	21	54	34	190	Dilatation. 16° 20′ N: 121° 15′ E by Manila and Baguio. Felt lightly in Manila.
		$\overline{S}$NEZ			58		
		F	22	07			
641	4	$\overline{P}$NEZ	17	35	04	135	
		$\overline{S}$NEZ			21		
		F		39			
644	5	PNE	20	33	02	3,400	Disturbed by microseisms.
		SNE		38	00		
		F	21	28			
649	10	iPEZ	15	52	22	7,745	Dilatation. 23° S: 179° W. h= 600km ± H=15:42:07.
		PN			24		
		SNEZ	16	00	46		
		LN		11	54		
		F	17	12			
650	11	iPZ	17	36	50	1,915	Compression. In region of 0°: 130° E by Manila and Pelew.
		PNE			50		
		SNE		40	04		
		F		53			
653	16	$\overline{P}$NE	17	30	23	185	From the Wiechert. No lights on Galitzin. Service interrupted by typhoon.
		$\overline{S}$NE			46		
		F		35			
654	18	i$\overline{P}$NEZ	7	01	56	20	Compression from SE. Felt in Manila.
		i$\overline{S}$NEZ		02	00		
		F		04			
655	18	iPZ	7	57	25	5,900	11° S: 167° E by Riverview, Hong Kong, Manila, Adelaide, Perth, Zikawei, Batavia, Pelew, Osaka, Melbourne.
		PNE			25		
		SNE	8	04	52		
		LNE		13	25ca		
		MNE		18	ca		
		F	9	30			
659	19	PNEZ	11	54	04	1,810	Disturbed by microseisms.
		SE		57	09		
		F	12	21			
660	19	$\overline{P}$NEZ	21	36	22	20	Felt in Manila.
		$\overline{S}$NEZ			26		
		F		38			
661	21	PNEZ	17	58	40	3,510	Region of 16° N: 153° E by Guam, Manila, Hong Kong, Osaka.
		SNEZ	18	04	00		
		LE		06	45ca		
		F		40			
662	24	PNEZ	6	12	59	120	Data after P from the Wiechert.
		iSNE		13	14		
		F		17			
663	26	PEZ	14	48	22	2,135	In region of 4° S: 124° E by Batavia, Manila, Butuan, Pelew.
		SNE		51	54		
		F	15	20			
664	26	iPNEZ	17	15	16	1,925	Compression from the northeast. 30.5° N: 132° E according to Zinsen.
		SNE		18	31		
		LNE		20	05		
		F	18	30			
666	28	PNEZ	23	38	20	1,210	24° N: 126° E by Taihoku, Manila, Hong Kong. Felt in Taihoku.
		SNEZ		40	26		
	29	F	0	50			
668	30	PNEZ	20	55	04	1,000	Compression from the southeast. 7° 40′ N: 127° 05′ E. Felt at Cateel and Davao, Mindanao.
		SNEZ		56	50		
		imN		58	11		
		imE		59	35		
		F	21	45			

In addition to the above there were seventeen insignificant or undecipherable disturbances on the following days of October; 2nd, 3rd, 4th (2), 5th, 6th (3), 8th, 15th (2), 19th (3), 28th, 29th, and 30th.

International Seismological Centre

NOVEMBER, 1934

MACROSEISMIC RECORD

3, $20^h\ 25^m$ [4, 4:25 A. M.] **Baguio, Mountain.** Earthquake felt by a few persons.

4, $4^h\ 11^m$ [4, 12:11 P. M.] **NE Mindanao.** Light earthquake felt at Butuan and Surigao.

9, $2^h\ 35^m$ [9, 10:35 A. M.] **Butuan, Agusan.** Very feeble earthquake.

10, $10^h\ 58^m$ [10, 6:58 P. M.] **Butuan, Agusan.** Very feeble earthquake of yolting motion.

11, $23^h\ 42^m\ 55^s$* [12, 7:42:55 A. M.] **Baguio, Mountain.** Earthquake felt by a few persons.

15, $19^h\ 00^m$ [16, 3:00 A. M.] **Janiuay, Iloilo.** Light earthquake.

17, $7^h\ 43^m$ [17, 3:43 P. M.] **Butuan, Agusan.** Earthquake of gentle oscillations with duration of fifteen seconds.

26, $12^h\ 09^m\ 35^s$* [26, 8:09:35 P. M.] **Luzon and Mindoro.** See special account at end of this bulletin.

27, $1^h\ 15^m\ 37^s$* [27, 9:15:37A. M.] **SE Luzon.** Earthquake in the Pacific Ocean about 25 kilometers southeast of Catanduanes Island. Felt at Naga to the northwest and Calbayog, Samar, to the south.

27, $6^h\ 10^m$ [27, 2:10 P. M.] **Siukun, Zamboanga.** Slight earthquake.

27, $6^h\ 17^m\ 34^s$* [27, 2:17:34 P. M.] **Davao, Davao.** Earthquake of intensity II.

27, $7^h\ 49^m\ 01^s$* [27, 3:49:01 P. M.] **Leyte and Samar.** Strong earthquake with its center in Leyte Gulf near Tacloban. Intensity VII in Tacloban with duration of thirty seconds. A wall of the Hight School Building was cracked and the people left their houses. It was also reported from Guiuan and Catbalogan.

49
International Seismological Centre

INSTRUMENTAL RECORD

No.	Date	Phase	Time	△	Remarks
			h. *m.* *s.*	*Km.*	
673	2	$\overline{P}$NEZ	0 07 39	120	
		$\overline{S}$NEZ	54		
		F	11		
679	3	PNEZ	14 53 39	3,520	Disturbed by microseisms.
		S?	58 45		
		F	15 35		
680	4	PNEZ	2 03 50	7,090	21° S: 175° E by Riverview, Wellington, Christchurch, Melbourne.
		SE	12 24		
		LNE	24 ca		
681	4	PNEZ	3 24 42	7,500	No. 680 still recording. Disturbed by microseisms. In region of 19° S: 175° E.
		SEZ	33 46		
		F	5 23		
682	4	PNEZ	15 10 46	215	
		$\overline{S}$NEZ	11 14		
		F	23		
685	5	PNEZ	13 27 23	1,155	Felt in north Moluccas according to Batavia.
		SNE	29 23		
		F	14 15		
686	5	iPZ	23 12 45	6,900	Compression. 53.2° N: 176.7° W by J. S. A. 52° N: 176° W by U. S. C. G. S.
		PNE	45		
		iN	51		
		SNE	21 18		
		PSNE	34		
		LNE	30 45ca		
	6	F	0 42		
691	11	PNEZ	21 20 07	2,220	24.3° N: 121.6° E according to Taihoku. Felt in northern Taiwan.
		SNE	23 46		
		I E	25 38		
		F	50		
692	11	$\overline{P}$NEZ	23 42 55	200	Felt in Baguio.
		$\overline{S}$NEZ	43 21		
		F	49		
693	12	PNEZ	3 06 23	215	
		SNEZ	51		
		F	10		
694	12	P?	7 30 50	8,240	37° N: 40° E by Strasbourg.
		SN	40 27		
		LN	50 ca		
		F	8 46		
695	12	$\overline{P}$NEZ	22 27 56	190	
		$\overline{S}$NEZ	28 20		
696	12	PNEZ	22 29 50	230	No. 695 still recording.
		$\overline{S}$NE	30 21		
		F	40		
700	16	PNEZ	13 49 45	3,000	Probably in Netherlands East Indies.
		SNEZ	54 17		
		LNE	57 10ca		
		F	15 05		
701	18	PNEZ	3 29 59	5,345	Compression. 31° N: 66.5° E by Strassbourg.
		iz	31 11		
		SNEZ	36 54		
		LNE	44 30		
		MNE	48 20		
		F	4 57		
702	18	iPZ	9 27 30	5,590	Compression.
		PNE	31		
		SN	34 40		
		F	10 20		
704	18	iPEZ	22 47 25	1,840	Compression from southeast. In region of Halmahera, N. E. I. by Batavia and Manila.
		SNE	50 35		
		L?	52 ca		
	19	F	0 42		
705	19	PNEZ	4 17 13	1,980	Netherlands East Indies.
		SNE	20 32		
		F	40		
709	22	PNEZ	3 31 10	2,400	
		SNE	35 01		
		LNE	37 11		
		F	4 00		

International Seismological Centre

INSTRUMENTAL RECORD—Continued

No.	Date	Phase	Time	Δ	Remarks
			h. *m.* *s.*	*Km.*	
711	22	iPNEZ	22 25 19	1,010	Compression from the southeast. 11° 35′ N: 129° 40′ E by Manila and Butuan.
		iSNE	27 06		
		F	23 07		
712	23	PNE	4 51 38	245	
		SNE	52 12		
		F	5 04		
716	24	iPZ	12 45 46	8,255	Dilatation. In region of 30° S: 174° E by Riverview and Manila. Subject to correction for depth of focus.
		PNE	46		
		iSNE	55 27		
		iNE	13 00 16		
		LNEZ	10 00ca		
		F	14 20		
719	26	$\overline{\text{i}}$PNEZ	12 09 35	100	Dilatation. All instruments put out of service by the shock. Felt at Lubang Island with intensity VII, and at Manila with intensity VI. Felt on the "Empress of Asia", 30 miles north of the epicenter. Epicenter, 14° 10′ N: 120° 10′ E. 35 aftershocks recorded.
739	27	iPNEZ	1 15 37	405	Compression. 13° 25′ N: 124° 30′ E, by Manila, Baguio and Butuan. Felt in southeast Luzon.
		$\overline{\text{i}}$SNEZ			
		F			
742	27	iPNEZ	6 17 34	1,500	Compression at Manila and Butuan. 2° 25′ N: 126° 50′ E. Felt in N. Celebes and N. Moluccas.
		iSN	20 15		
		LNE	21 30ca		
744	27	PNEZ	7 49 01	595	11° 05′ N: 125° 05′ E by Manila and Butuan. Felt at Tacloban with intensity VII. As on December 30th 1932.
		SNEZ	50 09		
		F	8 59		
757	28	$\overline{\text{P}}$NE	14 36 16	85	From the Wiechert.
		$\overline{\text{S}}$NE	27		
		F	37		
758	28	$\overline{\text{P}}$NE	16 46 26	85	Do.
		$\overline{\text{S}}$NE	37		
		F	48		
759	29	$\overline{\text{P}}$NE	13 13 20	95	Do.
		$\overline{\text{S}}$NE	32		
		F	15		
762	30	P?N	2 21 +	13,760	18° 30′ N: 105° W by J. S. A. 20° N: 104° 30′ W by U. S. C. G. S.
		SSNE	43 15		
		LNE	3 04 ca		
		F	4 24		

In addition to the above there were sixty-three insinificant or undecipherable disturbances on the following days of November; 1st (3), 2nd (4), 3rd, 4th, 5th, 6th, 9th (2), 11th, 13th, 15th, 18th, 19th, 20th, 21st, 22nd, 23rd (3), 25th (2), 26th (9), 27th (11), 28th (4).

International Seismological Centre

DECEMBER, 1934

MACROSEISMIC RECORD

1, 14h 56m 08s [2, 0:56:08 A. M.] **Agaña, Guam.** Earthquake recorded and felt.

5, ... **Lubuagan, Mountain.** Light earthquake felt. Time not given.

13, 10h 30m [13, 6:30 P. M.] **Mindanao.** Light earthquake felt at Hinatuan and Cateel.

14, 7h 42m* [14, 3:42 P. M.] **Manila.** Some very light earthquake were felt at intervals during the day in a small area of the business section of Manila. Reports came from the Osaka Bazaar, Kneedler Building, the TVT Building and from an Office on the Escolta. Six of these shocks were recorded at the Observatory.

15, 20h 00m [16, 4:00 A. M.] **Cateel, Davao.** Light earthquake felt.

16, 11h 00m 38s* [16, 7:00:38 P. M.] **Mindanao.** Earthquake felt at Butuan and Surigao. Duration of twelve seconds at Butuan. The center was in the Philippine Deep at 9° N; 126° 45′ E.

16, 13h 30m [16, 9:30 P. M.] **Mambajao, Oriental Misamis.** Light earthquake felt.

21, 18h 53m 36s* [22, 2:53:36 A. M.] **Aparri, Cagayan.** Light earthquake of ten seconds duration.

21, 19h 56m 58s [22, 5:56:58 A. M.] **Agaña, Guam.** Earthquake recorded and felt.

27, 17h 43m 28s* [28, 1:43:28 A. M.] **Luzon.** Earthquake felt in Manila with intensity IV. Felt strongly at Botocan Falls, Laguna. Epicenter in Lamon Bay, east of Luzon. Another shock at 2:07:09 A. M. was felt by a few persons in Ambulong.

31, 9h 03m 34s* [31, 5:03:34 P. M.] **Mindanao.** Light earthquake felt at Butuan and Surigao. Manila and Butuan seismograms indicate a center in southern Leyte.

International Seismological Centre

INSTRUMENTAL RECORD

No.	Date	Phase	Time			Δ	Remarks
			h.	*m.*	*s.*	*Km.*	
767	9	PNEZ	11	25	21		Felt in west Java according to Batavia.
		iNEZ		31	27		
		L?		37	ca		
		F	12	30			
770	10	iPNEZ	10	00	01	1,660	Compression from the southeast. Felt in Minahassa and Ternate. Region of 1° N: 126° E.
		SNEZ		02	52		
		F		36			
772	11	$\overline{P}$NE	15	55	02	90	Z component defective.
		$\overline{S}$NE			14		
		F		59			
775	12	iPz	8	50	58	6,220	Dilatation. In region of New Hebrides by Manila, Riverview, Batavia Chiufeng.
		PNE			58		
		SNE		58	45		
		F	9	25			
777	14	----------	----------			----------	No. 777 to No. 783 were records of very light earthquakes felt in a restricted area of the business district of Manila. 2 km from the Observatory.
786	14	eNE	20	49	30	8,000	Asia Minor.
		S?		57	30		
		F	21	21			
790	15	PNEZ	2	04	19	3,920	Compression. Data after P from the Wiechert. 32° N: 89° E by Chiufeng, Manila, Hong Kong, Osaka.
		SNE		09	50		
		LNE		13	50		
		MNE		17	30		
		F	4	45			
795	15	PNEZ	19	24	47	6,970	Dilatation. 21° S: 171° E by Manila and Riverview. Subject to correction for depth of focus.
		SNE		33	17		
		LNE		41	ca		
		F	20	45			
796	16	$\overline{P}$NEZ	7	45	29	50	
		$\overline{S}$NE			36		
		F		46	45		
798	16	$\overline{P}$NEZ	9	46	04	190	
		$\overline{S}$NE			28		
		F		49			
799	16	PNEZ	11	00	38	900	9° N: 126° 45′ E by Manila and Butuan. Felt in northeast Mindanao.
		SNEZ		02	15		
		F		12			
802	17	PNEZ	3	38	47	1,245	24° 12′ N: 121° 24′ E by Taihoku.
		SNEZ		40	56		
		LNE		42	40		
		F	4	10			
804	17	iPz	15	59	10	3,680	2° S: 150° E by Manila, Batavia, Hong Kong, Perth, Amboina, Riverview, Zikawei. Compression.
		PNE			10		
		SNE	16	04	26		
		LNE		07	20		
		F	18	00			
806	17	$\overline{P}$NEZ	18	13	38	135	
		$\overline{S}$NEZ			55		
		F		19			
808	18	PEZ	11	29	00	3,610	
		SNE		34	23		
		MNE		38	ca		
		F	12	20			
809	18	P?	14	31	02	1,040	
		SNE		32	52		
		F	15	00			
811	19	PNEZ	16	09	46	690	
		SNE		11	03		
		F		32			
819	21	PNEZ	12	45	46	5,220	Compression.
		SN		52	35		
		LNE		58	25		
		ME	13	02	ca		
		F		30			
820	21	P?	17	35	08	1,480?	P may be earlier.
		SNEZ		37	41		
		F		57			
821	21	PNE	18	53	36	560	Felt at Aparri.
		SNEZ		54	11		
		F	19	15			
822	22	PNE	11	02	54	1,945	
		SNE		06	11		
		iME		10	26		
		F	12	02			

International Seismological Centre

INSTRUMENTAL RECORD—Continued

No.	Date	Phase	Time	Δ	Remarks
			h *m.* *s.*	*Km.*	
823	22	P'N	14 48 45	15,850	Dilatation? 8° N: 89° W by U. S. C. G. S.
		PPE	51 30	----------	
		LNE	15 37 ca	----------	
		MNE	47 ca	----------	
		F	17 05	----------	
824	23	PNE	2 25 26	2,290	3° 30′ S: 131° E by Manila and Batavia.
		SEZ	29 10	----------	
		F	----------	----------	
825	23	PNEZ	10 13 17	3,190	
		SNE	18 02	----------	
		LN	21 ca	----------	
		iMN	28 34	----------	
		F	12 10	----------	
827	24	PNEZ	10 56 56	2,465	Felt in Flores, N. E. I., according to Batavia. 7° 30′ S: 123° E by Manila and Batavia.
		SNE	11 00 51	----------	
		F	30	----------	
828	24	PNEZ	15 43 18	3,145	
		SE	48 00	----------	
		LE	51 ca	----------	
		F	17 20	----------	
831	25	PNEZ	2 01 20	1,145	
		SEZ	03 19	----------	
		F	44	----------	
833	25	PNEZ	6 32 52	3,155	
		SNEZ	37 35	----------	
		LNE	40 40	----------	
834	25	PNEZ	7 55 08	2,620	No. 833 still recording.
		SNE	59 14	----------	
		LNE	8 01 35	----------	
		MNE	03 60	----------	
		F	9 15	----------	
835	25	PNEZ	12 53 12	2,980	
		SNE	57 42	----------	
		LNE	13 00 30	----------	
		F	14 02	----------	
836	26	PNE	14 14 53	410	
		SNE	15 44	----------	
		F	28	----------	
838	27	P̄NEZ	8 54 59	100	
		S̄NEZ	55 12	----------	
		F	9 01	----------	
841	27	iP̄NEZ	17 43 28	120	Compression. Felt in Manila. 14° 30′ N: 122° 05′ E by Manila and Baguio.
		iS̄NEZ	43	----------	
843	27	P̄NE	18 07 09	110	From the Wiechert.
		S̄NE	22	----------	
847	28	PNEZ	11 34 54	8,535	
		SNE	44 49	----------	
		LNE	12 00 ca	----------	
		ME	06 ca	----------	
		F	13 07	----------	
849	29	P̄NEZ	9 23 18	200	Compression.
		S̄NE	43	----------	
		F	39	----------	
852	30	PPNE	14 11 05	12,080	31° N: 116° W by U. S. C. G. S.
		PS?	20 38	----------	
		LNE	42 20	----------	
		MNE	52 20	----------	
		F	16 35	----------	
854	31	iPZ	9 03 34	640	In the region of southern Leyte by Manila and Butuan.
		PNE	34	----------	
		SNEZ	04 46	----------	
		F	40	----------	
856	31	PNEZ	19 00 43	12,145	30° N: 116° W by U. S. C. G. S.
		P'N	04 00	----------	
		PPNEZ	43	----------	
		iNZ	05 15	----------	
		PSNE	14 00	----------	
		LNE	36 ca	----------	
		MNE	44 30	----------	
		F	22 28	----------	

In addition to the above there were fifty-six insignificant or undecipherable disturbances on the following days of December; 3rd, 7th, (2), 8th, 9th, 10th (2), 11th, (2), 13th, 14th (9), 15th (7), 16th (2), 17th (4), 19th (4), 20th (3), 21st, 23rd, 24th, 25th (2), 26th, 27th (4), 28th (3), 30th (2), 31st (2).

International Seismological Centre

THE CHINA SEA EARTHQUAKE OF NOVEMBER 26th 1934

By Rev. W. C. Repetti, S. J.

Chief, Seismic and Magnetic Division
Weather Bureau, P. I.

The strongest earthquakes felt in Manila in modern times are give, according to intensity, in the following order; June, 1863; July, 1880; December, 1901; and November, 1934. The order of time coincides with decreasing intensity.

Macroseismic Data.—The strongest effect of this earthquake was felt in Lubang Island where the intensity was VII, R–F scale. Movable objects were overturned, water was splashed out of tanks, and considerable fright was experienced among the people. The perceptible motion is said to have lasted for one half of a minute, but this is probably underestimated. The shock was felt strongly on board the *Empress of Asia* which was about forty miles north of the epicenter. The intensity along the coast of Luzon, opposite the epicenter, was VI–VII, and in Manila VI. In Manila tall buildings oscillated alarmingly, some electric lines were broken by the swaying of poles, and some windows were cracked. Pieces of cement covering the contact of the Insular Life and Filipinas buildings were loosened and fell to the sidewalk. The perceptible motion lasted about one minute, and a vertical component could be detected. The earthquake was felt as far as Culion and Cuyo to the south and Baguio to the north. Two aftershocks were felt in Lubang Island during the night.

The Epicenter.—The coördinates of the epicenter of this earthquake are

14° 10′ North; 120° 10′ East.

The time at the focus was

12h 09m 23s, G. M. T.

This position is in the China Sea, 50 kilometers off the entrance of Manila Bay.

Microseismic Data.—A request was sent to the principal seismic observatories of the world for the loan of records or copies and the response was comparatively good, considering the light registration. The microseismic study of this earthquake has to be designated as a failure owing to lack of material. Many observatories having low sensitivity seismographs received no registration at all. Others having sensitive instruments obtained records lacking in sharpness, thus making it impossible to follow various phases in their transmission. The only tangible result obtained from the records of other observatories was an indication that the focus of this earthquake was below normal depth, but not deeper than 75 kilometers. This was found by comparing the P phase of this earthquake with the P phases of the earthquakes of May 13th 1927 and June 6th 1933. These two latter earthquakes were from the same section of the China Sea as the earthquake of November 26th. Their P travel times gave smooth curves and the two earthquake had focal depths below normal but less than 75 kilometers. This earthquake was of special interest in that its epicenter was only a few kilometers from those of the other two earthquakes felt strongly in Manila. Furthermore, that it has a focal depth of the same general values as the earlier earthquakes. The latter commenced with a compression, whereas the earthquake of November 26th commenced with a dilatation. The earthquake of December 14th 1901 also originated in this section of the China Sea.

International Seismological Centre

NUMBER OF EARTHQUAKES FELT IN THE PHILIPPINES, FROM 1903 TO 1934

Year	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1903	12	5	8	8	15	13	9	24	10	12	17	8	141
1904	22	10	10	9	6	8	11	5	11	15	4	6	117
1905	14	8	12	11	10	8	12	10	11	16	8	12	132
1906	13	6	5	12	6	11	9	9	9	11	5	7	103
1907	13	7	10	14	22	17	14	16	5	5	15	7	145
1908	17	6	11	6	13	9	5	11	8	10	15	11	122
1909	11	8	9	13	12	5	12	12	14	10	5	9	120
1910	13	13	14	12	23	18	22	8	12	21	23	17	196
1911	12	14	21	13	17	15	13	27	29	19	16	18	214
1912	14	21	28	16	15	18	22	15	15	14	12	12	202
1913	9	18	25	5	15	15	12	13	11	7	8	10	148
1914	15	17	12	10	5	11	14	12	13	10	13	14	146
1915	11	14	12	11	14	15	18	12	12	14	12	14	159
1916	13	15	12	7	8	8	15	18	20	15	7	5	143
1917	6	11	13	12	11	11	7	12	12	17	21	13	146
1918	12	17	8	12	19	11	16	14	11	13	20	14	167
1919	12	11	16	8	8	16	17	15	13	11	11	13	151
1920	19	11	12	7	15	10	8	18	8	18	12	9	147
1921	9	7	10	7	20	16	16	13	17	19	15	15	164
1922	15	12	16	13	21	15	13	14	11	14	17	11	172
1923	6	9	20	17	10	6	18	10	19	16	25	14	170
1924	11	12	15	14	15	8	13	14	15	13	7	12	149
1925	17	18	15	18	15	20	13	10	18	24	18	18	204
1926	23	16	11	13	13	4	13	12	7	18	10	18	158
1927	16	14	7	14	11	22	12	8	10	9	20	10	153
1928	11	14	11	15	7	15	6	9	5	5	7	9	114
1929	18	12	12	18	18	9	25	11	14	12	23	15	187
1930	10	13	11	9	10	8	10	15	17	14	9	7	133
1931	18	16	24	20	22	17	22	13	12	19	11	19	213
1932	17	17	18	19	19	16	8	37	16	15	12	20	214
1933	15	32	15	13	13	13	6	19	16	7	11	8	168
1934	12	8	5	16	14	8	14	13	12	18	14	15	149

The number of violent and destructive earthquakes (VII to X) during these years was 75. In 1913 and 1934 there were 6; 1907, 5; 1915, 1919, 1923 and 1925, 4; 1910, 1917, 1918, 1920, 1921, 1922, 1928 and 1933, 3; 1904, 1905, 1912, 1924, 1929 and 1931, 2; 1903, 1909, 1911, 1916, 1926 and 1932, 1. Their monthly distribution is the following: January 4, February 4, March 6, April 7, May 6, June 5, July 5, August 6, September 7, October 4, November 12 and December 9.

NUMBER OF SEISMIC DISTURBANCES RECORDED AT MANILA, FROM 1903 TO 1934

Year	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1903	21	20	13	15	16	6	16	16	8	13	9	14	167
1904	15	19	11	19	17	35	25	18	16	26	18	18	237
1905	30	23	18	22	22	29	28	9	24	26	14	29	274
1906	30	17	22	27	13	35	11	14	14	86	21	26	316
1907	16	12	21	32	35	17	19	15	21	14	43	14	259
1908	16	14	23	15	20	12	14	15	9	108	25	24	295
1909	21	24	24	22	25	14	26	15	20	6	13	7	217
1910	20	17	20	17	17	21	19	11	12	18	15	29	216
1911	16	19	30	22	24	30	31	35	30	28	28	22	315
1912	27	16	30	24	23	35	27	35	20	20	31	34	322
1913	44	20	37	61	42	25	22	41	36	24	13	6	371
1914	22	35	30	48	25	23	24	20	22	26	32	22	329
1915	27	19	21	32	38	33	28	28	30	24	27	31	338
1916	37	46	43	38	37	28	31	28	31	39	22	17	397
1917	31	27	27	35	47	34	39	33	27	43	38	25	406
1918	62	35	32	30	22	37	64	68	45	34	48	53	530
1919	37	31	42	44	47	45	42	23	48	20	24	17	420
1920	30	35	17	25	48	40	30	34	32	47	15	19	372
1921	19	23	37	20	80	35	42	25	40	19	24	27	391
1922	41	25	20	41	50	33	33	46	39	32	24	37	421
1923	16	42	34	31	49	20	38	35	46	30	53	22	416
1924	24	31	27	48	74	26	33	30	59	24	20	23	419
1925	36	27	34	28	77	43	26	22	35	38	97	35	498
1926	30	20	32	23	29	41	27	52	34	38	29	22	377
1927	27	28	24	36	39	36	36	32	16	33	32	13	352
1928	24	25	31	27	29	97	18	34	33	22	33	35	408
1929	67	41	46	35	39	74	51	43	32	28	45	47	548
1930	32	39	61	54	93	58	29	48	67	85	39	39	644
1931	77	74	86	63	76	70	97	37	62	65	51	49	807
1932	49	56	44	71	55	66	60	61	109	93	52	60	776
1933	71	78	84	63	83	85	75	94	69	44	40	48	834
1934	52	93	56	68	78	81	77	78	52	34	93	94	856

1903. Installation of Vicentini Seismograph.
1907. Installation of Horizontal Pendulums.
1911. Installation of Weichert 1000 Kg. Inverted Pendulum.
1930. Installation of Galitzin-Wilip Seismographs. Three components.

International Seismological Centre

TECTONIC LINES OF THE PHILIPPINE ISLANDS

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

If one examines a map of the Philippine Islands he gets the impression that the central islands, the Visayas as they appear on the map today, are parts of a former whole. Furthermore that, if we disregard minor irregularities of coast line, the islands would fit well together if subjected to some gradual terrestial force capable of shifting them. This implied disruption in the past and the position of the mountain ranges have had a strong influence on the geologists who have attempted to locate the fault lines and tectonic lines involved in the formation and development of the Philippines.

Historical resume.—Becker(1) said,

> "So large a portion of the Philippines consists of volcanic rocks as to make it manifest that there must be in the Archipelago a considerable number of volcanic belts. Such zones form one of the most prominent features of Malaysia as a whole, and when these are passed in review it appears that the volcanic structure of the Philippines must bear complex and interesting relations to the entire region."

He then enumerates the persons who have given attention to this subject; J. D. Dana(2), Naumann(3), Perrey(4), Suess(5), Junghuhn(6), Centeno(7), Wichmann(8), Verbeek(9), Martin(10), Molengraaf(11), Koto(12). He gives an excellent summary of their views and incorporates the opinions of Centeno, Spanish engineer, and Abella, geologist. In the course of this review he makes a very good remark, namely, "To my thinking, too much effort has been made to show unbroken continuity of volcanic zones".

The old concept of a necessary connection between volcanoes and earthquakes, and the spectacular phenomena of the former, caused them to receive undue emphasis. The catalogue of Philippine earthquakes goes back to the first years of the Spanish occupation of the Archipelago but nothing was done on the localization of earthquakes until the latter part of the 19th century.

Centeno(13) wrote a report on the earthquakes of the Surigao Province in 1879 and ascribed their origin to Lake Mainit which may be the site of a former caldera. He also wrote a report(14) on the earthquakes of 1880. In this report he makes an attempt at drawing isoseismals which indicate the central region of the earthquakes. He takes Father Faura to task for connecting the earthquakes with an extinct volcano in the mountains of northern Luzon. The criticism is unfair because, as Centeno states, Father Faura based his statement on reports which he had received from the north, whereas Centeno's report was made after he had the advantage of having made a thorough field trip over all of Luzon. Moreover, Centeno himself had stated, four years previously, that there were evident signs of volcanism, including the cone Data, in the districts of Benguet and Lepanto.

Abella(15) wrote on the Nueva Vizcaya earthquakes of 1881 and the Pangasinan earthquake(16) of 1892 but he was influenced by the old theory of the volcanic origin of all earthquakes.

In 1895, Father Saderra Maso made a beginning of epicentral determinations(17). From macroseismic reports he plotted zones of intensity of important earthquakes and thus indicated, in a general way, the location of the epicenters. After an absence of

International Seismological Centre

five years in Europe he returned to the Observatory in 1901 and resumed his post of seismologist. In the succeeding years he published a number of papers dealing with seismic centers and volcanoes. The old idea of a dependence of all earthquakes on volcanoes was gradually replaced by the more modern views of active faults and tectonic earthquakes.

In 1913, a paper was published by Saderra and Smith connecting seismic disturbances and geologic structure. It was still impossible at that time to make epicentral determinations with a high degree of accuracy. The importance of exact time on seismograms was not yet fully realized, and not always obtainable, and there was an insufficiency of data. The Wiechert Inverted Pendulum had been in operation in Manila only two years, and outside of Manila there were no instruments except a Vicentini at Ambulong, and a Vicentini and Horizontal Pendulums at Baguio. These secondary instruments were operated without damping and the time was inaccurate. The nearest seismographs, outside of the Philippines, were 1,000-kg Wiecherts at Zikawei and Batavia and a 200-kg Wiechert at Taihoku. Under these conditions it was impossible to locate the epicenters with an accuracy required by the paper just mentioned. As a consequence, too much emphasis was given to topographic features. It is stated in the paper that some "lines have been added where no epicenters are indicated." It is further stated that the lines on the map show the direction of greatest seismic intensity. This means that areas enclosed by isoseismals are elliptical in form. The present writer believes that such a determination of intensities has to be used very cautiously. The apparent ellipticity is due, in a majority of cases, to the impossibility of obtaining macroseismic reports from equal distances in all directions from the epicenter, because of the surrounding seas and ocean.

Montessus de Ballore(19) gives a map of central, southern and southeastern Luzon showing the axes of the epicentral areas of principal earthquakes from 1881 to 1890. The data which were available during that period were utterly insufficient to determine the slight differences in the axial directions as shown. The only seismograph in the Philippines at the time was in Manila and all other data were merely macroseismic reports based on personal perceptions. Modern investigation has shown that principal earthquakes of the Philippines, with very few exceptions, are all submarine.

The writer has issued two papers, one in 1931(20) and the other in 1932(21), on Philippine epicenters. Some of the epicenters of those two papers have been shifted slightly in the present work. Recent developments in seismology have justified these changes. Since 1932 the effect of focal depth has become recognized and better understood, and in November 1933 Macelwane issued a new set of travel time tables for earthquakes of normal depth, 10–15 km. The application of these developments has resulted in better epicentral determinations in several cases. Another development since 1932 has been the preparation of the bathymetric map of the Philippines which was presented to the Fifth Pacific Science Congress in Vancouver in 1933. It can now be seen that it is preferable to omit the seismic lines made by the writer in the paper on Epicenters North of Manila. One instance in point is the shoaling of the sea off Cape Bojeador at the extreme northwest end of Luzon. Previously it had been believed that the 2,000 meter contour line was straight, and parallel to the entire northwest coast of Luzon, and continued past Bojeador to the northeast. It seems more accurate to suggest a relation between the epicenters and the 2,000 meter contour, even though the latter, in the present state of our knowledge, pursues a rather sinuous course.

International Seismological Centre

Notes on the Present Paper.—In this paper we do not understand a tectonic or seismotectonic line to be necessarily restricted to a single straight line as shown on the map. We intend that the name be applied to, and the line on the map indicate, not merely fault traces on the surface of the earth, but also narrow zones in which, or close to which, are found geological features or seismic phenomena having a certain, or even, probable relationship to the zone, fracture zone, or rift. We may believe that thermal springs and volcanoes now at some distance from such a zone have been determined in their positions, at some time in the past, by action along the fault or zone. We may assume that relief of stress in the formation of faults, or movements along faults, was accompanied by the formation of subsidiary faults and fissures. These may have furnished outlets for the beginning of volcanoes and springs.

We do not assert, and do not wish to imply, that there are no other faults or fault zones than those shown on the accompanying map.

Names on the map have been kept to a minimum in order to avoid overloading the map and overshadowing the fault lines. It is expected that a person who reads the paper with interest will follow on the map and there should be no difficulty in locating places referred to in the text.

THE MASTER FAULT

We term this the Master Fault because, if it has the length which we believe to exist, it compares in magnitude with the San Andreas fault of California. We do not insist on the name "fault," it may more properly be called "zone." We shall refer to it as "line." It will be followed from its northwest end to the southern end, taking each feature in succession.

Beginning at the northwest end there is an epicenter at 16° 23′ N: 120° 08′ E, January 25th 1934, in the Lingayen Gulf. We have no evidence that the line extends further out into the China Sea, though possibly it does.

Proceeding towards the southeast, we have a very conspicuous geological feature in the fault scarp that crosses the entire island. This marks the southern edge of the mountains of northern Luzon. There is an abrupt change in the geological formations. Alvir (22) advanced the theory that northern Luzon has been shifted about 70 kilometers to the east along this fault. On the north side of the fault are the Caraballo mountains, where earthquakes are frequent. Only four epicenters, located by means of the seismograms of Baguio and Manila, are shown, but many more, not accurately determined, can be safely ascribed to this location. While not on the fault itself, these epicenters are sufficiently close to be related to it in some way, especially if the fault dips to the northeast. The Caraballo mountains have been called the "Central Knot" because they constitute the junction of the western Luzon mountain ranges and the eastern Cordillera.

There is a thermal spring at Pantabangan, "S" on the map.

At the east side of Luzon the fault is marked by a rift valley containing the Santor and the Dingalan rivers, the former heading up only six kilometers from the coast. The valley itself is about thirty kilometers long and eight wide from peak to peak. The peak summits on the northeast side range about 1,200 meters in height, while those on the southeast side are only about 600 meters high.

The fault then passes under the sea, crosses, or passes close to, Polillo Island and enters the land again at the northwest end of the Bicol peninsula. Just offshore there is an epicenter at 14° 22′ N: 122° 20′ E, November 26th 1933. It is possible, or

International Seismological Centre

better perhaps probable, that some of the earthquakes felt in Manila, originate along this fault in the vicinity of Polillo Islands.

On the land we find Pre-Tertiary intrusives in contact with Oligocene (sandstones, shales, limestones). We have marked the earthquake of February 19th 1933 at 14° 10′ N: 122° 40′ E without asserting that it is related to the master line.

We next come to another submarine section. The town of Naga reports a considerable number of earthquakes whose exact epicenters can not be determined for lack of seismographs. Nevertheless, the epicentral distances as given by Manila seismograms intersect the line in this particular section. We believe it reasonably safe to attribute these earthquakes to this line.

Two definite epicenters are at 12° 58′ N: 123° 20′ E, April 23rd 1922, and at 12° 25′ N: 123° 50′ E of the strong earthquake of July 12th 1931. This latter earthquake had an unusually large number of aftershocks. It also affected the flow of wells in neighboring island of Ticao.

Paralleling this section of the line there is a series of volcanoes and thermal springs. The volcanoes are in various stages of extinction or inactivity. At the northwest end of this line of volcanoes there is Isarog which may be called extinct, but still has thermal springs at the east side. Next are the extinct vents Iriga and Malinao, but with a very active thermal spring area at Tiwi at the eastern edge of the latter. The next volcano is the famous Mayon which erupted in 1928. The next is Bulusan which erupted in 1922. This has a hot spring at the town of Bulusan to the east.

Continuing along the line we come to an epicenter at 11° 50′ N: 124° 10′ E of September 28th 1921. There is some evidence that a number of earthquakes could be traced to this epicenter if more seismic records were available. At times shocks are reported from Calbayog, Samar, and the records of Manila and Butuan indicate distances that approximate this position of the earthquake of September 21st 1921. The records are usually too small or indefinite in phase to give the certainty we desire. Other instances are the earthquakes of November 1st 1932 and February 18th 1935.

Continuing southward we meet the island of Biliran, containing active and extinct solfataras. The extinct ones are on the western side of the island and the active ones on the east side, and therefore further from the fault. On April 21st 1931 a strong earthquake was felt in the town of Biliran between 11 P. M. and midnight and up to May 25th twenty five aftershocks were perceived. We may place the origin of these shocks on the fault line, as they were not reported from Ormoc only 50 kilometers distant.

The fault passes between Biliran and the northwest peninsula of Leyte, across Leyte to Ormoc and under Ormoc Bay. On July 23rd 1877 there was a violent earthquake in north Leyte, and again on February 7th 1890 a strong earthquake split walls in Carigara, Barugo and other places on the north coast. This latter quake was followed by two strong and twenty light aftershocks. Our data are not sufficient to locate the exact epicenters of these earthquakes, but it is not improbable that they originated on the line under consideration.

In June 1923, there were three moderate shocks felt in Ormoc and it was reported in the Bulletin of the Manila Observatory for that month that in the preceding twenty years there had been 83 similar shocks reported from Ormoc. There is a well-determined epicenter in Ormoc Bay at 10° 48′ N: 124° 42′ E, November 27th 1926. This earthquake was felt in Ormoc with intensity VI–VII, and there were numerous aftershocks during the next three days. On March 12th 1928 an earthquake of intensity

International Seismological Centre

VI–VII was felt, and followed by six aftershocks. The microseismic data together with the macro reports justify the location of this epicenter in the same position as that of November 27th 1926.

The next feature is another epicenter at 9° 45′ N: 124° 45′ E, May 24th 1931.

Further south we have Camiguin Volcano on the island of that name, or it might more proper to say the island which is Camiguin volcano. There are three distinct peaks but the whole island is evidently due to volcanic activity in the past. Its one eruption in historic times was that of April 30th 1871. Since then it has been inactive.

Continuing south the line reaches the island of Mindanao. Here there is a section of shore line which is significantly straight as though it originated as an escarpment. The bathymetric lines do not parallel the shore but this could be due to deposition of sediments. At the south end of this straight shore line there is Macajalar Bay into which the Cagayan river empties. Smith(23) calls attention to striking examples of raised terraces east of the Cagayan river. It is not certain whether these terraces have been caused by gradual or sudden uplift, but their existence here harmonizes with the presence of a fault or tectonic zone. There are terraces in other localities of Mindanao but Smith characterizes these of the Cagayan river, and some others at Point Blanca on the northwest coast, as exceptionally striking.

We continue the line into Mindanao as far as the epicenter of April 8th 1929 at 7° 48′ N: 124° 36′ E. This earthquake has been investigated in detail(24). Its focal depth has been found to be of the order of 600 kilometers and it is the best example of deep focus earthquakes in the Philippines. At this point the master line meets an arc of volcanoes designated by Smith(25) as the Kulingtang range. This name does not appear on the maps of the Philippines by the U. S. Coast and Geodetic Survey. Two of the cones, Katanglad and Kalatungan, forming the northeasterly half of the arc, are extinct. The westernmost cone is Makaturing and several eruptions were attributed to it. Saderra(26) states that the amount of vegetation covering this mountain indicates a long period of inactivity. In July, 1916, a Constabulary patrol discovered a volcano, which showed recent activity, to the ENE of Makaturing. It was investigated more carefully in September of that year by a party of Constabulary officers.(27) They found numerous jets of sulphurous vapors issuing from vents in a crater between the peaks of three surrounding cones. A well authenticated eruption took place in January 1873. The daily journal of the Jesuit Mission at Polloc, 30 kilometers to the south of Makaturing, on the shore of the Moro gulf, described the phenomena. It was assumed to be an eruption of Makaturing, but some Moros who came in from the hills reported that the place of eruption was two days' walk from Makaturing. It was an eruption of Ragang. If this range of volcanoes indicates an ancient fissure its direction cut across the master line, and there is no evidence that warrants the continuation of the latter to the south.

If the master line or fault actually exists as outlined in the proceding paragraphs, and if we indulge in a little speculation, we may say that it tends to confirm the impression mentioned in the introduction of this paper, that the central Philippines has been disrupted by some tremendous force pushing from the southwest, between Luzon and Mindanao.

May we not perceive some confirmation of this in the fact that the hot spring at Pantabangan, the higher side of the Dingalan-Santor rift valley, the volcanoes and springs of Isarog, Iriga, Malinao, Mayon and Bulusan, and the solfataras of Leyte are all on the outside, or convex side, of the master line?

International Seismological Centre

LINE I

Line I is in the China Sea northwest of northern Luzon. The line has a SW–NE trend and passes between Luzon and Formosa. Its position is suggested by the submarine contours and some epicenters. We notice a gradual deepening from the Pratas Shoals area towards the southeast until the 4,000 meter basin is reached. Then, continuing to the southeast, there is a shoaling of the sea, more abrupt than the opposite deepening. The valley or trough between Luzon and Formosa is even more pronounced.

The epicenters on or near this line are, starting from the north, at the following positions;

21° 35′ N: 122° 00′ E; August 3rd 1926,
21° 05′ N: 121° 40′ E; August 5th 1920,
20° 30′ N: 121° 00′ E; August 26th 1933,
20° 25′ N: 120° 30′ E; May 19th 1930,
20° 10′ N: 120° 25′ E; April 27th 1928,
19° 25′ N: 120° 05′ E; June 1st 1922.

In the entire area north and west of northern Luzon we note a coincidence of the epicenters with the submarine contours. This is conspicuous along the 2,000 and 4,000 meter lines. The wanderings of these lines and the clustering of epicenters along them may indicate that there are many small blocks involved in the crustal structure. The epicenters on or near the 2,000 meter line, starting from the north, are at the following positions;

20° 25′ N: 122° 15′ E; December 21st 1930,
20° 13′ N: 121° 55′ E; December 2nd 1933,
19° 55′ N: 121° 35′ E; June 27th 1928,
19° 55′ N: 121° 15′ E; April 5th 1929,
18° 50′ N: 120° 50′ E; June 14th 1932,
18° 50′ N: 120° 36′ E; October 14th 1922, November 2nd 1929,
18° 40′ N: 120° 15′ E; June 29th 1922, April 23rd 1927,
18° 20′ N: 120° 10′ E; March 19th 1931,
18° 10′ N: 120° 05′ E; June 18th 1927,
18° 05′ N: 120° 00′ E; June 14th 1932,
17° 20′ N: 119° 48′ E; December 24th 1924,
17° 14′ N: 119° 50′ E; June 3rd 1932,
17° 10′ N: 119° 50′ E; January 5th 1927.

The epicenters on or near the 4,000 meter line are, starting from the north, at the following positions,

20° 35′ N: 123° 00′ E; September 3rd 1928, somewhat doubtful.
18° 30′ N: 119° 35′ E; July 8th 1923, March 20th 1929,
18° 15′ N: 119° 25′ E; June 13th 1932,
17° 20′ N: 119° 20′ E; February 14th 1934.

Taking a general view of this region we note the presence of the epicenters on the southeast, or steeper, slop of the submarine valley or syncline; and their absence from the more gentle slope. This phenomenon is similar to the conditions which we

International Seismological Centre

note in regard to the Philippine Deep, east of Mindanao. The epicenters which are on the slope are, starting from the north, at the following positions;

21° 10′ N: 122° 15′ E; April 12th 1934,
20° 00′ N: 120° 50′ E; May 16th 1922,
19° 30′ N: 120° 30′ E; November 10th 1922,
19° 15′ N: 120° 35′ E; January 27th 1924,
19° 10′ N: 120° 10′ E; January 24th 1932,
19° 06′ N: 120° 10′ E; March 16th 1930.

We may refer here to one epicenter shown in the extreme northeast corner of Luzon at 18° 05′ N: 122° 00′ E; August 15th 1933. It is the only definite epicenter of this area in a period of 15 years and is not far from Cagua, an old volcano in late solfataric stage.

LINE II

This line is parallel to the west coast of Luzon from Cape Bolinao to Lubang Island. It is well defined by epicenters and its northern half coincides very closely with the 2,000-meter contour. The epicenters on this line are, starting from the north, at the following positions;

16° 15′ N: 119° 25′ E; May 6th 1924,
15° 33′ N: 119° 36′ E; December 6th 1931,
15° 12′ N: 119° 40′ E; January 12th 1927, April 13th 1927, (2), August 5th 1928, May 27th 1933,
15° 08′ N: 119° 47′ E; July 31st 1934, may belong also to Line IV,
14° 38′ N: 119° 45′ E; July 18th 1932,
13° 55′ N: 119° 45′ E; January 25th 1933.

Five earthquakes have been accurately located at 15° 12′ N: 119° 40′ E, but it is very probable that many more, felt over a small area only, have originated here. The earthquakes of January and April 1927 from this position were of different focal depths. The activity may be due to the junction of this line with Line IV running southeast to Manila and Angono.

The earthquakes of this line, north of 14° N, exhibit the general characteristic of commencing with a dilatation. There are very few, if any, exceptions to this rule.

At 14° 35′ N; 119° 45′ E another line, Line V, branches off to the SSE passing between Lubang Island and Cape Santiago and reaching the Verde Island Passage.

LINE III

This line is based on the earthquake of June 15th 1928 at 12° 22′ N: 121° 55′ E; secondly, on reports of earthquakes felt in Lubang Island whose distances, as given by the Manila seismograms, would place them on this line, and thirdly, on the submarine contours.

LINE IV

This is a new line which has not been previously suggested. It passes through the City of Manila. The evidence that may be adduced in support of its existence is the following.

On October 18th and 19th 1934 there were two earthquakes at a distance of twenty kilometers to the southeast of Manila. They may have been on the Marikina valley line, Line VIII, or they may have been at the junction of the latter with our new Line IV.

International Seismological Centre

The next point of evidence is the cut which the Pasig River makes through the Guadalupe tuff, east of Manila. The position of this cut may have been originally determined by the suggested fault line. In one section the Pasig follows a very winding course but its general direction and the cut through the tuff are in the direction of the suggested fault line.

Coming to Manila itself, on December 14th 1934 many small earthuakes were felt in one area of down-town Manila, the Plaza Goiti area. Seven of these were recorded at the Manila Observatory, 2.5 kilometers from the Plaza. Telephone reports indicated that an earthquake was felt every twenty or thirty minutes during the day. We shall see later, in treating of Line VIII, that there are reasons for ascribing the destructive earthquake of June 3rd 1863 to this line.

Proceeding northwest along the line we find that the northwest corner of Manila Bay makes a somewhat abnormal indentation called Pampanga Bay, which receives the Kulo river from the northwest. This is not a strong piece of evidence, but it may have some significance.

On the China Sea coast we find a flat valley, the largest along the coast, bounded by two streams, the Pamatuan and the Mapanüepe. The appearance of this valley on Map No. 5, U. S. Coast and Geodetic Survey, suggests that it may be a graben similar to the Marikina valley.

Continuing the line to the northwest we conncet with Line II at the point from which a large number of earthquakes have originated. This point has been dealt with in Line II.

It appears to the writer that these features, taken cumulatively, have considerable weight.

LINE V

This line is delineated by earthquakes. They are as follows, starting from the north,

14° 38′ N: 119° 45′ E; July 18th 1932. Mentioned with Line II,
14° 33′ N: 119° 54′ E; August 16th 1932,
14° 10′ N: 120° 10′ E; November 26th 1934,
14° 00′ N: 120° 20′ E; June 6th 1933,
13° 55′ N: 120° 23′ E; May 13th 1927.

LINE VI

Verde Island Passage and south of Lubang Island. No epicenters have been marked on this line and there is very little evidence for the line from submarine contours. Nevertheless, we may safely put a line in this position because many earthquakes give evidence of origin on this line. The macroseismic reports from Lubang, Mindoro and southern Luzon, together with the epicentral distances as given by the Manila seismographs indicate this line as the proper location of these earthquakes. Subsequent to 1932 there seems to have been much less activity on this line than in the preceding years.

LINE VII

The Laguna–Taal Line.—A special map, Plate I, has been made for this line in order to show the features more clearly. Previous investigations have placed a NE–SW line through the Pansipit river, Taal volcano and Laguna de Bay (28)(29). Our new line has more of an E–W trend and we believe it will thus show greater coincidence with existing geological features.

International Seismological Centre

Commencing at the west end we have two epicenters; one at 14° N: 120° 20′ E, June 6th 1933, the other at 13° 55′ N: 120° 23′ E, May 13th 1927. The earthquake of June 6th merits some attention. The Galitzin and Weichert seismograms indicated a compression from the southeast, whereas the seismogram of the Horizontals gave a compression from the south-southwest. The indications of the Galitzin and Wiechert are usually reliable when there is a strong initial throw of P. Yet in this instance an epicenter to the southeast of Manila did not give good agreement among the P–O residuals of other stations. Better, not fully satisfactory, results were obtained from an epicenter to the southwest in the China Sea. Assumptions of various focal depths were made and good results were obtained for a depth of 75 kilometers. Confirmation of this position in the China Sea was had from the effects at Nasugbu on the coast. Here the earthquake was felt very strongly and the brick work of some walls and furnaces in the sugar central were damaged. In favor of an epicenter to the southeast of Manila were reports from towns along the south side of Laguna de Bay that the earthquake had been felt strongly. We believe this was due chiefly to their location on

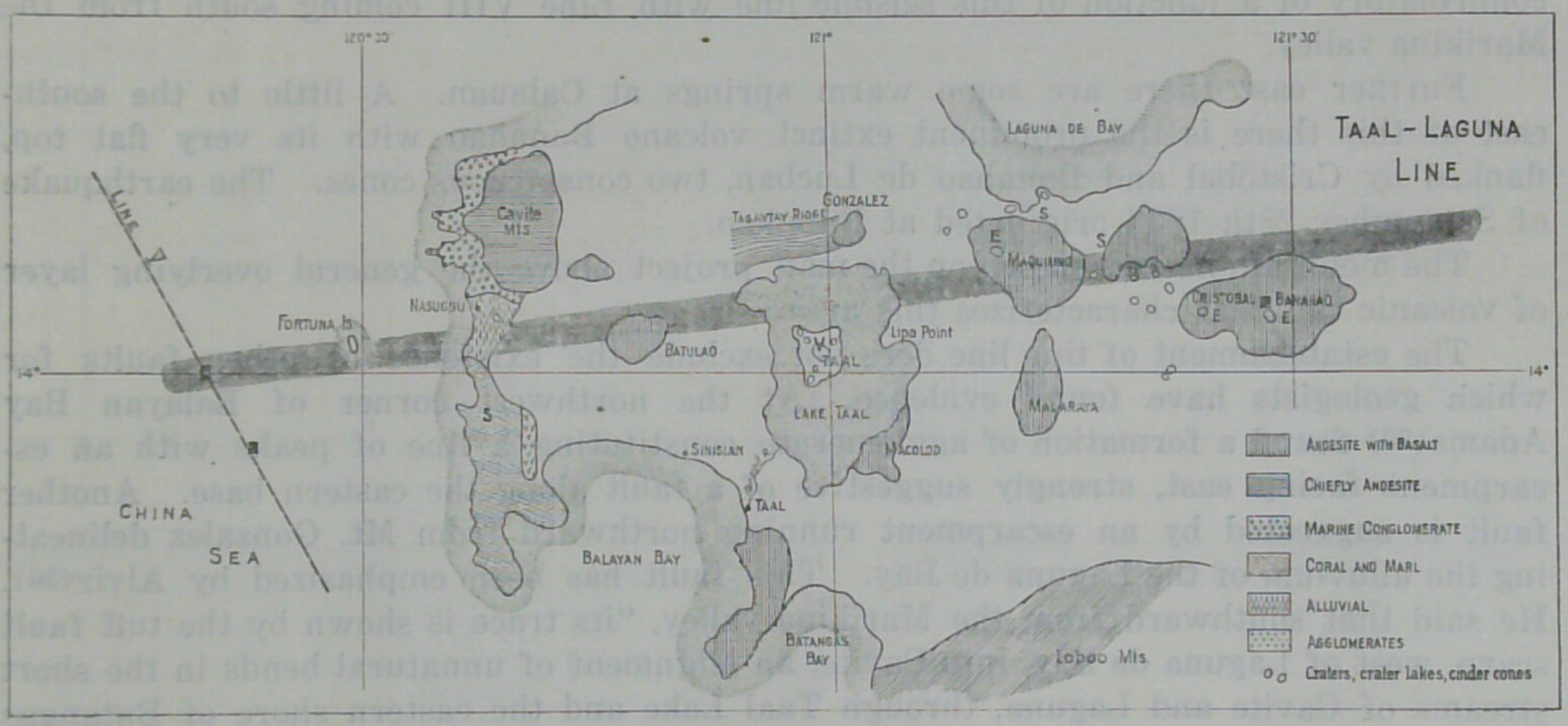


Plate I

alluvium although there may have been some subsidiary movement along the fault in this section. This explanation may save the evidence of the Galitzin and Wiechert seismograms which should not be lightly thrown over.

In the previous work of the writer on Earthquakes South of Manila the earthquake of May 13th 1927 was located further south than now shown. In the present work it was given its new position and a depth of 75 kilometers assumed. The results were very satisfactory. This earthquake of May 13th 1927 appears to belong more properly to Line V but its distance from the earthquake of June 6th 1933 is so small that it may have some relation to Line VII.

Proceeding eastward we find a small crater lake near Nasugbu and a warm spring, S, near the coast, south of the line, at a place named Binabusan. The diversity in geologic formation of this region, with the alluvium around Nasugbu, suggest a fault passing through this area.

North of Lake Taal we have the very conspicuous feature, Tagaytay scarp, rising to a height of 2,100 feet. One opinion considers this as a remnant of a caldera

International Seismological Centre

wall. Another opinion holds it to be the southern face of a fault block which has been tilted. This latter view is more in accord with the idea of a tectonic line as shown on our map.

South of the line we have Taal volcano which should not yet be called extinct. Surrounding this are various small craters. In 1707, an eruption occurred at the northwest corner of Taal island. In 1716 and 1731 the activity manifested itself in the lake between the island and Lipa point on the east shore. All other eruptions of any importance have occurred in the main crater. A list of eruptions in historical times and the eruption of 1911 can be found in "The Eruption of Taal Volvano, January 30th 1911" by M. Saderra Maso, S. J., Manila Observatory. An excellently illustrated article can be found in the National Geographic Magazine for April 1912.

Continuing eastward we find the extinct volcano Maquiling. To the north of it are some cones and small craters, including Alligator lake at the shore of Laguna de Bay. There are some hot springs near the north foot of the mountain, at Los Baños. This has been the locality of some earthquakes of very small extension. This is confirmatory of a junction of this seismic line with Line VIII coming south from the Marikina valley.

Further east there are some warm springs at Calauan. A little to the southeast of this there is the prominent extinct volcano Banahao with its very flat top, flanked by Cristobal and Banahao de Lucban, two conspicuous cones. The earthquake of September 28th 1933 originated at Banahao.

The mountain masses shown on the map project above the general overlying layer of volcanic tuff that characterizes this area.

The establishment of this line does not exclude the existence of other faults for which geologists have found evidence. At the northwest corner of Balayan Bay Adams(29) found a formation of agglomerate constituting a line of peaks with an escarpment facing east, strongly suggestive of a fault along the eastern base. Another fault is suggested by an escarpment running northward from Mt. Gonzalez delineating the alluvium of the Laguna de Bay. This fault has been emphasized by Alvir(30). He said that southward from the Marikina valley, "its trace is shown by the tuff fault scarp, west of Laguna de Bay, into Cavite, an alignment of unnatural bends in the short streams of Cavite and Laguna, through Taal Lake and the eastern shore of Batangas Bay, where it probably dies out." We shall refer to this fault again in dealing with the Marikina valley.

A fault from Balayan Bay, through Taal volcano, Laguna de Bay and onward to the northeast has been frequently suggested. As confirmatory of this, the coast of Balayan Bay from the town of Taal to Sinisian dropped a meter or so at the time of the Taal eruption of 1911. This was taken as indicative of a triangular fault block bounded by Balayan Bay and two faults converging towards Taal volcano.

LINE VIII

We commence this line at Los Baños where some earthquakes of small extension have been felt, and continuing north through Laguna de Bay, the line skirts the eastern side of the western arm of the Lake. Two earthquakes, 20 kilometers southeast of Manila on October 18th and 19th 1934 are on this line.

Continuing north, the prominent feature of this line is the basaltic escarpment that bounds the east side of the Marikina Valley. This is mentioned by Alvir who believes that it extends about 30 kilometers northward from the north end of Laguna de Bay. Marikina Valley is considered to ba a graben and the total throw is estimated by Alvir

International Seismological Centre

to have been as much as 270 meters. Bailey Willis commented on the remarkable preservation of this fault scarp.

The western fault of the Marikina Valley is the one which we mentioned in connection with the Taal region and receives considerable attention from Alvir. Being in tuff it is not so well preserved as the eastern fault. Alvir traces it from Batangas Bay in the south, as we have seen, northward past the Marikina Valley, through the eastern Cordillera, and along the Pacific side of northern Luzon. This may be geologically correct but we have not found any seismic evidence for it.

Alvir calls attention to the fact that Father Saderra in the Bureau of Science Publication No. 19, (1925) placed the axis of the earthquake of June 3rd 1863 in the direction of the eastern Cordillera, but that none of the seismotectonic lines of Saderra-Smith in this area have this direction. Alvir is inclined to believe that the movement originated along the two boundary lines of the Marikina Valley.

It is extremely difficult to make a determination of the epicenters of the old earthquakes from the descriptions which have come down to us. This is true of the earthquake of 1863. East of Manila there were no structures, except a few churches and Government buildings, by which to judge the intensity of the shocks in various places. In trying to estimate intensities by damage to structures there is a large element of uncertainty, namely, the actual condition of the structure when the shock occurred. An example of this was brought out in the earthquake of August 24th, 1932 near Baguio. The epicenter was not more than 15 kilometers to the west of Baguio and no serious damage was done in the city. Twenty five kilometers to the northwest of the epicenter the church at Bauang was damaged and the parochial residence rendered uninhabitable. There was no damage worth mentioning in the rest of Bauang. The damage in the residence was due to the rotten condition of the woodwork and the weakened condition of the mortar in the walls.

Another fact which has to be kept in mind in judging earthquake intensities from damage to structures is the nature of the underlying soil. Filled ground or soft alluvium, especially near rivers, is very dangerous soil on which to build in an earthquake country, unless very special precautions are taken. Such precautions were impossible until within recent years.

In the earthquake of 1863, we have the following collection of evidence by which to make a determination of the epicenter; agitation of the Pasig River, motion of the water in Manila Bay, motion of the ground as felt in Manila, and damage to and destruction of buildings in Manila and the surrounding provinces. We agree with Alvir that the epicenter was not in the eastern Cordillera.

Agitation of the Pasig River can not be taken as indicative of the position of the epicenter. Shallow restricted bodies of water of this kind are easily affected by the agitation of the bordering shores. The disturbance of the bay is of greater importance. At the time of the earthquake the water of the bay is said to have shown a movement towards Cavite and then a return towards Manila. In all cases of seismic sea waves in the Philippines, and in other regions also, the epicenter has been submarine and it is the vertical component of the motion that sets up the wave. It is conceivable that an epicenter very near the shore might have an effect on the sea. This part of the evidence indicates that the earthquake of 1863 must have originated, partly at least, under water, or not very far inland; otherwise, the vertical component would not have been sufficient to produce an appreciable effect on the water. If, by some exception, an earthquake in the eastern Cordillera produced such an effect in Manila Bay, as reported, there would have been very perceptible, and probably destructive, effects produced in Laguna de Bay. But none were reported.

International Seismological Centre

In Manila itself the earthquake commenced with concussions, i. e. vertical movements and these were followed by frightful oscillations, the first in a N–S direction. One report states that the second oscillation was in an E–W direction; another report said that the first oscillation was followed by circular movements. Such sharp movements, especially the vertical motion, are characteristic of epicentral motion. If the reports of the horizontal movements are trustworthy, then their directions and sequence would indicate an epicenter to the north or south of Manila, and not in the eastern Cordillera.

The fourth point of macroseismic evidence, damage to structures, also militates against an epicenter in the eastern Cordillera. Under the assumption of such a position, the towns nearest the center, and, therefore, the ones in which the greatest amount of damage would be expected would have been Antipolo; the lake towns Morong, Paete, Sinaloan, Tanay, Pililla; and the towns of Marikina Valley, viz, Taguig, Pasig, San Mateo, Marikina, Cainta and Taytay. Those which reported damages were Antipolo, Tanay, Pililla, Taguig, Pasig and San Mateo, and all of these, except Antipolo, are on the alluvium of Marikina Valley or the shore of Laguna de Bay. Therefore, the underlying soil has to be taken into account in judging the proximity of these towns to the epicenter. The parish priests of Pililla called attention to the peculiar location of the church on a narrow piece of land between a river and the lake and only about four feet above their level, and that the church had been previously damaged in earthquakes. All of the lake towns mentioned above suffered very much in the earthquake of 1880 which was more evidently in the eastern Cordillera.

We now turn our attention to Manila and Bulacan. The destruction in Manila has been described by Father Saderra in the Seismological Bulletin of the Manila Observatory for October, 1922. An account of the damages to churches and parochial residences of these sections, as well as those mentioned in the preceding paragraphs, has been compiled by Father Selga(34) from ecclesiastical archives.

The vicariate of south Bulacan, as represented by Polo, Bocaue and Santa Maria, reported less damage than the vicariate of north Bulacan. According to modern maps and boundaries these two vicariates would be more properly designated as the southeast and northwest sections of southern Bulacan. The towns of the vicariate of south Bulacan were probably favored with better foundation soil. They are in the neighborhood of Meycauayan which is noted for the good quality of its adobe (volcanic tuff). The following churches and parochial residences of north Bulacan were more or less severely damaged; Bulacan, Malolos, San Rafael, Angat, Pulilan, Guiguinto, and in the Province of Pampanga, those of Lubao and Macabebe. All of these places, except Angat, are in the low ground that is intersected and drained by the numerous branches of the Pampanga river delta emptying into Manila Bay. It seems quite evident that the nature of the underlying soil was an important factor in so much damage. This is borne out by the fact that the towns of Bulacan and Guiguinto are only about five kilometers from Bocaue and but little more from Santa Maria. South of Manila, damage was done in the churches and residences of Bacoor, Las Piñas, and San Pedro Tunasan. These places are, in general, about as far south of Manila as the towns of the vicariate of south Bulacan are to the north.

Taking a comprehensive view of all these areas, Manila itself; the sections north, south and east of Manila; comparing the destruction of 1863 with that of the earthquake of 1880, whose epicenter was more evidently in the eastern Cordillera; we conclude that Manila and Bulacan suffered more than they would have suffered if the epicenter had been in the eastern Cordillera.

International Seismological Centre

We now turn our attention to the suggestion of Alvir that the earthquake of 1863 originated on the fault lines of the Marikina Valley. We enumerated above four points of macroseismic evidence which we have at our command. What has been said on the first three in connection with an epicenter in the eastern Cordillera can be applied with almost equal force to the Marikina Valley. The fourth point, damage to structures, is of much greater importance. Taytay is directly on the eastern fault line of the Marikina Valley, and Cainta is very close to it and on alluvial soil. Taguig, Pasig and Marikina are very close to the western fault and also on alluvium. San Mateo is between, and close to, both faults. Now, if the earthquake of 1863, which caused so much destruction in Manila and Bulacan, was centered in the Marikina Valley it is almost inconceivable that the churches and entire towns of the whole valley, whether on hard soil or soft, could have escaped complete demolition.

Another point, previously alluded to and not to be overlooked, under the assumption of an epicenter in the Marikina Valley, is the effect on Laguna de Bay. If the earthquake in question produced a very noticeable effect in Manila Bay, similar, but more pronounced, effects would have appeared in the lake. It is more than probable that a large, perhaps destructive wave, would have washed up into the towns on the south shore of Laguna de Bay.

This evaluation of the macroseismic evidence in the earthquake of 1863 leads us to conclude that it took place on the Line IV which we have drawn from the China Sea to Laguna de Bay.

LINE IX

There is an epicenter at 10° 05′ N: 125° 05′ E, November 27th 1934. This earthquake was felt in Tacloban with intensity VII, but not for any great distance from its epicenter. A precisely similar earthquake occurred there on December 30th 1932.

In addition to these two there have been many other shocks reported from Tacloban, but not felt elsewhere, which were not strong enough to record in Butuan or Manila. We may reasonably attribute them to the position shown by the epicenter of November 27th 1934.

We continue the line southward past Leyte to Mindanao. Here we have a very straight section of coast line with the bottom dropping steeply into the Mindanao Sea, very similar to the conditions where the primary or master lines reaches Mindanao. A number of strong shocks have been felt at Butuan which did not have a wide extension and they seemed to come from the direction of the sea. We attribute them to this line. The line now enters the land at Butuan and coincides with the Agusan river. This valley has been the scene of many earthquakes and the lakes or swamps, stretching for fifty kilometers from Talacogon to Veruela along the course of the river, are attributed, in part at least, to subsidences in the earthquakes of June, 1893. The writer has called attention(21) to the probability that some earthquakes which have been attributed to this valley may have been actually centered in the Philippine Deep. We terminate this line at the headwaters of the Agusan river, although we would like to believe that it extends southeastward to the Pacific to connect with the line of epicenters running to the southeast in the Philippine Deep.

This Line IX, as we have traced it, coincides in part with a line suggested by Father Saderra(32). Starting in the south, he brings the line from Davao gulf into the Agusan Valley. He is influenced by the great number of earthquakes reported from Davao. Our investigation of more recent years shows that most of the earthquakes felt in Davao originate in the Philippine Deep or south of Mindanao, between it and

International Seismological Centre

the Netherlands East Indies. Two epicenters of Class Two (probable determinations) are shown in Davao gulf, but there is stronger evidence for an east-west line further south. Another factor given in favor of the Davao line is the low watershed of limestone and gravel separating the Agusan from the streams flowing into Davao gulf. We take this to be confirmatory of a vertical displacement west of the line suggested by us. The headwaters of the Agusan river are far to the south and east of the headwaters of the principal streams flow into Davao gulf.

On reaching Butuan Bay Father Saderra suggested that line enters Leyte and follows the mountain range through the island to Biliran. There is an extinct volcano, Cabalian, and solfataras in central Leyte in favor of this position of the line. But, in speaking of Leyte, Adams(33) said; "Much more study will be necessary before the relations of the volcanic zone of Leyte are determined definitely and in the meantime it will be better not to try to extend it too far."

We think it better to carry the line east of Leyte to the epicenter near Tacloban and leave the interior of Leyte for more detailed investigation later.

REFERENCES

(1) BECKER, GEORGE F. Geology of the Philippine Islands. Annual Report of the U. S. Geological Survey, 1899–1900. Part III.
(2) DANA J. D. U. S. Expl. Exp., Vol. X, 1849, pp. 11–23, 415–436.
(3) NAUMANN, C. F. Lehrbuch der Geognosie, Vol.°, 1858, p. 93.
(4) PERREY, ALEXIS. Phen. Volc.; Mem. Acad. de Dijon, Vol. VIII, 1860.
(5) SUESS, E. Antlitz der Erde, Vol. II, 1888, pp. 213–217.
(6) JUNGHUHN. Java, Vol. II, 1854, p. 807.
(7) CENTENO, J. Memoria geolog-min. Fil., 1876, p. 7.
(8) WICHMANN, A. Gesteine von der Insel Kisser; Beitr. z. Geol. von Ostasien, Vol. II, 1887, p. 197. Neues Jahrb., 1893, pt. 2, p. 176. Petermann's Mitteil., 1893, p. 18. Zeitschr. D. geol. Gesell., 1893, p. 543.
(9) VERBEEK, R. D. Verbeek et Fennema, Descrip. geol. d. Java et Madoura, 1896, p. 993.
(10) MARTIN, K. Reisen in den Molukken, geol. Th., 1897, p. 57.
(11) MOLENGRAAF, G. A. Petermann's Mitteil, Vol. XLI, 1895, p. 203.
(12) KOTO, B. Structure of the Malayan Archipelago. Jour. Coll. of Science, Toyko, Vol. XI, pt. 2, p. 83.
(13) CENTENO, J. Informe sobre los temblores de tierra occuridos en el mes de julio de 1879 en el distrito de Surigao, isla de Mindanao. Bol. com. del Mapa Geol. de España. Madrid, 9 (1882) pp. 215–221.
(14) CENTENO, J. Boletín de la Comisión del Mapa Geológico de España. Tomo X, Madrid, 1883, pp. 1–91.
(15) ABELLA, E. Terremotos de Nueva Vizcaya en 1881. Madrid, 1884.
(16) ABELLA, E. Terremotos experimentados en la Isla de Luzón, en Pangasinán, Unión y Benguet. Manila, 1893.
(17) SADERRA, S. J., M. Seismología en Filipinas, Manila, 1895.
(18) SADERRA, M. and SMITH, W. D. Relation of Seismic Disturbances in the Philippines to the Geologic Structure. Phil. Jour. of Science, Vol. VIII, No. 4, Sec. A. Chem. and Geol. Sci. Aug. 1913.
(19) BALLORE, MONTESSUS DE. La Geologie Seismologique. Paris, 1924, p. 283.
(20) REPETTI, S. J., W. C. Philippine Earthquake Epicenters, (1920–1929), North of Latitude 14° 30′. Manila Observatory, 1931.
(21) REPETTI, S. J., W. C. Philippine Earthquake Epicenters, South of Manila, (1920–1929). Manila Observatory, 1932.
(22) Alvir, ANTONIO. History of the Deformative Movements in the Philippine Islands. Proc. 3rd Pan-Pacific Science Congress, Tokyo, 1926, p. 454.
(23) SMITH, W. D. Geologic Reconnaissance of Mindanao and Sulu. Phil. Jour. of Science. Vol. V. Chem. and Geological Sciences, pp. 360–361.
(24) REPETTI, S. J., W. C. A Very Deep Earthquake in the Philippines. Seismological Bulletin, July–December, 1933, Manila Observatory.
(25) SMITH, W. D. Geologic Reconnaissance of Mindanao and Sulu. Phil. Jour. of Science. Vol. V., Chem. and Geological Sciences, p. 358.
(26) SADERRA, S. J., M. Active Philippine Volcanoes. Bulletin of the Manila Observatory, April, 1922.
(27) SADERRA, S. J., M. Volcanic Notes. Bulletin of the Manila Observatory, December, 1916.
(28) SADERRA, S. J., M. Seismotectonis Lines in Southern Luzon. Bulletin of the Manila Observatory, November, 1911.
(29) ADAMS, GEORGE I. A Geological Reconnaissance of Southwestern Luzon. Phil. Jour. of Science. Vol. V, Chem. and Geol. Sciences, March 1910, p. 101.
(30) ALVIR, ANTONIO. Some Observations on Active Faults in the Philippine Islands. Proc. 3rd Pan–Pacific Science Congress, Tokyo, 1926, Vol. I, p. 457.
(31) ALVIR, ANTONIO. Geology of the Angat–Novaliches Region. Philippine Jour. of Science, Vol. 40, pp. 359–421.
(32) SADERRA, S. J., M. The Seismic Centers of Samar, Leyte, and Eastern Mindanao. Bulletin of the Manila Observatory, August, 1910.
(33) ADAMS, GEORGE I. Geological Reconnaissance of the Island of Leyte. Phil. Jour. of Science, General Sciences, Vol. IV, No. 5.
(34) SELGA, S. J., M. El Terremoto del 3 de junio de 1883 en el Arzobispado de Manila. Rev. d. 1. Soc. d. España y América, No. 100 to No. 103, 1925.

293092——4

International Seismological Centre

No. 1. January, 1934.

International Seismological Centre

M A N I L A , P . I .

SEISMOLOGICAL BULLETIN OF THE OBSERVATORY

φ=14° 34' 42" N. λ=120° 58' 41" E. h=2.40 m. Alluvium.

GALITZIN-WILIP

WIECHERT. M=1000 Kg.
January 3, 1934.

	T_o	D	T_j	l	μ^2	K
N-S	12.4	100.5	12.6	11.5	0.017	97
E-W	11.8	100.5	11.9	11.4	-0.075	80
Z	11.6	100.5	9.0	14.8	1.250	200

	T_o	V	ε	$\frac{r}{T_o^2}$
N-S	4.5	193	2.3	0.026
E-W	4.8	203	2.7	0.029

No. and Date	Phase.	Greenwich Time h. m. s.	Dist. Km.	Remarks
1934 January				
No. 1	iPZ	6 21 40	2535	In region of 11°N; 137°E by Manila,
1st	ePNE	6 21 41		Hong Kong, Chiufeng.
	iE	6 21 44		
	iN	6 21 45		
	iSNEZ	6 25 42		
	F	7 20		
No. 2	PNE	3 14 09	395	
2nd	SNE	3 15 09		
	F	3 23		
No. 6	iPNEZ	17 29 49	2980	
2nd	iSNE	17 34 19		
	LN	17 37 09		
	MN	17 39 44		
	F	18 00		
No. 7	ePNEZ	19 11 34	2745	
2nd	SNE	19 15 49		
	LNE	19 18 25		
	F	19 35		
No. 9	iPNE	21 05 21	7165	
2nd	SNE	21 14 03		
	LNE	21 25 50ca		
	MNE	21 31 ca		
	F	22 20		
No. 10	iPZ	9 50 42	4948	Dilatation.
3rd	ePNE	9 50 42		Kamtchatka according to Koti.
	iSNE	9 57 16		53°N; 155°E; 0=9:42.0 by U.S.C.G.S.
	F	11 20		Disturbed by microseisms.

International Seismological Centre

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.
1934 January				
No. 13 8th	PNEZ	19 53 54	390	17° 50'N; 122° 15'E by Manila and Baguio.
	SNE	19 54 41		
	F	20 06		
No. 14 8th	PNEZ	23 12 18	2435	34°N; 133.8°E according to Koti.
	SNEZ	23 16 11		Felt in Kobe, Japan.
	F	23 26		
No. 15 9th	PNEZ	21 43 04	215	
	SNE	21 43 32		
	F	21 47		
No. 16 10th	PNEZ	3 36 58	390	
	SNEZ	3 37 46		
	F	3 55		
No. 18 11th	PNEZ	8 24 37	1150	
	SNE	8 26 36		
	F	8 50		
No. 19 11th	P?NEZ	10 31 40	5720?	
	SNE	10 38 57		
	LN	10 47 02		
	F	11 30		
No. 20 12th	PNEZ	13 36 21	2435	L from the Wiechert.
	SNE	13 40 14		23°N; 103°E according to Chiufeng.
	LNE	13 42 30ca		
	F	14 45		
No. 23 13th	PNE	22 16 01	1845	
	SNE	22 19 10		
	LNE	22 20 36		
	F	22 35		
No. 28 15th	iPZ	8 50 08	3845	Compression. Valley of the Ganges, India.
	iPE	8 50 09		
	PN	8 50 10		Data after P from the Wiechert.
	iN	8 51 55		25°N; 86°E; O=8:43.3 by U.S.C.G.S.
	SNE	8 55 33		
	L?N	8 59 55ca		
	MN	9 02 50ca		
	F	12 30		

International Seismological Centre

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.
1934 January				
No. 32 15th	PNEZ	21 34 51	215	Felt at Baguio with intensity I.
	SNEZ	21 35 18		Approx. 16° 30'N; 121°E by Manila
	F	21 39		and Baguio.
No. 33 16th	iPNEZ	18 42 02	1900	
	SNE	18 45 14		
	LNE	18 46 50ca		
	MNE	18 48 40		
	F	20 20		
No. 34 16th	ePNE	23 03 45	1200	Felt at Davao with Intensity I.
	SNE	23 05 50		
	LNE	23 06 44		
	F	23 50		
No. 38 . 19th	ePZ	12 38 26	2990	In region of 27°N; 98°E by Hong
	LNE	12 38 32		Kong, Manila, Chiufeng.
	SNE	12 42 57		
	LNE	12 45 50		
	F	13 40		
No. 39 19th	PNE	17 59 27	1435	
	SNE	18 01 56		
	LN	18 03 12		
	F	19 19		
No. 40 20th	PNE	18 02 03	3310	Felt at Tai-Yuan, Shansi.
	SNE	18 06 55		Disturbed by microseisms.
	LE	18 10 13		
	F	19 10		
No. 41 20th	SN	22 06 51		P lost in microseisms.
	F	22 26		
No. 42 20th 21st	P?EZ	22 29 26		Disturbed by microseisms.
	F	0 35		
No. 43 21st	ePZ	6 57 37	2200?	Disturbed by microseisms.
	S?EZ	7 01 14		
	F	8 30		
No. 44 22nd	P?E	7 51 46	3435?	Disturbed by microseisms.
	S?E	7 56 46		
	LE	8 00 20ca		
	F	9 10		

International Seismological Centre

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.
1934 January				
No. 47 25th	iPZ	18 21 22	215	Lingayen Gulf. 16° 23'N; 120° 08'E by Manila and Baguio.
	ePNE	18 21 24		
	iSNEZ	18 21 50		Dilatation at Báguio and Manila.
	F	18 31		Felt at Baguio and along coast of Lingayen Gulf.
No. 48 28th	ePNEZ	19 31 46		Disturbed by strong microseisms.
	F	21 40		
No. 49 29th	ePNEZ	5 29 41	220	Felt at Daet with intensity VI.
	SNEZ	5 30 11		
	F	5 35		
No. 50 29th	ePNE	12 55 07	2710	Deep. Prebably in region of New Guinea.
	SNEZ	12 59 19		
	F	13 22		Butuan, Δ=16.1°.
No. 52 31st	PNE	10 17 56	7765?	
	iPZ	10 17 56		
	S?N	10 27 13		
	F	11 15		

Twenty-two insignificant or undecipherable disturbances on the following days of January: 2nd(4), 6th, 7th, 10th, 13th(2), 14th(4), 15th(3), 17th(2), 18th, 23rd(2), and 30th.

Feb-Apr '34
Ref 2826

No. 5. February, 1934.

International Seismological Centre

M A N I L A , P . I .

SEISMOLOGICAL BULLETIN OF THE OBSERVATORY

Ø=14° 34' 42" N. λ=120° 58' 41" E. h=2.40 m. Alluvium.

GALITZIN-WILIP

WIECHERT. M=1000 Kg.
February 2, 1934.

	T_o	D	T_1	λ	μ^2	K
N-S	12.4	100.5	12.6	11.5	0.017	97
E-W	11.8	100.5	11.9	11.4	-0.075	80
Z	11.6	100.5	9.0	14.8	1.250	200

	T_o	V	ε	$\frac{r}{T_o^2}$
N-S	4.4	192	2.3	0.031
E-W	4.9	202	2.7	0.030

No. and Date	Phase.	Greenwich Time h. m. s.	Dist. Km.	Remarks.
1934 February				
No. 53 2nd	iPZ	15 10 28	2710	Compression,
	ePNE	15 10 28		Data after S from the Wiechert.
	iE	15 10 33		
	iN	15 10 40		
	iSNE	15 14 40		
	LNE	15 17 19		
	ME	15 19 29		
	F	16 50		
No. 56 3rd	P?NEZ	13 44 57	970?	Felt in Davao with intensity II.
	SN	13 46 40		Butuan △=230 Km.
	F	13 55		Disturbed by microseisms.
NO. 57 3rd	iPEZ	14 40 14	4535	Compression.
	ePN	14 40 15		Data after S from the Wiechert.
	SNE	14 46 23		
	LNE	14 52 05ca		
	F	15 45		
No. 58 4th	P?E	3 14 26		P doubtful because of microseisms.
	SNEZ	3 17 57		Butuan △=16°.5. Deep focus.
	F	3 58		
No. 59 4th	PE	13 46 04	7555?	Disturbed by microseisms.
	S?NE	13 54 09		
	L?NE	14 05 30ca		
	F	14 43		
No. 60 4th	iPNEZ	22 06 06	2490	Dilatation from [illegible] SE.
	SNEZ	22 10 04		Disturbed by microseisms.
	F	23 42		
No. 61 6th	P?E	20 09 29	930	Felt at Butuan with intensity I.
	SE	20 11 08		N-S recording lamp burned out.
	F	20 23		

International Seismological Centre

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.
1934 February				
No. 62 7th	iPNEZ	9 55 09	175	Dilatation from NE.
	SNEZ	9 55 31		Felt in Manila Observatory.
	mZ	9 55 41		
	F	10 15		
No. 64 9th	iPZ	9 34 51	1900	
	ePNE	9 34 51		
	SNE	9 38 03		
	LNE	9 39 35ca		
	MNE	9 41 15ca		
	F	10 30		
No. 68 11th	iPEZ	9 07 01	3875	Compression.
	SNE	9 12 31		In region of Bougainville Island by
	LNE	9 16 20ca		Manila, Hong Kong, Riverview.
	F	9 50		
No. 73 12th	iPZ	11 35 24	2380	Compression.
	PNE	11 35 26		
	SNE	11 39 14		
	LNEZ	11 41 14		
	MNE	11 43 20ca		
	F	13 20		
No. 76 14th	iPZ	1 26 07	300	
	ePNE	1 26 08		
	SNE	1 26 51		
	F	1 54		
No. 77 14th	iPNZ	4 00 32	345	Dilatation at Manila and Baguio.
	iPE	4 00 33		Felt over all of Luzon north of Manila.
				Slight damage in some towns on NW coast of Luzon.
				Max. intensity V at Vigan and Laoag.
				Surge of sea observed south of Vigan.
				Epicenter 17° 20'N; 119° 22'E by Manila and Baguio.
				17 aftershocks until No. 95.
				Between 4:01 and 4:02 the Manila-Shanghai cable broke near 18° N; 119° 25' E in 1350 fathoms of water.

No. 7. February, 1934.

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
1934 February 15				
No. 95 14th	PNE	17 ~~80~~ 40	345	Compression at Manila and Baguio.
	SNE	17 16 24		Epicenter, 17° 15'N; 119° 12'E by Manila and Baguio.
	F	17 54		Followed by 8 aftershocks until No. 104.
No. 104 15th	PNEZ	3 12 06	8690	Distance subject to correction for depth of focus.
	SNE	3 22 09		
	F	3 55		
No. 105 to No. 112, and No. 114 to No. 117 are aftershocks of No. 77.				
No. 113 16th	PNE	6 38 34	1190	In the region of the Sakishima Islands by Manila and Baguio.
	SNE	6 40 38		From the Wiechert. No. 112 still recording.
	F	7 40		
No. 118 17th	PNEZ	21 06 34	2255	Dilatation.
	SNE	21 10 15		
	F	22 15		
No. 124 18th	PNEZ	20 16 33	895	
	SNE	20 18 09		
	F	20 35		
No. 126 19th	iPZ	10 30 28	4140	
	ePNE	10 30 28		
	SNE	10 36 13		
	LNE	10 41 05		
	F	12 40		
No. 128 20th	PNEZ	4 15 05	680	
	SE	4 16 21		
	F	4 33		
No. 129 20th	PNEZ	15 11 22	630	
	SNEZ	15 12 33		
	F	15 31		
No. 130 21st	PNE	3 35 44	985	
	SNEZ	3 37 29		
	F	3 51		
No. 132 21st	$i\bar{P}Z$	18 49 25	160	Dilatation.
	$\bullet\bar{P}NE$	18 49 25		Baguio 120 Km.
	iNE	18 49 26		
	$\bar{S}NE$	18 49 45		
	F	18 56		

International Seismological Centre

M A N I L A , P . I .

SEISMOLOGICAL BULLETIN OF THE OBSERVATORY.--Continued.

International Seismological Centre

No. and Date	Phase.	Greenwich Time h. m. s.	Dist. Km.	Remarks.
1934 February				
No. 133 22nd	PNEZ	8 12 38		
	iNE	8 16 34		
	iNE	8 27 43		
	L?NE	8 50 ca		
	F	10 25		
No. 137 24th	iPNEZ	6 28 53	2765	Compression from NE.
	PR_1NE	6 29 28		
	iSNE	6 33 09		
	SR_1NE	6 34 19		
	SR_3NE	6 34 47		
	LNE	6 35 45ca		21°N; 145°E; O=6:23.7 by U.S.C.G.S.
	MNE	6 38 ca		
	F	9 50		
No. 138 25th	iPNEZ	16 23 52	370	Compression from NW.
	iSNE	16 24 39		
	F	17 52		
No. 139 25th	PNEZ	19 10 52	235	
	$\overline{S}$NEZ	19 11 24		
	F	19 26		
No. 142 27th	iPZ	21 36 47	1155?	Compression.
	ePNE	21 36 47		
	S?NE	21 38 44		
	MN	21 50 37		
	F	22 40		
No. 143 28th	$\overline{P}$NEZ	8 38 02	120	
	$\overline{S}$NEZ	8 38 17		
	F	8 46		
No. 144 28th	PNEZ	9 34 35	1535	
	SNEZ	9 37 14		
	F	9 56		
No. 145 28th	PNEZ	14 28 37	4055	In region of 4°S; 153°E by Manila, Riverview, Hong Kong.
	SNE	14 34 17		
	LN	14 39 ca		
	MNE	14 43 ca		
	F	16 20		

Sixty-two insignificant or undecipherable disturbances on the following days of February: 2nd(2), 7th, 9th, 10th(2), 11th(3), 12th (3), 14th(22), 15th(11), 16th(4), 18th(5), 19th(2), 21st, 22nd, 23rd(2), 25th, and 26th.

No. 9. March, 1934.

International Seismological Centre

M A N I L A , P . I .

SEISMOLOGICAL BULLETIN OF THE OBSERVATORY

Ø=14° 34' 32" N. λ=120° 58' 41" E. h=2.40 m. Alluvium.

GALITZIN-WILIP. WIECHERT. M=1000 Kg.

March 2, 1934.

	T_o	D	T_1	l	μ^2	K
N-S	12.4	100.5	12.6	11.5	0.017	97
E-W	11.8	100.5	11.9	11.4	-0.075	80
Z	11.6	100.5	9.0	14.8	1.250	200

	T_o	V	ε	$\frac{r}{T_o^2}$
N-S	4.4	192	2.3	0.031
E-W	4.8	206	2.7	0.034

No. and Date	Phase.	Greenwich Time h. m. s.	Dist. Km.	Remarks.
1934 March				
No. 146 1st	PNEZ	3 55 11	4210?	
	S?E	4 01 00		
	LNE	4 05 50ca		
	ME	4 09 ca		
	F	5 10		
No. 148 1st	PNEZ	19 48 03	4045	In the region of New Britain by Manila, Hong Kong, Chiufeng.
	SNE	19 53 42		
	LNEZ	19 58 30		
	MNE	20 01 30ca		
	F	21 30		
No. 149 1st	iPZ	22 05 04	13980	Dilatation.
	ePNE	22 05 04		
	iN	22 06 05		39°S; 73°W; O=21:45.4 by U.S.C.G.S.
	iEZ	22 28 10		
	iN	22 29 09		
	LE	22 45 ca		
2nd	F	0 10 ca		
No. 151 2nd	ePNEZ	19 57 29	2465?	
	S?NE	20 01 24		
	MN	20 06 05ca		Continues into following quake.
No. 154 3rd	PNE	0 38 42	2135	Japan.
	SNE	0 42 14		
	LN	0 44 05		
	MN	0 45 ca		
	F	1 15		
No. 155 3rd	eNEZ	16 16 05		Conspicuous group of 19 seconds period waves on E component from 16:36 to 16:41.
	iE	16 27 42		
	iE	16 28 00		
	F	17 10		

International Seismological Centre

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.
1934 March				
No. 156 3rd	PNEZ	18 38 27	435?	Baguio, △=175 Km.
	S?NEZ	18 39 20		
	F	18 50		
No. 157 4th	PNEZ	6 04 44	6080	Compression.
	SNEZ	6 12 22		In region of New Hebrides by Manila, Hong Kong, Riverview, Chiufeng.
	LNE	6 21 36		
	F	7 30		
No. 158 4th	iPZ	11 26 50	5925	Compression.
	ePNE	11 26 50		
	SNEZ	11 34 19		
	LE	11 42 ca		
	ME	11 47 ca		
	F	13 05		
No. 161 5th	PNE	0 01 29	220	From the Wiechert. No time marks on Galitzin records.
	SNE	0 01 59		
	F	0 09		
No. 163 5th	iPZ	11 57 56	8065	Compression from SE.
	PNE	11 57 57		New Zealand.
	SNE	12 07 28		Data after P from the Wiechert.
	LNE	12 21 30 ca		
	MNE	12 26 40 ca		
	F	14 50		
No. 165 6th	PNEZ	4 39 01	400	
	SNE	4 40 02		
	F	4 50		
No. 173 11th	ePNEZ	10 44 36	3110	Epicenter in Nero Deep, SE of Guam.
	iSNE	10 49 15		Felt at Guam, △=135 Km.
	iE	10 50 13		
	LE	10 52 24		
	F	11 20		
No. 174 11th	PNEZ	19 20 18	2810	
	SNE	19 24 37		
	LNE	19 27 40 ca		
	F	19 59		

No. 11. March, 1934.

International Seismological Centre

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.
1934 March				
No. 177 12th	ePNE	15 20 00	11685	Interpretation by Macelwane's New Tables.
	PR_1Z	15 24 10		41.7°N; 112.6°W; 0=15:05.8 by U.S.C.G.S.
	PSNE	15 33 30		
	LNE	15 55 00		
	MNE	16 04 00		
	PPSS'NE?	16 09 00		
	F	17 40		
No. 179 13th	iPZ	13 20 48	7060	Compression from SE.
	ePE	13 20 49		
	SNE	13 29 24		
	LNE	15 41 00ca		
	F	15 25		
No. 181 15th	iPZ	10 58 17	8080	Compression.
	ePNE	10 58 17		
	iSNEZ	11 07 51		
	LNE	11 21 05ca		
	MNE	11 27 ca		
	F	12 25		
No. 183 16th	PNEZ	8 47 21	390	Baguio, Δ=200 Km.
	SNEZ	8 48 09		
	F	8 56		
No. 184 16th	iPZ	14 20 02	4355	From the SE.
	ePNE	14 20 04		L and M not distinguishable.
	SNE	14 26 00		
	F	15 34		
No. 186 18th	ePNEZ	0 23 44	1165	
	SNE	0 25 45		
	LNE	0 26 40ca		
	MNE	0 28 ca		
	F	0 46		
No. 187 18th	iPZ	4 41 30	5065	From the NE.
	ePNE	4 41 30		In region of 50°N; 150°E by Chiufeng and Manila.
	SNE	4 48 10		
	F	5 55		
No. 188 18th	PNEZ	7 14 30	525	Butuan, Δ=325 Km.
	SNEZ	7 15 32		
	F	8 07		

International Seismological Centre

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.
1934 March				
No. 189 18th	PEZ	12 35 56	1605	Netherlands East Indies.
	SNEZ	12 38 43		Butuan, △=6.4°.
	F	13 16		
No. 192 20th	PNEZ	2 45 21	3810	From the SE.
	iSNE	2 50 45		
	LE	2 55 20ca		
	MNE	2 58 40ca		
	F	4 40		
No. 193 20th	PNEZ	20 54 17	835	9° 20'N; 126° 30'E by Manila, Butuan.
	SNEZ	20 55 47		
	F	21 33		Felt at Surigao and Butuan with intensity III and at Talisayan (Oriental Misamis) with intensity II-III.
No. 196 21st	PN	9 14 11	250	
	SNEZ	9 14 16		
	F	9 24		
No. 199 24th	PNEZ	12 12 58	5400	L from the Wiechert.
	SNE	12 19 56		10°S; 161°E; 0=12:04:30 by U.S.C.G.S.
	LNE	12 27 40ca		
	F	15 20		

Twenty-nine insignificant or undecipherable disturbances on the following days of March: 1st, 2nd(3), 4th(2), 5th(2), 6th, 7th(2), 9th(2), 10th(2), 12th(3), 14th, 16th(2), 18th, 19th, 21st(2), 22nd, 23rd, 28th, and 29th.

No. 13. April, 1934.

M A N I L A , P . I .

SEISMOLOGICAL BULLETIN OF THE OBSERVATORY

International Seismological Centre

Ø=14° 34' 42" N. λ=120° 58' 42" E. h=2.40 m. Alluvium.

GALITZIN-WILIP

	T_o	D	T_1	l	μ^2	K
N-S	12.4	100.5	12.6	11.5	0.017	97
E-W	11.8	100.5	11.9	11.4	-0.075	80
Z	11.6	100.5	9.0	14.8	1.250	200

WIECHERT. M=1000 Kg.
April 1, 1934.

	T_o	V	ε	$\frac{r}{T_o^2}$
N-S	4.5	181	2.3	0.035
E-W	4.8	209	2.7	0.036

No. and Date	Phase.	Greenwich Time h. m. s.	Dist. Km.	Remarks.
1934 April				
No. 202 1st	PNEZ	2 49 04	470	Dilatation.
	SNE	2 50 00		Felt at Iloilo.
	F	3 02		
No. 203 1st	iPNEZ	21 56 22	320	Compression from NW.
	SNEZ	21 57 04		
	F	22 35		
No. 204 2nd	iPZ	5 01 25	1880?	Dilatation.
	ePNE	5 01 25		
	S?NE	5 04 36		
	F	5 45		
No. 206 3rd	PNEZ	8 36 35	4880	
	SNEZ	8 43 04		
	L?E	8 49 15ca		
	MNE	8 54 ca		
	F	9 48		
No. 207 3rd	iPZ	22 37 02	2645	Compression.
	ePNE	22 37 03		Felt in Hukushima according to Koti.
	SNE	22 41 10		
4th	F	0 05		
No. 208 4th	PNEZ	21 31 21	215	
	$\overline{S}$NE	21 31 50		
	F	21 39		
No. 209 4th	$\overline{P}$NE	21 42 35	198	
	$\overline{S}$NE	21 43 00		
	F	21 53		
No. 211 6th	PNEZ	19 15 30	3165	Dilatation.
	SNEZ	19 20 13		Japan.
	LE	19 23 40 ca		
	F	20 30		

International Seismological Centre

M A N I L A , P . I .

SEISMOLIGICAL BULLETIN OF THE OBSERVATORY.--Continued,

No. and Date	Phase.	Greenwich Time h. m. s.	Dist. Km.	Remarks.
1934 April				
No. 215 9th	P?NEZ	15 50 30	8380?	
	L?NE	16 15 10ca		
	F	18 10		
No. 216 10th	iPZ	10 27 56	2635	Compression.
	iPNE	10 27 57		Deep focus.
	PR_1E	10 28 26		Probably in Netherlands East Indies.
	PR_2E	10 28 33		Data after P from the Wiechert.
	iSNE	10 32 03		
	SR_1N?	10 33 18		
	F	12 20		
No. 218 11th	ePNEZ	21 21 37	6490	Deep focus.
	iNE	21 22 32		In region of New Hebrides by Manila,
	iSNEZ	21 29 34		Riverview, Adelaide.
No. 219 11th	PNEZ	22 01 00	2535	No. 218 still recording. P and S in
	SNEZ	22 05 00		minute gap.
	F	23 10		Deep focus.
No. 220 12th	iPZ	3 22 03	450	From the north.
	ePNE	3 22 05		S from the Wiechert.
	SNE	3 22 58		Baguio, Δ=270 Km.
	F	4 30		
No. 221 12th	PNEZ	9 15 37	3310	
	SNE	9 20 29		
	ME	9 26 ca		
	F	10 05		
No. 224 13th	iPNZ	22 06 36	1390	Compression.
	ePE	22 06 36		
	SNE	22 09 00		
	F	22 32		
No. 225 15th	PNEZ	10 38 46	3440?	
	S?N	10 43 47		
	iE	10 44 34		
	LE	10 46 55		
	F	11 30		
No. 227 15th 16th	iPNEZ	22 17 29	1090	Compression. 6°N; 127°E by Manila,
	iSNE	22 19 24		Hong Kong, Koti, Chiufeng.
	F	1 20		Felt in central and eastern Mindanao and southeastern Visayas.
				S from the Wiechert.

International Seismological Centre

M A N I L A , P . I .

SEISMOLOGICAL BULIETIN OF THE OBSERVATORY.--Continued.

No. and Date	Phase.	Greenwich Time h. m. s.	Dist. Km.	Remarks.
1934 April				
No. 229	PNEZ	4 01 29	1100	Compression. Aftershock of No. 227.
16th	SNE	4 03 25		Felt at Davao with intensity I.
	F	5 55		S from the Wiechert.
No. 231	PNEZ	13 42 05	1100	In region of Formosa.
16th	SNEZ	13 44 01		
	F	15 00		
No. 232	PNEZ	4 10 08	1100	
18th	SNEZ	4 12 03		
	F	4 50		
No. 236	PNEZ	5 22 10	370	Felt at Capiz with intensity II.
18th	SNEZ	5 22 57		
	F	5 41		
No. 238	PNEZ	21 32 47	1030	
18th	SNEZ	21 34 36		
	MNE	21 38 20ca		
	F	22 28		
No. 239	iPNEZ	7 50 33	250	Compression. Approx. 121° 20' E; 16°
19th	SNE	7 51 07		50' N by Manila and Baguio.
	F	8 30		Felt at Aparri, Vigan and Baguio with intensity III.
				S from the Horizontal Pendulums.
No. 240	ePNEZ	16 17 59	1580?	30.5°N; 140°E according to Koti.
19th	S?NE	16 2o 43		
No. 243	PNEZ	17 55 38	1510	
2oth	SNEZ	17 58 14		
	F	18 25		
No. 246	PNEZ	9 52 28	190	Compression.
22nd	SNEZ	9 52 52		Felt at Baguio with intensity II.
	F	10 20		Baguio, Δ=100 Km.
No. 247	PNEZ	20 16 09	290	Felt at Vigan with intensity III.
22nd	SNEZ	20 16 48		Baguio, Δ=100 Km.
	F	20 29		
No. 248	iPZ	2 04 15	2560	Compression.
24th	ePNE	2 04 15		Deep focus.
	iSNEZ	2 08 17		
	F	2 45		

International Seismological Centre

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.
1934 April				
No. 249 24th	iPZ	17 47 54	6490	
	ePNE	17 47 57		
	eSE	17 55 56		
	LNE	18 06 ca		
	MNE	18 10 20ca		
	F	19 45		
No. 250 25th	ePNEZ	5 07 54	1820	Compression.
	SEZ	5 11 00		
	F	5 50		
No. 252 26th	iPZ	5 42 14	6790	Compression.
	ePNE	5 42 14		25°S; 173°E by Manila and Riverwiew.
	SNE	5 50 32		
	LNE	6 01 30ca		
	MN	6 06 00		
	F	7 15		
No. 253 26th	ePNE	8 07 33	6710	P on Z component lost in local disturbance.
	SNE	8 15 48		
	F	9 40		
No. 254 26th	iPZ	13 42 52	2920	Dilatation.
	iPNE	13 42 54		
	SNE	13 47 19		
	LNE	13 50 ca		
	MNE	13 52 20ca		
	F	15 20		
No. 255 26th	iPZ	21 09 42	6165	Dilatation.
	iPNE	21 09 43		In region of New Hebrides by Manila and Riverview.
	SNE	21 17 26		
	LNE	21 27 ca		
	MNE	21 31 20ca		
	F	23 15		
No. 256 27th	PNEZ	3 15 35	2635	Compression.
	SNEZ	3 19 42		Deep focus.
	F	3 40		
No. 258 27th	PNEZ	11 35 16	295	
	SNE	11 35 56		
	F	11 54		

No. 17.

April, 1934.

M A N I L A , P . I .

SEISMOLOGICAL BULLETIN OF THE OBSERVATORY.--Continued.

International Seismological Centre

No. and Date	Phase.	Greenwich Time h. m. s.	Dist. Km.	Remarks.
1934 April				
No. 259	iPZ	20 57 22	7055	Dilatation.
27th	ePNE	20 57 22		23°S; 173°E by Riverview, Manila,
	SNE	21 05 58		Hong Kong, Chiufeng.
	iN	21 06 14		
	iE	21 06 23		
	iN	21 13 14		
	LNE	21 17 30ca		
	MNE	21 22 30ca		
28th	F	0 15		
No. 260	ePNEZ	15 15 07	4375	Compression.
28th	SNE	15 21 19		
	LNE	15 27 20ca		
	F	17 05		
No. 261	P?NEZ	18 07 42	4275?	
28th	S?NE	18 13 35		
	iE	18 14 02		
	F	19 20		
No. 264	PNEZ	4 43 02	1622	
29th	SNE	4 45 50		
	F	5 40		
No. 266	PNEZ	12 35 00	1600?	
29th	S?NE	12 37 46		
	LNE	12 39 12ca		
	F	13 40		
No. 268	PNEZ	15 24 36	2435	Compression.
30th	SNEZ	15 28 29		
	F	16 40		

Twenty-six insignificant or undecipherable disturbances on the following days of April: 2nd, 4th, 8th(3), 10th, 13th(2), 15th, 16th-(2), 17th(2), 18th(2), 19th, 20th, 21st(2), 25th, 27th, 28th(2), 29th and 30th(2).

No. 18. May, 1934.

M A N I L A , P . I .

SEISMOLOGICAL BULLETIN OF THE OBSERVATORY

ϕ=14° 34' 42" N. λ=120° 58' 41" E. h=2.40 m. Alluvium.

GALITZIN-WILIP

	T_o	D	T_1	λ	μ^2	K
N-S	12.4	100.5	12.6	11.5	0.017	97
E-W	11.8	100.5	11.9	11.4	-0.075	80
Z	11.6	100.5	9.0	14.8	1.250	200

WIECHERT. M=1000 Kg.
May 1, 1934.

	T_o	V	ε	$\frac{r}{T_o^2}$
N-S	4.4	192	2.4	0.030
E-W	4.8	202	2.7	0.034

No. and Date	Phase.	Greenwich Time h. m. s.	Dist. Km.	Remarks
1934 May				
No. 271 1st	iPEZ	3 49 58	5540?	Conspicuous group of about 22 second period waves on E component from 4:13 to 4:16.
	SNE?	3 57 05		
	F	4 34		
No. 272 1st	iPNEZ	7 10 12	3710?	Compression from SW. 6° 30'S; 94°E by Hong Kong, Manila, Chiufeng, Oosaka.
	S?NE	7 15 30		
	ME	7 22 30ca		
	F	8 40		
No. 275 3rd	PNEZ	1 36 25	3325	27° 45'N; 145°E by Oosaka, Manila, Chiufeng, Hong Kong.
	SNZ	1 41 18		
	LE	1 44 30ca		
	ME	1 47 30ca		
	F	3 17		
No. 277 4th	iPNEZ	4 48 04	8450	Dilatation from NE.
	iSNE	4 57 55		
	LE	5 12 40ca		61°N; 148°W; 0=4:36:06 by U.S.C.G.S.
	MN	5 20 30ca		
	F	7 40		
No. 278 5th	eNE	5 30 25		
	F	5 40		
No. 279 5th	ePN	14 43 33	8345?	
	iZ	14 43 54		
	S?NE	14 53 19		
	F	16 10		
No. 280 5th	iPZ	16 47 38	2200	Dilatation.
	ePNE	16 47 38		
	iSNEZ	16 51 15		
	F	17 40		
No. 284 6th	PNEZ	21 57 12	1000	
	SNE	21 58 58		
	F	22 35		

International Seismological Centre

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.
1934 May				
No. 286	PNE	1 57 06	1480	Felt at Butuan with intensity II.
7th	SNE	1 59 39		P on Z component lost in local dis-
	F	3 30		turbance.
No. 287	iPNEZ	4 08 38	1545	Dilatation.
7th	SNE	4 11 18		Felt at Butuan with intensity II.
	LNE	4 12 30ca		
	F	5 40		
No. 289	PNEZ	7 28 12	1220	Felt at Butuan with intensity II.
7th	SNE	7 30 19		
	F	7 59		
No. 290	PNEZ	1 02 27	500	
8th	SNEZ	1 03 26		
	F	1 42		
No. 295	iPNEZ	15 39 21	50	Compression from SE.
9th	iSNEZ	15 39 28		Felt in Camiguin with intensity III
	F	15 52		and at Manila, II.
No. 301	PNEZ	9 06 31	2645	
11th	SNE	9 10 39		
	F	9 45		
No. 304	ePNE	18 28 48	7665?	
11th	S?NE	18 38 00		
	F	19 15		
No. 305	iPZ	10 39 53	970	Deep focus.
12th	ePNE	10 39 53		Compression.
	iSNEZ	10 41 36		
No. 306	PNEZ	10 56 52	2465	No. 305 still recording.
12th	SNE	11 00 47		
	F	12 06		
No. 308	ePEZ	20 32 10	3710	
12th	iZ	20 33 00		
	SNE	20 37 28		
	LNE	20 42 ca		
	MNE	20 44 30ca		
	F	21 20		
No. 312	iPEZ	9 09 23	4520	Compression from SSE.
13th	ePN	9 09 23		
	SNE	9 15 31		5°S; 154°E; O=9:01.9 by U.S.C.G.S.
	LNE	9 21 25ca		
	F	11 45		

International Seismological Centre

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.
1934 May				
No. 313 13th	PNEZ	14 37 29	2655	A second earthquake about 14:54:00.
	SNE	14 41 38		
	F	15 40		
No. 314 13th	iPZ	17 03 49	400	Compression. Epicenter in mountains of northern Luzon by Manila and Baguio.
	ePNE	17 03 49		
	SNE	17 04 45		
	F	18 15		Felt throughout northern Luzon.
				S from the Wiechert and Horizontals.
No. 317 14th	$\overline{P}$NEZ	10 48 39	180	
	$\overline{S}$NEZ	10 48 43		
	F	10 54		
No. 319 14th	iPZ	22 24 35	8300	Compression.
	ePNE	22 24 35		Deep.
	iSNE	22 34 18		
	LNE	22 49 30ca		59°N; 150°W; O=22:13.0 by U.S.C.G.S.
	F	23 35		
No. 322 16th	$\overline{P}$NEZ	3 42 19	325	
	$\overline{S}$NEZ	3 43 07		
	F	3 49		
No. 325 16th	PNEZ	23 10 32	520	
	SNE	23 11 34		
	mNE	23 13 30ca		
	F	23 33		
No. 326 17th	$\overline{P}$NEZ	9 21 31	135	
	$\overline{S}$NEZ	9 21 48		
	F	9 31		
No. 329 17th	PNEZ	22 16 14	2725	
	SNE	22 20 27		
	MNE	22 25 ca		
	F	22 55		
No. 330 19th	$\overline{P}$NEZ	8 57 11	515?	Felt in Aparri with intensity IV.
	$\overline{S}$NEZ?	8 58 32		
	F	9 15		
No. 331 19th	PNEZ	10 49 38	2755	
	SNEZ	10 53 54		
	F	12 30		
No. 332 21st	P?NEZ	4 39 22	2210?	P doubtfull: disturbed by micro-seisms.
	SNEZ	4 43 00		
	LNE	4 44 40ca		
	F	5 50		

International Seismological Centre

M A N I L A , P . I .

SEISMOLOGICAL BULIETIN OF THE OBSERVATORY.--Continued.

No. and Date	Phase.	Greenwich Time h. m. s.	Dist. Km.	Remarks.
1934 May				
No. 333 22nd	P?NEZ	1 28 43	3030?	P disturbed by wind.
	SNEZ	1 33 17		
	LNE	1 36 20ca		
	ME	1 38 ca		
	F	2 20		
No. 336 23rd	$\overline{1}$PNEZ	15 33 34	90	
	$\overline{S}$NEZ	15 33 46		
	F	15 36		
No. 337 23rd	P?NEZ	23 14 09	1480?	Disturbed by wind.
	S?N	23 16 42		
	F	23 46		
No. 341 26th	P?NEZ	4 25 12	1910?	
	SNEZ	4 28 25		
	F	5 00		
No. 342 27th	PNEZ	6 56 30	400	
	SNE	6 57 20		
	F	7 28		
No. 344 27th	PNEZ	20 20 54	575	
	$\overline{S}$NE	20 22 25		
	F	20 35		
No. 347 31st	$\overline{P}$NEZ	5 08 42	165	
	$\overline{S}$NEZ	5 09 03		
	F	5 12		

Forty-one insignificant or undecipherable disturbances on the following days of May: 1st, 2nd(2), 4th, 6th(3), 7th(2), 8th(2), 9th (3), 10th(2), 11th(4), 12th(2), 13th(2), 14th(3), 15th, 16th(3), 17th(2), 22nd(2), 24th(2), 25th, 27th, 28th, and 30th.

No. 22. June, 1934.

International Seismological Centre

M A N I L A , P . I .

SEISMOLOGICAL BULLETIN OF THE OBSERVATORY

φ=14° 34' 42" N. λ=120° 58' 41" E. h=2.40 m. Alluvium.

GALITZIN-WILIP

WIECHERT. M=1000 Kg.
June 1, 1934

	T_o	D	T_1	i	μ^2	K
N-S	12.4	100.5	12.6	11.5	0.017	97
E-W	11.8	100.5	11.9	11.4	-0.075	80
Z	11.6	100.5	9.0	14.8	1.250	200

	T_o	V	ε	$\frac{r}{T_o^2}$
N-S	4.4	189	2.4	0.035
E-W	4.8	202	2.7	0.035

No. and Date	Phase	Greenwich Time h. m. s.	Dist. Km.	Remarks.
1934 June				
No. 349	PNEZ	6 00 02	3635	Region of Bengal, India.
2nd	SN	6 05 15		
	LN	6 09 15ca		
	F	6 55		
No. 350	PZ	13 59 52	5020?	
2nd	S?N	14 06 29		
	ME	14 16 55		
	F	15 40		
No. 352	iPZ	21 05 30	5645	Dilatation.
2nd	ePNE	21 05 30		In region of New Hebrides by Manila
	SNE	21 12 45		and Riverview.
No. 353	eP?NE	21 33 42	2335?	No. 352 still recording.
2nd	SNEZ	21 37 29		
	F	22 35		
No. 355	ePNE	16 25 02	5980	Deep focus. No record on Z component.
3rd	iSNE	16 32 34		
	F	17 20		
No. 356	ePNE	21 07 22	3180	No record on Z component.
3rd	SNE	21 12 06		
	LNE	21 15 30ca		
	F	22 40		
No. 364	iPZ	9 43 54	595	Felt at Borongan with intensity VII.
6th	ePE	9 43 54		Dilatation.
	SNEZ	9 45 04		
	SN	9 45 27		
	F	10 05		
No. 365	PNEZ	10 17 53	7350	Deep focus.
6th	SN	10 26 46		
	F	11 00		

No. 22. June, 1934.

International Seismological Centre

M A N I L A , P . I .

SEISMOLOGICAL BULLETIN OF THE OBSERVATORY

ϕ=14° 34' 42" N. λ=120° 58' 41" E. h=2.40 m. Alluvium.

GALITZIN-WILIP

WIECHERT. M=1000 Kg.
June 1, 1934

	T_o	D	T_1	i	ρ^2	K
N-S	12.4	100.5	12.6	11.5	0.017	97
E-W	11.8	100.5	11.9	11.4	-0.075	80
Z	11.6	100.5	9.0	14.8	1.250	200

	T_o	V	ε	$\frac{r}{T_o^2}$
N-S	4.4	189	2.4	0.035
E-W	4.8	202	2.7	0.035

No. and Date	Phase.	Greenwich Time h. m. s.	Dist. Km.	Remarks.
1934 June				
No. 349	PNEZ	6 00 02	3635	Region of Bengal, India.
2nd	SN	6 05 15		
	LN	6 09 15ca		
	F	6 55		
No. 350	PZ	13 59 52	5020?	
2nd	S?N	14 06 29		
	ME	14 16 55		
	F	15 40		
No. 352	iPZ	21 05 30	5645	Dilatation.
2nd	ePNE	21 05 30		In region of New Hebrides by Manila
	SNE	21 12 43		and Riverview.
No. 353	eP?NE	21 33 42	2335?	No. 352 still recording.
2nd	SNEZ	21 37 29		
	F	22 35		
No. 355	ePNE	16 25 02	9980	Deep focus. No record on Z component
3rd	iSNE	16 32 34		
	F	17 20		
No. 356	ePNE	21 07 22	2180	No record on Z component.
3rd	SNE	21 12 06		
	LNE	21 15 30ca		
	F	22 40		
No. 364	iPZ	9 43 54	595	Felt at Borongan with intensity VII.
6th	ePE	9 43 54		Dilatation.
	SNEZ	9 45 04		
	SN	9 45 27		
	F	10 05		
No. 365	PNEZ	10 17 53	7350	Deep focus.
6th	SN	10 26 46		
	F	11 00		

International Seismological Centre

M A N I L A , P . I .

SEISMOLOGICAL BULIETIN OF THE OBSERVATORY.--Continued.

No. and Date	Phase.	Greenwich Time h. m. s.	Dist. Km.	Remarks.
1934 June				
No. 369 7th	iPZ	20 22 52	2545	Compression.
	ePNE	20 22 52		Deep focus.
	iSNEZ	20 26 53		
	F	21 07		
No. 370 8th	PEZ	18 34 41	8010	
	SNE	18 44 10		
	F	19 20		
No. 372 9th	PNE	2 27 45	470	Felt at Aparri with intensity IV.
	SNE	2 28 41		Epicenter in the Babuyan Channel by Manila and Baguio.
	F	3 25		S from the Wiechert.
No. 373 9th	PEZ	13 05 13	3570?	Dilatation.
	SNE	13 10 21		6° 30'S; 145° 30'E by Riverview, Adelaide, Manila, Chiufeng.
	F	15 00		
No. 375 12th	$\overline{P}$NEZ	7 44 50	150	Epicenter in Caraballo Mt. by Manila and Baguio.
	$\overline{S}$NEZ	7 45 09		
	F	7 50		
No. 376 13th	iPNEZ	1 58 02	4055	Dilatation from NE.
	iSNEZ	2 03 42		43° 30'N; 147°E; 0=1:50:40 by Manila and Chiufeng.
	LNE	2 08 27		
	F	4 00		
No. 378 13th	iPZ	22 19 59	6200	Dilatation.
	iPN	22 20 00		Approx. 32°N; 61° 30'E; 0=22:10:11
	PR_1N	22 22 24		By Manila, Chiufeng, Hong Kong.
	SNEZ	22 27 44		
	LNE	22 37 30ca		
	MNE	22 41 30ca		
14th	F	0 30		
No. 379 14th	PNEZ	19 11 43	1520	
	SNE	19 14 20		
	F	20 20		
No. 380 15th	PEZ	2 59 02	3235	Compression.
	SE	3 03 49		
	LN	3 07 25ca		
	F	3 57		
No. 382 15th	PNEZ	21 36 51	1520	
	SNE	21 39 29		
	F	22 25		
No. 386 16th	PNEZ	18 48 30	390	Felt in Iloilo with intensity III.
	SNEZ	18 49 18		
	$\overline{S}$NZ	18 49 28		
	F	19 30		

International Seismological Centre

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
1934 June				
No. 387 17th	$\overline{P}$NEZ	1 43 47	195	Compression.
	$\overline{S}$NEZ	1 44 12		
	F	1 55		
No. 391 18th	PNEZ	9 25 34	8290	
	iZ	9 25 53		62°N: 150°W; O=9:13.8 by U.S.C.G.S.
	SE	9 35 17		
	iE	9 36 58		
	iN	9 37 16		
	F	10 30		
No. 392 19th	PNEZ	2 50 12	1635	
	SNEZ	2 53 02		
	LNE	2 54 30 ca		
	F	3 25		
No. 393 19th	PNEZ	3 55 41	2890	
	iZ	3 55 47		
	SNEZ	4 00 06		
	iN	4 00 54		
	F	4 50		
No. 394 19th	PNEZ	15 51 26	1345	
	SN	15 53 45		
	F	16 42		
No. 400 22nd	PNZ	18 02 18	6490	Compression from the north.
	PE	18 02 19		
	iE	18 07 50		
	iSNE	18 10 20		
	F	19 50		
No. 403 23rd	PNEZ	5 26 20	3735	32° 30'N; 90° 12'E; O=5:19:25 by Chiufeng, Hong Kong, Manila.
	PR_1E	5 27 22		
	SNE	5 31 39		
	SR_1E	5 33 44		
	LNE	5 36 19		
	iMN	5 37 36		
	iME	5 38 00		
	iME	5 39 10		
	F	7 00		
No. 404 23rd	PNEZ	9 39 21	200	
	$\overline{S}$NEZ	9 39 47		
	F	9 44		
No. 406 24th	iPZ	6 19 31	18800?	Dilatation.
	iPE	6 19 33		23°S; 68°W; O=5:59:33 by Honolulu.
	iPN	6 19 34		
	LNE	7 19 ca		
	F	9 25		

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.
1934 June				
No. 417 28th	iPZ	1 05 17	5890	Dilatation.
	ePNE	1 05 17		16° 30'S; 165°E; 0=0:55:50 by Manila, Hong Kong, Chiufeng.
	iNE	1 10 30		
	SNE	1 12 44		
	LNE	1 21 30ca		
	ME	1 26 ca		
	F	2 50		
No. 421 29th	iPZ	8 29 21	1825	Compression from SE.
	iPNE	8 29 22		8° 30'N; 137° 30'E by Manila and Chiufeng.
	SNE	8 32 29		
	F	10 30		
No. 422 29th	iPEZ	12 38 42	1690	
	ePN	12 38 42		
	iN	12 38 47		
	SE	12 41 36		
	MN	12 44 40ca		
	F	13 50		
No. 426 30th	PNEZ	17 12 30	3945	Disturbed by microseisms.
	iN	17 17 11		
	SNE	17 18 02		
	LE	17 23 10		
	F	17 57		

Forty-nine insignificant or undecipherable disturbances on the following days of June: 2nd(2), 3rd, 4th(3), 5th(2), 6th(3), 7th(2), 8th, 10th, 13th, 15th, 16th(3), 17th, 18th(2), 20th, 21st(4), 23rd(2), 24th(3), 25th 3), 26th(3), 27th(2), 28th(3), and 30th(5).

CORRECTION TO EARTHQUAKES OF MAY 7, 1934.

Nos. 286, 287 and 289. Epicenter at 10°N; 127° 30'E by Manila, Hong Kong, Sikawei.

Corection to No. 142, February 27, 1934: Epicenter approximately 10°S; 150°E by Pelew, Manila, Chiufeng.

Hong Kong (PR_2)
Amboina (PR_1)

Correction to No. 144, February 28, 1934.

P 9:34:36
iS 9:38:09

No. 26. July, 1934.

International Seismological Centre

M A N I L A , P . I .

SEISMOLOGICAL BULLETIN OF THE OBSERVATORY

φ=14° 34' 42" N. λ=120° 58' 41" E. h=2.40 m. Alluvium.

GALITZIN-WILIP

WIECHERT. M=1000 Kg.
July 3, 1934.

	T_o	D	T_1	λ	μ^2	K
N-S	12.4	100.5	12.6	11.5	0.017	97
E-W	11.8	100.5	11.9	11.4	0.075	80
Z	11.6	100.5	9.0	14.8	1.250	200

	T_o	V	ε	$\frac{r}{T_o^2}$
N-S	4.4	194	2.4	0.046
E-W	4.8	199	2.7	0.038

No. and Date	Phase	Greenwich Time h. m. s.	Dist. Km.	Remarks
1934 July				
No. 432 3rd	iPZ	3 48 36	2210	Disturbed by microseisms.
	ePNE	3 48 36		
	SNZ	3 52 14		
	LNE	3 54 15ca		
	F	4 45		
No. 433 3rd	PNEZ	17 53 52	200	Disturbed by microseisms.
	$\overline{S}$NE	17 54 18		
	F	17 58		
No. 434 4th	PNEZ	2 04 51	2380	Disturbed by microseisms.
	SNEZ	2 08 41		
	F	3 30		
No. 435 4th	PNEZ	13 24 40	2700	Disturbed by microseisms.
	iE	13 24 46		
	SNE	13 28 51		
	F	14 05		
No. 436 6th	PNEZ	23 02 30	10800	
	PR_1	23 06 27		41°.5N; 124°.9W; H=22;48:56 by J.S.A.
	$\overline{S_cP_cS}$NE	23 13 10		41°.3 N; 125°.3 W; O=22:48:51 by
	PS	23 15 18		U.S.C.G.S.
	LNEZ	23 34 ca		
	MNEZ	23 41 ca		M ends at 23:56:00
7th	F	1 52		
No. 438 8th	iPNEZ	0 11 34	195	Compression from SE.
	iSNEZ	0 11 59		
	F	0 25		
No. 439 8th	PNEZ	14 32 15	245	
	$\overline{S}$NEZ	14 32 49		
	F	14 48		
No. 440 8th	PNEZ	16 05 34	210	Baguio 35 Km. Probably south side
	$\overline{S}$NEZ	16 06 01		of Mt. Pulog.
	F	16 20		

International Seismological Centre

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.
1934 July				
No. 442 10th	PNEZ	21 21 17	5765	Disturbed by microseisms.
	SNE	21 28 37		
	F	22 05		
No. 444 11th	PNEZ	4 01 26	780	Disturbed by microseisms.
	SNEZ	4 02 52		
	F	4 15		
No. 446 12th	$\overline{P}$NEZ	8 05 46	190	Dilatation.
	$\overline{S}$NE	8 06 10		Baguio, 35 Km.
	F	8 26		16° 20' N; 120° 57' E by Baguio and Manila.
No. 447 12th	P?NEZ	9 58 14	3735	Probably in Japan.
	SNE	10 03 33		
	ME	10 10 40ca		
	F	10 55		
No. 448 12th	PNEZ	14 30 40	610	Compression from SE.
	SNE	14 31 49		
	F	15 30		
No. 450 12th	PNEZ	19 30 13	550	
	$\overline{S}$NE	19 31 39		
	F	20 08		
No. 451 12th	$\overline{P}$NEZ	21 14 58	165	
	$\overline{S}$NE	21 15 19		
	F	21 18		
No. 452 12th	PNEZ	21 36 46	215	Compression.
	$\overline{S}$NEZ	21 37 14		
	F	21 46		
No. 457 18th	P'NEZ	1 56 11	16410	Compression.
	LE	2 50 00		P strong. L from the Wiechert. No
	F	4 15		Other definite phases. Disturbed by microseisms.
				7°.8N; 82°.5W; O=1:36:54 by U.S.C.G.S.
No. 459 18th	PNEZ	19 49 33	6120	Data after P from the Wiechert.
	SNE	19 57 12		12° 30' S; 169° 30' E by Adelaide,
	LNE	20 05 00		Manila, Hong Kong, Chiufeng.
	MNE	20 08 ca		O=19:35:55
	F	22 00		14°S; 167°E; O=19:40:00 by U.S.C.G.S.
No. 460 19th	PNEZ	0 16 01	5880	In region of 11°.4 S; 166° E by Chiufeng.
	SNE	0 23 27		P in minute gap. Disturbed by microseisms.
	F	1 07		
No. 461 19th	iPNEZ	1 31 57	2310	In region of 2°S; 133°E by Hong Kong, Chiufeng, Adelaide, Manila, Butuan.
	iSNE	1 35 42		S from the Wiechert. Disturbed by
	F	3 40		microseisms.

M A N I L A , P . I .

SEISMOLOGICAL BULLETIN OF THE OBSERVATORY.--Continued.

International Seismological Centre

No. and Date	Phase.	Greenwich Time h. m. s.	Dist. Km.	Remarks.
1934 July				
No. 462 19th	PNEZ	5 54 43	5780	13°S; 165° 30'E by Adelaide, Manila, Chiufeng.
	SN	6 02 03		Disturbed by microseisms.
	F	7 00		
No. 463 19th	PNEZ	7 46 13	6060	13° 45'S; 168°E by Adelaide, Manila, Hong Kong, Chiufeng.
	SNE	7 53 49		Disturbed by microseisms.
	LE	8 02 50ca		
	ME	8 08 20ca		
	F	9 50		
No. 467 20th	PEZ	16 57 31	5945	
	SNE	17 05 01		
	F	17 35		
No. 468 2oth	PNZ	18 19 28	4945	
	SNE	18 26 01		
	LNE	18 31 00ca		
	MN	18 35 30ca		
No. 469 20th	P?EZ	18 56 12	6700?	No. 468 still recording.
	SNE	19 04 26		
	LNE	19 15 00ca		
	MNE	19 19 00ca		
	F	20 40		
No. 470 21st	iPNEZ	4 38 05	230	Compression from the northeast. Felt in North and Central Luzon.
	$\overline{S}$NE	4 38 36		$\overline{S}$ from Wiechert and Horizontals.
	F	5 20		
No. 471 21st	iPZ	6 27 19	6455	Dilatation.
	PNE	6 27 21		In region of 12°S; 173°E by Adelaide, Manila, Hong Kong, Chiufeng.
	SNE	6 35 18		Data after P from the Wiechert.
	LNE	6 44 15ca		
	MNE	6 48 40ca		
No. 472 21st	PNE	7 31 46	6155	No. 471 still recording.
	SNE	7 39 28		From the Wiechert.
	F	8 50		
No. 473 21st	iPZ	10 58 54	16410	Compression. Panama.
	iPNE	10 59 00		Disturbed by microseisms.
	F	14 15		7°.8N; 82°.5W; O=10h 38.7m U.S.C.G.S.
No. 474 21st	PZ	20 20 31	5925	Disturbed by microseisms.
	PNE	2o 20 36		
	SNE	20 28 00		
	ME	20 41 20ca		
	F	21 35		
No. 475 22nd	iPZ	3 06 55	5660	
	ePNE	3 06 57		
	SNE	3 14 09		
	LN	3 21 30ca		
	F	4 40		

International Seismological Centre

M A N I L A , P . I .

SEISMOLOGICAL BULIETIN OF THE OBSERVATORY.--Continued.

No. and Date	Phase.	Greenwich Time h. m. s.	Dist. Km.	Remarks.
1934 July				
No. 476 22nd	$\overline{P}$NEZ	10 30 18	150	
	$\overline{S}$NE	10 30 37		
	F	10 36		
No. 477 22nd	P?Z	18 47 08	2210?	
	SNE	18 50 46		
	LN	18 52 40		
	F	19 55		
No. 478 22nd	ePNEZ	20 05 20	5355	In region of 47°N; 162°E by Chiufeng and Manila.
	iNE	20 06 51		
	iSNEZ	20 12 16		
	iE	20 12 33		
	iN	20 16 44		
	LN	20 19 52		
	F	21 30		
No. 488 25th	$\overline{P}$?NEZ	20 40 01	190	16° 20'N; 121° 22'E by Baguio (80 Km and Manila.
	$\overline{S}$NE	20 40 25		
	mNE	20 43 30		
	F	20 50		
No. 491 27th	PNEZ	12 34 52	5470	
	SNE	12 41 55		
	F	14 30		
No. 492 28th	iPZ	2 14 51	5110	
	iSNE	2 21 34		
	LN	2 28 30		
	F	3 15		
No. 493 28th	iPZ	21 48 34	8080	Compression. 56°N; 157°W; O=21h 37m U.S.C.G.S.
	ePNE	21 48 34		
	PR_1E	21 51 38		
	iSNE	21 58 07		
	LNE	22 12 30		
	MNE	22 18 20ca		
29th	F	0 50		
No. 494 29th	$\overline{P}$NEZ	5 33 05	150	Felt in Baguio with intensity II.
	$\overline{S}$NE	5 33 24		
	F	5 41		
No. 495 29th	$\overline{P}$NEZ	5 50 05	185	Compression. 16° 15' N; 120° 50' E by Baguio (30 Km.) and Manila.
	$\overline{S}$NE	5 50 28		
	F	6 00		
No. 498 30th	PNEZ	3 41 07	2700	
	SNE	3 45 18		
	LNE	3 47 30ca		
	F	4 20		

International Seismological Centre

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.
1934 July				
No. 500 30th	PNEZ	14 37 03	440	
	SNEZ	14 38 57		
	F	14 51		
No. 501 31st	iPNEZ	5 59 06	140	Dilatation. Epicenter in the China Sea at 15° 08' N; 119° 47' E by Manila and Baguio (165 Km.)
	SNE	5 59 24		Felt in Central Luzon. Intensity VI at Iba.
	F	7 20		S from the Horizontal Pendulums.
No. 502 31st	PNEZ	11 05 21	2780	
	SNE	11 09 38		
	F	11 35		
No. 503 31st	iPEZ	11 55 01	3745	P in minute gap. Probably dilatation.
	ePN	11 55 01		3° 30' S; 92° 30' E by Hong Kong, Manila, Chiufeng.
	SNE	12 00 21		
	LNE	12 05 ca		
	MNE	12 07 40ca		
	F	13 12		

Thirty-two insignificant or undecipherable disturbances on the following days of July: 1st, 2nd(2), 7th, 9th, 11th, 12th(2), 13th, 14th, 16th(2), 18th, 19th, 20th(2), 23rd(6), 24th, 25th(2), 26th(2), 29th, 30th(2), and 31st(2).

CORRECTION TO NUMBER 350.

PEZ	13h	56m	02s	Distance 10570 Km.
PR_1Z		59	52	
$\overline{S_cP_cS_N}$	14	06	35	
LNE		28	00	
MNE		36	00	

65°N; 20°W; H=13:42:46 G.M.T. by J.S.A.

International Seismological Centre

No. 31. August, 1934.

M A N I L A , P . I .

SEISMOLOGICAL BULLETIN OF THE OBSERVATORY.

Ø=14° 34' 42" N. λ=120° 58' 41" E. h=2.40 m. Alluvium.

GALITZIN-WILIP. WIECHERT. M=1000 Kg.
August 1, 1934.

	T_o	D	T_1	l	γ^2	K
N-S	12.4	100.5	12.6	11.5	0.017	97
E-W	11.8	100.5	11.9	11.4	-0.075	80
Z	11.6	100.5	9.C	14.8	1.250	200

	T_o	V	ε	$\frac{r}{T_o^2}$
N-S	4.6	190	2.3	0.045
E-W	4.9	202	2.7	0.032

No. and Date	Phase.	Greenwich Time h. m. s.	Dist. Km.	Remarks.
1934 August				
No. 507 1st	iN	9 31 52		
	eE	9 31 54		
	iZ	9 32 52		
	iZ	9 34 14		
	L?NE	9 34 28		
	F	10 22		
No. 512 2nd	iPZ	7 00 42	3780	Dilatation.
	ePE	7 00 42		
	ePN	7 00 45		
	SNE	7 06 04		
	F	8 32		
No. 520 4th	iPEZ	13 14 23	3700	6° 45' S; 145° 45' E by Manila,
	iPN	13 14 25		Hong Kong, Chiufeng.
	SNE	13 19 35		
	LNE	13 22 01		
	iN	13 22 12		
	LN	13 23 40		
	F	15 10		
No. 521 7th	PNEZ	3 49 23	5610	Compression.
	SNE	3 56 34		15° S; 162° 30' E by Manila, Hong-
	LE	4 04 10ca		Kong, Chiufeng, Taihoku.
	MNE	4 09 00ca		
	F	5 55		
No. 522 7th	iPNEZ	9 23 20	135	Compression from southwest.
	iSNZ	9 23 37		Felt in Manila with intensity II.
	F	9 40		
No. 523 7th	P?NEZ	11 59 31	5610?	Disturbed by microseisms.
	SN	12 06 42		
	LNE	12 13 38ca		
	iN	12 15 39		
	iME	12 17 20		
	F	13 02		
	F			

International Seismological Centre

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.
1934 August				
No. 525 8th	PNEZ	21 45 10	2600	Dilatation.
	iN	21 48 48		
	SNE	21 49 14		
	LNE	21 51 20ca		
	ME	21 53 50ca		
	F	22 37		
No. 527 9th	PNEZ	13 20 12	4610	
	SNE	13 26 24		
	LNE	13 32 30ca		
	MN	13 36 ca		
	F	14 50		
No. 528 9th	PNEZ	19 41 02	4020	P in minute gap,
	SNE	19 46 40		
	LN	19 51 ca		
	MN	19 54 40ca		
	F	21 30		
No. 529 9th	$\overline{P}$NEZ	20 03 21	150	No. 528 still recording.
	$\overline{S}$NEZ	20 03 40		
No. 533 10th	PNE	22 43 48	3690	
	SN	22 49 05		
	LNE	22 53 00		
	F	23 45		
No. 534 11th	$\overline{P}$NEZ	0 49 50	190	
	$\overline{S}$NEZ	0 50 14		
	F	0 56		
No. 535 11th	PNEZ	8 20 49	1120	Dilatation.
	SNE	8 23 17		24° 40' N; 121° 45' E by Zikawei,
	LE	8 25 ca		Hong Kong, Manila, Chiufeng, Taihoku
	MNE	8 27 ca		Felt at Giran, Taihoku Pref. Taiwan.
	F	10 40		Data after P from the Wiechert.
No. 536 11th	iPZ	12 04 48	4420	Dilatation.
	PNE	12 04 49		14° S; 149° E by Manila, Hong Kong,
	SNE	12 10 49		Chiufeng.
	LNE	12 14 20ca		
	MN	12 18 ca		
	F	14 10		
No. 541 12th	PNEZ	13 49 33	4045	Compression.
	SNE	13 55 13		
	LN	13 59 05ca		
	MNE	14 03 ca		
	F	15 00		

M A N I L A , P . I .

SEISMOLOGICAL BULLETIN OF THE OBSERVATORY.--Continued.

International Seismological Centre

No. and Date	Phase.	Greenwich Time h. m. s.	Dist. Km.	Remarks.
1934 August				
No. 542	iPNEZ	23 51 28	940	Compression from SE. Dilatation from E at Butuan.
12th	iSNEZ	23 53 08		Epicenter at 8° 20' N; 126° 50' E by Manila and Butuan as on Apr.29,1932 and June 13, 1929.
13th	F	2 30		Felt over of central and eastern Mindanao and southeastern Visayas.
No. 544	iPZ	10 46 44	4080?	
13th	ePNE	10 46 44		
	S?NE	10 52 25		
	LN	10 57 10ca		
	MN	11 00 40ca		
	F	12 00		
No. 545	$\overline{P}$NEZ	16 47 09	195	
13th	$\overline{S}$EZ	16 47 34		
	F	17 01		
No. 546	PNEZ	23 19 10	985	Felt at Davao with intensity II, and in Butuan with intensity I.
13th	SNEZ	23 20 55		
	F	23 40		
No. 548	iPZ	8 59 47	6910	
14th	ePNE	8 59 47		
	SNE	9 08 14		
	LN	9 19 15ca		
	MNE	9 24 20ca		
	F	10 25		
No. 550	PNEZ	15 12 36	390	Baguio, Δ=230 Km.
15th	SNEZ	15 13 24		Probably in NE Luzon.
	$\overline{S}$NE	15 13 35		
	F	15 30		
No. 552	$\overline{P}$E	17 11 36	290	Felt at Naga with intensity II.
16th	$\overline{S}$NEZ	17 12 18		
	F	17 30		
No. 553	PEZ	1 38 53	670	
17th	SNE	1 40 08		
	F	1 53		
No. 554	PNEZ	2 44 20	2855	Japan.
18th	SNE	2 48 42		Disturbed by microseisms.
	F	3 25		
No. 559	PNEZ	19 31 58	3420	Compression.
21st	SNE	19 36 58		In region of 1° S; 94° E by Manila,
	L?NE	19 40 35ca		Hong Kong, Chiufeng.
	MNE	19 43 42		
	F	20 40		
No. 563	PNEZ	18 42 42	3035	
22nd	SNE	18 47 16		
	LNE	18 50 15ca		
	MN	18 52 42		
	F	20 15		

International Seismological Centre

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.
1934 August				
No. 564 23rd	PNEZ	22 39 49	6065	
	SNEZ	22 47 26		
	LE	22 56 51		
	MN	23 01 51		
	F	23 20		
No. 565 23rd	PNEZ	23 39 44	6065	Continues into following earthquake.
	SNEZ	23 47 21		
No. 566 23rd 24th	iPNZ	23 58 08	6000	Compression.
	ePE	23 58 08		No. 565 still recording.
	iSNEZ	0 05 41		
	LNEZ	0 14 15		
	MNE	0 19 00		
	F	1 25		
No. 572 28th	PNEZ	18 27 05	2255?	
	S?NEZ	18 30 46		
	MN	18 41 14		
	ME	18 42 09		
	F	19 40		
No. 575 30th	PNEZ	12 04 38	195	
	SNEZ	12 05 03		
	F	12 11		
No. 579 30th	PNEZ	16 31 22	2500	
	SE	16 35 20		
	LNE	16 37 30ca		
	MN	16 39 30ca		
	F	17 28		
No. 582 31st	PEZ	5 16 00		Compression.
	PN	5 16 01		
	iZ	5 19 41		
	S?NE	5 21 00		
	F	7 40		
No. 583 31st	iPZ	15 06 41	5745	
	ePNE	15 06 41		
	iSNEZ	15 14 00		
	LNE	15 22 15ca		
	MNE	15 26 45ca		
	F	17 10		

Forty-four insignificant or undecipherable disturbances on the following days of August: 1st(3), 2nd(4), 3rd(5), 8th, 9th, 10th(3), 12th(4), 13th, 14th, 15th, 16th, 18th(2), 21st(2), 22nd(3), 24th, 25th, 26th, 27th, 28th, 29th(2), and 30th(5).

International Seismological Centre

No. 35. September, 1934.

M A N I L A , P . I .

SEISMOLOGICAL BULLETIN OF THE OBSERVATORY

φ=14° 34' 42" N. λ=120° 58' 41" E. h=2.40 m. Alluvium.

GALITZIN-WILIP.

	T_o	D	T_1		γ^2	K
N-S	12.4	100.5	12.6	11.5	0.017	97
E-W	11.8	100.5	11.9	11.4	-0.075	80
Z	11.6	100.5	9.0	14.8	1.250	200

WIECHERT. M=1000 Kg.
September 3, 1934.

	T_o	V	ε	$\frac{r}{T_o^2}$
N-S	4.6	183	2.3	0.032
E-W	4.9	201	2.8	0.030

No. and Date	Phase.	Greenwich Time h. m. s.	Dist. Km.	Remarks.
1934 September				
No. 586 1st	iPEZ	8 15 52	1700	Dilatation.
	PN	8 15 52		Butuan, Δ=8°.
	iSNEZ	8 18 48		Probably in N.E.I.
	LN	8 20 35c		
	F	9 30		
No. 591 2nd	P?NE	11 35 09	6880?	
	SNE	11 43 34		
	F	12 30		
No. 592 4th	P?NEZ	16 44 57	6290?	In region of 21° S; 169° E by Riverview and Manila.
	SNE	16 52 47		Disturbed by strong microseisms.
	F	17 40		
No. 593 5th	$\bar{P}$NEZ	0 45 26	150	Probably in Caraballo Mountains.
	$\bar{S}$NEZ	0 45 45		Disturbed by microseisms.
	F	0 57		
No. 594 6th	PNEZ	2 19 08	945	Felt at Davao with intensity II, and at Butuan with I-II.
	SNEZ	2 20 49		
	F	3 15		
No. 595 6th	i$\bar{P}$NEZ	7 07 16	135	Dilatation.
	i$\bar{S}$NEZ	7 07 33		
	F	7 12		
No. 598 11th	iPNZ	8 17 11	1690	Dilatation.
	ePE	8 17 11		
	SNEZ	8 20 06		
	LNE	8 21 30		
	F	9 50		

International Seismological Centre

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.
1934 Sept.				
No. 600 12th	$\overline{P}$Z	9 37 23	175	Disturbed by microseisms.
	$\overline{P}$NE	9 37 25		
	$\overline{S}$NEZ	9 37 45		
	F	9 43		
No. 601 12th	PNEZ	14 31 17	2075	Disturbed by microseisms.
	iSNEZ	14 34 44		
	LEZ	14 36 30		
	MN	14 38 25ca		
	F	16 10		
No. 602 12th	PZ	17 47 09	2065	Disturbed by microseisms.
	SNE	17 50 35		
	F	18 50		
No. 605 13th	PNZ	14 22 41	1980	Disturbed by microseisms.
	SNZ	14 26 00		
	F	15 03		
No. 609 15th	eNZ	7 16 13	12580	Disturbed by microsiesms. Mexico?
	LNE	7 54 ca		Group of long waves from 7:56 to 8:10.
	F	9 20		20°N; 105°W; O=6:56.9 by U.S.C.G.S.
No. 611 15th	PNEZ	17 50 17	2355	
	SNEZ	17 54 05		
	F	18 03		
No. 612 16th	ePNEZ	13 19 40	2090	Dilatation.
	SNE	13 23 08		
	ME	13 27 30ca		
	F	14 20		
No. 614 17th	$\overline{P}$NE	6 13 03	125	
	$\overline{S}$NE	6 13 19		
	F	6 17		
No. 619 21st	iPZ	12 44 18	3510	Compression.
	ePNE	12 44 18		
	SNEZ	12 49 23		
	LNE	12 53 10ca		
	MNE	12 57 ca		
	F	13 30		

International Seismological Centre

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.
1934 Sept.				
No. 625 23rd	PNEZ	16 49 12	235	
	$\overline{S}$NEZ	16 49 44		
	F	16 58		
No. 628 24th	PNEZ	15 27 39	520	Felt at Borongan with intensity VI and at Tacloban with IV.
	SNE	15 28 40		
	$\overline{S}$NEZ	15 29 01		
	F	15 36		
No. 632 25th	iPEZ	19 21 29	3045?	Compression.
	ePN	19 21 29		
	S?NE	19 26 04		
	LN	19 28 40ca		
	MNE	19 31 20ca		
	F	20 20		
No. 633 26th	iPE	7 47 30	660	
	ePN	7 47 30		
	SE	7 48 44		
	$\overline{S}$NE	7 49 15		
	F	8 13		

Thirty-two insignificant or undecipherable disturbances on the following days of September: 1st(3), 2nd(3), 8th, 9th, 11th, 13th(2), 14th(2), 15th(2), 16th, 17th(2), 21st(3), 22nd(2), 23rd(2), 24th(3), 25th(2), 27th, and 28th.

CORRECTION TO NO. 220, APRIL 12, 1934.

H= 3:20:23
S at 3:23:26

Epicenter 21° 10'N; 122° 15' E by Manila, Hong Kong, Phu-Lien, Batavia, Medan.

CORRECTIONS TO AUGUST REPORT.

No. 521, August 7th. 13° 45' S; 164° E by Riverview, Adelaide, Pelew, Manila, Hong Kong, Chiufeng.

No. 536, August 11th. 4° S; 155° 30' E by Riverview, Manila, Hong Kong.

No. 554, August 18th. 35° 30' N; 137° E by Osaka, Chiufeng, Manila.

No. 565, August 23rd. 14° S; 167° E by Riverview, Manila, Chiufeng.

No. 566, August 23rd. Same epicenter as No. 565 by same stations.

No. 38.

October, 1934

M A N I L A , P . I .

SEISMOLOGICAL BULLETIN OF THE OBSERVATORY

Ø=14° 34' 42" N. λ=120° 58' 41" E. h=2.40 m. Alluvium

GALITZIN-WILIP

WIECHERT. M=1000 Kg.
October 1, 1934.

	T_o	D	T_1	l	y^2	K
N-S	12.4	100.5	12.6	11.5	0.017	97
E-W	11.8	100.5	11.9	11.4	-0.075	80
Z	11.6	100.5	9.0	14.8	1.250	200

	T_o	V	ε	$\frac{r}{T_o^2}$
N-S	4.6	191	2.3	0.046
E-W	4.8	205	2.6	0.030

No. and Date	Phase.	Greenwich Time h. m. s.	Dist. Km.	Remarks.
1934 October No. 636 1st	$\overline{P}$NEZ	18 25 20	160	
	$\overline{S}$NEZ	18 25 40		
	F	18 32		
No. 637 1st	$\overline{P}$NEZ	21 54 34	190	Dilatation.
	$\overline{S}$NEZ	21 54 58		16° 20'N; 121° 15'E by Manila and Baguio.
	F	22 07		Felt very slightly in Manila.
No. 641 4th	$\overline{P}$NEZ	17 35 04	135	
	$\overline{S}$NEZ	17 35 21		
	F	17 39		
No. 644 5th	PNE	20 33 02	3400	Disturbed by microseisms.
	SNE	20 38 00		
	F	21 28		
No. 649 10th	iPEZ	15 52 22	6865	Dilatation.
	ePN	15 52 24		21°S; 172°E by Manila, Riverview,
	SNEZ	16 00 46		Taihoku, Hong Kong, Adelaide.
	LN	16 11 54		
	F	17 12		
No. 650 11th	iPZ	17 36 50	1915	Compression.
	ePNE	17 36 50		
	SNE	17 40 04		
	F	17 53		
No. 653 16th	$\overline{P}$NE	17 30 23	185	From the Wiechert. No records in the
	$\overline{S}$NE	17 30 46		Galitzin, owing to interruption of
	F	17 35		electric service by typhoon.
				Disturbed by microseisms.

International Seismological Centre

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.
1934 October				
No. 654 18th	i$\bar{P}$NEZ	7 01 56	20	Compression from SE. Felt in Manila with intensity II.
	i$\bar{S}$NEZ	7 02 00		
	F	7 04		
No. 655 18th	iPZ	7 57 25	5900	Dilatation.
	ePNE	7 57 25		11°S; 167°E by Riverview, Manila,
	SNE	8 04 52		Hong Kong, Adelaide.
	LNE	8 13 25ca		
	MNE	8 18 ca		
	F	9 30		
No. 659 19th	PNEZ	11 54 04	1810	Disturbed by microseisms.
	SE	11 57 09		
	F	12 21		
No. 660 19th	$\bar{P}$NEZ	21 36 22	20	Felt in Manila by some persons.
	$\bar{S}$NEZ	21 36 26		Disturbed by microseisms.
	F	21 38		
No. 661 21st	PNEZ	17 58 40	3510	Region of 16°N; 153°E by Guam, Manila, Hong Kong.
	SNEZ	18 03 44		Disturbed by microseisms.
	LE	18 06 45ca		
	F	18 40		
No. 662 24th	PNEZ	6 12 59	120	After P from the Wiechert.
	iSNE	6 13 14		
	F	6 17		
No. 663 26th	PEZ	14 48 22	2135	Butuan, $\Delta = 15^{\circ}$.
	SNE	14 51 54		
	F	15 20		
No. 664 26th	iPNEZ	17 15 16	1925	Compression from NE.
	SNE	17 18 31		30.5°N; 132°E according to Chiufong.
	LNE	17 20 05		
	F	18 30		
No. 666 28th 29th	PNEZ	23 38 20	1210	24°N; 126°E by Taihoku, Manila, Hong Kong.
	SNEZ	23 40 26		
	F	0 50		Felt in Taihoku.

International Seismological Centre

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.
1934 October No. 668 30th	PNEZ	20 55 04	1000	Compression from SE. 7° 40'N; 127° 05'E.
	SNEZ	20 56 50		
	imN	20 58 11		Felt at Davao with intensity III.
	imE	20 59 35		Strong at Cateel.
	F	21 45		

Seventeen insignificant o; undecipherable disturbances on the following days of October; 2nd, 3rd, 4th(2), 5th, 6th(3), 8th, 15th(2), 19th(3), 28th, 29th, and 30th.

A D D I T I O N S

August 14, 1934. No. 548:

Epicenter 19°30'S; 174°30'E by Wellington, Manila, Batavia, Chiufeng.

August 23, 1934. No. 566:

Epicenter 14°S; 167°E by Riverview, Manila, Chiufeng, Batavia.

C O R R E C T I O N

September 4, 1934. No. 592:

23°S; 171°30'E by Riverview, Manila, Batavia, Hong Kong, Chiufeng.

International Seismological Centre

M A N I L A , P . I .

SEISMOLOGICAL BULLETIN OF THE OBSERVATORY

ϕ=14° 34' 42" N. λ=120° 58' 41" E. h=2.40 m. Alluvium.

GALITZIN-WILIP

	T_o	D	T_1	1	μ^2	K
N-S	12.4	100.5	12.6	11.5	0.017	97
E-W	11.8	100.5	11.9	11.4	-0.075	80
Z	11.6	100.5	9.0	14.8	1.250	200

WIECHERT. M=1000 Kg.
November 1, 1934

	T_o	V	ϵ	$\frac{x}{T_o^2}$
N-S	4.4	192	2.3	0.035
E-W	4.8	198	2.7	0.036

No. and Date	Phase.	Greenwich Time h. m. s.	Dist. Km.	Remarks.
1934 November				
No. 673 2nd	$\overline{P}$NEZ	0 07 39	120	
	$\overline{S}$NEZ	0 07 54		
	F	0 11		
No. 679 3rd	PNEZ	14 53 39	3520?	Disturbed by microseisms.
	S?NE	14 58 45		
	F	15 35		
No. 680 4th	PNEZ	2 04 23?	4720?	Probably in region of 15°S; 169°E by Riverview and Manila.
	SE	2 10 43		Disturbed by microseisms.
	LNE	2 17 45ca		
	MNE	2 20 30ca		
No. 681 4th	PNEZ	3 24 42?	7500?	23° 30'S; 178°E by Riverview and Manila.
	SEZ	3 33 46		No. 680 still recording. Disturbed by microseisms.
	F	5 23		
No. 682 4th	PNEZ	15 10 46	215	
	$\overline{S}$NEZ	15 11 14		
	F	15 23		
No. 685 5th	PNEZ	13 27 23	1155	
	SNE	12 29 23		
	F	14 15		
No. 686 5th	iPZ	23 12 45	6900	Compression.
	ePNE	23 12 45		
	iN	23 12 51		52°N; 176°W; 0=23:02.4 by U.S.C.G.S.
	SNE	23 21 18		
	PSNE	23 21 34		
	LNE	23 30 45ca		
6th	F	0 42		
No. 691 11th	PNEZ	21 20 07	2220	24°.3N; 121°.6E according to Taihoku.
	SNE	21 23 46		Felt in northern Taiwan.
	LE	21 25 38		
	F	21 50		
No. 692 11th	$\overline{P}$NEZ	23 42 55	200	Felt at Baguio with intensity II.
	$\overline{S}$NEZ	23 43 21		15 KM. from Baguio.
	F	23 49		
No. 693 12th	$\overline{P}$NEZ	3 06 23	215	
	$\overline{S}$NEZ	3 06 51		
	F	3 10		

International Seismological Centre

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.
1934 November				
No. 694	P?NEZ	7 32 25	6490?	
12th	SN	7 40 27		
	LN	7 50 ca		
	F	8 46		
No. 695	PNEZ	22 27 56	190	
12th	SNEZ	22 28 20		
No. 696	PNEZ	22 29 50	230	No. 695 still recording.
12th	SNE	22 30 21		
	F	22 40		
No. 699	P?NEZ	12 17 44	2810?	Disturbed by microseisms.
16th	SNE	12 22 03		
	F	12 53		
No. 700	PNEZ	13 49 45	3000	Probably in Netherlands East Indies.
16th	SNEZ	13 54 17		Disturbed by microseisms.
	LNE	13 57 10ca		
	F	15 05		
No. 701	PNEZ	3 29 59	5310	Compression.
18th	iZ	3 31 11		In region of 50°N; 160°E by Chiufeng
	SNEZ	3 36 53		and Manila.
	LNE	3 44 30		
	MNE	3 48 20		
	F	4 57		
No. 702	iPZ	9 27 30	5590	Compression.
18th	PNE	9 27 31		
	SN	9 34 40		
	F	10 20		
No. 704	iPEZ	22 47 25	1840	Compression from SE.
18th	SNE	22 50 33		In region of Halmahera, N.E.I. by
	L?NE	22 52 ca		Manila and Guam.
19th	F	0 42		
No. 705	PNEZ	4 17 13	1980	
19th	SNE	4 20 32		
	F	4 40		
No. 709	PNEZ	3 31 10	2400	
22nd	SNE	3 35 01		
	LNE	3 37 11		
	F	4 00		
No. 711	iPNEZ	22 25 19	1010	Compression from SE.
22nd	iSNE	22 27 06		11° 35'N; 129° 40'E by Batuan and
	F	23 07		Manila.
No. 712	PNE	4 51 38	245	
23rd	SNE	4 52 12		
	F	5 04		

International Seismological Centre

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.
1934 November				
No. 716 24th	iPZ	12 45 46	8255	Dilatation.
	ePNE	12 45 46		In region of 30°S; 174°E by Riverview and Manila, subject to correction due to depth of focus.
	iSNEZ	12 55 27		
	iNE	13 00 16		
	LNEZ	13 10 00ca		
	F	14 20		
No. 719 26th	iPNEZ	12 09 35	100	Dilatation. Felt at Lubang Island with intensity VII and at Manila intensity VI. Felt strongly on the "Empress of Asia" which was 15 miles north of the epicenter. All instruments put out of service by the shocks. 14° 10'N; 120° 10'E by Manila and Baguio. Aftershocks of No. 719: Nos. 720 to 738; 740, 741, 743, 745 to 756.
No. 739 27th	iPNEZ	1 15 37	405	Compression. 13° 25'N; 124° 30'E. by Manila, Baguio and Butuan. Felt at Legaspi with intensity IV and at Naga and Virac with III. Time uncertain.
	iSNEZ	1 16 39		
	F	2 40		
No. 742 27th	iPNEZ	6 17 34	1410	Approx. 3°N; 125°E by Manila, Hong Kong, Guam. Compression at Manila and Butuan. Felt at Davao with intensity II. Data after P from the Wiechert.
	eSNE	6 20 00		
	iSN(?)	6 20 15		
	LNE	6 21 30ca		
No. 744 27th	PNEZ	7 49 01	595	11° 05'N; 125° 05'E by Butuan and Manila. Felt at Tacloban with intensity VII and at Guiuan with V.
	SNEZ	7 50 09		
	F	8 59		
No. 757 28th	PNE	14 36 16	85	From the Wiechert. Disturbed by microseisms.
	SNE	14 36 27		
	F	14 37		
No. 758 28th	PNE	16 46 26	85	From the Wiechert. Disturbed by microseisms.
	SNE	16 46 37		
	F	16 48		
No. 759 29th	PNE	13 13 20	95	From the Wiechert. Disturbed by microseisms.
	S NE	13 13 32		
	F	13 15		
No. 760 29th 30th	P?NE	23 57 17	660?	Disturbed by microseisms. Butuan 730 Km.
	S?NE	23 59 01		
	F	0 11		
No. 761 30th	iNEZ	2 12 13		Trace. Disturbed by microseisms.

International Seismological Centre

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.
1934 November				
No. 762 30th	P?N	2 21 +	13760	Disturbed by strong microsgisms.
	iNE	2 43 00		20°N; 104°W by U.S.C.G.S.
	F	4 24		P due at 2:21:06

Sixty insignificant or undecipherable disturbances on the following days of November: 1st(3), 2nd(4), 3rd, 4th, 5th, 6th, 9th(2), 11th 13th, 15th, 18th, 19th, 20th, 21st, 22nd, 23rd(3), 25th(2), 26th(19), 27th(11), and 28th(4).

CORRECTION TO NO. 649, OCTOBER 10th, 1934.

The epicenter as given in the October bulletin was determined before the receipt of New Zealand data, and on the assumption of normal focal depth. The arrival of New Zealand data made it evident that the focal depth must be great.

A tentative epicenter was determined from the S-P intervals of Manila and Wellington, using the table derived by the writer from the Philippine earthquake of April 8th 1929, and published in the Seismological Bulletin for July-December, 1933, Weather Bureau, Manila Central Observatory. The depth of focus of this earthquake was of the order of 600 Km.

The epicenter determined for October 10th was 23° S and 179° W.

Distances were calculated to Observatories whose reports had been received and satisfactory residuals were obtained.

The corrected data are now:

23° S; 179° W.

H=15h 42m 07s

h=600 Km. more or less.

Residuals:

Arapuni	15° 46'	15 45 30	+10s
Wellington	19° 00'	45 50	0
Christchurch	21° 26'	46 11	-4
Riverview	28° 15'	47 13	-7
Adelaide	38° 40'	48 45	-2
Manila	69° 42'	52 22	0
Osaka	72° 00'	52 40	+4
Taihoku	75° 00'	52 54	+2
Hong Kong	79° 15'	53 19	+4
Chiufeng	87° 18'	53 58	+3

No. 45. December, 1934.

M A N I L A , P . I .

SEISMOLOGICAL BULLETIN OF THE OBSERVATORY

Ø=14° 34' 42" N. =120° 58' 41" E. h=2.40 m. Alluvium.

GALITZIN-WILIP

	T_o	D	T_1		μ^2	K
N-S	12.4	100.5	12.6	11.5	0.017	97
E-W	11.8	100.5	11.9	11.4	-0.075	80
Z	11.6	100.5	9.0	14.8	1.250	200

WIECHERT. M=1000 Kg.
December 10, 1934.

	T_o	V		$\frac{\pi}{T_o}^2$
N-S	4.5	197	2.2	0.040
E-W	4.6	196	2.7	0.036

No. and Date	Phase.	Greenwich Time h. m. s.	Dist. Km.	Remarks.
1934 December				
No. 767 9th	ePNEZ	11 25 21	4490	
	SNEZ	11 31 27		
	L?NE	11 37 ca		
	F	12 30		
No. 770 10th	iPNEZ	10 00 01	510	Compression from the SE.
	SNEZ	10 01 01		P and S in minute gap.
	F	10 36		
No. 772 11th	$\overline{P}$NE	15 55 02	90	Z component defective.
	$\overline{S}$NE	15 55 14		
	F	15 59		
No. 775 12th	iPZ	8 50 58	6220	Dilatation.
	ePNE	8 50 58		In region of New Hebrides by Riverview, Manila, Chiufeng.
	SNE	8 58 45		
	F	9 25		
				No. 777 to No. 783 were records of very light earthquakes felt in a restricted area of the business district of Manila.
No. 786 14th	eNE	20 49 30	8000	Asia Minor.
	S?NE	20 57 30		
	F	21 21		
No. 790 15th	PNEZ	2 04 19	3920	Compression. Tibet.
	SNE	2 09 50		32°N; 89°E by Chiufeng, Hong Kong, Manila.
	LNE	2 13 50ca		
	MNE	2 17 30ca		Data after P from the Wiechert.
	F	4 45		
No. 795 15th	PNEZ	19 24 47	6970	Dilatation.
	SNE	19 33 17		21°S; 171°E By Manila and Riverview.
	LNE	19 41 ca		Subject to correction for depth of Focus.
	F	20 45		
No. 796 16th	$\overline{P}$NEZ	7 45 29	50	
	$\overline{S}$NE	7 45 36		
	F	7 46 45		

International Seismological Centre

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.
1934 December				
No. 798 16th	$\overline{P}$NEZ	9 46 04	190	
	SNE	9 46 28		
	F	9 49		
No. 799 16th	PNEZ	11 00 38	900	Felt at Surigao and Butuan with intensity II.
	SNEZ	11 02 15		9°N: 126° 45'E by Manila and Butuan.
	F	11 12		
No. 802 17th	PNEZ	3 38 47	1245	24°.2N: 121°.4E according to Taihoku.
	SNEZ	3 40 56		
	LNE	3 42 40ca		
	F	4 10		
No. 804 17th	iPZ	15 59 10	3675	Compression.
	ePNE	15 59 10		Eastern New Guinea by Guam, Manila,
	SNE	16 04 26		Hong Kong, Chiufeng, Adelaide.
	LNE	16 07 20ca		
	F	18 00		
No. 806 17th	$\overline{P}$NEZ	18 13 38	135	
	$\overline{S}$NEZ	18 13 55		
	F	18 19		
No. 808 18th	PEZ	11 29 00	3610	
	SNE	11 34 23		
	MNE	11 38 ca		
	F	12 20		
No. 809 18th	P?NE	14 31 02	1040?	
	SNE	14 32 52		
	F	15 00		
No. 811 19th	PNEZ	16 09 46	690	
	SNE	16 11 03		
	F	16 32		
No. 819 21st	PNEZ	12 45 46	5220	Compression.
	SN	12 52 35		
	LNE	12 58 25ca		
	ME	13 02 ca		
	F	13 30		
No. 820 21st	P?NEZ	17 35 08	1480?	P may be earlier.
	SNEZ	17 37 41		
	F	17 57		
NO.821 21st	PNE	18 53 36	560	Felt at Aparri with intensity III.
	SNEZ	18 54 41		
	F	19 15		
No. 822 22nd	PNE	11 02 54	1945	
	SNE	11 06 11		
	iME	11 10 26		
	F	12 02		

M A N I L A , P . I .

SEISMOLOGICAL BULIETIN OF THE OBSERVATORY.--Continued.

International Seismological Centre

No. and Date	Phase.	Greenwich Time h. m. s.	Dist. Km.	Remarks
1934 December				
No. 823 22nd	P'N	14 48 45	15850	Dilatation?
	PPE	14 51 30		8°N: 89°W: 0-14:29:00 by U.S.C.G.S.
	LNE	15 37 ca		
	MNE	15 47 ca		
	F	17 05		
No. 824 23rd	PNE	2 24 48	295	
	SEZ	2 25 28		
	F	2 45		
No. 825 23rd	PNEZ	10 13 17	3190	
	SN	10 18 02		
	LN	10 21 ca		
	1MN	10 28 34		
	F	12 10		
No. 827 24th	PNEZ	10 56 56	2465	
	SNE	11 00 51		
	F	11 30		
No. 828 24th	PNEZ	15 43 18	3145	
	SE	15 48 00		
	LE	15 51 ca		
	F	17 20		
No. 831 25th	PNEZ	2 01 20	1145	
	SEZ	2 03 19		
	F	2 44		
No. 833 25th	PNEZ	6 32 52	3155	
	SNEZ	6 37 35		
	LNE	6 40 40ca		
No. 834 25th	PNEZ	7 55 08	2620	No. 833 still recording.
	SNE	7 59 14		
	LNE	8 01 35ca		
	MNE	8 03 30ca		
	F	9 15		
No. 835 25th	PNEZ	12 53 12	2980	
	SNE	12 57 42		
	LNE	13 00 30ca		
	F	14 02		
No. 836 26th	PNE	14 14 53	410	
	SNE	14 15 44		
	F	14 28		
No. 838 27th	$\overline{P}$NEZ	8 54 59	100	
	$\overline{S}$NEZ	8 55 12		
	F	9 01		
No. 841 27th	i$\overline{P}$NEZ	17 43 28	120	Compression. Felt in Manila with intensity IV and at Botocan Falls, Laguna, strong. 14° 30'N: 122° 05'E by Manila and Baguio.
	i$\overline{S}$NEZ	17 43 43		

International Seismological Centre

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
1934 December				
No. 843 27th	$\overline{P}$NE	18 07 09	110	From the Wiechert.
	$\overline{S}$NE	18 07 22		
No. 847 28th	PNEZ	11 34 54	8535	Approximately 20°S: 170°W by Riverview, Manila, Chiufeng.
	SNE	11 44 49		
	LNE	12 00 ca		
	ME	12 06 ca		
	F	13 07		
No. 849 29th	$\overline{P}$NEZ	9 23 18	200	Compression.
	$\overline{S}$NE	9 23 43		
	F	9 39		
No. 852 30th	ePR$_1$NE	14 11 05	12080	
	PS?NE	14 20 38		31°N: 116°W: 0=13:51:52, U.S.C.G.S.
	LNE	14 42 20ca		
	MNE	14 52 20ca		
	F	16 35		
No. 854 31st	iPZ	9 03 34	640	In the region of southern Leyte by Manila and Butuan.
	ePNE	9 03 34		
	SNEZ	9 04 46		
	F	9 40		
No. 856 31st	ePNEZ	19 00 43	12145	California.
	eP N	19 04 00		
	ePR$_1$NEZ	19 04 43		30°N: 116°W: 0=18:45:30, U.S.C.G.S.
	iNZ	19 05 15		
	PSNE	19 14 00		
	LNE	19 36 aa		
	MNE	19 44 30ca		
	F	22 28		

Fifty-six insignifiqant or undecipherable disturbances on the following days of December: 3rd, 7th(2), 8th, 9th, 10th(2), 11th(2), 13th, 14th(9), 15th(7), 16th(2), 17th(4), 19th(4), 20th(3), 21st, 23rd, 24th, 25th(2), 26th, 27th(4), 28th(3), 30th(2), and 31st(2).

International Seismological Centre

M A N I L A O B S E R V A T O R Y

SPECIAL BULIETIN OF PRINCIPAL EARTHQUAKES

F E B R U A R Y , 1 9 3 4

2nd	iPZ	15 10 28	Compression.
	iSNE	15 14 40	
3rd	iPEZ	14 40 14	Compression.
	SNE	14 46 23	
4th	PE	13 46 04	Disturbed by microseisms.
	S?NE	13 54 09	
4th	iPNEZ	22 06 06	Dilatation from SE.
	SIEZ	22 10 04	
9th	iPZ	9 34 51	
	SNE	9 38 03	
11th	iPEZ	9 07 01	Compression.
	SNE	9 12 31	
12th	iPZ	11 35 24	Compression.
	SNE	11 39 14	
14th	iPNZ	4 00 32	Dilatation at Manila and Baguio. Felt over all of Luzon north of Manila. Slight damage in some towns on NW coast of Luzon. Maximum intensity V at Vigan and Laoag. Surge of sea observed south of Vigan. Epicenter 17° 20'N; 119° 22' E by Manila and Baguio. Followed by 17 aftershocks.
14th	PNE	17 15 40	Compression at Manila and Baguio. Epi-
	SNE	17 16 24	center 17° 15'N; 119° 12'E by Manila and Baguio. Followed by 8 aftershocks.
15th	PNEZ	3 12 06	Distance subject to correction for
	SNE	3 22 09	depth of focus.
16th	PNE	6 38 34	In the region of the Sakishima
	SNE	6 40 38	Islands by Manila and Baguio.
17th	PNEZ	21 06 34	Dilatation.
	SNE	21 10 15	
19th	iPZ	10 30 28	
	SNE	10 36 13	
22nd	PEZ	8 12 38	
	L?NE	8 50 ca	
24th	iPNEZ	6 28 53	Compression from NE.
	iSNE	6 33 09	
25th	iPNEZ	16 23 52	Compression from NW.
	iSNE	16 24 39	
27th	iPZ	21 36 47	Compression.
	S?NE	21 38 44	
28th	PNEZ	14 28 37	
	SNE	14 34 56	

M A N I L A O B S E R V A T O R Y

SPECIAL BULLETIN OF PRINCIPAL EARTHQUAKES

M A Y , 1 9 3 4 .

1st	iPNEZ	7 10 12	Compression from SW.	3170
	S?NE	7 15 30		
3rd	PNEZ	1 36 25		3140
	SNZ	1 41 18		
4th	iPNEZ	4 48 04	Dilatation from NE.	
	iSNE	4 57 55		5420
5th	ePN	14 43 33		8120
	S?NE	14 53 19		
5th	iPZ	16 47 38	Dilatation.	
	iSNEZ	16 51 15		7160
7th	PNE	1 57 06		1460
	SNE	1 59 39		
12th	PNEZ	10 56 52		2370
	SNE	11 00 47		
12th	ePEZ	20 32 10		3170
	SNE	20 37 28		
13th	iPEZ	9 09 23	Compression from SSE.	
	SNE	9 15 31		4370
13th	iPZ	17 03 49	Compression. Epicenter probably in	510
	SNE	17 04 45	Babuyan Channel. Felt in N Luzon.	
14th	iPZ	22 24 35	Compression.	
	iSNE	22 34 13	Deep focus.	8470
17th	PNEZ	22 16 14		2600
	SNE	22 20 27		
19th	PNEZ	10 49 38		2640
	SNEZ	10 53 54		
21st	P?NEZ	4 39 22		2170
	SNEZ	4 43 00		
22nd	P?NEZ	1 28 43		2480
	SNEZ	1 33 17		
27th	PNEZ	6 56 30		1160
	SNE	6 58 28		

M A N I L A O B S E R V A T O R Y

SPECIAL BULIETIN OF PRINCIPAL EARTHQUAKES.

J U L Y , 1 9 3 4

3rd	1PZ	3 48 36	2170	
	ePNE	3 48 36		
	SNZ	3 52 14		
4th	PNEZ	2 04 51	2320	
	SNEZ	2 08 41		
4th	PNEZ	13 24 40	470	
	SNE	13 28 51		
6th	ePNEZ?	23 06 35		P uncertain because of micros.
	iSNEZ	23 15 18	7280	
10th	PNEZ	2? 21 17	5700	
	SNE	2? 28 37		
12th	P?NEZ	9 58 14	3530	
	SNE	10 03 33		
18th	PNEZ	1 56 11		Compression, apparently from SE. P strong. No definite phases.
18th	PNEZ	19 49 33	5350	
	SNE	19 56 34		
19th	PNEZ	0 16 01		P in minute gap.
	SNE	0 23 27	5810	
19th	iPNEZ	1 31 57	2260	
	iSNE	1 35 42		
19th	PNEZ	7 46 13	6000	
	SNE	7 53 49		
20th	P?EZ	18 56 12		Precedent earthquake still recording.
	SNE	19 04 26	6710	
21st	iPZ	6 27 19		Dilatation.
	PNE	6 27 21		
	SNE	6 35 18	6430	
22nd	iPZ	3 06 55		
	ePNE	3 06 57	5590	
	SNE	3 14 09		
22nd	ePNEZ	20 05 20?	5250	
	iSNEZ	20 12 16		
31st	iPNEZ	5 59 06	160	Dilatation.
	SNE	5 59 24		Epicenter in the China Sea, off west coast of Luzon. Felt in Central Luzon Intensity VI at Iba.
31st	iPEZ	11 55 01		P in minute gap. Probably dilatation.
	ePN	11 55 01		
	SEN	12 00 21	460	

THE GOVERNMENT OF THE PHILIPPINE ISLANDS
DEPARTMENT OF AGRICULTURE AND COMMERCE
WEATHER BUREAU
CENTRAL OFFICE
MANILA

International Seismological Centre

M A N I L A O B S E R V A T O R Y

SPECIAL BULLETIN OF PRINCIPAL EARTHQUAKES

O C T O B E R , 1 9 3 4

5th	PME	20 33 02		3200
	SME	20 38 00		
10th	iPEZ	15 52 22	Dilatation.	6900
	SMEZ	16 00 46		
18th	iPZ	7 57 25	Dilatation.	5820
	SME	8 04 52		
21st	PMEZ	17 58 40		3290
	SMEZ	18 03 44		
26th	iPMEZ	17 15 16	Compression from ME.	3050
	SME	17 20 03		
28th	PMEZ	23 38 20		1910
	SMEZ	23 41 35		

THE GOVERNMENT OF THE PHILIPPINE ISLANDS

DEPARTMENT OF AGRICULTURE AND COMMERCE

WEATHER BUREAU

CENTRAL OFFICE

MANILA

International Seismological Centre

November 28th 1934.

Earthquake felt in Manila with intensity VI, R.-F. scale, at 12:09:35, G.M.T., November 26th. Perceptible about one minute. Epicenter about 95 kilometers to the southwest in the China Sea (14° 10' N: 120° 15' E). People badly frightened but no serious damage. 23 small aftershocks recorded but not felt.

Manila Observatory.

International Seismological Centre

M A N I L A O B S E R V A T O R Y

SPECIAL BULLETIN OF PRINCIPAL EARTHQUAKES

D E C E M B E R , 1 9 3 4

9th	ePNEZ	11 25 21	4330
	SNEZ	11 31 27	
15th	PNEZ	2 04 19	Compression.
	SNE	2 09 5o	3720
15th	PNEZ	19 24 47	Dilatation.
	SNE	19 33 17	Deeper than normal. (7020)
17th	iPEZ	15 59 10	Compression.
	SNE	16 04 26	2480
18th	PNEZ	11 34 23	1690
	SNE	11 37 18	
21st	PNEZ	12 45 46	Compression.
	SN	12 52 35	5130
22nd	P'NEZ	14 49 07	Dilatation?
	PR$_1$NE	14 53 50	18080 -
	LNE	15 35 ca	
23rd	PNEZ	10 13 17	3020
	SN	10 18 02	
24th	PNEZ	15 43 18	2490
	SE	15 48 00	
25th	PNEZ	6 32 52	3000
	SNEZ	6 37 35	
25th	PNEZ	7 55 08	2510
	SNE	7 59 14	
27th	1PNEZ	17 43 28	Compression. 120 -
	1SNEZ	17 43 43	Felt in Manila with intensity IV, and at Botocan Falls, Laguna.
28th	PNEZ	11 34 54	8960
	SNE	11 44 49	
30th	PNE	14 11 09	4220
	SNE?	14 1" 19	
31st	PNE	19 00 45	2470
	SNE	19 04 48	