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THE GOVERNMENT OF THE PHILIPPINE ISLANDS

WEATHER BUREAU

MANILA CENTRAL OBSERVATORY

SEISMOLOGICAL BULLETIN FOR 1929

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

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INTRODUCTION

The following is the list of the official seismological stations equipped with seismographs as they existed on January 1st, 1929.

Name	Province	North latitude	East longitude	Elevation	Equipment
		° ′	° ′	*m.*	
Manila	Manila	14 35	120 59	2.5	Wiechert Inverted Pendulum, mass 1000 Kg., 2 components. Vicentini seismograph, 3 components. Two horizontal pendulum seismographs, mass 20 Kg. each.
Baguio	Mountain	16 25	120 35	1,512.0	Vicentini seismograph, 3 components. Two horizontal pendulum seismographs.
Ambulong	Batangas	14 05	121 03	10.5	Vicentini seismopgrah, 3 components.
Butuan	Agusan	8 56	125 32	2.0	Wiechert Inverted Pendulum, mass 200 Kg., 2 components.
Agaña	Guam	13 24	144 38	5.0	Do.

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

The intensity of macroseisms is given in the notation known as the Rossi-Forel scale.

ROSSI–FOREL SCALE OF EARTHQUAKE INTENSITIES

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 furniture, 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.

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 Times (midnight$=0^h$), insular time being added in brackets for the convenience of Philippine readers.

The instrumental record is that of the Wiechert Inverted Pendulum in the Manila Observatory.

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Date	N–S Component				E–W Component			
	T_o	V	ϵ	$\frac{r}{T'_o}$	T_o	V	ϵ	$\frac{r}{T'_o}$
1929								
January 9	6.3	169	2.6	0.031	6.4	200	1.9	0.034
February 6	6.3	186	3.8	0.035	6.3	216	3.0	0.046
March 4	6.4	213	3.2	0.063	6.3	232	3.2	0.068
April 3	6.1	206	2.9	0.050	6.6	200	2.7	0.050
April 13	6.1	162	3.3	0.017	5.9	196	3.2	0.022
June 3	6.3	133	3.6	0.025	6.2	131	2.9	0.033

NOTE.—The sub-soil of Manila is alluvium.

SYMBOLS AND ABBREVIATIONS

P	Normal first preliminary tremors; longitudinal waves which have passed below the continental layer.
$\overline{P}$	Upper first preliminary tremors whose path lies wholly in the continental layer.
P′	Longitudinal waves that have traversed the earth's core.
PRn	Longitudinal waves reflected "n" times at the earth's surface.
PcP	Longitudinal waves reflected from the outer surface of the earth's core.
S	Normal second preliminary tremors; transverse waves that have passed below the continental layer.
$\overline{S}$	Second preliminary tremors whose path lies entirely in the continental layer.
PS	Waves transformed from longitudinal to transverse oscillations or vice versa through one reflection at the earth's crust.
SRn	Normal transverse waves reflected "n" times at the earth's surface.
ScS	Normal transverse waves reflected from the outer surface of the earth's core.
$\overline{ScPcP}$	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 begining 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 emergence 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.

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SPECIAL ARTICLES

FOURTH PACIFIC SCIENCE CONGRESS

The Manila Observatory was represented at the Fourth Pacific Science Congress in Java, May 16th–25th, by Rev. W. C. Repetti, S. J., Chief of the Seismic Division.

Seismology formed one of the Sections of the Division of Physical Sciences of the Congress.

Lieut.-Comm. L. C. Colbert, of the U. S. Coast and Geodetic Survey and a member of the Philippine Delegation, presented to the Seismological Section a proposal of Colonel E. Lester Jones, late Director of the U. S. Coast and Geodetic Survey, that the Manila Observatory be considered as a Central Seismological Observatory for the determination of the epicenters of severe earthquakes in the western part of the Pacific basin. The proposal was not accepted by the Section but, with a view to bettering the data in the Monthly Bulletins issued by the observatories of the Far East, it drew up the following resolution which was adopted by the Congress in its final general meeting.

"It be resolved that this Congress recommends that a monthly interchange of special bulletins of important earthquakes be made between the coöperating observatories of the Far East, to facilitate the determination of epicenters, without altering any existing interchange of reports".

These special bulletins are to be exchanged within a few days after the close of each month and will give briefly the station data on the important earthquakes of the preceding month which have been registered over great distances.

THE MINDORO EARTHQUAKE OF JUNE 15TH 1928

A macroseismic report of this earthquake has been prepared by Rev. M. Saderra–Maso, Assistant Director of the Manila Observatory, and appears in the Seismological Bulletin of the Observatory for the second half of the year 1928. He determined the epicenter to be in the vicinity of 12.3° N and 121° E.

In view of the fact that this earthquake was sufficiently intense to be recorded at almost every observatory in the world it is thought that some microseismic data will be of interest to seismologists.

The Central Bureau at Strasbourg placed the epicenter at 13.5° N and 118° E, but this is too far out in the China Sea and does not agree with the macroseismic data. The Central Office of the Jesuit Seismological Association, St. Louis, U. S. A., gave a tentative epicenter at 11.5° N and 114° E which also does not agree with the macroseismic evidence.

For a more accurate determination the writer fixed O at $6^h\ 12^m\ 36^s$ on the basis of the observed arrival time of P at Manila, the distance of Manila, and Mohorovicic's tables for surface layer waves. Distances to Manila, Taihoku, Hongkong, Phu-Lien, Zikawei, Nagasaki, and Batavia were calculated. The observed arrivals of P were as follows.

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TABLE I.

Station	Late	Early
	s.	s.
Manila		1
Taihoku		5
Hongkong		3
Phu Lien	1	
Zikawei		2 for H 8 for Z
Nagasaki		8
Batavia		3 for Z 2 for H

These residuals show that a shift of the epicenter to the NW and a change in the time of O would give better results. Accordingly O was changed to $6^h\ 12^m\ 35^s$ and the coördinates to 12° 22′ N and 120° 55′ E. The epicentral distances and expected arrivals of P were again calculated. The results appear in the first eight lines of Table II.

These coördinates were judged to be sufficiently accurate. The distances and arrival times were then calculated for all the stations whose reports were at hand. Table II shows the arcual distances and residuals.

The tables used were those of Macelwane.

TABLE II.

Station	Distance			Late	Early
	°	′	″	s.	s.
Manila	2	12	36	1	
Hongkong	11	50	20		1
Taihoku	12	40	50		2
Phu Lien	16	4	21	2	
Amboina	17	37	00	10	
Zikawei	18	50	54		1 for H 7 for Z
Nagasaki	21	57	32		6
Batavia	23	14	35		1 for H 2 for Z
Guam	23	14	50		10
Jinsen	25	37	45	13	
Kobe	25	48	9		26
Osaka	25	52	9		32
Melbourne	55	1	50		3
Wellington	73	2	26		350
Tananarive	78	46	12	9	
Ksara	79	5	33	8	
Helwan	83	33	31	3	
Lemberg	85	52	46		3
Beograd	88	41	16		22
Graz	88	49	32	16	
Copenhagen	89	51	32		1
Vienna	90	12	54		2
Zagreb	91	14	28		1
Hamburg	92	00	28	0	0
Jena	91	9	8		4
Scoresby Sound	93	20	32	215	
Rocca di Papa	94	52	24		6
Florence	95	6	36		5
DeBilt	95	15	8		1
Strasbourg	95	21	31		18
Zurich	95	23	22		5
Uccle	96	55	26		11
Kew	98	30	32		5
Paris	98	31	00		8
Spokane	100	36	44	ScPcS?	11
Berkeley	103	30	00	(P′) 100	
Granada	103	9	56	14	
Almeria	105	00	30	44	
Alicante	105	26	30	52	
Toledo	106	58	45	106	
Malaga	108	55	36	156	
San Fernando	110	17	37	206	
Tucson	113	24	46	(P′) 43	
Ottawa	120	18	55	(P′) 71	
St. Louis	121	16	55	(P′) 43	
Cincinnati	123	18	12	(P′) 63	
Georgetown	126	2	47	(P′)	9
La Plata	157	26	25	(P′)	13
La Paz	170	19	12	(P′)	8
Sucre	171	3	24	(P′)	6

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The results, in general, are considered good. Where P is observed excessively early it is suggested that a probable explanation is to be found in the mistaking of some isolated movement for P. Where P is observed 4–10 seconds early a possible explanation may be that the observed time is that of the vertical component which frequently leads the horizontal. This is shown in the case of Zikawei. The observed time used in the determination of the epicenter is that of H because the vertical component gives P 7–8 seconds early. Where P is excessively late it would seem to indicate a lack of sensitivity in the seismographs. The early arrival of P′ at the antipodes has been observed by the writer in previous instances and it is believed that slight modification of the table of travel times for these distances is desirable.

The position thus determined puts the epicenter 10 kilometers from the Mindoro shore line in the Apo East Passage of the Mindoro Strait. A Coast and Geodetic Survey sounding at this location shows a depth of 330 fathoms and the relief model of the Philippines, prepared by the Survey, shows that a submarine trench begins in the neighborhood of this point and runs NW into the China Sea, increasing in depth to more than 2,000 fathoms. The epicenter is shown in Plate 1.

The depth of focus seems to be of the order of 25 km., assuming the validity of Mohorovicic's tables for this region.

The first wave at Manila was compressional. There was about 60 aftershocks recorded at Manila, one of which, at $17^h\ 16^m\ 45^s$, appears to have almost equalled the first shock in intensity.

THE BOKOD SEISMIC PERIOD, JAN.–FEB. 1929

On January 15th at about 1.30 a. m., local time, an earthquake occurred near Bokod, Benguet subprovince, Luzon, that ushered in a period of seismic activity which lasted with intervals until February 25th. Bokod is 27 kilometers to the ENE of Baguio, the mountain resort of the Philippines. The Benguet Subprovince has been the scene of similar seismic periods in the past, among which may be mentioned those of August–September, 1913, October 8th–9th 1920, and September 17th–October 22nd 1925.

The topography and general geological structure of the region has been carefully described by Rev. M. Saderra–Maso, former Chief of the Seismic Division of the Manila Observatory, in the Bulletins for August 1913 and October 1925. A further detail may be added here concerning the location of Bokod. In 1926 the Bureau of Science of Manila issued a preliminary geological map of the Philippines which shows a small circular area of Mesozoic undifferentiated metamorphics in the center line of the elongated mass of Pre-Tertiary intrusives of the Central Cordillera. Bokod is just inside the boundary of this circular area. However, the general character and small scale of the map do not allow of great accuracy in this determination.

The list of earthquakes in this period, in approximate local time, is as follows:

January 15th.—

1:30 a. m. Felt as far as 100 km.
3:00 a. m.
3:30 a. m.
9:00 a. m.
10:00 a. m.

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January 16th—
4:08 p. m. and at intervals during the night. Rocks dislodged. Felt as far as Manila.
5:10 p. m. Reported from 4 places at 25 km. distance.
10:04 p. m. Felt as far as Manila.
January 17th—At intervals during the whole day. Reports as far as Malasiqui. 75 km.
January 18th—
6:00 a. m.
9:00 a. m.
10:00 a. m.
10:45 a. m.
8:30 p. m.
January 19th—At intervals.
January 20th—
5:30 a. m.
11:35 a. m.
January 21st—
9:00 a. m.
11.00 a. m.
January 26th—2:35 p. m.
January 27th—4:30 a. m.
January 29th—3:00 a. m.
January 30th—7:10 p. m.
February 3rd—0:30 a. m.
February 6th—8:10 p. m.
February 19th—
3:00 p. m.
8:00 p. m.
February 25th—9:00 p. m.

In this series there were three predominant shocks which were felt over Central and Northern Luzon, one at $17^h\ 29^m\ 40^s$, G. M. T. on the 14th, the second at $8^h\ 06^m\ 09^s$, G. M. T., and the third at $14^h\ 03^m\ 37^h$, G. M. T., on the 16th. The epicenter was determined by the travel times of P to Manila and Zikawei.

The first of these three shocks was registered as far as Zikawei, 1,850 km. to the north. It is probable that the second would also have been reported as registered there and at other observatories except for the fact that another earthquake occurred in China just a few minutes previously and its vibrations, no doubt, masked those of the Bokod earthquake.

The shock at $17^h\ 29^m\ 40^s$ on the 14th was felt at Dagupan, Kapangan, Manaoag, Baguio, Camiling and Baler and would probably have been reported from many other places had it occurred during the day. The second and third shock were perceptible in Manila as a very gentle rocking motion.

The isoseismals for the earthquake at $8^h\ 06^m\ 09^s$ on the 16th are shown in Plate I. Reports were received from twenty-one places other than those shown in the figure. The short lines drawn through various towns indicate the apparent azimuth of the oscillations as reported from those places. The number "1" refers to the first of the three important shocks, number "2" to the second, and number "3" to the third. It seems evident that in most cases the transverse waves, rather than the longitudinal, were felt.

These three predominant shocks of the series were evidently true tectonic earthquakes of at least moderately deep origin and it is interesting to note that the initial movement in the first was a compression, in the second a dilatation, and in the third a compression. It is suggestive of a sudden uplift, followed by a subsidence, and then another uplift. The other and less intense shocks might be considered as due to superficial readjustments following the main shocks.

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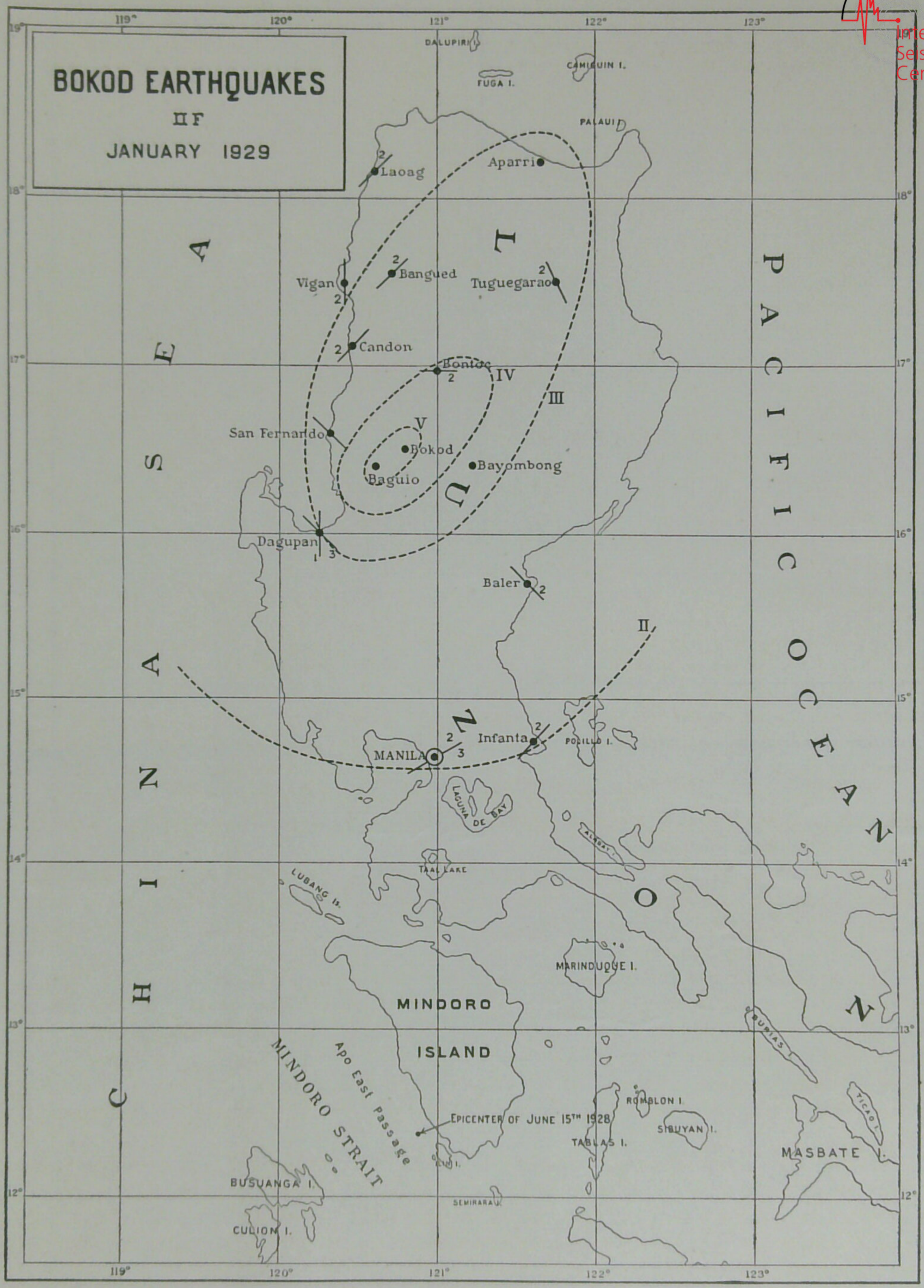


PLATE I

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SEISMOLOGICAL BULLETIN FOR 1929

JANUARY, 1929

MACROSEISMIC RECORD

1, $8^h\ 35^m\ 22^s$* [1, $16^h\ 35^m\ 22^s$] **Central Luzon.** Light earthquake at Dagupan (oscillations apparently NE–SW), Tarlac, and Camiling.

3, $12^h\ 45^m$ [3, $20^h\ 45^m$] **Mindanao.** Reported from Ganassi, Lanao.

4, $17^h\ 15^m$ [5. $1^h\ 15^m$] **Mindanao.** Light shock at Butuan.

6, $13^h\ 00^m$ [6, $21^h\ 00^m$] **Negros.** Light earthquake reported from Victorias.

8, $0^h\ 39^m$ [8, $8^h\ 39^m$] **Mindanao.** Earthquake at Malabang, Lanao.

9, $19^h\ 54^m\ 34^s$* [10, $3^h\ 54^m\ 34^s$] **SE Luzon.** Earthquake in Albay and Camarines Sur. Greatest intensity was V at Naga. At Legaspi the oscillations, which seemed to be NW–SE, lasted about 15 seconds. Also reported from Iriga and Guinobatan.

14, $17^h\ 30^m\ 11^s$* [15, $1^h\ 30^m\ 11^s$] **N Luzon.** Bokod earthquakes. See special account.

15, Time not given. **Mindanao.** Reported from Cotabato.

17, $7^h\ 42^m$ [17, $15^h\ 42^m$] **SW Luzon.** Light shock reported from Imus, Cavite.

17, $13^h\ 54^m\ 19^s$* [17, $21^h\ 54^m\ 19^s$] **SE Luzon.** Earthquake of intensity II felt at Daet in Camarines Norte. The vibrations seemed to be in a SW–NE direction and lasted for 2 seconds.

18, $16^h\ 05^m$ [19, $0^h\ 05^m$] **Mindanao.** An earthquake of intensity III was felt in Surigao.

19, $0^h\ 44^m\ 47^s$* [19, $8^h\ 44^m\ 47^s$] **Mindanao.** A light earthquake with vibrations lasting 15 seconds, occurred at Lais and Malita in the Province of Davao.

23, $7^h\ 28^m$ [23, $15^h\ 28^m$] **Mindanao.** Earthquake of intensity I reported from Cotabato.

26, $2^h\ 10^m$ [26, $10^h\ 10^m$] **Mindanao.** A light shock at Ganassi and Malabang, Lanao.

26, $4^h\ 14^m$ [26, $12^h\ 14^m$] **Batanes.** An earthquake of intensity II, and of short duration at Basco.

27, $14^h\ 00^m$ [27, $22^h\ 00^m$] **Mindanao.** Light shock at Butuan, Agusan.

28, $22^h\ 00^m$ [29, $6^h\ 00^m$] **Mindanao.** An earthquake lasting 10 seconds at Bual, Cotabato.

30, $15^h\ 28^m$ [31, $1^h\ 28^m$] **Guam.** A sharp shock.

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INSTRUMENTAL RECORD

No.	Date	Phase	Time	T	A_N μ	A_E μ	Δ	Remarks
			h. m. s.	s.			Km.	
1	1	$\overline{eP}_{NE}$	8 35 22				135	Felt in Central Luzon.
		$\overline{iS}_{NE}$	8 35 38					
		m_{NE}	8 36 19	4	60	28		
		F	8 47					
2	2	eP_{NE}	2 29 39				1100ca.	Felt in N Formosa. Microseisms.
		F	2 59					
3	7	eP_{NE}	14 49 29				1320	
		$\overline{iS}_{NE}$	14 52 21					
		M_N	14 52 26	6	30			
		M_E	14 52 57	4		6		
		F	15 07					
6	9	eP_{NE}	19 54 34				260	Felt in SE Luzon.
		$\overline{iS}_{NE}$	19 55 09					
		F	19 58					
8	12	eP_{NE}	14 25 09				130	
		$\overline{iS}_{NE}$	14 25 27					
		F	14 29					
9	13	iP_{NE}	0 11 16				5500	Okhotsk Sea. 58° N; 154° E. 0 = 0:02:17.
		iPR_{1E}	0 13 21					
		iPR_{2E}	[a]					
		iPR_{3E}	0 14 28					
		iS_E	0 18 21					
		iPS_E	0 18 32					
		iSR_{1E}	0 22 09					
		iSR_{2N}	0 23 35					
		L_E	0 26 21					
		F	2 56					
10	13	e_{NE}	18 51 00					Suiyuanting, China.
		F	19 31					
11	14	iP_{NE}	17 30 11	i	5	1	210	Compression. Near Bokod, Benguet Province, Luzon.
		$\overline{iS}_{NE}$	17 30 36					16.5° N; 120.75° E.
			17 31	[b]				0 = 17:29:40.
		F	17 46					
12	16	iP_{NE}	8 06 41				210	Dilatation. Same epicenter as No. 11. 0 = 8:06:09.
			8 06 56	[b]				Felt in Manila.
		$\overline{iS}_E$	8 07 04					
			0 07 16	[c]				
			8 13 30	[d]				
		F	[e]					
13	16	eP_{NE}	9 03 00				210	Aftershock of No. 12. Superimposed on No. 12.
14	16	eP_{NE}	9 10 54				210	Aftershock.
		iS_{NE}	9 11 17					
		F	10 18 ca					
15	16	eP_E	12 00 16				210	Do.
		$\overline{iS}_E$	12 00 39					
		F	12 08 ca					
16	16	eP_E	12 22 22				210	Do.
17	16	eP_E	12 27 32				210	Do.
18	16	eP_E	12 34 36				210	Do.
19	16	eP_E	12 40 37				210	Compression. Same epicenter as No. 11. Felt in Manila.
20	16	iP_{NE}	14 04 09					
		$\overline{iS}_{NE}$	14 04 32					
			14 04 42	[e]				
		M_N	14 07 09	4				
			14 10 10	[f]				
		F	14 45 ca					

[a] In minute gap.
[b] N–S pen off.
[c] E–W pen off.
[d] Both pens recording again.
[e] Still recording at 9:10:54.
[f] E–W pen recording again.

Instrumental Record—Continued

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No.	Date	Phase	Time	T	A_N μ	A_E μ	Δ	Remarks
			h. m. s.	s.			*Km.*	
21	16	eP_{NE}	15 31 32				210	Aftershock.
22	16	eP_{NE}	16 47 21				210	Do.
23	16	eP_{NE}	17 37 40				210	Do.
24	16	eP_{NE}	18 27 35				210	Do.
25	16	eP_{NE}	19 11 47				210	Do.
26	16	iP_{NE}	20 50 47	i	10	3	210	Do.
		$\overline{iS}_{NE}$	20 51 13		44	44		
		F	21 10					
27	16	eP_{NE}	21 20 16				210	Do.
28	16	eP_{NE}	23 33 46				210	Do.
29	17	eP_{NE}	1 23 11				210	Do.
30	17	eP_{NE}	6 48 56				315	
		$\overline{S}_{NE}$	6 49 31					
		F	6 57					
31	17	eP_{NE}	10 48 32				210	Felt in Baguio.
		F	10 59					
33	17	eP_E	13 54 19				210	Felt in SE Luzon.
		F	13 57					
34	17	$e\overline{P}_E$	15 03 45				210	Do.
35	17	eP_E	16 14 20				170	
		F	16 17					
36	17	eP_E	19 50 22				210	
		$\overline{S}_{NE}$	19 50 48					
		F	19 56					
37	17	eP_E	21 36 14				225	
		F	21 43					
38	17	eP_E	21 53 34				210	
		$i\overline{S}_E$	21 54					
		F	21 59					
39	17	eP_E	22 33 32					
		S_E	22 38 51					
		F	23 47					
40	18	iP_{NE}	1 06 25				210	Felt in Bokod.
		$\overline{iS}_{NE}$	1 06 51					
		m_N	1 08 46	5	92			
		m_E	1 09 43	6		111		
		F	1 19					
42	18	eP_{NE}	7 13 08					
		F	7 19					
43	18	eP_{NE}	11 03 12				210	Felt in Bayombong.
		$\overline{iS}_{NE}$	11 03 39					
		F	11 14					
44	18	eP_{NE}	12 56 53					
		F	13 01					
45	19	iP_{NE}	0 44 47				1050	Felt in Malita, Davao.
		iS_{NE}	0 46 58					
		F	1 09					
47	19	eP_{NE}	22 06 09				210	
		F	22 14					
48	20	$e\overline{P}_{NE}$	3 17 18				190	
		F	3 23					
49	20	eP_{NE}	3 38 47				210	Felt in Bokod
		F	3 44					
50	20	eP_{NE}	5 26 12				210	
		F	5 33					

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Instrumental Record—Continued

No.	Date	Phase	Time	T	A_N μ	A_E μ	Δ	Remarks
			h. *m.* *s.*	*s.*			*Km.*	
51	20	iP_{NE}	14 57 54		7	5	2056	Near 11.5° N; 140° E. A second shock at 15:00:50.
		PR_1	14 58 11					
		PR_2	14 58 14					
		iS_{NE}	15 01 20					
		PcP	15 02 22					
		L	15 02 57					
		PcS	15 09 35					
		F	16 20					
52	20	eP_{NE}	23 08 11				230	
		F	23 12					
54	21	eP_{NE}	8 58 46				200	
		$i\overline{S}_{NE}$	8 59 09					
		F	9 04					
55	21	e_E	10 42 00				8220	Fairbanks, Alaska.
		eL_{NE}	10 56 24					
		M	11 12 12					
		F	11 53					
56	24	eP'_{NE}	20 55 59				15520	South of Guatemala in the Pacific.
		eL_E	21 42 49					
		M_E	21 53 19					
		F	22 52					
57	25	i_{NE}	2 06 23					Disturbed by microseisms.
		F	2 42 ca					
58	25	eP_{NE}	8 09 24					
		F	8 15					
60	26	eP_{NE}	6 35 46				210	Felt in Bokod.
		$i\overline{S}_{NE}$	6 36 12					
		F	6 49					
61	26	$e\overline{P}_{NE}$	13 55 14				180	
		$i\overline{S}_{NE}$	13 55 34					
		F	13 59					
62	26	$e\overline{P}_{NE}$	20 50 10				190	
		$i\overline{S}_{NE}$	20 50 31					
		F	20 55					
64	30	eP_{NE}	11 12 39?				210	Do.
		$\overline{S}_{NE}$	11 12 53					
		F	11 18					
65	30	eP_{NE}	16 57 23				1560	Felt in NE Celebes and Ternate.
		S_{NE}	17 00 05					
		F	18 14					
66	30	eP_{NE}	22 32 56				180	
		F	22 35					

In addition to the above there were insignificant or undecipherable disturbances on the following days of January; 8, 9, 10, 17, 18, 19, 21, 25, 29, and 31.

International Seismological Centre

FEBRUARY, 1929

MACROSEISMIC RECORD

2, $6^h\ 10^m$ [2, $14^h\ 10^m$] **Mindanao.** Light shock at Talacogon, Agusan.

2, $7^h\ 22^m\ 10^s$ [2, $15^h\ 22^m\ 10^s$] **Mindanao.** A feeble earthquake, lasting 15 seconds, at Butuan, Agusan.

2, $13^h\ 10^m\ 50^s$ [2, $21^h\ 10^m\ 50^s$] **Mindanao.** Zamboanga reported a light earthquake whose vibrations seemed to be E–W, lasting 3 seconds. A shock occurred at Ganassi at the same time but it was probably from a different focus.

2, $21^h\ 40^m$ [3, $5^h\ 40^m$] **SE Luzon.** An earthquake of intensity III at Virac, Albay.

4, $19^h\ 30^m$ [5, $3^h\ 30^m$] **Mindanao.** An earthquake at Bual, Cotabato.

6, $12^h\ 10^m$ [6, $20^h\ 10^m$] **Central Luzon.** A light earthquake at Bokod, Benguet.

15, $5^h\ 43^m\ 13^s$* [15, $13^h\ 43^m\ 13^s$] **E Mindanao.** Reported as violent at Veruela in the Agusan Valley and felt as far as Glan to the south, Butuan to the north and Malay-balay to the west.

18, $7^h\ 14^m\ 35^s$* [18, $15^h\ 14^m\ 35^s$] **Central Luzon.** Reported from Baguio as intensity II.

18, $10^h\ 58^m\ 10^s$ [18, $18^h\ 58^m\ 10^s$] **Mindanao.** Earthquake of short duration in Butuan, Agusan.

22, $11^h\ 29^m\ 16^s$* [22, $19^h\ 29^m\ 16^s$] **S Luzon.** A slight earthquake at Los Baños and Santa Cruz, Laguna.

22, $17^h\ 30^m\ 39^s$ [23, $1^h\ 30^m\ 39^s$] **Mindanao.** An earthquake of intensity IV at Butuan, Agusan.

26, ... **Mindanao.** Earthquake at Cotabato in the early morning. Time not given.

INSTRUMENTAL RECORD

International Seismological Centre

No.	Date	Phase	Time	T	A_N μ	A_E μ	Δ	Remarks
			h. *m.* *s.*	*s.*			*Km.*	
68	1	$\underline{P}_{NE}$	6 05 ca				170?	Begins in minute gap.
		iS_{NE}	6 05 19					
		F	6 19					
69	1	iP_{EN}	17 23 00				5310	Begins in minute gap. Near 34° N, 63° E according to Kew.
		$iPcP_{NE}$	17 24 25					
		mE	17 24 35	5.5		21		
		iPR_{1NE}?	17 25 10					
		iS_{NE}	17 29 54					
		[a]						
70	1	iP_{NE}	17 30 04					
		m_{NE}	17 30 09	5.5	41	31		
		iL_{NE}?	17 37 36					
71	2	eP'_{NE}	0 21 25				15800	South Atlantic. 2° S, 23° W. 0 = 0:00:30.
		iScPcP	0 23 53					
		i_{NE}	0 25 35					
		e_{NE}	1 43	19				Train of long waves at intervals until 2h 32m.
		F	2 45 ca					
72	2	eP_{NE}	14 47 02					Begins in minute gap.
		iSE	14 51 ca					
		F	15 23					
73	3	iP_{NE}	2 48 23				1910	Off Naze, Riukyu Islands. 29.5° N, 130.3° E.
		iS_{NE}	2 51 37					
		F	3 29					
74	4	eP_{NE}	2 10 42				100	From Vicentini seismograph.
		F	2 14					
75	6	iP_{NE}	6 57 00				4610	Off Hokkaido, Japan. 44° N, 157° E.
		iS_{NE}	7 03 15					
		F	7 34					
76	7	eP_{NE}	2 22 44				200	
		F	2 29					
77	7	$\overline{eP}_{NE}$	5 54 21				170	
		$i\overline{S}_{NE}$	5 54 42					
		F	6 01					
78	8	eP_{NE}	7 45 32					Felt in Formosa.
		F	8 12					
79	8	$\overline{eP}_{NE}$	20 11 40				180	
		$\overline{iS}$	20 12					
80	9	eLE	2 05 00					Felt in Honan, China.
81	10	eE	16 01				14700	13° N, 98° W. 0 = 15:38:30.
		F	17 54 ca					
84	14	eP_{NE}	11 42 18				140	
		$\overline{iS}_{NE}$	11 42 35					
		F	11 51					
85	14	P_{NE}	14 43 ca				1820	Begins in minute gap.
		PR_{2NE}	14 43 37					
		iS_{NE}	14 46 06					
		iL_{NE}	14 49 21					
		F	15 53					
86	15	iP_{NE}	5 43 13	i	8	9	915	Compression. Felt in SE Mindanao. 8° N, 126° E.
		iS_{NE}	5 44 56					
		iL_{NE}	5 46					
		F	7 19					
89	18	$\overline{iP}_{NE}$	4 47 12				60	
		$\overline{iS}_{NE}$	4 47 20					
		F	4 53					
90	18	eP_{NE}	7 14 35				200	Central Luzon. Felt in Baguio
		$\overline{iS}_{NE}$	7 15					
		F	7 21					

[a] Overtaken by following earthquake.

International Seismological Centre

Instrumental Record—Continued

No.	Date	Phase	Time	T	A_N μ	A_E μ	Δ	Remarks
			h. *m.* *s.*	*s.*			*Km.*	
91	19	eP_{NE}	17 12 45				330	
		iS_{NE}	17 13 22					
		F	17 22					
92	20	eP_{NE}	4 34 54				130	
		iS_{NE}	4 35 09					
		F	4 41					
93	20	eP_{NE}	12 04 52				120	
		iS_{NE}	12 05 05					
		F	12 10					
94	20	i_{NE}	21 14 41					Samoa.
		F	22 08					
95	21	eP_{NE}	4 17 54				170	
		iS_{NE}	4 18 16	i	21	37		Extraordinary S.
		F	4 25					
96	22	eP_{NE}	11 29 16				60	Felt in Los Baños and Santa Cruz, Laguna Province.
		iS_{NE}	11 29 23					
		F	11 33					
97	22	eP_{NE}	13 41 08				70	
		iS_{NE}	13 41 16					
		F	13 45					
98	22	iP'_{NE}	21 01 46				16690	Atlantic Ocean. 10° N, 42° W. 0 = 20:41:36.
		i_{NE}	21 03 46					
		$iScPcP_{NE}$	21 05 17					
		$iPR_{1\,NE}$	21 05 24					
		$iPR_{2\,NE}$	21 08 31					
		iPS_{NE}?	21 16 44					
		eL_{NE}	21 49 15					
		eM_{NE}	22 04 21					
		$M_{1\,NE}$	22 09 43	18	73	66		
		F	23 30					
99	23	eP_{NE}	1 19 54				80	
		iS_{NE}	1 20 03					
		F	1 23					
100	23	eP_{NE}	10 42 41				40	
		iS_{NE}	10 42 45					
		F	10 45					
101	23	eP_{NE}	15 42 47				170	
		iS_{NE}	15 43 06					
		F	15 46					
104	26	eP_{NE}	3 31 38				210	
		iS_{NE}	3 32 04					
		F	3 35					
105	26	e_{NE}	3 39 54					
		iS_{NE}?	3 48 01					
		F	4 09					
106	26	P_{NE}	9 12 ?				7820	Begins in minute gap. 54° N, 163° W. 0 = 9:00:44.
		$iPcP_{NE}$	9 12 35					
		i_{NE}	9 12 54					
		iS_{NE}	9 21 11					
		iPS_{NE}	9 21 38					
		i_{NE}	9 23 37					
		eM_E?	9 49					
		F	10 44					
107	27	iP_{NE}	8 18 58	i	16	4	140	Compression.
		iS_{NE}	8 19 16	i	100	80		
		F	8 26					
108	28	e_{NE}	0 15 ca					Beginning lost in change of records.
		F	0 56					

In addition to the above there were insignificant or undecipherable disturbances on the following days in February: 11, 13, 16, 17, 24, and 25.

MARCH, 1929

MACROSEISMIC RECORD

4, Time not given. **Central Luzon.** Two small earthquakes at Bokod, Benguet. Probably related to the January–February series.

8, $8^h\ 35^m$ [8, $16^h\ 35^m$] **SE Luzon.** Felt at Bacon, Sorsogon.

10, $0^h\ 56^m$* [10, $8^h\ 56^m$] **Leyte.** Felt at Tacloban.

13, $4^h\ 42^m$ [13, $12^h\ 42^m$] **Mindanao.** A slight earthquake at Talacogon, Agusan.

14, $18^h\ 00^m$ [15, $2^h\ 00^m$] **Mindanao.** An earthquake at Bual, Cotabato.

16, $16^h\ 05^m$ [17, $0^h\ 05^m$] **Mindanao.** Shock of intensity II reported from Cotabato.

16, $22^h\ 59^m\ 28^s$* [17, $6^h\ 59^m\ 28^s$] **Mindanao.** Earthquake of intensity II in Butuan, Agusan.

16, $23^h\ 23^m$ [17, $7^h\ 23^m$] **Mindanao.** Slight shock at Talacogon, Agusan.

19, $18^h\ 23^m$ [20, $2^h\ 23^m$] **N Luzon.** Earthquake of intensity III, of 4 seconds duration, at Vigan.

20, $21^h\ 11^m\ 42^s$* [21, $5^h\ 11^m\ 42^s$] **N Luzon.** An earthquake affecting the northern end of Luzon. Reported as having an intensity IV at Cape Bojeador and lasting 6 seconds. Aparri reported it as strong, with duration of 32 seconds, and oscillations apparently E–W. Recorded at Zikawei.

23, $5^h\ 07^m$ [23, $13^h\ 07^m$] **Leyte.** Earthquake of intensity II at Tacloban.

26, $4^h\ 18^m\ 49^s$* [26, $12^h\ 18^m\ 49^s$] **Mindanao.** In the western part of Cotabato and the southwestern part of Lanao Provinces. Reported from Malabang, Lebak, Pikit, and Cotabato in which last place it had an intensity of II.

INSTRUMENTAL RECORD

International Seismological Centre

No.	Date	Phase	Time	T	A_N μ	A_E μ	Δ	Remarks
			h. *m.* *s.*	*s.*			*Km.*	
110	4	iP_{NE}	14 42 23				200	
		$i\overline{S}_{NE}$	14 42 49					
		F	14 47					
111	4	$\overline{eP}_{NE}$	17 23 08				140	
		$i\overline{S}_{NE}$	17 23 26					
		F	17 28					
112	7	eP_{NE}	1 45 23				7350	Aleutian Islands.
		iP_{NE}	1 45 27					51° N, 170° W. U. S. C. G. S.
		$iPcP_{NE}$	1 46 16	7				0 = 1:34:37 U. S. C. G. S.
		m_N	1 46 24	7	42			
		iPR_{1NE}	1 48 16	7	50			
		iPR_{2NE}	1 49 29	9.5				
		iS_{NE}	1 54 16					
		m_E	1 54 28	8.5		175		
		$iPPPS_{NE}$	1 55 05					
		m_E	1 55 12	7.8		80		
		$iScS_{NE}$	1 56 ca	[a]				
		i_{NE}	1 56 14					
		m_{NE}	1 56 22	8 5	105	175		
		SR_1 PPSS NE	1 59 00					
		m_E	1 59 15	8		95		
		m_N	1 59 15	11	220			
		iSR_{2NE}	2 01 50					
		i_{NE}	2 03 55					
		iL_{NE}	2 06 47					
		M_{NE}	2 11 50					
		F	5 21					
113	7	eP_{NE}	11 12 36					Java.
		F	11 58					
115	9	iP_{NE}	2 16 55				3070	25° N, 150° E.
		iS_{NE}	2 21 31					
		iL_{NE}	2 24 31					
		F	3 51					
116	9	eP_{NE}	11 02 12				7980?	New Zealand. 43° S; 171.5° E.
		iS_{NE}	11 11 40					
		iL_{NE}	11 25 40					
		F	12 55					
117	10	eP_{NE}	0 56 00					Felt in Tacloban, Leyte.
		F	1 06					
118	10	iP_{NE}	14 39 49				2410	20° N, 145° E.
		iS_{NE}	14 43 40					
		iL_{NE}	14 45 46					
		F	15 56					
120	13	$\overline{eP}_{NE}$	14 10 34				60	
		F	14 13					
121	14	e_{NE}	18 42 14					Off Bonin Islands.
		F	19 29					
123	15	eP_{NE}	8 30 11					
		F	9 22					
124	16	eP_{NE}	6 09 53				2845	
		eS_{NE}	6 14 14					
		iL_{NE}	6 16 51					
		F	6 49					
125	16	eP_{NE}	22 59 28				920	Felt in Butuan.
		iS_{NE}	23 01 08					
		F	23 33					
126	18	eP_{NE}	0 50 51				1030	
		iS_{NE}	0 52 40					
		F	1 09					

[a] In minute gap.

International Seismological Centre

Instrumental Record—Continued

No.	Date	Phase	Time	T	A_N μ	A_E μ	Δ	Remarks
			h. *m.* *s.*	*s.*			*Km.*	
127	18	eP_{NE}	1 48 30				2890	
		iS_{NE}	1 52 55					
		F	2 54					
128	18	e_{NE}	23 27 51				3400	East of Japan.
	19	F	0 12					
129	19	e_{NE}	21 13 55					
		e_N	21 16 54					
		F	21 46					
130	20	iP_{NE}	12 13 32					
		iS_{NE}	12 18 20					
		F	12 32					
131	20	iP_N	21 11 42					
		$i\overline{P}_{NE}$	21 11 56				460	Felt in N Luzon.
		iS_{NE}	21 12 3[illegible]					N 18° 30'; E 119° 35'.
		F	22 17					
132	21	eP'_{NE}	2 57 00					11° N, 90.6° W. J. S. A
		F	3 28					
133	22	eP_{NE}	3 08 38				2550	
		iS_{NE}	3 12 40					
		iL_{NE}	3 14 52					
		F	3 52					
134	23	iP_{NE}	20 03 53				1630	Manila, Batavia, Phu-Lien, and Hongkong give epicenter in northern Celebes.
		iS_{NE}	20 06 43					
		iL_{NE}	20 08 07					
		F	21 56					
135	24	eP_{NE}	1 06 17				125	
		F	1 12					
137	24	eP_{NE}	7 33 06				130	
		F	7 38					
138	24	eP_{NE}	16 13 15					
		F	16 24					
141	25	e_{NE}	15 01 00					
		F	15 37					
142	26	e_{NE}	4 18 49					Felt in Cotabato Province, Mindanao.
		F	4 53					
144	26	e_{NE}	13 30 49					
		F	13 47					
145	26	e_{NE}	19 57 42					
		F	20 41					
146	28	iP_{NE}	13 01 46				45	
		F	13 04					
147	28	eP_{NE}	20 37 20				2690	
		eS_{NE}	20 41 40					
		F	21 14					
149	30	$i\overline{P}_{NE}$	10 03 40				140	
		$i\overline{S}_{NE}$	10 03 58					
		F	10 08					
150	31	eP_{NE}	5 30 53				3390	
		eS_{NE}	5 35 50					
		eL_N	5 39 20					
		F	6 38					
151	31	eP_{NE}	9 31 27				340	
		$e\overline{S}_{NE}$	9 32 18					
		F	9 38					
152	31	eP_{NE}	9 40 05				340	
		F	9 49					
153	31	eP_{NE}	14 27 51					
		F	14 50					
154	31	eP_{NE}	20 24 35				2710	
		eS_{NE}	20 28 47					
		F	21 16					

In addition to the above there were insignificant or undecipherable disturbances on the following days of March; 1, 8, 13, 15, 24, 25, 26, and 28.

International Seismological Centre

APRIL, 1929

MACROSEISMIC RECORD

1, 18h 33m [2, 2h 33m] **Mindanao.** Earthquake at Butuan, Agusan. Pendulum clock stopped by the shock.

2, 6h 12m 32s* [2, 14h 12m 32s] **Luzon.** Earthquake of intensity IV at Olongapo. Felt in Manila by a few persons. Epicenter in the China Sea.

2, 6h 43m 00s* [2, 14h 43m 00s] **Mindanao.** Light earthquake across Mindanao along NE–SW area. Reported from Talacogon, Agusan; Impalutao, Bukidnon; and Ganassi, Lanao.

2, 23h 27m 32s* [3, 7h 27m 32s] **Luzon.** Felt by a few persons in Manila.

4, 3h 40m [4, 11h 40m] **Mindanao.** Slight at Talacogon, Agusan.

5, 8h 28m 03s* [5, 16h 28m 03s] **N Luzon.** Reported as strong at Aparri, lasting 15 seconds with oscillations apparently E–W. Laoag reported an intensity of III, duration 5 seconds, oscillations NE–SW, and rumbling sounds in a NE direction before the earthquake. Recorded at Hongkong.

6, 19h 09m [7, 5h 09m] **Guam.** Slight earthquake at Sumay.

8, 10h 18m 51s* [8, 18h 18m 51s] **Mindanao.** Reported from Butuan as strong and from Lais, Davao, as slight. Recorded in the Far East.

9, 0h 00m [9, 8h 00m] **Samar.** Earthquake of intensity I and 5 seconds duration at Catbalogan.

18, 3h 41m 16s* [18, 11h 41m 16s] **Mindanao.** Earthquake of intensity IV, with oscillations apparently NE–SW, at Cotabato. Also reported from Ganassi, Malabang, Lebak and Pikit. The epicenter must have been in the Moro Gulf near SW coast of Mindanao.

20, 10h 03m 38s* [20, 18h 03m 38s] **Samar.** Earthquake of intensity II.

21, 19h 50m [22, 3h 50m] **S Luzon.** Slight earthquake at Bolbok, Batangas.

22, 19h 00m [23, 3h 00m] **SW Luzon.** At Mendez, Cavite.

23, 15h 14m [23, 23h 14m] **Samar.** Earthquake of intensity III at Calbayog.

23, 18h 25m 54s* [24, 2h 25m 54s] **SW Luzon.** Earthquake having its epicenter in the Verde Island passage. Reported from Batangas as having an intensity of IV and a duration of 30 seconds. Calapan, Mindoro reported it as strong with oscillations apparently NE–SW having a duration of 12 seconds. It was felt by a few persons in Manila.

23, 19h 15m [24, 3h 15m] **S Luzon.** An earthquake of intensity II having a duration of 5 seconds, with oscillations apparently E–W, at Atimonan, Tayabas.

25, 9h 53m [25, 17h 53m] **Mindanao.** Earthquake of intensity IV at Cotabato. Also reported from Ganassi.

28, 7h 39m 34s* [28, 15h 39m 34s] **Central Luzon.** Feeble earthquake reported from Bayombong, Nueva Vizcaya.

International Seismological Centre

INSTRUMENTAL RECORD

No.	Date	Phase	Time	T	A_N μ	A_E μ	Δ	Remarks
			h. *m.* *s.*	*s.*			*Km.*	
155	1	eP_{NE}	5 28 30				2580	Off coast of Japan.
		eS_{NE}	5 32 33					
		F	5 58					
156	2	e_{NE}	3 33					
		M_E	3 46 30					
		F	4 12					
157	2	$i\overline{P}_{NE}$	6 12 32				120	Dilatation. China Sea near Zambales coast. Felt in Manila.
		$i\overline{S}_{NE}$	6 12 49					
		m_N	6 12 50	2.3	104			
		m_E	6 13 12	1.8		134		
		F	6 37					
158	2	$e\overline{P}_{NE}$	6 19 41				120	Aftershock of No. 157.
		$i\overline{S}_{NE}$	6 19 56					
159	2	$e\overline{P}_{NE}$	6 40 20				120	Do.
160	2	eP_{NE}	6 43 00				850	Felt in N Mindanao.
		S_{NE}	6 44 20					
		F	7 28					
161	2	$e\overline{P}_{NE}$	20 49 22				120	Aftershock of No. 157.
		F	20 54					
162	2	$e\overline{P}_{NE}$	21 56 45				120	Do.
		F	21 59					
163	2	$i\overline{P}_{NE}$	23 27 32				120	Dilatation. Aftershock of No. 157. Felt in Manila.
		$i\overline{S}_{NE}$	23 27 47					
		m_E	23 28 42	4.5		89		
		m_N	23 28 54	3.8	96			
		F	24 02					
164	3	$e\overline{P}_{NE}$	0 58 23				120	Aftershock of No. 157.
		$i\overline{S}_{NE}$	0 58 38					
		F	1 02					
165	4	$e\overline{P}_{NE}$	17 04 41				120	Do.
		$i\overline{S}_{NE}$	17 04 56					
		F	17 13					
166	4	$e\overline{P}_{NE}$	19 09 55				160	Aftershock of No. 157?
		$i\overline{S}_{NE}$	19 10 15					
		F	19 12					
167	4	$e\overline{P}_{NE}$	22 19 32				120	Aftershock of No. 157.
		F	22 24					
168	5	$e\overline{P}_{NE}$	8 28 03				440	Near Batanes Islands.
		$i\overline{S}_{NE}$	8 29 10					
		F	9 13					
169	5	eP_{NE}	14 34 25				440	Aftershock of preceding earthquake.
		$e\overline{S}_{NE}$	14 35 34					
		F	14 55					
170	8	iP_{NE}	10 18 51				830	Compression. Mindanao.
		iS_{NE}	10 20 24	2.5		125		
		m_E	10 20 33	7.5		178		
		m_E	10 20 40	6.6		135		
		F	11 57					
171	8	e_{NE}	17 57 20					
		F	18 19					
172	9		4 04 44				3570?	
		e_{NE}	4 10 00					
		S_{NE}	4 14 00					
		eL_{NE}	5 05					
		F						
178	18	iP_{NE}	3 41 16				1090	Moro Gulf. Near SW coast of Mindanao.
		S_{NE}?	3 43 12					
		iL_{NE}	3 44 25					
		F	4 32					

International Seismological Centre

Instrumental Record—Continued

No.	Date	Phase	Time	T	AN μ	AE μ	Δ	Remarks
			h. *m.* *s.*	*s.*			*Km.*	
179	19	eP_{NE}	13 55 39					
		F	14 10					
181	20	eP_{NE}	10 03 38					Felt at Catbalogan, Samar.
		iS_{NE}	10 05 07					
		F	10 37					
182	22	eP_{NE}	15 55 39				140	
		F	15 58					
183	23	$i\overline{P}_{NE}$	18 25 54				130	Compression. South Luzon.
		$i\overline{S}_{NE}$	18 26 10					
		m_N	18 26 13					Pen went to limit of its swing, 73 mm.
		m_E	18 26 22	1.2		165		
		F	18 47					
184	25	eP_{NE}	10 41 30				220	
		$i\overline{S}_{NE}$	10 41 58					
		F	10 48					
185	27	eP_{NE}	21 09 40				4310?	
		eS_{NE}?	21 15 35					
		F	22 22					
186	28	eP_{NE}	7 39 34				230	Felt in Bayombong, Luzon.
		$i\overline{S}_{NE}$	7 40 06					
		F	7 49					
187	28	$e\overline{P}_{NE}$	13 17 09				140	
		$i\overline{S}_{NE}$	13 17 27					
		F	13 23					
188	28	iP_{NE}	14 38 19				2640	
		iS_{NE}	14 42 27					
		F	15 32					
189	30	eP_{NE}	18 53 44					
		F	20 00					

In addition to the above there were insignificant or undecipherable disturbances on the following days in April; 10, 13, 15, 16, and 20.

International Seismological Centre

MAY, 1929

MACROSEISMIC RECORD

3, 14h 32m [3, 22h 32m] **Mindanao.** Feeble shock in Surigao.

4, 8h 58m 39s* [4, 16h 58m 39s] **Mindanao.** Strong earthquake of shallow origin near Butuan, probably in the Bay. Vertical vibrations were perceptible and the oscillatory movement seemed to be first in ESE–WNW direction and then NNE–SSW. Clocks were stopped. Felt in Surigao with intensity II and also in Talacogon, Agusan.

5, 20h 00m [6, 6h 00m] **Guam.** Earthquake felt in Sumay.

9, 19h 30m [10, 3h 30m] **Leyte.** Earthquake of intensity II felt in Ormoc for a period of 28 seconds. The oscillations seemed to be SW–NE.

9, 21h 10m [10, 5h 10m] **Mindanao.** Slight earthquake of 3 seconds duration felt in Zamboanga.

10, 10h 40m [10, 18h 40m] **Luzon.** An earthquake of intensity II felt in Bayombong.

12, 10h 15m [12, 18h 15m] **Mindanao.** Slight earthquake felt in Talacogon, Agusan.

12, 15h 35m [12, 23h 35m] **Mindanao.** Earthquake reported from Lais, Davao.

13, 20h 17m 42s [14, 4h 17m 42s] **Mindanao.** Light earthquake of 10 seconds, and oscillations NNE–SSW, felt in Butuan. Also reported from Talacogon.

13, 23h 43m 50s [14, 7h 43m 50s] **Luzon.** Feeble earthquake in Baguio.

16, 6h 15m [16, 14h 15m] **Luzon.** Very feeble earthquake of intensity I felt in Vigan, Ilocos Sur.

17, 2h 40m 05s [17, 10h 40m 05s] **Leyte.** An earthquake of intensity I, duration 10 seconds, oscillations NW–SE, felt in Ormoc.

17, 13h 27m [17, 21h 27m] **Mindanao.** Slight earthquake felt at Talacogon, Agusan.

18, 5h 05m [18, 13h 05m] **Mindanao.** Earthquake reported from Lebak, Cotabato.

20, 23h 04m 16s [21, 7h 04m 16s] **Mindanao.** Feeble earthquake felt in Butuan.

23, 11h 43m 31s [23, 19h 43m 31s] **Mindanao.** Earthquake of about 30 seconds duration felt in Butuan. The shocks which seemed to come from the west were preceded by a rumbling noise.

23, 12h 30m [23, 20h 30m] **Mindanao.** Slight earthquake felt at Talacogon, Agusan.

30, 10h 00m [30, 18h 00m] **Mindanao.** Slight earthquake felt at Cateel, Davao.

International Seismological Centre

INSTRUMENTAL RECORD

No.	Date	Phase	Time	T	A_N μ	A_E μ	Δ	Remarks
			h. *m.* *s.*	*s.*			*Km.*	
190	1	eNE	7 41 01					
		F	9 13					
191	1	eP_{NE}	15 48 16				6370	Persia. 41° N, 53° E.
		$iPcP_{NE}$	15 48 40					
		iS_{NE}	15 56 10					
		iPS_{NE}	15 56 30					
		eL_{NE}	16 07 24					
		eM_{NE}	16 12 00					
		M_{1E}	16 16 55	17		630		
		M_{2N}	16 19 45	13.5	295			
		F	18 15					
193	2	$\overline{iP}_{NE}$	6 14 34				120	
		$\overline{iS}_{NE}$	6 14 49					
		F	6 20					
194	2	eP_{NE}	14 33 22				4400	
		iS_{NE}	14 39 32					Near Hokkaido.
		F	15 41					
195	4	iP_{NE}	8 58 39				800?	Felt in Butuan. Shallow origin.
		iS_{NE}?	9 00 49					
		F	9 58					
196	4	$\overline{eP}_{NE}$	12 41 10				90	
		$\overline{iS}_{NE}$	12 41 22					
		F	12 48					
197	5	$\overline{eP}_{NE}$	5 27 18				180	
		$\overline{iS}_{NE}$	5 27 40					
		F	5 36					
198	5	$\overline{eP}_{NE}$	6 21 29					
		F	6 28					
199	5	$\overline{eP}_{NE}$	8 29 56					
		F	8 39					
200	5	eP_{NE}	13 35 41					
		F	13 42					
2	6	iP_{NE}	5 13 44				2670	Approximate epicenter 5° S: 135° E. Manila–Wellington–Melbourne.
		iS_E	5 17 54					
		F	7 44					
202	7	eP_{NE}	8 47 54				1545	
		iS_{NE}	8 50 34					
		F	9 42					
203	7	iP_{NE}	16 40 19				2750	
		i_{NE}	16 40 35					
		iS_{NE}	16 44 34					
		L_{NE}	16 47 ca					
		F	18 14					
204	10	iP_E	17 29 14					
		F	17 56					
205	11	$\overline{eP}_{NE}$	2 22 43					
206	11	eP_{NE}	11 40 23					
		F	11 59					
207	12	P_{NE}	2 43 ca				170?	Begins in minute gap.
		iS_N	2 43 20					
		F	2 59					
208	13	e_{NE}	13 45 00					
		F	14 47					
209	14	eP_{NE}	0 32 40				210	
		$\overline{iS}_{NE}$	0 33 07					
		F	0 46					
210	15	$\overline{iP}_{NE}$	13 21 06				80	
		$\overline{iS}_{NE}$	13 21 17					
		F	13 23					

Instrumental Record—Continued

International Seismological Centre

No.	Date	Phase	Time	T	A_N μ	A_E μ	Δ	Remarks
			h. *m.* *s.*	*s.*			*Km.*	
212	18	eP_{NE}	6 49 38				8240	Asia Minor. 40.5° N, 37° E by Strasbourg.
		iS_{NE}	6 59 19					
		L_{NE}?	ca7 14 10					
		F	8 13					
214	20	eP_{NE}	4 46 52				220	
		$\overline{S}_{NE}$	4 47 24					
		F	4 58					
215	20	iP_{NE}	5 03 39				6710	Aleutian Islands. 54° N, 178° W.
		iS_{NE}	5 11 44					
		F	6 35					
216	21	iP_{NE}	16 40 23				2200	Off coast of Kyusyu Island, Japan.
		iS_{NE}	16 44					
		F	18 47					
217	22	eP_{NE}	0 35 40				5433	
		eS_{NE}	0 42 41					
		F	1 22					
219	22	eP_{NE}	20 18 41				5660?	
		iL_{NE}?	20 34 10					
		F	21 30					
220	22	eP_{NE}	22 47 35				3822	
		S_{NE}	22 53					
		F	23 33					
221	24	eP_{NE}	18 41 39				3856?	
		L_{NE}?	18 51 30					
		F	19 19					
223	26	iP_{NE}	8 46 57				2190	Ceram, Netherlands East Indies.
		iS_{NE}	8 50 33					
		F	9 57					
224	26	eP_{NE}	22 53 00				9310	Gulf of Alaska. 0 = 22:38:55. 54° N, 139° W, by J. S. A.
		iS_{NE}	23 03 30					
		iL_{NE}	23 20 47					
		m_E	32 24 57	9.6		38		
		m_N	23 25 17	15.9	107			
		M_{1E}	23 45	18		288		
	27	F	1 40					
225	30	eP_{NE}	3 16 24			100		
		F	3 21					

In addition to the above there were insignificant or undecipherable disturbances on the following days of May; 2, 17, 19, 22, 25, and 30(3).

International Seismological Centre

JUNE, 1929

MACROSEISMIC RECORD

1, 23h 10m 32s* [2, 7h 10m 32s] **Mindanao.** A strong earthquake of 45 seconds duration in Butuan. The first shocks seemed to come from the NE and the succeeding oscillations seemed to be in SSE–NNW and SW–NE directions. Felt with an intensity II in Surigao.

13, 6h 40m [13, 14h 40m] **Luzon.** Earthquake felt at Kapangan, Benguet Subprovince.

13, 7h 50m [13, 15h 50m] **Luzon.** Slight earthquake at Bokod, Benguet Subprovince.

13, 9h 26m 42s* [13, 17h 26m 42s] **Mindanao.** A very severe earthquake whose epicenter seemed to be located on the eastern side of the Agusan Valley in the southeastern part of the Province of Agusan. As happens in many of the earthquakes of this region the macroseismic area had a much greater extension in a N–S direction than E–W. Legaspi and Sorsogon, about 550 kilometers to the NNW reported an intensity of III, while Cotabato and Ganassi, about 170 kilometers to the west and southewest reported an intensity of only II. Hinatuan, on the Pacific coast, suffered more damage than any other place. Davao, to south, reported an intensity of V, and Lais, about 170 kilometers to the south reported it as "heavy." In the central part of the Agusan Valley aftershocks were felt daily until the end of the month. Hinatuan also experienced the aftershocks, noting as many as 22 in one day.

This earthquake will be treated more fully in the next number of the Bulletin. It seems to have been very similar in intensity and area to that of July 12, 1911 which was fully described in the Bulletin for July 1911, and was recorded at all observatories.

15, 8h 59m 50s* [15, 16h 59m 50s] **Panay, Cebu and Negros.** An earthquake of intensity IV in Iloilo. The vibrations seemed to be in a N–S direction. In the island of Cebu the intensity was II and III.

18, 12h 13m 30s* [18, 20h 13m 30s] **Luzon.** An earthquake whose origin was under the China Sea off the NW end of Luzon. Felt at Laoag with intensity III and also reported from Cape Bojeador and Pasuquin.

26, 11h 29m 57s* [26, 19h 29m 57s] **Sámar and Leyte.** Felt along the southwest coast of Samar and the northeast coast of Leyte. Tacloban reported an intensity of V, with duration 4 seconds, and Catbalogan an intensity of IV.

30, 2h 16m [30, 10h 16m] **Samar.** Earthquake of intensity II, duration 10 seconds, direction NE–SW, reported from Catbalogan.

30, 13h 30m [30, 21h 30m] **Luzon.** Slight earthquake felt at Itogon, Benguet Subprovince.

International Seismological Centre

INSTRUMENTAL RECORD

No.	Date	Phase	Time	T	A_N μ	A_E μ	Δ	Remarks
			h. m. s.	*s.*			*Km.*	
229	1	eP_{NE}	7 48 34				2620	
		iS_{NE}	7 52 40					
		F	8 10					
230	1	iP_{NE}	18 02 27				1540	Off Okinawa Island. Japan.
		iS_{NE}	18 05 08					
		F	18 57					
231	1	eP_{NE}	23 10 22				800	Near NE coast of Mindanao.
		iS_{NE}	23 11 51					
		F	23 24					
233	2	iP_{NE}	21 43 20				3500	Off coast of Wakayama, Japan. Double earthquake.
		m_E	21 47 30	5.2		72		
		iS_{NE}?	21 48 16					
		m_N	21 50 06	7.2	70			
		m_E	21 51 09	6.4		79		
		iL_{NE}?	21 52 06					
		m_N	21 52 30	7.4	75			
		m_E	21 53 52	5.3		71		
		M_N	21 54 42	7.9	32			
		F	22 56					
234	3	iP_{NE}	20 39 37				5740	Data of Manila, Hamburg and Ottawa give epicenter about 54° N, 80° E.
		iS_{NE}	20 46 56					
		F	21 32					
236	4	iP_{NE}	15 18 07				645	
		$\overline{iP}_{NE}$	15 18 29					
		$\overline{iS}_{NE}$	15 19 50					
		m_N	15 19 47	5.2	204			
		m_E	15 19 58	3.5		157		
		M_N	15 20 26	7.4	198			
		M_E	15 21 24	7.0		184		
		F	16 42					
239	6	eP_{NE}	15 48 50				2980	
		iS_{NE}	15 53 20					
		L_{NE}	15 56 08					
		F	16 48					
240	8	iP_{NE}	12 32 50					
		F	12 40					
241	9	eP_{NE}	9 15 31				4710	Kurile Islands. 47.1° N, 153.7° E, by J. S. A.
		S_{NE}	9 21 37					
		L_{NE}	ca9 27 20					
		M_N	9 27 22	9	18			
		F	11 31					
245	12	P_{NE}	11 48 58				4555	In minute gap. 2° N, 162° E: Manila–Melbourne–Zikawei.
		iS_{NE}	11 55 08					
		F	13 22					
246	12	eP_{NE}	14 35 40					
		F	15 11					
247	13	eP_{NE}	0 19 56				4740	Kurile Islands. 47.1° N, 153.7° E, by J. S. A. 0 = 0:11:47.
		iS_N	0 26 20					
		L_N	0 31 15					
		M_N	0 43 14	14.6	94			
		M_E	0 43	15.0		112		
		F	3 08					
248	13	eP_{NE}	9 26 42				880	Compression. Felt over SE Philippines. 8° 20′ N, 126° E, ca.
		iP_{NE}	9 26 45					
		iS_{NE}	9 28 25					
			9 30	[a]				
		F	12 22					
249	13	eP_{NE}	19 49 44					Aftershock of No. 248
		iS_{NE}	19 51 32					
		L	19 52 42					
		F	22 14					
250	13	eP_{NE}	23 02 46					Do.
		iS_{NE}	23 04 32					
		iL_{NE}	23 05 42					
		M_E	23 06 30	10		395		
		M_N	23 06 30	12	700			

[a] Pens thrown off.

Instrumental Record—Continued

International Seismological Centre

No.	Date	Phase	Time	T	A_N μ	A_E μ	Δ	Remarks
			h. *m.* *s.*	*s.*			*Km.*	
251	14	P?	0 18 32					No. 250 still recording. Aftershock of No 248.
		S_{NE}	0 20 21					
		L	0 21 34					
253	14	eP_{NE}	7 55 50					Aftershock of No. 248.
		iS_{NE}	7 57 40					
		L	7 58 42					
		F	9 19					
256	14	eP_{NE}	23 15 24					Do.
		iS_{NE}	23 17 10					
		L	23 18 24					
	15	F	0 58					
258	15	iP_{NE}	8 59 50	7			450?	Felt in Panay.
		iS_{NE}?	9 00 45					
		i_{NE}	9 01 32					
		F	10 08					
259	15	iP_{NE}	11 11 38					Aftershock of No. 248.
		F	11 34					
260	15	iP_{NE}	16 04 ca					Do.
		iS_N	16 05 44					
		L	16 06 46					
261	15	$\overline{eP}_{NE}$	17 43 08				155	
		i_{NE}	17 43 10					
		$\overline{iS}_{NE}$	17 43 25					
		F	18 26					
262	15	eP_{NE}	19 37 33					Do.
		iS_N	19 39 48					
263	15	eP_{NE}	21 10 ca					Begins in minute gap and No. 262 still recording.
		iS_N	21 11 50					Aftershock of No. 248?
		F	23 08					
264	16	eP_{NE}	5 29 11					Aftershock of No. 248?
		F	6 02					
265	16	eP_{NE}	14 54 00					Do.
		F	15 58					
266	16	iP_{NE}	22 53 ca				8260	Begins in minute gap. New Zealand. 0 = 22:47:26
		PcP_{NE}	22 59 21					
		i_N	23 01 31					
		iPR_{1N}	23 02 10					Epicenter, 41.9° S; 172.5° E, according to Wellington.
		iS_{NE}	23 08 44					
		iPS_{NE}	23 09 20					
		$i\,ScS_{NE}$	23 09 42					
		i_{NE}	23 13 48					
		SR_{2N}	23 17 40					
		m_E	23 18 24	13.7		310		
		L_{NE}	23 23 00					
		m_N	23 25 58	19.7	800			
		M_N	23 28 19					
	17	F	2 34					
267	17	eP_{NE}	4 04 44					Aftershock of No. 248?
268	17	iP_{NE}	10 18 34					Aftershock of No. 248.
		iS_{NE}	10 20 23					
		L	10 21 33					
		F	12 49					
269	17	eP_{NE}	21 17 16					
		F	21 26					
271	18	eP_{NE}	12 13 30				440	N Luzon.
		iS_{NE}	12 14 19					
		F	12 28					
273	18	eP_E	18 22 56					
		F	18 52					
275	19	iP_{NE}	7 32 53					Aftershock of No. 248.
		iS_{NE}	7 34 52					
		m_N	7 37 27	9.2	460			
		m_E	7 38 09	10.5		468		
		F	10 19					

International Seismological Centre

Instrumental Record—Continued

No.	Date	Phase	Time	T	A_N μ	A_E μ	Δ	Remarks
			h. *m.* *s.*	*s.*			*Km.*	
278	19	eP_{NE}	22 39 27					
		F	23 28					
279	20	eP_{NE}	18 26 06				2600	East Java.
		iS_{NE}	18 32 10					
		F	19 02					
280	20	eP_{NE}	20 12 41					Aftershock of No. 248.
		iS_N	20 14 41					
		iL_N	20 15 47					
		F	22 01					
281	21	iP_{NE}	4 43 04					Do.
		iS_{NE}	4 45					
		F	6 38					
282	21	eP_N	13 22 22					Do.
		iS_N?	13 24 50					
		F	14 20					
286	22	iP_{NE}	15 41 40					New Zealand?
		F	16 48					
287	22	eP_{NE}	17 41 44					
		iS_{NE}	17 43 48					
		F	19 19					
288	23	eP_{NE}	3 14 22					Aftershock of No. 248.
		S_{NE}	3 16 08					
		L_{NE}	3 17 15					
		F	4 34					
289	23	iP_{NE}	21 49 26					Do.
		iS_{NE}	21 51 19					
		L_{NE}	21 52 25					
	24	F	0 11					
291	25	eP_E	18 48 36				230	
		iS_{NE}	18 49 06					
		F	19 07					
292	26	eP_{NE}	3 18 08				190	
		iS_{NE}	3 18 34					
		F	3 29					
293	26	eP_{NE}	11 29 57				740	Samar and Leyte.
		eS_E	11 31 18					
		F	11 51					
294	26	eP_{NE}	15 54 42				880?	
		eS_N?	15 56 18					
		F	16 18					
295	26	eP_{NE}	16 55 23					Off Cape Inubo, Japan.
		F	17 28					
297	27	e_N	13 06 21					Extreme South Atlantic.
		i_E	13 06 28					
		i_N	13 06 33					
		i_N	13 09 54					
		i_{NE}	13 10 58					
		i_{NE}	13 12 34					
		F	16 22					
298	28	eP_{NE}	9 07 47				1190	
		iS_{NE}	9 09 50					
		F	10 04					
299	30	iP_{NE}	2 46 48					Aftershock of No. 248?
		iS_{NE}	2 49					
		iL_{NE}	2 50 12					
		M	2 51 18					
		M_{1E}	2 51 48	7.8		225		
300	30	iP_{NE}	5 15 48					No. 299 still recording.
		iS_{NE}	5 17 30					
		L	5 18 42					
		F	7 27					

In addition to the above there were insignificant or undecipherable disturbances on the following days of June; 2, 4, 6(2), 10(3), 14(3), 15, 18(3), 19(2), 21, 22(2), 25, 26, and 30(2).

International Seismological Centre

INTRODUCCIÓN

Damos en el texto inglés la lista de las estaciones sísmicas existentes en enero de 1929. Además todas las estaciones meteorológicas oficiales y voluntarias, cuyo número asciende a doscientas cincuenta, tienen las instrucciones necesarias para dar cuenta de todos los temblores perceptibles.

La intensidad de los terremotos se indica conforme a la conocida escala de Rossi-Forel. Cuanto a la hora en que tuvieron lugar, adoptamos la indicada por los sismógrafos de este Observatorio siempre que los hayan registrado, distinguiéndola por medio de un asterisco (*). En caso contrario copiamos la hora apuntada por los observadores que nos envían las notas. Todas las horas se refieren a la hora media de Greenwich (medianoche=0^h). Para conveniencia de los lectores de Filipinas se añade también la hora insular.

ESCALA DE INTENSIDADES DE ROSSI-FOREL

I. *Temblor instrumental:* registrado tan sólo por los sismógrafos.
II. *Temblor muy ligero:* sentido solamente por algunas personas en estado de reposo, especialmente en los pisos superiores de las casas, o por personas nerviosas y muy sensibles.
III. *Temblor ligero:* sentido por varias personas en reposo; bastante fuerte para apreciar su dirección y duración.
IV. *Temblor bien sensible:* sentido por muchas personas en movimiento.
V. *Temblor de regular intensidad:* sentido generalmente por todos. Movimientos de muebles y otros objetos no muy pesados; grandes oscilaciones de objetos suspendidos.
VI. *Temblor fuerte:* despiértanse los dormidos; tocan las pequeñas campanas; parada de relojes de péndulo; pánico y salida de las personas de sus viviendas.
VII. *Temblor muy fuerte:* movimientos sentidos por todos; espanto general; todos se precipitan a la calle; caída de objetos y del yeso de las paredes; desperfectos en algunos edificios poco sólidos.
VIII. *Temblor excesivamente fuerte, violento:* tocan las campanas, caen chimeneas, tejas de los tejados, etc., daños de poca consideración en muchos edificios.
IX. *Terremoto ruinoso:* ruina parcial de algunos edificios y desperfectos notables en los demás. Sin desgracias personales, fuera de algunos contusos y heridos.
X. *Terremoto desastroso:* ruina total o casi total de muchos edificios y grandes desperfectos en los demás; víctimas numerosas. Grietas y hundimientos en el suelo y derrumbes en los montes.

International Seismological Centre

ENERO, 1929

1, $8^h\ 35^m\ 22^s$* [1, $16^h\ 35^m\ 22^s$] **Centro de Luzón.** Ligero temblor en Dagupan (oscilaciones al parecer de NE–SW), Tárlac y Camiling.

3, $12^h\ 45^m$ [3, $20^h\ 45^m$] **Mindanao.** Temblor en Ganassi, Lánao.

4, $17^h\ 15^m$ [5, $1^h\ 15^m$] **Mindanao.** Ligera sacudida en Butúan.

6, $13^h\ 00^m$ [6, $21^h\ 00^m$] **Negros.** Ligero temblor en Victorias.

8, $0^h\ 39^m$ [8, $8^h\ 39^m$] **Mindanao.** Temblor en Malabang, Lánao.

9, $19^h\ 54^m\ 34^s$* [10, $3^h\ 54^m\ 34^s$] **SE de Luzón.** Temblor sentido en Albay y Camarines Sur. La mayor intensidad fué V sentido en Naga. En Legaspi las oscilaciones fueron al parecer de NW–SE, que duraron unos 15 segundos. También se sintió en Iriga y Guinobatan.

14, $17^h\ 30^m\ 11^s$* [15, $1^h\ 30^m\ 11^s$] **N de Luzón.** Temblores en Bokod. Véase la nota especial.

15, Sin hora. **Mindanao.** Temblor en Cotabato.

17, $7^h\ 42^m$ [17, $15^h\ 42^m$] **SW de Luzón.** Ligera sacudida en Imus, Cavite.

17, $13^h\ 54^m\ 19^s$* [17, $21^h\ 54^m\ 19^s$] **SE de Luzón.** Temblor de intensidad II sentido en Dáet, Camarines Norte. Las vibraciones al parecer eran en la dirección SW–NE y su duración fué de dos segundos.

18, $16^h\ 05^m$ [19, $0^h\ 05^m$] **Mindanao.** Temblor de intensidad III sentido en Surigao.

19, $0^h\ 44^m\ 47^s$* [19, $8^h\ 44^m\ 47^s$] **Mindanao.** Ligero temblor oscilatorio con vibraciones que duraron 15 segundos en Lais y Malita, provincia de Dávao.

23, $7^h\ 28^m$ [23, $15^h\ 28^m$] **Mindanao.** Temblor de intensidad II en Cotabato.

26, $2^h\ 10^m$ [26, $10^h\ 10^m$] **Mindanao.** Ligera sacudida en Ganassi y Malabang, Lánao.

26, $4^h\ 14^m$ [26, $12^h\ 14^m$] **Batanes.** Temblor de intensidad II, y de corta duración sentido en Basco.

27, $14^h\ 00^m$ [27, $22^h\ 00^m$] **Mindanao.** Ligera sacudida en Butúan, Agusan.

28, $22^h\ 00^m$ [29, $6^h\ 00^m$] **Mindanao.** Temblor en Bual, Cotabato que duró 10 segundos.

30, $15^h\ 28^m$ [31, $1^h\ 28^m$] **Guam.** Repentina sacudida en Sumay.

FEBRERO, 1929

2, 6h 10m [2, 14h 10m] **Mindanao.** Ligera sacudida en Talacogon, Agusan.

2, 7h 22m 10s [2, 15h 22m 10s] **Mindanao.** Ligerísimo temblor en Butúan, Agusan, duración 15 segundos.

2, 13h 10m 50s [2, 21h 10m 50s] **Mindanao.** Zamboanga sintió un ligero temblor cuyas oscilaciones, al parecer eran de E–W, su duración fué de 3 segundos. Otro temblor ocurrió en Ganassi a la misma hora, pero probablemente era de diferente foco.

2, 21h 40m [3, 5h 40m] **SE de Luzón.** Temblor de intensidad III en Virac, subprovincia de Catanduanes.

4, 19h 30m [5, 3h 30m] **Mindanao.** Temblor en Bual, Cotabato.

6, 12h 10m [6, 20h 10m] **Centro de Luzón.** Ligero temblor en Bokod, Benguet.

15, 5h 43m 13s* [15, 13h 43m 13s] **E de Mindanao.** En Veruela, valle de Agusan temblor violento, también fué sentido en Glan hacia el sur, en Butúan hacia el norte y en Malaybalay al oeste.

18, 7h 14m 35s* [18, 15h 14m 35s] **Centro de Luzón.** Temblor de intensidad II en Baguio.

18, 10h 58m 10s [18, 18h 58m 10s] **Mindanao.** Temblor de corta duración en Butúan, Agusan.

22, 11h 29m 16s* [22, 19h 29m 16s] **S de Luzón.** Ligero temblor en Los Baños y en Santa Cruz, Laguna.

22, 17h 30m 39s [23, 1h 30m 39s] **Mindanao.** Temblor de intensidad IV en Butúan, Agusan.

26, ... **Mindanao.** En la madrugada temblor en Cotabato. No se menciona la hora.

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MARZO, 1929

4, Sin hora. **Centro de Luzón.** Dos temblores pequeños sentidos en Bokod, Benguet. Probablemente relacionados con la serie de enero–febrero.

8, $8^h\ 35^m$ [8, $16^h\ 35^m$] **SE de Luzón.** Temblor sentido en Bacon, Sorsogón.

10, $0^h\ 56^m$* [10, $8^h\ 56^m$] **Leyte.** Temblor sentido en Tacloban.

13, $4^h\ 42^m$ [13, $12^h\ 42^m$] **Mindanao.** Ligero temblor en Talacogon, Agusan.

14, $18^h\ 00^m$ [15, $2^h\ 00^m$] **Mindanao.** Temblor en Bual, Cotabato.

16, $16^h\ 05^m$ [17, $0^h\ 05^m$] **Mindanao.** Una sacudida de intensidad II sentido en Cotabato.

16, $22^h\ 59^m\ 28^s$* [17, $6^h\ 59^m\ 28^s$] **Mindanao.** Temblor de intensidad II en Butúan, Agusan.

16, $23^h\ 23^m$ [17, $7^h\ 23^m$] **Mindanao.** Ligera sacudida en Talacogon, Agusan.

19, $18^h\ 23^m$ [20, $2^h\ 23^m$] **N de Luzón.** Temblor de intensidad III, de 4 segundos de duración, sentido en Vigan.

20, $21^h\ 11^m\ 42^s$* [21, $5^h\ 11^m\ 42^s$] **N de Luzón.** Temblor que afectó el extremo norte de Luzón. En Cabo Bojeador la intensidad fué IV y duró 6 segundos; en Aparri fué fuerte con 32 segundos de duración y con oscilaciones aparentemente de E–W. Registrado en Zikawei.

23, $5^h\ 07^m$ [23, $13^h\ 07^m$] **Leyte.** Temblor de intensidad II en Tacloban.

26, $4^h\ 18^m\ 49^s$* [26, $12^h\ 18^m\ 49^s$] **Mindanao.** Temblor sentido al oeste de Cotabato y sudoeste de Lánao. Los pueblos que dieron la noticia fueron: Malabang, Lebak, Pikit y Cotabato en este último lugar tuvo intensidad II.

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ABRIL, 1929

1, 18h 33m [2, 2h 33m] **Mindanao.** Temblor en Butúan, Agusan. Por efecto de la sacudida el reloj de péndulo paró.

2, 6h 12m 32s* [2, 14h 12m 32s] **Luzón.** Temblor de intensidad IV en Olongapó. Sentido también por varias personas en Manila. Epicentro en el mar de la China.

2, 6h 43m 00s* [2, 14h 43m 00s] **Mindanao.** Ligero temblor sentido en Mindanao a lo largo de un área del NE al SW. Las estaciones que dieron cuenta fueron: Talacogon, Agusan; Impalutao, Bukidnón; y Ganassi, Lánao.

2, 23h 27m 32s* [3, 7h 27m 32s] **Luzón.** Temblor sentido por varias personas en Manila.

4, 3h 40m [4, 11h 40m] **Mindanao.** Ligero temblor en Talacogon, Agusan.

5, 8h 28m 03s* [5, 16h 28m 03s] **N de Luzón.** Temblor fuerte en Aparri con oscilaciones aparentemente de E–W, duración 15 segundos. Laoag lo sintió con intensidad III, las oscilaciones fueron de NE–SW y su duración 5 segundos, se oyó ruido subterráneo hacia el NE antes del temblor. Registrado en Hongkong.

6, 19h 09m [7, 5h 09m] **Guam.** Ligero temblor en Sumay.

8, 10h 18m 51s* [8, 18h 18m 51s] **Mindanao.** Temblor algo fuerte en Butúan y ligero en Lais, Dávao. Registrado en Hongkong.

9, 0h 00m [9, 8h 00m] **Sámar.** Temblor de intensidad II y 5 segundos de duración en Catbalogan.

18, 3h 41m 16s* [18, 11h 41m 16s] **Mindanao.** Temblor de intensidad IV, con oscilaciones aparentemente de NE–SW sentido en Cotabato. También se sintió en Ganassi, Malabang, Lebak y Pikit. El epicentro debía hallarse en el mar de Célebes cerca de la costa SW de Mindanao.

20, 10h 03m 38s* [20, 18h 03m 38s] **Sámar.** Temblor de intensidad II.

21, 19h 50m [22, 3h 50m] **S de Luzón.** Ligero temblor en Bolbok, Batangas.

22, 19h 00m [23, 3h 00m] **SW de Luzón.** Temblor en Méndez, Cavite.

23, 15h 14m [23, 23h 14m] **Sámar.** Temblor de intensidad III sentido en Calbayog.

23, 18h 25m 54s* [24, 2h 25m 54s] **SW de Luzón.** Temblor cuyo centro se hallaba en el paso de Isla Verde. Sintióse en Batangas con intensidad IV y 30 segundos de duración, en Calapán, Mindoro, fué fuerte, con oscilaciones aparentemente de NE–SW y 12 segundos de duración. También fué sentido en Manila por algunas personas.

23, 19h 15m [24, 3h 15m] **S de Luzón.** Temblor en Atimonan, Tayabas, de intensidad II, sus oscilaciones aparentemente fueron de E–W, su duración de 5 segundos.

25, 9h 53m [25, 17h 53m] **Mindanao.** Temblor de intensidad IV en Cotabato, también fué sentido en Ganassi.

28, 7h 39m 34s* [28, 15h 39m 34s] **Centro de Luzón.** Ligerísimo temblor en Bayombong, Nueva Vizcaya.

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MAYO, 1929

3, 14h 32m [3, 22h 32m] **Mindanao.** Ligerísima sacudida en Surigao.

4, 8h 58m 39s* [4, 16h 58m 39s] **Mindanao.** Fuerte temblor de origen poco profundo cerca de Butúan, probablemente en la bahía. Se percibieron movimientos verticales y las oscilaciones parecían ser al principio de ESE–WNW y después de NNE–SSW. Hubo parada de relojes. Se sintió en Surigao y en Talacogon, Agusan, con intensidad III.

5, 20h 00m [6, 6h 00m] **Guam.** Temblor sentido en Sumay.

9, 19h 30m [10, 3h 30m] **Leyte.** Temblor de intensidad II en Ormoc que duró 28 segundos, las oscilaciones parecían ser de SW–NE.

9, 21h 10m [10, 5h 10m] **Mindanao.** Ligero temblor de 3 segundos de duración en Zamboanga.

10, 10h 40m [10, 18h 40m] **Luzón.** Temblor de intensidad II en Bayombong, Nueva Vizcaya.

12, 10h 15m [12, 18h 15m] **Mindanao.** Ligero temblor en Talacogon, Agusan.

12, 15h 35m [12, 23h 35m] **Mindanao.** Temblor en Lais, Dávao.

13, 20h 17m 42s [14, 4h 17m 42s] **Mindanao.** Ligero temblor de 10 segundos de duración y oscilaciones NNE–SSW sentido en Butúan. También se sintió en Talacogon.

13, 23h 43m 50s [14, 7h 43m 50s] **Luzón.** Ligerísimo temblor en Baguio.

16, 6h 15m [16, 14h 15m] **Luzón.** Ligerísimo temblor de intensidad II sentido en Vigan, Ilocos Sur.

17, 2h 40m 05s [17, 10h 40m 05s] **Leyte.** Temblor de intensidad II, duración 10 segundos, oscilaciones NW–SE sentido en Ormoc.

17, 13h 27m [17, 21h 27m] **Mindanao.** Ligero temblor en Talacogon, Agusan.

18, 5h 05m [18, 13h 05m] **Mindanao.** Temblor en Lebak, Cotabato.

20, 23h 04m 16s [21, 7h 04m 16s] **Mindanao.** Ligero temblor en Butúan.

23, 11h 43m 31s [23, 19h 43m 31s] **Mindanao.** Temblor en Butúan de unos 30 segundos de duración. Las sacudidas que parecían venir del oeste fueron precedidas de un ruido subterráneo.

23, 12h 30m [23, 20h 30m] **Mindanao.** Ligero temblor en Talacogon, Agusan.

30, 10h 00m [30, 18h 00m] **Mindanao.** Ligero temblor en Cateel, Dávao.

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JUNIO, 1929

1, 23h 10m 32s* [2, 7h 10m 32s] **Mindanao.** Fuerte temblor de 45 segundos de duración en Butúan. Los primeros choques parecían venir del NE y las siguientes oscilaciones parecían ser de SSE–NNW y de SW–NE. Sentido en Surigao con intensidad II.

13, 6h 40m [13, 14h 40m] **Luzón.** Temblor en Kapangan, subprovincia de Benguet.

13, 7h 50m [13, 15h 50m] **Luzón.** Ligero temblor en Bokod, subprovincia de Benguet.

13, 9h 26m 42s* [13, 17h 26m 42s] **Mindanao.** Temblor excesivamente fuerte cuyo epicentro parecía hallarse hacia el lado este del valle del Agusan en la parte sudeste de la provincia del mismo nombre. Como sucede en muchos de los temblores sentidos en esta región el área macrosísmica es de mucha mayor extensión en la dirección N–S que en la E–W. Legaspi y Sorsogón que están a unos 550 kilómetros de distancia hacia el NNW tuvo intensidad III, mientras que Cotabato y Ganassi que están a unos 170 kilómetros hacia el oeste y sudoeste sólo fué de intensidad II. Hinatuan, que está en la costa del Pacífico sufrió más daños que cualquier otro lugar. Dávao que está hacia el sur tuvo intensidad V, y Lais a unos 170 kilómetros hacia el sur lo calificó de "muy fuerte." Diariamente hasta fines del mes se sintieron varias repeticiones en la parte central del valle del Agusan. Hinatuan también sintió las repeticiones haciendo notar que en un solo día hubo 22.

Este temblor se tratará más extensamente en el siguiente número del Boletín. Parece ser semejante en intensidad y extensión al del 12 de julio de 1911, el cual fué extensamente descrito en el Boletín de julio de 1911, y fué registrado en todos los observatorios.

15, 8h 59m 50s* [15, 16h 59m 50s] **Panay, Cebú y Negros.** Temblor de intensidad IV en Iloílo. Las oscilaciones parecían tener la dirección de N–S. En la isla de Cebú la intensidad fué de II a III.

18, 12h 13m 30s* [18, 20h 13m 30s] **Luzón.** Temblor de intensidad III en Laoag, también fué sentido en Cabo Bojeador y Pasuquin. Su origen se hallaba en el mar de la China algo lejos del extremo NW de Luzón.

26, 11h 29m 57s* [26, 19h 29m 57s] **Sámar y Leyte.** Temblor sentido a lo largo de la costa sudoeste de Sámar y de la costa nordeste de Leyte. En Tacloban tuvo intensidad V con 4 segundos de duración, y en Catbalogan intensidad IV.

30, 2h 16m [30, 10h 16m] **Sámar.** Temblor de intensidad II en Catbalogan, duración 10 segundos, dirección NE–SW.

30, 13h 30m [30, 21h 30m] **Luzón.** Ligero temblor en Itogon, subprovincia de Benguet.

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SEISMOLOGICAL BULLETIN FOR 1929

JULY-DECEMBER

DOMINION OBSERVATORY
RECEIVED
24 OCT. 1930
WELLINGTON, N.Z.

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INTRODUCTION

SEISMIC STATIONS

The following is the list of seismological stations equipped with seismographs.

Name	Province	North latitude	East longitude	Elevation	Equipment
		° ′	° ′	*m.*	
Manila	Manila	14 35	120 59	2.5	Wiechert Inverted Pendulum, mass 1000 Kg., 2 components. Vicentini seismograph, 3 components. Two horizontal pendulum seismographs, mass 20 Kg. each.
Baguio	Mountain	16 25	120 35	1,512.0	Vicentini seismograph, 3 components. Two horizontal pendulum seismographs, mass 120 Kg. each.
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., 2 components.
Agaña	Guam	13 24	144 38	5.0	Do.

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

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 (midnight=0^h), 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 of the Wiechert Inverted Pendulum in the Manila Observatory.

ROSSI-FOREL SCALE OF EARTHQUAKE INTENSITIES

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 furniture, 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-falls from mountains.

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CONSTANTS OF THE WIECHERT PENDULUM

Date	N–S component				E–W component			
	T_o	V	ϵ	$\frac{r}{T_o^2}$	T_o	V	ϵ	$\frac{r}{T_o^2}$
1929								
July	7.34	144	3.9	0.025	7.43	160	3.3	0.024
August	7.38	159	4.3	0.025	7.49	146	4.4	0.028
September	7.56	130	3.6	0.026	7.75	141	4.4	0.027
October	7.54	150	4.1	0.029	7.48	164	4.5	0.030
November	7.82	156	4.7	0.019	7.85	155	5.5	0.024
December	7.74	153	4.8	0.020	7.78	157	6.3	0.019

NOTE.—The subsoil of Manila Observatory is alluvium.

SYMBOLS AND ABBREVIATIONS

P	Normal first preliminary tremors; longitudinal waves which have passed below the continental layer.
$\overline{P}$	Upper first preliminary tremors whose path lies wholly in the continental layer.
P′	Longitudinal waves that have traversed the earth's core.
PRn	Longitudinal waves reflected "n" times at the earth's surface.
PcP	Longitudinal waves reflected from the outer surface of the earth's core.
S	Normal second preliminary tremors; transverse waves that have passed below the continental layer.
$\overline{S}$	Second preliminary tremors whose path lies entirely in the continental layer.
PS	Waves transformed from longitudinal to transverse oscillations or vice versa through one reflection at the earth's crust.
SRn	Normal transverse waves reflected "n" times at the earth's surface.
ScS	Normal transverse waves reflected from the outer surface of the earth's core.
$\overline{ScPcP}$	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 emergence 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.

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MACROSEISMIC RECORD

1, $3^h\ 30^m$ [1, $11^h\ 30^m$] **Mindanao.** Slight earthquake felt at Talacogon.

1, $19^h\ 24^m\ 37^s$* [2, $3^h\ 24^m\ 37^s$] **Samar and Cebu.** Earthquake of intensity II, lasting 15 seconds, felt at Catbalogan, Samar. Felt slightly at Tuburan, Cebu.

2, $0^h\ 40^m\ 15^s$* [2, $8^h\ 40^m\ 15^s$] **Mindanao.** Earthquake felt over the NE part of Mindanao. At Butuan it was felt for 70 seconds and attained an intensity of IV. The beginning was characterized by gentle waves and these were followed by a strong phase. Probably from the same epicenter as the earthquake of June 13th. Felt also at Cantilan, Province of Surigao, and at Talacogon, Province of Agusan.

Ten or more light shocks were felt at Butuan during the course of the day.

3, $10^h\ 28^m\ 49^s$* [3, $18^h\ 28^m\ 49^s$] **Luzon.** Light earthquake felt in Manila and in the Provinces of Cavite and Batangas. Epicenter probably in the Verde Island Passage.

6, $1^h\ 50^m$ [6, $9^h\ 50^m$] **Mindanao.** Slight shock felt at Talacogon. A second shock at $11^h\ 16^m$, local time.

6, $15^h\ 47^m$ [6, $23^h\ 47^m$] **Mindanao.** Shock of intensity II felt at Butuan. Duration 15 seconds.

8, $10^h\ 50^m\ 30^s$* [8, $18^h\ 50^m\ 30^s$] **SE Luzon.** Earthquake of intensity V at Virac and IV at Legaspi. The origin was in the Philippine Deep.

9, $2^h\ 01^m$ [9, $10^h\ 01^m$] **Leyte.** A local shock of intensity III felt at Tacloban.

9, $2^h\ 48^m\ 05^s$ [9, $10^h\ 48^m\ 05^s$] **Mindanao.** Earthquake of intensity II, lasting 20 seconds, felt at Butuan. Felt slightly at Talacogon.

9, $17^h\ 31^m\ 10^s$ [10, $1^h\ 31^m\ 10^s$] **Mindanao.** Local shock of intensity II felt at Butuan.

10, $6^h\ 30^m$ [10, $14^h\ 30^m$] **Mindanao.** Slight earthquake felt at Talacogon.

13, $4^h\ 53^m\ 22^s$* [13, $12^h\ 53^m\ 22^s$] **Luzon.** Felt by few persons in Manila.

14, $19^h\ 25^m$ [15, $3^h\ 25^m$] **Palawan.** Earthquake of intensity II felt at Puerto Princesa.

15, $0^h\ 16^m$ [15, $8^h\ 16^m$] **Mindanao.** Slight shock felt at Talacogon.

16, $12^h\ 05^m$ [16, $20^h\ 05^m$] **Luzon.** Strong local shock of intensity VI reported from Baler, Province of Tayabas.

17, $17^h\ 22^m\ 16^s$ [18, $1^h\ 22^m\ 16^s$] **Mindanao.** A light earthquake of short duration felt by some persons.

17, $19^h\ 00^m$ [18, $3^h\ 00^m$] **Mindanao.** Slight earthquake felt at Talacogon.

18, $10^h\ 07^m$ [18, $18^h\ 07^m$] **Luzon.** Local earthquake of intensity III reported from Infanta.

19, $7^h\ 06^m$ [19, $15^h\ 06^m$] **Mindanao.** Very light shock felt at Butuan and Talacogon.

21, $13^h\ 16^m\ 55^s$* [21, $21^h\ 16^m\ 55^s$] **Luzon.** Strong earthquake felt through the Provinces of Albay and the Camarines. At Virac, island of Catanduanes, its intensity was V and it was preceded by a roaring sound. Some concrete walls were cracked and some fences overthrown.

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A second, but lighter, shock was felt over the same area at 13h 22m 30s*. The epicenter was at about 14° 34′ N; 123° 58′ E.

21, 13h 36m [21, 21h 36m] **Mindanao.** Local earthquake of intensity V felt at Zamboanga.

24, 2h 37m 28s* [24, 10h 37m 28s] **SE Luzon.** Earthquake lasting 8 seconds felt at Baras, island of Catanduanes.

24, 5h 07m 23s* [24, 13h 07m 23s] **SE Luzon.** Light earthquake felt over the same area as on the 21st. Intensity III at Daet and Naga.

27, 1h 30m [27, 9h 30m] **Luzon.** Earthquake reported from Tabaco, Province of Albay.

28, 18h 15m [29, 2h 15m] **Mindanao.** Slight shock felt at Cantilan and Talacogon.

INSTRUMENTAL RECORD

No.	Date	Phase	Time	T	A_N μ	A_E μ	Δ	Remarks
			h. m. s.	*s.*			*Km.*	
302	1	e_{NE}	6 31 47					
		F	7 35					
303	1	e_{NE}	19 24 37					Felt at Catbalogan, Samar.
304	1	$\overline{iP}$	23 45 19				150	
		$i\overline{S}$	45 38					
305	2	iP_{NE}	0 40 15				1456	End overtaken by following record. Felt in NE Mindanao.
		iS_{NE}	42 16					
306	2	eP_{NE}	1 57 32				1890	Epicenter probably same as June 13th.
		iS_{NE}?	2 00 43					In hour gap.
		F	3 08					
307	2	iP_{NE}	3 29 07					
		F	4 04					
309	2	eP_{NE}	4 48 32				1870	
		eS_E	51 42					
		F	5 12					
310	2	eP_E	6 45 27					Japan.
		F	7 07					
312	2	iP_{NE}	7 54 34				420	
		iS_E	55 39					
		F	8 27					
315	3	iP_{NE}	10 28 49				120	Felt in Manila.
		iS_{NE}	ca 29 05					Begins in minute gap.
		M_E	29 07					Pen swings to limit, 93 mm.
		F	52					Epicenter probably in Verde Island passage.
316	3	e_{NE}	18 00 49					
		F	27 00					
318	5	eP_{NE}	14 29 19				6730	O = 14:19:06.
		iPR_{1NE}	31 18					50° N; 177° W. By J. S. A.
		eS_{NE}	37 35					Aleutian Islands.
		PS_{NE}	37 51					
		iL_{NE}	47 45					
		F	16 57					
319	5	eP_{NE}	22 46 32				6600	O = 22:36:11.
		iS_{NE}	54 40					Related to preceding earthquake.
		iL_{NE}?	23 04 37					
	6	F	0 52					
320	6	eP_{NE}	2 14 05				6750	O = 2:03:48.
		iS_{NE}	22 24					50° N; 177° W. By J. S. A.
		iL_{NE}?	34 00					Disturbed by microseisms.
		F	4 04					

International Seismological Centre

Instrumental record—Continued

No.	Date	Phase	Time	T	A_N μ	A_E μ	Δ	Remarks
			h. *m.* *s.*	*s.*			*Km.*	
321	6	iP_E	10 06 11					O = 9:46:02. Atlantic Ocean.
		eP_N	06 11					15.6° N; 43.4° W. By J. S. A.
		F	07					Disturbed by microseisms.
322	6	eL_E	10 52					Do.
		F	11 25					
323	6	eP_{NE}	13 25 28				1444	Do.
		iS_E	27 58					
		F	57					
324	7	i_{NE}	5 08					Do.
		F	6 16					
325	7	iP_{NE}	21 33 28				6680	O = 21:23:18.
		$iPR2_N$	37 11					Aleutian Islands.
		iS_{NE}	41 41					50° N; 177° W. By J. S. A.
		ScS_N	43 43					Disturbed by microseisms.
		$SR1_E$	46 14					
		$iSR2_E$	48 27					
		iL_{NE}	52 24					
		M	57 19					
	8	F	0 26					
326	8	iP_{NE}	10 50 30				490	Off SE Luzon.
		$\overline{iS}_{NE}$	51 09					
		F	11 04					
327	9	eP_{NE}	16 54 28					
		eS_{NE}	55 42					
		F	17 18					
328	9	eP_{NE}	17 25 22					
		iS_{NE}	27 51					
		iL	29 18					
		F	18 52					
331	12	eP_{NE}	18 02 54				1800	O = 17:59:05.
		iS_{NE}	05 56					27° 50′ N; 131° E. From P at Manila–Zikawei–Hong Kong.
		iL_N	07 28					
		M_{NE}	09 07					
		F	19 21					
332	13	$i\overline{P}_{NE}$	4 53 22				200	Felt slightly in Manila.
		$\overline{S}_{NE}$	53 47	0.9		120		
		F	5 38					
333	13	eP_{NE}	14 56 30					Overtaken by following earthquake.
		iS_{NE}	56 48					
334	13	S?	14 59 54					
335	13	e_{NE}	18 51					
		F	19 17					
338	14	iP_{NE}	9 45 ca				4867	Begins in minute gap.
		iS_{NE}	51 28					Kurile Islands?
		M	10 01 25					2nd shock? 10:16:24.
		F	11 00					
339	15	iP_{NE}	7 55 16					Felt in Khorassan, Persia.
		$iS?_E$	8 04 11					Disturbed by microseisms, continuing until the 20th.
		F	9 02					
340	15	eP_{NE}	20 26 22				1711	
		iS_N	29 19					
		F	48					
341	18	$i\overline{P}_{NE}$	10 04 14				160	Off E Luzon.
		$\overline{iS}_{NE}$	04 34					
		F	09					
342	21	iP_{NE}	13 16 55				325	Compression. SE Luzon.
		iS_{NE}	17 37					O = 13:16:09.
		$\overline{iS}_{NE}$	17 44					14° 34′ N; 124° E.
		L?	17 52					
		M_N	18 ca					Pen swings to limit, 162 mm·d.a.
		M_E	18 06	1.5		340		

International Seismological Centre

Instrumental record—Continued

No.	Date	Phase	Time	T	A_N μ	A_E μ	Δ	Remarks
			h. *m.* *s.*	*s.*			*Km.*	
343	21	iP_{NE}	13 23 30					Superposed on preceding record. SE Luzon.
344	21	eP_{NE}	22 02 51				170	
		iS_{NE}	03 12					
		F	07					
345	23	eP_{NE}	14 48 30				1694?	
		$iS?_N$	51 25					
		F	16 03					
346	23	eL_{NE}	19 38 00					20° W; 66.4° N.
		F	20 07					Iceland.
347	24	eP_{NE}	2 37 28					Felt at Baras, island of Catanduanes.
		F	3 54					
348	24	iP_{NE}	5 07 23				350?	SE Luzon.
		iS_{NE}	08 10					
		L?	08 16					
		F	34					
349	25	iP_{NE}	18 31 12	i	10	4	180	Compression.
		iS_{NE}	31 36	i	48			
		m_E	31 38	1.0		95		
		F	41					
350	26	$eP?_{NE}$	22 54 38				3450	Japan.
		iS_{NE}	59 39					
		$iL?_E$	23 02 45					
	27	F	0 06					
351	29	eP_{NE}	10 57 56				210	Disturbed by microseisms.
		iS_{NE}	58 22					
352	29	eP_{NE}	11 00 42					Do.
		F	04					

Nine insignificant or undecipherable disturbances on the following days of July; 2nd (4), 4th, 10th (2), and 14th (2).

International Seismological Centre

AUGUST, 1929

MACROSEISMIC RECORD

1, 21h 17m 10s [2, 5h 17m 10s] **Mindanao.** A light earthquake felt at Butuan and Talacogon. It caused a slight movement of the iron roof of the church at Butuan.

5, 11h 00m [5, 19h 00m] **Luzon.** Light earthquake at Bokod, Mountain Province.

5, 17h 47m [6, 1h 47m] **Leyte and Cebu.** Earthquake felt with intensity IV at Ormoc, Leyte, and slightly at Tuburan, Cebu. Probable origin near the west coast of Leyte.

8, 6h 36m 27s* [8, 14h 36m 27s] **Masbate.** Local earthquake of intensity IV and shallow origin in or near the island of Masbate.

8, 20h 37m [9, 6h 37m] **Guam.** Earthquake reported from Sumay.

13, 6h 30m [13, 14h 30m] **Luzon.** A short, light shock felt at Legaspi.

15, 20h 50m [16, 4h 50m] **Mindanao.** Slight earthquake at Talacogon.

21, 8h 25m [21, 16h 25m] **Luzon.** Feeble shock felt at San Narciso, Province of Tayabas.

21, 9h 27m* [21, 17h 27m] **Luzon.** Earthquake felt in the island of Mindoro and in Batangas and southern Tayabas. The origin was under the sea to the northeast of Mindoro. The shock was distinctly felt on board the steamer *Vizcaya* which was off Pola, Mindoro, at the time.

An aftershock was felt at Calapan, Mindoro, at 9h 43m.

22, 16h 12m [23, 0h 12m] **Luzon.** An extremely feeble shock lasting 40 seconds was felt at San Narciso, Tayabas.

22, 20h 20m [23, 4h 20m] **Luzon.** An aftershock of the earthquake of the 21st was felt at Calapan and the Halcon Rubber Plant on Mindoro.

28, 6h 01m 00s* [28, 14h 01m 00s] **Mindanao.** A violent local shock was felt at Malabang, Lanao. The duration was only 2 seconds.

International Seismological Centre

INSTRUMENTAL RECORD

No.	Date	Phase	Time	T	A_N μ	A_E μ	Δ	Remarks
			h. *m.* *s.*	*s.*			*Km.*	
354	1	P_{NE}	5 07 41				3530	O = 5:01:03.
		i_{NE}	09 08					12° N; 89° E. Approximate. By Medan, Phu-Lien, Batavia, Hong Kong, Manila, and Zikawei.
		iS_{NE}	12 33					
		L_{NE}	16 00					
		M_{NE}	18 50					
		M_{1N}	20 13	9.5	10			
		M_{2E}	20 19	13		40		
		F	6 25					
355	3	eP_{NE}	12 59 50					
		F	13 39					
356	3	eP_E	15 04 32				5078	
		eS_{NE}	11 13					
		F	53					
360	8	eP_{NE}	6 36 27				400	Felt in Masbate.
		F	41					
361	8	P_{NE}	13 01 37				2711	Burma. Epicenter approximately 22° N: 95°E.
		PR_1	02 08					
		iS_{NE}	05 49					
		iSR_1	06 55					
		iL_{NE}	08 17					
		$iPcS_{NE}$	08 43					
		M_{1N}	13 14	9.5	310			
		M_{1E}	13 44	10.3		305		
		F	14 12					
362	12	$e\overline{P}_{NE}$	7 42 23				100	
		F	45					
364	12	$e\overline{P}_{NE}$	12 53 ca				165	Begins in minute gap.
		F	59					
365	12	$e\overline{P}_{NE}$	14 55 58				125	
		F	59					
367	16	eP_{NE}	16 09 16				325	
		$i\overline{S}_{NE}$	10 04					
		F	22					
368	16	eP_{NE}	21 34 48				630	Reports from other stations seem to indicate that they recorded another earthquake at this time.
		$i\overline{S?}_{NE}$	36 29					
		F	22 12					
369	17	$e\overline{P}_{NE}$	14 20 24				85	
		$i\overline{S}_{NE}$	20 36					
		F	23					
371	18	$e\overline{P}_{NE}$	5 31 18				175	
		$i\overline{S}_E$	51 40					
		F	57					
372	18	eP_{NE}	8 43 39				4944	
		iS_{NE}	50 12					
		F	9 45					
373	18	$e\overline{P}_{NE}$	15 39 29				125	
		$i\overline{S}_E$	39 45					
		F	44					
374	19	eP_{NE}	2 45 22				1035	O = 2:45:06.
		iS_{NE}	47 12					22° 50′ N; 122° 05′ E.
		L_{NE}	48 09					From P at Taihoku, Zikawei, Hong Kong, Nagasaki, and Phu-Lien.
		M_{NE}	49 13					
		M_{1E}	52 48	11		215		
		M_{2N}	52 56	13	345			Volcanic explosion reported from this locality, November 1st, 1924.
		F	4 49					
375	19	eP_{NE}	20 46 51				1050	O = 20:44:32.
		S_{NE}	48 43					24° N; 122° E.
		L_{NE}	49 36					From P at Taihoku, Zikawei, Hong Kong, Manila, and Nagasaki.
		$iM?_{NE}$	52 18					
		M_{1N}	53 11	11.6	38			
		F	22 05					
376	20	$e\overline{P}_{NE}$	5 17 52				155	
		$i\overline{S}_{NE}$	18 11					
		F	24					

International Seismological Centre

Instrumental record—Continued

No.	Date	Phase	Time	T	A_N μ	A_E μ	Δ	Remarks
			h. *m.* *s.*	*s.*			*Km.*	
377	20	ePNE	16 40 34					O=16:38:17.
		S?NE	42 25					23° 55′N; 122° 10′E.
		iLNE	43 21					From P at Taihoku, Zikawei, Hong Kong, Manila, and Nagasaki.
		iMNE	44 38					
		M_1E	46 37	15.4		115		
		M_2E	48 00	14.5		142		
		M_3N	48 45	15.0	97			
		F	18 13					
378	21	$\overline{P}$NE	9 27 ca				150ca.	Begins in minute gap.
		i$\overline{S}$NE	27 18					O=9:26:38.
								13.4° N; 121.5° E. East end of Verde Island Passage. Felt on the steamer *Vizcaya*. After $\overline{S}$ pen swing to limit, 9 cm. Two very small aftershocks.
379	21	i$\overline{P}$N	9 53 04				150	
		Ri$\overline{P}$	53 08					
		i$\overline{S}$NE	53 23					
380	21	i$\overline{P}$N	10 34 53				150	
		i$\overline{S}$N	35 13					
382	22	e$\overline{P}$NE	20 52 39				142	
		i$\overline{S}$NE	52 57					
383	22	i$\overline{P}$NE	20 54 53				150	No. 382 still recording.
		i$\overline{S}$NE	55 14					
		F	21 03					
384	23	eNE	15 17					
		mNE	21 52					
385	23	ePNE	15 26 56				2178	
		eSN	30 31					
		eLN	32 27					
		F	16 00					
387	24	ePNE	6 32 ca				465ca.	Begins in minute gap.
		e$\overline{S}$E	33 11					
		F	46					
390	27	e$\overline{P}$NE	7 13 28				142	
		i$\overline{S}$NE	13 47					
		F	25					
391	27	e$\overline{P}$E	12 51 42				142	
		i$\overline{S}$NE	52 ca					In minute gap.
		F	13 02					
392	28	ePE	6 01 ca					Begins in minute gap.
		ePN	01 10					Felt at Malabang, Mindanao.
		F	21					
393	28	ePNE	18 58 11				3970	O=18:50:55.
		SNE	19 03 37					44° 30′N; 153° 20′E.
		L?NE	08 30					
		M?	10 55					
		M_1E	12 28	15.2		28		
		M_2N	14 38	15.8	38			
		M_3N	17 12	15.0	50			
		M_4E	17 16	14.7		50		
		F	20 42					
395	29	ePNE	10 48 10				1689	O=10:44:34.
		PR_2NE	48 21					
		eSNE	51 04					
		SR_1NE	51 24					
		eLN	52 30					
		F	11 39					
396	29	ePNE	19 49 41				2111	O=19:45:16.
		iSE	53 11					
		SR_1N	53 45					
		iLNE	55 00					In minute gap.
		MN	56 58					
		F	20 52					

Eleven insignificant or undecipherable disturbances on the following days of August; 4th, 5th(2), 12th, 13th, 17th, 22nd, 24th(2), 26th, and 29th.

International Seismological Centre

SEPTEMBER, 1929

MACROSEISMIC RECORD

2, $11^h\ 14^m\ 54^s$* [2, $19^h\ 14^m\ 54^s$] **Mindanao.** Earthquake in the Provinces of Agusan and Surigao. Epicenter was in the mountains east of Butuan. The intensity in Butuan was about V.

4, $4^h\ 25^m$ [4, $12^h\ 25^m$] **Samar.** Shock of intensity III at Borongan.

7, $2^h\ 29^m\ 26^s$* [7, $10^h\ 29^m\ 26^s$] **Mindoro.** Light earthquake felt at Halcon Rubber Experiment Station. Epicenter in Verde Island Passage.

11, $2^h\ 28^m$ [11, $10^h\ 28^m$] **Mindanao.** Light earthquake in the Agusan Valley and at Lebak on the coast of Cotabato. Probably two earthquakes. Repetition at Talacogon in the Agusan Valley at $4^h\ 10^m$ [$12^h\ 10^m$] and at Lebak at $18^h\ 35^m$ [12, $2^h\ 35^m$].

12, $5^h\ 15^m$ [12, $13^h\ 15^m$] **Mindanao.** Light shock reported from Lais, Davao, and Managok, Bukidnon.

12, $8^h\ 55^m$ [12, $16^h\ 55^m$] **Mindanao.** Light earthquake felt at Butuan and Talacogon.

14, ... **Luzon.** Earthquake reported from Mendez, Cavite. No time given.

15, $0^h\ 05^m\ 42^s$* [15, $8^h\ 05^m\ 42^s$] **Luzon.** Earthquake felt in southern Batangas. Epicenter probably in Verde Island Passage. Repetitions at $5^h\ 36^m\ 48^s$*, $9^h\ 35^m\ 56^s$*, $13^h\ 14^m\ 34^s$*, and at $1^h\ 01^m\ 23^s$*, on the 16th G. M. T.

19, $11^h\ 06^m\ 00^s$* [19, $19^h\ 06^m\ 00^s$] **Mindanao.** Earthquake felt throughout northeast section of Mindanao. Intensity about V at Butuan. Epicenter at 8° N; 129° E, on the eastern side of the Philippine Deep.

21, $13^h\ 25^m$ [21, $21^h\ 25^m$] **Mindanao.** Slight shock at Talacogon.

21, $17^h\ 35^m$ [22, $1^h\ 35^m$] **Leyte and Samar.** Earthquake with epicenter probably in the Pacific. Reported from Borongan, Guiuan, and Tacloban where the intensity was II.

23, $3^h\ 30^m$ [23, $11^h\ 30^m$] **Leyte.** Reported from Maasin.

23, $17^h\ 48^m\ 18^s$ [24, $1^h\ 48^m\ 18^s$] **Leyte.** Earthquake of intensity III felt at Ormoc.

27, $5^h\ 45^m$ [27, $13^h\ 45^m$] **Luzon.** Short earthquake of intensity III felt at Legaspi.

International Seismological Centre

INSTRUMENTAL RECORD

No.	Date	Phase	Time	T	A_N μ	A_E μ	Δ	Remarks
			h. *m.* *s.*	*s.*			*Km.*	
397	1	e_{NE}	3 23 21					Heavy microseisms.
		F	42					
399	2	iP_N	11 14 54				860	O = 11:12:41.
		eP_E	14 54					8° 50; N; 125° 50′ E. From P at Hong Kong,
		iS_{NE}	16 27					Phu-Lien, Zikawei, and Batavia. Microseisms.
		F	13 10					
400	3	eP_N	16 34 42				305?	Heavy microseims.
		$iS_{?N}$	35 26					
		F	44					
401	7	$\overline{eP}_{NE}$	2 29 26				125	
		$\underline{iS}_{NE}$	29 42					
		F	33					
402	9	$\overline{eP}_{NE}$	21 43 04				235	
		$\underline{iS}_{NE}$	43 36					
		F	57					
403	10	$\overline{eP}_{NE}$	12 05 24				310	Microseisms decrease.
		$\underline{eS}_{NE}$	06 09					
		F	12					
404	11	eP_N	22 21 00				1052	Begins in minute gap.
		eS_{NE}	22 53					O = 22:18:42.
		M_N	35 15	9.5	42			24° N; 120° E. From P at Taihoku, Zikawei,
	12	F	0 31					Hong Kong, Manila, Nagasaki, and I'hu-Lien.
406	12	$\overline{eP}_{NE}$	9 06 52				200	Cf., August 19th–20th.
		$\underline{iS}_{NE}$	07 18					
		F	17					
407	12	$\overline{eP}_{NE}$	21 35 21				200	
		$\underline{eS}_{NE}$	35 47					
408	12	$\overline{eP}_{NE}$	21 39 15				200	
		$\underline{iS}_{NE}$	39 41					
409	12	$\overline{eP}_{NE}$	21 50 14				200	
		$\underline{iS}_{NE}$	50 40					
		F	22 00					
413	15	$\overline{eP}_{NE}$	0 05 42				100	Felt in southern Batangas.
		$\underline{iS}_{NE}$	05 55					
		M_N	06 55	5.2	130			
		F	24					
414	15	$\overline{eP}_{NE}$	5 36 48				100	Do.
		$\underline{iS}_{NE}$	37 ca					In minute gap.
		M_N	38 05	4.7	45			
		M_E	38 06	5.3		70		
		F	6 00					
415	15	$\overline{eP}_{NE}$	9 35 56				144?	Felt in southern Batangas.
		$\underline{iS?}_{NE}$	36 14					
		M_E	37 22	4.7		170		
		M_N	37 54	5.5	100			
		F	57					
416	15	$\overline{eP}_{NE}$	13 14 34				100	Do.
		$\underline{iS}_{NE}$	14 47					
		F	22					
417	16	$\overline{eP}_{NE}$	1 01 23				100	Do.
		$\underline{iS}_{NE}$	01 36					
		F	16					

International Seismological Centre

Instrumental record—Continued

No.	Date	Phase	Time	T	A_N μ	A_E μ	Δ	Remarks
			h. *m.* *s.*	*s.*			*Km.*	
418	17	eP_{NE}	19 30 47				9756	O = 19:17:57.
		iS_{NE}	41 35					52° N; 134° W. U. S. C. & G. S.
		F	21 19					53° N; 133° W. J. S. A.
419	19	P_{NE}	11 06 00				1140	Begins in minute gap.
		iS_E	07 59					O = 11:03:31.
		m_E	08 45	6.4		20		8° N; 129° E. By Manila, Hong Kong, Batavia,
		L_N	09 00					and Zikawei.
	4	m_N	09 06	9.2	28			Disturbed by microseisms.
		F	22					
420	21	eP_{NE}	5 20 15				210	Microseisms.
		eS_E	20 42					
		F	31					
421	21	iP_{NE}	18 55 49	i	14	25	655	Sharp compression at Manila, dilatation at Zika-
		iS_{NE}	57 09					wei.
		m_N	57 23	7.2	73			Felt in Samar.
		m_E	57 32	7.2		82		11° 30′ N; 126° 10′ E. Approximate, by Manila,
		F	19 36					Batavia, Medan, Zikawei, and Hong Kong.
422	21	eP_{NE}	21 59 00				165	Extraordinary S.
		iS_{NE}	59 21	1.5		22		P too small for measurement.
		F	22 02					
424	23	eP_{NE}	7 03 29				135	
		iS_E	03 46	2.0		11		
		F	09					
425	23	eP_{NE}	15 38 30				600?	
		$eS?_E$	40 05					
		F	56					
426	25	eP_{NE}	4 42 17				117	
		iS_{NE}	42 32					
		F	45					
427	26	e_{NE}	7 59 48					36° S; 177° W. By Wellington.
		$L?_N$	8 08 30					
		F	27					
428	28	eP_{NE}	15 08 49					Disturbed by microseisms.
		F	19					Near Hokkaido, Japan.

Six insignificant or undecipherable disturbances on the following days of September; 1st, 12th, 14th, (2), and 22nd.

International Seismological Centre

OCTOBER, 1929

MACROSEISMIC RECORD

1, 11h 44m 00s* [1, 19h 44m 00s] **Mindanao.** Earthquake in the Province of Zamboanga and island of Basilan. The intensity in Zamboanga reached IV–V and noises were perceived.

7, 22h 23m 23s* [8, 6h 23m 23s] **Luzon.** A feeble shock lasting 3 seconds, was felt at Iba.

14, 2h 08m 26s* [14, 10h 08m 26s] **Mindanao.** A slight earthquake in the Agusan Valley. Reported from Butuan and Talacogon.

16, 5h 35m [16, 15h 35m] **Guam.** Earthquake reported from Sumay.

16, 23h 30m [17, 9h 30m] **Guam.** Another shock at Sumay.

17, 1h 14m 00s* [17, 9h 14m 00s] **Marinduque.** Light shock of 2 seconds duration felt at Boac.

17, 23h 25m 32s* [18, 7h 25m 32s] **Marinduque.** Another very short earthquake at Boac.

19, 20h 00m [20, 4h 00m] **Mindanao.** A slight earthquake reported from Talacogon.

21, 10h 00m [21, 18h 00m] **Luzon.** Earthquake reported from Bokod and Pasuquin. Probably two epicenters.

22, 9h 32m 57s* [22, 17h 32m 57s] **Luzon.** Light earthquake at extreme northwest end of Luzon. Intensity II at Laoag. Epicenter probably in the China Sea.

28, 17h 14m [29, 1h 14m] **Palawan.** Feeble earthquake, intensity I, reported from Iwahig.

30, 0h 44m [30, 8h 44m] **Mindanao.** Slight shock felt at Cantilan, Province of Surigao.

INSTRUMENTAL RECORD

No.	Date	Phase	Time	T	A_N μ	A_E μ	Δ	Remarks
			h. m. s.	*s.*			*Km.*	
429	1	eP_N	11 44 ca					Begins in minute gap.
		F	59					Felt at Zamboanga.
430	3	$\overline{eP}_{NE}$	5 50 47				190	
		$\overline{iS}_{NE}$	51 11					
		F	6 00					
431	3	$\overline{eP}_{NE}$	23 58 57				190	
		$\overline{iS}_{NE}$	59 21					
	4	F	0 06					
434	5	eP_{NE}	17 08 45				6811	O = 16:58:27.
		e_{SE}	17 06					55° N; 160° E. J. S. A.
		L_{NE}	28 06					Kamtchatka.
		M_N	33 05	16.4	15			
		F	18 47					
435	5	eP_{NE}	19 07 50				3700	
		S_E	13 07					
		F	32					
436	6	eP_{NE}	8 03 42				8600	O = 7:51:49.
		iS_{NE}	13 40					
		P_{SE}	14 14					19.5° N; 156° W. J. S. A.
		i_{NE}	16 04					
		L_E	28 27					
		F	9 55					

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Instrumental record—Continued

No.	Date	Phase	Time	T	A_N μ	A_E μ	Δ	Remarks
			h. *m.* *s.*	*s.*			*Km.*	
438	7	$\overline{eP}_{NE}$	22 23 23				150	Felt at Iba, west coast of Luzon.
		$\overline{iS}_{NE}$	23 42					
		F	28					
439	8	eP_{NE}	17 27 56				8465	O = 17:16:10.
		iS_{NE}	37 49					Probably in Tonga Deep.
		L_E	52 08					Disturbed by microseisms.
		F	18 24					
440	11	$\overline{eP}_{NE}$	10 04 55				142	Disturbed by microseisms.
		$\overline{eS}_{NE}$	05 13					
		F	08					
443	16	eP_{NE}	20 32 58				2778	Begins in minute gap.
		iPR_{1E}	33 28					O = 20 27:13.
		iPR_{2E}	33 39					25° 30′ N; 97° E. By Phu-Lien, Hong Kong,
		iS_E	37 16					Zikawei, Manila, and Batavia.
		L_{NE}	39 45					
		m_N	41 24	11.2	50			
		M_N	42 10	13.1				
		m_N	45 16	12.4	70			
		m_E	46 16	12.4		70		
		F	21 25					
444	17	$\overline{P}_{NE}$	1 14 ca				150	Begins in minute gap.
		$\overline{iS}_{NE}$	14 19					Felt at Boac, island of Marinduque.
		F	18					
445	17	$\overline{eP}_E$	23 25 32				150	Felt at Boac.
		$\overline{S}_E$	25 51					
		F	29					
446	19	iP_{NE}	10 33 00					O = 10:13:00.
		SPS_{NE}	59 20					20° S; 72.5° W. U. S. C. & G. S.
		L_E	11 31 00					21.5° S; 72° W. J. S. A.
		L_N	32 00					Disturbed by heavy microseisms.
		F	12 35					
447	22	eP_{NE}	9 32 57				465?	Felt at Laoag; NW coast of Luzon.
		$e\overline{S?}_{NE}$	34 09					
		F	40					Heavy microseisms.
448	22	eP_{NE}	18 45 00					Begins in minute gap.
		F	58					Microseisms continue.
449	24	eP_{NE}	6 36 10				980	O = 6:34:04.
		iS_{NE}	37 55					23° N; 118° 20′ E. By Taihoku, Hong Kong,
		iL_{NE}	38 47					Manila, Zikawei, and Batavia. Felt in Hong
		F	7 18					Kong and Formosa.
450	24	eP_{NE}	16 14 13				296	
		$\overline{iS}_{NE}$	14 56					
		F	20					
451	27	eP_{NE}	19 32 47				1190	O = 19:30:11.
		eS_{NE}	34 50					
		F	58					
452	29	eP_{NE}	4 43 09				166	
		$\overline{iS}_{NE}$	43 30					
		F	50					
454	29	$\overline{eP}_{NE}$	21 53 42				166	
		$\overline{iS}_{NE}$	54 03					
		F	22 01					
455	30	$\overline{eP}_{NE}$	5 45 38				67	
		$\overline{iS}_{NE}$	45 47					
		F	47					
456	31	eP_{NE}	8 17 04				210	
		$\overline{eS}_{NE}$	17 31					
		F	20					

Six insignificant or undecipherable disturbances on the following days of October; 5th(2), 6th, 14th(2), and 29th.

International Seismological Centre

NOVEMBER, 1929

MACROSEISMIC RECORD

2, 1h 33m 47s* [2, 9h 33m 47s] **Luzon.** Earthquake felt throughout the NW portion of Luzon. Intensity IV at Cape Bojeador and III at Vigan and Laoag. Epicenter in the China Sea at 18° 25′ N; 120° E.

2, 22h 33m 09s* [3, 6h 33m 09s] **Luzon.** Earthquake of intensity V at Aparri. Epicenter in the Babuyan Channel.

4, 19h 50m [5, 3h 50m] **Luzon.** Earthquake reported from Bacon, Province of Sorsogon. A local shock.

5, 11h 40m 11s* [5, 19h 40m 11s] **Mindanao, Samar and Leyte.** Earthquake felt over eastern Mindanao and southern Samar and Leyte. It was perceptible as far as Lais to the south and Catbalogan to the north, a distance of 600 kilometers. Surigao and Agusan Provinces felt it the most severely as the epicenter was in the Philippine Deep at 10° N and 126° 30′ E.

5, 18h 14m 52s* [6, 2h 14m 52s] **SE Luzon and Samar.** Earthquake felt in the Provinces of Camarines, Albay, Sorsogon, in the island of Catanduanes and in Samar. The intensity was IV at Virac and Legaspi. The epicenter was south of Catanduanes Island in the Lagonoy Gulf. Repetitions from the same epicenter were felt at 4h 01m 49s* [12h 01m 49s] and at 5h 23m 19s* [13h 23m 19s] on the 7th. Light aftershocks of this last earthquake were felt at Legaspi and Sorsogon at 5h 30m [13h 30m] and 8h 10m [16h 10m].

5, 20h 20m [6, 4h 20m] **SE Luzon.** Earthquake reported from Tabaco, Tiwi and Baras.

8, 8h 55m 23s* [8, 16h 55m 23s] **Samar and Leyte.** Earthquake felt throughout the greater part of Samar and eastern Leyte. The epicenter seems to have been in the Samar Sea.

8, 15h 13m 48s* [8, 23h 13m 48s] **SE Luzon.** Earthquake reported from Legaspi and Bacon. From the same source of disturbance as the earthquakes of the 5th and 7th.

10, ... **Negros.** Slight earthquake during the night. Time not given.

10, 21h 37m 45s* [11, 5h 37m 45s] **Luzon.** Earthquake of intensity IV felt at Naga. Reported also from Daet, Ragay and San Narciso, Tayabas.

11, 9h 16m [11, 17h 16m] **Mindanao.** Very slight earthquake felt at Butuan.

11, 16h 09m [12, 2h 09m] **Guam.** Earthquake felt at Sumay.

14, 18h 30m [15, 2h 30m] **Luzon.** Earthquake felt at Bato, Camarines Sur.

15, 0h 05m 47s* [15, 8h 05m 47s] **Leyte and Cebu.** Earthquake felt with intensity IV at Ormoc. Felt in northern Cebu.

17, 3h 45m 39s* [17, 11h 45m 39s] **Mindanao.** Earthquake felt over the entire island of Mindanao with the exception of the Province of Zamboanga in the extreme west. An intensity of VII was reported from Butuan. The epicenter seems to have been in the SW portion of Agusan Province at about 8° 10′ N and 125° 30′ E. It was also reported to have been felt in Tacloban, Leyte which gives the macroseismic area an extension of at least 600 kilometers in a N–S direction. The E–W extension was about 300 kilometers.

17, 14h 25m 35s* [17, 22h 25m 35s] **Luzon.** Earthquake of intensity III at Dagupan.

International Seismological Centre

17, $21^h\ 09^m\ 54^s$* [18, $5^h\ 09^m\ 54^s$] **Mindanao.** Earthquake reported from Lais. At $22^h\ 21^m\ 12^s$* [18, $6^h\ 21^m\ 12^s$] a second shock was felt at Lais and also at Davao with intensity III.

18, $2^h\ 07^m\ 49^s$* [18, $10^h\ 07^m\ 49^s$] **Mindanao.** Slight earthquake felt at Talacogon.

18, $4^h\ 09^m\ 00^s$* [18, $12^h\ 09^m\ 00^s$] **Mindanao.** Earthquake reported from Lais.

18, $5^h\ 43^m\ 28^s$* [18, $13^h\ 43^m\ 28^s$] **Mindanao.** Rather extensive earthquake felt in Eastern Mindanao. From Butuan to Lais. Epicenter probably in the Philippine Deep. Two repetitions were reported from Davao.

22, $23^h\ 55^m$ [23, $7^h\ 55^m$] **Mindanao.** Earthquake of intensity III felt at Zamboanga. Also felt at Sibuku, about 50 kilometers north.

23, $4^h\ 30^m$ [23, $12^h\ 30^m$] **Mindanao.** Earthquake felt at Lais.

25, $7^h\ 54^m$* [25, $15^h\ 54^m$] **Mindanao.** Light shock reported from Talacogon and Malita. Probably different earthquakes.

25, $20^h\ 54^m\ 20^s$* [26, $4^h\ 54^m\ 20^s$] **Mindanao.** Earthquake felt throughout Western Mindanao. Intensity III at Cotabato and Zamboanga points to an epicenter in the Moro Gulf.

INSTRUMENTAL RECORD

No.	Date	Phase	Time	T	A_N μ	A_E μ	Δ	Remarks
			h. m. s.	*s.*			*Km.*	
457	2	iP_{NE}	1 38 47				438	Compression. O = 1:32:46.
		m_E	34 46	3.4		45		18° 25′ N; 120° E. By Hong Kong and Manila.
		iS_{NE}	34 41					
		$\overline{iS}_{NE}$	34 52					
		M_E	36 19	4.4		105		
		M_N	37 35	5.6	75			
		F	2 12					
458	2	eP_N	22 33 09				430	Off N Luzon. Epicenter in the Babuyan Channel.
		$\overline{iS}_N$	34 15					
		F	50 00					
460	4	$\overline{iP}_{NE}$	5 41 12				180	
		$\overline{iS}_{NE}$	41 34					
		F	44					
462	5	eP_{NE}	11 40 11				785	Compression.
		iS_{NE}	41 38					O = 11:38:25.
		L_E?	42 34					10° N; 126° 30′ E; from P at Manila, Hong Kong,
		L_N?	42 46					Phu-Lien, Batavia, and Taihoku.
		m_N	43 05	7.7	190			
		m_E	43 25	8.9		170		
		F	13 26					
463	5	eP_{NE}	18 14 52				390	Off S Catanduanes Island.
		$\overline{iS}_{NE}$	15 51					
		F	51					
464	7	eP_{NE}	4 01 49				350	SE Luzon.
		$e\overline{S}_E$	02 41					
		F	15					
465	7	eP_{NE}	5 23 19				360	Do.
		$\overline{iS}_E$	24 13					
		M_E	24 45					
		F	6 42					
466	8	eP_{NE}	8 55 23				420	Felt in Samar.
		$\overline{iS}_{NE}$	56 27					
		F	9 20					
467	8	$\overline{eP}_{NE}$	11 57 25				67	
		$\overline{iS}_N$	57 34					
		F	12 00					
468	8	eP_{NE}	15 13 48				365	Felt in Legaspi.
		$\overline{eS}_{NE}$	14 43					
		F	27					

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Instrumental record—Continued

No.	Date	Phase	Time	T	A_N μ	A_E μ	Δ	Remarks
			h. *m.* *s.*	*s.*			*Km.*	
471	10	eP_{NE}	8 38 34					
		F	9 04					
472	10	iP_{NE}	21 37 45				220	SE Luzon.
		$i\overline{S}_{NE}$	38 15					
		m_B	38 25	1.5		40		
		F	48					
473	11	$e\overline{P}_{NE}$	7 55 05				75	Disturbed by microseisms.
		$e\overline{S}_{NE}$	55 15					
		F	58					
474	11	$e\overline{P}_E$	16 07 41				135	Do.
		$i\overline{S}_E$	07 58					
		F	10					
475	13	eP_{NE}	0 38 10				1990?	Do.
		$eS?_N$	41 38					
		$L?_N$	43 10					
		F	1 28					
476	13	e_{NE}	13 07 15					Do.
		F	16					
477	14	eP_{NE}	20 47 08				1625	O = 20:43:40.
		iS_{NE}	49 57					
		m_N	50 07	9.7	70			
		m_E	50 25	11.1		75		
		F	21 22					
478	15	eP_{NE}	0 05 47				530	Felt in Leyte and Cebu.
		$e\overline{S}_E$	07 10					
		F	17					
479	15	iP_E	18 55 27				2622	Compression.
		eP_N	55 27					O = 18:50:07.
		iS_{NE}	59 35					
		iL_{NE}	19 01 50					Guam, Manila, Hong Kong, Phu-Lien, Melbourne,
		m_E	02 23	10.2		370		and Batavia, give epicenter at 9° 25′ N,
		m_N	02 34	10.0	660			144° 30′ E.
		M_E	04 21	10.3		365		
		m_E	06 48	10.4		500		
		F	22 02					
480	17	iP_E	3 45 39				985	O = 3:43:19. Epicenter probably 7° 20′ N; 126°
		eP_N	45 39					10′ E. Felt in eastern half of Mindanao.
		iS_{NE}	47 24					
		M_N	49 02	7.9				N–S pen swings to limit, 61 mm. (A shock re-
		M_E	49 21	8.0		280		ported by the "El Oso" at 4:22, G. M. T. at 6°
		F	6 34					56′ N; 126° 41′ E.)
481	17	eP_{NE}	12 11 00					
		F	53					
482	17	$e\overline{P}_{NE}$	14 25 35				175	Felt at Dagupan, N Central Luzon.
		$e\overline{S}_{NE}$	25 56					
		F	36					
483	17	eP_{NE}	19 04 34					
		F	26					
486	18	eP_{NE}	2 07 49				1220	O = 2:05:09.
		eS_{NE}	09 56					
		eL_E	11 05					
		iL_N	11 05					
		M_N	12 27	10.3	15			
		F	3 06					
487	18	eP_{NE}	4 09 00				1256	Begins in minute gap.
		eS_{NE}	11 12					O = 4:06:16.
		iL_N	12 27					
		M_N	13 53	10.9	25			
		F	5 26					

International Seismological Centre

Instrumental record—Continued

No.	Date	Phase	Time	T	A_N μ	A_E μ	Δ	Remarks
			h. *m.* *s.*	*s.*			*Km.*	
488	18	iP_{NE}	5 43 28				1330	O = 5:40:35.
		iS_{NE}	45 46					Felt at Butuan and Davao.
		iL_{NE}	46 57					
		M_{NE}	48 13					
		M_{1N}	48 44	9.0	75			
		M_{2E}	49 18	11.2		65		
		F	7 24					
489	18	eP_{NE}	12 11 24				260	
		iP_{NE}	11 28					
		$i\overline{S}_{NE}$	12 00					
		F	21 00					
490	18	$e\overline{P}_{NE}$	14 47 58				160	
		$e\overline{S}_{NE}$	48 18					
		F	50					
491	18	$e\overline{P}_{NE}$	19 12 12				180	
		$e\overline{S}_{NE}$	12 34					
492	18	eP'_{NE}	20 51 10				13156	Disturbed by microseisms.
		PR1	52 34					O = 20:32:08.
		iN_E	21 02 22					47° 30′ N; 58° W. U. S. C. G. S.
		PPS_N	03 24					
		SR_2?	13 53					
		eL_E	28 20					
		eL_N	29 ca					
		M_{NE}	39 ca					
		M_{1N}	47 01	20.2	150			
		M_{2N}	48 51	18.1	105			
		M_{3E}	49 53	15.9		80		
		M_{4N}	52 35	16.2	80			
		M_{5E}	53 25	15.9		80		
		F	22 56					
494	22	$e\overline{P}_{NE}$	4 19 24				150	
		$i\overline{S}_{NE}$	19 43					
		F	24					
495	22	$e\overline{P}_{NE}$	10 06 46				200	
		$i\overline{S}_{NE}$	07 12					
		F	14					
496	23	iP_E	0 07 10				2765	O = 0:01:37.
		PR_{1E}	07 43					4° S; 138° E. By Zikawei, Phu-Lien, Hong Kong,
		PR_{2NE}	07 53					Manila, Batavia, Wellington, and Melbourne.
		iS_{NE}	11 26					
		SR_{1NE}	12 30					
		m_N	12 42	9.9	150			
		m_E	12 47	11.8		115		
		m_E	13 47	9.4		95		
		iL_N	13 58					
		m_N	14 33	9.9	155			
		m_E	14 34	9.6		105		
		F	1 21					
501	28	eP_{NE}	20 15 35				360	
		$i\overline{S}_{NE}$	16 29					
		F	28					

In addition to the above there were eleven insignificant or undecipherable disturbances on the following days of November; 3rd, 4th, 9th(2), 17th(2), 22nd, 23rd, and 25th(3).

International Seismological Centre

DECEMBER, 1929

MACROSEISMIC RECORD

1, $22^h\ 30^m$ [2, $6^h\ 30^m$] **Mindanao.** Slight earthquake at Talacogon, Agusan.

3, $9^h\ 24^m\ 47^s$* [3, $17^h\ 24^m\ 47^s$] **Luzon.** Earthquake of intensity III at Legaspi, Albay. Also reported from Bacon, Sorsogon.

4, $16^h\ 47^m$ [5, $0^h\ 47^m$] **Mindanao.** Slight earthquake at Talacogon, Agusan.

6, $14^h\ 22^m$ [6, $22^h\ 22^m$] **Mindanao.** Another slight earthquake at Talacogon.

7, $4^h\ 05^m$ [7, $12^h\ 05^m$] **Bohol.** Earthquake of intensity II reported from Tagbilaran.

7, $6^h\ 50^m$ [7, $14^h\ 50^m$] **Mindanao.** Strong earthquake felt at Malita, Davao.

9, $4^h\ 15^m$ [9, $12^h\ 15^m$] **Mindanao.** Earthquake reported as strong at Managok, Bukidnon.

9, $6^h\ 07^m\ 00^s$* [9, $14^h\ 07^m\ 00^s$] **Mindanao.** Earthquake felt over SE Mindanao. Intensity IV at Davao. Felt as far north as Talacogon.

9, $22^h\ 35^m\ 42^s$* [10, $6^h\ 35^m\ 42^s$] **Luzon.** Earthquake of intensity II and of 3 seconds duration felt at Dagupan, Pangasinan.

16, $4^h\ 45^m$ [16, $12^h\ 45^m$] **Mindanao.** Slight earthquake felt at Talacogon, Agusan.

18, $8^h\ 49^m$ [18, $16^h\ 49^m$] **Mindanao.** Another slight earthquake at Talacogon.

22, $2^h\ 55^m\ 59^s$* [22, $10^h\ 55^m\ 59^s$] **Mindanao.** Earthquake felt over the NE section of Mindanao. Intensity III and 40 seconds duration at Butuan.

22, $14^h\ 28^m\ 46^s$* [22, $22^h\ 28^m\ 46^s$] **Mindanao.** Earthquake of intensity VI felt at Davao. Probably a shallow focus in Davao Gulf.

24, $14^h\ 35^m$ [24, $22^h\ 35^m$] **Catanduanes.** Earthquake of 3 seconds duration at Baras.

25, $5^h\ 35^m$ [25, $13^h\ 35^m$] **Luzon.** Earthquake reported from Bacon, Sorsogon.

INSTRUMENTAL RECORD

No.	Date	Phase	Time	T	A_N μ	A_E μ	Δ	Remarks
			h. m. s.	*s.*			*Km.*	
502	1	$e\overline{P}_{NE}$	0 25 30				117	
		$i\overline{S}_{NE}$	25 45					
		F	29					
503	1	$i\overline{P}_{NE}$	0 29 58				117	
		$i\overline{S}_{NE}$	30 13					
		F	33					
504	3	eP_{NE}	7 40 21				2722	O = 7:34:51.
		iS_{NE}	44 34					
		iE	45 24	4.9		25		
		SR_{iE}	45 36					
		F	8 19					
505	3	eP_{NE}	9 24 47				320	Felt at Legaspi.
		$\overline{S}_{NE}$	25 34					
		F	29					
506	5	$e\overline{P}_{NE}$	13 02 21				50	
		$i\overline{S}_{NE}$	02 28					
		F	05					
508	6	e_{NE}	17 09 ca					Distant earthquake. Disturbed by microseisms.
		F	18 25					
509	6	e_{NE}	20 43 ca					Disturbed by microseisms.
510	7	e_{NE}	13 56 46					Do.
		F	14 11					

International Seismological Centre

Instrumental Record—Continued

No.	Date	Phase	Time	T	A_N μ	A_E μ	Δ	Remarks
			h. *m.* *s.*	*s.*			*Km.*	
511	9	eP_{NE}	6 07 ca				1180	Begins in minute gap.
		eS_{NE}	09 02					O = 6:04:25. Pacific, near SE coast of Mindanao.
		iL_E	10 10					Felt at Davao.
		M_E	11 59	8.5		15		
512	9	eP_{NE}	6 35 53				3610	No. 511 still recording.
		i_N	57 39	4.4	18			Approximately 5° N; 88° E by Batavia, Hong
		S_{NE}	7 01 05					Kong, Manila, Zikawei.
		m_N	02 43	6.9	30			
		iL_N	04 45					
		m_N	05 03	9.9	85			
		M_{1E}	07 23	14.8		240		
		M_{2N}	07 51	13.9	175			
		M_{3E}	09 37	15.2		255		
		M_{4E}	11 14	15.7		350		
		M_{5N}	11 35	11.6	180			
		M_{6E}	13 48	12.3		160		
		F	9 18					
513	9	eP_{NE}	22 35 42				218	Felt at Dagupan, Luzon
		$i\overline{S}_{NE}$	36 11					
		F	44					
515	13	eP_{NE}	8 31 21				2656	O = 8:25:57.
		eS_{NE}	35 30					
		M_N	40 44					
		F	9 06					
516	13	eP_{NE}	9 49 19					
		F	10 32					
517	14	$\overline{P}_{NE}$	15 31 04				140	
		$i\overline{S}_{NE}$	31 22					
		F	48					
518	14	$e\overline{P}_{NE}$	15 50 42				134	
		iS_{NE}	50 59					
		F	16 00					
519	14	$e\overline{P}_{NE}$	19 18 30				100	
		$i\overline{S}_{NE}$	18 43					
		F	23					
520	15	$e\overline{P}_{NE}$	18 12 56				115	
		$i\overline{S}_{NE}$	13 11					
		F	16					
523	16	$e\overline{P}_{NE}$	7 32 31				165	
		$i\overline{S}_{NE}$	32 52					
		F	37					
524	16	eP_{NE}	11 32 40				3245	O = 11:26:21.
		eS_{NE}	37 28					
		eL_{NE}	40 57					
		M_{1E}	43 51	9.7		15		
		M_{2E}	44 24	14.2		25		
		M_{3N}	46 19	11.7	20			
		F	12 55					
525	16	eP_E	15 03 44					
		F	44					
526	17	iP_E	11 08 14				6160	Disturbed by microseisms
		eP_N	08 14					O = 10:58:42. 53° N; 172° E by U. S. C. G. S.
		PR_{1N}	10 26					
		PR_{2E}	11 22					
		iS_{NE}	15 56					Hong Kong, Zikawei, Phu-Lien, and Manila give
		PS_N	16 09					O = 10:58:38.
		SR_1	19 58					
		m_E	20 37	8.9		155		
		m_N	21 39	11.6	210			
		SR_{2NE}	21 56					
		m_E	25 12	11.7		255		
		m_N	25 35	11.7	210			
		L_{NE}	26 ca					
		m_N	29 38	13.7	290			
		M_{NE}	30 ca					
		M_{1E}	32 31	15.2		375		
		M_{2N}	37 30	13.6	285			
		F	15 20					

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Instrumental Record—Continued

No.	Date	Phase	Time	T	A_N μ	A_E μ	Δ	Remarks
			h. *m.* *s.*	*s.*			*Km.*	
527	17	eP_{NE}	21 35 43				6660?	
		$eS?_E$	43 55					
		F	22 22					
528	18	eP_{NE}	7 01 12				1100	O = 6:58:42.
		iS_{NE}	03 09					24° 20′ N: 122° 30′ E, by Zikawei, Hong Kong,
		iL_N	04 10					Taihoku, and Manila.
		M_{NE}	05 15					
		M_{1N}	07 22	11.8	55			
		M_{2E}	08 10	14.7		70		
		F	8 10					
532	19	eP_{NE}	19 07 41				1500	O = 19:04:27.
		iS_{NE}	10 16					
		F	57					
533	21	eP_{NE}	9 37 36					
		F	57					
535	22	iP_{NE}	13 11 35				420	
		iS_{NE}	12 39					
		F	36					
538	24	eP_{NE}	16 02 29				330	
		$iS?_E$	03 17					
		F	14					
539	24	iP_N	17 28 06				240	
		iS_{NE}	28 36					
		F	32					
540	26	eP_{NE}	22 47 31				135	
		iS_{NE}	47 48	(i)	10			
		F	50					
541	28	iP_{NE}	1 13 21				230	
		iS_{NE}	13 50					
		F	17					
542	27	iP_{NE}	13 36 32				2090	O = 13:32:03.
		i_{NE}	36 35					4° S; 125° E, by Batavia, Manila, Hong Kong,
		PR_{1N}	36 49					and Melbourne.
		PR_{2NE}	36 53					
		iS_{NE}	40 ca					In minute gap.
		SR_{1NE}	40 33					
		m_N	40 43	6.7	25			
		iL_{NE}	41 41					
		m_N	42 35	7.9	30			
		M_N	43 49	6.7	20			
		F	14 26					
543	28	eP_{NE}	1 33 45?					Deal Island according to Melbourne.
		F	2 18					
544	28	e_{NE}	11 44					
		F	12 12					
546	31	P_{NE}	1 08 35				2310	O = 1:03:48.
		PR_{1NE}	08 53					
		iS_{NE}	12 20					
		m_N	12 37	7.5	45			
		SR_{1NE}	13 07					
		m_E	13 45	8.6		35		
		L_{NE}	14 16					
		M_N	16 16	8.0	60			
		M_E	16 24	10.1		30		
		F	2 51					

In addition to the above there were 13 insignificant or undecipherable disturbances of the following days of December; 5th, 11th, 15th, 16th, 18th(2), 19th, 22nd(2), 24th, and 31st (3).

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INTRODUCCIÓN

Damos en el texto inglés la lista de las estaciones sísmicas existentes en enero de 1929. Además todas las estaciones meteorológicas oficiales y voluntarias, cuyo número asciende a doscientas cincuenta, tienen las instrucciones necesarias para dar cuenta de todos los temblores perceptibles.

La intensidad de los terremotos se indica conforme a la conocida escala de Rossi-Forel. Cuanto a la hora en que tuvieron lugar, adoptamos la indicada por los sismógrafos de este Observatorio siempre que los hayan registrado, distinguiéndola por medio de un asterisco (*). En caso contrario copiamos la hora apuntada por los observadores que nos envían las notas. Todas las horas se refieren a la hora media de Greenwich (medianoche=0^h). Para conveniencia de los lectores de Filipinas se añade también la hora insular.

ESCALA DE INTENSIDADES DE ROSSI-FOREL

I. *Temblor instrumental:* registrado tan sólo por los sismógrafos.
II. *Temblor muy ligero:* sentido solamente por algunas personas en estado de reposo, especialmente en los pisos superiores de las casas, o por personas nerviosas y muy sensibles.
III. *Temblor ligero:* sentido por varias personas en reposo; bastante fuerte para apreciar su dirección y duración.
IV. *Temblor bien sensible:* sentido por muchas personas en movimiento.
V. *Temblor de regular intensidad:* sentido generalmente por todos. Movimientos de muebles y otros objetos no muy pesados; grandes oscilaciones de objetos suspendidos.
VI. *Temblor fuerte:* despiértanse los dormidos; tocan las pequeñas campanas; parada de relojes de péndulo; pánico y salida de las personas de sus viviendas.
VII. *Temblor muy fuerte:* movimientos sentidos por todos; espanto general; todos se precipitan a la calle; caída de objetos y del yeso de las paredes; desperfectos en algunos edificios poco sólidos.
VIII. *Temblor excesivamente fuerte, violento:* tocan las campanas, caen chimeneas, tejas de los tejados, etc., daños de poca consideración en muchos edificios.
IX. *Terremoto ruinoso:* ruina parcial de algunos edificios y desperfectos notables en los demás. Sin desgracias personales, fuera de algunos contusos y heridos.
X. *Terremoto desastroso:* ruina total o casi total de muchos edificios y grandes desperfectos en los demás; víctimas numerosas. Grietas y hundimientos en el suelo y derrumbes en los montes.

JULIO, 1929

REGISTRO MACROSÍSMICO

International Seismological Centre

1, 3h 30m [1, 11h 30m] **Mindanao.** Ligero temblor sentido en Talacogon.

1, 19h 24m 37s* [2, 3h 24m 37s] **Sámar y Cebú.** Temblor de intensidad II, duración 15 segundos, sentido en Catbalogan, Sámar. Sintióse ligeramente en Tuburan, Cebú.

2, 0h 40m 15s* [2, 8h 40m 15s] **Mindanao.** Temblor sentido al NE de Mindanao. En Butúan su intensidad llegó a IV y duró 70 segundos. Principió con oscilaciones ligeras y luego siguió fuertes sacudidas. Su epicentro probablemente sea el mismo que el ocurrido en junio 13. Sintióse también en Cantilan, Provincia de Surigao, y en Talacogon, Provincia de Agusan.

Hubo ligeras repeticiones diez o más veces durante el día.

3, 10h 28m 49s* [3, 18h 28m 49s] **Luzón.** Ligero temblor sentido en Manila y en las Provincias de Cavite y Batangas. Su epicentro probablemente se hallaba en el paso de Isla Verde.

6, 1h 50m [6, 9h 50m] **Mindanao.** Ligera sacudida sentida en Talacogon. Repitió a las 11h 16m hora local.

6, 15h 47m [6, 23h 47m] **Mindanao.** En Butúan se sintió una sacudida de intensidad II que duró 15 segundos.

8, 10h 50m 30s* [8, 18h 50m 30s] **SE de Luzón.** Temblor de intensidad V sentido en Virac y IV en Legaspi. Su origen se hallaba en el Abismo Filipino.

9, 2h 01m [9, 10h 01m] **Leyte.** Una sacudida local sentida en Tacloban.

9, 2h 48m 05s [9, 10h 48m 05s] **Mindanao.** Temblor de intensidad II sentido en Butúan que duró 20 segundos. Sintióse ligeramente en Talacogon.

9, 17h 31m 10s [10, 1h 31m 10s] **Mindanao.** Temblor local de intensidad II sentido en Butúan.

10, 6h 30m [10, 14h 30m] **Mindanao.** Ligero temblor sentido en Talacogon.

13, 4h 53m 22s* [13, 12h 53m 22s] **Luzón.** Temblor sentido en Manila por algunas personas.

14, 19h 25m [15, 3h 25m] **Palawan.** Temblor de intensidad II sentido en Puerto Princesa.

15, 0h 16m [15, 8h 16m] **Mindanao.** Ligera sacudida sentida en Talacogon.

16, 12h 05m [16, 20h 05m] **Luzón.** Una sacudida local de intensidad VI sentida en Baler, Provincia de Tayabas.

17, 17h 22m 16s [18, 1h 22m 16s] **Mindanao.** Ligero temblor de corta duración sentido en Butúan por algunas personas.

17, 19h 00m [18, 3h 00m] **Mindanao.** Ligero temblor sentido en Talacogon.

18, 10h 07m [18, 18h 07m] **Luzón.** Temblor local de intensidad III en Infanta.

19, 7h 06m [19, 15h 06m] **Mindanao.** Ligerísima sacudida en Butúan y Talacogon.

21, 13h 16m 55s* [21, 21h 16m 55s] **Luzón.** Fuerte temblor sentido en las Provincias de Albay y Camarines. En Virac, Catanduanes, su intensidad fué V y precedido de ruidos como ráfagas de viento. Algunas paredes se rajaron y algunos cercos se destruyeron.

Repitió con menos intensidad a 13h 22m 30s* en la misma área. El epicentro estaba próximamente a los 14° 34′ N y 123° 58′ E.

21, 13h 36m [21, 21h 36m] **Mindanao.** Temblor local de intensidad V en Zamboanga.

24, 2h 37m 28s* [24, 10h 37m 28s] **SE** de **Luzón.** Temblor de 8 segundos de duración en Barás, isla de Catanduanes.

24, 5h 07m 23s* [24, 13h 07m 23s] **SE de Luzón.** Ligero temblor sentido en la misma área que el ocurrido el día 21. En Daet y Naga la intensidad fué III.

27, 1h 30m [27, 9h 30m] **Luzón.** Temblor en Tabaco, Provincia de Albay.

28, 18h 15m [29, 2h 15m] **Mindanao.** Ligera sacudida en Cantilan y Talacogon.

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AGOSTO, 1929

REGISTRO MACROSíSMICO

1, 21h 17m 10s [2, 5h 17m 10s] **Mindanao.** Ligero temblor sentido en Butúan y Talacogon. El techo de la iglesia de Butúan hizo ruido dos veces.

5, 11h 00m [5, 19h 00m] **Luzón.** Ligero temblor en Bokod, Provincia Montañosa.

5, 17h 47m [6, 1h 47m] **Leyte y Cebú.** Temblor sentido con intensidad IV en Ormoc, Leyte, y ligeramente en Tuburan, Cebú. Probable origen cerca de la costa oeste de Leyte.

8, 6h 36m 27s* [8, 14h 36m 27s] **Masbate.** Temblor local de intensidad IV y origen poco profundo en o cerca de la isla de Masbate.

8, 20h 37m [9, 6h 37m] **Guam.** Temblor sentido en Sumay.

13, 6h 30m [13, 14h 30m] **Luzón.** Ligera sacudida y de corta duración en Legaspi.

15, 20h 50m [16, 4h 50m] **Mindanao.** Ligero temblor en Talacogon.

21, 8h 25m [21, 16h 25m] **Luzón.** Ligera sacudida sentida en San Narciso, Provincia de Tayabas.

21, 9h 27m* [21, 17h 27m] **Luzón.** Temblor sentido en la isla de Mindoro, en Batangas y sur de Tayabas. Su origen se hallaba en el mar al nordeste de Mindoro. La sacudida fué bien perceptible abordo del vapor *Vizcaya* que estaba navegando cerca del barrio Pola, de Mindoro.

Hubo una repetición sentida en Calapán, Mindoro, a las 9h 43m.

22, 16h 12m [23, 0h 12m] **Luzón.** Ligerísima sacudida que duró 40 segundos, sentida en San Narciso, Tayabas.

22, 20h 20m [23, 4h 20m] **Luzón.** Una repetición del temblor del 21 se sintió en Calapán y en "Halcon Rubber Plant" en Mindoro.

28, 6h 01m 00s* [28, 14h 01m 00s] **Mindanao.** Violenta sacudida local sentida en Malabang, Lanao, sólo duró 2 segundos.

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SEPTIEMBRE, 1929

REGISTRO MACROSíSMICO

2, 11h 14m 54s* [2, 19h 14m 54s] **Mindanao.** Temblor sentido en las Provincias de Agusan y Surigao. Su epicentro se hallaba en las montañas al este de Butúan. La intensidad en Butúan fué cerca de V.

4, 4h 25m [4, 12h 25m] **Sámar.** Sacudida de intensidad III en Borongan.

7, 2h 29m 26*s [7, 10h 29m 26s] **Mindoro.** Temblor ligero sentido en la estación de "Halcon Rubber Experiment." Su epicentro se hallaba en el paso de isla Verde.

11, 2h 28m [11, 10h 28m] **Mindanao.** Temblor ligero sentido en el Valle de Agusan y en Lebak costa de Cotabato. Probablemente son dos temblores. Repitió en Talacogon, Valle de Agusan a las 4h 10m [12h 10m] y en Lebak a las 18h 35m [12, 2h 35m].

12, 5h 15m [12, 13h 15m] **Mindanao.** Ligera sacudida en Lais, Dávao, y en Managok, Bukidnon.

12, 8h 55m [12, 16h 55m] **Mindanao.** Temblor ligero sentido en Butúan y Talacogon.

14, ... **Luzón.** Tembor sentido en Méndez, Cavite. Sin hora.

15, 0h 05m 42s* [15, 8h 05m 42s] **Luzón.** Temblor sentido al sur de Batangas. Su epicentro probablemente se hallaba en el paso de isla Verde. Hubo repeticiones a las 5h 36m 48s*, 9h 35m 56s*, 13h 14m 34s*, y a la 1h 01m 23s* del 16, hora de Greenwich.

19, 11h 06m 00s* [19, 19h 06m 00s] **Mindanao.** Temblor sentido en la parte nordeste de Mindanao. Su intensidad en Butúan fué casi V. El epicentro se hallaba a los 8° N y 129° E, hacia el lado este del Abismo de Filipinas.

21, 13h 25m [21, 21h 25m] **Mindanao.** Ligera sacudida en Talacogon.

21, 17h 35m [22, 1h 35m] **Leyte y Sámar.** Temblor cuyo epicentro se hallaba probablemente en el Pacífico. Dieron cuenta de él Borongan, Guiuan con intensidad VI y Tacloban con intensidad II.

23, 3h 30m [23, 11h 30m] **Leyte.** Temblor sentido en Maasin.

23, 17h 48m 18s [24, 1h 48m 18s] **Leyte.** Temblor de intensidad III en Ormoc.

27, 5h 45m [27, 13h 45m] **Luzón.** Temblor de intensidad III sentido en Legaspi, corta duración.

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OCTUBRE, 1929

REGISTRO MACROSÍSMICO

1, $11^h\ 44^m\ 00^s$* [1, $19^h\ 44^m\ 00^s$] **Mindanao.** Temblor sentido en la Provincia de Zamboanga y en la isla de Basilan. En Zamboanga la intensidad llegó a IV–V y fué acompañado de ruidos subterráneos.

7, $22^h\ 23^m\ 23^s$* [8, $6^h\ 23^m\ 23^s$] **Luzón.** Ligerísima sacudida sentida en Iba, que duró 3 segundos.

14, $2^h\ 08^m\ 26^s$* [14, $10^h\ 08^m\ 26^s$] **Mindanao.** Ligero temblor en el Valle del Agusan. Las estaciones de Butúan y Talacogon son las que dieron la noticia.

16, $5^h\ 35^m$ [16, $15^h\ 35^m$] **Guam.** Temblor local sentido en Sumay.

16, $23^h\ 30^m$ [17, $9^h\ 30^m$] **Guam.** Otro temblor sentido en Sumay.

17, $1^h\ 14^m\ 00^s$* [17, $9^h\ 14^m\ 00^s$] **Marinduque.** Ligero temblor sentido en Boac, duración 2 segundos.

17, $23^h\ 25^m\ 32^s$* [18, $7^h\ 25^m\ 32^s$] **Marinduque.** Otro temblor en Boac de corta duración.

19, $20^h\ 00^m$ [20, $4^h\ 00^m$] **Mindanao.** Ligero temblor local sentido en Talacogon.

21, $10^h\ 00^m$ [21, $18^h\ 00^m$] **Luzón.** Temblor sentido en Bokod y Pasuquin. Probablemente dos epicentros.

22, $9^h\ 32^m\ 57^s$* [22, $17^h\ 32^m\ 57^s$] **Luzón.** Ligero temblor sentido en el extremo noroeste de Luzón. En Laoag tuvo intensidad II. Su epicentro probablemente se hallaba en el mar de la China.

28, $17^h\ 14^m$ [29, $1^h\ 14^m$] **Palawan.** Temblor de intensidad I sentido en Iwahig.

30, $0^h\ 44^m$ [30, $8^h\ 44^m$] **Mindanao.** Ligero temblor sentido en Cantilan, Provincia de Surigao.

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NOVIEMBRE, 1929

REGISTRO MACROSÍSMICO

2, 1h 33m 47s* [2, 9h 33m 47s] **Luzón.** Extenso temblor sentido al noroeste de Luzón. Cabo Bojeador tuvo intensidad IV, Vigan y Laoag III. El epicentro se hallaba en el mar de la China a los 18° 25′ N y 120°E.

2, 22h 33m 09s* [3, 6h 33m 09s] **Luzón.** Temblor de intensidad V sentido en Aparri. El epicentro se hallaba en el canal de Babuyanes.

4, 19h 50m [5, 3h 50m] **Luzón.** Temblor local sentido en Bacon, Provincia de Sorsogón.

5, 11h 40m 11s* [5, 19h 40m 11s] **Mindanao, Sámar y Leyte.** Temblor sentido al este de Mindanao y al sur de Sámar y Leyte. Fué también perceptible en Lais hacia el sur a una distancia de 600 kilómetros y en Catbalogan hacia el norte. En las Provincias de Surigao y Agusan lo sintieron con mayor intensidad por hallarse el epicentro en el Abismo de Filipinas a los 10° N y 126° 30′ E.

5, 18h 14m 52s* [6, 2h 14m 52s] **SE de Luzón y Sámar.** Temblor sentido en las Provincias de Camarines, Albay, Sorsogón, en la isla de Catanduanes y en Sámar. Virac y Legaspi tuvieron intensidad IV. El epicentro se hallaba en el golfo de Lagonoy al sur de la isla de Catanduanes. Hubo repeticiones del mismo centro el día 7 a las 4h 01m 49s* y a las 5h 23m 19s* [12h 01m 49s y 13h 23m 19s]. En Legaspi y Sorsogón sintieron ligeras repeticiones del mismo temblor a las 5h 30m y 8h 10m [13h 30m y 16h 10m].

5, 20h 20m [6, 4h 20m] **SE de Luzón.** Temblor sentido en Tabaco, Tiwi y Barás.

8, 8h 55m 23s* [8, 16h 55m 23s] **Sámar y Leyte.** Temblor sentido en gran parte de Sámar y al este de Leyte. El epicentro parece hallarse en el mar de Sámar.

8, 15h 13m 48s* [8, 23h 13m 48s] **SE de Luzón.** Temblor sentido en Legaspi y Bacon. Del mismo origen que los temblores de los días 5 y 7.

10, ... **Negros.** Ligero temblor durante la noche. Sin hora.

10, 21h 37m 45s* [11, 5h 37m 45s] **Luzón.** Temblor de intensidad IV sentido en Naga. Fué también sentido en Daet, Ragay y San Narciso, Tayabas.

11, 9h 16m [11, 17h 16m] **Mindanao.** Ligerísimo temblor sentido en Butúan.

11, 16h 09m [12, 2h 09m] **Guam.** Temblor sentido en Sumay.

14, 18h 30m [15, 2h 30m] **Luzón.** Temblor sentido en Bato, Camarines Sur.

15, 0h 05m 47s* [15, 8h 05m 47s] **Leyte y Cebú.** Temblor de intensidad IV en Ormoc; sintióse también al norte de Cebú.

17, 3h 45m 39s* [17, 11h 45m 39s] **Mindanao.** Extenso temblor sentido en toda la isla excepto en la Provincia de Zamboanga. En Butúan fué sentido con intensidad VII. El epicentro al parecer se hallaba al sudoeste de la Provincia de Agusan a unos 8° 10′ N y 125° 30′ E. También se sintió en Tacloban, Leyte, a una distancia de unos 300 kilómetros, dando con esto una gran área afectada de unos 600 kilómetros de extensión en la dirección de N–S, mientras que en la dirección de E–W solo era de 300 kilómetros.

17, 14h 25m 35*s [17, 22h 25m 35s] **Luzón.** Temblor de intensidad III en Dagupan.

17, 21h 09m 54s* [18, 5h 09m 54s] **Mindanao.** Temblor sentido en Lais. A 22h 21m 12s* [18, 6h 21m 12s] una segunda sacudida sentida en Lais y en Dávao con intensidad III.

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18, 2^h 07^m 49^s* [18, 10^h 07^m 49^s] **Mindanao.** Ligero temblor sentido en Talacogon.

18, 4^h 09^m 00^s* [18, 12^h 09^m 00^s] **Mindanao.** Temblor sentido en Lais.

18, 5^h 43^m 28^s* [18, 13^h 43^m 28^s] **Mindanao.** Temblor algo extenso sentido al este de Mindanao, desde Butúan a Lais. Su epicentro probablemente se hallaba en el Abismo de Filipinas. En Dávao hubo dos repeticiones.

22, 23^h 55^m [23, 7^h 55^m] **Mindanao.** Temblor de intensidad III en Zamboanga, también se sintió en Sibuku a unos 50 kilómetros al norte.

23, 4^h 30^m [23, 12^h 30^m] **Mindanao.** Temblor sentido en Lais.

25, 7^m 54^s* [25, 15^h 54^m] **Mindanao.** Ligera sacudida sentida en Talacogon y Malita, probablemente dos diferentes temblores.

25, 20^h 54^m 20^s* [26, 4^h 54^m 20^s] **Mindanao.** Temblor sentido en toda la parte oeste de Mindanao. Cotabato y Zamboanga tuvieron intensidad III, el epicentro se hallaba en el golfo Moro.

DICIEMBRE, 1929

REGISTRO MACROSÍSMICO

1, 22^h 30^m [2, 6^h 30^m] **Mindanao.** Ligero temblor en Talacogon, Agusan.

3, 9^h 24^m 47^s* [3, 17^h 24^m 47^s] **Luzón.** Temblor de intensidad III en Legaspi, Albay. También se sintió en Bacon, Sorsogón.

4, 16^h 47^m [5, 0^h 47^m] **Mindanao.** Ligero temblor en Talacogon, Agusan.

6, 14^h 22^m [6, 22^h 22^m] **Mindanao.** Otro ligero temblor en Talacogon.

7, 4^h 05^m [7, 12^h 05^m] **Bohol.** Temblor de intensidad II en Tagbilaran.

7, 6^h 50^m [7, 14^h 50^m] **Mindanao.** Fuerte temblor sentido en Malita, Dávao.

9, 4^h 15^m [9, 12^h 15^m] **Mindanao.** Temblor algo fuerte sentido en Managok, Bukidnon.

9, 6^h 07^m 00^s* [9, 14^h 07^m 00^s] **Mindanao.** Temblor sentido hacia el SE de Mindanao. En Dávao la intensidad fué IV. También se sintió en Talacogon.

9, 22^h 35^m 42^s* [10, 6^h 35^m 42^s] **Luzón.** Temblor de intensidad II sentido en Dagupan, Pangasinan, de 3 segundos de duración.

16, 4^h 45^m [16, 12^h 45^m] **Mindanao.** Ligero temblor sentido en Talacogon, Agusan.

18, 8^h 49^m [18, 16^h 49^m] **Mindanao.** Otro ligero temblor en Talacogon.

22, 2^h 55^m 59^s* [22, 10^h 55^m 59^s] **Mindanao.** Temblor sentido hacia el NE de Mindanao. En Butúan tuvo intensidad III y 40 segundos de duración.

22, 14^h 28^m 46^s* [22, 22^h 28^m 46^s] **Mindanao.** Temblor de intensidad VI sentido en Dávao. Probablemente de un foco superficial en el golfo de Dávao.

24, 14^h 35^m [24, 22^h 35^m] **Catanduanes.** Temblor de 3 segundos de duración en Barás.

25, 5^h 35^m [25, 13^h 35^m] **Luzón.** Temblor sentido en Bacon, Sorsogón.

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CATALOGUE OF PRINCIPAL EARTHQUAKES OF THE PHILIPPINE ISLANDS, 1929 [a]

Date	Approximate time of occurrence G. M. F.		Place	Probable epicenter		Approximate extension shaken area		Intensity (Rossi-Forel)	Remarks
				ϕ	λ	Major axis	Minor axis		
	h.	*m.*		°	°	*Km.*	*Km.*		
Jan. 9	19	55	Southeastern Luzon			100	100	V	Registered at Manila.
14	17	30	Bokod, Benguet (N Luzon)	16.5 N	120.75 E	400	300	III	Registered in the Far East. Two repetitions: 8:06:41 and 14:04:09 on the 16th.
Feb. 15	5	43	Veruela, Glan, Butuan and Malaybalay.	8.0 N	126.0 E	300	200	IV–V	Recorded in the Far East.
22	17	31	Butuan, Agusan (N Mindanao)					IV	
Mar. 20	21	12	Northern Luzon	18.5 N	119.6 E	200	200	VI	Do.
April 1	18	33	Butuan, Agusan (N Mindanao)					V	Local earthquake.
2	6	13	Olongapo and Manila (W Luzon).	14.7 N	120.0 E	100	100	IV	
5	8	28	Northern Luzon	18.9 N	120.8 E	100	100	III–IV	Registered at Manila, Phu-Lien and Hong Kong.
8	10	19	Eastern Mindanao			270	?	III-IV	Recorded in the Far East.
18	3	41	Cotabato (SW Mindanao)	7.2 N	123.7 E	100	100	IV	Registered at Manila, Phu-Lien and Hong Kong.
23	18	26	Verde Island Passage	13.6 N	121.0 E	100	100	IV–V	Felt by a few persons in Manila.
25	9	53	Cotabato (SW Mindanao)					IV	Local earthquake.
May 4	8	59	Butuan, Agusan (N Mindanao)	9.2 N	125.3 E	130	?	IV	Registered at Manila.
June 1	23	10	Northeastern Mindanao	9.0 N	126.0 E	200	100	III–IV	Do.
13	9	27	Hinatuan, Surigao (E Mindanao)	8.3 N	126.9 E	1200	600	VII–VIII	Registered throughout the world. Many aftershocks till the end of this month.
15	9	00	Central Panay	10.0 N	121.6 E	300	300	IV	Registered in the Far East.
18	12	14	Northwestern Luzon	18.5 N	120.0 E			III–IV	Registered at Manila.
26	11	30	Tacloban (NE Leyte)	11.3 N	124.7 E			V	Registered at Manila and Butuan.
July 2	0	40	Northeastern Mindanao	9.0 N	126.7 E	130	130	III–IV	Registered in the Far East. Ten or more light repetitions felt at Butuan during the day.
3	10	29	Southern Luzon	13.6 N	120.6 E	200	200	III–IV	Felt at Manila.
8	10	50	Virac and Legaspi (SE Luzon)	13.3 N	124.2 E	75	75	V	Registered at Manila.
16	12	05	Baler, Tayabas (E Luzon)					VI	Local earthquake.
21	13	17	Southeastern Luzon	14.6 N	124.0 E	250	250	VI–VII	Recorded in the Far East. Repetitions with less intensity at 13h 22m.
21	13	36	Zamboanga (W Mindanao)					V	Local earthquake.
24	5	07	Southeastern Luzon	14.5 N	124.2 E			III–IV	Registered at Manila.
Aug. 1	21	17	Agusan Valley (E Mindanao)			75	?	III–IV	
8	6	36	Masbate Island					IV	Do.
21	9	27	NE Mindoro and S Luzon	13.4 N	121.5 E			VI	Registered in the Far East. Aftershocks at 9h 43m and on 22nd at 20h 20m.
Sept. 2	11	15	Butuan, Agusan (N Mindanao)	8.8 N	125.8 E	150	150	IV–V	Registered in the Far East.
15	0	06	Balayan, Batangas (S Luzon)	13.7 N	120.7 E			IV	Repetitions at 5h 37m, 9h 36m, 13h 15m and 1h 01m on the 16th. All registered at Manila.
19	11	06	NE Mindanao	8.0 N	129.0 E			V	Registered in the Far East.
21	17	35	Borongan (E Samar)	11.5 N	126.2 E			IV	Do.
Oct. 1	11	44	Zamboanga (W Mindanao)					IV–V	Registered at Manila.
Nov. 2	1	34	Northwestern part of Luzon	18.4 N	120.0 E	320	320	IV	Recorded at Manila and Hong Kong.
2	22	33	Aparri, Cagayan (NE Luzon)					V	Registered at Manila.
5	11	40	S Samar and Leyte and E Mindanao	10.0 N	126.5 E	700	700	VI–VII	Recorded in the Far East.
5	18	15	SE Luzon and Samar Island	13.3 N	124.2 E	260	260	IV	Registered at Manila. Four aftershocks on the 7th.
8	8	55	Samar and E Leyte					IV–V	Registered at Manila.
10	21	38	Southeastern part of Luzon					IV	Do.
15	0	06	W Leyte and N Cebu					IV	Do.
17	3	46	Mindanao Island	7.3 N	126.2 E	800	460	VII	Registered in the Far East.
18	5	43	Eastern part of Mindanao			200	?	III–IV	Registered at Manila and Hong Kong. Two aftershocks.
Dec. 9	6	07	SE Mindanao					IV	Registered at Manila and Batavia.
22	14	29	Davao (SE Mindanao)					IV	Registered at Manila.

[a] This catalogue is intended only as a convenient reference list of the more important earthquakes. The date should not be used for accurate epicentral determinations.

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NUMBER OF EARTHQUAKES FELT IN THE PHILIPPINES, FROM 1903 TO 1929

Year	January	February	March	April	May	June	July	August	September	October	November	December	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	55	7	15	6	9	5	5	7	9	114
1929	18	12	12	18	18	9	25	11	14	12	23	15	187

The number of violent and destructive earthquakes (VII to X) during these years was 63. In 1913 there were 6; 1907, 5; 1915, 1919, 1923 and 1925, 4; 1910, 1917, 1918, 1920, 1921, 1922 and 1928, 3; 1904, 1905, 1912, 1924 and 1929, 2; 1903, 1909, 1911, 1916 and 1926, 1. Their monthly distribution is the following: January 4, February 2, March 6, April 7, May 6, June 2, July 3, August 5, September 7, October 3, November 10 and December 8.

NUMBER OF SEISMIC DISTURBANCES RECORDED AT MANILA, FROM 1903 TO 1929

Year	January	February	March	April	May	June	July	August	September	October	November	December	Total
0903	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

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NEW VALUES FOR SOME OF THE DISCONTINUITIES IN THE EARTH

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The interior of the earth has been subject of interest from earliest times but it has remained for Seismology to afford the most direct means of investigating actual conditions in the earth beyond the reach of borings.

A severe earthquake sets up elastic waves which are transmitted throughout the earth and their behavior reveals the path over which they have travelled and something of the nature of that path. Thus we have come to a knowledge of the core of the earth and its overlying layers.

This investigation had its inception in a design to examine the shape of the core of the earth by means of elastic waves. Time did not permit the attainment of that object, but the development of the work has revealed new values for the depth of some of the discontinuities between the earth's surface and its core.

HISTORICAL SUMMARY

Legendre(1) was the first to formulate an equation to express the variation of density in the interior of the earth. It was empirical and based on the known density of the surface of the earth and that of the earth as a whole. He assumed that the greater density of the interior was due to simple pressure of the superimposed material. Roche(2) expressed the same law in a more convenient form. Poincare, Lipschitz,(3) Helmert,(4) Oekinghaus,(5) G. H. Darwin and other investigators, making the same assumption as Legendre, have formulated similar equations.

Another line of thought was initiated in 1840 when Hopkins(6) suggested that the interior of the earth is in a rigid condition, at least to a depth of one-fourth of the radius. Lord Kelvin called attention to the fact that the earth must be rigid in order that the force of attraction of the sun and moon may produce the tides. Darwin took up this idea and from tidal analysis found that the rigidity of the earth as a whole must exceed that of steel.

In 1897 Wiechert(7) advanced the hypothesis, based on astronomical and geophysical data, that the earth is constituted of an iron core and rock mantle. In 1906 Oldham(8) advanced the view, based on the behavior of transverse seismic waves, that the elastic properties of the earth undergo a change at a depth of about six-tenths of the radius, i. e., at about 3800 km., thus indicating the existence of a central nucleus and an outer shell. In 1906–1907, also from seismological data, Wiechert and Zoeppritz(9) confirmed this view of change of properties but they put the discontinuity at about 1500 km. deep. They further stated that the inner portion is composed, most probably, of iron, as this would satisfy the value for the density of the earth as a whole.

Using more accurate seismological data, Geiger and Gutenberg,(10) early in 1912, determined by the method of amplitudes, discontinuities at depths of 1194 km., 1677 km., and 2436 km. As a result of their study of the Columbian earthquake of January 31st 1906, Rudolph and Szirtes,(11) in 1912, located discontinuities at depths of 1592 km. and 3180 km. The latter figure was the greatest depth at which a discontinuity

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had been located by any investigator except Oldham. By 1916 S. Mohorovičic,(12) by the method of travel times, gave the following values as the depths of the discontinuities, 120 km., 400 km., 1200 km., 1700 km., 2000 km., and 2500 km. In 1918, Knott(13) obtained the same value for the depth of the core as Oldham had in 1906, namely 3800 km.

As early as 1912 Gutenberg(14) (15) found evidence for a discontinuity at 2900 km. and subsequent observations have shown that this is the most probable value of the depth of the core. This discontinuity produces such marked effects on the seismic waves that reach it that Gutenberg styled it a discontinuity of the first order.

THE CORE AND DISCONTINUITY SURFACES

The investigations of Gutenberg(16) show that there are two phenomena which indicate a sharp boundary for the core. The first is that the travel time curve for P beyond 102° is a straight line showing that the wave paths differ only by a distance which is traversed with a constant velocity. This finds an explanation if the P–waves, beyond 102°, travel along the surface of the core, thus passing through a medium with constant properties. The second phenomenon is the existence of a focal point in the neighborhood of 143° for longitudinal waves transmitted through the core, and the good agreement of calculated and observed arrival times of P′ and other phases for distances beyond 143°. Macelwane(17) has also found evidence for a sharp boundary in the records of the South Pacific earthquake of June 26th 1924. Toronto at 143.59° received a very weak wave while Ottawa at 146.72° received a comparatively strong P′.

Gutenberg calculated travel time curves for PcP and ScS, and similar curves for PcS and PcSScP have been calculated by Macelwane, and all of them have been incorporated into the Table of Travel Times of St. Louis University. The existence of all these phases has been verified by Macelwane.(18)

If the core is capable of reflecting elastic waves we are justified in looking for reflections, weak though they may be, from the various discontinuities between the surface and the core. Such reflections will be subject to the limitation, pointed out by Lord Rayleigh and Wilcken,[19] that the intensity is a function of the sharpness of the boundary. This sharpness in a continuously varying medium is, in turn, a function of the wave-length of the phenomenon involved, the shorter the wave-length the more rapidly must the properties of the medium change in the neighborhood of the boundary to produce a given intensity of reflection.

Several arguments are advanced against the existence of physical discontinuities, one being drawn from the interpenetration of solids in intimate contact under pressure, another from the apparent impossibility of formation of distinct layers in a gradually cooling sphere. These and similar arguments are based on the behavior of matter under conditions prevailing on the surface of the earth or under conditions which can be produced by man, whereas we have no certain knowledge of the behavior of matter under conditions prevailing at great depths in the earth.

We have a strong argument in favor of the existence of a discontinuity at a definite depth, if the travel times for elastic waves reflected from such a discontinuity are calculated, and observed arrivals of such waves are found to be in agreement with the calculated times. This test has been adopted in this investigation.

CALCULATIONS

The calculation of the discontinuities has been based on the travel times of P (longitudinal wave) as given in the Table of Travel Times of St. Louis University. These

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values were read from travel times curves based on the tables published by A. and S. Mohorovičic in 1921.

The P–O curve was drawn on a very large scale, one centimeter to one degree and one centimeter to two and a half seconds. The apparent surface velocity was then read at intervals of four-tenths, and in some sections at intervals of two-tenths, of a degree. At least two independent drawings and readings of the curve were made. Some sections were repeated as many as five times. Plate I shows the curve obtained by plotting apparent surface velocity against distance along the surface, the former in kilometers per second, the latter in degrees. Abrupt changes in the apparent surface velocity appear at 32.2°, 39.4°, 65° and 77.5°. Table 1 gives the apparent surface velocity for each degree of distance measured along the surface of the earth.

TABLE 1

D°	$V\frac{km}{sec}$	D°	$V\frac{km}{sec}$	D°	$V\frac{km}{sec}$	D°	$V\frac{km}{sec}$
0	8.0						
1	8.0	26	10.4	51	16.1	76	19.4
2	8.0	27	10.7	52	16.3	77	19.6
3	8.0	28	11.0	53	16.4	78	19.8
4	8.0	29	11.3	54	16.6	79	19.8
5	8.1	30	11.7	55	16.8	80	19.8
6	8.1	31	12.1	56	17.0	81	19.8
7	8.1	32	12.6	57	17.2	82	19.9
8	8.1	33	13.1	58	17.3	83	19.9
9	8.1	34	13.3	59	17.5	84	19.9
10	8.2	35	13.4	60	17.7	85	19.9
11	8.2	36	13.6	61	17.9	86	20.0
12	8.2	37	13.8	62	18.1	87	20.1
13	8.3	38	14.0	63	18.2	88	20.1
14	8.3	39	14.2	64	18.4	89	20.2
15	8.4	40	14.3	65	18.6	90	20.3
16	8.5	41	14.4	66	18.6	91	20.4
17	8.6	42	14.5	67	18.6	92	20.5
18	8.7	43	14.7	68	18.6	93	20.7
19	8.8	44	14.8	69	18.6	94	20.8
20	9.0	45	15.0	70	18.6	95	21.0
21	9.2	46	15.2	71	18.7	96	21.1
22	9.4	47	15.4	72	18.7	97	21.3
23	9.6	48	15.5	73	18.8	98	21.5
24	9.8	49	15.7	74	19.0	99	21.7
25	10.1	50	15.9	75	19.2	100	21.9

The values were then used to obtain the velocity of the waves at increasing depths. The equation giving the value of the velocity is

$$v = \frac{R}{r} V_r$$

in which R is the radius of the earth, V_r the apparent surface velocity at the point reached by a ray which has gone down to a depth whose distance from the center of the earth is r.

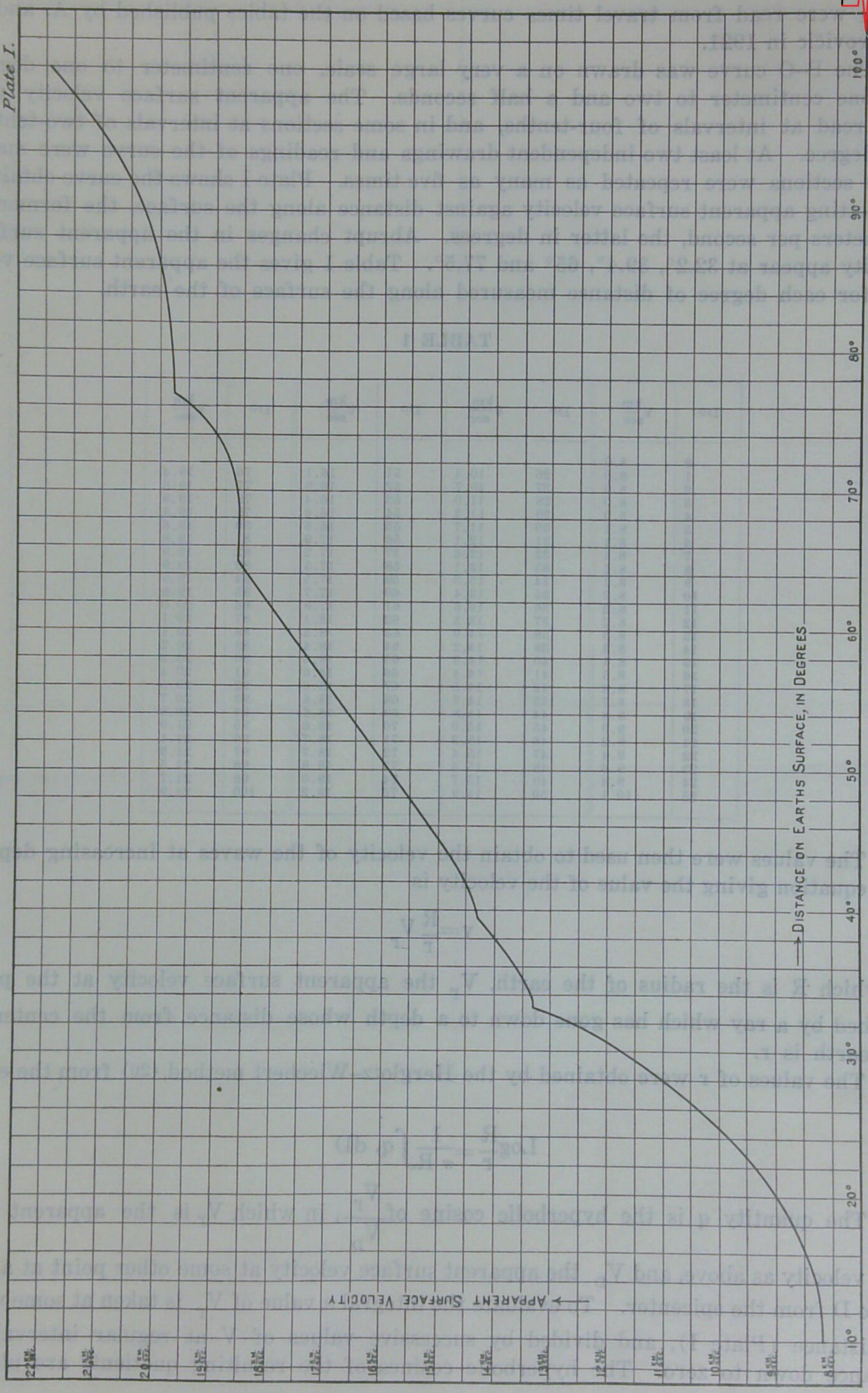
The values of r were obtained by the Herglotz–Wiechert method,(20) from the equation

$$\mathrm{Log}\frac{R}{r} = \frac{1}{\pi R}\int q.\, dD$$

The quantity q is the hyperbolic cosine of $\frac{V_r}{V_D}$, in which V_r is the apparent surface velocity as above, and V_D the apparent surface velocity at some other point at a distance D from the epicenter. To evaluate the integral a value of V_r is taken at some value of distance (Plate I), and divided by successive values of V at regular intervals of distance down to zero. The hyperbolic cosines of the resulting quotients are plotted

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Plate I.



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against distances in degrees as in Plate II. The resulting curve is then integrated within the limits D=O and D== the value at which V_r is taken. The equation is then solved for r. Plate II shows the curves obtained by taking the value of V_r at every five degrees and at some intermediate values. The upper portions of some of the curves cut off in the Plate were drawn on a separate sheet for the integration.

TABLE 2

D°	d	r	$\frac{r}{R}$	V_r	$v=\frac{r}{R} V_r$
5	29.0	6337.0	.9954	8.05	8.013
10	54.6	6311.4	.9914	8.13	8.06
15	136.3	6229.7	.9786	8.36	8.18
20	292.9	6073.1	.9539	8.97	8.55
25	512.5	5853.5	.9194	10.07	9.26
29	719.4	5646.6	.8869	11.34	10.06
32	897.0	5469.0	.8590	12.61	10.83
33.2	973.0	5393.0	.8471	13.20	11.18
35	1000.4	5365.6	.8428	13.39	11.28
39	1128.0	5238.0	.8228	14.22	11.70
39.4	1141.0	5225.0	.8207	14.30	11.76
42	1174.8	5191.2	.8154	14.49	11.81
45	1277.2	5098.8	.8009	15.02	12.03
50	1414.0	4952.0	.7778	15.89	12.36
55	1569.6	4796.4	.7534	16.79	12.65
60	1723.0	4843.0	.7293	17.70	12.90
64.5	1855.3	4510.7	.7085	18.50	13.107
70	1882.1	4483.9	.7043	18.61	13.107
75	2004.0	4362.0	.6852	19.14	13.115
77	2095.1	4270.9	.6708	19.63	13.157
80	2135.0	4231.0	.6616	19.81	13.166
85	2234.0	4132.0	.6490	19.95	12.947
90	2254.1	4111.9	.6459	20.29	13.105
95	2411.5	3954.5	.6211	20.97	13.02
100	2584.0	3782.0	.5940	21.94	13.03
105	2685.0	3681.0	.5782		

Table 2 gives the values obtained for D, distance in degrees along the surface of the earth: d, greatest depth below the surface of the earth reached by a ray: r, distance of this deepest point from the center of the earth: the ratio $\frac{r}{R}$: V_r from Plate I: and v, the velocity at the deepest point reached by the ray. "Ray" is taken in the optical sense as denoting the path of a wave as determined by the perpendicular to the wave-front at any instant.

The values of v in Table 2 were then plotted as ordinates, as shown in Plate III, against a double scale of abscissae, distance from the center of the earth and the corresponding depth below the surface.

The resulting curve shows discontinuities at depths of

973 km. 1,140 km. 1,570 km.? 1,860 km. 2,100 km.?

DISCUSSION

A question mark is placed after the value 1,570 km. because there was no corresponding change in the velocity curve of Plate I.

A question mark is also placed after the value 2,100 km. and the curve is drawn as a broken line beyond 1,860 km. because of the scattered position of the points involved. This uncertainty is due to the extremely flat character of the P—O curve for the higher values of D.

The discontinuities found by S. Mohorovičic(12) at depths of 120 km. and 400 km. do not appear.

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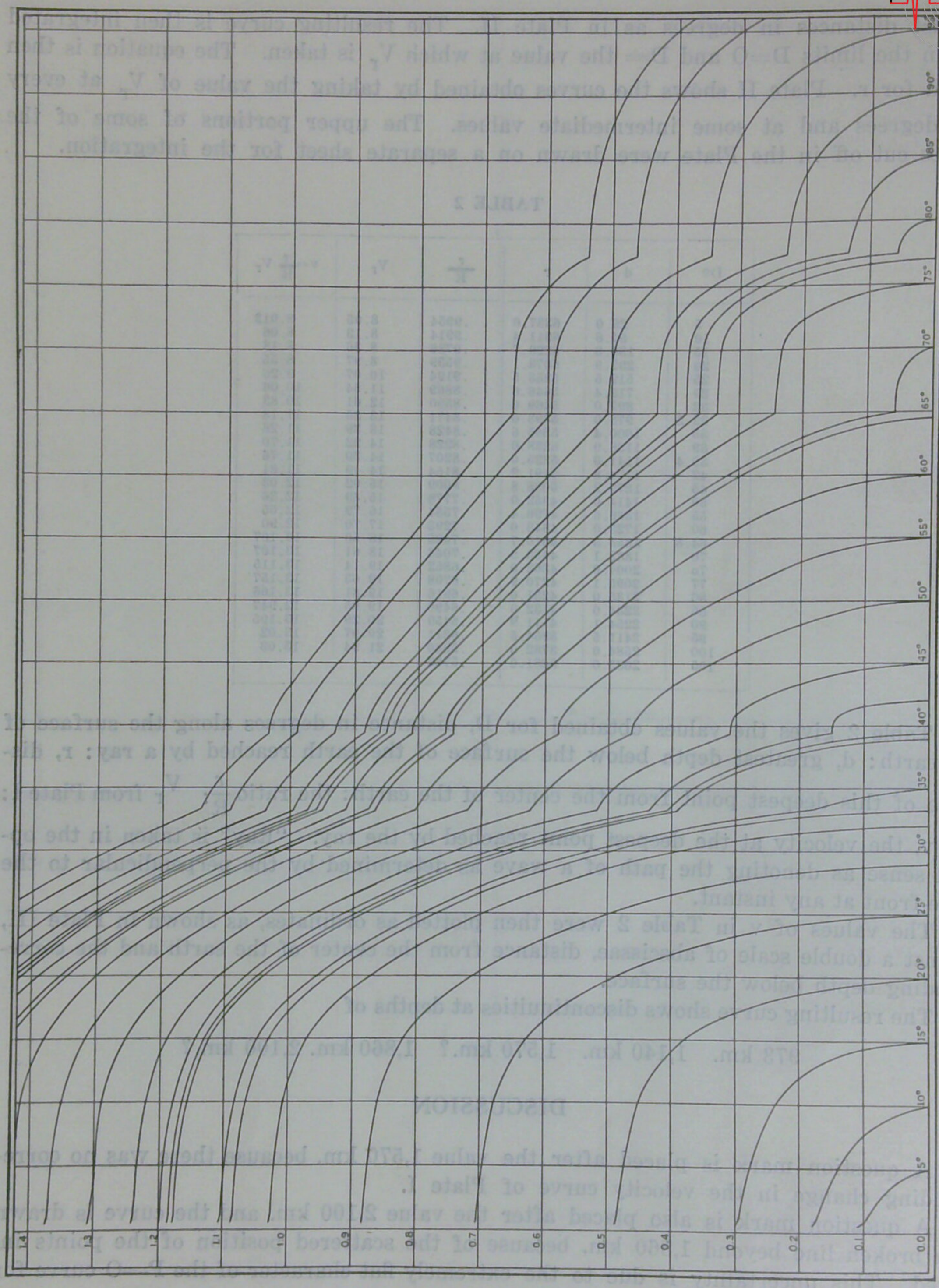


Plate II

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There is some correspondence between the values 1,140 km. and 2,100 km. just found and the values obtained by Mohorovičic at 2,000 km. and by Mohorovičic and others at 1,200 km.

The values 973 km. and 1,860 km. are new values.

To test the reality of a discontinuity at a depth of 973 km. a travel time curve was drawn for waves reflected from that depth. The method is that of Gutenberg,(14) using the equations

$$\Delta = \frac{360}{2\pi}\int \frac{\tan i}{r}\,dr \qquad (1)$$

and

$$T = \int \frac{1}{v \cos i}\,dr \qquad (2)$$

The quantities involved are represented in Figure 1.

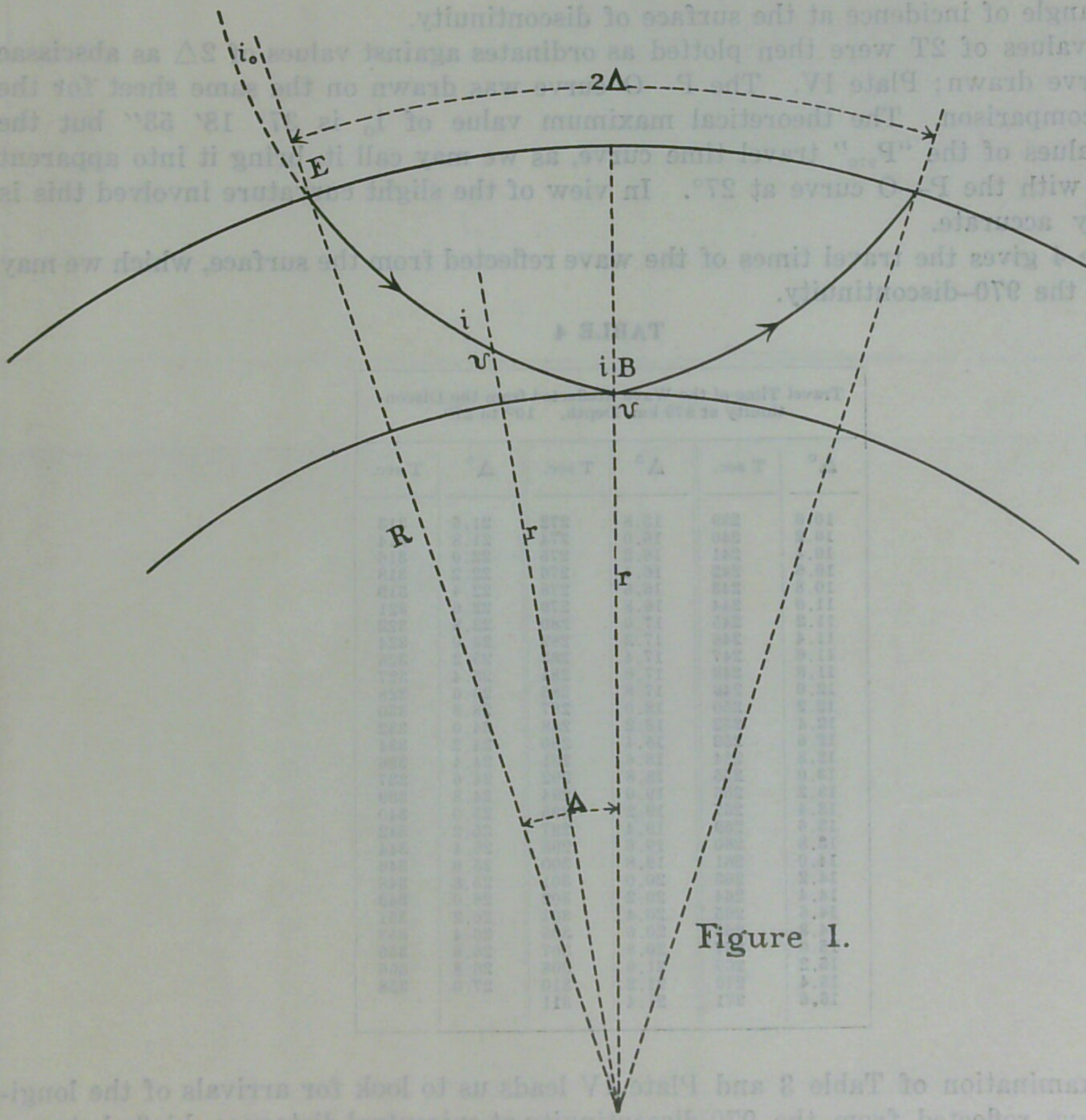


Figure 1.

"△" is the angle at the center of the earth, between the radius to the epicenter and the radius to the point where the ray touches the surface of the discontinuity. "T" is the time consumed in travelling the distance EB. "v" is the velocity at a point,

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distant "r" from the center of the earth, and "i" is the angle of incidence of the ray at that distance. The angle i_o, the angle of incidence at the surface of the earth, was given, successively, the values 0°, 7°, 15°, 30°, 33° and 36° 30′, and the corresponding values of △ and T calculated.

Table 3 contains the results of the integrations indicated in equations (1) and (2).

TABLE 3

i_o		i_d			Δ	2Δ	T	2T
°	′	°	′	″	°	°	s	s
36	30	78	51	58	13.44	26.88	178.59	357.18
33	00	63	56	53	9.96	19.92	150.42	300.84
30	00	55	33	53	8.25	16.5	138.53	277.06
15	00	25	16	22	4.06	8.12	115.67	231.34
7	00	11	35	48	1.44	2.88	106.87	213.74
0	00	0	00	00	0.00	0.00	95.79	208.00

i_d=angle of incidence at the surface of discontinuity.

The values of 2T were then plotted as ordinates against values of 2△ as abscissae and a curve drawn; Plate IV. The P—O curve was drawn on the same sheet for the sake of comparison. The theoretical maximum value of i_o is 37° 18′ 53″ but the plotted values of the "P_{970}" travel time curve, as we may call it, bring it into apparent tangency with the P—O curve at 27°. In view of the slight curvature involved this is sufficiently accurate.

Table 4 gives the travel times of the wave reflected from the surface, which we may designate the 970–discontinuity.

TABLE 4

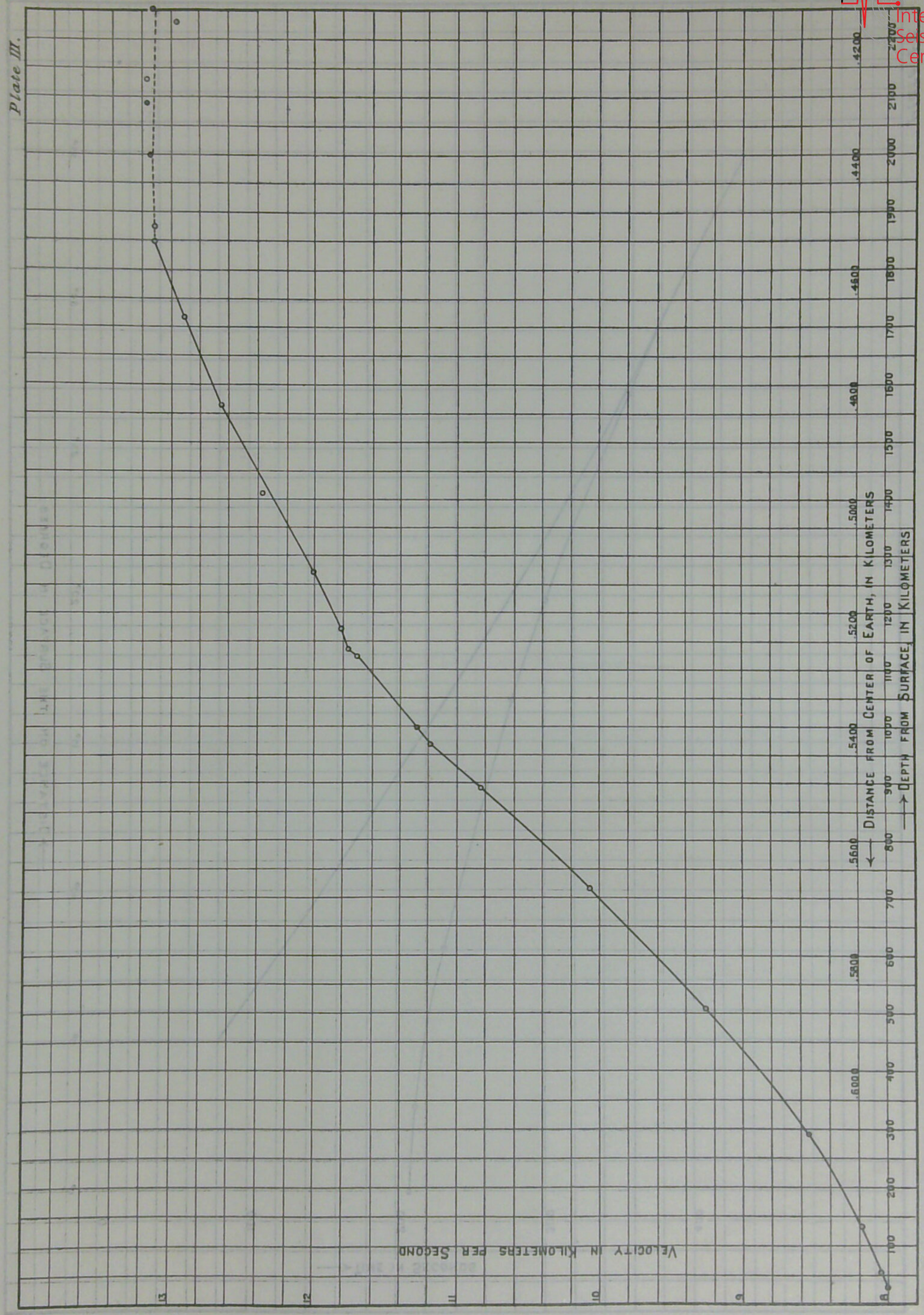
Travel Time of the Wave Reflected from the Discontinuity at 970 km. Depth. 10° to 27°.

Δ°	T sec.	Δ°	T sec.	Δ°	T sec.
10.0	239	15.8	272	21.6	313
10.2	240	16.0	274	21.8	314
10.4	241	16.2	275	22.0	316
10.6	242	16.4	276	22.2	318
10.8	243	16.6	278	22.4	319
11.0	244	16.8	279	22.6	321
11.2	245	17.0	280	22.8	322
11.4	246	17.2	282	23.0	324
11.6	247	17.4	283	23.2	326
11.8	248	17.6	284	23.4	327
12.0	249	17.8	286	23.6	328
12.2	250	18.0	287	23.8	330
12.4	252	18.2	288	24.0	332
12.6	253	18.4	290	24.2	334
12.8	254	18.6	291	24.4	336
13.0	255	18.8	292	24.6	337
13.2	256	19.0	294	24.8	339
13.4	257	19.2	295	25.0	340
13.6	259	19.4	297	25.2	342
13.8	260	19.6	298	25.4	344
14.0	261	19.8	300	25.6	346
14.2	263	20.0	301	25.8	348
14.4	264	20.2	302	26.0	349
14.6	265	20.4	304	26.2	351
14.8	266	20.6	305	26.4	353
15.0	267	20.8	307	26.6	355
15.2	269	21.0	308	26.8	356
15.4	270	21.2	310	27.0	358
15.6	271	21.4	311		

An examination of Table 3 and Plate IV leads us to look for arrivals of the longitudinal wave reflected from the 970-discontinuity at epicentral distances chiefly between 15° and 25°. For epicentral distances less than 15° the angle of incidence at the discontinuity is small and we expect most of the energy to be transmitted into the lower media, unless the boundary is very sharp. This latter condition is improbable, because

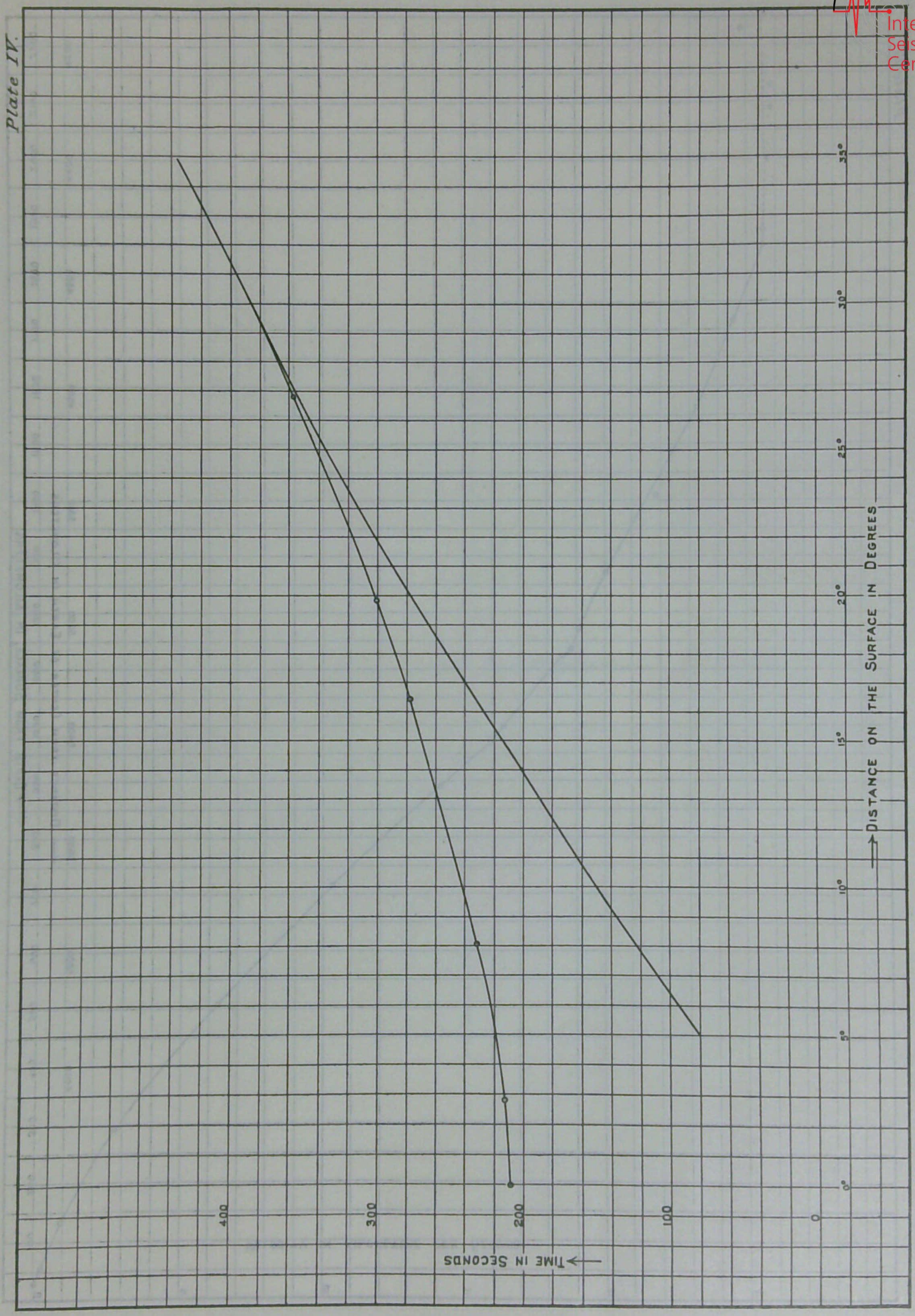
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Plate III.



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Plate IV.



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P-waves which have crossed the boundary and emerged at greater epicentral distances still show great energy.

Beyond 25° the interval between the P–O curve and the 970-curve becomes very small and hence the P-wave will mask a wave reflected from the 970-discontinuity.

From Table 3 we see that a wave emerging at an epicentral distance greater than 17° has an angle of incidence on the discontinuity greater than 55° and we may expect more of the incident energy to be reflected as the angle increases.

An extension of the investigation to the deeper discontinuities had to be deferred to some future time.

SEISMOGRAPHIC EVIDENCE

1. SUMMARY OF SEISMOGRAPHIC DATA

TABLE 5

Earthquake	Date	Station	Distance	Seismograph	Record
Montana, U. S. A.	June 28, 1925	Berkeley, California	11.8°	Wiechert Vertical Bosch–Omori N–S component Bosch–Omori E–W component	Pl. V, Fig. 1. Pl. V, Fig. 2. Pl. V, Fig. 3.
Kansu, China	May 23, 1927	Zikawei, Shanghai	16.55°	Galitzin Vertical Wiechert E–W component Wiechert N–S component	Pl. V, Fig. 4. Pl. V, Fig. 5. Pl. V, Fig. 6.
Kansu, China	May 23, 1927	Phu-Lien, Indo-China	17.0°	Mainka E–W component Mainka N–S component	Pl. V, Fig. 7. Pl. V, Fig. 8.
South Pacific 56.93° S 155.63° E	June 26, 1924	Sydney, Australia	23.3°	Wiechert N–S component Wiechert E–W component	Pl. VI, Fig. 1. Pl. VI, Fig. 2.
Off coast of California	Nov. 4, 1927	St. Louis, Missouri	25.8° (From S–P)	Wood–Anderson E–W component	Pl. VI, Fig. 3.
Off coast of Mexico	Mar. 22, 1928	St. Louis, Missouri	24.5° (From S–P)	Wood–Anderson E–W component Wood–Anderson N–S component	Pl. VI, Fig. 4. Pl. VI, Fig. 5.
Off coast of Mexico	Apr. 16, 1928	St. Louis, Missouri	23.6°	Wood–Anderson E–W component Wood–Anderson N–S component	Pl. VI, Fig. 6. Pl. VI, Fig. 7.

2. EXPLANATION OF THE SEISMOGRAMS

Plate V. Figures 1–2–3.—P_{970} was due at Berkeley 78s after P. A new impulse appears on the three components at 76s, 77s, and 79s respectively, as shown in the figures. None of the surface-layer phases calculated by Mohorovičic(21) are due at these times.

Plate V. Figure 4.—P_{970} was due at Shanghai 43s after P. At "b" there was a decay in amplitude of 5 mm. Just after the interval of 43s after P the amplitude increased 6 mm. instead of decaying 5 mm. or more, indicating the arrival of new impulse.

Plate V. Figure 5.—A new impulse at 43s after P appears quite clearly on this record.

Plate V. Figure 6.—A new impulse at 43s after P appears clearly on this component also. PR_1, PR_2, and PR_3 were due in the interval 12s to 18s after P.

Plate V. Figures 7 and 8.—P_{970} was due at Phu-Lien 40s after P. A new impulse at this time is quite evident.

Plate VI. Figure 1.—P_{970} was due at Sydney 9s after P. The evidence that can be adduced from this component is that at 9s after P the pen was on its downward stroke and moved through an amplitude of 33 mm. below the median line, where as its preceding amplitude above the median was 27 mm.

Plate VI. Figure 2.—This component shows some evidence of a new impulse 9s after P. The pen was on a downward stroke and the new impulse sent it further down than it, apparently, would have gone. This also confirms the view of the entrance of a new impulse on the N–S component at this moment.

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Figure 1.

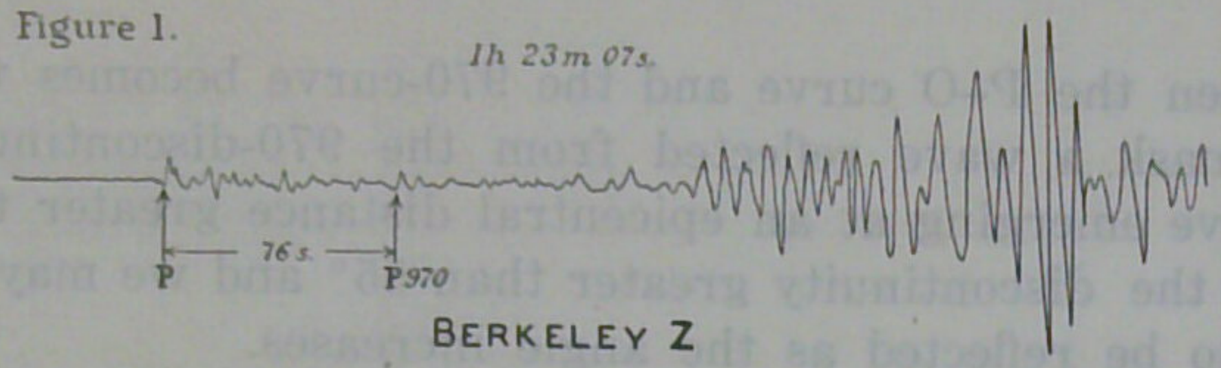


Figure 2.

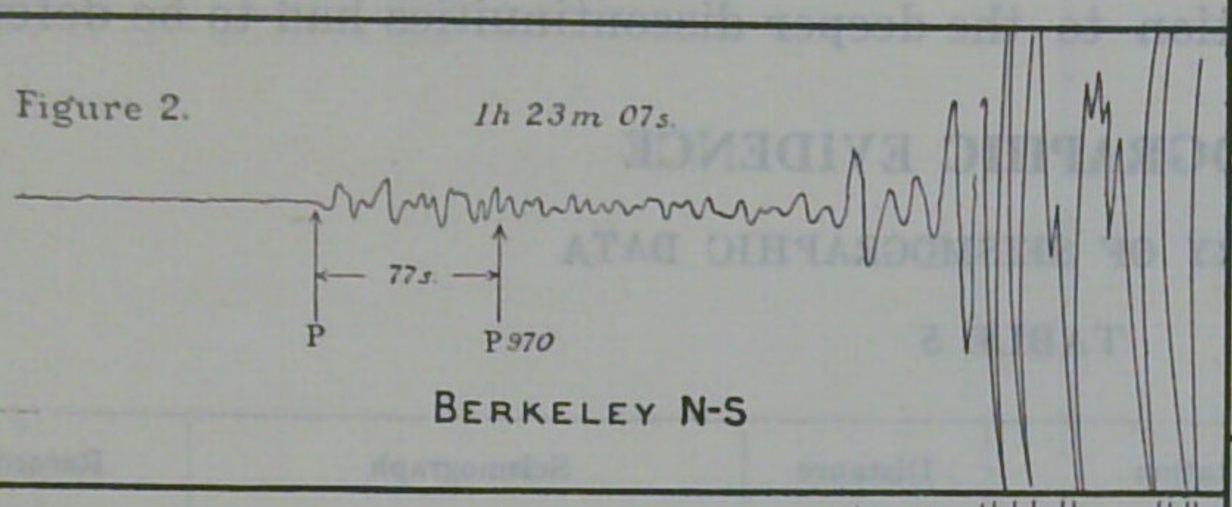


Figure 3.

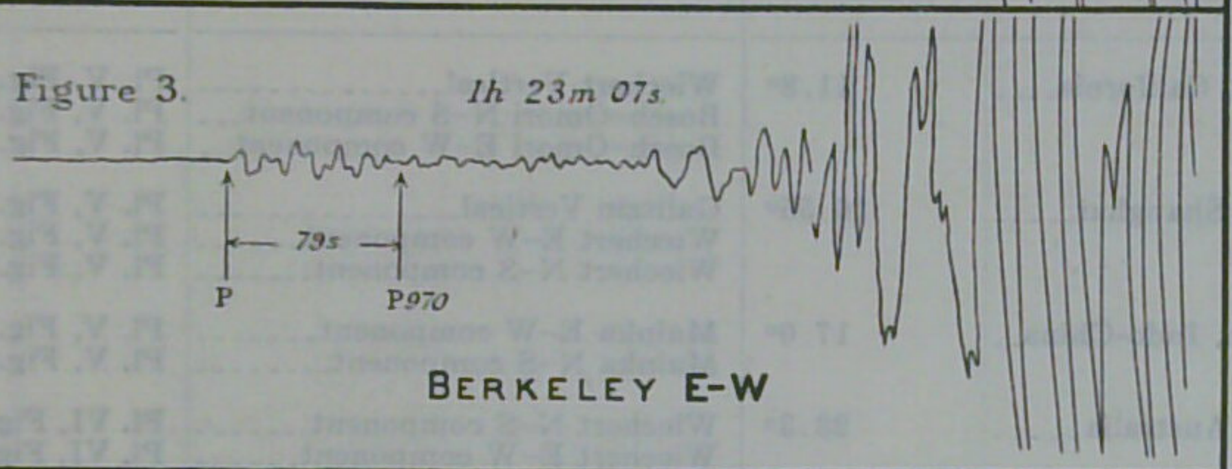


Figure 4.

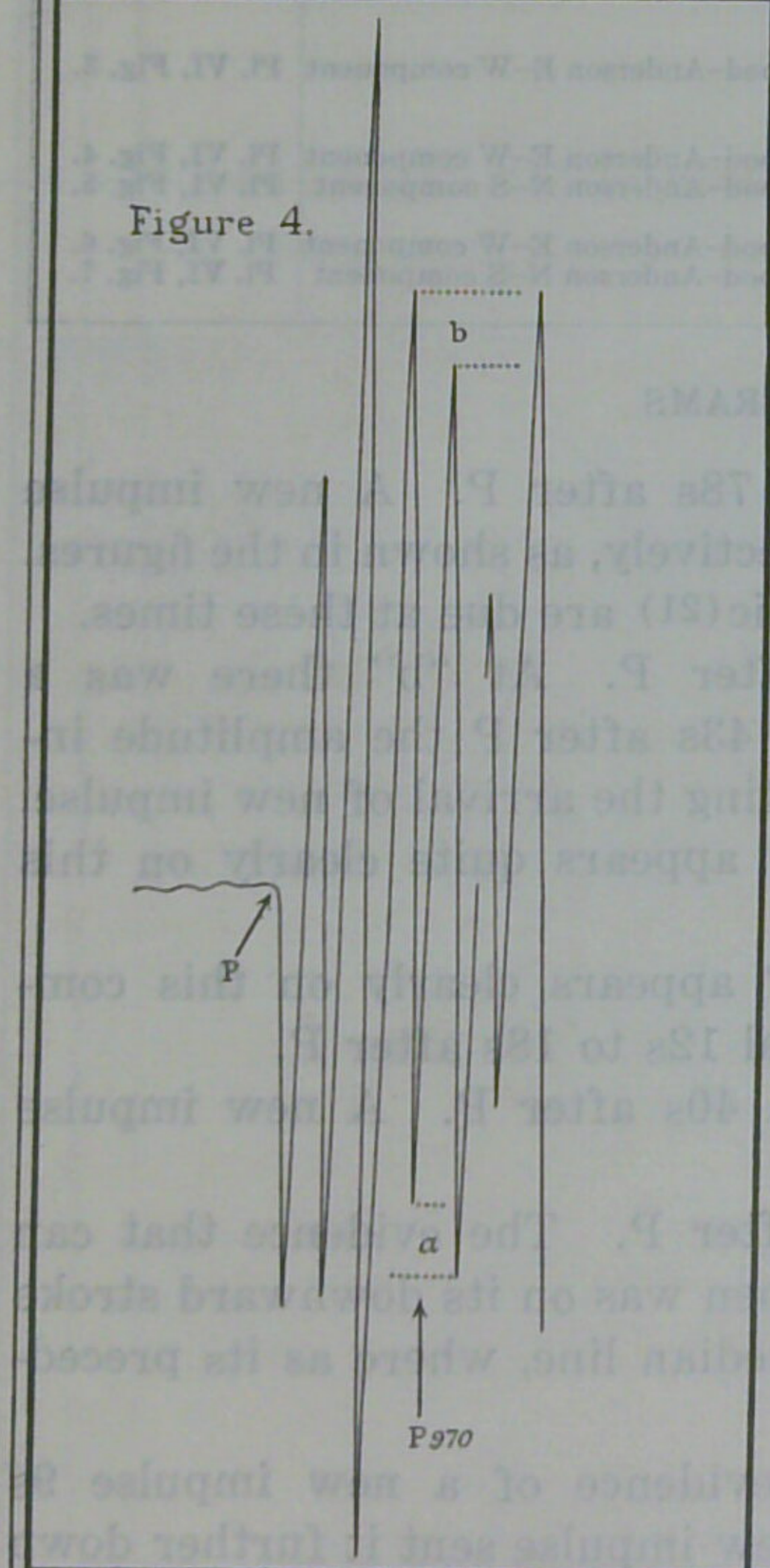


Figure 5.

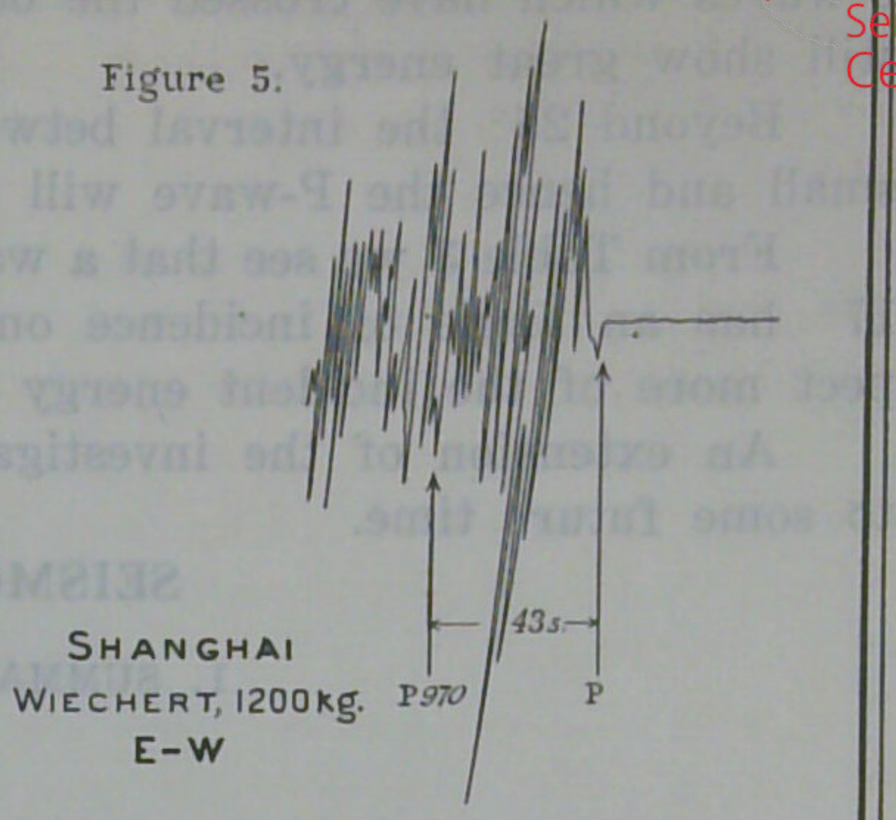


Figure 6.

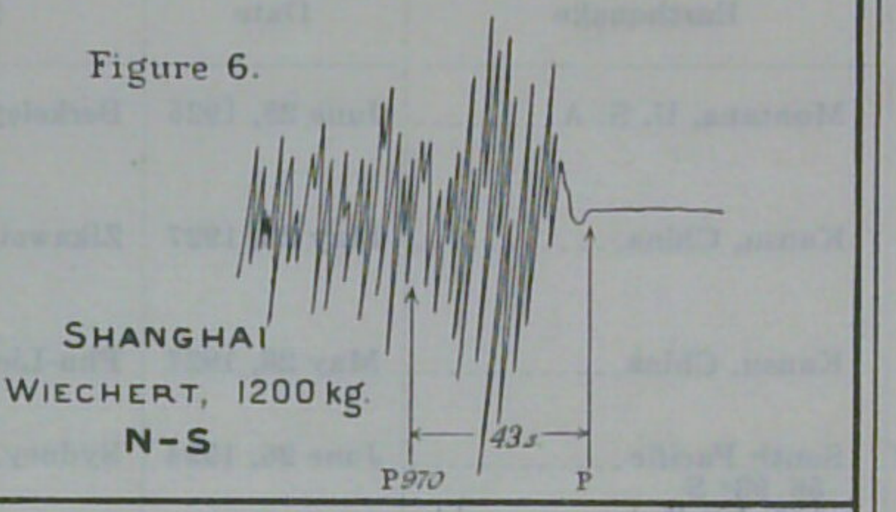


Figure 7.

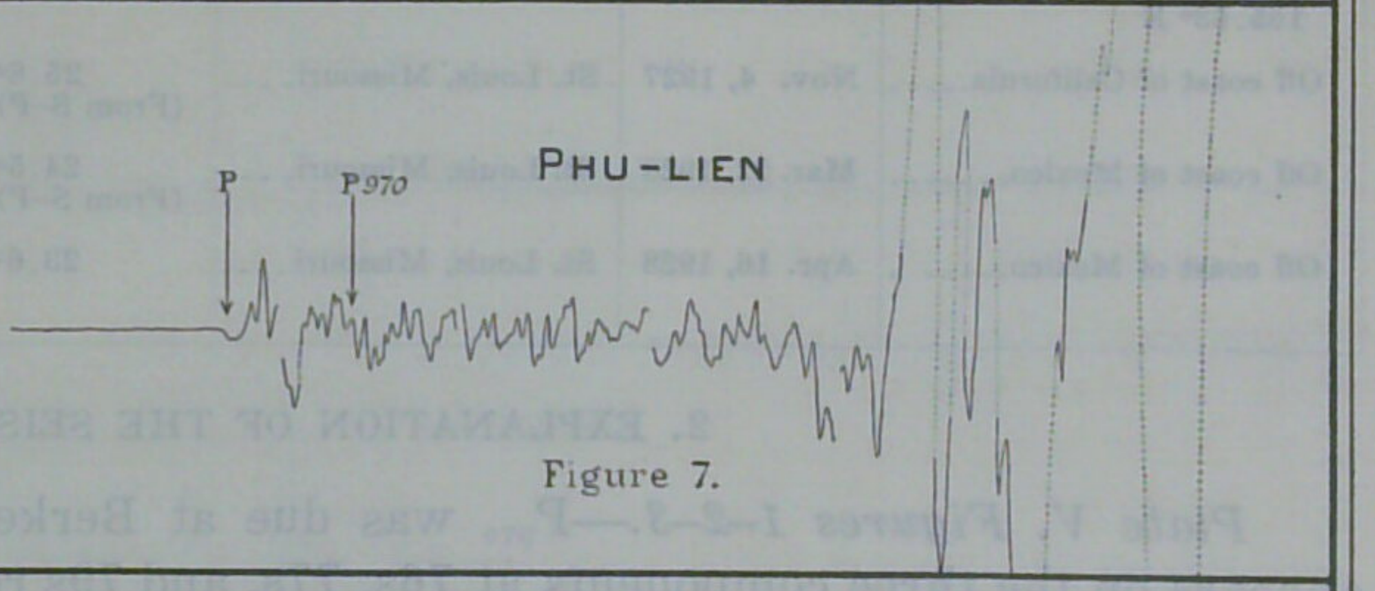


Figure 8.

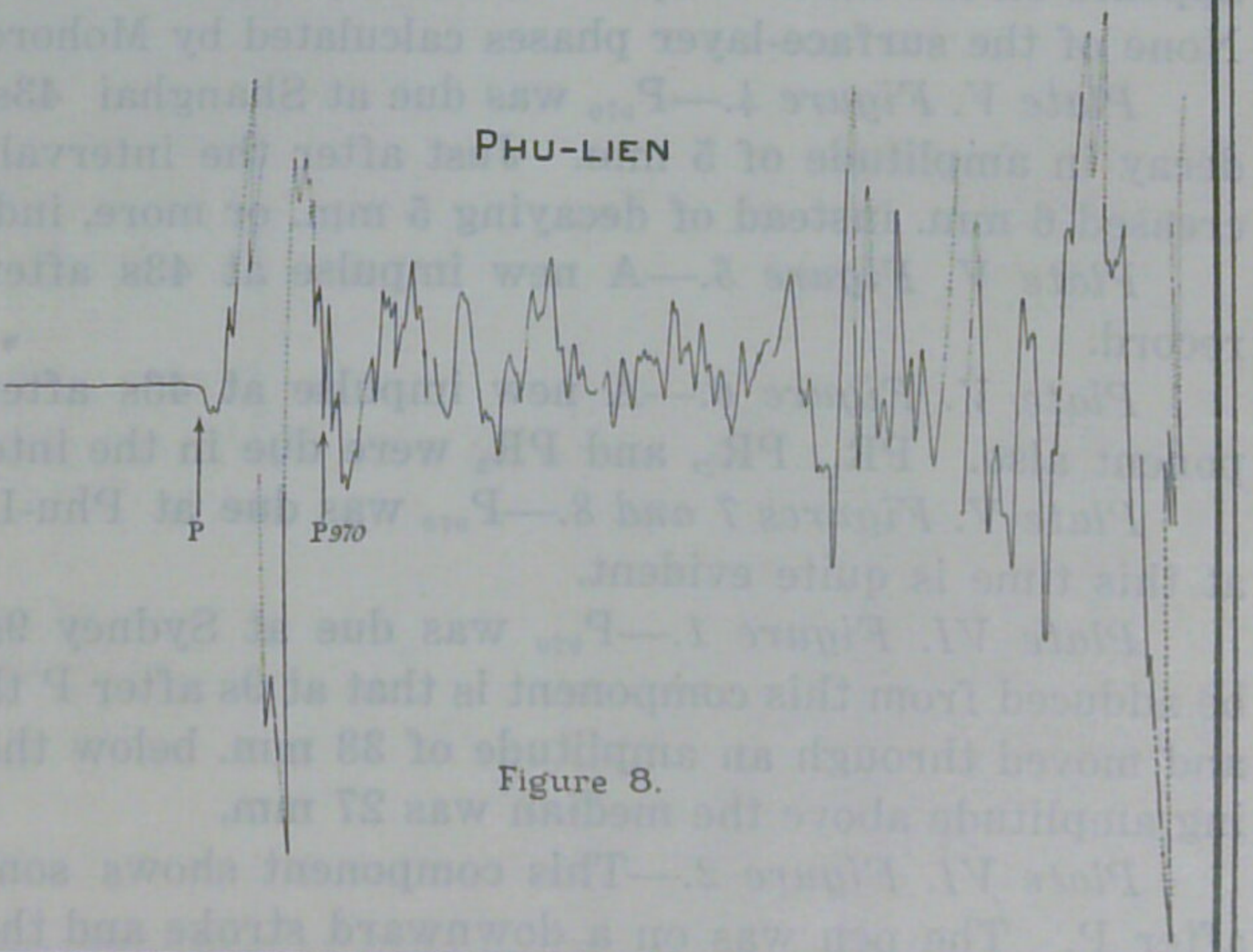


Plate V

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Plate VI. Figure 3.—P_{970} was due 4s after P. The seismometer vane had swung to the east and had returned less than one-third of the distance of the median line when the new impulse sent it to the east again, slightly further than its previous excursion. The N–S component received such a small amount of the longitudinal energy, and microseisms were magnified so greatly, that a satisfactory interpretation of the beginning of the record could not be made.

Plate VI. Figure 4.—P_{970} was due 6s after P. On this record we see that an impulse enters 7s after P causing the light spot to swing from one millimeter below the median line to eleven millimeters above.

Plate VI. Figure 5.—At 6s after P the light spot received a sudden acceleration which increased its velocity to such an extent that it failed to record on the paper. This new impulse, however, did not increase the amplitude because the turning point can be seen. After that the trace is lost for about 45s.

Plate VI. Figure 6.—P_{970} was due 8s after P. At 9s after P there is clear evidence of the arrival of a new impulse which greatly increases the motion of the seismometer vane, producing oscillations of 1.7 seconds period.

Plate VI. Figure 7.—This component also shows a distinct new impulse 9s after P, producing three oscillations of 1.7 seconds period.

CONCLUSION

The concordance of the seismographic observations with the results of the calculation appears to be very satisfactory. The diversity of the earthquakes, of the distances of the stations, and of the variety of the seismographs, strengthens the validity of the inference that the phases which have been noted really represent longitudinal waves reflected from a discontinuity at a depth of the order of 970 kilometers.

The results here obtained seem to warrant the view that the discontinuities between the surface of the earth and its core have not received sufficient attention from seismologists, and that a closer examination along the lines here followed may serve to identify some, at least, of the phases whose presence in seismograms has not been explained.

SUMMARY

Elastic waves produced by an earthquake afford a means of investigating regions of the interior of the earth which are inaccessible by other means. An enumeration is made of the surfaces of discontinuity so far located by this means, and some of their characteristics are mentioned. Calculations are then carried through to ascertain the depths of the discontinuities and the velocity of longitudinal elastic waves at various depths. The resulting curves are shown. Some of the values of depths previously obtained are confirmed and some new values revealed, in particular, one at a depth of 970 km.

The travel times for waves reflected from a discontinuity at 970 km. are calculated and the travel time curve is drawn. A summary of the seismographical data used to verify the existence of such waves is given. The seismograms are reproduced and an explanation of them is appended. The bibliography is given at the end of the investigation.

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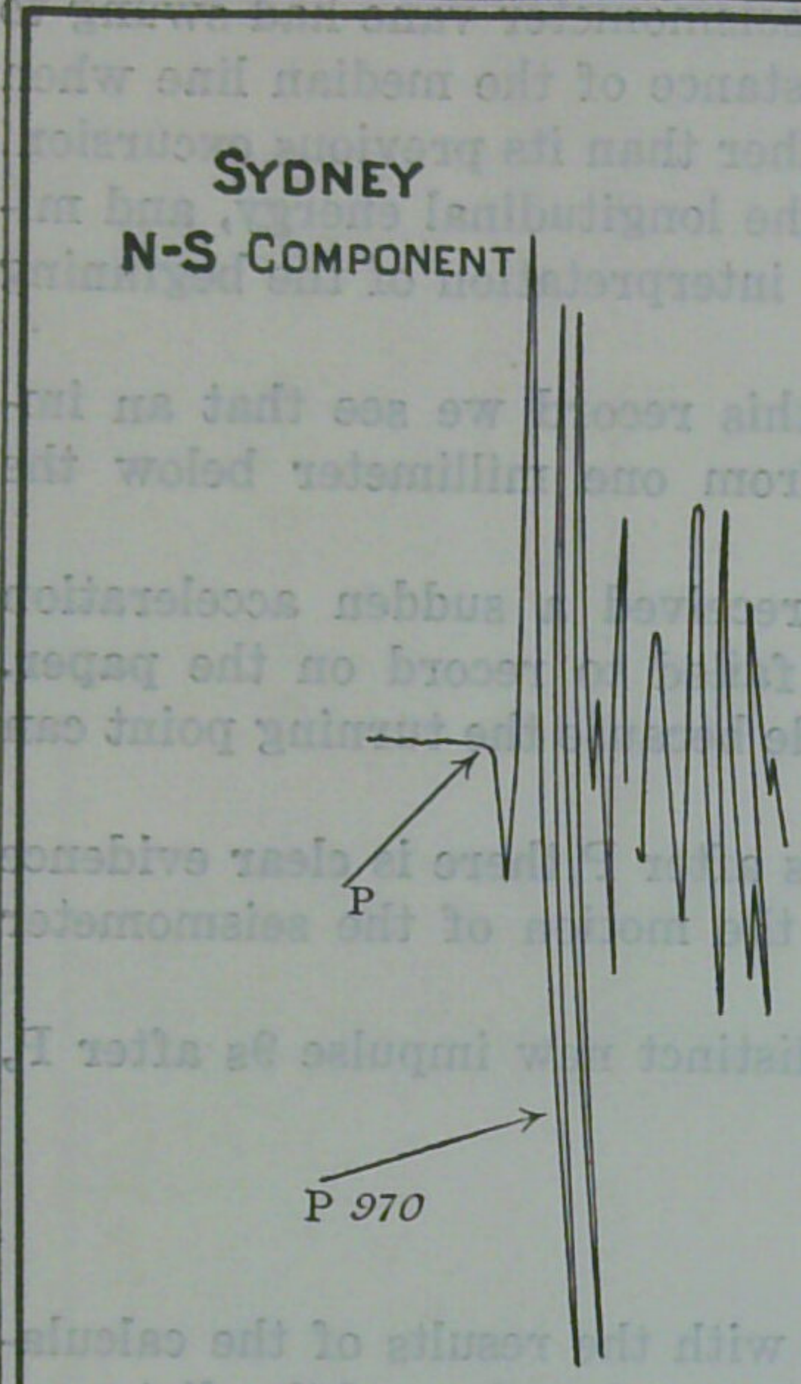


Figure 1.

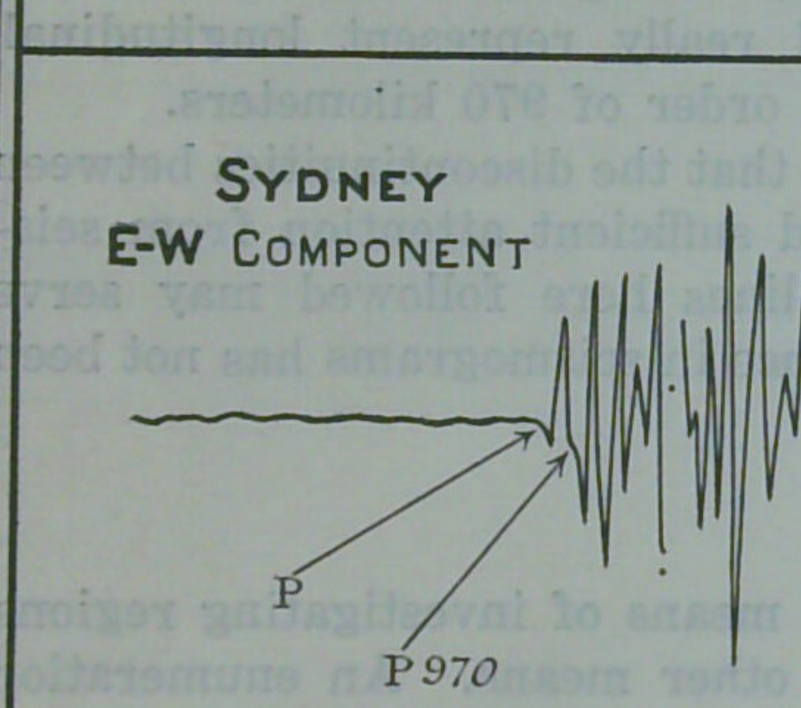


Figure 2.

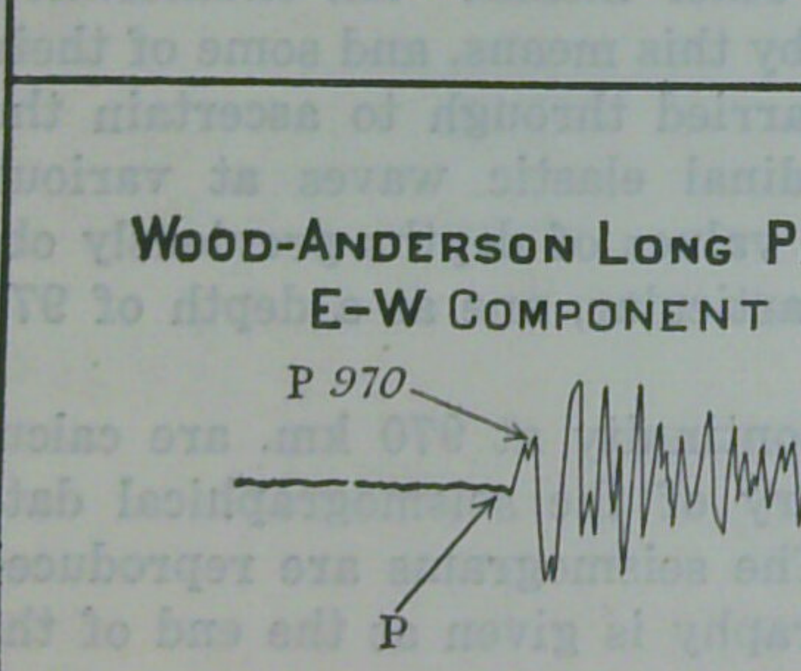


Figure 3.

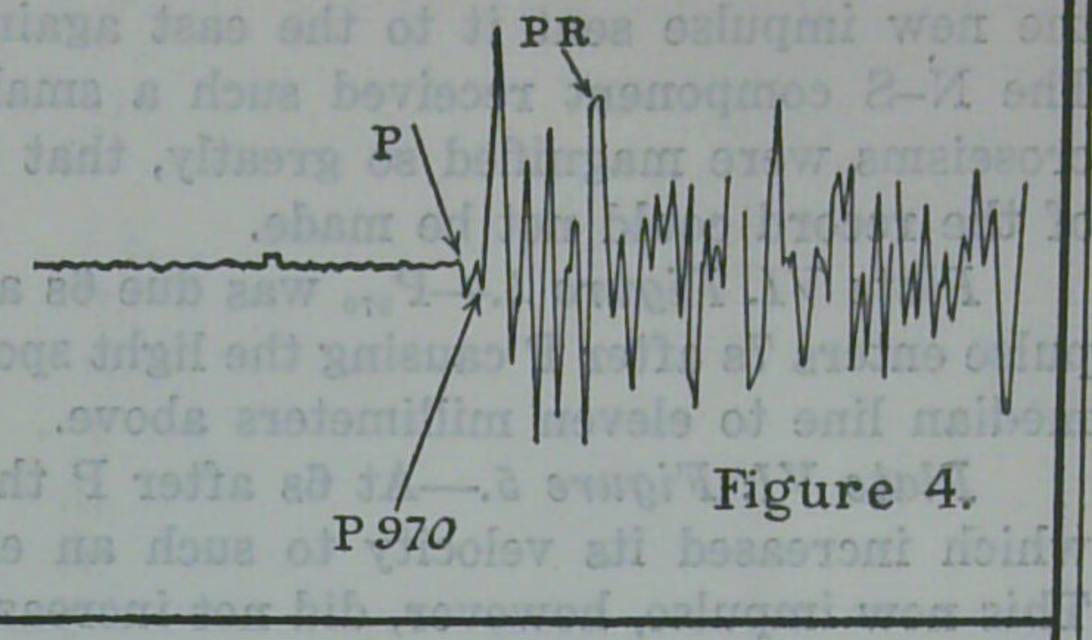


Figure 4.

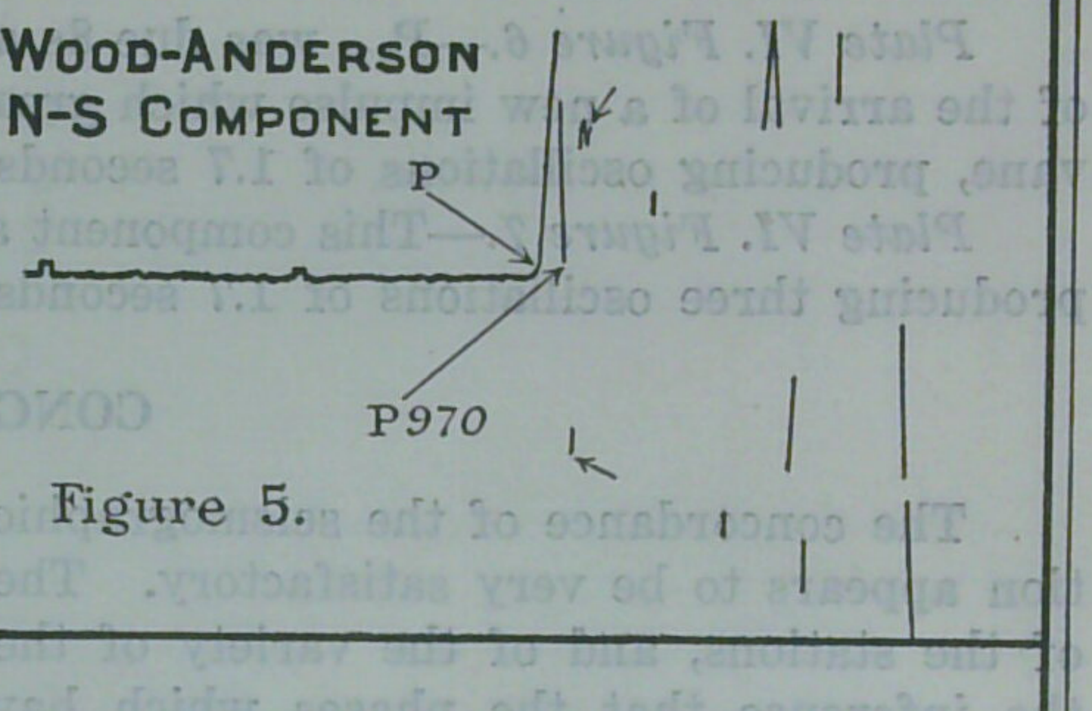


Figure 5.

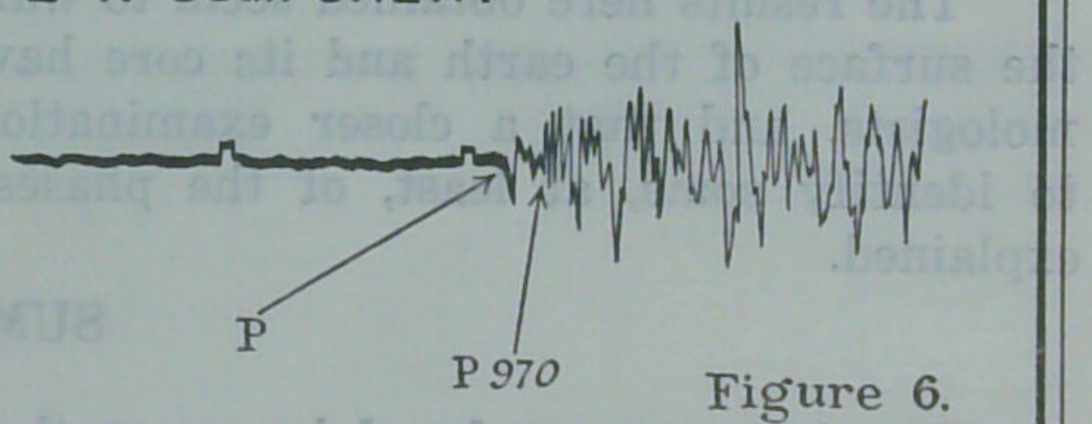


Figure 6.

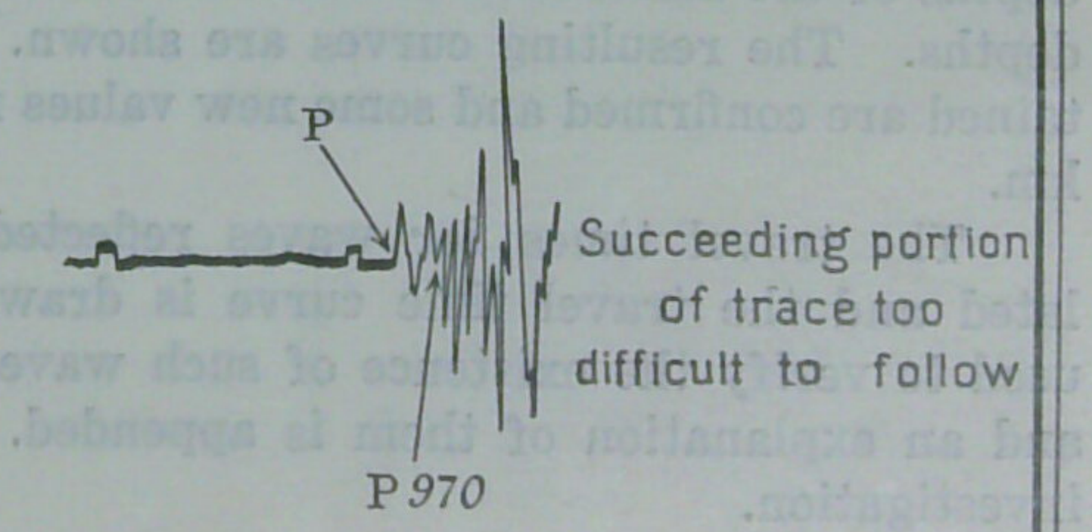


Figure 7.

Plate VI

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Ref 2694.

Year 1929, No. 1. January 1st to 13th, 1929.

M A N I L A, P. I.

SEISMOLOGICAL BULLETIN OF THE OBSERVATORY.

$\phi = 14^\circ\ 34'\ 41''$ N. $\lambda = 120^\circ\ 58'\ 33''$ E. h=2.40 ms. Alluvium.

Instrument: Wiechert's astatic pendulum (1,000 Kg.)

	V	T_o	ε	$\frac{r}{T_o^2}$
A_N	169	6.30	2.592	0.031
A_E	200	6.44	1.889	0.034

No.	Date	Character	Phase	Greenwich mean time	Period	Amplitude A_N	Amplitude A_E	Distance	Remarks.
				h. m. s.	s.	μ	μ	Km.	
1	1	II_V	ePNE	8 35 22				140	Central Luzon.
			iLNE	8 35 38					
			M_N	8 36 19	4	60			
			M_E	8 36 19	4		28		
			F	8 47					
2	2	I	ePNE	2 29 39					
			F	2 59					
3	7	I_r	ePNE	14 49 29					
			iLNE	14 52 21					
			MN	14 52 26	6	30			
			ME	14 52 57	4		6		
			F	15 07					
4	8	I	ePNE	7 35 41					
			F	7 53					
5	9	I_V	ePNE	18 56 52				230	
			eLNE	18 57 18					
			F	18 59					
6	9	I_V	ePNE	19 54 34				315	SE Luzon.
			iLNE	19 55 09					
			F	19 58					
7	10	I	eE	2 49 36					Traces only.
			F	3 02					
8	12	I_V	ePNE	14 25 09				160	
			iLNE	14 25 27					
			F	14 29					
9	13	III_r	iPNE	0 11 16				1844	Distance 16°.6.
			iN	0 11 23					0=0:07:22. Origin
			iPR_1E	0 11 28					ca. 29° N, 129° E.
			iPR_2N	0 11 37					
			iPR_3N	0 11 41					
			iSE	0 14 25					
			iSR_1N	0 15 19					
			iSR_2N	0 15 28					
			PcP	0 15 30					
			iSR_3N	0 15 32					
			iLNE	0 15 55					
			PcS	0 19 15					
			F	2 56					

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M A N I L A , P . I .

SEISMOLOGICAL BULLETIN OF THE OBSERVATORY.--Continued:

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No.	Date	Character	Phase	Greenwich mean time h. m. s.	Period. s.	Amplitude A_N μ	Amplitude A_E μ	Distance Km.	Remarks.
10	13	I	eNE	18 51					Small movements.
			F	19 31					
11	14	III$_v$	iPNE	17 30 11		5	1	225	Near Baguio. N-S lever system disjoined at 17:31:00.
			iLNE	17 30 36					
			F	17 46					
				8 06 09					
12	16	III$_v$	iPNE	8 06 41				210	Near Baguio. 16°.5 N, 120°.75 E. 8:06:56 N-S lever system disjoined. 8:07:16 E-W lever system disjoined. 8:13:30 both pens recording again.
			iLE	8 07 04					
			F	Still recording at 9:10:51					
13	16	I$_v$	ePE	9 03 00				210	Aftershock of the No. 12. Superimposed on preceding trace.
14	16	II$_v$	ePNE	9 10 54				210	Aftershock.
			iLE	9 11 17					
			F	10 18 ca.					
15	16	I$_v$	ePE	12 00 16				210	Do.
			iSE	12 00 39					
			F	12 08 ca.					
16	16	I$_v$	ePE	12 22 22				210	Do.
17	16	I$_v$	ePE	12 27 32				210	Do.
18	16	I$_v$	ePE	12 34 36				210	Do.
19	16	I$_v$	ePE	12 40 37				210	Do.
				14 03 37					
20	16	III$_v$	iPNE	14 04 09				210	Near Baguio. Aftershock. At 14:04:42 E-W lever system disjoined. Recording again at 14:10;00.
			iLNE	14 04 32					
			MN	14 07 09	4				
			F	14 45 ca.					
21	16	I$_v$	ePE	15 31 32				210	Aftershock.
22	16	I$_v$	ePNE	16 47 21				210	Do.
23	16	I$_v$	ePNE	17 37 40				210	Do.
			eSNE	17 38 06					
24	16	I$_v$	ePNE	18 27 35				210	Do.
			F	18 37					
25	16	I$_v$	ePNE	19 11 47				210	Do.
26	16	II$_v$	iPNE	20 50 46				210	Do.
			iPNE	20 50 47.6		10	3		
			iSNE	20 51 13		44	44		
			F	21 10					
27	16	I$_v$	ePNE	21 20 16				210	Do.
			F	21 30					
28	16	I$_v$	ePNE	23 33 46				210	Do.

M A N I L A , P . I .

SEISMOLOGICAL BULLETIN OF THE OBSERVATORY.--Continued.

No.	Date	Character	Phase	Greenwich mean time	Period	Amplitude A_N	Amplitude A_E	Distance	Remarks.
				h. m. s.	s.	μ	μ	Km.	
29	17	I_V	ePNE	1 23 11				210	Aftershock.
30	17	I_V	ePNE	6 48 56				315	
			SNE	6 49 31					
			F	6 57					
31	17	I_V	ePNE	10 48 32				210	Do.
			F	10 59					
32	17	I	M_E	13 26.7					Traces only
			F	13 53					
33	17	I_V	ePE	13 54 19				210	SE Luzon.
			F	13 57					
34	17	I_V	ePE	15 03 45				210	SE Luzon.
			F	15 08					
35	17	I_V	ePE	16 14 20				170	
			F	16 17					
36	17	I_V	ePE	19 50 22				200	
			SNE	19 50 48					
			F	19 56					
37	17	I_V	ePE	21 36 14				225	
			F	21 43					
38	17	I_V	ePE	21 53 41				840	
			iLE	21 55 32					
			F	21 59					
39	17	I_F	ePE	22 33 32					
			S^E	22 38 51					
			F	23 47					
40	18	IIv	ePNE	1 06 25				230	
			iLNE	1 06 51					
			M_N	1 08 46	5	92			
			M_E	1 09 43	6		111		
			F	1 19					
41	18	I_V	ePNE	6 47 34				230	
			F	6 54					
42	18	I_V	ePNE	7 13 08				230	
			F	7 19					
43	18	II_V	ePNE	11 03 11				250	
			iLNE	11 03 39					
			F	11 14					
44	18	I_V	ePNE	12 56 53				220	
			F	13 01					
45	19	I_V	iPNE	0 44 47				920?	
			iLE	0 46 45					
			F	1 09					
46	19	I	eNE	11 28					Small movements.
			F	11 51					

International Seismological Centre From the ISC collection scanned by SISMOS

MANILA, P. I.

SEISMOLOGICAL BULLETIN OF THE OBSERVATORY.--Continued.

No.	Date	Character	Phase	Greenwich mean time	Period.	Amplitude A_N	Amplitude A_E	Distance	Remarks.
				h. m. s.	s.	μ	μ	Km.	
47	19	I_V	ePNE	22 06 09				210	
			F	22 14					
48	20	I_V	ePNE	3 17 18				190	
			F	3 23					
49	20	I_V	ePNE	3 38 47				225	
			F	3 44					
50	20	I_V	ePNE	5 26 12				210	
			F	5 33					
51	20	II_r	iPNE	14 57 54		7	5	2056	Distance 18°.5. At 15:00:50 a second shock.
			PR_1	14 58 11					
			PR_2	14 53 14					
			iSNE	15 01 20					
			SR_1	15 01 51					
			PcP	15 02 22					
			L	15 02 57					
			PcS	15 09 35					
			F	16 20					
52	20	I_V	ePNE	23 08 11				230	
			F	23 12					
53	21	I	eE	5 07					
			F	5 51					
54	21	I_V	ePNE	8 58 46				200	
			iSNE	8 59 09					
			F	9 04					
55	21	I_u	eE	10 42				8222	Distance 74°, Fairbanks, Alaska.
			eLNE	10 56 24					
			M	11 12 12					
			F	11 53					
56	24	I_u	ePNE	2o 55 59				15522	Distance 139°.7. South of Guatemala in the Pacific.
			eLE	21 42 49					
			M_E	21 53 19					
			F	22 52					
57	25	I	iNE	2 06 23					Disturbed by microseisms.
			F	2 42 ca.					
58	25	I_V	ePNE	8 09 24				270	
			F	8 15					
59	25	I_r	eNE	8 4o 23					Disturbed by microseisms.
			F	9 03					

International Seismological Centre From the ISC collection scanned by SISMOS

Year 1929, No. 5. January 26th to 31st, 1929.

MANILA, P. I.

SEISMOLOGICAL BULLETIN OF THE OBSERVATORY.--Continued.

No.	Date	Character	Phase	Greenwich mean time	Period	Amplitude A_N	Amplitude A_E	Distance	Remarks.
				h. m. s.	s.	μ	μ	Km.	
60	26	I_V	iPNE	6 35 38				240	
			iSNE	6 36 12					
			F	6 49					
61	26	I_V	iPNE	13 55 14				180	
			iSNE	13 55 34					
			F	13 59					
62	26	I_V	iPNE	2o 50 10				190	
			iSNE	20 50 31					
			F	20 55					
63	29	I	eE	2 30					
			F	3 03					
64	30	I_V	ePNE	11 12 39				125	
			LE	11 12 53					
			F	11 18					
65	30	Ir	ePNE	16 57 23				3178	Distance 28°6.
			PRgE	16 58 11					O=16:51:10.
			PRgN	16 58 24					
			iSNE	17 02 07					
			iLNE	17 05 27					
			F	18 14					
66	30	I_V	ePNE	22 32 56				180	
			F	22 35					
67	31	I	eE	14 49					
			F	15 51					

Miguel Selga, S.J.
Director, Weather Bureau,
Manila, P.I.

William C. Repetti, S. J.
Seismologist.
Cesáreo Dulueña,
Asst. Seismologist.

International Seismological Centre From the ISC collection scanned by SISMOS

Year 1929, No. 6. February 1st to 8th, 1929.

M A N I L A , P . I .

SEISMOLOGICAL BULLETIN OF THE OBSERVATORY.

φ=14° 34' 41" N. λ=120° 58' 33" E. h=2.40 ms. Alluvium.

Instrument: Wiechert's astatic pendulum (1,000 Kg.)

	T_o	V	ε	$\frac{r}{T_o^2}$
A_N	6.31	186	3.834	0.035
A_E	6.29	216	2.970	0.046

No.	Date	Character	Phase	Greenwich mean time	Period	Amplitude A_N	Amplitude A_E	Distance	Remarks.
				h. m. s.	s.	μ	μ	Km.	
68	1	I_V	ePNE	6 05 00				170	
			iLNE	6 05 19					
			F	6 19					
69	1	II_u	iPNE	17 23 00				5200	Distance 46°.8. North of Lahore India in Himalaya Mountain?
			iSNE	17 29 48					
			PS	17 29 55					
			F	19 04					
70	2	I	eP'NE	0 20 16					
			iScPcPNE	0 23 53					
			iNE	0 25 35					
			eNE	1 43 00	19				Trains of long waves at intervals until 2h 32m.
			F	2 45 ca.					
71	2	I_r	ePNE	14 47 02					
			iLE	14 51 51					
			F	15 23					
72	3	I_r	iPNE	2 48 23					
			iLNE	2 51 34					
			F	3 29					
73	4	I_V	ePNE	2 10 42				100	From Vicentini seismograph.
			F	2 14					
74	6	I	iPNE	6 67 00					
			iSNE	7 03 15					
			F	7 34					
75	7	I_V	ePNE	2 22 44				200	
			F	2 29					
76	7	I_V	ePNE	5 54 16				220	
			F	6 01					
77	8	I_r	ePNE	7 45 32					
			F	8 12					

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M A N I L A . P . I .

SEISMOLOGICAL BULLETIN OF THE OBSERVATORY.--Continued.

No.	Date	Character	Phase	Greenwich mean time h. m. s.	Period. s.	Amplitude A_N μ	Amplitude A_E μ	Distance Km.	Remarks.
78	8	I_V	ePNE	20 11 40				90	
			F	20 14					
79	9	I	eLE	2 05					
			F	3 06 ca.					
80	10	I	eE	16 01					
			PR_4E	16 07 23					
			PSE	16 10 52					
			F	17 54 ca.					
81	11	I	eE	13 14					Traces only.
			F	13 38					
82	13	I	iNE	17 13					Traces only.
			F	17 43					
83	14	I_V	ePNE	11 42 20				225	
			iSNE	11 42 45					
			F	11 51					
84	14	I_r	ePNE	14 43 00					
			PR_2NE	14 43 37					
			iSNE	14 46 06					
			iLNE	14 49 21					
			F	15 53					
85	15	II_r	iPNE	5 43 13		8	9	1100	Condensation. Distance 9°.9. Probable epicenter 9°.5 N., 130° E.
			iSNE	5 45 05					
			iSR_1E	5 45 16					
			iLE	5 46 10					
			F	7 19					
86	16	I	eE	19 43					
			ME	20 23					
			F	20 46					
87	17	I	e	21 02					Traces only.
			F	21 32					
88	18	I_V	iPNE	4 47 12				80	
			iSNE	4 47 20					
			F	4 53					
89	18	I_V	ePNE	7 14 45				130	Central Luzon.
			iSNE	7 15 00					
			F	7 21					
90	19	I_V	ePNE	17 12 45				330	
			iSNE	17 13 22					
			F	17 22					
91	20	I_V	ePNE	4 34 54				130	
			iSNE	4 35 09					
			F	4 41					
92	20	I_V	ePNE	12 04 52				120	
			iSNE	12 05 05					
			F	12 10					

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M A N I L A , P . I .

SEISMOLOGICAL BULLETIN OF THE OBSERVATORY.--Continued.

No.	Date	Character	Phase	Greenwich mean time	Period.	Amplitude A_N	Amplitude A_E	Distance	Remarks.
				h. m. s.	s.	μ	μ	Km.	
93	20	I	iNE	21 14 41					Small and weak record.
			F	22 08					
94	21	Iv	ePNE	4 17 54				200	
			iSNE	4 18 16					
			F	4 25					
95	22	Iv	ePNE	11 29 16				60	Felt at Los Baños and Santa Cruz, La Laguna Province.
			iSNE	11 29 23					
			F	11 33					
96	22	Iv	ePNE	13 41 08				70	
			iSNE	13 41 16					
			F	13 45					
97	22	Iu	iP'NE	21 01 46				16689	Distance 150°.2. O=20:41:36.
			iNE	21 03 46					
			iScPcPNE	21 05 17					
			iPNE	21 05 24					
			iPNE	21 08 31					
			iPNE	21 15 43					
			iPSNE?	21 16 44					
			eLNE	21 49 15					
			eMNE	22 04 21					
			MNE	22 09 43	18	73	66		
			F	23 30					
98	23	Iv	ePNE	1 19 54				80	
			iSNE	1 20 03					
			F	1 23					
99	23	Iv	ePNE	10 42 41				40	
			iSNE	10 42 45					
			F	10 45					
100	23	Iv	ePNE	15 42 47				170	
			iSNE	15 43 06					
			F	15 46					
101	24	I	eE	22 03					Traces only.
			F	22 31					
102	25	I	eLNE	2 00					
			F	2 19					

International Seismological Centre From the ISC collection scanned by SISMOS

Year 1929, No. 9. February 26th to 28th, 1929.

M A N I L A , P . I .

SEISMOLOGICAL BULLETIN OF THE OBSERVATORY.--Continued.

No.	Date	Character	Phase	Greenwich mean time	Period.	Amplitude A_N	Amplitude A_E	Distance	Remarks.
				h. m. s.	s.	μ	μ	Km.	
103	26	I_V	ePNE	3 31 38				230	
			iSNE	3 32 04					
			F	3 35					
104	26	I_u	eNE	3 39 54					
			iSNE	3 48 01					
			F	4 09					
105	26	I_u	O	9 00 44					
			PNE	9 12 (?)	In minute	gap.		7822	Distance 70°.4.
			iPcPNE	9 12 35					
			iNE	9 12 54					
			iSNE	9 21 11					
			iPSNE	9 21 38					
			iNE	9 23 37					
			eME?	9 49 00					
			F	10 44					
106	27	I_V	iPNE	8 18 58				160	
			iSNE	8 19 16					
			F	8 26					
107	28	I	eNE	0 15 ca.					
			F	0 56					

Miguel Selga, S.J.,
Director, Weather Bureau,
Manila, P.I.

William C. Repetti, S.J.,
Seismologist,
Cesáreo Dulueña,
Asst. Seismologist.

International Seismological Centre From the ISC collection scanned by SISMOS

BULLETINS RECEIVED

FEBRUARY

1929

We thankfully acknowledge the receipt of the following and hope for their continuance in the future.

STATIONS.	BULLETINS/
Santiago.....	Bol. Seis. Serv. XVII.
Sverdlovsk.....	Nov.-Dec., 1927.
Makeevka.....	Oct.-Dec., 1927.
Tashkent.....	Sept.-Dec., 1927.
Kucino.....	Sept.-Dec., 1927.
Baku.....	Oct.-Dec., 1927.
Pulkovo.....	Nov.-Dec., 1927.
Nagasaki.....	Aug.-Oct., 1928.
Paris	Ann. d. l'Inst. Phy. d G. 1926
Batavia.....	July-Sept., 1928. Seis. Bull. 1928.
Copenhagen.....	Seis. Bull. i Scoresby-Sund.
Hongkong.....	Oct.-Nov., 1928.
Taihoku.....	Nos. 21-22-23-24.
Granada.....	Sept.-Oct., 1928.
Kew	Nov., 1928.
St Louis Jes. Seis. Soc	Prelim. Bull. Dec. 1st, 1928.
La Paz	July-Aug., 1928.
Barcelona	Nos. 126-127-128.
Ottawa	Nov., 1928. Including Halifax and Saskatoon.
Harvard	Nos. 11-12.
San Fernando	July, 1928.
Georgetown	July, 1928. Seis. Dec.-Oct., 1928.
U.S.C.G.S.	Chicago-Honolulu-Tucson-Sitka-U. of Va. Oct., 1928. Radio Reports Jan.21-Jan.24.
Paris	Oct., 1928.
Strasbourg	Prelim. Reports, Oct., 1928.
	Station Report Oct., 1928.
	Central Bur. Bull. Oct., 1928.

Miguel Selga,
Director, Weather Bureau,
Manila, P.I.

William C. Repetti, S.J.
Seismologist.
C. Dulueña,
Asst. Seismologist.

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BULLETINS RECEIVED

FEBRUARY

1929

We thankfully acknowledge the receipt of the following and hope for their continuance in the future.

STATIONS.	BULLETINS.
La Plata	October, 1928.
Zi-ka-wei	June 28th to December 27th, 1928.
Strasbourg	Preliminary Reports, November and December, 1928.
Strasbourg	Station Report, November and December, 1928.
Strasbourg	Central Bureau Bulletin, Novem. and Decem., 1928.
Toledo	May and June, 1928.
Almeria	May and June, 1928.
Malaga	May and June, 1928.
Alicante	May and June, 1928.
Batavia	Advance Seismological Report, December, 1928.
Georgetown	August to November, 1928.
U.S. C. and G. S.	Radio Report, February 2nd and 10th, 1929.
Kew	December, 1928.
Saint Louis	Preliminary Bulletin, January 13, 17 and 24, 1929.
Oxford	Inter. Seism. Summary for 1925 April, May, June.
Hamburg	October, November and December, 1928.
Hohenheim	October, November and December, 1928.
Ravensburg	October, November and December, 1928.
Riverview	April, May and June, 1926.
Phu-Lien	January, 1928.
Taihoku	January 1st to February 3rd, 1929.
Apia	July - September, 1928.
U.S. C. and G. S.	Chicago, Honolulu, Tucson, Sitka & Virginia, November, 1928.

Miguel Selga,
Director, Weather Bureau,
Manila, P.I.

William C. Repetti, S.J.
Seismologist,
Cesáreo Dulueña,
Asst. Seismoligist.

International Seismological Centre From the ISC collection scanned by SISMOS

Year 1929, No. 9. March 1st to 8th, 1929.

M A N I L A , P . I .

SEISMOLOGICAL BULLETIN OF THE OBSERVATORY

$\phi = 14^\circ\ 34'\ 41''$ N. $\lambda = 120^\circ\ 58'\ 33''$ E. h=2.40 m. Alluvium.

Instrument: Wiechert Inverted Pendulum (1000 Kg.)

	T_o	V	ε	$\frac{r}{T_o^2}$
N-S	6.40	213	3.172	0.068
E-W	6.32	232	3.152	0.068

No.	Date	Character	Phase	Greenwich Time h. m. s.	Period s.	Amplitude N μ	Amplitude E μ	Dist. Km.	Remarks.
108	1	I	eNE	7 54					Traces only.
			F	8 15					
109	4	I_V	iPNE	14 42 18				270	
			iSNE	14 42 48					
			F	14 48					
110	4	I_V	ePNE	17 23 04				200	
			iSNE	17 23 26					
			F	17 27					
111	7	II_u	ePEN	1 45 23				7350	Aleutian Islands.
			iPEN	1 45 27					
			iPcPEN	1 46 16	7				
			M_N	1 46 24	7	42			
			iPR_1EN	1 48 16	7	50			
			iPR_2EN	1 49 29	9.5				
			iSEN	1 54 16					
			ME	1 54 28	8.5		175		
			iPPPSEN	1 55 05					
			ME	1 55 12	7.8		80		
			iScSEN	1 56 +	in minute gap				
			iEN	1 56 14					
			MEN	1 56 22	8.5	105	175		
			SR1EN	1 59 00					
			PPSS)						
			ME	1 59 15	8		95		
			M_N	1 59 15	11	220			
			iSR_2EN	2 01 50					
			iEN	2 03 55					
			iLEN	2 06 47					
			MEN	2 11 50					
			F	5 21					
112	7	I	ePNE	11 12 36					Traces only.
			F	11 58					
113	8	I	eNE	10 59 ca.					Small movements.
			F	11 40					

International Seismological Centre From the ISC collection scanned by SISMOS

M A N I L A , P . I .

SEISMOLOGICAL BULLETIN OF THE OBSERVATORY.--Continued.

No.	Date	Character	Phase	Green. Time h. m. s.	Per. s.	Amplitude N μ	Amplitude E μ	Dist. Km.	Remarks.
114	9	II_r	iPNE	2 16 55					
			iSNE	2 21 31					
			iLNE	2 24 31					
			F	3 51					
115	9	I_u	iPE	11 02 12					
			iSNE	11 11 40					
			iLNE	11 25 40					
			F	12 55					
116	10	I	ePNE	0 56					
			F	1 06					
117	10	I_r	iPNE	14 39 49					
			iSNE	14 43 40					
			iLNE	14 45 46					
			F	15 56					
118	13	I	eNE	11 10					Small movements.
			F	11 42					
119	13	I_v	ePNE	14 10 34				60	
			F	14 13					
120	14	I	eNE	18 42 14					
			F	19 29					
121	15	I	eNE	2 07 00					
			F	2 41					
122	15	I	ePNE	8 30 11					
			F	9 22					
123	16	I_r	ePNE	6 09 53					
			eSNE	6 14 14					
			iLNE	6 16 51					
			F	6 49					
124	16	I_r	ePNE	22 39 28				000?	
			iSNE	23 01 08					
			F	23 33					
125	18	I_r	ePNE	0 50 51				1010	
			iSNE	0 52 40					
			F	1 09					
126	18	I_r	ePNE	1 48 30					
			iSNE	1 52 55					
			F	2 54					
127	18	I	eNE	23 27 51					
	19		F	0 12					
128	19	I	eNE	21 13 55					
			iN	21 16 54					
			F	21 46					

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M A N I L A , P . I .

SEISMOLOGICAL BULIETIN OF THE OBSERVATORY.--Continued.

No.	Date	Character	Phase	Green. Time h. m. s.	Per. s.	Amplitude N μ	Amplitude E μ	Dist. Km.	Remarks.
129	20	I	ePNE	12 13 32					
			F	12 32					
130	20	II_v	ePNE	21 11 48				445	NE Luzon.
			iSNE	21 12 37					
			M_N	21 13 17	4				
			M_E	21 13 27	5				
			F	22 17					
131	21	I	eP'NE	2 57.					
			F	3 28					
132	22	I_r	ePNE	3 08 38					
			iSNE	3 12 40					
			iLNE	3 14 52					
			F	3 52					
133	23	II_r	iPNE	20 03 53					
			iSNE	20 06 43					
			iLNE	20 08 07					
			F	21 56					
134	24	I_v	ePNE	1 06 17				140	
			F	1 12					
135	24	I	eNE	5 51					Traces only.
			F	6 02					
136	24	I_v	ePNE	7 33 06				130	
			F	7 38					
137	24	I_v	ePNE	16 13 15				410	
			F	16 24					
138	25	I	eNE	4 00					
			F	4 22					
139	25	I	eLNE	8 40 19					
			F	8 57					
140	25	I	eNE	15 01					
			F	15 37					
141	26	I	eNE	4 18 49					
			F	4 53					
142	26	I	eN	10 43 ca.					
			F	11 03					
143	26	I	eNE	13 30 49					
			F	13 47					

International Seismological Centre From the ISC collection scanned by SISMOS

M A N I L A , P . I .

SEISMOLOGICAL BULLETIN OF THE OBSERVATORY.--Continued.

No.	Date	Character	Phase	Green. Time h. m. s.	Per. s.	Amplitude N	Amplitude E	Dist. Km.	Remarks.
						)l	)u		
144	26	I	eNE	19 57 42					
			F	20 41					
145	28	I_V	ePNE	13 01 46				45	
			F	13 04					
146	28	I_r	ePNE	20 37 20					
			eSNE	20 41 40					
			F	21 14					
147	28	I	eE	21 37					
			F	21 52					
150	30	I_V	ePNE	10 03 29				190	
			F	10 08					
151	31	I_r	ePNE	5 30 53					
			eSNE	5 35 50					
			eLN	5 39 20					
			F	6 38					
152	31	I_V	ePNE	9 31 27				460	
			eSNE	9 32 18					
			F	9 38					
153	31	I_V	ePNE	9 40 05				460	
			F	9 49					
154	31	I_V	ePNE	14 27 51				440	
			F	14 50					
155	31	I_r	ePNE	2o 24 35					
			eSNE	20 28 47					
			F	21 16					

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BULLETINS RECEIVED

MARCH, 1929.

We thankfully acknowledge the receipt of the following and hope for their continuance in the future,

STATIONS.	BULLETINS.
Chicago (Loyola)	April 27 to December 28,1928.
Cincinnati	September 21 to December 19, 1928.
Melbourne	October 9 to December 31, 1928.
Toledo	July and August, 1928.
Almeria	July and August, 1928.
Malaga	July and August, 1928.
Alicante	July and August, 1928.
U.S. C. and G. S.	Radio Report, March 1, 1929.
Hukuoka, Japan	January, 1927 to December, 1928.
Ottawa	December, 1928 and January, 1929.
St.Louis,Jes.Seis.Soc.	Prel.Bull. Jan.21 and 31,and Feb. 1,2,10,13 and 15, 1929.
Honolulu	Prel. Determination, Feb. 15, 1929.
Zinsen, Tyosen (Korea)	April 14 to Nov. 28, 1928.
La Plata	December, 1928.
Georgetown	December, 1928.
Kew	January, 1929.
Batavia	October, November and December, 1928, and Catalogue of Earthquakes in East Indies, 1927.
Tananarive	July 7 to August 24, 1928.
Zikawei	November 29 to January 14, 1929.
San Fernando	November and December, 1928 and January,1929.

Miguel Selga, S.J.
Director, Weather Bureau,
Manila, P.I.

William C. Repetti, S.J.,
Seismologist.
Cesáreo Dulueña,
Asst. Seismologist.

International Seismological Centre From the ISC collection scanned by SISMOS

Year 1929, No. 13. April 1st to 4th, 1929.

M A N I L A , P . I .

SEISMOLOGICAL BULLETIN OF THE OBSERVATORY.

ϕ=14° 34' 41" N. λ=120° 58' 33" E. h=2.40 m. Alluvium.

Instrument: Wiechert Inverted Pendulum (1000 Kg.)

	T_o	V	ε	$\frac{r}{T_o^2}$
N-S	6.10	206	2.939	0.050
E-W	6.57	200	2.708	0.050

No.	Date	Character	Phase	Green. Time h. m. s.	Per. s.	Amplitude N μ	Amplitude E μ	Dist. Km.	Remarks.
156	1	I_r	eNE	5 28 30					
			eSNE	5 32 33					
			F	5 58					
157	2	I	eNE	3 33					
			M_E	3 46 30					
			F	4 12					
158	2	III_d	iPNE	6 12 32				150	China Sea, near Zambales coast.
			iS_{NE}	6 12 49					
			m_N	6 12 50	2.3	104			
			M_E	6 13 12	1.8		134		
			F	6 37					
159	2	I_v	ePNE	6 19 00				150	Aftershock of the preceding quake.
160	2	I_v	ePNE	6 40 20				150	Do.
161	2	I	eNE	6 42 00					Distant earthquake.
			F	7 28					
162	2	I_v	ePNE	20 49 22				150	Aftershock of the No. 158.
			F	20 54					
163	2	I_v	ePNE	21 56 45				150	Do.
			F	21 59					
164	2	III_d	iPNE	23 27 31				150	Another repetition of the No. 158.
			iS_{NE}	23 27 48					
			M_E	23 28 42	4.5		89		
			M_N	23 28 54	3.8	96			
	3		F	1 02					
165	3	I_v	ePN_E	0 58 22				150	Aftershock of the No. 158.
			iS_{NE}	0 58 39					
			F	1 02					
166	4	I_v	ePN_E	17 04 40				150	Do.
			iS_{NE}	17 04 57					
			F	17 13					

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M A N I L A , P . I .

SEISMOLOGICAL BULLETIN OF THE OBSERVATORY.--Continued.

No.	Date	Character	Phase	Green. Time h. m. s.	Per. s.	Amplitude N. μ	Amplitude E. μ	Dist. Km.	Remarks.
167	4	I_V	eP_{NE}	19 09 01				150	Aftershock of the No. 158.
			F	19 12					
168	4	I_V	eP_{NE}	22 19 32				150	Do.
			F	22 24					
169	5	I_V	eP_{NE}	8 28 03				630	Near Batanes Islands.
			iS_N	8 29 09					
			iS_E	8 29 11					
			F	9 13					
170	5	I_V	eP_{NE}	14 34 25				630	Aftershock of the preceding quake.
			eS_{NE}	14 35 34					
			F	14 55					
171	8	II_V	iP_{NE}	10 18 50				870	Lanao, Mindanao.
			iS_{NE}	10 20 24					
			m_N	10 20 31					
			m_E	10 20 33	7.5		178		Pen went to limit of its swing 73.0 mm.
			m_E	10 20 40	6.6		135		
			M_E	10 21 43	7.8		96		
			F	11 57					
172	8	I_V	eNE	17 57 20					
			F	18 19					
173	9	I_r	eNE	4 04 44					
			S_N	4 10 00					
			eL_{NE}	4 14 00					
			F	5 05					
174	10	I	eNE	6 11 ca.					Small movements.
			F	6 56					

Constants found on April 13th, 1929.

	T_o	V	ε	$\frac{r}{T_o^2}$
N-S	6.08	162	3.3	0.017
E-W	5.93	196	3.2	0.022

175	13	I	eP_{NE}	9 20 06					
			F	9 46					
176	13	I	eNE	21 27					Traces only.
			F	21 51					
177	15	I	eNE	16 24					Do.
			F	16 58					
178	16	I	eNE	0 59					Do.
			F	1 27					

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M A N I L A , P . I .

SEISMOLOGICAL BULLETIN OF THE OBSERVATORY.--Continued.

No.	Date	Character	Phase	Green. Time h. m. s.	Per. s.	Amplitude N	Amplitude E	Dist. Km.	Remarks.
						μ	μ		
179	18	I_r	iPNE	3 41 16				1090	N Celebes Sea, near SW coast of Min-
			iSNE	3 43 12					
			iLNE	3 44 26					
			F	4 32					
180	19	I	ePNE	13 55 39					
			F	14 10					
181	20	I	ePN	6 27 ca					Distant quake.
			F	8 31					
182	20	I_r	ePNE	10 03 38					
			iSNE	10 05 48					
			F	10 37					
183	22	I_v	ePNE	15 55 39				125	
			F	15 58					
184	23	II_v	iPNE	18 25 54				140	S Luzon.
			iSNE	18 26 10					
			mE	18 26 13					Pen went to limit
			mN	18 26 22	1.2	165			of its swing, 73
			F	18 47					mm.
185	25	I_v	ePNE	10 41 30				250	
			iSNE	10 41 58					
			F	10 48					
186	27	I_r	ePNE	21 09 40					
			eSNE?	21 15 35					
			F	22 22					
187	28	I_v	ePNE	7 39 34				250	
			iSNE	7 40 02					
			F	7 49					
188	28	I_v	ePNE	13 17 09				160	
			iSNE	13 17 27					
			F	13 23					
189	28	I_r	iPNE	14 38 19					
			iSNE	14 42 27					
			F	15 32					
190	30	I	ePNE	18 53 44					
			F	20 00					

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M A N I L A , P . I .

SEISMOLOGICAL BULLETIN OF THE OBSERVATORY.--Continued.

No.	Date	Character	Phase.	Green. Time h. m. s.	Per. s.	Amplitude N μ	Amplitude E μ	Dist. Km.	Remarks.
191	1	I	eNE	7 41 01					
			F	9 13					
192	1	II_u	ePNE	15 47 48				7728	Aleutian Islands?
			ePcPE	15 48 26					
			iPR1E	15 50 47					
			iPR2NE	15 52 16					
			mN	15 56 17	7.6	6.4mm			
			mE	15 56 38	10.2		5.9mm		
			iSNE	15 57 03					
			iPPPSNE	15 57 47					
			iPcSScPNE	16 03 23					
			iSR2E	16 05 08					
			iINE	16 10 15					
			MN	16 16 40	17.9	9.1mm			
			ME	16 16 48	15.4		18.2mm		
			F	18 15					
193	2	I	eNE	4 53 52					
			F	5 42					
194	2	I_v	iPE	6 14 34				130	
			F	6 20					
195	2	I_r	iPNE	14 33 22					
			iSNE	14 39 32					
			F	15 41					
196	4	I_r	ePNE	8 58 36					
			iSNE?	9 00 56					
			F	9 58					
197	4	I_v	ePNE	12 41 10				110	
			F	12 48					
198	5	I_v	ePNE	5 27 33				390	
			F	5 36					
199	5	I_v	ePNE	6 21 29				300	
			F	6 28					
200	5	I_v	ePNE	8 29 56				620	
			F	8 39					
201	5	I_v	ePNE	13 35 41				560	
			F	13 42					
202	6	I_r	iPNE	5 13 44					
			iSE	5 17 51					
			F	7 44					
203	7	I	ePNE	8 47 54					
			F	9 42					

International Seismological Centre From the ISC collection scanned by SISMOS

M A N I L A , P . I .

SEISMOLOGICAL BULLETIN OF THE OBSERVATORY.--Continued.

No.	Date	Character	Phase	Green. Time h. m. s.	Per. s.	Amplitude N μ	Amplitude E μ	Dist. Km.	Remarks.
204	7	II_r	iPE	16 40 27					
			iSNE	16 44 32					
			iLNE	16 46 50					
			F	18 14					
205	10	I	iPE	17 29 14					
			F	17 56					
206	11	I_v	ePNE	11 40 23				315	
			F	11 59					
207	12	I_v	ePNE	2 43 00				225	
			iSN	2 43 25					
			F	2 59					
208	13	I	eNE	13 45 00					
			F	14 47					
209	14	I_v	ePNE	0 32 42				240	
			iSNE	0 33 09					
			F	0 46					
210	15	I_v	ePNE	13 21 03				80	
			F	13 23					
211	17	I	eNE	17 32					
			F	18 03					
212	18	I_u	ePNE	6 49 38					
			iSNE	6 59 19					
			iLNE?	7 03 49					
			F	8 13					
213	19	I	ePNE	5 01 01					
			F	7 ca					
214	20	I_v	ePNE	4 46 52				310	
			F	4 58					
215	20	I_u	iPNE	5 03 36				6589	Aleutian Islands.
			iSNE	5 11 44					
			F	6 53					
216	21	II_r	iPNE	16 40 23				2200	
			iSNE	16 44 00					
			F	18 47					
217	22	I_u	ePNE	0 35 40					
			iSNE	0 42 41					
			F	1 22					
218	22	I	eNE	2 05 21					
			F	2 19					

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BULLETINS RECEIVED

We thankfully acknowledge the receipt of the following and hope for their continuance in the future.

APRIL, 1929.

STATIONS.	BULLETINS.
Ottawa	February, 1929.
Sucre	May 20th to December 31st, 1928.
La Paz	Sept. 3rd to Dec. 31st, 1928.
St. Louis, Jes. Seis. Sec	Prel. Bull. Feb. 22 & 26 and March 1, 7, 19 & 21, 1929.
Georgetown	January, 1929.
Taihoku	Feb. 8 to March 13, 1929.
Hongkong	December, 1928.
Firenze	April to December, 1928 and its record.
Wien	May 27, 1928 to Jan. 30, 1929.
Graz	Aug. 25, 1928 to Feb. 3, 1929.
Lemberg	May 28, to Dec. 31, 1928.
Innsbruck	Oct. 3 to Dec. 31, 1926 and the whole year of 1927.
Zikawei	Jan. 16 to Feb. 9, 1929.
Kew	February, 1929.
Oxford	International Seis. Summary for 1925 July, August, September.
Florissant	August, 1928.

MAY, 1929.

Riverview College	July 1st to Sept. 7th, 1926.
Königsberg i/Pr	July to Dec., 1926.
Washington	Feb. & March, 1929.
Parc St. Maur	February, 1929.
Strasbourg	
L'Institut	Jan and Feb., 1929.
Bureau Central	Jan and Feb., 1929.
Union International	Jan. and Feb., 1929.
La Plata	January, 1929.
Kew	March, 1929.
Hamburg	January-March, 1929.
Zagreb	July-September, 1928.
Kobe	July-December, 1928.
Denver	Nov. 1 to Dec. 19, 1928.
Saint Louis	Sept. 1-26, 1928.
Riverview	Jan. 1 to March 16, 1929.
Uccle, Belgium	Jan. 1 to July 7, 1928.

MIGUEL SELGA, S.J.
Director, Weather Bureau,
Manila, Philippine Islands.

William C. Repetti, S.J.
Seismologist,
Cesáreo Dulueña,
Asst. Seismologist.

From the ISC collection scanned by SISMOS

M A N I L A , P . I .

SEISMOLOGICAL BULLETIN OF THE OBSERVATORY.--Continued.

No.	Date	Character	Phase	Green. Time h. m. s.	Per. s.	Amplitude N	Amplitude E	Dist. Km.	Remarks.
						½	½		
219	22	I_u	ePNE	20 18 41					
			iLNE?	20 34 10					
			F	21 30					
220	22	I_r	ePNE	22 47 35					
			iSNE	22 53 00					
			F	23 33					
221	24	I_r	ePNE	18 41 39					
			iLNE?	18 51 30					
			F	19 19					
222	25	I	eNE	12 19					
			F	12 54					
223	26	I_r	iPNE	8 46 57				2150	
			iSNE	8 50 33					
			F	9 57					
224	26	II_u	ePNE	22 53 00				9311	Gulf of Alaska.
			iPR$_3$E	23 00 03					
			iSNE	23 03 30					
			iLNE	23 20 47					
			mE	23 24 57	9.6		4.0mm		
			mN	23 25 17	15.9	2.8mm			
	27		F	1 40					
225	30	I_v	ePNE	3 16 24				140	
			F	3 21					
226	30	I	eNE?	6 04					Disturbed by microseisms.
			F	6 38					
227	30	I	eNE?	8 34					Do.
			F	9 22					
228	30	I	eNE?	10 03					Do.
			F	12 04					
			F	11 47					

International Seismological Centre From the ISC collection scanned by SISMOS

Year 1929, No.19. June 1st to 6th, 1929.

M A N I L A , P . I .

SEISMOLOGICAL BULLETIN OF THE OBSERVATORY.

$\phi = 14^{\circ}\ 34'\ 41''$ N. $\lambda = 120^{\circ}\ 58'\ 33''$ E. h=2.40 m. Alluvium.

Instrument: Wiechert Inverted Pendulum (1000 Kg.)

	T_o	V	ε	$\frac{r}{T_o^2}$
N-S	6.31	133	3.568	0.025
E-W	6.22	131	2.852	0.033

No.	Date	Character	Phase	Green Time h. m. s.	Per. s.	Amplitude N	Amplitude E	Dist. Km.	Remarks.
						μ	μ		
229	1	I_r	ePNE	7 48 34					
			iSNE	7 52 40					
			F	8 10					
230	1	I_r	iPNE	18 02 27					
			iSNE	18 05 08					
			F	18 57					
231	1	I_v	ePE	23 10 22				820	Near NE coast of Mindanao.
			iSE	23 11 51					
			F	23 24					
232	2	I	eNE	4 24					
			F	4 39					
233	2	II_r	iPNE	21 43 20				3500	Near Japan.
			mE	21 47 30	5.2		72		
			iSNE	21 48 23					
			mN	21 50 06	7.2	70			
			mE	21 51 09	6.4		79		
			iLNE	21 52 06					
			mN	21 52 30	7.4	75			
			mE	21 53 52	5.3		71		
			MN	21 54 42	7.9	32			
			F	22 56					
234	3	I_u	iPNE	20 39 37					
			iSNE	20 46 56					
			F	21 32					
235	4	I	eNE	7 47					Disturbed by micro-seisms.
			F	8 32					
236	4	II_v	iPNE	15 18 07				980	
			iSNE	15 19 53					
			mN	15 19 57	5.2	204			
			mE	15 19 58	3.5		157		
			MN	15 20 26	7.4	198			
			ME	15 21 24	7.0		184		
			F	16 42					
237	6	I	eNE	11 13 00					
			F	11 47					

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M A N I L A , P . I .

SEISMOLOGICAL BULLETIN OF THE OBSERVATORY.--Continued.

No.	Date	Character	Phase	Green. Time h. m. s.	Per. s.	Amplitude N μ	Amplitude E μ	Dist. Km.	Remarks.
238	6	I	eNE	14 30 38					
			F	14 47					
239	6	I	ePNE	15 48 50					
			iSE	15 52 28					
			iLNE	15 54 22					
			F	16 48					
240	8	I_V	iPNE	12 32 50				340	
			F	12 40					
241	9	I_r	iPNE	9 15 31					
			iPR_2N	9 16 46					
			iSNE	9 20 43					
			iSR_2N	9 23 13					
			iSR_3E	9 23 33					
			iSR_3N	9 23 35					
			iLNE	9 24 43					
			MN	9 27 22	9.0	180			
			F	11 31					
242	10	I	eNE	19 54					
			F	20 15					
243	10	I	eNE	22 37					
			F	22 54					
244	10	I	eNE	23 15					
	11		F	0 26					
245	12	I_r	iPNE	11 49 00				1120	
			iSE	11 51 00					
			F	13 22					
246	12	I	ePNE	14 35 40					
			F	15 11					
247	13	II_u	iPNE	0 19 56					
			iPR_1N	0 22 48					
			iPR_1E	0 22 51					
			iPR_3N	0 25 16					
			iSN	0 29 05					
			iLN	0 42 02					
			mN	0 43 14	14.6	94			
			mE	0 45 00	15.0		112		
			F	3 08					
248	13	III_V	iPNE	9 26 42				950	Pacific.
			iSNE	9 28 25					
				9 30	Pens thrown off.				
			F	12 22					
249	13	II_r	iPNE	19 49 44				1270	Related to the preceding quake.
			iSNE	19 52 00					
			F	22 14					

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M A N I L A , P . I .

SEISMOLOGICAL BULLETIN OF THE OBSERVATORY.--Continued.

No.	Date	Character	Phase	Green. Time h. m. s.	Per. s.	Amplitude N μ	Amplitude E μ	Dist. Km.	Remarks.
250	13	II_r	iPNE	23 02 46				1430	Related to No.248.
			iSNE	23 05 11					
			iLNE	23 06 08					
			ME	23 06 30	10		395		
			MN	23 06 30	12	700			
251	14	I_r	P?	0 38 58					Phases confused by cauda of preceding earthquake. Related to No.248?
252	14	I	eN	4 34					
			F	5 22					
253	14	I_r	ePNE	7 55 48				1310	Related to No.248.
			iSNE	7 58 07					
			F	9 19					
254	14	I	eNE	9 44					
			F	10 27					
255	14	I	eNE	10 40					
			F	11 22					
256	14	II_r	iPNE	23 15 35				1140	Related to No.248.
			iSN	23 17 37					
	15		F	0 58					
257	15	I	eNE	5 59					
			F	6 22					
258	15	I_v	iPNE	8 59 52				410	Near Iloilo.
			iSN?	9 00 31	In hour gap.				
			F	10 08					
259	15	I_r	iPNE	11 11 38				1300	Related to No.248.
			F	11 34					
260	15	I_r	iPNE	16 04 12				1150	Related to No.248.
			iSN	16 06 15					
			F	17 20					
261	15	I_v	ePNE	17 43 08				300	
			F	18 26					
262	15	II_r	ePNE	19 37 31				1320	Related to No.248. End overtaken by following quake.
			iSN	19 39 48					
263	15	I_r	ePNE	21 10 ca				1290	Begins in minute gap. Related to No. 248.
			iSN	21 12 14					
			F	23 08					
264	16	I_r	ePNE	5 29 11				1280	Related to No.248.
			F	6 02					
265	16	I_r	ePNE	14 54 00				1320	Related to No.248.
			F	15 58					

From the ISC collection scanned by SISMOS

M A N I L A , P . I .

SEISMOLOGICAL BULLETIN OF THE OBSERVATORY.--Continued.

No.	Date	Character	Phase	Green. Time h. m. s.	Per. s.	Amplitude N μ	Amplitude E μ	Dist. Km.	Remarks.
266	16	III_u	iPNE	22 58 ca				8056	Begins in minute gap.
			PcPN	22 59 21					0=22:47:37.
			iN	23 01 31					Near New Zealand.
			iPR_1N	23 02 10					
			iSNE	23 08 46					
			iPSNE	23 09 20					
			iScSNE	23 09 42					
			iNE	23 13 48					3 waves about 30" period enter.
			SR_2N	23 17 40					
			mE	23 18 24	13.7		310		
			LNE	23 23 00					
			mN	23 25 58	19.7	800			
			MN	23 28 19					
	17		F	2 34					
267	17	I_r	ePNE	4 04 44				1360	Related to No.248.
			F	4 56					
268	17	III_r	iPNE	10 18 34				1410	Related to No.248.
			iSNE	10 21 ca					S begins in minute gap.
			MN	10 23 54	7.7	320			
			F	12 49					
269	17	I_v	ePNE	21 17 16				435	
			F	21 26					
270	18	I	eNE	3 57					
			F	4 23					
271	18	I_v	ePNE	12 13 30				440	N Luzon.
			iSNE	12 14 19					
			F	12 28					
272	18	I	eE	16 45 45					
			F	17 26					
273	18	I	ePE	18 22 56					
			F	18 52					
274	18	I_v	ePE	18 56 58				400	
			F	19 08					
275	19	II_r	iPNE	7 32 53				1410	Related to No.248.
			iSNE	7 35 16					
			iSR_1E	7 36 46					
			mN	7 37 27	9.2	460			
			iLNE	7 38 00					
			mE	7 38 09	10.5		468		
			F	10 19					
276	19	I	eNE	19 24 58					
			F	19 54					
277	19	I	ePNE	21 45 23					
			F	22 03					

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M A N I L A , P . I .

SEISMOLOGICAL BULLETIN OF THE OBSERVATORY.--Continued.

No.	Date	Character	Phase	Green. Time h. m. s.	Per. s.	Amplitude N μ	Amplitude E μ	Dist. Km.	Remarks.
278	19	I	ePNE	22 39 27					
			F	23 28					
279	20	I_r	ePNE	18 28 06					
			iSNE	18 32 10					
			F	19 02					
280	20	I_r	ePNE	20 12 41					
			iSN	20 14 41					
			iLN	20 15 47					
			F	22 01					
281	21	II_r	iPNE	4 43 04				1416	Related to No.248.
			iSNE	4 [illegible] 30					
			F	6 38					
282	21	I_r	ePN	13 22 22				1422	Related to No.248.
			iSN	13 24 50					
			F	14 20					
283	21	I	eNE	15 24 48					
			F	15 45					
284	22	I	eNE	1 37					
			F	2 05					
285	22	I	eE	3 41					
			F	4 14					
286	22	I	iPNE	15 41 40					
			F	16 48					
287	22	I_r	ePNE	17 41 44					
			iSNE	17 43 48					
			F	19 19					
288	23	I_r	ePNE	3 14 22					
			iSN	3 17 17					
			F	4 34					
289	23	II_r	iPNE	21 49 22				1500	Related to No.248.
			iSNE	21 51 38					
			LNE	21 52 32					
	24		F	0 11					
290	25	I	eE	7 39 37					
			F	8 00					
291	25	I_v	ePE	18 48 36				400	
			iSNE	18 49 20					
			F	19 07					
292	26	I_v	ePNE	3 18 09				230	
			iSNE	3 18 35					
			F	3 29					

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M A N I L A , P . I .

SEISMOLOGICAL BULLETIN OF THE OBSERVATORY.--Continued.

No.	Date	Character	Phase	Green. Time h. m. s.	Per. s.	Amplitude N μ	Amplitude E μ	Dist. Km.	Remarks.
293	26	I_V	ePNE	11 29 57					
			eSE	11 31 18				740	
			F	11 51					
294	26	I_V	ePNE	15 54 42					
			eSN	15 56 18				880	
			F	16 18					
295	26	I_V	ePNE	16 55 23					
			eSE	16 56 52				820	
			F	17 28					
296	26	I	eNE	22 15					
			F	23 53					
297	27	II_u	eN	13 06 21					
			iPE	13 06 28					
			iPN	13 06 33					
			iN	13 09 44					
			iNE	13 10 58					
			iNE	13 12 34					
			F	16 22					
298	28	I_r	ePNE	9 07 47					
			iSNE	9 09 50				1150	
			F	10 04					
299	30	III_r	iPNE	2 46 48					
			iSNE	2 49 00				1240	
			iLNE	2 50 12					
			mE	2 51 48	7.8		225		End overtaken by following quake.
300	30	I_r	iPNE	5 15 53					
			iSN	5 18 07				1260	
			F	7 27					
301	30	I	eNE	11 47 30					
			F	12 43					Disturbed by micro-seisms.
302	30	I	e?N	22 21 06					
			F	23 02					

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BULLETINS RECEIVED

JUNE, 1929.

We thankfully acknowledge the receipt of the following and hope for their continuance in the future.

STATIONS	BULLETINS
Ottawa	March and April, 1929.
Cartuja(Granada)	Nov., 1928 to March 14th, 1929.
Taihoku, Taiwan	April 10th to June 4th, 1929.
Zikawei	March 7th to May 1st, 1929.
Taunus	August 30th to December 28th, 1928.
Apia	October to December, 1928.
Florissant	August, 1928 to March, 1929.
Denver	November, 1928 to February 22, 1929.
New Zealand and Fiji	January to June, 1928.
Jena	April to December, 1928.
Leipzig	Years 1925, 1926 and 1927.
Athenes	March to December, 1926.
Hongkong	January and February, 1929.
La Plata	February and March, 1929.
Stations of J. S. Ass	Prel. Bull., March 19 and 21, and May 1 and 20, 1929.
Kew	April, 1929.
California	Bull. of the Seis. Society of America, Vol. 18, No. 4, 1928.
Nagasaki	April and March, 1929.
Washington	April, 1929.

MIGUEL SELGA, S.J.,
Director, Weather Bureau,
Manila, Philippine Islands.

WILLIAM C. REPETTI, S.J.,
Seismologist.
Cesáreo Dulueña,
Asst. Seismologist.

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B U L L E T I N S R E C E I V E D

JULY, 1929.

We thankfully acknowledge the receipt of the following and hope for their continuance in the future.

STATIONS	BULLETINS
Beograd	July 15, 1928 to February 26, 1929.
Madagascar	Sept., Nov. and Dec., 1928.
Irkutsk	September to December, 1927.
Adelaide	Year 1926.
Melbourne	Jan., Feb. and March, 1929.
Hongkong	March, April and May, 1929.
Sydney	June 16 and 17, 1929.
Spain, Seis. Sevice	Nos. 50, 51, 52 and 53.
U. S. C. and G. S.	Prel. Det. Epic. June 12 and 13,1929
Tiflis	Nos. 8 and 9, 1927.
Saint Louis	Sept.-Dec., 1928.
Saint Louis	Prel.Bull. June 9, 12, 13 and 16,1929
U. S. C. and G. S.	Radio Report for July 17, 1929.
Ottawa,Halifax,Saskatoon,Canada	May, 1929.
St. Louis University, U.S.A.	Jan. and Feb., 1929.
Georgetown University, U.S.A.	Seismological Despatches, May, 1929.
Kew	May, 1929.
U.S.C. and G.S.	March, 1929: Reports of Honolulu, Charlottesville, Tucson, Sitka, and Chicago.
Zikawei	May, 1929.
STRASBOURG	
L'Institut	May, 1929.
Bureau Central	May, 1929.
Union International	May, 1929.
Parc St. Maur	May, 1929.
Fordham University, New York	Nov.Dec.,1927 and Jan,-May, 1929.
St. Xavier Coll. Cinc.Ohio	Dec.20,1928-June, 1929.
Phu-Lien	February-December, 1928.
Tananarive	July-December, 1928.
Taihoku	June 4-28, 1929.

MIGUEL SELGA, S.J.,
Director, Weather Bureau,
Manila, Philippime Islands.

WILLIAM C. REPETTI, S.J.,
Seismologist.
Cesáreo Dulueña,
Asst. Seismologist.

318	5	ePNE iPR, NE eSNE PSNE iLNE F	14 29 19 14 31 18 14 37 35 14 37 51 14 47 45 16 57				6730	Aleutian Islands. 0=14:19:06 Lat. 50°N, longitude 177°W, J.S.A.

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International Seismological Centre

M A N I L A , P . I .

SEISMOLOGICAL BULLETIN OF THE OBSERVATORY

$\phi = 14^\circ\ 34'\ 42''$ N. $\lambda = 120^\circ\ 58'\ 41''$ E. h=2.40 m. Alluvium.

Instrument: Wiechert Inverted Pendulum (1000 Kg.)

	T_o	V	ε	$\frac{r}{T_o^2}$
N-S	7.34	144	3.926	0.025
E-W	7.43	160	3.256	0.024

No.	Date	Phase	Green. Time h. m. s.	Per. s.	A_N μ	A_E μ	Dist. Km.	Remarks.
302	1	eNE	6 31 47					
		F	7 35					
303	1	eNE	19 24 37					
		F	19 42					
304	1	$i\underline{P}$	23 45 19				150	
		iS	23 45 38					
305	2	iPNE	0 40 15				1456	End overtaken by following quake,
		iSNE	0 42 46					
306	2	ePNE	1 57 32				1889	
		iSNE?	2 00 43	in hour gap.				
		F	3 08					
307	2	iPNE	3 29 07					
		F	4 04					
309	2	ePNE	4 48 32				1870	
		eSE	4 51 42					
		F	5 12					
310	2	ePE	6 45 27					
		F	7 07					
312	2	iPNE	7 54 34				420	
		iSE	7 55 39					
		F	8 27					
315	3	iPNE	10 28 49				120	
		iSNE	10 29 05	ca. Begins in gap.				
		ME	10 29 07					Pens swings to limit, 93 mm.
		F	10 52					
316	3	eNE	18 00 49					
		F	18 27					
318	5	ePNE	14 29 19				6730	Aleutian Islands. O=14:19:06 Lat. 50°N, longitude 177°W, J.S.A.
		iPR, NE	14 31 18					
		eSNE	14 37 35					
		PSNE	14 37 51					
		iLNE	14 47 45					
		F	16 57					

M A N I L A , P . I .

SEISMOLOGICAL BULLETIN OF THE OBSERVATORY.--Continued.

International Seismological Centre

No.	Date	Phase	Green. Time h. m. s.	Per. s.	A_N μ	A_E μ	Dist. Km.	Remarks.
319	5	ePNE	22 46 32				6600	Related to preceding earthquake.
		iSNE	22 54 40					O=22:36:11
		iLNE?	23 04 37					
	6	F	0 52					
320	6	ePNE	2 14 05				6750	Lat.50°N, long.177°W,
		iSNE	2 22 24					O=2:03:48, J.S.A.
		iLNE?	2 34 00					Disturbed by microseisms
		F	4 04					
321	6	iPE	10 06 11					Atlantic Ocean.
		ePN	10 06 11					Lat.15.6°N,long.43.4°W,
		F	10 47					O=9:46:02, J.S.A.
								Disturbed by microseisms
322	6	eLE	10 52					Disturbed by microseisms
		F	11 25					
323	6	ePNE	13 25 28				1444	Disturbed by microseisms
		iSE	13 27 58?					
		F	13 57					
324	7	iNE	5 08					Do.
		F	6 16					
325	7	iPNE	21 33 28				6680	Aleutian Islands.
		iPR_2N	21 37 11					O=21:23:18
		iSNE	21 41 41					Disturbed by microseisms
		S_cSN	21 43 43					
		SR_1E	21 46 14					Lat.50°N,long.177°W, O=
		iSR_2E	21 48 27					21;23:13, J.S.A.
		iLNE	21 52 24					Shanghai iP_Z 21:31:56
		M	21 57 19					Batavia P 21:35:55
		F	0 26					
326	8	iPNE	10 50 30				490	Off SE Luzon.
		iSNE	10 51 09					
		F	11 04					
327	9	ePNE	16 54 28					
		eSNE	16 55 42					
		F	17 18					
328	9	ePNE	17 25 22					
		iSNE	17 27 51					
		iL	17 29 18					
		F	18 52					
331	12	ePNE	18 02 54				1756	
		iSNE	18 05 55					
		iLN	18 07 28					
		MNE	18 09 07					
		F	19 21					
332	13	iPNE	4 53 22				200	
		SNE	4 53 47	0.9		120		
		F	5 38					

M A N I L A , P . I .

SEISMOLOGICAL BULLETIN OF THE OBSERVATORY.--Continued.

No.	Date	Character	Phase	Greenwich mean time	Period	Amplitude A_N	Amplitude A_E	Distance	Remarks.
				h. m. s.	s.	μ	μ	Km.	
29	17	I_V	ePNE	1 23 11				210	Aftershock.
30	17	I_V	ePNE	6 48 56				315	
			SNE	6 49 31					
			F	6 57					
31	17	I_V	ePNE	10 48 32				210	Do.
			F	10 59					
32	17	I	M_E	13 26.7					Traces only
			F	13 53					
33	17	I_V	ePE	13 54 19				210	SE Luzon.
			F	13 57					
34	17	I_V	ePE	15 03 45				210	SE Luzon.
			F	15 08					
35	17	I_V	ePE	16 14 20				170	
			F	16 17					
36	17	I_V	ePE	19 50 22				200	
			SNE	19 50 48					
			F	19 56					
37	17	I_V	ePE	21 36 14				225	
			F	21 43					
38	17	I_V	ePE	21 53 41				840	
			iLE	21 55 32					
			F	21 59					
39	17	I_F	ePE	22 33 32					
			S^E	22 38 51					
			F	23 47					
40	18	IIv	ePNE	1 06 25				230	
			iLNE	1 06 51					
			M_N	1 08 46	5	92			
			M_E	1 09 43	6		111		
			F	1 19					
41	18	I_V	ePNE	6 47 34				230	
			F	6 54					
42	18	I_V	ePNE	7 13 08				230	
			F	7 19					
43	18	II_V	ePNE	11 03 11				250	
			iLNE	11 03 39					
			F	11 14					
44	18	I_V	ePNE	12 56 53				220	
			F	13 01					
45	19	I_V	iPNE	0 44 47				920?	
			iLE	0 46 45					
			F	1 09					
46	19	I	eNE	11 28					Small movements.
			F	11 51					

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MANILA, P. I.

SEISMOLOGICAL BULLETIN OF THE OBSERVATORY.--Continued.

No.	Date	Character	Phase	Greenwich mean time	Period.	Amplitude A_N	Amplitude A_E	Distance	Remarks.
				h. m. s.	s.	μ	μ	Km.	
47	19	I_V	ePNE	22 06 09				210	
			F	22 14					
48	20	I_V	ePNE	3 17 18				190	
			F	3 23					
49	20	I_V	ePNE	3 38 47				225	
			F	3 44					
50	20	I_V	ePNE	5 26 12				210	
			F	5 33					
51	20	II_r	iPNE	14 57 54		7	5	2056	Distance 18°.5. At 15:00:50 a second shock.
			PR_1	14 58 11					
			PR_2	14 53 14					
			iSNE	15 01 20					
			SR_1	15 01 51					
			PcP	15 02 22					
			L	15 02 57					
			PcS	15 09 35					
			F	16 20					
52	20	I_V	ePNE	23 08 11				230	
			F	23 12					
53	21	I	eE	5 07					
			F	5 51					
54	21	I_V	ePNE	8 58 46				200	
			iSNE	8 59 09					
			F	9 04					
55	21	I_u	eE	10 42				8222	Distance 74°, Fairbanks, Alaska.
			eLNE	10 56 24					
			M	11 12 12					
			F	11 53					
56	24	I_u	ePNE	2o 55 59				15522	Distance 139°.7. South of Guatemala in the Pacific.
			eLE	21 42 49					
			M_E	21 53 19					
			F	22 52					
57	25	I	iNE	2 06 23					Disturbed by microseisms.
			F	2 42 ca.					
58	25	I_V	ePNE	8 09 24				270	
			F	8 15					
59	25	I_r	eNE	8 4o 23					Disturbed by microseisms.
			F	9 03					

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Year 1929, No. 5. January 26th to 31st, 1929.

MANILA, P. I.

SEISMOLOGICAL BULLETIN OF THE OBSERVATORY.--Continued.

No.	Date	Character	Phase	Greenwich mean time	Period	Amplitude A_N	Amplitude A_E	Distance	Remarks.
				h. m. s.	s.	μ	μ	Km.	
60	26	I_V	iPNE	6 35 38				240	
			iSNE	6 36 12					
			F	6 49					
61	26	I_V	iPNE	13 55 14				180	
			iSNE	13 55 34					
			F	13 59					
62	26	I_V	iPNE	2o 50 10				190	
			iSNE	20 50 31					
			F	20 55					
63	29	I	eE	2 30					
			F	3 03					
64	30	I_V	ePNE	11 12 39				125	
			LE	11 12 53					
			F	11 18					
65	30	Ir	ePNE	16 57 23				3178	Distance 28°6.
			PRgE	16 58 11					O=16:51:10.
			PRgN	16 58 24					
			iSNE	17 02 07					
			iLNE	17 05 27					
			F	18 14					
66	30	I_V	ePNE	22 32 56				180	
			F	22 35					
67	31	I	eE	14 49					
			F	15 51					

Miguel Selga, S.J.
Director, Weather Bureau,
Manila, P.I.

William C. Repetti, S. J.
Seismologist.
Cesáreo Dulueña,
Asst. Seismologist.

International Seismological Centre From the ISC collection scanned by SISMOS

Year 1929, No. 6. February 1st to 8th, 1929.

M A N I L A , P . I .

SEISMOLOGICAL BULLETIN OF THE OBSERVATORY.

φ=14° 34' 41" N. λ=120° 58' 33" E. h=2.40 ms. Alluvium.

Instrument: Wiechert's astatic pendulum (1,000 Kg.)

	T_o	V	ε	$\frac{r}{T_o^2}$
A_N	6.31	186	3.834	0.035
A_E	6.29	216	2.970	0.046

No.	Date	Character	Phase	Greenwich mean time	Period	Amplitude A_N	Amplitude A_E	Distance	Remarks.
				h. m. s.	s.	μ	μ	Km.	
68	1	I_V	ePNE	6 05 00				170	
			iLNE	6 05 19					
			F	6 19					
69	1	II_u	iPNE	17 23 00				5200	Distance 46°.8. North of Lahore India in Himalaya Mountain?
			iSNE	17 29 48					
			PS	17 29 55					
			F	19 04					
70	2	I	eP'NE	0 20 16					
			iScPcPNE	0 23 53					
			iNE	0 25 35					
			eNE	1 43 00	19				Trains of long waves at intervals until 2h 32m.
			F	2 45 ca.					
71	2	I_r	ePNE	14 47 02					
			iLE	14 51 51					
			F	15 23					
72	3	I_r	iPNE	2 48 23					
			iLNE	2 51 34					
			F	3 29					
73	4	I_V	ePNE	2 10 42				100	From Vicentini seismograph.
			F	2 14					
74	6	I	iPNE	6 67 00					
			iSNE	7 03 15					
			F	7 34					
75	7	I_V	ePNE	2 22 44				200	
			F	2 29					
76	7	I_V	ePNE	5 54 16				220	
			F	6 01					
77	8	I_r	ePNE	7 45 32					
			F	8 12					

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M A N I L A . P . I .

SEISMOLOGICAL BULLETIN OF THE OBSERVATORY.--Continued.

No.	Date	Character	Phase	Greenwich mean time h. m. s.	Period. s.	Amplitude A_N μ	Amplitude A_E μ	Distance Km.	Remarks.
78	8	I_V	ePNE	20 11 40				90	
			F	20 14					
79	9	I	eLE	2 05					
			F	3 06 ca.					
80	10	I	eE	16 01					
			PR_4E	16 07 23					
			PSE	16 10 52					
			F	17 54 ca.					
81	11	I	eE	13 14					Traces only.
			F	13 38					
82	13	I	iNE	17 13					Traces only.
			F	17 43					
83	14	I_V	ePNE	11 42 20				225	
			iSNE	11 42 45					
			F	11 51					
84	14	I_r	ePNE	14 43 00					
			PR_2NE	14 43 37					
			iSNE	14 46 06					
			iLNE	14 49 21					
			F	15 53					
85	15	II_r	iPNE	5 43 13		8	9	1100	Condensation. Distance 9°.9. Probable epicenter 9°.5 N., 130° E.
			iSNE	5 45 05					
			iSR_1E	5 45 16					
			iLE	5 46 10					
			F	7 19					
86	16	I	eE	19 43					
			ME	20 23					
			F	20 46					
87	17	I	e	21 02					Traces only.
			F	21 32					
88	18	I_V	iPNE	4 47 12				80	
			iSNE	4 47 20					
			F	4 53					
89	18	I_V	ePNE	7 14 45				130	Central Luzon.
			iSNE	7 15 00					
			F	7 21					
90	19	I_V	ePNE	17 12 45				330	
			iSNE	17 13 22					
			F	17 22					
91	20	I_V	ePNE	4 34 54				130	
			iSNE	4 35 09					
			F	4 41					
92	20	I_V	ePNE	12 04 52				120	
			iSNE	12 05 05					
			F	12 10					

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M A N I L A , P . I .

SEISMOLOGICAL BULLETIN OF THE OBSERVATORY.--Continued.

No.	Date	Character	Phase	Greenwich mean time	Period.	Amplitude A_N	Amplitude A_E	Distance	Remarks.
				h. m. s.	s.	μ	μ	Km.	
93	20	I	iNE	21 14 41					Small and weak record.
			F	22 08					
94	21	Iv	ePNE	4 17 54				200	
			iSNE	4 18 16					
			F	4 25					
95	22	Iv	ePNE	11 29 16				60	Felt at Los Baños and Santa Cruz, La Laguna Province.
			iSNE	11 29 23					
			F	11 33					
96	22	Iv	ePNE	13 41 08				70	
			iSNE	13 41 16					
			F	13 45					
97	22	Iu	iP'NE	21 01 46				16689	Distance 150°.2. O=20:41:36.
			iNE	21 03 46					
			iScPcPNE	21 05 17					
			iPNE	21 05 24					
			iPNE	21 08 31					
			iPNE	21 15 43					
			iPSNE?	21 16 44					
			eLNE	21 49 15					
			eMNE	22 04 21					
			MNE	22 09 43	18	73	66		
			F	23 30					
98	23	Iv	ePNE	1 19 54				80	
			iSNE	1 20 03					
			F	1 23					
99	23	Iv	ePNE	10 42 41				40	
			iSNE	10 42 45					
			F	10 45					
100	23	Iv	ePNE	15 42 47				170	
			iSNE	15 43 06					
			F	15 46					
101	24	I	eE	22 03					Traces only.
			F	22 31					
102	25	I	eLNE	2 00					
			F	2 19					

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Year 1929, No. 9. February 26th to 28th, 1929.

M A N I L A , P . I .

SEISMOLOGICAL BULLETIN OF THE OBSERVATORY.--Continued.

No.	Date	Character	Phase	Greenwich mean time	Period.	Amplitude A_N	Amplitude A_E	Distance	Remarks.
				h. m. s.	s.	μ	μ	Km.	
103	26	I_V	ePNE	3 31 38				230	
			iSNE	3 32 04					
			F	3 35					
104	26	I_u	eNE	3 39 54					
			iSNE	3 48 01					
			F	4 09					
105	26	I_u	O	9 00 44					
			PNE	9 12 (?)	In minute	gap.		7822	Distance 70°.4.
			iPcPNE	9 12 35					
			iNE	9 12 54					
			iSNE	9 21 11					
			iPSNE	9 21 38					
			iNE	9 23 37					
			eME?	9 49 00					
			F	10 44					
106	27	I_V	iPNE	8 18 58				160	
			iSNE	8 19 16					
			F	8 26					
107	28	I	eNE	0 15 ca.					
			F	0 56					

Miguel Selga, S.J.,
Director, Weather Bureau,
Manila, P.I.

William C. Repetti, S.J.,
Seismologist,
Cesáreo Dulueña,
Asst. Seismologist.

International Seismological Centre From the ISC collection scanned by SISMOS

BULLETINS RECEIVED

FEBRUARY

1929

We thankfully acknowledge the receipt of the following and hope for their continuance in the future.

STATIONS.	BULLETINS/
Santiago.....	Bol. Seis. Serv. XVII.
Sverdlovsk.....	Nov.-Dec., 1927.
Makeevka.....	Oct.-Dec., 1927.
Tashkent.....	Sept.-Dec., 1927.
Kucino.....	Sept.-Dec., 1927.
Baku.....	Oct.-Dec., 1927.
Pulkovo.....	Nov.-Dec., 1927.
Nagasaki.....	Aug.-Oct., 1928.
Paris	Ann. d. l'Inst. Phy. d G. 1926
Batavia.....	July-Sept., 1928. Seis. Bull. 1928.
Copenhagen.....	Seis. Bull. i Scoresby-Sund.
Hongkong.....	Oct.-Nov., 1928.
Taihoku.....	Nos. 21-22-23-24.
Granada.....	Sept.-Oct., 1928.
Kew	Nov., 1928.
St Louis Jes. Seis. Soc	Prelim. Bull. Dec. 1st, 1928.
La Paz	July-Aug., 1928.
Barcelona	Nos. 126-127-128.
Ottawa	Nov., 1928. Including Halifax and Saskatoon.
Harvard	Nos. 11-12.
San Fernando	July, 1928.
Georgetown	July, 1928. Seis. Dec.-Oct., 1928.
U.S.C.G.S.	Chicago-Honolulu-Tucson-Sitka-U. of Va. Oct., 1928. Radio Reports Jan.21-Jan.24.
Paris	Oct., 1928.
Strasbourg	Prelim. Reports, Oct., 1928.
	Station Report Oct., 1928.
	Central Bur. Bull. Oct., 1928.

Miguel Selga,
Director, Weather Bureau,
Manila, P.I.

William C. Repetti, S.J.
Seismologist.
C. Dulueña,
Asst. Seismologist.

International Seismological Centre From the ISC collection scanned by SISMOS

BULLETINS RECEIVED

FEBRUARY

1929

We thankfully acknowledge the receipt of the following and hope for their continuance in the future.

STATIONS.	BULLETINS.
La Plata	October, 1928.
Zi-ka-wei	June 28th to December 27th, 1928.
Strasbourg	Preliminary Reports, November and December, 1928.
Strasbourg	Station Report, November and December, 1928.
Strasbourg	Central Bureau Bulletin, Novem. and Decem., 1928.
Toledo	May and June, 1928.
Almeria	May and June, 1928.
Malaga	May and June, 1928.
Alicante	May and June, 1928.
Batavia	Advance Seismological Report, December, 1928.
Georgetown	August to November, 1928.
U.S. C. and G. S.	Radio Report, February 2nd and 10th, 1929.
Kew	December, 1928.
Saint Louis	Preliminary Bulletin, January 13, 17 and 24, 1929.
Oxford	Inter. Seism. Summary for 1925 April, May, June.
Hamburg	October, November and December, 1928.
Hohenheim	October, November and December, 1928.
Ravensburg	October, November and December, 1928.
Riverview	April, May and June, 1926.
Phu-Lien	January, 1928.
Taihoku	January 1st to February 3rd, 1929.
Apia	July - September, 1928.
U.S. C. and G. S.	Chicago, Honolulu, Tucson, Sitka & Virginia, November, 1928.

Miguel Selga,
Director, Weather Bureau,
Manila, P.I.

William C. Repetti, S.J.
Seismologist,
Cesáreo Dulueña,
Asst. Seismoligist.

International Seismological Centre From the ISC collection scanned by SISMOS

Year 1929, No. 9. March 1st to 8th, 1929.

M A N I L A , P . I .

SEISMOLOGICAL BULLETIN OF THE OBSERVATORY

$\phi = 14^\circ\ 34'\ 41''$ N. $\lambda = 120^\circ\ 58'\ 33''$ E. h=2.40 m. Alluvium.

Instrument: Wiechert Inverted Pendulum (1000 Kg.)

	T_o	V	ε	$\frac{r}{T_o^2}$
N-S	6.40	213	3.172	0.068
E-W	6.32	232	3.152	0.068

No.	Date	Character	Phase	Greenwich Time h. m. s.	Period s.	Amplitude N μ	Amplitude E μ	Dist. Km.	Remarks.
108	1	I	eNE	7 54					Traces only.
			F	8 15					
109	4	I_V	iPNE	14 42 18				270	
			iSNE	14 42 48					
			F	14 48					
110	4	I_V	ePNE	17 23 04				200	
			iSNE	17 23 26					
			F	17 27					
111	7	II_u	ePEN	1 45 23				7350	Aleutian Islands.
			iPEN	1 45 27					
			iPcPEN	1 46 16	7				
			M_N	1 46 24	7	42			
			iPR_1EN	1 48 16	7	50			
			iPR_2EN	1 49 29	9.5				
			iSEN	1 54 16					
			ME	1 54 28	8.5		175		
			iPPPSEN	1 55 05					
			ME	1 55 12	7.8		80		
			iScSEN	1 56 +	in minute gap				
			iEN	1 56 14					
			MEN	1 56 22	8.5	105	175		
			SR1EN	1 59 00					
			PPSS)						
			ME	1 59 15	8		95		
			M_N	1 59 15	11	220			
			iSR_2EN	2 01 50					
			iEN	2 03 55					
			iLEN	2 06 47					
			MEN	2 11 50					
			F	5 21					
112	7	I	ePNE	11 12 36					Traces only.
			F	11 58					
113	8	I	eNE	10 59 ca.					Small movements.
			F	11 40					

International Seismological Centre From the ISC collection scanned by SISMOS

M A N I L A , P . I .

SEISMOLOGICAL BULLETIN OF THE OBSERVATORY.--Continued.

No.	Date	Character	Phase	Green. Time h. m. s.	Per. s.	Amplitude N μ	Amplitude E μ	Dist. Km.	Remarks.
114	9	II_r	iPNE	2 16 55					
			iSNE	2 21 31					
			iLNE	2 24 31					
			F	3 51					
115	9	I_u	iPE	11 02 12					
			iSNE	11 11 40					
			iLNE	11 25 40					
			F	12 55					
116	10	I	ePNE	0 56					
			F	1 06					
117	10	I_r	iPNE	14 39 49					
			iSNE	14 43 40					
			iLNE	14 45 46					
			F	15 56					
118	13	I	eNE	11 10					Small movements.
			F	11 42					
119	13	I_v	ePNE	14 10 34				60	
			F	14 13					
120	14	I	eNE	18 42 14					
			F	19 29					
121	15	I	eNE	2 07 00					
			F	2 41					
122	15	I	ePNE	8 30 11					
			F	9 22					
123	16	I_r	ePNE	6 09 53					
			eSNE	6 14 14					
			iLNE	6 16 51					
			F	6 49					
124	16	I_r	ePNE	22 39 28				000?	
			iSNE	23 01 08					
			F	23 33					
125	18	I_r	ePNE	0 50 51				1010	
			iSNE	0 52 40					
			F	1 09					
126	18	I_r	ePNE	1 48 30					
			iSNE	1 52 55					
			F	2 54					
127	18	I	eNE	23 27 51					
	19		F	0 12					
128	19	I	eNE	21 13 55					
			iN	21 16 54					
			F	21 46					

International Seismological Centre From the ISC collection scanned by SISMOS

M A N I L A , P . I .

SEISMOLOGICAL BULIETIN OF THE OBSERVATORY.--Continued.

No.	Date	Character	Phase	Green. Time h. m. s.	Per. s.	Amplitude N μ	Amplitude E μ	Dist. Km.	Remarks.
129	20	I	ePNE	12 13 32					
			F	12 32					
130	20	II_v	ePNE	21 11 48				445	NE Luzon.
			iSNE	21 12 37					
			M_N	21 13 17	4				
			M_E	21 13 27	5				
			F	22 17					
131	21	I	eP'NE	2 57.					
			F	3 28					
132	22	I_r	ePNE	3 08 38					
			iSNE	3 12 40					
			iLNE	3 14 52					
			F	3 52					
133	23	II_r	iPNE	20 03 53					
			iSNE	20 06 43					
			iLNE	20 08 07					
			F	21 56					
134	24	I_v	ePNE	1 06 17				140	
			F	1 12					
135	24	I	eNE	5 51					Traces only.
			F	6 02					
136	24	I_v	ePNE	7 33 06				130	
			F	7 38					
137	24	I_v	ePNE	16 13 15				410	
			F	16 24					
138	25	I	eNE	4 00					
			F	4 22					
139	25	I	eLNE	8 40 19					
			F	8 57					
140	25	I	eNE	15 01					
			F	15 37					
141	26	I	eNE	4 18 49					
			F	4 53					
142	26	I	eN	10 43 ca.					
			F	11 03					
143	26	I	eNE	13 30 49					
			F	13 47					

International Seismological Centre From the ISC collection scanned by SISMOS

M A N I L A , P . I .

SEISMOLOGICAL BULLETIN OF THE OBSERVATORY.--Continued.

No.	Date	Character	Phase	Green. Time h. m. s.	Per. s.	Amplitude N	Amplitude E	Dist. Km.	Remarks.
						)l	)u		
144	26	I	eNE	19 57 42					
			F	20 41					
145	28	I_V	ePNE	13 01 46				45	
			F	13 04					
146	28	I_r	ePNE	20 37 20					
			eSNE	20 41 40					
			F	21 14					
147	28	I	eE	21 37					
			F	21 52					
150	30	I_V	ePNE	10 03 29				190	
			F	10 08					
151	31	I_r	ePNE	5 30 53					
			eSNE	5 35 50					
			eLN	5 39 20					
			F	6 38					
152	31	I_V	ePNE	9 31 27				460	
			eSNE	9 32 18					
			F	9 38					
153	31	I_V	ePNE	9 40 05				460	
			F	9 49					
154	31	I_V	ePNE	14 27 51				440	
			F	14 50					
155	31	I_r	ePNE	2o 24 35					
			eSNE	20 28 47					
			F	21 16					

International Seismological Centre From the ISC collection scanned by SISMOS

BULLETINS RECEIVED

MARCH, 1929.

We thankfully acknowledge the receipt of the following and hope for their continuance in the future,

STATIONS.	BULLETINS.
Chicago (Loyola)	April 27 to December 28,1928.
Cincinnati	September 21 to December 19, 1928.
Melbourne	October 9 to December 31, 1928.
Toledo	July and August, 1928.
Almeria	July and August, 1928.
Malaga	July and August, 1928.
Alicante	July and August, 1928.
U.S. C. and G. S.	Radio Report, March 1, 1929.
Hukuoka, Japan	January, 1927 to December, 1928.
Ottawa	December, 1928 and January, 1929.
St.Louis,Jes.Seis.Soc.	Prel.Bull. Jan.21 and 31,and Feb. 1,2,10,13 and 15, 1929.
Honolulu	Prel. Determination, Feb. 15, 1929.
Zinsen, Tyosen (Korea)	April 14 to Nov. 28, 1928.
La Plata	December, 1928.
Georgetown	December, 1928.
Kew	January, 1929.
Batavia	October, November and December, 1928, and Catalogue of Earthquakes in East Indies, 1927.
Tananarive	July 7 to August 24, 1928.
Zikawei	November 29 to January 14, 1929.
San Fernando	November and December, 1928 and January,1929.

Miguel Selga, S.J.
Director, Weather Bureau,
Manila, P.I.

William C. Repetti, S.J.,
Seismologist.
Cesáreo Dulueña,
Asst. Seismologist.

International Seismological Centre From the ISC collection scanned by SISMOS

Year 1929, No. 13. April 1st to 4th, 1929.

M A N I L A , P . I .

SEISMOLOGICAL BULLETIN OF THE OBSERVATORY.

ϕ=14° 34' 41" N. λ=120° 58' 33" E. h=2.40 m. Alluvium.

Instrument: Wiechert Inverted Pendulum (1000 Kg.)

	T_o	V	ε	$\frac{r}{T_o^2}$
N-S	6.10	206	2.939	0.050
E-W	6.57	200	2.708	0.050

No.	Date	Character	Phase	Green. Time h. m. s.	Per. s.	Amplitude N μ	Amplitude E μ	Dist. Km.	Remarks.
156	1	I_r	eNE	5 28 30					
			eSNE	5 32 33					
			F	5 58					
157	2	I	eNE	3 33					
			M_E	3 46 30					
			F	4 12					
158	2	III_d	iPNE	6 12 32				150	China Sea, near Zambales coast.
			iS_{NE}	6 12 49					
			m_N	6 12 50	2.3	104			
			M_E	6 13 12	1.8		134		
			F	6 37					
159	2	I_v	ePNE	6 19 00				150	Aftershock of the preceding quake.
160	2	I_v	ePNE	6 40 20				150	Do.
161	2	I	eNE	6 42 00					Distant earthquake.
			F	7 28					
162	2	I_v	ePNE	20 49 22				150	Aftershock of the No. 158.
			F	20 54					
163	2	I_v	ePNE	21 56 45				150	Do.
			F	21 59					
164	2	III_d	iPNE	23 27 31				150	Another repetition of the No. 158.
			iS_{NE}	23 27 48					
			M_E	23 28 42	4.5		89		
			M_N	23 28 54	3.8	96			
	3		F	1 02					
165	3	I_v	ePN_E	0 58 22				150	Aftershock of the No. 158.
			iS_{NE}	0 58 39					
			F	1 02					
166	4	I_v	ePN_E	17 04 40				150	Do.
			iS_{NE}	17 04 57					
			F	17 13					

International Seismological Centre From the ISC collection scanned by SISMOS

M A N I L A , P . I .

SEISMOLOGICAL BULLETIN OF THE OBSERVATORY.--Continued.

No.	Date	Character	Phase	Green. Time h. m. s.	Per. s.	Amplitude N. μ	Amplitude E. μ	Dist. Km.	Remarks.
167	4	I_V	eP_{NE}	19 09 01				150	Aftershock of the No. 158.
			F	19 12					
168	4	I_V	eP_{NE}	22 19 32				150	Do.
			F	22 24					
169	5	I_V	eP_{NE}	8 28 03				630	Near Batanes Islands.
			iS_N	8 29 09					
			iS_E	8 29 11					
			F	9 13					
170	5	I_V	eP_{NE}	14 34 25				630	Aftershock of the preceding quake.
			eS_{NE}	14 35 34					
			F	14 55					
171	8	II_V	iP_{NE}	10 18 50				870	Lanao, Mindanao.
			iS_{NE}	10 20 24					
			m_N	10 20 31					
			m_E	10 20 33	7.5		178		Pen went to limit of its swing 73.0 mm.
			m_E	10 20 40	6.6		135		
			M_E	10 21 43	7.8		96		
			F	11 57					
172	8	I_V	eNE	17 57 20					
			F	18 19					
173	9	I_r	eNE	4 04 44					
			S_N	4 10 00					
			eL_{NE}	4 14 00					
			F	5 05					
174	10	I	eNE	6 11 ca.					Small movements.
			F	6 56					

Constants found on April 13th, 1929.

	T_o	V	ε	$\frac{r}{T_o^2}$
N-S	6.08	162	3.3	0.017
E-W	5.93	196	3.2	0.022

175	13	I	eP_{NE}	9 20 06					
			F	9 46					
176	13	I	eNE	21 27					Traces only.
			F	21 51					
177	15	I	eNE	16 24					Do.
			F	16 58					
178	16	I	eNE	0 59					Do.
			F	1 27					

International Seismological Centre From the ISC collection scanned by SISMOS

M A N I L A , P . I .

SEISMOLOGICAL BULLETIN OF THE OBSERVATORY.--Continued.

No.	Date	Character	Phase	Green. Time h. m. s.	Per. s.	Amplitude N	Amplitude E	Dist. Km.	Remarks.
						μ	μ		
179	18	I_r	iPNE	3 41 16				1090	N Celebes Sea, near SW coast of Min-
			iSNE	3 43 12					
			iLNE	3 44 26					
			F	4 32					
180	19	I	ePNE	13 55 39					
			F	14 10					
181	20	I	ePN	6 27 ca					Distant quake.
			F	8 31					
182	20	I_r	ePNE	10 03 38					
			iSNE	10 05 48					
			F	10 37					
183	22	I_v	ePNE	15 55 39				125	
			F	15 58					
184	23	II_v	iPNE	18 25 54				140	S Luzon.
			iSNE	18 26 10					
			mE	18 26 13					Pen went to limit
			mN	18 26 22	1.2	165			of its swing, 73
			F	18 47					mm.
185	25	I_v	ePNE	10 41 30				250	
			iSNE	10 41 58					
			F	10 48					
186	27	I_r	ePNE	21 09 40					
			eSNE?	21 15 35					
			F	22 22					
187	28	I_v	ePNE	7 39 34				250	
			iSNE	7 40 02					
			F	7 49					
188	28	I_v	ePNE	13 17 09				160	
			iSNE	13 17 27					
			F	13 23					
189	28	I_r	iPNE	14 38 19					
			iSNE	14 42 27					
			F	15 32					
190	30	I	ePNE	18 53 44					
			F	20 00					

From the ISC collection scanned by SISMOS

M A N I L A , P . I .

SEISMOLOGICAL BULLETIN OF THE OBSERVATORY.--Continued.

No.	Date	Character	Phase.	Green. Time h. m. s.	Per. s.	Amplitude N μ	Amplitude E μ	Dist. Km.	Remarks.
191	1	I	eNE	7 41 01					
			F	9 13					
192	1	II_u	ePNE	15 47 48				7728	Aleutian Islands?
			ePcPE	15 48 26					
			iPR1E	15 50 47					
			iPR2NE	15 52 16					
			mN	15 56 17	7.6	6.4mm			
			mE	15 56 38	10.2		5.9mm		
			iSNE	15 57 03					
			iPPPSNE	15 57 47					
			iPcSScPNE	16 03 23					
			iSR2E	16 05 08					
			iINE	16 10 15					
			MN	16 16 40	17.9	9.1mm			
			ME	16 16 48	15.4		18.2mm		
			F	18 15					
193	2	I	eNE	4 53 52					
			F	5 42					
194	2	I_v	iPE	6 14 34				130	
			F	6 20					
195	2	I_r	iPNE	14 33 22					
			iSNE	14 39 32					
			F	15 41					
196	4	I_r	ePNE	8 58 36					
			iSNE?	9 00 56					
			F	9 58					
197	4	I_v	ePNE	12 41 10				110	
			F	12 48					
198	5	I_v	ePNE	5 27 33				390	
			F	5 36					
199	5	I_v	ePNE	6 21 29				300	
			F	6 28					
200	5	I_v	ePNE	8 29 56				620	
			F	8 39					
201	5	I_v	ePNE	13 35 41				560	
			F	13 42					
202	6	I_r	iPNE	5 13 44					
			iSE	5 17 51					
			F	7 44					
203	7	I	ePNE	8 47 54					
			F	9 42					

International Seismological Centre From the ISC collection scanned by SISMOS

M A N I L A , P . I .

SEISMOLOGICAL BULLETIN OF THE OBSERVATORY.--Continued.

No.	Date	Character	Phase	Green. Time h. m. s.	Per. s.	Amplitude N μ	Amplitude E μ	Dist. Km.	Remarks.
204	7	II_r	iPE	16 40 27					
			iSNE	16 44 32					
			iLNE	16 46 50					
			F	18 14					
205	10	I	iPE	17 29 14					
			F	17 56					
206	11	I_v	ePNE	11 40 23				315	
			F	11 59					
207	12	I_v	ePNE	2 43 00				225	
			iSN	2 43 25					
			F	2 59					
208	13	I	eNE	13 45 00					
			F	14 47					
209	14	I_v	ePNE	0 32 42				240	
			iSNE	0 33 09					
			F	0 46					
210	15	I_v	ePNE	13 21 03				80	
			F	13 23					
211	17	I	eNE	17 32					
			F	18 03					
212	18	I_u	ePNE	6 49 38					
			iSNE	6 59 19					
			iLNE?	7 03 49					
			F	8 13					
213	19	I	ePNE	5 01 01					
			F	7 ca					
214	20	I_v	ePNE	4 46 52				310	
			F	4 58					
215	20	I_u	iPNE	5 03 36				6589	Aleutian Islands.
			iSNE	5 11 44					
			F	6 53					
216	21	II_r	iPNE	16 40 23				2200	
			iSNE	16 44 00					
			F	18 47					
217	22	I_u	ePNE	0 35 40					
			iSNE	0 42 41					
			F	1 22					
218	22	I	eNE	2 05 21					
			F	2 19					

International Seismological Centre From the ISC collection scanned by SISMOS

BULLETINS RECEIVED

We thankfully acknowledge the receipt of the following and hope for their continuance in the future.

APRIL, 1929.

STATIONS.	BULLETINS.
Ottawa	February, 1929.
Sucre	May 20th to December 31st, 1928.
La Paz	Sept. 3rd to Dec. 31st, 1928.
St. Louis, Jes. Seis. Sec	Prel. Bull. Feb. 22 & 26 and March 1, 7, 19 & 21, 1929.
Georgetown	January, 1929.
Taihoku	Feb. 8 to March 13, 1929.
Hongkong	December, 1928.
Firenze	April to December, 1928 and its record.
Wien	May 27, 1928 to Jan. 30, 1929.
Graz	Aug. 25, 1928 to Feb. 3, 1929.
Lemberg	May 28, to Dec. 31, 1928.
Innsbruck	Oct. 3 to Dec. 31, 1926 and the whole year of 1927.
Zikawei	Jan. 16 to Feb. 9, 1929.
Kew	February, 1929.
Oxford	International Seis. Summary for 1925 July, August, September.
Florissant	August, 1928.

MAY, 1929.

Riverview College	July 1st to Sept. 7th, 1926.
Königsberg i/Pr	July to Dec., 1926.
Washington	Feb. & March, 1929.
Parc St. Maur	February, 1929.
Strasbourg	
L'Institut	Jan and Feb., 1929.
Bureau Central	Jan and Feb., 1929.
Union International	Jan. and Feb., 1929.
La Plata	January, 1929.
Kew	March, 1929.
Hamburg	January-March, 1929.
Zagreb	July-September, 1928.
Kobe	July-December, 1928.
Denver	Nov. 1 to Dec. 19, 1928.
Saint Louis	Sept. 1-26, 1928.
Riverview	Jan. 1 to March 16, 1929.
Uccle, Belgium	Jan. 1 to July 7, 1928.

MIGUEL SELGA, S.J.
Director, Weather Bureau,
Manila, Philippine Islands.

William C. Repetti, S.J.
Seismologist,
Cesáreo Dulueña,
Asst. Seismologist.

From the ISC collection scanned by SISMOS

M A N I L A , P . I .

SEISMOLOGICAL BULLETIN OF THE OBSERVATORY.--Continued.

No.	Date	Character	Phase	Green. Time h. m. s.	Per. s.	Amplitude N	Amplitude E	Dist. Km.	Remarks.
						½	½		
219	22	I_u	ePNE	20 18 41					
			iLNE?	20 34 10					
			F	21 30					
220	22	I_r	ePNE	22 47 35					
			iSNE	22 53 00					
			F	23 33					
221	24	I_r	ePNE	18 41 39					
			iLNE?	18 51 30					
			F	19 19					
222	25	I	eNE	12 19					
			F	12 54					
223	26	I_r	iPNE	8 46 57				2150	
			iSNE	8 50 33					
			F	9 57					
224	26	II_u	ePNE	22 53 00				9311	Gulf of Alaska.
			iPR$_3$E	23 00 03					
			iSNE	23 03 30					
			iLNE	23 20 47					
			mE	23 24 57	9.6		4.0mm		
			mN	23 25 17	15.9	2.8mm			
	27		F	1 40					
225	30	I_v	ePNE	3 16 24				140	
			F	3 21					
226	30	I	eNE?	6 04					Disturbed by microseisms.
			F	6 38					
227	30	I	eNE?	8 34					Do.
			F	9 22					
228	30	I	eNE?	10 03					Do.
			F	12 04					
			F	11 47					

International Seismological Centre From the ISC collection scanned by SISMOS

Year 1929, No.19. June 1st to 6th, 1929.

M A N I L A , P . I .

SEISMOLOGICAL BULLETIN OF THE OBSERVATORY.

$\phi = 14^{\circ}\ 34'\ 41''$ N. $\lambda = 120^{\circ}\ 58'\ 33''$ E. h=2.40 m. Alluvium.

Instrument: Wiechert Inverted Pendulum (1000 Kg.)

	T_o	V	ε	$\frac{r}{T_o^2}$
N-S	6.31	133	3.568	0.025
E-W	6.22	131	2.852	0.033

No.	Date	Character	Phase	Green Time h. m. s.	Per. s.	Amplitude N	Amplitude E	Dist. Km.	Remarks.
						μ	μ		
229	1	I_r	ePNE	7 48 34					
			iSNE	7 52 40					
			F	8 10					
230	1	I_r	iPNE	18 02 27					
			iSNE	18 05 08					
			F	18 57					
231	1	I_v	ePE	23 10 22				820	Near NE coast of Mindanao.
			iSE	23 11 51					
			F	23 24					
232	2	I	eNE	4 24					
			F	4 39					
233	2	II_r	iPNE	21 43 20				3500	Near Japan.
			mE	21 47 30	5.2		72		
			iSNE	21 48 23					
			mN	21 50 06	7.2	70			
			mE	21 51 09	6.4		79		
			iLNE	21 52 06					
			mN	21 52 30	7.4	75			
			mE	21 53 52	5.3		71		
			MN	21 54 42	7.9	32			
			F	22 56					
234	3	I_u	iPNE	20 39 37					
			iSNE	20 46 56					
			F	21 32					
235	4	I	eNE	7 47					Disturbed by micro-seisms.
			F	8 32					
236	4	II_v	iPNE	15 18 07				980	
			iSNE	15 19 53					
			mN	15 19 57	5.2	204			
			mE	15 19 58	3.5		157		
			MN	15 20 26	7.4	198			
			ME	15 21 24	7.0		184		
			F	16 42					
237	6	I	eNE	11 13 00					
			F	11 47					

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M A N I L A , P . I .

SEISMOLOGICAL BULLETIN OF THE OBSERVATORY.--Continued.

No.	Date	Character	Phase	Green. Time h. m. s.	Per. s.	Amplitude N μ	Amplitude E μ	Dist. Km.	Remarks.
238	6	I	eNE	14 30 38					
			F	14 47					
239	6	I	ePNE	15 48 50					
			iSE	15 52 28					
			iLNE	15 54 22					
			F	16 48					
240	8	I_V	iPNE	12 32 50				340	
			F	12 40					
241	9	I_r	iPNE	9 15 31					
			iPR_2N	9 16 46					
			iSNE	9 20 43					
			iSR_2N	9 23 13					
			iSR_3E	9 23 33					
			iSR_3N	9 23 35					
			iLNE	9 24 43					
			MN	9 27 22	9.0	180			
			F	11 31					
242	10	I	eNE	19 54					
			F	20 15					
243	10	I	eNE	22 37					
			F	22 54					
244	10	I	eNE	23 15					
	11		F	0 26					
245	12	I_r	iPNE	11 49 00				1120	
			iSE	11 51 00					
			F	13 22					
246	12	I	ePNE	14 35 40					
			F	15 11					
247	13	II_u	iPNE	0 19 56					
			iPR_1N	0 22 48					
			iPR_1E	0 22 51					
			iPR_3N	0 25 16					
			iSN	0 29 05					
			iLN	0 42 02					
			mN	0 43 14	14.6	94			
			mE	0 45 00	15.0		112		
			F	3 08					
248	13	III_V	iPNE	9 26 42				950	Pacific.
			iSNE	9 28 25					
				9 30	Pens thrown off.				
			F	12 22					
249	13	II_r	iPNE	19 49 44				1270	Related to the preceding quake.
			iSNE	19 52 00					
			F	22 14					

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M A N I L A , P . I .

SEISMOLOGICAL BULLETIN OF THE OBSERVATORY.--Continued.

No.	Date	Character	Phase	Green. Time h. m. s.	Per. s.	Amplitude N μ	Amplitude E μ	Dist. Km.	Remarks.
250	13	II_r	iPNE	23 02 46				1430	Related to No.248.
			iSNE	23 05 11					
			iLNE	23 06 08					
			ME	23 06 30	10		395		
			MN	23 06 30	12	700			
251	14	I_r	P?	0 38 58					Phases confused by cauda of preceding earthquake. Related to No.248?
252	14	I	eN	4 34					
			F	5 22					
253	14	I_r	ePNE	7 55 48				1310	Related to No.248.
			iSNE	7 58 07					
			F	9 19					
254	14	I	eNE	9 44					
			F	10 27					
255	14	I	eNE	10 40					
			F	11 22					
256	14	II_r	iPNE	23 15 35				1140	Related to No.248.
			iSN	23 17 37					
	15		F	0 58					
257	15	I	eNE	5 59					
			F	6 22					
258	15	I_v	iPNE	8 59 52				410	Near Iloilo.
			iSN?	9 00 31	In hour gap.				
			F	10 08					
259	15	I_r	iPNE	11 11 38				1300	Related to No.248.
			F	11 34					
260	15	I_r	iPNE	16 04 12				1150	Related to No.248.
			iSN	16 06 15					
			F	17 20					
261	15	I_v	ePNE	17 43 08				300	
			F	18 26					
262	15	II_r	ePNE	19 37 31				1320	Related to No.248. End overtaken by following quake.
			iSN	19 39 48					
263	15	I_r	ePNE	21 10 ca				1290	Begins in minute gap. Related to No. 248.
			iSN	21 12 14					
			F	23 08					
264	16	I_r	ePNE	5 29 11				1280	Related to No.248.
			F	6 02					
265	16	I_r	ePNE	14 54 00				1320	Related to No.248.
			F	15 58					

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M A N I L A , P . I .

SEISMOLOGICAL BULLETIN OF THE OBSERVATORY.--Continued.

No.	Date	Character	Phase	Green. Time h. m. s.	Per. s.	Amplitude N μ	Amplitude E μ	Dist. Km.	Remarks.
266	16	III_u	iPNE	22 58 ca				8056	Begins in minute gap.
			PcPN	22 59 21					0=22:47:37.
			iN	23 01 31					Near New Zealand.
			iPR_1N	23 02 10					
			iSNE	23 08 46					
			iPSNE	23 09 20					
			iScSNE	23 09 42					
			iNE	23 13 48					3 waves about 30" period enter.
			SR_2N	23 17 40					
			mE	23 18 24	13.7		310		
			LNE	23 23 00					
			mN	23 25 58	19.7	800			
			MN	23 28 19					
	17		F	2 34					
267	17	I_r	ePNE	4 04 44				1360	Related to No.248.
			F	4 56					
268	17	III_r	iPNE	10 18 34				1410	Related to No.248.
			iSNE	10 21 ca					S begins in minute gap.
			MN	10 23 54	7.7	320			
			F	12 49					
269	17	I_v	ePNE	21 17 16				435	
			F	21 26					
270	18	I	eNE	3 57					
			F	4 23					
271	18	I_v	ePNE	12 13 30				440	N Luzon.
			iSNE	12 14 19					
			F	12 28					
272	18	I	eE	16 45 45					
			F	17 26					
273	18	I	ePE	18 22 56					
			F	18 52					
274	18	I_v	ePE	18 56 58				400	
			F	19 08					
275	19	II_r	iPNE	7 32 53				1410	Related to No.248.
			iSNE	7 35 16					
			iSR_1E	7 36 46					
			mN	7 37 27	9.2	460			
			iLNE	7 38 00					
			mE	7 38 09	10.5		468		
			F	10 19					
276	19	I	eNE	19 24 58					
			F	19 54					
277	19	I	ePNE	21 45 23					
			F	22 03					

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M A N I L A , P . I .

SEISMOLOGICAL BULLETIN OF THE OBSERVATORY.--Continued.

No.	Date	Character	Phase	Green. Time h. m. s.	Per. s.	Amplitude N μ	Amplitude E μ	Dist. Km.	Remarks.
278	19	I	ePNE	22 39 27					
			F	23 28					
279	20	I_r	ePNE	18 28 06					
			iSNE	18 32 10					
			F	19 02					
280	20	I_r	ePNE	20 12 41					
			iSN	20 14 41					
			iLN	20 15 47					
			F	22 01					
281	21	II_r	iPNE	4 43 04				1416	Related to No.248.
			iSNE	4 [illegible] 30					
			F	6 38					
282	21	I_r	ePN	13 22 22				1422	Related to No.248.
			iSN	13 24 50					
			F	14 20					
283	21	I	eNE	15 24 48					
			F	15 45					
284	22	I	eNE	1 37					
			F	2 05					
285	22	I	eE	3 41					
			F	4 14					
286	22	I	iPNE	15 41 40					
			F	16 48					
287	22	I_r	ePNE	17 41 44					
			iSNE	17 43 48					
			F	19 19					
288	23	I_r	ePNE	3 14 22					
			iSN	3 17 17					
			F	4 34					
289	23	II_r	iPNE	21 49 22				1500	Related to No.248.
			iSNE	21 51 38					
			LNE	21 52 32					
	24		F	0 11					
290	25	I	eE	7 39 37					
			F	8 00					
291	25	I_v	ePE	18 48 36				400	
			iSNE	18 49 20					
			F	19 07					
292	26	I_v	ePNE	3 18 09				230	
			iSNE	3 18 35					
			F	3 29					

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M A N I L A , P . I .

SEISMOLOGICAL BULLETIN OF THE OBSERVATORY.--Continued.

No.	Date	Character	Phase	Green. Time h. m. s.	Per. s.	Amplitude N μ	Amplitude E μ	Dist. Km.	Remarks.
293	26	I_V	ePNE	11 29 57					
			eSE	11 31 18				740	
			F	11 51					
294	26	I_V	ePNE	15 54 42					
			eSN	15 56 18				880	
			F	16 18					
295	26	I_V	ePNE	16 55 23					
			eSE	16 56 52				820	
			F	17 28					
296	26	I	eNE	22 15					
			F	23 53					
297	27	II_u	eN	13 06 21					
			iPE	13 06 28					
			iPN	13 06 33					
			iN	13 09 44					
			iNE	13 10 58					
			iNE	13 12 34					
			F	16 22					
298	28	I_r	ePNE	9 07 47					
			iSNE	9 09 50				1150	
			F	10 04					
299	30	III_r	iPNE	2 46 48					
			iSNE	2 49 00				1240	
			iLNE	2 50 12					
			mE	2 51 48	7.8		225		End overtaken by following quake.
300	30	I_r	iPNE	5 15 53					
			iSN	5 18 07				1260	
			F	7 27					
301	30	I	eNE	11 47 30					
			F	12 43					Disturbed by micro-seisms.
302	30	I	e?N	22 21 06					
			F	23 02					

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BULLETINS RECEIVED

JUNE, 1929.

We thankfully acknowledge the receipt of the following and hope for their continuance in the future.

STATIONS	BULLETINS
Ottawa	March and April, 1929.
Cartuja(Granada)	Nov., 1928 to March 14th, 1929.
Taihoku, Taiwan	April 10th to June 4th, 1929.
Zikawei	March 7th to May 1st, 1929.
Taunus	August 30th to December 28th, 1928.
Apia	October to December, 1928.
Florissant	August, 1928 to March, 1929.
Denver	November, 1928 to February 22, 1929.
New Zealand and Fiji	January to June, 1928.
Jena	April to December, 1928.
Leipzig	Years 1925, 1926 and 1927.
Athenes	March to December, 1926.
Hongkong	January and February, 1929.
La Plata	February and March, 1929.
Stations of J. S. Ass	Prel. Bull., March 19 and 21, and May 1 and 20, 1929.
Kew	April, 1929.
California	Bull. of the Seis. Society of America, Vol. 18, No. 4, 1928.
Nagasaki	April and March, 1929.
Washington	April, 1929.

MIGUEL SELGA, S.J.,
Director, Weather Bureau,
Manila, Philippine Islands.

WILLIAM C. REPETTI, S.J.,
Seismologist.
Cesáreo Dulueña,
Asst. Seismologist.

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B U L L E T I N S R E C E I V E D

JULY, 1929.

We thankfully acknowledge the receipt of the following and hope for their continuance in the future.

STATIONS	BULLETINS
Beograd	July 15, 1928 to February 26, 1929.
Madagascar	Sept., Nov. and Dec., 1928.
Irkutsk	September to December, 1927.
Adelaide	Year 1926.
Melbourne	Jan., Feb. and March, 1929.
Hongkong	March, April and May, 1929.
Sydney	June 16 and 17, 1929.
Spain, Seis. Sevice	Nos. 50, 51, 52 and 53.
U. S. C. and G. S.	Prel. Det. Epic. June 12 and 13,1929
Tiflis	Nos. 8 and 9, 1927.
Saint Louis	Sept.-Dec., 1928.
Saint Louis	Prel.Bull. June 9, 12, 13 and 16,1929
U. S. C. and G. S.	Radio Report for July 17, 1929.
Ottawa,Halifax,Saskatoon,Canada	May, 1929.
St. Louis University, U.S.A.	Jan. and Feb., 1929.
Georgetown University, U.S.A.	Seismological Despatches, May, 1929.
Kew	May, 1929.
U.S.C. and G.S.	March, 1929: Reports of Honolulu, Charlottesville, Tucson, Sitka, and Chicago.
Zikawei	May, 1929.
STRASBOURG	
L'Institut	May, 1929.
Bureau Central	May, 1929.
Union International	May, 1929.
Parc St. Maur	May, 1929.
Fordham University, New York	Nov.Dec.,1927 and Jan,-May, 1929.
St. Xavier Coll. Cinc.Ohio	Dec.20,1928-June, 1929.
Phu-Lien	February-December, 1928.
Tananarive	July-December, 1928.
Taihoku	June 4-28, 1929.

MIGUEL SELGA, S.J.,
Director, Weather Bureau,
Manila, Philippime Islands.

WILLIAM C. REPETTI, S.J.,
Seismologist.
Cesáreo Dulueña,
Asst. Seismologist.

318	5	ePNE iPR, NE eSNE PSNE iLNE F	14 29 19 14 31 18 14 37 35 14 37 51 14 47 45 16 57				6730	Aleutian Islands. 0=14:19:06 Lat. 50°N, longitude 177°W, J.S.A.

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MANILA, P. I.

SEISMOLOGICAL BULLETIN OF THE OBSERVATORY.--Continued.

No.	Date	Phase	Green. Time h. m. s.	Per. s.	A_N μ	A_E μ	Dist. Km.	Remarks.
333	13	ePNE	14 56 30					Overtaken by following earthquake.
		iSNE	14 56 48					
334	13	S?	14 59 54					
335	13	eNE	18 51					
		F	19 17					
338	14	iPNE	9 45 ca	in minute gap.			4867	2nd shock? 10:16:24.
		iSNE	9 51 28					Kurile Islands?
		M	10 01 25					Batavia 9:47:56
		F	11 00					
339	15	iPNE	7 55 16					Disturbed by microseisms and continuing until the 20th.
		iSE?	8 04 11					
		F	9 02					
340	15	ePNE	20 26 22				1711	Batavia P_E 20:26:59
		iSN	20 29 19					
		F	20 48					
341	18	iPNE	18 04 14				160	Off E Luzon.
		iSNE	18 04 34					
		F	18 09					
342	21	iPNE	13 16 55				325	Compression. Southeastern part of Luzon.
		iSNE	13 17 37					
		iSNE	13 17 44					Shanghai P 13:20:04
		L?	13 17 52					
		MN	13 18 ca					Pens swings to limit 162mm, double amplitude.
		ME	13 18 06	1.5		340		
343	21	iPNE	13 22 30					Superposed on preceding record. Southeastern part of Luzon.
344	21	ePNE	22 02 51				170	
		iSNE	22 03 12					
		F	22 07					
345	23	ePNE	14 48 30				1694?	
		iSN?	14 51 25					
		F	16 03					
346	23	eLNE	19 38 00					
		F	20 07					
347	24	ePNE	2 37 28					
		F	3 54					

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MANILA, P. I.

SEISMOLOGICAL BULLETIN OF THE OBSERVATORY.--Continued.

No.	Date	Phase	Green. Time h. m. s.	Per. s.	A_N μ	A_E μ	Dist. Km.	Remarks.
348	24	iPNE	5 07 23				350?	Southeastern part of Luzon.
		iSNE	5 08 10					
		L?	5 08 16					
		F	5 34					
349	25	iPNE	18 31 12	i	10	4	180	Compression.
		iSNE	18 31 36	i	48			
		mE	18 31 38	1.0		95		
		F	18 41					
350	26	e(P?)NE	22 54 38				3450	Shanghai P 22:51:54, 1900 Km.
		iSNE	22 59 39					
		iLE?	23 02 45					
		F	0 06					
351	29	ePNE	10 57 56				210	Disturbed by micro-seisms.
		iSNE	10 58 22					
352	29	ePNE	11 00 42					disturbed by micro-seisms.
		F	11 04					

Nine insignificant or undecipherable disturbances, on the following days of July: 2nd (4), 4th, 10th (2) and 14th (2).

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Year 1929, No. 29. August 1st to 16th, 1929.

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.

Instrument: Wiechert Inverted Pendulum (1000 Kg.)

	T_o	V	ε	$\frac{r}{T_o^2}$
N-S	7.38	159	4.276	0.025
E-W	7.49	146	4.423	0.028

No.	Date	Phase	Green. Time h. m. s.	Per. s.	A_N μ	A_E μ	Dist. Km.	Remarks.
354	1	PNE	5 07 41				3530	Zikawei-Hongkong-Manila give epicenter about 16°N, 89°E.
		iNE	5 09 08					
		iSNE	5 12 33					
		LNE	5 16 00					
		MNE	5 18 50					Zikawei 5:08:03,3711Km
		M_1N	5 20 13	9.5	10			
		M_2E	5 20 19	13.0		40		
		F	6 25					
355	3	ePNE	12 59 50					
		F	13 39					
356	3	ePE	15 04 32				5078	
		eSNE	15 11 13					
		F	15 53					
360	8	ePNE	6 36 27				400	Felt in Masbate.
		F	6 41					
361	8	PNE	13 01 37				2711	Hongkong-Manila give epicenter in Bay of Bengal.
		PR_1NE	13 02 08					
		iSNE	13 05 49					
		iSR_1	13 06 55					
		iLNE	13 08 17					Distance from Zikawei 3305 Km.
		iP_cSNE	13 08 43					
		M_1N	13 13 44	9.5	310			
		M_1E	13 13 44	10.3		305		
		F	14 12					
362	12	ePNE	7 42 23				100	
		F	7 45					
364	12	ePNE	12 53 ca	in minute gap.			165	
		F	12 59					
365	12	ePNE	14 55 58				125	
		F	14 59					
367	16	ePNE	16 09 16				325	
		iSNE	16 10 04					
		F	16 22					

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M A N I L A , P . I .

SEISMOLOGICAL BULLETIN OF THE OBSERVATORY.--Continued.

No.	Date	Phase.	Green. Time h. m. s.	Per. s.	A_N μ	A_E μ	Dist. Km.	Remarks.
368	16	ePNE	21 34 48				630	
		iSNE?	21 36 29					
		F	22 12					
369	17	ePNE	14 20 24				85	
		iSNE	14 20 36					
		F	14 23					
371	18	ePNE	5 51 18				175	
		iSE	5 51 40					
		F	5 57					
372	18	ePN	8 43 39				4944	
		iSNE	8 5o 12					
		F	9 45					
373	18	ePNE	15 39 29				125	
		iSE	15 39 45					
		F	15 44					
374	19	ePNE	2 45 22				1035	O=2:43:06. Manila-Zikawei-Hongkong-PhuLien give an epicenter at 23° 50' N, 122° 05' E.
		iSNE	2 47 12					
		LNE	2 48 09					
		MNE	2 49 13					
		M_1E	2 52 48	11		215		
		M_2N	2 52 56	13	345			
		F	4 49					
375	19	ePNE	20 46 51					Manila-Hongkong-Zikawei give epicenter at 24° 05' N, 121° 50' E.
		SNE	20 48 43					
		LNE	20 49 36					
		iMNE?	2o 52 18					
		M_1N	20 53 11	11.6	38			
		F	22 05					
376	20	ePNE	5 17 52				155	
		iSNE	5 18 11					
		F	5 24					
377	20	ePNE	16 4o 34					O=16:38:15. Manila-Hongkong-Zikawei give epicenter at 24° N 122° E.
		SNE?	16 42 25					
		iLN	16 43 21					
		iLE	16 43 22					
		iMNE	16 44 38					
		M_1E	16 46 37	15.4		115		
		M_2E	16 48 00	14.5		142		
		M_3N	16 48 45	15/0	97			
		F	18 13					
378	21	PNE	9 27 ca	in minute gap.			150ca	East end Of Verde Island Passage. Felt on the S.S. "Vizcaya" 13°4 N, 121°5 E. After S pens swing to limit, 9 cm. Two very small aftershocks. Zikawei 9h 30m 45s.
		iSNE	9 27 18					

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M A N I L A , P . I .

SEISMOLOGICAL BULLETIN OF THE OBSERVATORY.--Continued.

No.	Date	Phase	Green. Time h. m. s.	Per. s.	A_N μ	A_E μ	Dist. Km.	Remarks.
379	21	iP̄N	9 53 04				150	
		RiP̄	9 53 08					
		iS̄NE	9 53 23					
380	21	iP̄N	10 34 53				150	
		iS̄N	10 35 13					
382		eP̄NE	20 52 39				142	
		iS̄NE	20 52 57					
383	22	iP̄NE	20 54 53				150	recording.
		iS̄NE	20 55 14					No. 381 still recording.
		F	21 03					
384	23	eNE	15 17					
		mNE	15 21 52					
385	23	ePNE	15 26 56				2178	
		eSN	15 30 31					
		eLN	15 32 27					
		F	16 00					
387	24	ePNE	6 32 ca	in minute gap.			465ca	
		eS̄E	6 33 11					
		F	6 46					
390	27	eP̄NE	7 13 28				142	
		iS̄NE	7 13 47					
		F	7 25					
391	27	eP̄E	12 51 42				142	
		iS̄NE	12 52 ca	in minute gap.				
		F	13 02					
392	28	ePE	6 01 ca	in minute gap.				Small movements.
		ePN	6 01 10					
		F	6 21					
393	28	ePNE	18 58 11				3833	0=18:51:05. Hokkaido?
		SNE	19 03 37					
		LNE?	19 07 55					
		M?	19 10 55					
		M_1E	19 12 28	15.2		28		
		M_2N	19 14 38	15.8	38			
		M_3N	19 17 12	15.0	50			
		M_4E	19 17 16	14.7		50		
		F	20 42					

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M A N I L A , P . I .

SEISMOLOGICAL BULLETIN OF THE OBSERVATORY.--Continued.

No.	Date	Phase	Green. Time h. m. s.	Per. s.	A_N μ	A_E μ	Dist. Km.	Remarks.
395	29	ePNE	10 48 10				1689	0 =10:44:34
		PR_2NE	10 48 21					
		eSNE	10 51 04					
		SR_1NE	10 51 24					
		eLN	10 52 30					
		F	11 39					
396	29	ePNE	19 49 41				2111	0= 19:45:16
		iSE	19 53 11					
		SR_1N	19 53 45					
		iLNE	19 55 00	in minute gap.				
		MN	19 56 58	13.6				
		F	20 52					

Eleven insignificant or undecipherable disturbances, on the following days of August: 4th, 5th (2), 12th, 13th, 17th, 22nd, 24th (2), 26th and 29th.

From the ISC collection scanned by SISMOS

Year 1929, No. 33. September 1st to 12th, 1929.

M A N I L A , P . I .

SEISMOLOGICAL BULIETIN OF THE OBSERVATORY.

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

Instrument; Wiechert Inverted Pendulum (1000 Kg.)

	T_o	V	ε	$\frac{r}{T_o^2}$
N-S	7.56	130	3.584	0.026
E-W	7.75	141	4.407	0.027

No.	Date	Phase	Green. Time h. m. s.	Per. s.	A_N. μ	A_E μ	Dist. Km.	Remarks.
397	1	eNE	3 23 21					Disturbed by heavy microseisms.
		F	3 42					
399	2	iPN	11 14 54				860	0=11:12;40
		ePE	11 14 54					Epicenter 8° 30' N; 125° 50' E by Phu-Lien, Zi-Ka-Wei, Batavia, Hongkong.
		iSNE	11 16 27					
		F	13 10					
400	3	ePN	16 34 42				305?	Disturbed by heavy microseisms.
		iSN?	16 35 26					
		F	16 44					
401	7	ePNE	2 29 26				125	
		iSNE	2 29 42					
		F	2 33					
402	9	ePNE	21 43 04				235	
		iSNE	21 43 36					
		F	21 57					
403	10	ePNE	12 05 24				310	Microseisms decrease.
		eSNE	12 06 09					
		F	12 16					
404	11	ePN	22 21 00	in minute gap.			3422	0=22:18:34
		eSNE	22 22 53					24° N; 124° 30' E by Manila, Phu-Lien and Zikawei.
		MN	22 35 15	9.5	42			
	12	F	0 31					
406	12	ePNE	9 06 52				200	
		iSNE	9 07 18					
		F	9 17					
407	12	ePNE	21 35 21				200	
		eSNE	21 35 47					
408	12	ePNE	21 39 15				200	
		iSNE	21 39 41					
409	12	ePNE	21 50 14				200	
		iSNE	21 50 40					
		F	22 00					

International Seismological Centre From the ISC collection scanned by SISMOS

M A N I L A , P . I .

SEISMOLOGICAL BULLETIN OF THE OBSERVATORY.--Continued.

No.	Date	Phase	Green. Time h. m. s.	Per. s.	A_N μ	A_E μ	Dist. Km.	Remarks.
413	15	ePNE	0 05 42				100	Felt in southern Batangas.
		iSNE	0 05 55					
		MN	0 06 55	5.2	130			
		F	0 24					
414	15	ePNE	5 36 48				100	Felt in southern Batangas.
		iSNE	5 37 ca	in minute gap.				
		MN	5 38 05	4.7	45			
		ME	5 38 06	5.3		70		
		F	6 00					
415	15	ePNE	9 35 56				144?	Felt in southern Batangas.
		iSNE?	9 36 14					
		ME	9 37 22	4.7		170		
		MN	9 37 54	5.5	100			
		F	9 57					
416	15	ePNE	13 14 34				100	Felt in southern Batangas.
		iSNE	13 14 47					
		F	13 22					
417	16	ePNE	1 01 23				100	Felt in southern Batangas.
		iSNE	1 01 36					
		F	1 16					
418	17	ePNE	19 30 47				9756	0=19:17:57 U.S.C.& G.S. 52° N; 134° W.
		iSNE	19 41 35					
		F	21 19					
419	19	PNE	11 06 00	in minute gap.			1140	0=11:03 31 8° N; 129° E by Manila, Batavia and Zikawei. Disturbed by microseisms.
		iSE	11 07 59					
		mE	11 08 45	6.4		20		
		LN	11 09 00					
		mN	11 09 06	9.2	28			
		F	11 22					
420	21	ePNE	5 20 15				210	Disturbed by microseisms.
		eSE	5 20 42					
		F	5 31					
421	21	iPNE	18 55 49	i	14	25	655	Sharp compression at Manila; dilatation at Zikawei. Felt in Samar. Approx. epicenter, 11°30' N; 126° 10' E by Manila, Batavia, Medan and Zikawei.
		iSNE	18 57 09					
		mN	18 57 23	7.2	73			
		mE	18 57 32	7.2		82		
		F	19 36					
422	21	ePNE	21 59 00				165	Extraordinary S. P too small for measurement.
		iSNE	21 59 21	1.5		22		
		F	22 02					

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International Seismological Centre

M A N I L A , P . I .

SEISMOLOGICAL BULLETIN OF THE OBSERVATORY.--Continued.

No.	Date	Phase	Green. Time h. m. s.	Per. s.	A_N μ	A_E μ	Dist. Km.	Remarks.
424	23	ePNE	7 03 29				135	
		iSE	7 03 46	2.0		11		
		F	7 09					
425	23	ePNE	15 39 30				600?	
		eSE?	15 40 05					
		F	15 56					
426	25	ePNE	4 42 17				117	
		iSNE	4 42 32					
		F	4 45					
427	26	e?NE	7 59 48				3472?	
		L?N	8 08 30					
		F	8 27					
428	28	ePNE	15 08 49					Disturbed by microseisms.
		F	15 19					

Six insignificant or undecipherable disturbances on the following days of September: 1st, 12th, 13th, 14th (2) and 22nd.

Year 1929, No. 36. October 1st to 15th, 1929.

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.

Instrument: Wiechert Inverted Pendulum (1000 Kg.)

	T_o	V	ε	$\frac{\varepsilon}{T_o^2}$
N-S	7.54	150	4.131	0.029
E-W	7.48	164	4.471	0.030

No.	Date	Phase	Green. Time h. m. s.	Per. s.	Amplitude N μ	Amplitude E μ	Dist. Km.	Remarks.
429	1	ePN	11 44 00	in minute gap.				Felt at Zamboanga. E-W component confused by overlapping lines.
		F	11 59					
430	3	ePNE	5 50 47				190	
		iSNE	5 51 11					
		F	6 00					
431	3	ePNE	23 58 57				190	
		iSNE	23 59 21					
	4	F	0 06					
434	5	ePNE	17 08 45				6811	O=16:58:27
		eSE	17 17 06					
		LNE	17 28 06					
		MN	17 33 05	16.4	15			
		F	18 47					
435	5	ePNE	19 07 50				3700	
		SE	19 13 07					
		F	19 32					
436	6	ePNE	8 03 42				8511	O=7:51:54
		iSNE	8 13 36					U.S.C.G.S. O=7:52:12,
		PSE	8 14 14					19°N., 154°W. 8967 Km.
		iNE	8 16 04					
		LE	8 28 27					
		F	9 55					
438	7	ePNE	22 23 23				150	Felt at Iba, W coast of Luzon.
		iSNE	22 23 42					
		F	22 28					
439	8	ePNE	17 27 56				8465	O=17:16:10. Diturbed by microseisms.
		iSNE	17 37 49					
		LE	17 52 08					
		F	18 24					
440	11	ePNE	10 04 55				142	Disturbed by microseisms
		eSNE	10 05 13					
		F	10 08					

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M A N I L A , P . I .

SEISMOLOGICAL BULLETIN OF THE OBSERVATORY.--Continued.

No.	Date	Phase	Green. Time h. m. s.	Per. s.	Amplitude N μ	Amplitude E μ	Dist. Km.	Remarks.
443	16	ePNE	20 32 58	in minute gap.			2778	0=20;27:25
		iPR_1E	20 33 28					Phu-Lien - Hongkong -
		iPR_2E	20 33 39					Manila give epicenter
		iSE	20 37 16					approx. 24°N, 97° E.
		LNE	20 39 45					
		mN	20 41 24	11.2	50			
		MN	20 42 10	13.1				
		mN	20 45 16	12.4	70			
		mE	20 46 16	12.4		70		
		F	21 25					
444	17	PNE	1 14 ca	in minute gap.			150	Felt at Boac, island of
		iSNE	1 14 19					Marinduque.
		F	1 18					
445	17	ePE	23 25 32				150	Felt at Boac, island of
		SE	23 25 51					Marinduque.
		F	23 29					
446	19	iPNE	10 33 00					Disturbed by heavy mi-
		SPSNE	10 59 20					croseisms.
		LE	11 31 00					U.S.C.G.S. 0=10:13:00,
		LN	11 32 00					Lat.20°S, long.72?5 W.
		F	12 35					
447	22	ePNE	9 32 57				465?	Felt at Laoag, NW coast
		eSNE?	9 34 09					of Luzon. Heavy micro-
		F	9 40					seisms.
448	22	ePNE	18 45 00	in minute gap.				Heavy microseisms.
		F	18 58					
449	24	ePNE	6 36 10				860	Hongkong-Manila-Zikawei
		iSNE?	6 37 43					give epicenter approxi-
		F	7 18					mate 20° 50' N; 116°
								10' E. Disturbed by
								heavy microseisms.
450	24	ePNE	16 14 13				296	
		iSNE	16 14 56					
		F	16 20					
451	27	ePNE	19 32 47				1189	0=19:30;11
		eSNE	19 34 50					
		F	19 58					

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M A N I L A , P . I .

SEISMOLOGICAL BULLETIN OF THE OBSERVATORY.--Continued.

No.	Date	Phase	Green. Time h. m. s.	Per. s.	Amplitude N μ	Amplitude E μ	Dist. Km.	Remarks.
452	29	ePNE	4 43 09				166	
		iS̄NE	4 43 30					
		F	4 50					
454	29	eP̄NE	21 53 42				166	
		iS̄NE	21 54 03					
		F	22 01					
455	30	eP̄NE	5 45 38				67	
		iS̄NE	5 45 47					
		F	5 47					
456	31	ePNE	8 17 04				210	
		eS̄NE	8 17 31					
		F	8 20					

Six insignificant or undecipherable disturbances on the following days of October: 5th (2), 6th, 14th (2) and 29th.

International Seismological Centre From the ISC collection scanned by SISMOS

MaNILA, P. I.

SEISMOLOGICAL BULLETIN OF THE OBSERVATORY

International Seismological Centre

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

Instrument: Wiechert Inverted Pendulum (1000 Kg.)

	T_o	V	ε	$\frac{r}{T_o^2}$
N-S	7.82	156	4.733	0.019
E-W	7.85	155	5.525	0.024

No.	Date	Phase	Green. Time h. m. s.	Per. s.	Amplitude N μ	Amplitude E μ	Dist. Km.	Remarks.
457	2	iPNE	1 33 47				430	Off N Luzon.
		mE	1 34 46	3.4		45		
		iSN	1 34 51					
		iSE	1 34 53					
		ME	1 36 19	4.4		105		
		MN	1 37 35	5.6	75			
		F	2 12					
458	2	ePN	22 33 09				430	Off N Luzon.
		iSN	22 34 15					
		F	22 50					
460	4	iPNE	5 41 12				180	
		iSNE	5 41 34					
		F	5 44					
462	5	ePNE	11 40 11					Compression. O=11:38:25. 10° N; 126° 30' E, from P at Manila, Hongkong, Phu-Lien.
		iSNE	11 41 38					
		LE?	11 42 34					
		LN?	11 42 46					
		mN	11 43 05	7.7	190			
		mE	11 43 26	8.9		170		
		F	13 26					
463	5	ePNE	18 14 52				390	Off S Catanduanes Island
		iSNE	18 15 51					
		F	18 51					
464	7	ePNE	4 01 49				350	SE Luzon.
		eSE	4 02 41					
		F	4 15					
465	7	ePNE	5 23 19				360	SE Luzon.
		iSE	5 24 13					
		ME	5 24 45	7.8		75		
		F	6 42					
466	8	ePNE	8 55 23				420	Felt in Samar.
		iSNE	8 56 27					
		F	9 20					
467	8	ePNE	11 57 25				67	
		iSN	11 57 34					
		F	12 00					
468	8	ePNE	15 13 48				365	Felt at Legaspi.
		eSNE	15 14 43					
		F	15 27					

M A N I L A , P . I .

SEISMOLOGICAL BULLETIN OF THE OBSERVATORY.--Continued.

International Seismological Centre

No.	Date	Phase	Green. Time h. m. s.	Per. s.	Amplitude N μ	Amplitude E μ	Dist. Km.	Remarks.
471	10	ePNE	8 38 34					
		F	9 04					
472	10	iPNE	21 37 45				220	SE Luzon. S_g-P^x = 30sec for 215Km
		iSNE	21 38 15					
		mE	21 38 25	1.5		40		
		F	21 48					
473	11	ePNE	7 55 05				75	Disturbed by microseisms.
		eSNE	7 55 15					S_g-P^x = 10 sec for 75 Km
		F	7 58					
474	11	ePE	16 07 41				135	Do.
		iSE	16 07 58					
		F	16 10					
475	13	ePNE	0 38 10				1990?	Do.
		eSN?	0 41 30					
		LN?	0 43 10					
		F	1 28					
476	13	eNE	13 07 15					Do.
		F	13 16					
477	14	ePNE	20 47 08				1625	0=20:43:40
		iSNE	20 49 57					
		mN	20 50 07	9.7	70			
		mE	20 50 25	11.1		75		
		F	21 22					
478	15	ePNE	0 05 47				530	Felt in Leyte and Cebu.
		eSE	0 07 10					
		F	0 17					
479	15	iPE	18 55 27				2622	Compression. 0=18:50:07
		ePN	18 55 27					U.S.C.G.S. 0=18:50:23,
		iSNE	18 59 35					8° N, 143° E.
		iLNE	19 01 50					
		mE	19 02 23	10.2		370		Manila - Hongkong - Phu-
		mN	19 02 34	10.0	660			Lien - Guam give epi-
		ME	19 04 21	10.3		365		center 9° 25' N, 144°30'
		mE	19 06 48	10.4		500		E.
		F	22 02					
480	17	iPE	3 45 39				840	Felt in eastern half of
		ePN	3 45 39					Mindanao. Epicenter
		iSNE	3 47 09					probably in upper Agus-
		MN	3 49 02	7.9				an Valley. The N-S pen
		ME	3 49 21	8.0		280		swings to limit, 61mm.
		F	6 34					
481	17	ePNE	12 11 00					
		F	12 53					
482	17	ePNE	14 25 35				175	Felt at Dagupan, north
		eSNE	14 25 56					Central Luzon.
		F	14 36					S_g-P_g = 30.6 sec for 175 Km

M A N I L A , P . I .

SEISMOLOGICAL BULLETIN OF THE OBSERVATORY.--Continued.

No.	Date	Phase.	Green. Time h. m. s.	Per. s.	Amplitude N μ	Amplitude E μ	Dist. Km.	Remarks.
483	17	ePNE	19 04 34					
		F	19 26					
486	18	ePNE	2 07 49				1220	0=2:05:09
		eSNE	2 09 56					
		eLE	2 11 05					
		iLN	2 11 05					
		MN	2 12 27	10.3	15			
		F	3 06					
487	18	ePNE	4 09 00	in minute gap.			1256	0=4:06:16
		eSNE	4 11 12					
		iLN	4 12 27					
		MN	4 13 53	10.9	25			
		F	5 26					
488	18	iPNE	5 43 28				1333	0=5:40:35.
		iSNE	5 45 46					Felt at Butuan and
		iLNE	5 46 57					Davao.
		MNE	5 48 13					
		M_1N	5 48 44	9.0	75			
		M_2E	5 49 18	11.2		65		
		F	7 24					
489	18	ePNE	12 11 24				257	
		iPNE	12 11 28					
		iSNE	12 12 00					
		F	12 21					
490	18	ePNE	14 47 58				160	
		eSNE	14 48 18					
		F	14 50					
491	18	ePNE	19 12 12				180	
		eSNE	19 12 34					
		F	19 19					
492	18	eP'NE	20 51 10				13156	Disturbed by mi-
		PR_1NE	20 52 34					cro seisms.
		iNE	21 02 22					U.S.C.G.S. 0=20:32:08,
		PPSN	21 03 24					47°.5 N, 58° W.
		SR_2NE?	21 13 53					
		eLE	21 28 20					
		eLN	21 39 ca					
		MNE	21 39 ca					
		M_1N	21 47 01	20.2	150			
		M_2N	21 48 51	18.1	105			
		M_3E	21 49 53	15.9		80		
		M_4N	21 52 35	16.2	80			
		M_5E	21 53 25	15.9		80		
		F	22 56					
494	22	ePNE	4 19 24				150	
		iSNE	4 19 43					
		F	4 24					

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M A N I L A , P . I .

SEISMOLOGICAL BULLETIN OF THE OBSERVATORY.--Continued.

No.	Date	Phase	Green. Time h. m. s.	Per. s.	Amplitude N μ	Amplitude E μ	Dist. Km.	Remarks.
495	22	ePNE	10 06 46				200	
		iSNE	10 07 12					
		F	10 14					
496	23	iPE	0 07 10				2765	0=0:01:37. About 1° 45' S; 140° E. By Zikawei -Phu-Lien-Hongkong-Manila.
		ePN	0 07 10					
		PR_1E	0 07 43					
		PR_2E	0 07 52					
		PR_2N	0 07 54					
		iSNE	0 11 26					
		SR_1NE	0 12 30					
		mN	0 12 42	9.9	150			
		mE	0 12 47	11.8		115		
		mE	0 13 47	9.4		95		
		iLN	0 13 58					
		mN	0 14 33	9.9	155			
		mE	0 14 34	9.6		105		
		F	1 21					
501	28	ePNE	20 15 35				360	
		iSNE	20 16 29					
		F	20 28					

Eleven insignificant or undecipherable disturbances on the following days of November: 3rd, 4th, 9th(2), 17th (2), 22nd, 23rd, and 25th (3).

CORRECTION TO PREVIOUS REPORT.

Correction to September 11th, 1929: Distance 1100 Km.

Correction to October 16th, 1929: Distance 2775 Km. Phu-Lien, Hongkong, Batavia, Zikawei, Manila give epicenter at 25° 30' N; 97° E. 0=20:27:13.

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B U L L E T I N S R E C E I V E D

N O V E M B E R , 1 9 2 9 .

We thankfully acknowledge the receipt of the following and hope for their continuance in the future.

S T A T I O N S	B U L L E T I N S
Wellintong	-Prel.Bull. of July and August, 1929.
Kobe	-April to June, 1929.
U.S.C.G.S.	-Prel. Determ. of Epicenter of October 6th, 1929.
Hongkong	-August, 1929 and Prel. reprt of principal earthquakes of Oct., 1929.
Ottawa	-September, 1929.
Florissant	-May 26 to July 11, 1929.
Florissant	-July 1st to July 17th, 1929.
Vienne	-May 11th to July 15th, 1929.
Graz	-June 18th to August 31st, 1929.
Denver	-May 26th to August 17th, 1929.
Saint Louis J.S.A.	-Prel.Bull.Sept, 27 and October 5th and 6th, 1929.
Zikawei-	-July 13th to August 3rd, 1929.
Wellinteng	-Prel.Bull. fron Sept.15 to Oct.12,1929.
Sydney	-September 9th to December 31st, 1926.
Melbourne-	-July 1st to September 28th, 1929.
Hamburg-	-July, August and September, 1929.
Frdham Univ. New York-	-June 2nd to September 27th, 1929.
Hongkong	-September, 1929.
Parc St. Maur-	-September, 1929.
STRASBOURG	
L' Institut-	-September, 1929.
Bureau Central	-September, 1929.
Union International-	-September, 1929.
Barcelona-	-June 1st, 1928 to June 27th, 1929.
San Fernando	-April to September, 1929.

MIGUEL SELGA, S.J.,
Director, Weather Bureau,
Manila, Philippine Islands.

WILLIAM C. REPETTI, S.J.,
Seismologist.
CESÁREO DULUEÑA,
Asst. Seismologist.

International Seismological Centre From the ISC collection scanned by SISMOS

Year 1929, No. 43. December 1st to 9th, 1929.

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.

Instrument: Wiechert Inverted Pendulum (1000 Kg.)

	T_o	V	ε	$\frac{r}{T_o^2}$
N-S	7.74	153	4.794	0.020
E-W	7.78	157	6.253	0.019

No.	Date	Phase	Greenwich Time h. m. s.	Per. s.	Amplitude N μ	Amplitude E μ	Dist. Km.	Remarks.
502	1	ePNE	0 25 30				117	
		iSNE	0 25 45					
		F	0 29					
503	1	iPNE	0 29 58				117	
		iSNE	0 30 13					
		F	0 33					
504	3	ePNE	7 40 21				2722	0=7:34:51
		PR_3N	7 41 05					
		iSNE	7 44 34					
		iE	7 45 24	4.9		25		
		SR_1E	7 45 36					
		F	8 19					
505	3	ePNE	9 24 47				320	Felt at Legaspi.
		SNE	9 25 34					
		F	9 29					
506	5	ePNE	13 02 21				50	
		iSNE	13 02 28					
		F	13 05					
508	6	eNE	17 09 ca					Distant earthquake disturbed by microseisms.
		F	18 25					
509	6	eNE	20 43 ca					Disturbed by microseisms.
510	7	eNE	13 56 46					Do.
		F	14 11					
511	9	ePNE	6 07 ca in minute gap.				1178	0=6:04:25
		eSNE	6 09 02					Pacific, near SE coast
		iLE	6 10 10					of Mindanao. Felt at
		ME	6 11 59	8.5		15		Davao.

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BULLETINS RECEIVED

DECEMBER, 1929.

We thankfully acknowledge the receipt of the following and hope for their continuance in the future.

STATIONS	BULLETINS
Nagasaki	September, 1929.
Kew	September and October, 1929.
Belgium	January 1st to May 21st, 1929.
Wellington	October 12th to November 10th, 1929, Preliminary Bulletin of principal earthquakes.
Osaka	January, February and March, 1929.
U.S.C.G.S.	
Tucson	July and August, 1929.
Honolulu	July and August, 1929.
Sitka	July and August, 1929.
Chicago	July and August, 1929.
Charlettesville, Va.	July and August, 1929.
Berkeley	October 1st to March 31st, 1929.
Ottawa	October, 1929.
Hongkong	Preliminary Bulletin of November, 1929.
Oxford	Seismological Summary for April, May and June, 1926.
Granada	June 30th to August 1st, 1929.
INDIA WEATHER REVIEW	
Kodaikanal	Seismic Records of 1928.
Colaba	Seismic Records of 1928.
Calcuta	Seismic Records of 1928.
Strasbourg	Annuaire de l'Institut de Physique du Globe, 1927.-Part II, Seismologie.
Zikawei	August 23rd to October 6th, 1929.
Florissant	Galitzin.-July 18th to Sept. 28, 1929.
Saint Louis, J.S.A.	Prel.Bull. Nov. 15, 17, and 18, 1929.
Washington	September, 1929.
Beograd	March 7th to September 17th, 1929.

MIGUEL SELGA, S.J.,
Director, Weather Bureau,
Manila, Philippine Islands.

WILLIAM C. REPETTI, S.J.,
Seismologist.
CESÁREO DULUEÑA,
Asst. Seismologist.

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M A N I L A , P . I .

SEISMOLOGICAL BULLETIN OF THE OBSERVATORY.--Continued.

No.	Date	Phase	Green. Time h. m. s.	Per. s.	Amplitude N μ	Amplitude E μ	Dist. Km.	Remarks.
512	9	ePNE	6 55 53				3610	No. 511 still recording. Approx. 5° N, 88° E by Batavia, Hongkong, Manila, Zikawei.
		iN	6 57 39	4.4	18			
		SNE	7 01 05					
		mN	7 02 43	6.9	30			
		iLN	7 04 45					
		mN	7 05 03	9.9	85			
		M_1E	7 07 23	14.8		240		
		M_2N	7 07 51	13.9	175			
		M_3E	7 09 37	15.2		255		
		M_4E	7 11 14	15.7		350		
		M_5N	7 11 35	11.6	180			
		M_6E	7 13 48	12.3		160		
		F	9 18					
513	9	ePNE	22 35 42				218	
		iSNE	22 36 11					
		F	22 44					
515	13	ePNE	8 31 21				2656	0=8:25:57
		eSNE	8 35 30					
		MN	8 40 44					
		F	9 06					
516	13	ePNE	9 49 19					
		F	10 32					
517	14	iPNE	15 31 04				140	
		iSNE	15 31 22					
		F	15 48					
518	14	ePNE	15 50 42				134	
		iSNE	15 50 59					
		F	16 00					
519	14	ePNE	19 18 30				100	
		iSNE	19 18 43					
		F	19 23					
520	15	ePNE	18 12 56				117	
		iSNE	18 13 11					
		F	18 16					
523	16	ePNE	7 32 31				167	
		iSNE	7 32 52					
		F	7 37					
524	16	ePNE	11 32 40				3244	0=11:26:21
		eSNE	11 37 28					
		eLNE	11 40 57					
		M_1E	11 43 51	9.7		160		
		M_2E	11 44 24	14.2		25		
		M_3N	11 46 19	11.7	20			
		F	12 55					

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M A N I L A , P . I .

SEISMOLOGICAL BULLETIN OF THE OBSERVATORY.--Continued.

No.	Date	Phase	Green. Time h. m. s.	Per. s.	Amplitude N μ	Amplitude E μ	Dist. Km.	Remarks.
525	16	ePE	15 03 44					
		F	15 44					
526	17	iPE	11 08 14				6160	Disturbed by microseisms.
		ePN	11 08 14					U.S.C.G.S. 0=10:58:42, 53° N, 172° E. Hongkong, Zikawei, Phu-Lien, Manila give 0=10:58:38.
		PR_1N	11 10 26					
		PR_2E	11 11 22					
		iSNE	11 15 56					
		PSN	11 16 09					
		SR_1	11 19 58					
		mE	11 20 37	8.9		155		
		mN	11 21 39	11.6	210			
		SR_2NE	11 21 56					
		mE	11 25 12	11.7		255		
		mN	11 25 35	11.7	210			
		LNE	11 26 ca					
		mN	11 29 38	13.7	290			
		MNE	11 30 ca					
		M_1E	11 32 31	15.2		375		
		M_2N	11 37 30	13.6	285			
		F	15 20					
527	17	ePNE	21 35 43				6667?	
		eSE?	21 43 55					
		F	22 22					
528	18	ePNE	7 01 12				1100	0=6:58:47, 24° 30' N; 121° 30' E by Zikawei, Hongkong, Manila.
		iSNE	7 03 09					
		iLN	7 04 10					
		MNE	7 05 15					
		M_1N	7 07 22	11.8	55			
		M_2E	7 08 10	14.7		70		
		F	8 10					
532	19	ePNE	19 07 41				1505	0=19:04:27.
		iSNE	19 10 16					
		F	19 57					
533	21	ePNE	9 37 36					
		F	9 57					
535	22	iPNE	13 11 35				420	
		iSNE	13 12 39					
		F	13 36					
538	24	ePNE	16 02 29				328	
		iSE?	16 03 17					
		F	16 14					
539	24	iPN	17 28 06				240	
		iSNE	17 28 36					
		F	17 32					

17693

17696

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M A N I L A , P . I .

SEISMOLOGICAL BULLETIN OF THE OBSERVATORY.--Continued.

No.	Date	Phase	Green. Time h. m. s.	Per. s.	Amplitude N μ	Amplitude E μ	Dist. Km.	Remarks.
540	24	ePNE	22 47 31				135	
		iSNE	22 47 48	i	10			
		F	22 50					
541	26	iPNE	1 13 21				230	
		iSNE	1 13 50					
		F	1 17					
542	27	iPNE	13 36 32				2089	0=13:32:09
		iNE	13 36 35					
		PR_1N	13 36 49					
		PR_2NE	13 36 53					
		iSNE	13 40 ca in minute gap.					
		SR_1NE	13 40 33					
		mN	13 40 43	6.7	25			
		SR_3N	13 40 47					
		iLNE	13 41 41					
		mN	13 42 35	7.9	32			
		MN	13 43 49	6.7	18			17697
		F	14 26					
543	28	ePNE	1 33 11					
		F	2 18					
544	28	eNE	11 44					
		F	12 12					
545	28	eNE	16 12					
		F	16 20					
546	31	iPE	1 08 35				2311	0=1:03:48
		ePN	1 08 35					
		PR_1NE	1 08 53					
		PR_3E	1 09 07					
		iSNE	1 12 20					
		mN	1 12 37	7.5	47			
		SR_1NE	1 13 07					
		mE	1 13 45	8.6		37		
		LNE	1 14 16					
		MN	1 16 16	8.0	60			
		ME	1 16 24	10.1		32		
		F	2 51					17699
547	31	iPNE	4 50 08					
		F	6 06					

Eleven insignificant or undecipherable disturbances on the following days of December: 5th, 11th, 15th, 16th 18th (2), 19th, 22nd (2), 24th and 31st.

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