

Original bulletins of the International Seismological Summary (ISS) have been obtained thanks to funding provided by the US National Science Foundation through grant EAR-9725140 (Villaseñor et al., 1997) and have been scanned and collected by SGA Storia Geofisica Ambiente (Bologna) thanks to funding provided by the Istituto Nazionale di Geofisica e Vulcanologia (Rome), in the frame of the EUROSEISMOS project.

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The International Seismological Summary for 1919 July, August, September.

FORMERLY THE BULLETIN OF THE
BRITISH ASSOCIATION SEISMOLOGY COMMITTEE.

Attention may be called to the cases of deep focus on August 18d. 16h. 55m. 25s. and August 18d. 20h. 52m. 0s., when a focal depth 0.050 radius has been assumed as for the same epicentre (17° 0S. 177° 5W.) on 1918 May 22, though a smaller value would fit the present records rather better: and on August 31d. 17h. 20m. 34s., when a focal depth 0.015 radius is ventured.

Between the two shocks on August 18, presumably from the same focus, we have an interval of 236.6m. = 11 × 21m. + 5.6m. The case for a periodicity of 21m. is on its trial, and all pieces of evidence may be of value. The Helwan Observatory gives a number of records to which nothing corresponds elsewhere, and which may therefore be local shocks. It seems worth while to test them for the existence of a 21-minute periodicity, and the following comparison was made for the month of September, during which such records were numerous. The first date being taken as zero-point, multiples of 21.0min. indicated by the column N were subtracted from the records to form the column O—C. Brackets indicate cases where the mean of two instrumental records was taken; there seems no good reason for excluding these cases. If we collect the values of O—C. for each minute of the 21 we find that the cycle divides itself readily into two parts, of which one has 29 records in 11 minutes or 2.7 per minute, as follows:—

O—C.	-1	-2	-3	-4	-5	-6	-7	-8	-9	-10	+10
No.	2	2	5	2	1	2	5	4	1	2	3

and the other has 44 records in 10 minutes or 4.4 per minute, as follows:—

O—C.	0	+1	+2	+3	+4	+5	+6	+7	+8	+9
No.	6	6	5	0	3	5	5	3	4	7

This suggests further inquiry, which shall be made.

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HELWAN RECORDS IN SEPTEMBER, 1919.

Date.			N.	O - C.	Date.			N.	O - C.
d.	h.	m.			d.	h.	m.		
1	13	52	0	0	16	0	9	989	+ 8
1	14	(52)	3	(- 3)	16	12	(42)	1025	(+ 5)
2	9	17	55	+10	17	9	38	1085	+ 1
2	14	6	69	+ 5	18	5	52	1143	- 3
3	10	(33)	128	(- 7)	18	7	59	1149	- 2
3	11	(31)	130	(+ 9)	18	11	6	1158	- 4
3	18	(24)	150	(+ 2)	18	16	46	1174	0
5	8	(16)	258	(+ 6)	18	21	6	1186	+ 8
5	15	(36)	279	(+ 5)	19	0	28	1196	0
5	17	(50)	286	(- 8)	19	4	31	1208	- 9
5	19	58	292	- 6	19	5	42	1211	- 1
6	9	54	332	-10	19	8	42	1220	-10
6	15	(19)	347	(0)	19	12	(44)	1231	(+ 1)
7	21	(43)	434	(- 3)	19	16	(48)	1243	(- 7)
8	4	(46)	454	(0)	20	10	(18)	1293	(- 7)
10	11	2	609	+ 1	21	12	47	1368	+ 7
10	12	10	612	+ 6	21	21	56	1394	+10
10	14	53	620	+ 1	22	5	4	1415	- 3
11	14	(42)	688	(+ 2)	23	0	11	1469	+10
12	6	(50)	734	(+ 4)	23	2	41	1477	- 8
12	13	(55)	754	(+ 9)	23	4	0	1480	+ 8
12	19	2	769	+ 1	23	21	56	1532	- 8
12	21	3	775	- 4	24	2	22	1544	+ 6
13	11	22	816	- 6	25	10	54	1637	+ 5
13	16	9	829	+ 8	25	16	47	1654	+ 1
13	18	(26)	836	(- 2)	26	7	51	1697	+ 2
13	22	45	848	+ 5	26	9	27	1702	- 7
14	4	25	864	+ 9	27	1	49	1748	+ 9
14	13	(21)	890	(- 1)	27	4	9	1755	+ 2
14	15	(20)	896	(- 8)	27	7	41	1765	+ 4
15	4	(34)	933	(+ 9)	27	9	50	1771	+ 7
15	6	14	938	+ 4	29	12	16	1915	+ 9
15	11	(4)	952	(0)	30	2	58	1957	+ 9
15	13	3	958	- 7	30	4	40	1962	+ 6
15	18	1	972	- 3	30	9	35	1976	+ 7
15	22	32	985	- 5	30	15	10	1992	+ 6
					30	17	(12)	1998	(+ 2)

A case of mean alignment of several epicentres is noticed on August 29d. 5h.

H. H. TURNER.

University Observatory, Oxford,
1924 April 7.

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1919 JULY, AUGUST, SEPTEMBER.

July 1d. 3h. 34m. 30s. Epicentre 43°-8N. 11°-2E. (Florence), (as on 1919 June 30d.).

A = +.708, B = +.140, C = +.692; D = +.194, E = -.981;
G = +.679, H = +.134, K = -.722.

	Δ	Az.	P.	O-C.	S.	O-C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Florence	0.0	—	0 0	0	—	—	—	0.2
Pola	2.2	61	e 0 11	-23	(0 43)	-17	0.7	2.3
Rocca di Papa	2.3	152	e 0 42	+ 6	—	+ 6	—	1.4
Milan	2.3	320	1 32	?L	—	—	(1.5)	1.9
Moncalieri	2.8	295	0 47	+ 3	1 29	+12	—	2.0
Pompeii	3.9	142	e 1 41	+40	—	—	2.5	—
Zurich	4.0	332	0 56	- 6	2 6	+16	—	2.5
Strasbourg	5.3	334	e 1 34	+12	e 2 24	- 1	—	—
Vienna	5.7	37	e 1 2	-26	2 3	-33	2.7	3.2
De Bilt	9.2	336	e 4 54	?L	—	—	e 5.3	—
Hamburg	9.8	356	—	—	—	—	e 4.5	—

Additional records: Zurich gives ePE = +0m.55s., MN = +2.2m., iZ = +2m.14s. Pola MN = +2.7m.

July 1d. 21h. 30m. 25s. Epicentre 14°-5N. 91°-0W. (as on 1919 April 28d.).

A = -.017, B = -.968, C = +.250; D = -1.000, E = +.018;
G = -.004, H = -.250, K = -.968.

	Δ	Az.	P.	O-C.	S.	O-C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Georgetown	27.3	24	e 6 2	+ 1	—	—	e 19.1	—
Chicago	27.4	6	6 1	- 1	10 43	- 5	13.4	—
Toronto	30.8	17	—	—	—	—	18.5	—
Ottawa	33.5	20	e 7 10	+ 9	1 12 51	+19	e 22.2	—
Bidston	77.2	38	e 12 23	+21	—	—	—	23.6
De Bilt	82.5	38	—	—	e 23 38	+46	e 53.0	54.3

Additional records: Georgetown gives eLN = +19.2m. Ottawa L = +23.8m. De Bilt records S at 22h.8m.43s., which has been taken as applicable to the following shock.

July 1d. 21h. 49m. 36s. At 50°-0N. 128°-0W. (as on 1917 Dec. 23d.15h.).

A = -.396, B = -.507, C = +.767.

	Δ	P.	O-C.	S.	O-C.	L.	M.
	°	m. s.	s.	m. s.	s.	m.	m.
Victoria	3.4	0 53	0	—	—	—	2.4
Tucson	E. 21.8	5 46	+43	—	—	7.7	7.9
De Bilt	70.5	—	—	19 7	-85	34.4	49.9

Possibly repeated at 22h.4m.22s., for which Victoria gives P = +0m.53s., L = +1.9m., M = +2.9m. Tucson PN = +5m.40s.

July 1d. Records also at 2h. (Manila and Apia), 4h. and 13h. (Rocca di Papa), 17h. (Chicago), 22h. (San Fernando and Lick), 23h. (Helwan).

July 2d. 7h. 21m. 10s. Epicentre 34°-0N. 131°-0E.

A = -.544, B = +.626, C = +.559; D = +.755, E = +.656;
G = -.367, H = +.422, K = -.829.

	Δ	Az.	P.	O-C.	S.	O-C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Kobe	3.5	83	1 0	+ 5	(1 41)	+ 4	1.7	1.8
Osaka	3.8	83	1 9	+10	(1 50)	+ 6	1.8	3.2
Zi-ka-wei	8.5	254	e 2 8	- 1	—	—	—	—
Victoria	74.4	43	—	—	e 47 8	?L	64.0	—
Chicago	96.4	28	—	—	e 48 20	?L	e 52.8	—
Ottawa	97.1	18	e 32 50	?SR ₁	e 48 20	?L	e 52.8	—
Toronto	97.5	21	—	—	—	—	40.4	—

Additional records: Osaka gives MN = +3.3m. Chicago L = +54.8m. Ottawa L = +56.8m. and +68.9m.

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July 2d. Records also at 0h. (Pompeii), 2h. (Mizusawa, De Bilt, and Helwan), 7h. (San Fernando), 10h. (Taihoku and Zi-ka-wei—separate shocks), 11h. (Vienna), 14h. (Apia), 15h. and 16h. (Colombo), 18h. (Azores), 22h. (San Fernando, Barcelona, De Bilt, Manila), 23h. (Lick, De Bilt, Helwan, and San Fernando).

July 3d. Records at 1h. (Batavia (2)), 2h. (Colombo and Manila), 4h. (San Fernando and Florence), 5h. (Bidston), 7h. (Manila and Batavia), 14h. (Colombo), 15h. (Rocca di Papa), 16h. (De Bilt), 17h. (Zurich), 22h. (San Fernando and Lick), 23h. (Manila and Riverview).

July 4d. 13h. 29m. 20s. Epicentre 7°48. 35°9E.

$$A = +.803, B = +.582, C = -.129; D = +.586, E = -.810;$$

$$G = -.104, H = -.076, K = -.992.$$

It is assumed that this is an anticipation of the shock on July 8d. 21h., as no better alternative was found, after much searching.

	Δ	Az.	P.	O-C.	S.	O-C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Cape Town	31.0	209	23 52	?L	—	—	(23.9)	27.5
Helwan	E. 37.5	355	-10 32	?	—	—	—	15.1
N.	37.5	355	-10 14	?	—	—	—	19.3
Kodaikanal	E. 45.0	69	22 16	?L	—	—	23.6	26.5
Rocca di Papa	53.6	340	e 11 10	+100	e 19 15	+131	e 26.5	34.1
Barcelona	57.8	331	—	—	—	—	e 25.5	23.4
Lemberg	58.2	352	—	—	e 16 46	-75	—	23.9
Moncalieri	58.2	339	e 10 4	+ 4	20 2	+121	28.7	30.0
San Fernando	59.0	322	27 58	?L	—	—	(28.0)	34.7
Rio Tinto	60.1	323	24 40	?L	—	—	(24.7)	32.2
Strasbourg	61.2	340	e 9 40	-40	—	—	—	—
Coimbra	62.8	324	20 40	?S	(20 40)	+102	29.7	31.2
Paris	63.4	338	—	—	—	—	e 30.7	—
Hamburg	64.8	345	e 10 40	- 4	—	—	e 34.7	41.9
De Bilt	65.1	341	10 48	+ 2	—	—	e 32.7	40.2
Oxford	67.2	337	11 6	+ 7	19 11	-41	—	39.9
Eskdalemuir	70.6	339	—	—	—	—	34.2	—
Edinburgh	71.1	339	11 32	+ 8	19 46	-53	28.7	36.4
Washington	112.5	310	—	—	—	—	e 57.0	—

The Helwan records must refer to another shock.

Additional records: Moncalieri gives MN = +30.1m. Hamburg MN = +35.5m. De Bilt MN = +34.8m.

July 4d. Records also at 0h. (Manila), 1h. (close to Manila), 7h. (near San Fernando), 8h. (Chicago), 9h. (Paris and Manila), 11h. (Tokyo), 12h. (near Batavia), 13h. (Kodaikanal), 16h. (close to Batavia), 18h. (Manila), 21h. (La Paz), 22h. (Batavia, close to La Paz), 23h. (Edinburgh, De Bilt, Rocca di Papa, Eskdalemuir, Moncalieri, Kew, Helwan, Hamburg, and close to La Paz.).

July 5d. Records at 2h. (Helwan, De Bilt, and Edinburgh), 3h. (Simla, Hamburg, and De Bilt), 6h. (Helwan), 7h. (close to La Paz), 9h. (Apia), 13h. (San Fernando).

July 6d. 7h. 4m. 10s. Epicentre 14°5N. 91°0W.

(as on 1d.).

$$A = -.017, B = -.968, C = +.250; D = -1.000, E = +.018;$$

$$G = -.004, H = -.250, K = -.968.$$

	Δ	Az.	P.	O-C.	S.	O-C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Vieques	E. 24.8	78	8 55	?S	(8 55)	-64	14.1	12.4
N.	24.8	78	—	—	—	—	12.1	—
Tucson	N. 25.4	318	5 12	-30	9 23	-48	12.5	—
Washington	27.3	24	5 50	-11	11 10	+24	15.3	—
Georgetown	E. 27.3	24	e 6 5	+ 4	11 25	+39	e 14.4	—
N.	27.3	24	e 5 55	- 6	11 25	+39	—	—
Z.	27.3	24	e 5 54	- 7	11 25	+39	—	—
Cheltenham	E. 27.3	25	6 5	+ 4	11 7	+21	16.7	17.2
N.	27.3	25	6 20	+19	10 50	+ 4	16.8	18.3

Continued on next page.

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	Δ	Az.	P.	O-C.	S.	O-C.	L.	M.
			m. s.	s.	m. s.	s.	m.	m.
Chicago	27.4	6	5 45	-17	i 10 50	+ 2	14.0	—
Ann Arbor	E. 28.5	12	—	—	11 32	+24	—	16.8
N. 28.5	12	6 32	+19	11 44	+36	15.1	15.8	—
Ithaca	N. 30.7	23	e 7 2	+27	e 12 15	+29	16.3	—
Toronto	30.8	17	6 50	+14	11 26	-22	e 13.4	19.7
Northfield	31.0	25	e 8 0	+82	—	—	14.3	—
Ottawa	33.5	20	6 44	-17	11 58	-34	e 15.2	—
Berkeley	36.2	316	—	—	e 11 35	-98	—	—
La Paz	38.3	143	i 7 56	+16	i 14 2	+20	17.9	20.5
Victoria	43.1	329	11 43	?	15 1	+12	20.6	24.6
Honolulu	63.7	287	e 11 8	+32	19 20	+11	29.2	31.3
Eskdalemuir	76.8	36	12 0	0	21 46	-1	37.6	e 41.4
Edinburgh	76.8	35	12 2	+ 2	21 44	- 3	35.8	43.6
Bidston	77.2	38	(12 50)	+48	12 50	?P	—	44.0
Paris	81.4	42	e 12 30	+ 3	e 22 33	- 6	40.8	42.8
Uccle	82.2	40	e 12 31	0	e 22 44	- 4	e 35.8	—
De Bilt	82.5	38	12 34	+ 1	22 46	- 6	e 38.8	43.2
Barcelona	82.8	49	—	—	—	—	39.5	44.3
Algiers	84.6	53	e 12 20	-26	23 8	- 7	39.8	44.3
Hamburg	84.7	37	i 12 48	+ 2	i 23 3	-13	e 39.8	44.8
Strasbourg	84.9	41	e 12 50	+ 3	e 22 50	-28	33.8	—
Moncalieri	85.8	45	e 12 52	0	23 9	-19	44.2	—
Rocca di Papa	90.3	47	12 38	-40	—	—	—	—

NOTES TO JULY 6d. 7h. 4m. 10s.

Determinations of T_0 -7h.

	m. s.		m. s.
Georgetown	3 9	Eskdalemuir	4 23
Ottawa	4 17	Paris	4 34
Toronto	5 30	Uccle	4 24
Ann Arbor	4 6	De Bilt	4 30
Ithaca	4 37	Hamburg	4 41
La Paz	4 23	Moncalieri	4 43

Additional records: Ottawa L = +20.8m. and +40.8m. T_0 = 7h.4m.7s.
 Edinburgh PR₁ = +15m.20s. Paris iS = +22m.40s., T_0 = 7h.4m.34s.
 De Bilt MN = +58.8m., T_0 = 7h.4m.30s. Barcelona MN = +46.9m.
 La Paz P = +18m.12s. (a second shock ?) T = 7h.4m.25s.

July 6d. 19h. 29m. 3s. At 11°-5S. 64°-0W.

A = +.430, B = -.881, C = -.199.

The epicentre 18°-5S. 63°-5W. of 1918 Aug. 17d. does not fit the De Bilt S, though it would accord with L.

	Δ	P.	O-C.	S.	O-C.	L.	M.
	m. s.	m. s.	s.	m. s.	s.	m.	m.
La Paz	6.4	1 39	+1	2 54	-1	3.6	4.8
De Bilt	E. 86.7	—	—	e 23 39	+1	e 45.0	48.7

De Bilt gives MN = +51.0m.

July 6d. Records also at 3h. (La Paz), 7h. (close to Cipolletti), 9h. (La Paz), 13h. (Bidston), 14h. (Eskdalemuir), 18h. (Melbourne), 20h. (Helwan), 22h. (San Fernando).

July 7d. 13h. 55m. 0s. Epicentre 2°-0S. 137°-0E. (as on 1916 Jan. 13d. 6h.).

A = -.731, B = +.689, C = -.035; D = +.682, E = +.731;
 G = +.026, H = -.024, K = -.999.

	Δ	Az.	P.	O-C.	S.	O-C.	L.	M.
			m. s.	s.	m. s.	s.	m.	m.
Manila	23.0	317	e 4 55	-22	—	—	—	—
Batavia	30.4	261	e 6 37	+ 5	—	—	—	—
Riverview	34.5	159	e 2 12	?	e 7 3	?P	10.7	12.3
Melbourne	36.5	169	8 30	+64	12 48	-29	14.5	16.4
Honolulu	67.7	64	e 14 12	?PR ₁	e 20 18	+20	e 24.0	32.1
Mauritius	79.1	250	42 24	?L	—	—	(42.4)	45.8
Victoria	98.0	42	26 47	?S	(26 47)	+71	40.3	48.8
Helwan	104.5	300	29 0	?S	(29 0)	+142	—	—

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		Δ	Az.	P.	O-C.	S.	O-C.	L.	M.
		°	°	m. s.	s.	m. s.	s.	m.	m.
De Bilt	E.	116.0	320	e 19 31	?PR ₁	—	—	e 57.0	70.7
	N.	116.0	320	—	—	—	—	e 61.0	67.4
Bidston		118.7	334	55 24	?L	—	—	(55.4)	66.5
Chicago		123.7	39	—	—	—	—	e 52.0	—
Toronto		127.3	33	—	—	—	—	62.5	69.9
Ottawa		128.0	29	—	—	—	—	e 55.0	—
Georgetown		131.8	35	—	—	—	—	e 53.0	—
La Paz		140.9	127	19 19	[-22]	—	—	—	—

Additional records: Riverview gives PR₁ = +3m.26s., SR₁ = +9m.3s.,
 MN = +17.8m., Helwan PN = +31m.0s. Chicago M = +55.0m. and
 +61.0m. Toronto eL = +65.9m.

July 7d. Records also at 3h. (close to Mizusawa), 17h. (Apia), 21h. (Accra and San Fernando), 23h. (Moncalieri).

July 8d. 5h. 53m. 40s. At 43°-8N. 11°-2E. (Florence) (as on July 1d. 3h.).

A = +.708, B = +.140, C = +.692; D = +.194, E = -.981;
 G = +.679, H = +.134, K = -.722.

		Δ	Az.	P.	O-C.	S.	O-C.	L.	M.
		°	°	m. s.	s.	m. s.	s.	m.	m.
Florence		0.0	—	1 4	+64	—	—	—	1.3
Pola		2.2	61	—	—	—	—	e 0.8	1.8
Rocca di Papa		2.3	152	0 32	-4	1 11	+8	—	1.4
Moncalieri		2.8	295	0 45	+1	1 21	+4	1.7	—
Chur		3.2	338	—	—	1 29	+1	—	—
Pompeii		3.9	142	e 1 9	+8	e 1 41	-6	2.2	2.7
Zurich	E.	4.0	332	e 0 59	-3	i 2 8	+18	—	2.5
	N.	4.0	332	e 0 58	-4	i 2 6	+16	—	2.4
	Z.	4.0	332	e 1 0	-2	i 2 6	+16	—	—
Marselles		4.3	266	e 1 44	+37	e 2 38	+40	—	—
Besancon		5.0	316	1 54	+37	—	—	—	2.3
Strasbourg		5.3	334	e 1 40	+18	2 42	+17	—	—
Vienna		5.7	37	e 1 4	-24	2 4	-32	2.9	3.3
Barcelona		7.0	254	—	—	—	—	4.0	5.3
Paris		7.8	313	e 3 21	?S	(e 3 21)	-10	4.8	5.3
Uccle		8.4	329	—	—	e 3 20	-27	—	—
De Bilt	E.	9.2	336	—	—	e 4 16	+8	5.0	5.5
Algiers		9.3	224	e 3 0	+40	—	—	—	9.8
Hamburg		9.8	356	—	—	e 4 20	-3	—	6.6
Lemberg		10.7	51	—	—	e 6 20	?SR ₁	—	8.6
Edinburgh		15.3	328	—	—	6 20	-19	—	—

Additional records: Zurich iPE = +1m.18s., iPN = +1m.17s., iPZ = +1m.17s.,
 T₁ = 5h.55m.46s. De Bilt eSN = +4m.32s., MN = +5.6m. Hamburg
 MN = +5.5m., MZ = +6.7m.

1919. July 8d. 21h. 6m. 0s. Epicentre 7°-4S. 35°-9E.

(as on 1919 July 4.)

(Adopted, after trial solution, from De Bilt.)

A = +.803, B = +.582, C = -.129; D = +.586, E = -.810;
 G = -.104, H = -.076, K = -.992.

		Δ	Az.	P.	O-C.	S.	O-C.	L.	M.
		°	°	m. s.	s.	m. s.	s.	m.	m.
Cape Town		31.0	209.	6 54	+16	10 54	-57	14.9	17.4
Helwan	E.	37.5	355	7 42	+8	—	—	—	20.6
	N.	37.5	355	7 0	-34	—	—	—	21.2
Bombay		44.9	52	8 59	+27	—	—	—	26.5
Kodakanal	E.	45.0	69	8 36	+3	—	—	23.0	28.1
Colombo	E.	46.0	74	8 12	-28	15 42	+14	22.0	31.2
Athens	N.	46.8	348	18 40	-6	i 15 24	-14	e 25.1	27.0
	E.	46.8	348	8 42	-4	—	—	—	26.6
Pompeii		52.0	340	19 19	-1	i 22 0	?SR ₁	31.0	23.5
Rocca di Papa		53.6	340	9 24	-6	16 54	-10	e 30.4	33.0
Algiers		53.9	329	9 25	-7	16 47	-21	27.9	33.5
Pola		56.9	343	e 9 47	+2	e 17 49	+16	e 30.6	39.2
Barcelona		57.8	331	9 55	-3	17 43	-13	27.4	36.4

Continued on next page.

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	Δ	Az.	P.	O-C.	S.	O-C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Marselles	57.8	333	9 56	- 2	—	—	13.3	35.6
Lemberg	58.2	352	e 10 0	0	e 18 24	+23 e	33.2	36.2
Moncalieri	58.2	339	i 10 5	+ 5	18 3	+ 2	23.4	36.8
Tortosa	58.2	330	9 59	- 1	18 8	+ 7	28.9	33.6
Vienna	58.3	348	10 4	+ 3	18 21	+18 e	28.0	39.0
San Fernando	59.0	322	10 12	+ 7	18 12	+ 1	32.5	39.0
Zurich	59.9	340	e 10 12	+ 1	—	—	e 25.1	—
Rio Tinto	60.1	323	24 0	?L	—	—	(24.0)	32.0
Besancon	60.7	339	10 21	+ 4	—	—	35.0	—
Strasbourg	61.2	340	i 10 23	+ 3	i 18 48	+10 e	28.0	40.2
Coimbra	62.8	324	10 25	- 6	i 18 45	-13	29.4	39.6
Paris	63.4	338	i 10 36	+ 2	e 19 14	+ 8	29.0	32.0
Uccle	64.3	340	i 10 42	+ 2	e 19 10	- 7	e 29.0	41.4
Hamburg	64.8	345	i 10 49	+ 5	i 19 44	+21 e	31.0	43.5
De Bilt	65.1	341	i 10 50	+ 4	i 19 44	+18 e	30.0	36.2
Kew	66.5	337	19 0	?S	(19 0)	-44	—	43.0
Oxford	67.2	337	11 2	+ 3	19 53	+ 1	27.7	40.5
West Bromwich	68.1	337	11 11	+ 6	19 55	- 8	—	—
Bidston	69.2	337	11 12	0	20 42	+26	—	40.8
Batavia	70.3	93	i 11 56	+37 e	21 29	+59 e	35.1	39.1
Eskdalemuir	70.6	339	10 25	-56	19 28	-65	33.0	43.6
Edinburgh	71.1	339	11 24	0	20 55	+16	34.0	43.0
Dyce	71.8	340	i 11 40	+12	i 21 9	+21	—	42.0
Azores	72.9	314	16 0	?PR ₁	—	—	—	—
Rio de Janeiro	77.1	249	21 48	?S	(21 48)	- 2	36.4	—
Manila	87.1	76	e 13 23	+23	—	—	—	—
Taihoku	89.3	65	15 18	+126	—	—	33.9	53.2
Adelaide	96.0	127	24 54	?S	(24 54)	-22	48.6	60.3
Cipolletti	96.1	230	23 42	?S	(23 42)	-95	49.1	61.7
Andalgala	97.1	240	22 12	?	—	—	46.8	56.5
Mendoza	97.7	235	23 55	?S	(23 55)	-98	47.6	67.8
La Quiaca	97.8	246	—	—	—	—	76.4	80.6
La Paz	101.2	252	14 4	-12	1 24 37	-90	42.1	52.4
Vieques	103.0	288	—	—	—	—	48.2	53.2
Riverview	106.2	129	—	—	e 27 3	+ 9 e	48.7	62.4
Sydney	106.3	129	38 12	?	—	—	54.7	58.8
Ootomari	106.9	42	18 27	?PR ₁	—	—	—	—
Ottawa	110.4	315	i 19 4	[+41]	e 28 30	+58 e	49.0	—
Ithaca	111.5	312	—	—	—	—	53.6	—
Cheltenham	112.4	310	—	—	—	—	53.0	64.7
	112.4	310	—	—	—	—	55.8	61.1
Washington	112.5	310	19 15	[+45]	28 48	+58	50.0	—
Georgetown	112.5	310	e 19 52	[+82]	—	—	e 41.0	—
	112.5	310	19 52	[+82]	e 28 42	+51 e	41.1	—
Toronto	113.3	314	—	—	—	—	i 55.0	70.1
Ann Arbor	116.7	314	18 36?	[-7]	—	—	47.0	68.0
	116.7	314	—	—	25 24	—	—	65.0
Chicago	119.6	314	20 0	[+69]	30 0	+74	45.0	66.0
Berkeley	143.8	330	—	—	—	—	e 72.1	—
Lick	143.8	329	—	—	—	—	e 70.0	—
Honolulu	160.6	42	e 25 0	?PR ₁	—	—	32.5	49.0

Additional records: Athens gives SRN = +19m.11s., ME = +24m.18s., T₀ = 21h.6m.9s. Algiers T₀ = 21h.6m.10s. Pola MN = +36.6m. Barcelona PR = +12m.3s., T₀ = 21h.6m.11s. Lemberg ePR? = +13m.24s. Moncalieri MN = +36.8m., T₀ = 21h.6m.11s. Vienna PR = +12m.32s., PR₂ = +13m.49s., SR₁ = +23m.23s. San Fernando MN = 37.0m., T₀ = 21h.6m.18s. Rio Tinto gives +4m.0s. This has been altered to 24m.0s. Strasbourg iPR₁ = 12m.36s., T₀ = 21h.6m.0s. Coimbra iSN = +18m.41s., LN = +26.9m., MN = +38.6m., T₀ = 21h.6m.11s. Paris PR₁ = +12m.55s., iSN = +19m.1s., T₀ = 21h.6m.13s. Uccle iPR = +13m.1s., T₀ = 21h.6m.15s. Hamburg iSN = +19m.30s., MN = +41.8m., MZ = +39.9m., T₀ = 21h.6m.9s. De Bilt iSN = 19m.29s., MN = +43.0m., T₀ = 21h.6m.12s. Epicentre 7° 45', 35° 0' E. Batavia SP = +22m.23s., T₀ = 21h.6m.12s. Eskdalemuir PR₁ = +13m.16s., PR₂ = +34m.41s., T₀ = 21h.6m.22s. Edinburgh PR₁ = +14m.25s., PR₂ = +16m.26s., SR₁ = +25m.27s., SR₂ = +29m.0s. Adelaide S = +35m.36s. La Quiaca gives MN = +80.5m. Riverview ePR = +19m.31s., eSR₁ = +39m.5s., MN = +57.0m. Ann Arbor for W. Instrument LE = +45.0m., ME = +64.0m. Ottawa e = +25m.54s. and +34m.24s., eL = +52.0m.

July 8d. Records also at 0h. (Zurich), 1h. (Osaka and Kobe), 7h. (Helwan), 8h. (Edinburgh), 12h. (Manila (2)), 13h. (Osaka, Kobe, and Manila), 14h. (Manila), 15h. (Melbourne), 16h. (Helwan), 17h. (Vienna), 18h. (Vienna and Mendoza), 19h. (Ootomari), 21h. (Melbourne and Mauritius), 22h. (Berkeley).

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July 9d. 16h. 20m. 35s. Epicentre 36°-0N. 141°-0E.

A = -·629, B = +·509, C = +·588.

Apparently 37°-0N. 143°-0E. as on 1918 May 31 and 37°-5N. 142°-5E. as on 1918 Aug. 25d. 0h. will not suit the records. But possibly this is an anticipation of the shocks on July 26 and August 3, at 35°-0N. 143°-0E.

		Δ	P.	O-C.	S.	O-C.	L.	M.
		°	m. s.	s.	m. s.	s.	m.	m.
Tokyo		1.1	0 16	- 1	0 37	+ 6	—	0.7
Mizusawa	E.	3.1	0 53	+ 4	1 27	+ 1	—	—
	N.	3.1	0 50	+ 1	1 26	0	—	—
Osaka	E.	4.7	1 31	+18	—	—	2.6	3.4

Mizusawa records a second shock at 16h.47m.25s. with PE = +0m.49s., SE = +1m.27s. Osaka MN = +3.0m.

1919. July 9d. 19h. 19m. 25s. Epicentre 17°-0N. 112°-0W.

A = -·358, B = -·887, C = +·292; D = -·927, E = +·375;

G = -·110, H = -·271, K = -·956.

		Δ	Az.	P.	O-C.	S.	O-C.	L.	M.
		°		m. s.	s.	m. s.	s.	m.	m.
Tucson	N.	15.3	5	3 49	+ 6	7 55	+76	10.4	10.8
	E.	15.3	5	—	—	7 49	+70	9.4	—
Lick		22.1	339	—	—	e 9 35	+28	—	—
Berkeley		22.7	339	e 5 19	+ 6	—	—	—	—
Chicago		32.4	36	6 13	-39	i 11 5	-69	13.8	18.1
Victoria		32.8	347	15 53	?L	18 21	?L	19.3	42.0
Ann Arbor	E.	35.0	39	12 47	?S	(12 47)	- 8	(15.9?)	19.4
	N.	35.0	39	—	—	16 29	?L	(16.5)	19.5
Georgetown		37.5	47	e 6 35	-58	e 12 15	-75	e 18.6	—
Cheltenham	N.	37.5	48	12 16	?S	(12 16)	-75	18.9	19.6
Washington		37.5	47	6 51	-43	12 20	+71	18.8	—
Ithaca	N.	39.5	42	e 8 0	+ 9	—	—	e 18.3	—
Ottawa		41.4	40	18 51	+45	i 13 19	-68	e 20.4	—
Northfield		42.8	41	—	—	—	—	e 23.6	—
La Paz		54.7	125	9 36	- 1	17 14	- 3	26.2	28.1
Edinburgh		86.1	32	22 59	?S	(22 59)	-32	44.6	49.6
Eskdalemuir		86.3	32	—	—	23 35	+ 2	—	—
San Fernando	N.	92.1	50	44 35	?L	—	—	(44.6)	—
De Bilt		92.2	32	—	—	e 24 4	-33	42.6	48.9
Hamburg		93.8	30	—	—	e 26 35	+101	e 43.6	61.6
Moncalieri		97.4	39	—	—	—	—	e 46.0	—
Rocca di Papa		102.2	39	—	—	—	—	—	41.9
Helwan		121.3	37	79 35	?L	—	—	(79.6)	—

Additional records: Ann Arbor gives L as S. W. Instrument LE = +17.8m., ME = +19.1m. Georgetown LN = +22.6m., LE = +23.6m. Ottawa iN = +16m.9s., L = +22.6m. and +40.6m. La Paz T₀ = 19h.19m.28s. De Bilt MN = +44.2m. Hamburg MN = +56.6m. Helwan PN = +77m.35s.(?LN). Moncalieri L = +51.9m.

July 9d. Records also at 1h. (San Fernando), 5h. (La Paz), 7h. (Edinburgh, Hamburg, De Bilt, and Batavia), 8h. (Helwan), 10h. (La Paz), 18h. (Helwan), 20h. (Mendoza), 21h. (Lick, Simla, and Florence (2)).

July 10d. 2h. 22m. 10s. Epicentre 50°-0N. 128°-0W. (as on 1919 July 1d.).

A = -·396, B = -·507, C = +·767.

		Δ	Az.	P.	O-C.	L.	M.
		°		m. s.	s.	m.	m.
Victoria		3.4	114	0 53	0	1.4	1.9
Chicago		28.9	91	—	—	e 15.3	—
Toronto		33.4	81	—	—	18.3	—
Ottawa		34.8	77	—	—	16.6	—
Georgetown		37.2	88	e 19 20	?L	(e 19.3)	—
Washington		37.2	88	—	—	e 20.5	—
De Bilt	E.	70.5	29	—	—	e 34.8	—

Ottawa L = +18.3m. and +21.8m. Georgetown gives also eN = +19m.6s., LN = +22.0m. De Bilt LN = e33.8m.

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July 10d. Records also at 3h. (La Paz), 4h. (close to Florence), 8h. (Colombo), 13h. (close to Athens), 16h. (close to Taihoku), 19h. (near Balboa Heights), 20h. (San Fernando and close to Kobe and Osaka), 21h. (close to Taihoku), 22h. (Taihoku).

1919. July 11d. 0h. 30m. 30s. Epicentre 8°-0N. 72°-0W.

A = +306, B = -942, C = +139; D = -951, E = -309;
G = +043, H = -132, K = -990.

		Δ	Az.	P.	O-C.	S.	O-C.	L.	M.
		°	°	m. s.	s.	m. s.	s.	m.	m.
Vieques	E.	12.0	31	6 1	+182	7 8	+109	8.3	8.5
La Paz		24.8	171	15 29	-7	19 46	-13	11.6	15.9
Georgetown		31.2	352	e 6 30	-10	11 42	-12	e 14.0	—
Washington		31.2	352	6 27	-13	13 30	+96	e 20.3	—
Ithaca	E.	34.7	355	—	—	e 12 18	-33	14.9	—
Andalgala	N.	36.0	171	—	—	—	—	—	18.6
Toronto		36.2	351	—	—	—	—	15.8	25.8
Chicago		36.5	340	17 20	-6	113 0	-17	17.6	24.5
Ottawa		37.5	357	17 41	+7	113 50	+19	27.5	—
Pilar		40.4	169	—	—	—	—	22.2	23.0
Río de Janeiro		41.8	140	e 21 0	?	22 48	?	24.4	24.7
Cipolletti		47.1	175	20 6	?L	—	—	27.9	32.2
Victoria		59.0	323	—	—	—	—	36.4	43.8
Coimbra		64.8	50	—	—	—	—	e 24.5	—
Río Tinto		65.7	52	44 30	?L	—	—	(44.5)	49.5
Bidston		71.1	38	9 0	-144	16 48	?PR ₁	—	34.9
Eskdalemuir		71.4	35	—	—	20 50	+7	34.5	—
De Bilt		75.8	39	—	—	e 21 37	+2	e 35.5	43.3
Moncalieri		77.1	46	—	—	(21 46)	-4	21.8	—
Hamburg		78.9	37	e 12 14	+2	e 22 18	+7	e 35.5	40.5
Rocca di Papa		80.8	50	—	—	(e 22 36)	+3	e 22.6	25.7
Helwan		97.4	59	26 30	?S	(26 30)	+60	—	—

Additional records: Vieques PN = +5m.27s. Georgetown SN = +11m.43s., To = 0h.30m.26s. Ithaca eN = +9m.0s. and +12m.2s. Toronto L = +18.5m. Chicago SR₁ = +15m.45s. Ottawa LN = +9m.3s., eN? = +20m.0s., T₂ = 0h.30m.25s. Pilar MN = +26.7m. De Bilt eLN = +32.5m., MN = +36.5m. Hamburg MN = +38.5m., T₁ = 0h.30m.36s. Helwan PN = +24m.30s. (?S).

July 11d. 4h. 9m. 25s. Epicentre 8°-0N. 72°-0W. (as at 0h.).

		Δ	P.	O-C.	S.	O-C.	L.	M.
		°	m. s.	s.	m. s.	s.	m.	m.
La Paz		24.8	15 27	-9	19 45	-14	11.7	15.8
Chicago		36.5	7 18	-8	13 5	-12	21.1	—
De Bilt	E.	75.8	—	—	—	—	e 38.6	39.9

Chicago gives SR₁ = +15m.50s. De Bilt eLN = +33.6m.

July 11d. 18h. 3m. 50s. Repetition from 8°-0N. 72°-0W.?. La Paz gives eP = +5m.27s., S = +9m.43s., M = +18.8m. Possibly some or all of the following records only at La Paz, which would ordinarily have been mentioned below in the notes, represent other repetitions, and may be here tabulated:—

La Paz P = 3h.27m.14s. eP = 3h.31m.41s.
P = 4h. 7m.13s. eP = 5h.33m.40s.

July 11d. Records also at 1h. (La Quiaca), 2h. (Colombo), 4h. (Balboa Heights), 5h. (Helwan and close to Athens), 17h. (Manila), 19h. (Moncalieri), 21h. (San Fernando).

July 12d. 12h. 4m. 30s. Epicentre 42.5N. 7°-5E. (as on 1918 Aug. 10d. 18h.).

A = +731, B = +096, C = +676.

		Δ	P.	O-C.	S.	O-C.	L.	M.
		°	m. s.	s.	m. s.	s.	m.	m.
Rocca di Papa		3.9	e 1 25	+24	—	—	—	3.1
Zurich		4.9	1 17	+1	11 56	-18	—	2.0
Vienna		8.5	e 2 0	-9	—	—	—	2.8

Zurich. The records on E, N, V instruments are sensibly the same: also eP = +1m.13s.

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July 12d. 22h. 28m. 0s. Epicentre 55°·0N. 35°·0W. (as on 1919 May 5d.).

A = +·470, B = -·329, C = +·819; D = -·574, E = -·819;
G = +·671, H = -·470, K = -·574.

	Δ	Az.	P.	O-C.	S.	O-C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Edinburgh	17·9	75	4 18	+ 2	6 22	-76	8·0	10·3
Eskdalemuir	18·0	76	14 21	+ 4	—	—	9·0	—
Oxford	20·2	85	4 53	+10	8 45	+18	10·3	14·2
Kew	20·9	84	—	—	—	—	—	11·0
Coimbra	23·0	119	5 40	+23	10 0	+35	11·9	—
Paris	23·6	90	e 5 31	+ 7	—	—	12·0	13·7
De Bilt	23·7	80	e 5 29	+ 4	9 43	+ 5	11·4	14·0
Uccle	23·8	83	e 5 27	+ 1	e 9 42	+ 2	e 11·5	13·0
Hamburg	26·0	74	e 5 45	- 3	1 10 22	0	e 14·0	15·0
Strasbourg	26·8	86	5 51	- 5	10 43	+ 6	e 15·7	—
San Fernando	27·0	122	14 0	?L	—	—	(14·0)	17·5
Tortosa	27·3	106	6 17	+16	10 43	- 3	13·5	19·2
Ottawa	27·3	266	—	—	e 10 30	-16	e 15·5	—
Moncalieri	28·7	94	6 26	+11	—	—	14·8	—
Toronto	30·5	266	—	—	—	—	14·1	—
Rocca di Papa	33·5	92	e 7 5	+ 4	—	—	—	—
Chicago	35·9	270	7 45	+24	13 38	+29	19·5	—
Helwan	52·6	88	—	—	17 0	+ 9	—	—

Additional records: Coimbra T₀ = 22h.28m.13s. De Bilt MN = +17·4m.,
T₀ = 22h.28m.11s., Epicentre 57°·3N., 35°·1W. Hamburg T₀ = 22h.27m.56s.
San Fernando MN = +17·0m.

July 12d. Records also at 0h. (Rio Tinto and close to Mizusawa), 2h. (close to Rocca di Papa), 3h. (La Paz), 4h. (near Tokyo and Osaka), 3h. (Taihoku), 9h. (Manila), 10h. (Tokyo), 16h. (Rocca di Papa), 17h. (Bidston), 19h. (Colombo).

July 13d. Records at 2h. (San Fernando), 5h. (close to Manila and La Paz), 13h. (Helwan), 14h. (Manila and close to Mizusawa).

July 14d. 13h. 44m. 50s. At 52°·0N. 178°·0W. (as on 1919 May 22d.).

A = -·615, B = -·021, C = +·788; D = -·035, E = +·999;
G = -·788, H = -·028, K = -·616.

	Δ	Az.	P.	O-C.	S.	O-C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Honolulu	34·4	146	e 5 28	-100	—	—	14·7	20·2
Osaka	37·2	262	7 51	+19	—	—	14·7	17·8
Zi-ka-wei	48·2	271	e 8 38	-17	e 15 30	-26	—	—
Chicago	58·5	61	—	—	—	—	40·2	—
Manila	60·8	259	e 10 10	- 8	—	—	—	—
Toronto	61·5	55	29 4	?L	—	—	e 38·2	53·7
Ottawa	62·0	51	—	—	—	—	e 31·2	—
Georgetown	66·1	58	e 31 27	?L	—	—	e 41·8	—
Washington	66·1	58	—	—	—	—	e 41·8	—
Hamburg	74·1	355	e 11 54	+11	—	—	e 40·2	50·2
Bidston	74·5	2	24 22	?L	23 58	?L	—	48·2
De Bilt	75·8	357	e 12 12	+18	e 21 55	+20	—	51·9
Kew	76·5	2	—	—	—	—	—	57·2
Uccle	77·1	358	e 12 10	+ 8	e 22 10	+20	e 37·2	54·2
Vienna	79·0	350	12 12	- 1	—	—	e 42·7	53·7
Strasbourg	79·3	355	12 19	+ 4	e 22 24	+ 9	e 40·2	—
Pola	82·6	351	—	—	—	—	—	51·2
Moncalieri	82·9	357	e 10 14	-141	23 11?	+15	46·6	53·8
Rocca di Papa	85·8	352	12 52	0	—	—	53·2	59·2
Rio Tinto	89·9	7	51 10	?L	—	—	(51·2)	60·2
Helwan	94·2	335	25 10	?S	(25 10)	+12	—	—

Additional records: Zi-ka-wei T₀ = 13h.44m.48s. Ottawa L = +40·2m.
Washington eE = +31m.27s., eN? = +41m.38s. Eskdalemuir Δ = 72°·5,
gives simply 13h.52m. -15h.30m. De Bilt eSN = +21m.49s., eSR, N =
+27m.11s., MN = +54·7m., T₀ = 13h.45m.17s. Uccle SR, = +27m.32s.,
T₀ = 13h.45m.0s. Vienna MN = +57·2m. The P record is from Z
machine. Helwan PN = +17m.10s.

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July 14d. 14h. 22m. 0s. At 40°·0N. 60°·0E. ?

A = +·383, B = +·664, C = +·643.

If the records all refer to a single shock, the solution below is about the best we can get from the material. But it seems more probable that there were two shocks, one in India and one in Western Europe.

	Δ	P.	O-C.	S.	O-C.	L.	M.
	°	m. s.	s.	m. s.	s.	m.	m.
Simla	16·5	e 3 48	-11	—	—	—	8·0
Lemberg	27·0	e 6 54	+56	—	—	—	13·6
Kodaikanal	33·5	14 12	?S	(14 12)	+100	17·3	18·3
Colombo	37·6	16 0	?S	(16 0)	+148	—	27·4
Coimbra	51·0	8 45	-28	—	—	19·8	—
San Fernando	51·0	17 30	?S	(17 30)	+59	—	29·5

July 14d. Records also at 3h. (close to Athens (2)), 8h. (Apia), 10h. (Helwan and Taihoku), 11h. (Manila (2) and La Paz), 12h. (Helwan), 18h. (close to Tokyo at 18h.19m., Zi-ka-wei at 18h.51m.).

July 15d. 5h. 25m. 30s. Epicentre 45°·1N. 147°·2E. (as on 1918 May 31d.).

A = -·593, B = +·382, C = +·708; D = +·542, E = +·841;
G = -·595, H = +·384, K = -·706.

	Δ	Az.	P.	O-C.	S.	O-C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Mizusawa E.	7·5	219	1 56	+ 2	3 23	+ 4	—	—
N.	7·5	219	2 6	+12	3 29	+ 5	—	—
Manila	37·7	224	7 30	- 6	—	—	—	—
Hamburg	74·8	335	—	—	—	—	e 44·5	43·5
De Bilt	77·5	337	—	—	—	—	e 36·5	50·7
Uccle	78·8	337	e 11 30	-42	—	—	—	36·5
Bidston	78·2	341	47 0	?L	—	—	—	(47·0)

De Bilt gives eLN = +43·5m., MN = +48·6m.

July 15d. Records also at 2h. (San Fernando and Taihoku), 12h. (La Paz), 13h. (Berkeley), 16h. (Batavia), 17h. (Athens), 23h. (Lick).

July 16d. 4h. 9m. 15s. Epicentre 45°·1N. 147°·2E. (as on 1919 July 15d.).

A = -·593, B = +·382, C = +·708.

	Δ	Az.	P.	O-C.	S.	O-C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Ootomaci	3·5	298	1 16	+21	—	—	2·0	—
Mizusawa	7·5	219	1 47	- 7	2 57	-27	—	—
Tokyo	11·0	213	2 44	0	4 17	-37	—	—
Osaka	13·8	225	3 30	+ 7	—	—	6·1	6·4
Zi-ka-wei	24·4	244	e 5 25	- 7	e 9 41	-11	—	—
Manila	37·7	224	12 57	?S	(12 57)	-37	—	—
Hamburg	74·8	335	11 53	+ 5	—	—	e 44·7	46·7
De Bilt	77·5	337	—	—	e 22 3	+ 8	e 41·8	42·9
Bidston	78·2	341	32 21	?L	39 3	?L	(39·0)	40·8
Uccle	78·8	337	e 12 17	+ 5	e 22 15	+ 5	e 4·8	48·8
Strasbourg	79·9	334	e 12 20	—	—	—	—	—
Helwan	85·1	308	23 45	?S	(23 45)	+25	—	—

Eskdalemuir ($\Delta = 76^\circ\cdot 5$) gives simply 4h.31m. to 5h.22m. Helwan PN = +22m.45s.
De Bilt eLN = +42·8m., MN = +47·1m.

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July 16d. 18h. 6m. 30s. Epicentre 16°0S. 171°0W. (as on 1917 June 28d.).

A = -.949, B = -.150, C = -.276; D = -.156, E = +.988;
G = +.272, H = +.043, K = -.961.

	Δ	Az.	P.	O-C.	S.	O-C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Apia	2.3	340	i 0 37	+ 1	—	—	—	1.1
Riverview	38.3	—	—	—	e 13 32	-10	e 18.4	21.7
Honolulu	39.5	19	e 14 24	?S	(14 24)	+25	22.9	26.0
Melbourne	44.4	232	—	—	—	—	24.4	27.6
Manila	73.6	291	e 12 18	+38	—	—	—	—
Chicago	95.8	48	e 44 30	?L	—	—	51.5	—
De Bilt	143.8	4	—	—	—	—	e 83.5	89.3
Uccle	145.0	5	—	—	—	—	e 82.5	—
Helwan	155.3	308	105 30	?L	—	—	(105.5)	—

Riverview eS = +3m55s., MN = +30.5m. Helwan gives also PN =
+107m.30s. De Bilt MN = +89.4m.

July 16d. Records also at 0h. (San Fernando and close to Manila), 1h. (Florence), 3h. (Riverview), 8h. (Mizusawa), 10h. (Manila), 11h. (Colombo), 14h. (Tokyo), 17h. (Helwan).

July 17d. 9h. 49m. 5s. Epicentre 24°0N. 121°0E. (as on 1918 Sept. 24d.).

A = -.470, B = +.783, C = +.407; D = +.857, E = +.515;
G = -.210, H = +.349, K = -.914.

It seems clear that there must be at least one erroneous record, or a double shock. Difficulties were also found on 1918 April 18d.

	Δ	Az.	P.	O-C.	S.	O-C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Taihoku	1.1	24	0 43	+26	—	—	2.0	2.4
Zi-ka-wei	7.2	3	e 1 24	-25	e 2 38	-37	(41.1)	6.5
Manila	9.4	180	2 35	+13	—	—	5.1	7.3
Nagasaki	11.8	39	1 41	-75	—	—	—	—
Osaka	16.5	48	5 19	+80	9 22	+135	12.5	17.0
Tokyo	20.0	50	0 40	?	10 53	+150	—	—
Batavia	33.2	208	7 2	+ 4	—	—	—	—
Simla	39.2	290	—	—	—	—	e 22.2	—
Riverview	64.6	152	—	—	—	—	e 34.6	36.8
Lemberg	76.1	319	41 7	?L	—	—	(41.1)	52.8
Helwan	77.9	297	46 55	?L	—	—	(46.9)	—
Vienna	81.4	320	e 44 55	?L	—	—	(44.9)	53.9
Hamburg	82.3	327	e 41 55	?L	—	—	e 44.9	e 45.9
De Bilt	85.6	326	—	—	—	—	44.9	50.0
Strasbourg	86.2	321	43 55	?L	—	—	(43.9)	—
Rocca di Papa	86.8	315	—	—	(21 55)	-104	2.9	50.9
Uccle	86.7	328	—	—	—	—	e 42.9	56.9
Moncalieri	88.1	319	e 38 5	?	—	—	47.8	—
Kaw	88.6	328	—	—	—	—	—	51.9
Bidston	88.7	330	31 19	?SR ₁	43 43	?L	(43.7)	59.5
Paris	88.9	325	—	—	—	—	46.9	56.9
Colmbra	100.4	324	e 44 25	?L	—	—	53.9	—
San Fernando	101.6	319	52 55	?L	—	—	(52.9)	58.9
Ottawa	109.0	12	—	—	—	—	52.9	—
Chicago	109.1	22	—	—	—	—	e 53.9	—

Additional records: Zi-ka-wei MN = +6.3m., T. = 9h.48m.58s. Manila
MN = +7.4m. Osaka T. = 9h.49m.20s. Uccle MN = +43.4m.
Eskdalemuir ($\Delta = 87^\circ.5$) gives 10h.30m. to 11h.7m. De Bilt eLN = +43.9m.,
MN = +48.6m.

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1919. July 17d. 16h. 19m. 34s. Epicentre 11°0N. 88°0W.

(as on 1918 July 31d. 14h.).

A = +.034, B = -.982, C = +.191; D = -.999, E = -.035;
G = +.007, H = -.191, K = -.982.

		Δ	Az.	P.	O-C.	S.	O-C.	L.	M.
		°	°	m. s.	s.	m. s.	s.	m.	m.
Balboa Hts.	E.	8.6	104	2 30	+20	4 18	+25	6.0	6.3
	N.	8.6	104	2 40	+30	—	—	6.0	6.2
Vieques	E.	23.0	67	8 16	?S	(8 16)	-69	16.2	17.3
Cheltenham	E.	29.4	18	11 8	?S	(11 8)	-16	17.1	—
	N.	29.4	18	11 37	?S	(11 37)	+13	16.3	19.4
Washington		29.6	17	6 23	-1	11 26	+1	16.3	—
Georgetown		29.6	17	16 24	0	e 11 30	+3	e 16.4	—
Chicago		30.8	0	6 31	-5	11 36	-12	18.4	—
Ann Arbor	E.	31.5	6	6 20	-23	—	—	17.4	—
	N.	31.5	6	6 32	-11	11 50	-10	17.9	21.6
Ithaca	E.	33.0	17	—	—	12 22	-2	e 17.5	—
	N.	33.0	17	6 46	-10	e 12 12	-12	e 19.2	—
Toronto		33.5	11	16 56	-5	e 14 20	+108	19.8	29.1
La Paz		33.8	144	7 27	+24	13 9	+31	17.5	22.9
Ottawa		35.9	16	17 18	-3	13 6	-3	e 18.4	—
Victoria		47.6	330	—	—	30 14	?	33.7	37.4
Coimbra		75.1	51	—	—	e 21 16	-11	37.0	39.9
Eskdalemuir		78.0	35	—	—	—	—	36.4	—
Kew		80.0	39	—	—	—	—	—	49.4
Paris		82.2	42	—	—	—	—	e 38.4	46.4
Uccle		83.0	40	—	—	e 22 26	-31	—	42.4
De Bilt	E.	83.3	39	—	—	—	—	e 39.4	48.3
	N.	83.3	39	—	—	—	—	e 37.4	45.5
Strasbourg		85.6	41	—	—	e 22 56	-30	—	50.8
Hamburg		85.9	37	—	—	—	—	e 41.4	54.4
Moncalieri		86.3	46	—	—	e 24 44	+71	42.5	—
Zurich		86.4	43	36 0	?	—	—	—	—
Helwan		108.9	52	57 26	?L	—	—	(57.4)	—

Additional records: Georgetown gives LEN = +21.4m., T₀ = 16h.19m.31s.
Ann Arbor (W Instrument) LE = +17.57m., PN = +7m.32s., Toronto
iP = +10m.50s., L = +21.0m., Ottawa PR₁N = +8m.30s., PR₂N =
+8m.50s., L = +20.4m., T₀ = 16h.19m.46s., Zurich gives six records
practically identical.

July 17d. Records also at 4h. (Helwan), 7h. (close to Manila), 8h. (Riverview),
11h. (close to La Paz, also Taihoku and Zi-ka-wei, possibly repetition
from 9h.), 12h. (Taihoku (2) and Zi-ka-wei: other repetitions from 9h.?),
13h. (Mizusawa), 14h. (Taihoku and Zi-ka-wei), 15h. (Manila), 16h.
(Mizusawa), 17h. (Mauritius), 19h. (Zi-ka-wei), 20h. (close to Batavia
and Helwan), 21h. (close to Batavia), 22h. (La Paz).

July 18d. 2h. 28m. 0s. Epicentre 39°5N. 27°0W. (as on 1917 June 30d.).

A = +.687, B = -.350, C = +.636.
(Very uncertain).

		Δ	P.	O-C.	S.	O-C.	L.	M.
		°	m. s.	s.	m. s.	s.	m.	m.
Uccle		24.6	e 5 52	+18	e 9 50	-5	e 11.5	—
De Bilt		25.4	—	—	e 10 2	-9	e 12.1	13.1
Strasbourg		26.3	7 0	+69	—	—	14.0	—
Chicago		45.0	—	—	—	—	e 25.0	—

Uccle gives T₀ at 2h.28m.(54s.).

July 18d. 7h. 1m. 20s. Epicentre 36°0N. 28°0E. (as on 1918 Sept. 23d.).

A = +.714, B = +.380, C = +.588; D = +.470, E = -.883;
G = +.519, H = +.276, K = -.809.

		Δ	Az.	P.	O-C.	S.	O-C.	L.	M.
		°	°	m. s.	s.	m. s.	s.	m.	m.
Athens		3.9	302	e 0 56	-5	2 0	+13	e 2.2	2.5
Rocca di Papa		13.2	301	e 2 59	-17	—	—	e 7.7	9.5
Vienna		15.0	329	3 40	+1	11 0	?	24.7	—
Strasbourg		19.4	317	4 21?	-13	5 0	?	—	—
Hamburg		21.6	330	e 4 46	-14	e 9 4	+7	—	16.3
Paris		22.6	313	e 9 17	?S	(9 17)	0	13.7	—
De Bilt		22.8	322	—	—	e 9 18	-3	e 12.7	15.6

Additional records: Athens MN = +2.9m., T₀ = 7h.0m.57s., Rocca di Papa
e = +1m.29s., Hamburg MN = +15.3m., De Bilt MN = +13.6m.

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July 18d. 13h. 37m. 0s. Epicentre 43°-0N. 125°-0W. (as on 1918 June 12d.).

A = -·420, B = -·599, C = +·682.

(Very uncertain).

	Δ	Az.	P.	O-C.	S.	O-C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Victoria	5·5	12	1 20	- 5	—	—	2·8	3·3
Chicago	27·4	80	5 44	-18	11 10	+22	16·2	—
Washington	36·0	80	e 6 50	-32	—	—	21·0	—
Cheltenham	36·2	80	—	—	—	—	21·6	23·3
De Bilt	75·6	29	—	—	e 29 0	?	e 34·0	37·8
Uccle	76·4	30	—	—	—	—	e 33·0	37·0

Additional records: Victoria PV = +1m.16s., MV = +3·6m. Cheltenham
LN = +20·8m. De Bilt eN = +31m.0s., MN = +38·8m.

July 18d. 15h. 7m. 0s. Epicentre 24°-0N. 121°-0E. (as on 1919 July 17d. 9h.).

A = -·470, B = +·783, C = +·407.

The solution is not satisfactory, but no solution suggests itself which will suit all three near stations. Difficulties appeared also on 1919 July 17d. and 1918 April 18d.

	Δ	Az.	P.	O-C.	S.	O-C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Taihoku	1·1	24	1 41	+84	—	—	1·9	2·3
Hokoto	1·3	251	0 17	- 3	—	—	0·6	0·7
Zi-ka-wei	7·2	3	—	—	—	—	e 4·3	—
Manila	9·4	180	—	—	e 5 16	+63	—	—
De Bilt	85·6	326	—	—	—	—	e 49·0	50·0
Uccle	86·7	326	—	—	—	—	e 48·0	—

De Bilt gives MN = +50·2m.

July 18d. Records also at 0h. (San Fernando and Helwan), 5h. (Pompeii and near Osaka), 6h. (3°-3 from Tokyo and 5°-6 from Mizusawa at 6h.52m.30s., almost simultaneously with another shock recorded by Moncalieri ($\Delta = 31^\circ$) and Florence), 7h. (La Paz), 8h. (Taihoku), 10h. (Batavia and Manila), 13h. (Toronto), 17h. (Eskdalemuir), 22h. (Helwan).

July 19d. Records at 2h. (San Fernando), 5h. (Taihoku (2)), 6h. (Taihoku and Apia), 10h. (Tokyo), 14h. (Paris).

July 20d. 0h. 3m. 50s. Epicentre 36°-0N. 28°-0E. (as on July 18d. 7h.).

A = +·714, B = +·380, C = +·588.

	Δ	Az.	P.	O-C.	S.	O-C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Athens	3·9	302	1 7	+ 6	1 49	+ 2	1·9	2·2
Rocca di Papa	13·2	301	3 4	-12	—	—	—	6·0
Strasbourg	19·4	317	—	—	6 10	?	16·2	—
Uccle	22·6	318	—	—	e 9 10	- 7	e 12·2	—
De Bilt	22·8	322	—	—	e 9 14	- 7	—	15·4

Athens gives also MN = +2·4m., T₀ = 0h.4m.4s. Rocca di Papa P = +4m.4s.

July 20d. Records also at 6h.25m.20s. (between Mizusawa, Tokyo, and Osaka), 8h. (Chicago, Batavia, and Manila), 15h. 39m.0s. (close to Batavia), 16h. (San Fernando and Tokyo).

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July 21d. 19h. 3m. 53s. Epicentre 3°0S. 100°9E. (adopted from Batavia).

A = -189, B = +981, C = -052; D = +982, E = +189;
G = +010, H = -051, K = -999.

There was apparently more than one shock about this time. The Osaka records indicate one close to Osaka, and the Athens records one close to Athens; but it does not seem likely that the latter is responsible for the other European records.

	Δ	Az.	P.	O-C.	S.	O-C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Batavia	6.7	119	i 1 44	+ 2	3 6	+ 4	—	4.8
Colombo	23.3	295	10 7	?S	(10 7)	+36	—	12.1
Manila	26.5	48	e 5 35	-18	—	—	—	—
Bombay	35.2	310	6 37	-38	—	—	—	—
Osaka	49.7	39	8 39	-26	—	—	9.8	9.8
Helwan	74.0	303	23 7	?	(20 7)	-67	—	—
Rocca di Papa	90.7	313	i 13 11	- 9	—	—	—	15.1
Hamburg	93.0	324	e 14 7	+35	i 23 31	-74	e 38.1	—
De Bilt	95.9	322	—	—	e 23 48	-37	—	—
La Paz	157.6	209	20 37	[+31]	—	—	—	—

Batavia gives $T_0 = 19h.3m.53s.$ Epicentre 3°0S. 100°9E., as adopted above.

July 21d. 23h. 49m. 20s. Epicentre 42°0N. 141°0E.

A = -577, B = +467, C = +669.

This fits the observations, though a more usual position would be 38°5N. 144°5E. (as on 1917 Mar. 15).

	Δ	P.	O-C.	S.	O-C.	L.	M.
	°	m. s.	s.	m. s.	s.	m.	m.
Mizusawa	2.9	0 44	- 1	1 14	- 6	—	—
Tokyo	6.4	e 1 51	+13	—	—	—	—
Osaka	8.5	2 13	+ 4	—	—	4.3	4.5

Mizusawa SN = +1m.12s.

July 21d. Records also at 5h. (Batavia), 8h. and 12h. (Colombo), 13h. (Manila).

July 22d. 22h. 1m. 25s. Epicentre 13°0N. 83°0W. (as on 1917 Oct. 22d.).

A = +119, B = -967, C = +225; D = -993, E = -122;
G = +027, H = -223, K = -974.

The residuals suggest an epicentre about 2° nearer La Paz, say at 12°0N. 82°0W.

	Δ	Az.	P.	O-C.	S.	O-C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Balboa Heights	E. 5.3	139	0 59	-23	—	—	1.0	1.2
N.	5.3	139	1 1	-21	—	—	2.5	2.6
Vieques	E. 17.7	71	4 43	+30	—	—	9.4	11.3
Cheltenham	E. 26.3	11	6 0	+ 9	10 32	+ 4	12.7	13.2
Washington	26.4	10	i 5 45	- 7	i 10 22	- 8	12.9	—
Georgetown	E. 26.4	10	i 5 48	- 4	i 10 23	- 7	e 12.4	—
Chicago	29.1	353	i 5 49	-30	i 10 27	-52	13.1	—
Ann Arbor	29.3	359	i 5 53	-28	10 47	-35	13.1	13.5
Ithaca	E. 29.9	10	6 31	+ 4	11 29	- 4	13.7	—
Toronto	30.8	5	6 41	+ 5	12 35	+47	e 18.4	20.8
Northfield	32.4	14	6 36	-16	11 56	-18	e 15.6	—
Ottawa	33.0	9	i 6 40	-16	i 11 57	-27	e 16.1	—
La Paz	33.0	153	6 39	-17	11 56	-28	15.9	16.9
Victoria	48.6	325	—	—	—	—	33.6	37.6
Coimbra	69.9	51	—	—	e 21 5	+40	34.6	—
Esksdalemuir	73.5	36	—	—	21 35	+27	—	—
Bidston	73.6	39	10 35	-65	14 59	?PR ₁	—	26.3
Kew	75.3	40	—	—	—	—	—	43.6
Tortosa	76.7	50	11 39	-20	21 51	+ 6	33.0	41.2
Uccle	78.3	41	e 12 6	- 3	e 22 0	- 4	e 38.6	40.6
De Bilt	78.6	39	12 8	- 3	e 22 4	- 3	e 38.6	41.2
Strasbourg	80.8	42	12 21	- 3	22 27	- 6	e 29.6	—
Hamburg	81.3	37	i 12 56	+29	e 22 30	- 8	e 33.6	—
Rocca di Papa	85.6	48	e 12 47	- 4	—	—	16.6	24.2
Vienna	Z. 86.4	40	e 12 29	-26	—	—	23.6	—
Helwan	E. 103.7	54	19 35	?PR ₁	—	—	—	—
N.	103.7	54	26 35	?S	(26 35)	+ 5	—	—

For Notes see next page.

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NOTES TO JULY 22d. 22h. 1m. 25s.

Additional records: Vieques gives PN = +4m.41s. Cheltenham PN = +5m.56s., LN = +12.6m., MN = +22.3m. Georgetown IPN = +5m.47s., IPZ = +5m.46s., SZ = +10m.28s., eLZ = +12.1m., T₀ = 22h.1m.25s. Chicago PR₁ = +7m.19s. Ann Arbor. The records above are for the Bosch inst. The Wiechert gives P = +6m.5s., with others the same as above. Ithaca N sensibly same as E, T₀ = 22h.1m.42s. Toronto i = +10m.5s., T₁ = 22h.0s.42s. Ottawa i = +7m.12s., e = +7m.45s., e = +12m.55s., i = +14m.41s., T₀ = 22h.1m.25s. La Paz T₀ = 22h.1m.24s. Uccle PR₁ = +15m.10s., T₀ = 22h.1m.35s. De Bilt ePR₁E = +15m.16s., e(SR₁) = +28m.10s., m = +28m.24s., m = +28m.32s., eLN = +34.6m., MN = +45.9m., T₀ = 22h.1m.35s. Strasbourg T₀ = 22h.1m.38s. Hamburg T₀ = 22h.2m.45s. Vienna i = +13m.22s.

July 22d. Records also at 0h. (Lick), 2h. (Barcelona), 8h. (Manila), 15h. (Batavia), 17h. (Manila and Florence), 19h. (Mizusawa, Florence, and Helwan).

July 23d. Records at 0h. (San Fernando), 0h. (Batavia), 9h.53m.0s. (close to Athens), 18h. (Manila), 19h.30m.35s. (Mizusawa, perhaps repetition from 38°5N. 144°5E., as on July 21d. 23h.), 20h. (La Paz).

1919. July 24d. 2h. 3m. 20s. Epicentre 40°0N. 76°0E.

A = +.185, B = +.743, C = +.643 ; D = +.970, E = -.242 ;
G = +.155, H = +.624, K = -.766.

Since an epicentre near this (37°5N. 70°0E.) on 1917 April 21 was found to have a deep focus, the present observations were discussed for this possibility, but without a positive result.

	Δ	Az.	P.	O-C.	S.	O-C.	L.	M.
	m.	s.	m.	s.	m.	s.	m.	m.
Simla	9.0	174	e 1 58	-18	—	—	e 4.3	4.6
Dehra Dun	9.8	171	3 40	+73	—	—	—	—
Calcutta	E. 20.4	146	4 40	-6	8 22	-10	11.1	—
Bombay	21.3	188	4 48	-9	—	—	—	11.1
Kodaikanal	E. 29.9	177	10 58	?S	(10 58)	-34	15.1	16.1
Colombo	33.3	173	—	—	12 40	+11	15.7	18.2
Lemberg	37.2	301	e 8 52	+80	13 22	-5	19.4	22.8
Zi-ka-wei	37.5	89	7 29	-5	e 13 17	-14	—	26.8
Helwan	E. 37.6	268	12 46	?S	(12 46)	-46	—	27.1
	N. 37.6	268	11 46	?S	(11 46)	-106	—	22.7
Athens	E. 40.1	282	7 47	-9	i 13 55	-13	e 21.2	31.7
Taihoku	40.7	98	7 28	-33	—	—	e 23.2	24.6
Budapest	40.8	300	7 40	-21	—	—	—	—
Vienna	42.5	301	i 8 10	-5	14 16	-26	17.9	24.7
Pola	45.0	298	e 14 40	?S	(e 14 40)	-35	e 18.7	29.5
Hamburg	45.4	310	e 8 32	-4	e 15 17	+3	—	31.9
Pompeii	45.9	291	i 8 34	-5	15 30	+3	30.7	—
Kobe	46.4	78	8 48	+5	—	—	30.9	—
Manila	46.6	110	e 8 48	+4	16 58	+82	27.8	32.0
Osaka	46.7	78	8 40	-5	—	—	25.4	31.4
Rocca di Papa	46.8	293	i 8 41	-5	e 15 33	-5	e 29.2	35.2
Florence	47.1	297	9 34	+46	17 40	+118	—	24.7
Otomari	47.5	59	9 1	+10	—	—	—	—
Zurich	47.8	300	e 8 43	-10	—	—	—	—
Strasbourg	48.0	302	i 8 52	-2	i 15 52	-2	e 23.7	—
De Bilt	48.6	310	9 0	+2	16 3	+2	e 24.7	33.8
Moncalieri	49.1	300	9 3	+2	16 3	+4	e 25.4	31.0
Uccle	49.4	309	e 9 0	-3	i 16 12	+1	24.7	33.6
Besancon	49.5	302	9 4	0	16 12?	-1	—	29.7
Tokyo	49.8	74	9 9	+3	28 43	?L	(28.7)	—
Paris	51.2	308	e 9 18	+4	e 16 35	+1	20.7	31.7
Marseilles	51.3	298	e 16 29	?S	(e 16 29)	-6	30.2	—
Kew	52.0	310	19 40	?S	—	—	—	29.7
Bakdalemuir	52.4	315	9 30	+8	17 1	+12	27.7	35.0
Orford	52.5	310	9 26	+3	16 54	+4	27.6	37.6
Barcelona	54.2	297	9 36	+2	17 15	+4	30.2	35.7
Batavia	54.2	140	e 9 33	-1	—	—	30.3	12.6

Continued on next page.

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	Δ	Az.	P.	O-C.	S.	O-C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Tortosa	55.6	297	9 48	+ 5	17 32	+ 3	24.8	34.7
Rio Tinto	61.9	296	13 40	?S	(18 40)	- 7	—	45.7
Colmbra	61.9	300	19 0	?S	(19 0)	+13	30.6	40.5
San Fernando	62.3	295	13 10	?S	(18 10)	-42	35.7	38.2
Victoria	39.9	12	41 56	?L	—	—	46.9	60.8
Ottawa	90.9	340	e 13 18	- 3	e 23 52	-31	46.7	—
Cape Town	91.0	224	53 34	?L	—	—	(53.6)	54.6
Toronto	93.4	342	—	—	—	—	e 57.7	58.8
Chicago	96.8	348	24 21	?S	(24 21)	-63	43.3	—
Washington w.	97.3	339	—	—	e 24 36	-53	—	—
Honolulu	100.6	50	e 26 22	?S	(e 26 22)	+21	60.7	65.7
Riverview	101.2	—	—	—	—	—	e 61.2	—
La Paz	141.0	297	19 47	[+ 6]	34 3	?	73.7	76.2

Additional records: Lemberg gives $iS_1 = +16m.8s.$, $e = +23m.22s.$
 Zi-ka-wei $MN = +23.2m.$, $T_0 = 2h.3m.30s.$ Athens $MN = +27.1m.$, $T_0 = 2h.3m.22s.$ Hamburg $SR_1 = +19m.29s.$, $MN = +26.6m.$, $MZ = +31.8m.$,
 $T_0 = 2h.3m.21s.$ Kobe $LN = +29.4m.$ Manila $MN = +32.5m.$
 Osaka $MN = +29.6m.$ Strasbourg $SR_1 = +19m.36s.$, $T_0 = 2h.3m.23s.$
 De Bilt $PR_1E = +10m.57s.$, $SR_1E = +19m.31s.$, $eN = +19m.47s.$, $MN = +29.7m.$, $T_0 = 2h.3m.27s.$, epicentre $42^\circ 1'N. 78^\circ 0'E.$ Moncalieri $MN = +30.7m.$, $T_0 = 2h.3m.34s.$ Uccle $SR_1 = +20m.0s.$, $MN = +30.2m.$, $T_0 = 2h.3m.17s.$ Besancon $T_0 = 2h.3m.26s.$ Paris $T_0 = 2h.3m.29s.$ Eskdalemuir $SR_1 = +21m.7s.$, $T_0 = 2h.3m.25s.$ Oxford $PR_1 = +12m.35s.$, $i = +21m.0s.$ Barcelona $T_0 = 2h.3m.22s.$ Coimbra $S = +26m.4s.$, $MN = +40.3m.$ San Fernando $S = +26m.40s.$, $MN = +40.2m.$ Ottawa $eN = +17m.4s.$, $eLE = +42.2m.$, $L = +51.7m. +56.7m.$, and $+61.7m.$ Toronto $E = +44m.2s.$ and $+53m.46s.$, $eL = +72.5m.$ Chicago $S = +31m.50s.$, $L = +55.7m.$

July 24d. 4h. 43m. 55s. Epicentre $1^\circ 5'S. 76^\circ 0'W.$

$A = +.242$, $B = -.970$, $C = -.026$; $D = -.970$, $E = -.242$;
 $G = -.006$, $H = +.025$, $K = -1.000.$

	Δ	Az.	P.	O-C.	S.	O-C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
La Paz	16.9	153	14 10	+ 6	17 33	+17	8.7	10.9
Cipolletti	38.2	170	18 29	?L	—	—	24.8	27.9
Chicago	44.5	349	?8 23	- 7	?14 9	-60	?18.4	—
Bidston	81.1	37	35 35	?	40 11	?L	(40.2)	47.3
Uccle	85.1	40	—	—	e 23 24	+ 4	e 39.1	45.1
De Bilt	85.7	39	—	—	e 23 29	+ 2	e 43.1	46.0
Helwan	105.8	59	45 5	?L	—	—	(45.1)	—

La Paz gives $T_0 = 4h.43m.53s.$ De Bilt $eLN = +39.1m.$, $MN = +43.9m.$
 Helwan $PN = +46m.5s.$

July 24d. 20h. 46m. 30s. Epicentre $24^\circ 0'N. 121^\circ 0'E.$ (as on 1919 July 18d.).

$A = -.470$, $B = +.783$, $C = +.407.$

	Δ	P.	O-C.	L.	M.
	°	m. s.	s.	m.	m.
Taihoku	1.1	e 0 15	- 2	0.5	—
Zi-ka-wei	7.2	2 29	+40	—	3.4

Zi-ka-wei gives $MN = +3.5m.$

July 24d. Records also at 1h. (Pompeii), 2h. (Ootomari), 4h. (Batavia, Riverview, Manila, and La Paz), 8h. (La Paz), 11h. (Taihoku and Manila), 17h. (Rio Tinto), 20h. (San Fernando).

July 25d. 3h. 17m. 50s. Epicentre $38^\circ 5'N. 22^\circ 5'E.$ (as on 1917 Mar. 14d.).

Athens ($\Delta = 1^\circ 2'$) gives $eP = +16s.$, $L = +18s.$, $M = +20s.$ Also $eL = +29s.$, $M = +31s.$

July 25d. 3h. 43m. 0s. Close to Tokyo which gives $P = +11s.$, $S = +25s.$ Perhaps $35^\circ 0'N. 139^\circ 5'E.$ (as on 1918 June 26d.).

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July 25d. 18h. 56m. 0s. Epicentre 10°·0N. 103°·0W.?

A = -·171, B = -·970, C = +·174; D = -·974, E = +·225;
G = -·039, H = -·169, K = -·985.

	Δ	Az.	P.	O-C.	S.	O-C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Chicago	34·5	21	7 10	+ 1	12 48	0	18·8	—
Washington	37·0	36	e 9 0	?PR ₁	13 14	-10	—	—
Toronto	39·4	28	—	—	—	—	17·8	—
Victoria	42·0	340	—	—	—	—	20·6	24·6
La Paz	43·5	128	e 8 18	- 4	14 52	- 3	21·5	28·1
Honolulu	53·9	290	e 17 42	?S	(17 42)	+34	25·0	30·5
Cipolletti	57·3	149	—	—	—	—	31·1	33·6
Edinburgh	87·2	35	—	—	—	—	45·0	—
San Fernando N.	89·5	53	48 0	?L	—	—	(48·0)	—
De Bilt	93·0	36	—	—	—	—	e 45·0	50·4
Hamburg	95·1	33	—	—	—	—	e 52·0	—
Helwan	120·8	45	e 74 0	?L	—	—	(e 74·0)	—

Toronto L = +23·6m. De Bilt MN = +50·9m. Helwan gives PN = +76m.0s.

July 25d. Records also at 0h. (San Fernando), 6h. (Berkeley), 15h. (Apia), 16h. (Colombo), 17h. (Georgetown), 22h. (Barcelona), 23h. (Mizusawa).

July 26d. 13h. 47m. 40s. Epicentre 35°·0N. 143°·0E. (as on 1918 July 25d.).

A = -·654, B = +·493, C = +·574.

	Δ	Az.	P.	O-C.	S.	O-C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Tokyo	2·8	285	0 12	-32	1 6	-11	—	—
Mizusawa E.	4·4	340	1 31	+23	2 53	+52	—	—
Mizusawa N.	4·4	340	1 35	+27	2 58	+57	—	—
Osaka	6·2	270	1 36	+ 1	—	—	2·3	3·1

It is not easy to reduce these residua much by changes in adopted elements, and it seems a fair presumption that the shock is preliminary to that of August 3.

July 26d. Records also at 4h.16m. (close to Mizusawa), 5h.43m. (close to Mizusawa), 9h.17m. (near Tokyo and Mizusawa, possibly as at 13h.), 11h. (Helwan), 20h. (Perth), 22h. (San Fernando).

July 27d. 21h. 49m. 10s. Epicentre 36°·0N. 134°·0E.

A = -·562, B = +·582, C = +·588.

A position near 34°·0N. 138°·0E. would suit equally well, but is nearer Tokyo, where the shock was not recorded.

	Δ	P.	O-C.	S.	O-C.	L.	M.
	°	m. s.	s.	m. s.	s.	m.	m.
Kobe	1·6	0 35	+11	—	—	1·2	—
Osaka	1·8	0 32	+ 4	—	—	1·2	1·9
Mizusawa E.	6·4	1 38	0	2 22	-33	—	—

July 27d. Records also at 0h. (San Fernando), 13h. (Colombo), 18h. (Mizusawa), 19h. (Rio Tinto), 20h. (San Fernando).

July 28d. Records at 7h. (Helwan), 9h., 10h., 11h. (Apia), 13h. (Strasbourg and Paris), 13h. (Bidston), 14h. (Florence), 19h. (Apia).

July 29d. 13h. 27m. 40s. At 8°·0S. 105°·0E. (as on 1918 Aug. 12.).

A = -·256, B = +·956, C = -·139.

	Δ	Az.	P.	O-C.	L.	M.
	°	°	m. s.	s.	m.	m.
Batavia	2·6	45	e 0 41	0	—	1·3
Sydney	49·7	128	8 56	- 9	13·9	14·5
Riverview	49·7	128	9 20	+15	—	13·9

Manila ($\Delta = 27^{\circ} \cdot 6$) records e = +40s., which must refer to a separate shock. No way of reconciling all three records suggests itself.

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July 29d. 19h. 25m. 0s. Epicentre 33°·3N. 9°·0W. (as on 1918 April 1d.).

A = +·826, B = -·131, C = +·549; D = -·156, E = -·988;
G = +·542, H = -·086, K = -·836.

	Δ	Az.	P.		O-C.		S.		O-C.		L.		M.	
			m.	s.	m.	s.	m.	s.	m.	s.	m.	s.	m.	s.
San Fernando	3·9	35	1	12	+11	—	—	—	—	—	—	2·0	2·8	—
Tortosa	10·7	42	1	42	-62	—	—	—	—	—	—	4·0	5·0	—
Barcelona	12·0	44	—	—	—	—	—	—	—	—	e 5·3	—	5·8	—
Rocca di Papa	19·2	57	—	—	—	—	—	—	—	—	e 11·2	—	—	—
Strasbourg	19·7	34	—	—	—	—	e 9 0	+43	—	—	—	—	—	—
Uccle	20·1	26	—	—	—	—	e 9 18	+53	—	—	—	—	—	—
De Bilt	E. 21·4	24	—	—	—	—	e 9 36	+43	e 10·6	—	—	—	12·9	—

The S observations of Strasbourg, Uccle, and De Bilt suggest a more distant epicentre, but the evidence of San Fernando and Tortosa is against this. Perhaps the 3 records in question, which are simply given as e, are not S records at all, but L. De Bilt gives MN = +13·8m.

July 29d. Records also at 0h. and 2h. (San Fernando), 14h. (Helwan), 15h. (La Paz), 18h. (Barcelona).

July 30d. Records at 0h. (Pompeii), 3h. and 4h. (Florence), 9h.46m. (close to Rocca di Papa and another close to Zurich recorded also at Strasbourg and Florence), 20h. (La Paz), 21h. (Zi-ka-wei), 22h. (Zi-ka-wei and Lick (2)), 23h. (San Fernando).

July 31d. 21h. 52m. 50s. Epicentre 53°·5N. 159°·0W. (as on 1918 June 27d.).

A = -·555, B = -·213, C = +·804.

It seems impossible to reconcile the different records with a single shock. The above solution satisfies some of them approximately; others suggest another shock about three minutes later. The Strasbourg record is probably local (as on July 28), and a Lick ($\Delta = 30^\circ \cdot 3$) record iP = +23m.33s., M = +23·7m. is clearly local, and has been relegated to the final note for July 31.

	Δ	Az.	P.		O-C.		S.		O-C.		L.		M.	
			m.	s.	m.	s.	m.	s.	m.	s.	m.	s.	m.	s.
Victoria	22·8	89	(5	35)	+20	—	—	—	—	—	—	5·6	7·9	—
Chicago	47·4	76	8	21	-29	15	45	-1	e 25·2	—	—	—	—	—
Toronto	50·7	87	(13	4)	+233	(19	40)	+193	—	—	—	19·7	—	—
Ottawa	51·6	63	12	22	+185	e 16	34	-5	e 19·2	—	—	—	—	—
Northfield	54·0	61	—	—	—	e 18	0	+51	—	—	—	—	—	—
Washington	55·3	70	9	52	+11	19	23	+118	—	—	—	—	—	—
Georgetown	55·3	70	e 12	53	+192	19	26	+121	—	—	—	—	—	—
Cheltenham	55·6	70	19	53	18	(19	53)	+144	—	—	—	23·3	—	—
De Bilt	73·6	10	—	—	—	—	—	—	—	—	e 31·2	—	36·5	—
Uccle	74·7	11	—	—	—	—	—	—	—	—	e 32·2	—	—	—
Strasbourg	77·3	9	5	26	1	—	—	—	—	—	—	—	—	—

Ottawa iN = +13m.27s. The records for P and S were not assigned to them at the station. The same applies to Georgetown P and Northfield S. Cheltenham FN(=PS?) = +19m.55s. De Bilt MN = +35·8m.

July 31d. Records also at 0h. and 1h. (Rocca di Papa), 2h. (San Fernando and Zi-ka-wei), 3h. (Rocca di Papa), 5h. (La Paz), 7h. (Rocca di Papa, Honolulu, Melbourne, Riverview, Victoria, and Chicago), 8h. (La Paz, Toronto, Uccle, De Bilt, and Helwan), 19h. (Zi-ka-wei and Athens), 20h. (Hamburg, De Bilt, Uccle, Strasbourg, and San Fernando), 21h. (Strasbourg, Lick, and Berkeley), 23h. (Lick).

Aug. 1d. Records at 1h. (Manila), 5h. (Zi-ka-wei), 6h. (De Bilt), 7h. (Kingston and San Fernando), 13h. (Riverview), 14h. (Hamburg and Helwan).

Aug. 2d. Records at 0h. (San Fernando and La Paz), 3h. (Simla), 10h. (Bidston), 11h.7m. (close to Tokyo), 15h.42m. (close to Tokyo), 16h. (Taihoku), 18h. (Simla), 22h. (Chicago).

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Aug. 3d. 9h. 45m. 0s. Epicentre 31°·5N. 19°·5E.

A = +·804, B = +·285, C = +·523; D = +·334, E = -·943;
G = +·492, H = +·174, K = -·853.

This epicentre fits the observations, but lies sensibly to the S.W. of the usual region. A mistake in any of the records would modify it considerably, e.g. if the Athens P is really S.

	Δ	Az.	P.	O-C.	S.	O-C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Athens	7·3	28	1 56	+ 5	—	—	2·5	3·1
Pompeii	10·1	338	e 2 45	+14	e 3 30	-62	—	15·0
Helwan	E. 10·3	96	11 0	?	—	—	—	—
Rocca di Papa	11·6	334	e 2 54	+ 1	5 12	+ 3	—	5·7
Vienna	16·9	353	—	—	e 7 6	-10	—	8·3
Hamburg	23·1	346	—	—	e 11 0	?L (e 11·0)	—	—
De Bilt	23·1	337	—	—	—	e 11·0	—	13·1

Additional records: Athens MN = +2·8m. Helwan PN = +15m.0s. De Bilt MN = +12·5m. Pompeii gives its record 1m. late.

Aug. 3d. 18h. 8m. 40s. Epicentre 35°·0N. 143°·0E. (as on 1919 July 26d.).

A = -·654, B = +·493, C = +·574; D = +·602, E = +·799;
G = -·458, H = +·345, K = -·819.

The La Paz residual suggests a high focus, but there is no support elsewhere.

	Δ	Az.	P.	O-C.	S.	O-C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Tokyo	2·8	285	0 40	- 4	1 8	- 9	—	—
Mizusawa	E. 4·4	340	1 20	+12	2 27	+26	—	—
Osaka	6·2	270	1 41	+ 6	—	—	3·0	3·8
Kobe	6·4	266	1 42	+ 4	—	—	3·0	3·8
Otomari	11·6	359	5 10	?S	(5 10)	+ 1	7·8	8·8
Taihoku	21·0	247	8 33	?S	(8 33)	-11	14·0	—
Manila	28·5	230	e 7 34	+81	—	—	—	—
Honolulu	53·0	88	—	—	—	—	34·3	39·3
Colombo	64·2	260	39 20	?L	—	—	(39·3)	43·3
Hamburg	32·6	335	—	—	e 22 20	-33	e 42·3	47·3
Vienna	Z. 34·1	328	12 47	+ 4	—	—	e 46·3	—
Edinburgh	34·7	342	—	—	—	—	44·3	55·3
Eskdalemuir	35·1	341	—	—	e 23 15	- 5	43·3	—
De Bilt	E. 35·4	336	—	—	23 18	- 5	e 44·3	53·2
Uccle	N. 35·4	336	—	—	23 19	- 4	e 45·3	52·7
Bidston	36·8	340	e 13 2	+ 5	e 23 20	-18	e 43·3	55·1
Strasbourg	37·4	331	43 50	?L	—	—	(43·8)	53·7
Kew	37·7	338	—	—	e 23 30	-15	e 45·3	—
Helwan	38·6	306	—	—	24 20	+21	—	56·3
Paris	39·1	335	—	—	—	—	e 48·3	56·3
Chicago	90·3	37	—	—	e 24 20	+ 3	41·3	—
Rocca di Papa	90·7	326	17 17	?PR ₁	27 5	+164	e 51·8	58·4
Barcelona	95·5	331	e 42 50	?	—	—	e 51·6	55·9
San Fernando	E. 103·0	335	59 20	?L	—	—	(59·3)	85·3
La Paz	N. 103·0	335	56 50	?L	—	—	(56·8)	87·3
	146·6	65	20 28	[+37]	—	—	—	—

Additional records: Mizusawa SN = +2m.23s. Osaka MN = +3·7m.
Kobe MN = +3·3m. Otomari gives S = +6m.55s. (?L). Hamburg
MZ = +54·3m., MN = +55·6m. De Bilt SR₂N = +29m.32s. Uccle SR₁ =
+29m.20s., MN = +46·3m. Strasbourg eL = +49·3m. Chicago L =
+51·3m.

Aug. 3d. 20h. 27m. 8s. Epicentre 35°·0N. 143°·0E. (as at 18h.).

	Δ	P.	O-C.	S.	O-C.	M.
	°	m. s.	s.	m. s.	s.	m.
Tokyo	2·8	0 48	+ 4	0 57	-20	—
Mizusawa	E. 4·4	0 46	-22	2 4	+ 3	—
Osaka	6·2	2 4	+29	—	—	3·5

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Aug. 3d. 20h. 53m. 7s. Epicentre 35°·0N. 143°·0E. (as at 20h. 27m.).

		Δ	P.	O-C.	S.	O-C.	L.	M.
		°	m. s.	s.	m. s.	s.	m.	m.
Tokyo		2·8	0 36	- 8	1 15	- 2	—	—
Mizusawa	E.	4·4	1 8	0	2 9	+ 8	—	—
	N.	4·4	1 12	+ 4	2 13	+12	—	—
Osaka	E.	6·2	2 0	+25	—	—	3·0	3·7
Batavia		53·5	8 48	-42	9 3	?	—	—

Osaka gives MN = +4·0m. The Batavia record probably refers to a local shock.

Aug. 3d. 21h. 15m. 52s. Epicentre 35°·0N. 143°·0E. (as at 20h., &c.).

		Δ	Az.	P.	O-C.	S.	O-C.	L.	M.
		°	°	m. s.	s.	m. s.	s.	m.	m.
Tokyo		2·8	285	0 44	0	0 58	-19	—	—
Mizusawa	E.	4·4	340	1 20	+12	2 9	+ 8	—	—
De Bilt		85·1	338	—	—	—	—	e 27·1	30·4
Uccle		86·7	338	—	—	—	—	e 23·1	29·1
Helwan		88·6	306	34 8	?L	—	—	(34·1)	—

Mizusawa gives SN = +2m.8s. De Bilt MN = +29·9m. Helwan PN (=LN?) = 38·1m. But the last three records almost certainly refer to some other shock.

Aug. 3d. Records also at 0h. (Perth), 1h. (Rocca di Papa), 2h. (San Fernando), 3h. (La Paz and Kodaikanal), 6h. (Batavia), 9h. (Florence), 11h. (Helwan), 14h. (Manila), 16h. (Chicago, Vieques, Batavia, and Taihoku), 17h. (Helwan), 18h. (Colombo, Edinburgh, and Barcelona), 22h. (close to Tokyo and Taihoku).

Aug. 4d. Records at 3h. (La Paz and Helwan), 4h. (Tokyo), 19h. (San Fernando).

Aug. 5d. Records at 4h. (Riverview), 5h. (Apia and Melbourne), 6h. (Helwan and Rio Tinto), 9h. (Apia), 10h. (Manila), 20h. (La Paz), 22h. (Barcelona).

Aug. 6d. Records at 4h. (San Fernando), 5h. (Manila and Batavia), 11h. (close to Tokyo), 14h.-16h. (Florence), 16h. (Taihoku), 18h. (Manila, Batavia, following Manila as at 5h., De Bilt e 18h.34m.18s., Uccle e 18h.35m., Helwan and Strasbourg 18h.40m.).

Aug. 7d. 6h. 50m. 50s. Epicentre 24°·0N. 121°·0E. (as on 1919 July 24d.).

A = -·470, B' = +·783, C = +·407; D = +·857, E = +·515;
G = -·210, H = +·349, K = -·914.

	Δ	Az.	P.	O-C.	L.	M.
	°	°	m. s.	s.	m.	m.
Taihoku	1·1	24	0 15	- 2	0·6	0·6
Hokoto	1·3	251	0 32	+12	1·3	—
Zi-ka-wei	7·2	3	e 1 34	-15	—	4·1
Helwan	77·9	297	52 10	?	—	—
Hamburg	82·3	327	e 42 10	?L	(e 42·2)	52·2
De Bilt	85·6	326	—	—	e 44·2	54·7
Edinburgh	87·2	332	—	—	54·2	—

Additional records: Zi-ka-wei MN = +3·8m. Helwan PN = +51m.10s.
De Bilt MN = +56·0m.

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Aug. 7d. 16h. 31m. 25s. Epicentre 38°·5N. 146°·0E. (as on 1918 June 1d.).

A = -·649, B = +·438, C = +·622; D = +·559, E = +·829;
G = -·516, H = +·348, K = -·783.

	Δ	Az.	P.	O-C.	S.	O-C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Mizusawa	3·8	274	0 56	- 3	1 40	- 4	—	—
Tokyo	5·7	243	1 18	-10	2 37	+ 1	4·0	4·7
Osaka	9·3	249	2 44	+24	—	—	4·4	5·2
Zi-ka-wei	21·3	259	—	—	e 9 39	+49	—	—
Hamburg	80·4	335	—	—	—	—	e 41·6	51·6
Eskdalemuir	82·6	343	—	—	—	—	44·6	—
Edinburgh	82·1	343	—	—	—	—	46·6	—
De Bilt	83·8	337	—	—	22 45	-22	e 41·6	47·3
Uccle	84·6	337	—	—	—	—	e 44·6	—
Helwan	88·4	308	24 35	?S	(24 35)	+39	—	—
Rocca di Papa	89·1	327	—	—	—	—	e 49·3	58·3
San Fernando	100·8	338	52 35	?L	—	—	(52·6)	—

Additional records: Mizusawa SN = +1m.36s. Osaka MN = +5·4m.
De Bilt eLN = +43·6m., MN = +55·8m. Helwan PN = +23m.35s. (?S).

Aug. 7d. Records also at 0h. (San Fernando), 8h. (La Paz and Edinburgh),
10h. (close to Apia), 16h. (Mizusawa (2)).

Aug. 8d. 5h. 1m. 10s. Epicentre 21°·0S. 67°·0W. (as on 1917 Nov. 2d.).

A = +·365, B = -·860, C = -·358; D = -·920, E = -·391;
G = -·140, H = +·330, K = -·934.

	Δ	Az.	P.	O-C.	S.	O-C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
La Paz	4·6	345	i 1 26	+15	—	—	2·2	2·9
Andalgalá	6·6	176	—	—	—	—	6·4	8·0
Pilar	11·1	166	5 26	?S	(5 26)	+29	6·4	17·5
Mendoza	12·0	186	(3 26)	+27	(5 44)	+25	5·7	(5·9)
Cipolletti	18·0	183	—	—	(6 32)	-68	6·5	10·6
Washington	60·6	351	10 12	- 4	18 14	-17	—	—
Chicago	65·6	344	10 28	-21	19 1	-31	e 31·8	—
Coimbra	82·0	41	e 13 24	+54	22 25	-21	e 40·3	—
Granada	83·3	47	e 12 43	+ 5	i 24 0	+60	—	—
Tortosa	88·0	45	13 15	+10	(e 23 33)	-33	e 23·6	—
Barcelona	89·3	34	—	—	(23 14)	-86	—	39·8
Bidston	92·5	34	23 14	?S	—	—	—	—
Eskdalemuir	93·4	29	—	—	23 40	-69	39·8	—
Edinburgh	93·7	30	—	—	23 58	-55	40·8	—
Uccle	95·1	38	—	—	e 24 4	-63	e 43·8	—
Strasbourg	96·1	40	—	—	e 24 14	-63	e 43·8	—
De Bilt	E. 96·1	36	—	—	24 3	-74	e 48·8	50·0
	N. 96·1	36	—	—	—	—	e 49·8	51·4
Rocca di Papa	96·5	49	e 24 14	?S	(e 24 14)	-67	—	27·3
Helwan	107·2	64	—	—	26 50	-13	—	—

Additional records: La Paz gives MN = +2·2m. Pilar MN = +8·5m.
Mendoza. All the records have been increased by 4m.0s. Chicago L =
+34·8m. and +41·3m. Coimbra eLN = +35·3m. Bidston gives
S as P. Eskdalemuir gives S as P, with S = +30m.44s. Edinburgh
S as P, with S = +31m.15s. Rocca di Papa gives S as P. Granada
iP = +12m.59s., i = +22m.59s. Helwan gives S as P, with PN =
+23m.50s.

Aug. 8d. Records also at 0h. (San Fernando), 4h. (La Quiaca), 8h. (Apia), 12h.
(Mizusawa), 13h. (Apia and Manila), 20h. (Rocca di Papa).

Aug. 9d. 12h. 25m. 35s. Epicentre 21°·0S. 67°·0W. (as on Aug. 8d.).

	Δ	P.	O-C.	S.	O-C.	L.	M.
	°	m. s.	s.	m. s.	s.	m.	m.
La Paz	4·6	1 24	+13	—	—	2·1	2·3
Mendoza	12·0	4 25	+86	—	—	—	7·9
Uccle	95·1	—	—	e 24 1	-66	—	—
Strasbourg	96·1	—	—	22 25	-172	30·4	—
De Bilt	96·1	—	—	24 6	-71	49·4	—

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Aug. 9d. 14h. 38m. 0s. Epicentre 48°·5N. 28°·0E.?

$$A = +.585, B = +.311, C = +.749.$$

The adopted epicentre lies outside the usual region, and the solution is otherwise unsatisfactory, for the residuals suggest a position nearer Vienna and Rocca di Papa, but further from the other stations, which are inconsistent requirements.

	Δ	P.	O-C.	S.	O-C.	L.	M.
	°	m. s.	s.	m. s.	s.	m.	m.
Vienna	z. 7.7	e 1 46	-11	—	—	e 3.5	5.4
Strasbourg	12.0	—	—	e 6 0	+41	—	—
Hamburg	12.4	—	—	e 6 0	+31	—	—
Rocca di Papa	12.7	3 6	-3	—	—	—	4.5
De Bilt	15.0	—	—	e 6 54	+22	e 7.6	8.8
Uccle	15.4	—	—	e 8 0	?L	(e 8.0)	—

De Bilt MN = +9.1m.

Aug. 9d. 22h. 41m. 30s. Epicentre 33°·3N. 9°·0W. (as on 1919 July 29d.).

$$A = +.826, B = -.131, C = +.549; \quad D = -.156, E = -.988; \\ G = +.542, H = -.086, K = -.836.$$

	Δ	Az.	P.	O-C.	S.	O-C.	L.	M.
	°		m. s.	s.	m. s.	s.	m.	m.
Granada	5.9	47	2 11	+40	2 53	+12	13.1	—
Coimbra	6.9	4	e 5 15	+210	6 7	+180	6.8	7.2
Algiers	10.5	67	1 32	-65	—	—	2.2	2.2
Tortosa	10.7	42	2 10	-30	—	—	3.1	4.2
Barcelona	12.0	44	e 3 12	+13	—	—	3.6	4.4
Rocca di Papa	19.2	57	e 3 33	-58	—	—	e 8.0	11.0
Oxford	19.4	15	—	—	—	—	9.2	10.3
Strasbourg	19.7	34	—	—	—	—	e 8.3	9.9
Uccle	20.1	26	—	—	—	—	e 7.9	9.5
De Bilt	21.4	24	—	—	—	—	e 8.9	12.8
Edinburgh	23.0	9	—	—	—	—	11.3	13.3
Hamburg	24.4	28	—	—	—	—	e 11.5	—
Helwan	34.4	84	19 30	?L	—	—	(19.5)	—

Additional records: De Bilt LN = +10.1m. Helwan PN = +18m.30s.

Aug. 9d. Records also at 0h. (San Fernando and Lemberg), 4h. (La Paz), 5h. Denver, 7h. (Edinburgh), 11h. (Vieques), 12h. (Helwan), 13h. (close to La Quiaca and Helwan).

Aug. 10d. Records at 3h. (Denver and San Fernando), 7h. (Taihoku), 14h. (Helwan), 20h. (San Fernando), 21h. (La Paz).

Aug. 11d. 5h. 5m. 0s. Epicentre 51°·5S. 75°·5W.

$$A = +.156, B = -.603, C = -.783.$$

	Δ	Az.	P.	O-C.	S.	O-C.	L.	M.
	°		m. s.	s.	m. s.	s.	m.	m.
La Paz	35.5	10	7 16	-2	13 0	-3	17.4	19.1
Uccle	122.5	48	—	—	—	—	—	67.0
Helwan	123.0	83	81 0	?	—	—	—	—
De Bilt	E. 123.7	47	—	—	—	—	e 61.0	67.4
	N. 123.7	47	—	—	e 38 54	?SR ₁	65.0	67.5
Strasbourg	125.7	50	—	—	—	—	e 61.0	—

Helwan gives PN = +87m.0s. De Bilt gives eE = +43m.18s.

Aug. 11d. Records also at 7h. (Zi-ka-wei and Apia), 8h. (Colombo), 9h. (Simla), 11h. (La Paz), 13h. (Lemberg), 18h. (San Fernando), 23h. (San Fernando and Rocca di Papa).

Aug. 12d. Records at 10h. (Helwan), 14h. (Helwan), 16h. (La Paz), 18h. (San Fernando), 19h. (Taihoku), 22h. (Mizusawa).

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Aug. 13d. 0h. 21m. 0s. Epicentre 39°·5N. 27°·0W. (as on 1919 July 18d.).

A = +·687, B = -·350, C = +·636; D = -·454, E = -·891;
G = +·567, H = -·289, K = -·772.

	Δ	Az.	P.	O-C.	S.	O-C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Azores	2·1	148	0	12	-21	—	—	2·3
Tortosa	21·2	77	2	24	-151	—	10·4	11·3
Edinburgh	22·7	36	—	—	10	0	+41	—
Uccle	24·6	52	—	—	e 10	48	+53	46·0
De Bilt	E. 25·4	49	—	—	e 11	24	+73	13·8
	N. 25·4	49	—	—	10	18	+7	13·6
Strasbourg	26·3	58	—	—	e 11	0	+32	16·3
Kingston	47·9	260	9	0	+7	—	+33	20·0
Victoria	65·2	314	—	—	(20	0)	—	—

If Azores record is 1m. too small, we can increase T_0 by 30—40sec., which will remove the greater part of the errors. Tortosa may also be 2m. in error.

Aug. 13d. Records also at 0h. (Riverview), 1h. (De Bilt), 2h. (San Fernando), 6h. (Rio Tinto), 12h. (Azores), 13h. (De Bilt), 20h. (Taihoku), 21h. (Helwan, San Fernando, and Berkeley), 22h. (Manila).

Aug. 14d. 7h. 59m. 30s. About 2° from Manila, which gives $eP = +25s.$, $L = +1·0m.$, $ME = +1·3m.$, $MN = +1·7m.$

Aug. 14d. 16h. 6m. 55s. About 0°·5 from Rocca di Papa, which records $eP = +8s.$, $S = +16s.$, $M = +0·3m.$

Aug. 14d. Records also at 0h. and 2h. (La Paz), 5h. (Mizusawa), 6h. (Manila), 13h. (close to Tokyo), 15h. (La Quiaca), 17h. (Kodaikanal), 21h. (San Fernando), 22h. (Lick and Rocca di Papa).

Aug. 15d. 2h. 6m. 30s. Epicentre 34°·6N. 140°·7E. (as on 1919 June 8d.).

A = -·637, B = +·521, C = +·568.

	Δ	P.	O-C.	S.	O-C.	L.	M.	
	°	m. s.	s.	m. s.	s.	m.	m.	
Tokyo	1·3	0	7	-13	0	19	-17	—
Osaka	4·3	1	28	+21	—	—	2·5	3·4
Mizusawa	4·5	1	0	-10	—	—	—	—

Osaka gives $MN = +3·1m.$

Aug. 15d. 4h. 17m. 26s. Epicentre 31°·0S. 43°·0W.

A = +·627, B = -·585, C = -·515; D = -·682, E = -·731;
G = -·377, H = +·351, K = -·857.

	Δ	Az.	P.	O-C.	S.	O-C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Pilar	17·8	262	7	22	?S	(7 22)	-14	10·9
Andalgala	20·6	274	—	—	—	—	—	18·4
Cipolletti	22·0	242	4	40	-25	(6 10)	-175	6·2
La Paz	27·1	397	6	2	+3	11	4	+21
Chicago	33·5	329	12	39	0	22	49	-14
Strasbourg	91·8	31	e 16	34	+188	—	—	35·9
Uccle	91·8	38	e 16	34	+188	—	—	—
De Bilt	93·1	28	—	—	e 30	1	?SR ₁	e 52·6
Helwan	93·2	57	21	34	?S	(21 34)	?	e 58·6
Edinburgh	93·7	21	—	—	—	—	—	60·6
Vienna	z. 95·3	35	e 13	13	-32	—	—	—
Hamburg	96·2	29	e 16	34	+164	—	—	—
Melbourne	110·8	187	—	—	—	—	—	41·6
								46·6

Additional records: Strasbourg gives $e_1 = +14m.34s.$, $e_2 = +16m.34s.$ The former has been credited to the following shock. Uccle gives $e_1 = +29m.52s.$, $e_2 = +36m.34s.$ De Bilt gives $e(PR) = +17m.49s.$, $e = +37m.5s.$, $eLN = +63·6m.$, $MN = +67·5m.$ For Rocca di Papa and Pompeii see following shock:

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Aug. 15d. 4h. 23m. 50s. About 11°·0 from Rocca di Papa, which records eP = +2m.41s., S = +4m.50s., M = +5.3m. Pompell gives eP = +2m.54s., M = +4.5m. The record of this shock would perhaps obscure that of the previous shock. Again some of the European records, credited to the above shock, may be really due to this, but it is not easy to specify the epicentre for this. Query 37°·0N.0°?

Aug. 15d. Records also at 0h. (San Fernando), 5h. (Hamburg and Helwan), 10h. (near Sidney and Riverview), 12h. (Lemberg), 14h. (Helwan), 15h. (Edinburgh and Manila), 17h. (Lemberg and Mizusawa), 19h. (Kingston), 23h. (Rocca di Papa, San Fernando, and Lick).

Aug. 16d. Records at 4h. (San Fernando), 8h. (Colombo), 11h.4m.50s. (about 1° from Taihoku, which gives P = +28s., L = +0.7m., M = +1.2m.), 12h. (Helwan), 15h. (Manila), 16h. (Helwan), 19h. (Mizusawa), 21h. (Zurich), 22h. (Batavia).

Aug. 17d. Records at 2h. (San Fernando and Batavia), 5h., 8h., and 14h. (Helwan), 17h. (Nagasaki), 18h. (Mizusawa), 19h. (La Quiaca and La Paz.).

Aug. 18d. 11h. 17m. 30s. Epicentre 51°·0N. 34°·0W. (as on 1917 April 20d.).

A = +.521, B = -.352, C = +.777; D = -.559, E = -.829;
G = +.644, H = -.434, K = -.629.

	Δ	Az.	P.	O-C.	S.	O-C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Edinburgh	18.3	63	—	—	8 30	+43	—	—
Uccle	23.9	75	—	—	—	—	e 10.7	—
De Bilt	24.1	72	—	—	e 9 40	- 6	e 11.5	13.8
Hamburg	26.6	67	e 8 20	+146	—	—	e 14.0	15.5
Strasbourg	26.6	79	—	—	—	—	e 12.6	—
Rocca di Papa	32.9	88	e 8 49	+113	—	—	—	11.3
Pompell	34.6	88	8 11	+61	—	—	—	10.8
Chicago	37.2	279	—	—	e 13 30	+ 3	e 19.2	—
Helwan	52.1	89	17 30	?S	(17 30)	+45	—	—

De Bilt gives MN = +14.3m. Strasbourg gives its record 1h. wrong.
Pompell gives its record 1h. late. Helwan gives PN = +13m.30s.

1919. Aug. 18d. 16h. 55m. 25s. Epicentre 17°·0S. 177°·5W.

(as on 1918 May 22d.).

A = -.955, B = -.042, C = -.292; D = -.044, E = +.999;
G = +.292, H = +.013, K = -.955.

(The same focal depth 0.050 has been assumed as on 1918 May 22, but seems rather excessive).

	Corr. for Focus	Δ	Az.	P.	O-C.	S.	O-C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.	m.
Apia	+0.1	6.3	61	i 1 57	+19	—	—	8.5	—
Sydney	E. -3.4	32.7	232	3 29	-172	5 23	-359	8.2	10.8
Riverview	-3.4	32.7	232	e 5 52	-29	i 11 32?	+10	12.5	13.4
Melbourne	-3.9	38.9	230	6 35	-38	—	—	14.6	15.4
Honolulu	-4.3	42.8	29	8 17	+25	i 14 5	+20	e 20.6	36.6
Perth	-5.6	61.6	242	9 27	-19	—	—	17.2	—
Tokyo	-5.8	66.4	324	9 33	-43	e 18 3	-28	31.4	—
Mizusawa	E. -5.8	68.1	328	10 43	+16	19 22	+30	—	—
	N. -5.8	68.1	328	10 44	+17	19 29	+37	—	—
Osaka	-5.8	68.3	320	10 45	+16	—	—	19.5	21.9
Manila	-5.9	68.4	295	e 10 41	+12	15 44	-191	19.3	20.0
Kobe	E. -5.9	68.5	320	10 39	+10	—	—	19.4	20.4
Taihoku	-6.0	72.7	306	11 18	+22	—	—	20.1	—
Otomari	-6.0	73.0	334	11 22	+24	—	—	20.6	20.7
Batavia	-6.1	74.5	269	11 10	+ 3	i 20 13	+ 6	e 32.6	—
Berkeley	N. -6.1	75.4	41	e 11 27	+14	e 20 53	+35	—	—
	E. -6.1	75.4	41	e 11 30	+17	e 20 52	+34	—	—
Zi-ka-wei	-6.1	75.9	311	e 11 27	+11	20 47	+23	—	—
Victoria	-6.2	81.2	33	—	—	—	—	—	21.7
Cipolletti	-6.5	93.6	133	—	—	24 53	+71	(24.9)	27.4

Continued on next page.

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	Corr. for Focus	Δ	Az.	P.	O-C.	S.	O-C.	L.	M.
			m. s.	m. s.	s.	m. s.	s.	m.	m.
Andalgala	-6.7	99.8	125	31.1
Pilar	-6.7	99.9	130	27.2
Calcutta	E. -6.7	100.1	290	23 23	?S	(23 23)	-86	—	—
Chicago	-6.8	101.1	50	10 24	?	23 30	-89	35.6	—
La Paz	-6.8	102.7	112	e 17 45	?PR ₁	23 32	-103	27.0	27.6
Ann Arbor	-6.9	104.0	50	25 5?	?S	(25 5?)	-22	44.6	—
Colombo	E. -6.9	104.1	271	23 35	?	25 35	+7	29.4	30.6
Toronto	-7.0	107.3	49	—	—	—	—	36.1	38.3
Washington	-7.0	108.5	53	—	—	e 25 40	-30	44.4	—
Ithaca	-7.0	109.3	48	e 20 11	?PR ₁	25 50	-28	33.7	—
Ottawa	-7.1	110.1	46	—	—	i 26 7	-17	44.2	—
Simla	-7.1	111.5	298	e 26 11	?S	(e 26 11)	-26	—	34.5
Mauritius	E. -7.2	114.2	237	19 41	?PR ₁	—	—	—	47.4
Cape Town	—	128.9	196	39 17	?	—	—	—	41.9
Edinburgh	—	140.9	6	40 25	?	46 8	?	54.6	—
Eskdalemuir	—	141.4	6	18 55	[-47]	28 38	-153	44.6	—
Lemberg	—	142.8	358	e 18 59	[-46]	e 28 41	-159	e 67.7	69.9
Hamburg	—	142.9	352	i 19 6	[-39]	i 28 51	-149	e 46.6	—
De Bilt	—	144.8	357	19 14	[-34]	e 32 47	+76	—	90.1
Kew	—	145.5	3	—	—	—	—	—	42.6
Uccle	—	148.2	358	e 19 16	[-34]	i 29 6	-152	—	—
Vienna	—	148.8	341	i 19 12	[-39]	i 29 12	-149	44.6	65.6
Strasbourg	—	148.1	351	i 19 26	[-27]	—	—	—	—
Paris	—	148.2	1	e 19 27	[-26]	i 29 21	-147	38.6	—
Zurich	—	149.2	351	e 19 21	[-33]	—	—	—	—
Helwan	—	150.7	302	19 53	[-4]	—	—	—	44.6
Florence	—	152.2	346	—	—	—	—	—	—
Rocca di Papa	—	153.7	343	e 19 19	[-42]	19 55	[-6]	—	20.0
Pompeii	—	154.1	339	e 19 27	[-34]	29 27	?	—	—
Coimbra	—	154.9	21	i 19 48	[-14]	28 24	?	36.9	—
Barcelona	—	155.5	0	e 19 52	[-10]	29 57	?	—	44.0
Tortosa	—	158.1	5	18 47	[-76]	29 58	?	43.6	43.7
Granada	—	159.1	14	e 19 29	[-38]	i 33 43	?	—	—
San Fernando	—	159.1	20	23 35	?PR ₁	30 5	?	45.6	53.6

Additional records: Apia has been corrected by -1h. Riverview gives eP = +5m.58s., iPR₁ = +7m.11s. and +7m.28s., i = +13m.6s., MN = +13.5m., T₀ = 16h.55m.17s. Melbourne gives SR₁ = +10m.11s. Osaka MN = +20.4m. Berkeley ePV = +11m.29s., T₀ = 16h.57m.26s. Chicago L = +55.1m. Ann Arbor PN = +25m.17s. Toronto L = +30.0m., eL = +58.5m. Ithaca SN = +25m.53s., L = +28.8m. Ottawa iN = +20m.53s., eE = +20m.55s., iN = 38m.3s. and +44m.13s., eL = +47.2m., LE = +64.6m. Eskdalemuir PR = +22m.20s. Lemberg iPR₁ = +22m.15s., ePR₂ = +24m.53s., eSR₁ = +32m.11s., eSR₂ = +34m.53s., +37m.35s., and +40m.17s. De Bilt iPRN = +29m.1s., eN = +32m.23s., MN = +76.3m. Uccle PR₁ = +22m.47s. Vienna PR₁ = +23m.1s., SR₂ = +38m.59s., SR₃ = +39m.54s. Strasbourg iPR₁ = +28m.31s. Paris ePN = +19m.21s. Helwan PN = +22m.17s., MN = +42.3m. Florence simply gives 17h. to 19h. Coimbra LN = +35.8m. Granada i = +20m.15s.

Aug. 18d. 20h. 52m. 0s. Repetition from 17°-0S. 177°-5W. (as at 16h.?).

(Reduced with same elements as at 16h.).

	Corr. for Focus	Δ	Az.	P.	O-C.	S.	O-C.	L.	M.
			m. s.	m. s.	s.	m. s.	s.	m.	m.
Sydney	-3.4	32.7	232	5 12	-69	—	—	9.8	11.0
Riverview	-3.4	32.7	232	—	—	(e 11 24)	+2	e 11.4	16.6
Melbourne	-3.9	38.9	230	—	—	13 0	+5	e 15.1	18.8
Berkeley	-6.1	75.4	41	—	—	—	—	e 37.0	—
Chicago	-6.8	101.1	50	—	—	—	—	e 52.0	—
De Bilt	—	144.8	357	—	—	—	—	e 88.0	—
Uccle	—	148.2	357	—	—	—	—	e 86.0	91.0
Helwan	—	150.7	302	33 0	?S	—	—	—	—

Additional records: Riverview gives MN = +13.4m. Chicago L = +58.0m. and +64.0m. Helwan a later PE = +88.0m., PN = +91.0m., which might possibly refer to some phase of the above shock.

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Aug. 18d. Records also at 0h. (Athens), 1h. and 3h. (San Fernando), 4h. (Taihoku), 5h. (Toronto), 7h. (Helwan), 8h. (De Bilt and Hamburg), 12h. (Pompeii and Strasbourg), 17h. (La Paz, Marseilles, and Taihoku), 19h. (Rio Tinto), 20h. (Colombo).

Aug. 19d. 14h. 20m. 55s. Epicentre $18^{\circ}5'N$. $120^{\circ}0'E$ (as on 1917 Sept. 17d.).

$$A = -474, B = +821, C = +309.$$

	Δ	P.	O-C.	S.	O-C.	L.	M.
	°	m. s.	s.	m. s.	s.	m.	m.
Manila	4.0	e 0 53	- 9	—	—	1.8	2.2
Taihoku	7.2	1 56	+ 7	—	—	2.9	—
Zi-ka-wei	12.8	—	—	e 6 9	+30	—	—

Manila gives $MN = +2.3m.$, and suggests as epicentre $18^{\circ}8'N$. $121^{\circ}0'E$. But the residuals favour a position further South, say $17^{\circ}5'N$. or $18^{\circ}0'N$.

Aug. 19d. 20h. 17m. 20s. Epicentre $35^{\circ}2'N$. $34^{\circ}7'E$. (as on 1918 Sept. 29d.).

$$A = +672, B = +465, C = +576; \quad D = +569, E = -822; \\ G = +474, H = +328, K = -817.$$

	Δ	Az.	P.	O-C.	S.	O-C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Helwan	6.0	209	7 40	?M	—	—	—	—
Athens	9.2	291	—	—	e 6 5	+117	i 7.1	7.6
Lemberg	16.6	335	e 6 16	?S	(e 6 16)	-53	8.8	12.3
Budapest	17.0	321	16 34	?M	—	—	—	—
Rocca di Papa	18.4	298	e 4 47	+25	e 8 28	+39	e 11.3	13.7
Vienna	18.8	320	e 4 34	+ 7	7 54	- 4	e 10.6	15.1
Strasbourg	24.1	311	e 5 19	-10	e 10 1	+15	e 13.7	—
Hamburg	25.2	324	e 6 28	+48	—	—	e 14.3	16.7
Uccle	26.9	315	—	—	10 30	- 9	e 14.7	—
De Bilt	26.9	318	—	—	10 31	- 8	e 13.7	17.9
Tortosa	27.3	290	6 39	+38	11 13	+27	12.6	20.7
Kew	29.7	314	—	—	—	—	—	22.7
Eskdalemuir	32.8	320	—	—	e 12 0	-21	18.7	—
Edinburgh	33.0	321	19 40	?M	—	—	—	—

De Bilt gives $iN = +10m.36s.$, $MN = +16.2m.$. Helwan $PN = +9m.40s.$ The solution fits certain stations (Vienna, Strasbourg, Uccle, De Bilt) fairly well, but other records are puzzling, especially those nearest the adopted epicentre, which suggests an origin much further away. It is not, however, easy to satisfy the two sets of conditions.

Aug. 19d. Records also at 0h. (Eskdalemuir, De Bilt, Uccle), 1h. (Sydney and Melbourne), 2h. (close to Balboa Heights), 3h. (Taihoku and Helwan), 4h. (Kew), 5h. (Taihoku and Rocca di Papa), 6h. (Kobe), 7h. (Rio Tinto), 9h. (Apia), 11h. (close to Athens), 21h. (Rocca di Papa and Florence (3)), 22h. (La Paz).

Aug. 20d. 3h. 58m. 0s. Close to Rocca di Papa, which gives $P = +25s.$, $S = +43s.$, $M = 51s.$ Pompeii gives $eP = +29s.$

Aug. 20d. 11h. 12m. 30s. Close to Batavia, which gives $P = +24s.$, $S = M = +40s.$, and notes Malabar $iS - P = 15s.$

Aug. 20d. 19h. 32m. 10s. Close to Rocca di Papa, which gives $eP = +8s.$, $M = +2.5m.$ Pompeii gives $eP = +59s.$, $eS = +1m.39s.$

Aug. 20d. Records also at 0h. (San Fernando), 9h. (Melbourne), 10h. (Colombo and Helwan), 15h. (Helwan), 21h. (San Fernando), 23h. (Taihoku (2) and Zi-ka-wei).

Aug. 21d. 9h. 39m. 15s. Close to Manila, which gives $eP = +17s.$, $L = +34s.$, $MN = +37s.$

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Aug. 22nd 18m. 30s. Close to Taihoku, which gives P = +14s., L = +29s., I = +30s.

Aug. 22nd records also at 4h. (close to Tokyo), 7h. (Rio Tinto and Batavia), 8h. (Helwan and Rio Tinto), 9h. (Manila), 12h. (Helwan), 15h. (Azores), 16h. (Azores, Batavia, and Taihoku), 17h. (La Paz), 20h. (San Fernando and La Paz), 22h. (Azores (3)), 23h. (Azores).

Aug. 22nd 30m. 15s. Epicentre 19°-0N. 70°-0W. (as on 1919 May 20d.).

$$A = +.323, B = -.889, C = +.326.$$

	Δ	P.	O-C.	S.	O-C.	L.	M.
	°	m. s.	s.	m. s.	s.	m.	m.
Vieques	4.4	0 42	-26	—	—	1.1	1.3
Washington	20.8	4 52	+ 1	8 10	-30	—	—
Chiba	27.3	6 2	+ 1	10 59	+13	15.1	—
La Paz	35.6	7 12	- 6	—	—	—	—

Vieques also MN = +1.2m.

Aug. 22nd 35m. 55s. Epicentre 41°-0N. 24°-6E. (as on 1919 Jan. 22d.).

$$I = +686, B = +.314, C = +.656; D = +.416, E = -.909;$$

$$G = +.596, H = +.273, K = -.755.$$

	Δ	Az.	P.	O-C.	S.	O-C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Athens	3.2	193	e 0 49	- 1	1 30	+ 2	1.6	1.9
Pompi	7.6	272	i 1 13	-42	2 40	-46	—	3.3
Budapest	7.6	331	1 59	+ 4	—	—	—	—
Pech	8.7	300	e 2 59	+47	—	—	e 4.3	4.4
Rome/Papa	9.0	279	e 1 26	-50	3 24	-39	—	3.7
Vieques	9.3	324	e 2 35	+15	5 10	+60	i 5.6	6.3
Florence	10.2	290	—	—	—	—	—	4.1
Helwan	12.4	152	8 5	?	—	—	—	—
Zurich	13.1	305	e 3 1	-13	—	—	—	—
Strasbourg	14.1	308	e 3 5	-22	e 7 36	+86	i 8.9	—
Madrid	14.4	286	e 2 47	-45	—	—	—	—
Hamburg	16.0	327	e 4 17	+25	—	—	e 8.7	9.8
Batavia	16.8	279	—	—	—	—	e 5.7	9.3
Uchi	17.1	312	—	—	e 6 59	-21	e 8.9	9.5
De Bilt	17.3	316	—	—	7 15	-10	9.0	11.3
Pech	17.3	304	—	—	e 9 5	?L	(9.1)	10.1
Kiev	20.0	310	—	—	—	—	—	13.1
Oxford	20.7	310	8 7	?S	(8 7)	-31	11.2	13.7
Batavia	23.2	318	—	—	e 9 2	-27	12.1	—
Edinburgh	23.4	319	6 27	+66	9 17	-16	12.1	15.3
Colum	24.9	279	8 51	?S	(8 51)	-70	12.1	—

Additional records: Athens iP = +0m.55s., T. = 22h.35m.52s. Helwan
 PN = 4m.5s. = S?. Florence M = +4.6m. Hamburg MN = +12.2m.,
 MZ = 11.9m. De Bilt LN = +8.2m., MN = +10.9m. Coimbra
 eLN = 11.2m.

Aug. 22nd records also at 0h. (Azores (2) and Tokyo), 1h. (Azores), 2h. (San Fernando), 3h. (Denver), 3h. (near Azores), 7h. (near Azores), 11h. (Florence and Rocca di Papa), 12h. (close to Azores), 20h. (Azores), 21h. (San Fernando and La Paz), 23h. (San Fernando).

Aug. 23rd 12m. 30s. Epicentre 24°-0N. 121°-0E. (as on 1919 Aug. 7d.).
 (See below Taihoku records P = +0m.30s. Zi-ka-wei e(?S) = +2m.46s.
 A nearby Taihoku at 5h.30m.0s. is possibly a repetition.

Aug. 23rd 12m. 30s. Epicentre 24°-0N. 121°-0E. (as above).

	Δ	P.	O-C.	S.	O-C.	L.	M.
	°	m. s.	s.	m. s.	s.	m.	m.
Taihoku	1.1	0 21	+ 4	—	—	0.7	0.7
Hokkaido	1.5	0 42	?S	(0 42)	0	—	—
Zi-ka-wei	7.2	—	—	e 2 56	-19	—	—

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Aug. 23d. 8h. 22m. 30s. Possible repetition of above. * Taihoku records P = +0m.23s., L = +0m.39s.

Aug. 23d. Records also at 5h. (Taihoku, as above), 10h. and 11h. (Azores), 13h. (Zi-ka-wei), 16h. (Honolulu), 17h. (Lick and Azores), 18h. (San Fernando), 23h. (Apia and Zi-ka-wei).

Aug. 24d. 1h. 45m. 55s. Epicentre 41°·7N. 8°·5E. (as on 1918 May 6d. 8h.).

$$A = +\cdot738, B = +\cdot110, C = +\cdot665.$$

	Δ	P.	O-C.	S.	O-C.	M.
	°	m. s.	s.	m. s.	s.	m.
Rocca di Papa	3·1	e 0 46	- 3	1 25	- 1	1·6
Pompeii	4·6	1 15	+ 4	—	—	—

Aug. 24d. 5h. 13m. 40s. Epicentre 43°·0N. 125°·0W. (as on 1919 July 18d.).

$$A = -\cdot420, B = -\cdot599, C = +\cdot682; \quad D = -\cdot819, E = +\cdot574; \\ G = -\cdot391, H = -\cdot559, K = -\cdot731.$$

(But whole solution very uncertain owing to slenderness of material.)

	Δ	Az.	S.	O-C.	L.	M.
	°	°	m. s.	s.	m.	m.
Victoria	5·5	12	—	—	—	2·8
Berkeley	5·5	157	—	—	e 4·3	—
Chicago	27·4	80	e 11 4	+16	—	—
Toronto	32·8	72	—	—	i 15·6	15·9
Ottawa	34·9	69	—	—	e 17·3	—
Honolulu	34·9	243	—	—	14·6	20·3
Ithaca	35·1	74	—	—	48·3	—
Georgetown	36·0	80	e 17 46	?L	26·5	—
Washington	36·0	80	e 11 20	-110	—	—
Edinburgh	69·6	31	—	—	40·3	—
De Bilt	75·6	29	e 21 32	- 1	e 32·3	43·0

Toronto gives L = +1·5m. (which probably refers to another shock), also e = +22m.8s. and +46m.56s. Ottawa gives +45·3m. De Bilt MN = +44·6m.

Aug. 24d. 18h. 16m. 18s. Epicentre 36°·0N. 28°·0E. (as on 1919 July 20d.).

$$A = +\cdot714, B = +\cdot380, C = +\cdot588; \quad D = +\cdot470, E = -\cdot883; \\ G = +\cdot519, H = +\cdot276, K = -\cdot809.$$

	Δ	Az.	P.	O-C.	S.	O-C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Athens	3·9	302	e 1 12	+11	2 12	+25	2·4	2·5
Helwan	6·7	154	6 42	?M	—	—	—	(6·7)
Rocca di Papa	13·2	301	e 3 18	+ 2	e 6 24	+35	e 8·3	9·7
Strasbourg	19·4	317	4 36	+ 2	—	—	—	15·7
Hamburg	21·6	330	—	—	e 8 42	-15	—	14·7
Uccle	22·5	318	e 5 10	- 1	e 9 6	- 9	—	15·7
De Bilt	22·8	322	—	—	e 9 30	+ 9	—	16·4
Edinburgh	29·0	323	—	—	—	—	—	16·7

Athens gives the T, adopted, but notes "P uncertain." Also MN = +2·5m. Helwan PN = +8m.42s. Rocca di Papa gives ePN = 4m.0s. and another P at +3m.24s. De Bilt eN = +10m.42s., MN = +14·4m.

Aug. 24d. Records also at 0h. (Apia), 1h. (San Fernando), 5h. (Mizusawa), 8h. (Azores), 10h. (La Paz), 11h. (La Paz and Sydney), 12h. (Victoria, Edinburgh, Berkeley, Toronto, Chicago, and Helwan; possibly repetition from 43°·0N. 125°·0W., as at 5h.; if so at T₀ = 12h.41m. ± it is curious that Toronto again gives a double record, L = 12h.45m.54s. and L = 12h.58m.54s., of which the second is appropriate to the above supposition), 13h. (Edinburgh, possibly due to the shock just mentioned), 14h. (Helwan), 16h. (Azores), 19h. (Melbourne, Sydney, Riverview, and Chicago), 20h. (Taihoku and close to Osaka), 21h. (San Fernando and Helwan).

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Aug. 25d. 3h. 33m. 0s. Close to Granada, which records $iP = +16s$. Tortosa gives $P = +1m.32s.$, $L = +2.7m.$, $M = +3.6m$.

Aug. 25d. 19h. 55m. 15s. Epicentre $32^{\circ}0'N$, $100^{\circ}0'E$.

$A = -.148$, $B = +.835$, $C = +.530$; $D = +.985$, $E = +.174$;
 $G = -.092$, $H = +.522$, $K = -.848$.

The epicentre $29^{\circ}0'N$, $104^{\circ}0'E$. of 1917 July 30d. was tried and found quite unsuitable.

	Δ	Az.	P.	O-C.	S.	O-C.	L.	M.
	$^{\circ}$	$^{\circ}$	m. s.	s.	m. s.	s.	m.	m.
Calcutta	14.2	230	5 57	?S	(5 57)	-16	8.8	—
Zi-ka-wei	18.3	87	e 4 22	+ 1	e 7 52	+ 5	—	12.0
Simla	19.4	274	e 8 51	?S	(8 51)	+41	—	12.4
Nagasaki	25.1	80	10 14	?S	(10 14)	+ 9	13.9	14.5
Manila	25.9	128	5 45	- 2	—	—	14.8	17.1
Osaka	29.6	75	—	—	11 0	-27	—	19.0
Kodaikanal	30.2	230	21 45	?	—	—	—	—
Colombo	31.0	221	14 45	?L	—	—	—	23.3
Tokyo	33.0	72	—	—	—	—	e 16.2	—
Batavia	38.7	169	7 36	- 8	13 33	-15	e 20.3	21.4
Lemberg	57.5	312	—	—	e 26 9	?	32.4	34.3
Helwan	58.0	286	—	—	26 45	?	—	—
Budapest	61.3	311	—	—	—	—	e 43.1	—
Vienna	62.8	312	e 12 45	+134	—	—	e 32.7	40.7
Hamburg	64.8	320	—	—	e 19 45	+22	e 34.8	41.6
De Bilt	67.6	319	—	—	20 47	+50	e 34.8	44.2
Florence	67.7	310	e 34 45	?L	—	—	(34.8)	39.5
Strasbourg	68.0	314	—	—	—	—	e 38.3	—
Uccle	69.0	318	e 20 51	?S	(20 51)	+37	e 35.8	44.9
Edinburgh	70.7	324	—	—	—	—	37.8	47.0
Paris	71.0	317	—	—	—	—	e 37.8	—
Eskdalemuir	71.0	324	—	—	—	—	35.8	—
Kew	71.3	320	—	—	—	—	—	44.8
Coimbra	82.2	313	—	—	—	—	e 42.7	—
San Fernando	82.9	310	43 45	?L	—	—	(43.8)	—

Additional records: Zi-ka-wei gives $MN = +10.4m.$, $T_0 = 19h.55m.16s.$
 Manila $MN = +17.9m.$, Osaka $MN = +18.2m.$, Helwan $PN = +27m.45s.$, Hamburg $MN = +36.7m.$, De Bilt $SN = +20m.49s.$, $e = +28m.35s.$, $MN = +39.2m.$, epicentre $30^{\circ}7'N$, $99^{\circ}6'E$. Uccle $S = +29m.3s.$
 $MN = +39.6m.$

Aug. 25d. 21h. 50m. 14s. About $0^{\circ}6'$ from Athens, which records $P = +9s.$, $iLN = +23s.$, $ME = +35s.$, $MN = +32s.$ See two other shocks on Aug. 26d.

Aug. 25d. Records also at 1h. (San Fernando), 4h. (Azores), 7h. and 9h. (Apia), 12h. (Barcelona and Tortosa), 15h. (Lick), 16h. (Pompeii), 20h. (Taihoku and Apia).

Aug. 26d. 0h. 2m. 20s. About $0^{\circ}6'$ from Athens (as on Aug. 25d. 21h.), which records $PN = +9s.$, $L = +23s.$, $ME = +27s.$, $MN = +30s.$ (possibly $39^{\circ}0'N.$, $23^{\circ}0'E.$, as on 1918 Jan. 20d.).

Aug. 26d. 3h. 17m. 57s. About $0^{\circ}6'$ from Athens as above, $eP = +9s.$, $eL = +23s.$, $ME = +27s.$, $MN = +30s.$

Aug. 26d. Records also at 5h. (La Paz and Tortosa), 7h. (Rio Tinto), 9h. (Azores), 12h. (Lick and Berkeley), 14h. (Berkeley and Lick (2)), 22h. (San Fernando), 23h. (Lick).

Aug. 27d. 1h. 1m. 56s. Epicentre $24^{\circ}0'N$, $121^{\circ}0'E$. (as on 1919 Aug. 23d.).

$A = -.470$, $B = +.783$, $C = +.407$.

	Δ	P.	O-C.	L.	M.
	$^{\circ}$	m. s.	s.	m.	m.
Taihoku	1.1	0 14	- 3	0.3	0.4
Zi-ka-wei	7.2	e 1 56	+ 7	—	—

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Aug. 27d. 5h. 21m. 18s. Epicentre 19°·0N. 144°·0E. (as on 1919 May 19d.).

A = -·765, B = +·556, C = +·326; D = +·588, E = +·809;
G = -·263, H = +·191, K = -·946.

	Δ	Az.	P.	O-C.	S.	O-C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Tokyo	17·1	348	3 46	-20	7 2	-18	9·8	—
Kobe	17·4	336	4 10	0	—	—	7·7	13·4
Osaka	17·4	336	4 10	0	—	—	—	—
Mizusawa	20·3	354	4 24	-21	7 51	-38	—	—
Taihoku	21·6	290	—	—	e 9 24	+27	11·2	—
Manila	22·5	262	e 5 36	+25	—	—	12·5	—
Zi-ka-wei	23·7	305	e 5 24	-1	e 42 38	?	—	—
Ootomari	27·7	358	5 54	-11	—	—	—	—
Batavia	44·4	238	e 8 33	+4	—	—	—	12·1
Riverview	53·3	173	—	—	—	e 23·3	25·7	—
Honolulu	54·2	78	e 8 24	-70	16 12	-59	26·7	33·9
Adelaide	54·2	184	16 54	?S	(16 54)	-17	29·0	31·8
Melbourne	56·8	179	18 18	?S	(18 18)	+34	31·5	37·7
Colombo	63·4	268	19 42	?S	(19 42)	+36	—	41·7
Kodaikanal	64·8	272	37 24	?L	—	—	(37·4)	—
Victoria	77·6	42	21 1	?S	(21 1)	-55	—	47·1
Berkeley	81·3	52	—	—	—	—	e 32·7	—
Lemberg	93·2	325	—	—	—	—	e 57·5	62·3
Hamburg	97·4	334	e 17 36	?PR ₁	—	—	e 47·7	56·7
Vienna	98·1	328	17 36	?PR ₁	—	—	e 53·7	65·2
Helwan	98·9	306	24 42	?S	(24 42)	-63	—	—
Edinburgh	100·1	340	—	—	32 12	?SR ₁	47·7	—
De Bilt	100·4	334	—	—	e 24 36	-84	e 49·7	51·6
Eskdalemuir	100·6	340	—	—	—	—	48·7	—
Uccle	101·7	334	—	—	—	—	e 50·7	65·7
Strasbourg	102·0	330	—	—	—	—	e 50·2	63·7
Chicago	102·8	37	24 27	?S	(24 27)	-115	40·4	—
Kew	102·9	339	—	—	—	—	—	68·7
Florence	103·7	325	49 42	?	—	—	53·7	56·7
Rocca di Papa	104·4	324	e 15 31	+59	—	—	e 54·0	76·8
Ann Arbor	104·5	34	—	—	23 42	-176	—	—
Toronto	105·9	30	—	—	—	—	57·9	73·2
Ottawa	106·1	27	e 18 26	[+18]	e 27 36	+43	50·9	—
Barcelona	110·0	330	—	—	—	—	e 57·2	74·4
Georgetown	110·5	32	e 17 42	[-42]	—	—	64·1	—
Coimbra	115·4	337	35 42	?	—	—	51·7	—
La Paz	149·3	90	19 43	[-12]	33 52	+118	71·7	81·1

Additional records: Osaka MN = +13·6m. Mizusawa PN = +4m.23s., SN = +7m.55s., T₀ = 5h.21m.23s. Riverview e = +5m.7s., MN = +38·1m. Adelaide PR₁ = +18m.54s., S = +23m.30s., SR₁ = +25m.36s. Melbourne PR₁ = +20m.0s. (=SR₁?), SR₁ = +28m.30s.(?). Perth (Δ = 57°·7) gives simply 5h.49m. to 7h.9m. Victoria gives S = +25m.27s. (=SR₁?). Hamburg MNZ = +65·7m. Helwan PN = +30m.42s. De Bilt MN = +55·6m., epicentre 21°·0N.145°·1E. Chicago S = +31m.54s. = SR₁?, L = +50·7m. and +63·7m. Toronto alternatives for L +24·5m. (=S?), +38·5m. (=SR₁?), and +62·0m. Ottawa IPN = +18m.27s., i = +24m.52s., eN = +27m.42s., eL = +65·8m. and +78·2m. Coimbra ePN = +34m.24s., LN = +61·7m., LE = +63·7m.

Aug. 27d. Records also at 1h. (San Fernando), 4h. (Helwan), 6h. (Azores), 7h. (Manila), 11h. (Denver), 16h. (Helwan), 17h. (Apia), 18h. (Azores), 20h. (San Fernando), 22h. (La Paz).

Aug. 28d. 19h. 34m. 22s. Epicentre 24°·0N. 121°·0E. (as on 27d.).

A = -·470, B = +·783, C = +·407; D = +·857, E = +·515;
G = -·210, H = +·349, K = -·914.

	Δ	Az.	P.	O-C.	S.	O-C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Taihoku	1·1	24	0 35	+18	—	—	0·8	1·1
Hokoto	1·4	252	0 8	-13	—	—	0·5	0·5
Zi-ka-wei	7·2	3	e 1 49	0	e 3 27	+12	—	4·5
Colombo	42·9	255	29 8	?	—	—	—	30·3
Kodaikanal	43·6	260	28 26	?	—	—	—	—
Honolulu	73·6	74	—	—	—	—	e 41·6	52·6

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	Δ	Az.	P.	O-C.	S.	O-C.	L.	M.
	$^{\circ}$	$^{\circ}$	m. s.	s.	m. s.	s.	m.	m.
Vienna z.	81.3	320	12 23	4				
Hamburg	82.3	326					e 42.6	
De Bilt	85.6	326			e 23 41	+15	e 42.6	46.5
Strasbourg	86.2	321						57.6
Uccle	86.7	326						46.6
Edinburgh	87.2	332					44.6	56.6
Eskdalemuir	87.5	332					42.6	
Kew	88.6	328						57.6

Additional records: Hokoto M = +1.0m. Zi-ka-wei MN = +5.0m., T_o = 19h.34m.12s. De Bilt eLN = +43.8m., MN = +45.8m. Colombo and Kodaikanal probably record a local shock, as indicated by the short interval from P to M at Colombo. Strasbourg gives another vague record at +61.8m.

Aug. 28d. Records also at 2h. (San Fernando and Helwan), 14h. (La Paz and Helwan), 20h. (Helwan and San Fernando), 23h. (close to Osaka and Kobe).

1919. Aug. 29d. 5h. 43m. 45s. Epicentre 3°S. 128°5E.

A = -621, B = +781, C = -061; D = +783, E = +622;
G = +038, H = -048, K = -998.

This earthquake was originally assigned to the epicentre 2°0S. 133°0E., as on 1918 Jan. 21d.; but the residuals showed the solution to be defective and on discussion in the usual way indicated the above position, which was then seen to fall with some precision on the line through four other epicentres, as below. The column C for the latitude is from the formula 35°0 - 0.3 X long.

	Long E.	Lat.	C.	O-C.
1917 Nov. 14d.	119.7	-0.7	-0.9	+0.2
1917 June 3d.	122.0	-2.0	-1.6	-0.4
1919 Aug. 29d.	128.5	-3.5	-3.6	+0.1
1917 Aug. 30d.	136.0	-6.0	-5.8	-0.2
1917 July 27d.	140.0	-7.0	-7.0	0.0

	Δ	Az.	P.	O-C.	S.	O-C.	L.	M.
	$^{\circ}$	$^{\circ}$	m. s.	s.	m. s.	s.	m.	m.
Manila	19.5	338	4 27	-8	(8 15)	+2	8.3	11.7
Batavia	21.7	262	e 4 58	-3	9 1	+2		9.6
Taihoku	29.3	347	6 12	-9	(11 36)	+14	11.6	18.7
Perth	31.0	201	6 41	+3	10 57	-54	17.6	
Adelaide	32.8	165	6 45	-10	11 57	-34	15.2	20.2
Zi-ka-wei	35.4	350	e 7 3	-14	e 12 27	-34	e 15.2	17.8
Riverview	37.0	146	e 7 34	+4	i 13 18	-6	i 15.8	26.4
Sydney	37.0	146	7 33	+3	13 27	+3	20.3	27.0
Melbourne	37.5	160	8 3	+29	(13 15)	-16	20.3	32.0
Kobe	38.6	10	7 46	+3			19.8	20.3
Osaka	38.8	10	7 36	-8	13 38	-11	18.6	22.2
Tokyo	40.6	15	7 45	-15	16 7	+112	20.4	22.2
Mizusawa	44.2	15	8 20	-7	14 53	-12		
Calcutta	47.0	307	8 39	-8	(15 21)	-20	15.3	
Colombo	49.6	282	8 45	-19	16 45	+31	20.7	36.6
Ootomari	51.7	12	9 25	+7	(16 45)	+5	16.8	
Kodaikanal	52.6	286	11 45	?PR ₁			27.6	34.8
Bombay	59.1	296	10 11	+5				33.6
Simla	59.8	310	10 39	+28	18 33	+12	25.2	40.4
Apia	59.8	103	e 10 33	+22	(18 50)	+29	18.8	36.3
Mauritius	70.8	250	6 15	?	(20 45)	+9	20.8	35.5
Honolulu	76.0	67	e 16 15	?	21 45	+8	43.3	47.4
Helwan	98.0	300	14 51	+51				
Lemberg	101.9	320	e 19 45	?PR ₁	e 27 15	+61	e 54.9	77.3
Athens	103.8	309	e 17 33	[-27]	e 27 51	+80	53.3	56.3
Capetown	104.4	232	24 45	?S	(24 45)	-112		56.3
Victoria	104.6	40	18 18	?PR ₁	24 42	-116	28.3	28.6
Budapest	105.6	319	e 17 57	[-10]				
Vienna	107.2	320	e 18 45	?PR ₁	28 9	+66	e 62.3	80.8
Berkeley	107.2	50	e 18 36	?PR ₁				
Lick	107.9	50					e 45.3	
Hamburg	109.4	326	e 19 15	?PR ₁			e 52.3	63.4

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	Δ	Az.	P.	O-C.	S.	O-C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Rocca di Papa	111.4	313	e 18 51	?PR ₁	—	—	e 58.8	79.0
Florence	111.8	316	19 25	?PR ₁	—	—	—	33.3
De Bilt	112.6	326	—	—	e 25 33	-138	e 57.3	69.7
Strasbourg	112.6	320	e 18 45	[+15]	e 30 22	?SR ₁	—	69.1
Uccle	113.6	325	e 19 39	?PR ₁	25 39	-140	—	70.6
Edinburgh	114.9	331	19 51	?PR ₁	—	—	—	75.1
Eskdalemuir	115.3	331	19 51	?PR ₁	29 33	+81	45.8	62.4
Paris	115.6	323	e 25 43	?S	(25 43)	-152	59.3	68.3
Kew	115.9	327	25 15	?S	(25 15)	-182	—	73.3
Oxford	116.3	327	—	—	—	—	—	129.2
Bidston	116.4	330	24 33	?S	33 51	?SR ₁	—	81.8
Tucson	117.5	53	—	—	—	—	55.1	64.6
Barcelona	118.9	315	e 19 27	?PR ₁	136 27	?SR ₁	61.3	74.1
Tortosa	120.3	315	20 23	?PR ₁	36 50	?SR ₁	58.3	75.2
Granada	124.8	313	e 20 56	?PR ₁	—	—	—	—
Coimbra	126.6	320	22 20	?PR ₁	32 40	+183	47.0	78.1
San Fernando	126.9	313	21 18	?PR ₁	—	—	72.8	97.3
Chicago	130.0	34	21 32	?PR ₁	28 25	-96	35.4	—
Toronto	132.9	26	23 3	?PR ₁	(32 33)	+133	67.0	85.8
Ottawa	133.0	21	i 23 2	?PR ₁	e 32 7	+106	68.2	—
Ithaca	135.1	26	e 22 19	?PR ₁	—	—	71.1	—
Washington	137.7	30	e 22 37	?PR ₁	29 27	-83	e 72.3	—
Georgetown	137.7	30	e 22 32	?PR ₁	—	—	e 72.3	—
Cheltenham	137.9	30	22 46	?PR ₁	—	—	72.6	82.7
La Paz	154.1	141	i 20 19	[+18]	134 27	?	75.6	81.6

Additional records: Manila MN = +10.4m. Adelaide PR₁ = +8m.27s., SR₁ = +13m.27s. Zi-ka-wei MN = +19.0m. T₀ = 5h.44m.0s. River-view PR₁ = +9m.5s., PR₂ = +9m.17s., PS = +13m.39s., SR₁ = +15m.35s., SR₂ = +16m.8s., MN = +24.4m., T₀ = 5h.43m.59s. Sydney PR₁ = +9m.15s. Melbourne SR₁ = +13m.15s., SR₂ = +15m.27s. Kobe MN = +20.7m. Osaka MN = +20.2m., T₀ = 5h.43m.44s., Δ = 5040km. Mizusawa SN = +14m.51s., T₀ = 5h.43m.51s. Mauritius L = +20m.51s., MN = +31.6m. Helwan PN = +17m.39s. = PR₁?. Lemberg i = +24m.39s. Athens iPR₁ = +24m.49s. Capetown M = +67.8m. Victoria L = +35.2m. Budapest recorded at 5h.1m.42s.: altered to 6h. Hamburg MN = +63.2m., MZ = +70.3m. De Bilt PR₁ = +19m.36s., e = +22m.6s., eLN = +58.3m., MN = +64.7m. Strasbourg e = +19m.15s. iPR₁ = +30m.20s., e = +35m.25s., e = +39m.23s., e = +46m.19s., MN = +75.4m. Uccle i = +35m.28s., i = +39m.34s., i = +46m.39s., MN = +64.6m. Edinburgh M = +84.6m. Eskdalemuir T₀ = 5h.51m.52s. Barcelona PR₁(?) = +26m.34s. Coimbra PN = +20m.52s., SN = +33m.8s., SR₁N = +38m.7s., SR₁N = +42m.48s., MN = 81.2m. San Fernando MN = +92.3m. Chicago L = +39.0m. and +62.3m. Toronto E? = +14m.57s., L = +32.6m., L = +51.2m., eL = +73.3m., i = +70m.51s., i = +71m.39s. Ottawa eN = +28m.48s., eN = +40m.5s., L = +81.3m., +91.3m. Ithaca eN = +43m.30s., eE = +49m.13s., eN = +54m.58s., LN = +67.4m. Washington eL = +37.3m. Georgetown PN = 22m.43s., ePZ = +22m.43s., eL = +42.3m., L = +42.5m. Cheltenham PN = +22m.53s., LN = +71.6m. La Paz Δ = 18000km.

Aug. 29d. 6h. 41m. 30s. At 36°2N. 21°4E. (as on 1918 Jan. 27d.?).

A = +.751, B = +.294, C = +.591.

	Δ	P.	O-C.	S.	O-C.	L.	M.
	°	m. s.	s.	m. s.	s.	m.	m.
Athens	2.5	e 0 43	+ 4	e 1 19	+10	e 1.4	1.6
Rocca di Papa E.	8.7	2 18	+ 6	—	—	—	—
N.	8.7	1 54	-18	—	—	—	—

Aug. 29d. 13h. 46m. 45s. Epicentre 15°0S. 165°0E.

A = -.933, B = +.250, C = -.259; D = +.259, E = +.966;
G = +.250, H = -.067, K = -.966.

	Δ	Az.	P.	O-C.	S.	O-C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Sydney	22.6	211	6 33	+81	(9 27)	+10	9.5	12.3
Riverview	22.6	211	e 5 5	- 7	i 9 12	- 5	—	10.4
Melbourne	28.9	214	6 45	+28	10 45	-30	12.4	14.3
Adelaide	31.0	225	5 45	-53	11 21	-31	15.8	17.3
Honolulu	51.3	46	e 15 21	?S (e 15 21)	—	-74	27.3	32.3

Continued on next page.

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	Δ	Az.	P.	O-C.	S.	O-C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Manila	52.6	303	e 9 41	+17	—	—	—	—
Batavia	57.7	274	e 10 1	+ 4	17 56	+ 1	—	—
Zi-ka-wei	62.3	320	10 14	-13	—	—	—	—
Colombo	87.1	278	23 45	?S	(23 45)	+ 3	—	25.3
Victoria	89.6	40	47 48	?L	—	—	(47.8)	53.7
Toronto	119.0	48	—	—	47 48	?	49.4	—
Helwan	135.0	297	23 15	?PR ₁	(29 15)	-78	—	—
Vienna	137.9	330	19 14	[-22]	—	—	—	24.6
Rocca di Papa	144.1	323	19 22	[-25]	—	—	—	19.6
Tortosa	150.9	336	19 41	[-16]	—	—	20.9	21.0

Additional records: Adelaide PR₁ = +7m.21s., SR₁ = +13m.27s. River-view PR₁ = +5m.39s., PR₁ = +6m.4s., PS = +9m.22s., SR₁ = +10m.1s., T₀ = 13h.46m.25s. Honolulu gives eS as eP and records eS = +21m.15s.

Aug. 29d. Records also at 0h. (Osaka), 5h. (La Paz), 6h. (Victoria and Athens), 8h. (Kodakanal and Tokyo), 23h. (Tucson).

Aug. 30d. 6h. 4m. 0s. Epicentre 19° 3N. 62° 5W. (as on 1918 June 11d.).

A = +.436, B = -.837, C = +.330; D = -.887, E = -.462;
G = +.153, H = -.293, K = -.944.

	Δ	Az.	P.	O-C.	S.	O-C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Vieques E.	3.0	249	0 49	+ 2	(1 12)	-11	1.2	1.6
Washington	23.3	330	5 36	+16	9 20	-11	—	—
Chicago	31.0	321	5 36	-62	11 17	-34	16.3	—
La Paz	36.2	189	—	—	e 13 0	-13	22.3	23.8
De Bilt	61.2	40	—	—	—	e 30.0	35.4	—

Additional records: Vieques PN = +48s. It is above assumed that L should be S. De Bilt gives eLN = +34.0m., MN = +37.5m.

Aug. 30d. Records also at 0h. (San Fernando), 2h. (Hamburg), 3h. (San Fernando), 11h. (Helwan (2)), 13h. (Ithaca), 15h. (Azores), 17h. (Manila), 19h. (La Paz), 20h. (Taihoku, Rio Tinto, and San Fernando), 22h. (Taihoku).

Aug. 31d. 0h. 24m. 40s. Epicentre 59° 2N. 151° 0W. (as on 1918 April 15d. 8h.).

A = -.448, B = -.248, C = +.859.

(Very uncertain; it is difficult to interpret the Chicago record.)

	Δ	P.	O-C.	S.	O-C.	L.	M.
	°	m. s.	s.	m. s.	s.	m.	m.
Victoria	19.4	4 32	- 2	—	—	9.9	12.9
Chicago	42.0	—	—	e 26 40	?M	—	—
Toronto	44.8	—	—	(14 44)	-28	14.7	—

Aug. 31d. 2h. 32m. 48s. Epicentre 34° 5N. 41° 8E. (as on 1918 April 25d.).

A = +.614, B = +.549, C = +.566; D = +.667, E = -.746;
G = +.422, H = +.378, K = -.824.

	Δ	Az.	P.	O-C.	S.	O-C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Lemberg	20.1	325	e 7 30	?S	(7 30)	-55	e 10.8	12.1
Vienna	23.3	314	1 5 16	- 4	—	—	e 9.8	15.2
Rocca di Papa	33.9	297	5 24	- 3	9 42	0	18.4	—
Strasbourg	28.8	310	e 17 12	?M	—	—	—	—
De Bilt	31.4	315	—	—	e 12 0	+ 2	—	20.3
Uccle	31.5	313	—	—	—	e 16.2	—	18.2

Additional records: Lemberg gives e = +9m.12s. Rocca di Papa PN = +5m.54s., eS = +10m.18s. De Bilt MN = +18.5m.

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1919. Aug. 31d. 17h. 20m. 34s. Epicentre 15° OS. 165° OE.
(as on 1919 Aug. 29d.).

A = -.933, B = +.250, C = -.259; D = +.259, E = +.966;
G = +.250, H = -.067, K = -.966.

(But see Note at end as regards deep focus and for revised epicentre to 15° 7S. 167° 3E.)

	E. N.	Δ	Az.	P.		O-C.		S.	O-C.		L.	M.
				m. s.	s.	m. s.	s.		m.	m.		
Apia		22.5	90	i 4	34	-37	i 9	1	-14	—	—	9.4
Sydney		22.6	211	5	2	-10	9	8	-9	12.0	—	13.2
Riverview		22.6	211	i 5	10	-2	i 9	16	-1	10.1	—	13.1
Melbourne		28.0	214	6	44	+27	11	44	+29	14.4	—	15.4
Adelaide		31.9	225	6	26	-12	11	32	-19	15.3	—	18.5
Honolulu		51.3	46	i 8	50	-25	—	—	—	e 19.4	—	22.4
Manila		52.6	303	e 9	30	+6	(17	0)	+9	(17.0)	—	17.6
Tokyo		56.0	338	9	29	-17	12	8	?PR ₁	19.4	—	—
Osaka		57.1	331	10	0	+7	17	52	+5	24.9	—	30.4
Batavia		57.7	274	e 10	8	-11	19	55	+120	e 30.4	—	—
Taihoku		58.3	314	10	17	+16	(18	18)	+15	18.3	—	20.2
Mizusawa		58.5	340	10	1	-1	—	—	—	24.9	—	—
		58.5	340	10	2	0	—	—	—	24.8	—	—
Zi-ka-wei		62.3	320	e 10	34	+7	e 18	56	+4	—	—	34.4
Otomari		64.8	346	11	48	+64	(20	25)	+62	20.4	—	—
Calcutta		83.9	295	12	14	-27	(22	56)	-12	22.9	—	24.2
Berkeley		86.1	49	e 12	36	-18	e 23	45	+14	—	—	35.4
Lick		86.4	50	e 7	26	?	—	—	—	—	—	—
Colombo		87.1	278	12	2	-58	(21	50)	-112	21.8	—	23.7
Victoria		89.6	40	(13	8)	-6	(22	58)	-72	23.0	—	52.0
Kodaikanal		90.4	280	17	38	?PR ₁	(23	32)	-46	23.5	—	27.3
Tucson		93.1	55	13	27	-6	24	27	-19	46.8	—	54.8
Simla		95.9	301	e 18	8	?PR ₁	23	50	-85	31.5	—	32.1
Bombay		96.8	288	14	10	+17	—	—	—	—	—	—
Mauritius		100.2	246	—	—	—	24	24	-94	24.4	—	31.9
Cipolletti		106.8	139	19	26	?PR ₁	(30	14)	+195	30.2	—	36.8
Chicago		112.8	50	18	38	[+8]	(28	31)	+39	55.8	—	—
Pilar		113.9	134	—	—	—	(29	14)	+73	29.2	—	30.2
Ann Arbor		115.7	50	18	14	[-26]	30	56	+160	51.4	—	71.4
Toronto		119.0	47	—	—	—	i 31	2	+140	e 59.8	—	68.6
La Paz		118.8	120	e 18	43	[-6]	i 29	44	+64	49.4	—	55.8
Ithaca		121.0	48	e 20	38	?PR ₁	e 30	13	+76	e 46.7	—	—
Washington		121.0	51	e 19	26?	?PR ₁	—	—	—	—	—	—
Georgetown		121.0	51	e 18	48	[-7]	30	26	+89	e 44.8	—	—
Cheltenham		121.1	51	20	19	?PR ₁	29	59	+61	67.1	—	71.0
Ottawa		121.1	44	i 20	2	?PR ₁	e 29	49	+51	e 49.9	—	—
Capetown		121.6	213	22	8	?PR ₁	36	56	?SR ₁	77.6	—	85.6
Lemberg		133.0	324	e 19	18	[-7]	e 22	20	?PR ₁	e 64.3	—	66.5
Holwan		135.0	297	18	56	[-34]	—	—	—	—	—	45.4
Dyce		136.6	349	i 19	46	[+13]	—	—	—	—	—	—
Hamburg		136.7	359	i 19	24	[-9]	—	—	—	—	—	76.3
Vienna		137.9	350	e 19	16	[-20]	22	49	?PR ₁	e 24.9	—	65.8
Edinburgh		138.1	349	19	32	[-4]	—	—	—	—	—	41.4
Eskdalemuir		138.7	349	19	14	[-23]	28	12	-162	41.9	—	—
Athens		138.9	310	e 19	26	[-12]	—	—	—	101.5	—	107.7
De Bilt		139.6	340	19	23	[-16]	—	—	—	e 57.9	—	68.7
Bidston		140.5	347	19	38	[-2]	—	—	—	—	—	81.4
Uccle		140.9	340	e 19	21	[-20]	—	—	—	e 45.4	—	88.4
Pola		141.5	326	e 19	28	[-14]	—	—	—	e 23.2	—	23.9
Oxford		141.6	346	19	27	[-15]	e 25	58	?	—	—	—
Strasbourg		141.6	353	19	24	[-18]	—	—	—	67.4	—	91.0
Kew		141.7	346	31	26	?S	(31	26)	+13	—	—	70.9
Zurich		142.2	351	e 19	30	[-13]	—	—	—	—	—	—
Paris		143.2	340	i 19	33	[-12]	—	—	—	68.4	—	—
Milan		143.4	351	19	39	[-7]	20	45	?	—	—	20.8
Besancon		143.4	335	19	32?	[-14]	—	—	—	—	—	74.4
Florence		143.5	327	19	41	[-5]	30	16	-68	—	—	41.4
Pompeii		143.7	320	e 19	30	[-16]	—	—	—	—	—	20.9
Rocca di Papa		144.1	323	i 19	37	[-10]	—	—	—	—	—	19.8
Marseilles		146.8	351	18	48	[-63]	19	29	[-23]	23.6	—	—
Barcelona		149.7	332	19	47	[-8]	26	47	?	50.0	—	77.3
Tortosa		150.9	336	19	48	[-9]	—	—	—	84.6	—	100.5
Algiers		152.9	327	19	48	[-12]	—	—	—	44.4	—	65.4
Coimbra		154.2	348	19	19	[-42]	24	21	?PR ₁	e 44.7	—	54.3
Azores		155.4	21	29	38	?S	(29	38)	?	—	—	—
Rio Tinto		156.1	343	19	26	[-37]	—	—	—	—	—	40.4
San Fernando		157.2	342	20	16	[+11]	—	—	—	108.4	—	120.4

For Notes see next page.

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NOTES TO AUG. 31d. 17h. 20m. 34s.

Additional records: Apia P = +4m.40s., +5m.14s., +5m.22s. Riverview
 PR₁ = +5m.42s. and +6m.1s., PS = +9m.31s., T₀ = 17h.20m.24s., 16° 0S.
 Melbourne SR₁ = +12m.50s. Adelaide SR₁ = +13m.38s.
 Manila S = +14m.5s., MN = +17·7m., T₀ = 17h.20m.40s. Osaka MN =
 +13·9m., T₀ = 17h.20m.46s., Δ 6550km. Zi-ka-wei MN = +32·1m.,
 T₀ = 17h.30m.48s. Ootomari, L is probably S; time one minute wrong?
 Calcutta LN = +23·1m., MN = +24·3m. Colombo S = +15m.44s.
 Victoria records P = +7m.14s. (which must refer to some earlier shock—see
 Lick), and then P as S, and S as L. Berkeley ePN = +12m.34s., ePV =
 +12m.33s., eSV = +23m.43s., T₀ = 17h.22m.53s. Lick records the earlier
 shock (see Victoria). Chicago PR = +25m.29s., probably SL = +59·4m.
 and +19·4m. Ann Arbor PE = +17m.56s., SE = +30m.26s., LN =
 +11·4m., MN = +69·4m. Toronto eL = +60·9m., eL = +65·1m. La
 Paz i = +19m.56s. = PR₁? i = +30m.38s., T₀ = 17h.26m.12s. Ithaca
 eL = +21m.19s., eN = +36m.36s., eE = +37m.44s., eLN = +51·6m.
 Georgetown PN = +19m.48s. = PR₁? Cheltenham PN = +20m.51s. =
 PR₁? LN = +51·9m., MN = +78·6m. Ottawa ePN = +18m.46s. =
 PR₁? e = +26m.34s. and +27m.56s. Helwan PN = +24m.8s., MN =
 +13·3m. Dyce i = +20m.2s. Hamburg i = +22m.59s. = PR₁,
 M = +74·4m. Vienna i = +19m.26s., eL = +51·4m., M = +87·4m.
 Edinburgh record at +72m.16s. Eskdalemuir PR = +22m.22s.
 Athens iPRE = +23m.6s., eLN = +100·7m., MN = +102·7m. De Bilt
 iPR = +23m.9s., eLN = +67·4m., MN = +68·5m., T₀ = 17h.19m.23s., 14° 9S.
 14° 2E. Uncle iPR₁ = +23m.8s. Strasbourg iPR₁ = +23m.17s.
 Low M = +100·4m. Paris PR₁ = +23m.21s., PR₂ = +24m.11s. Rocca
 di Papa MN = +20·7m. Coimbra ePN = +19m.47s. = [-14s.], PR₁N =
 +12m.3s., PR₂N = +23m.15s. San Fernando MN = +124·4m.

NOTE TO 1919 AUGUST 31d. 17h. 20m. 34s.

The antipodal stations give fairly consistent residuals in [P]. If we take the
 latest record for Coimbra from the Notes, i.e. [-14s.], instead of [-42s.]
 given by the E inst. in the Table, and exclude Rio Tinto (only given to
 whole minutes), they are

s.	s.	s.	s.	s.	s.	s.	s.	s.	s.	s.
+13	-4	-7	-9	-10	-12	-14	-15	-20	-26	
+11	-5	-7	-9	-12	-13	-14	-17	-20	-34	
-2	-5	-7	-9	-12	-14	-15	-18	-23	-62	

of which the mean is -13s., the mean numerical difference from this being
 ±1s. The probable error of the mean is thus about ±1s., and the focal
 depth indicated is about +·014 of the earth's radius. Of course, the de-
 termination of T₀ is uncertain: the stations within 90° of the epicentre give
 the following corrections to T₀ determined from the S and P residuals:

	s.	s.	s.
Ootomari	+65	Zi-ka-wei	+11
Melbourne	+26	Osaka	+10
Tachoku	+17	Manila	+2
Colombo	+12	Adelaide	-3
		Sydney	-10
		Calcutta	-46
		Berkeley	-58
		Apia	-66

The question is whether we can reasonably increase all the residuals by +10s.,
 which means correcting T₀ by -10s., and it will be seen that it is difficult to
 justify this. The more consistent corrections to T₀ (from +27s. to -11s.)
 have a mean value +8s. We proceed then to assume a focal depth ·015
 radius and to discuss a correction to the adopted epicentre. Grouped in
 stations we find the following corrections to Δ on the above supposition:—

Station	Az.	δ Δ	Station.	Az.	δ Δ	Station.	Az.	δ Δ	Station.	Az.	δ Δ
Victoria	40	+1·0	Sydney	210	+0·1	Calcutta	298	-0·9	Osaka	332	+2·4
Honolulu	43	-2·4	Melbourne	212	+2·1	Manila	304	+2·4	Mizusawa	340	+1·5
Berkeley	50	+1·1	Adelaide	225	-0·2	Taihouku	315	+3·1	Ootomari	346	+1·3
Apia	90	-1·2			Zi-ka-wei	320	+2·0				

We see that the corrections indicated by Victoria and Berkeley are opposite
 in sign to the other two in the same group. In itself this would not justify
 us in excluding them; but there is some evidence that they may not be true
 records. Victoria and Lick record an earlier shock, and though the S and L
 records for Victoria have been assigned to the P and S of this shock, the
 identification is doubtful. The Berkeley records may also be affected.
 Excluding them also we get five equations as below, separating Honolulu
 and Apia:—

Az.	No. of Stations.	δ Δ	Calc.	O - C.
48	1	-2·4 = +·74x +·67y	-1·2	-1·2
90	1	-1·2 = +1·00x +·00y	-2·2	+1·0
216	3	+0·7 = -·59x -·81y	+0·8	-0·1
309	4	+1·9 = -·78x +·63y	+2·2	-0·3
339	3	+1·7 = +·36x +·93y	+1·4	+0·3

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The values of $\delta \Delta$ are equated to terms of the form $xX \sin Az. + yX \cos Az.$, and the values of x and y are found to be $x = -2^{\circ}25$ $y = +0^{\circ}68$, with which the column "Calc." has been formed. The column O-C shows that the major part of the discrepancies are removed by these assumptions. Hence we may give a revised solution for the epicentral stations in the following form:—

Aug. 31d. 17h. 20m. 34s. Epicentre $15^{\circ}7'S$. $167^{\circ}3'E$.

$A = -.940$, $B = +.212$, $C = -.271$. Focal depth $+015$.

	Corr. for Focus	Δ	P.		O-C.		S.		O-C.		Former Residuals.	
			m.	s.	s.		m.	s.	s.	s.	s.	
Apia	-0.6	20.3	14	34	-3		19	1	+44		-37	-14
Sydney	-0.7	23.4	5	2	-11		9	8	-11		-10	-9
Melbourne	-1.0	29.7	6	44	+29		11	42	+30		+27	+29
Adelaide	-1.1	32.1	6	26	-12		11	32	-19		-12	-19
Honolulu	-1.5	50.3	18	50	-9						-25	
Manila	-1.7	54.9	9	30	+3	(17	0)		+1		+6	+9
Osaka	-1.8	58.8	10	0	+8		17	52	+6		+7	+5
Mizusawa	-1.8	60.0	10	1	+1							
Taihoku	-1.8	60.4	10	17	+14	(18	18)		+12		+16	+15
Zi-ka-wei	-1.9	64.1	e 10	34	+8	e 18	56		+5		+7	+4
Ootomari	-1.9	66.1	11	48	+69	(20	25)		+70		+64	+62
Calcutta	-2.1	86.2	12	14	-29	(22	56)		-13		-27	-12
Colombo	-2.1	89.5	12	2	-59	(21	50)		-115		-58	-112

Comparison of the new residuals with the former shows that there is a considerable improvement in the P for Apia and Honolulu; but for the other stations the effects of deep focus and alteration of epicentre neutralise each other. The example is valuable as showing how the effects of a deep focus may be obscured by altering the epicentre and neglecting one or two outstanding results.

Aug. 31d. Records also at 1h. (Helwan and De Bilt), 6h. (Taihoku), 9h. (Azores), 17h. (Kobe), 19h. (La Paz), 22h. (Edinburgh).

Sept. 1-21. For a series of Helwan records see Introductory Note to this number of the Summary (preceding July 1).

Sept. 1d. 13h. 14m. 30s. Epicentre $22^{\circ}0'S$. $170^{\circ}0'E$. (as on 1919 Jan. 12d.).

$A = -.913$, $B = +.161$, $C = -.375$; $D = +.174$, $E = +.985$;
 $G = +.369$, $H = -.065$, $K = -.927$.

	Δ	Az.	P.		O-C.		S.		O-C.		L.	M.
			m.	s.	s.		m.	s.	s.	m.		
Sydney	20.4	230	4	42	-4						9.6	11.9
Riverview	20.4	230									e 7.1	11.8
Melbourne	26.7	228					10	30	-5		13.5	13.8
Chicago	113.5	51					e 33	30	?SR ₁		57.2	
Helwan	142.2	290	37	30	?SR ₁							
De Bilt	147.7	343								e 76.5	85.6	
Uccle	149.1	343								e 81.5	82.5	
Strasbourg	149.9	333									81.5	
Azores	159.3	37										54.0

Additional records: Riverview gives MN = +10.9m. Chicago L = +45.5m.
De Bilt MN = +87.3m. Helwan PE = +94m.30s., PN = +99m.30s.,
which may represent some later phase of this shock.

Sept. 1d. 19h. 12m. 25s. Epicentre $69^{\circ}0'S$. $108^{\circ}0'W$.

$A = -.111$, $B = -.341$, $C = -.934$; $D = -.951$, $E = +.309$;
 $G = +.288$, $H = +.888$, $K = -.358$.

	Δ	Az.	P.		O-C.		S.		O-C.		L.	M.
			m.	s.	s.		m.	s.	s.	m.		
Cipolletti	36.8	58					20	59	?			22.0
Pilar	44.9	59										29.2
Andalgala	47.9	53										31.0
La Paz	58.1	47	9	55	-5	1	17	53	-7		27.2	31.4
Melbourne	60.7	240	18	35	?S	(18	35)		+3		29.1	32.1
Sydney	62.4	248	25	35	?						28.8	31.6

Continued on next page.

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	Δ	Az.	P.	O-C.	S.	O-C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Riverview	62.4	248	—	—	18 47	- 6	e 27.6	31.5
Capetown	69.9	135	38 53	?L	—	—	(38.9)	50.9
Georgetown	110.3	26	—	—	—	—	53.6	—
Washington	110.3	26	—	—	—	—	e 54.6	—
Chicago	111.8	18	24 35?	?	32 50	?SR ₁	53.6	—
Toronto	114.6	21	—	—	—	—	57.8	—
Ottawa	116.8	25	e 18 11	?PR ₁	—	—	—	53.6
Victoria	118.0	349	—	—	—	—	52.3	54.8
San Fernando	127.8	86	65 27	?L	—	—	(65.4)	109.6
Helwan	134.5	129	38 17	?SR ₁	—	—	—	94.3
Rocca di Papa	141.3	100	—	—	—	—	e 83.7	85.2
Kew	143.0	80	—	—	—	—	—	87.6
Bidston	143.6	79	14 35	?	—	—	—	—
Uccle	144.2	85	e 19 47	[0]	—	—	e 60.6	85.6
De Bilt	145.4	85	—	—	e 31 35	+ 1	e 62.6	79.4
Edinburgh	145.5	75	—	—	—	—	74.6	88.8
Hamburg	148.3	87	20 11	[+18]	—	—	e 78.6	83.6

Additional records : Riverview gives MN = +31.1m. Chicago L = +42.6m.
 Ottawa eN = +18m.11s., eLN = +57.6m. Helwan PN = +37m.53s.,
 MN = +37.9m. De Bilt e = +42m.23s., MN = +84.7m. Hamburg
 P is on Z machine, MN = +90.6m. Eskdalemuir ($\Delta = 145^\circ \pm$) records simply
 20h. to 21h. 30m.

Sept. 1d. Records also at 0h. (Batavia and San Fernando), 6h. (Zi-ka-wei and Azores), 7h. (San Fernando), 12h. (Riverview), 13h. (Apia), 16h. (Mizusawa), 20h. (San Fernando, Colombo, Kodaikanal, and Simla), 21h. (close to Athens).

Sept. 2d. Records at 9h. (Helwan), 14h. (Lick and Helwan), 18h. (Mizusawa), 21h. 22m. 25s. (close to Berkeley, which records IP = +3s., IL = +6s., MN = +7s.).

Sept. 3d. Records at 0h. (Lick and San Fernando), 2h. (La Paz), 3h. (Apia), 9h.6m.20s. (near La Paz, which records P = +1m.20s., S = +2m.1s., L = +2.7m.), 10h. (Helwan), 11h. (Helwan), 14h. (La Paz), 17h. (Mizusawa, Ootomari, and De Bilt), 18h. (Hamburg and Helwan), 20h. (San Fernando).

Sept. 4d. Records at 7h. (San Fernando), 11h. (Ascension), 12h.27m. (near Batavia), 15h. (Lick), 20h.15m.45s. (close to Berkeley, which records IPEN = +3s., IPV = +4s., ILMEN = +5s., ILMV = +6s.; Lick gives e = +23s.), 20h.39m. (Berkeley).

Sept. 5d. 7h. 52m. 20s. Epicentre $32^\circ 0'N$, $74^\circ 0'E$.

A = +.234, B = +.815, C = +.530.

(Very doubtful.)

	Δ	Az.	P.	O-C.	S.	O-C.	L.
	°	°	m. s.	s.	m. s.	s.	m.
Simla	2.8	108	10 52	+ 8	—	—	—
Bombay	13.1	185	5 33	?S	(5 33)	-13	—
Calcutta	15.9	123	3 40	-12	—	—	8.7
Helwan	36.4	277	24 40	?	—	—	—
Hamburg	49.7	317	—	—	—	—	e 26.7
De Bilt	52.7	315	—	—	e 13 40	?	—

Helwan PN = +21m.40s.

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Sept. 5d. 16h. 52m. 12s. Epicentre 18°·0N. 133°·0E.

A = -·649, B = +·696, C = +·309; D = +·731, E = +·682;
G = -·211, H = +·226, K = -·951.

	Δ	Az.	P.	O-C.	S.	O-C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Manila	12·1	256	e 2 56	- 4	5 12	- 9	5·9	6·3
Taihoku	12·9	305	3 13	+ 1	—	—	4·5	—
Kobe	16·6	6	—	—	8 11	+62	—	11·2
Zi-ka-wei	16·8	324	e 4 6	+ 4	—	—	—	—
Colombo	52·9	267	30 48	?L	—	—	(30·8)	—
Helwan	90·8	301	62 48	?L	—	—	(62·8)	—
Hamburg	93·5	330	—	—	—	—	e 47·8	49·8
De Bilt	96·6	330	e 31 44	?SR ₁	—	—	e 46·8	52·4
Uccle	97·8	330	—	—	—	—	e 48·8	52·8
Rocca di Papa	98·7	319	—	—	—	—	e 54·5	63·6

Helwan gives also PN = +52·8m. (=LN?).

Sept. 5d. 19h. 2m. 10s. Epicentre 19°·5N. 65°·0W. (as later on Sept. 6d. 9h.?).

A = +·398, B = -·854, C = +·334.

	Δ	Az.	P.	O-C.	S.	O-C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Vieques	1·4	200	0 52	+31	—	—	1·1	1·9
Washington	22·0	334	5 12	+ 7	9 25	+20	e 15·3	—
Chicago	29·4	324	5 16	-66	11 0	-24	14·1	—
La Paz	36·1	186	—	—	—	—	23·2	24·7
De Bilt	E. 62·6	40	—	—	—	—	e 30·8	35·7
Florence	66·9	49	9 34	-83	—	—	—	—
Helwan	85·6	60	55 50	?L	—	—	(55·8)	—

Additional records: Vieques LN = +1·6m. Washington T₀ = 19h.2m.15s.
De Bilt eLN = +32·8m., MN = +39·6m. Helwan P = +54m.50s.

Sept. 5d. 20h. 37m. 20s. Epicentre 47°·5N. 15°·8E. (as on 1917 Aug. 8d.).

A = -·650, B = +·184, C = +·737.

	Δ	P.	O-C.	S.	O-C.	L.	M.
	°	m. s.	s.	m. s.	s.	m.	m.
Vienna	0·8	10 7	- 5	—	—	0·6	0·6
Zurich	4·9	e 1 4	-12	1 2 40	+26	—	—
Strasbourg	5·5	e 1 38	+13	3 10	+39	—	—
De Bilt	8·3	—	—	e 4 41	+56	—	—

Additional records: Vienna iZ = +10s., MN = +0·6m., MZ = +0·8m.
Zurich eV = +1m.1s., eE = +1m.5s., iSE = +2m.39s.

Sept. 5d. Records also at 2h. (San Fernando), 3h. (Manila (2)), 4h. and 5h. (3) (Taihoku), 6h. (Taihoku (2) and Zi-ka-wei), 7h. (Taihoku and Zi-ka-wei), 8h. (near Mizusawa), 15h. (Helwan, De Bilt, Uccle, Athens, and Moncaheri), 16h. (Melbourne and Azores), 18h. (near Lick).

1919. Sept. 6d. 9h. 29m. 45s. Epicentre 19°·5N. 65°·0W.

(as on Sept. 5d.).

A = +·398, B = -·854, C = +·334; D = -·906, E = -·423;
G = +·141, H = -·303, K = -·943.

	Δ	Az.	P.	O-C.	S.	O-C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Vieques	N. 1·4	200	0 30	+ 9	—	—	—	1·6
	E. 1·4	200	0 31	+10	—	—	—	1·6
Port-au-Prince	7·0	264	0 44	-62	2 14	-56	2·5	2·8
Cheltenham	N. 21·8	335	5 0	- 3	9 3	+ 2	12·2	19·5
	E. 21·8	335	5 0	- 3	9 3	+ 2	10·9	16·3
Georgetown	N. 22·0	334	e 4 58	- 7	19 3	- 2	e 11·0	—
	E. 22·0	334	e 5 3	- 2	19 3	- 2	e 11·0	—
Washington	22·0	334	5 5	0	9 5	0	12·2	—
Ithaca	N. 24·9	340	5 59	+22	10 22	+21	11·5	—
	E. 24·9	340	—	—	10 18	+17	11·8	—

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	Δ	Az.	P.	O-C.	S.	O-C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Northfield	25.5	347	e 6 35	+52	9 59	-14	e 15.2	—
Toronto	27.0	337	6 15	+17	—	—	11.4	15.2
Ottawa	27.4	344	—	—	(e 10 33)	-15	e 10.6	—
Ann Arbor	27.7	330	7.21	+76	—	—	13.2	19.2
Chicago	27.7	330	—	—	—	—	13.0	19.0
Chicago	29.4	324	5 45	-37	11 5	-19	14.2	—
La Paz	36.1	186	i 7 9	-14	15 10	?SR ₁	21.6	24.6
Colmbra	52.3	53	e 8 23	-59	i 15 41	-67	23.0	28.2
Berkeley	52.6	305	—	—	—	e 26.2	—	—
San Fernando	53.8	60	33 15	?L	—	—	(33.2)	35.2
Victoria	54.6	319	20 3	?	—	—	28.4	35.3
Eskdalemuir	58.1	36	—	—	i 17 49	-11	27.2	—
Edinburgh	58.2	36	17 51	?S	(17 51)	-10	28.2	33.6
Oxford	58.6	41	10 6	+ 3	18 1	- 5	e 27.3	33.4
Tortosa	59.1	53	10 3	- 3	18 13	+ 1	26.2	38.2
Kew	59.2	41	—	—	—	—	—	27.2
Barcelona	60.3	52	—	—	—	e 29.0	34.2	—
Paris	60.8	44	—	—	—	e 27.2	35.2	—
Uccle	62.0	42	e 10 21	- 4	18 45	- 3	e 29.2	44.2
De Bilt	62.6	40	10 32	+ 3	18 55	- 1	e 29.2	35.2
Strasbourg	64.2	45	e 10 15	-24	—	—	—	—
Moncalieri	64.3	49	e 10 36	- 4	19 13	- 4	26.6	—
Hamburg	65.6	39	e 10 49	0	i 19 31	- 1	e 30.2	37.2
Rocca di Papa	68.2	51	e 20 4	?S	(e 20 4)	0	e 32.6	33.8
Lemberg	74.6	42	—	—	e 21 15	- 6	e 43.6	44.5
Helwan	85.6	60	23 15	?S	(23 15)	-11	—	—

Additional records: Port-au-Prince $T_0 = 9h.28m.39s.$ Cheltenham $T_0 = 9h.28m.41s.$ Georgetown $LE = +12.1m., LN = +12.2m., T_0 = 9h.29m.36s.$ Washington $L = +15.1m., T_0 = 9h.29m.49s.$ Ithaca $T_0 = 9h.30m.18s.$ Toronto $eL = +13.8m.$ Ottawa $L^? = +46.3m.$ Ann Arbor $P = +0m.21s.$ and $S = +7m.21s. (=P?)$ Chicago $L = +33.2m., +50.2m., T_0 = 9h.28m.47s.$ La Paz $T_0 = 0h.26m.56s.$ Coimbra apparently time 1min. in error, also $ePN = +11m.15s., MN = +23.8m.$ San Fernando $MN = +37.2m.$ Eskdalemuir $LN = +17m.54s.$ Edinburgh $S = +23m.59s.$ Uccle $T_0 = 9h.29m.42s.$ De Bilt $eE = +22m.59s. = SR_1, ?., eN = +23m.11s. = SR_1, ?., MN = 40.1m., T_0 = 9h.29m.56s.$ Helwan ($S?$) = +24m.15s.

Sept. 6d. Records also at 1h. (Georgetown and Washington), 4h.42m.50s. (close to Taihoku $P = +9s., L = +17s.; Zi-ka-wei e = +3m.24s.$), 6h. (Taihoku), 7h. (Dehra Dun), 8h.35m. (Taihoku and Zi-ka-wei; repetition of 4h.42m.?), 10h. (San Fernando), 11h. (Florence), 12h. (Ascension), 14h. (Manila and Riverview), 15h. (Melbourne, Helwan, and Azores; possibly same as Manila 14h.), 16h. (Apia), 20h. (Azores), 21h. (Batavia).

Sept. 7d. 18h. 21m. 43s. Epicentre $24^\circ 0'N. 120^\circ 0'E.$ (as on 1917 Jan. 4d.).

$$A = -457, B = +792, C = +407.$$

	Δ	Az.	P.	O-C.	S.	O-C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Taihoku	1.8	53	0 28	0	—	—	—	—
Zi-ka-wei	7.3	10	—	—	e 3 23	+ 5	—	—
Manila	9.5	172	—	—	e 3 30	-46	—	—
De Bilt	85.2	326	—	—	—	—	e 47.3	48.3

De Bilt gives $MN = +48.5m.$

Sept. 7d. 20h. 21m. 16s. (La Paz). Epicentre $29^\circ 0'S. 98^\circ 0'W.$ (rough).

$$A = -122, B = -866, C = -485; D = -996, E = +139; G = +067, H = +480, K = -875.$$

	Δ	Az.	P.	O-C.	S.	O-C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Cipolletti	26.6	120	12 38	?S	(12 38)	+125	15.7	16.7
Andalgala	27.9	95	—	—	—	—	21.2	24.9
Pilar	29.5	104	11 38	?S	(11 38)	+12	—	19.3
La Paz	29.5	104	5 20	-63	—	—	14.3	16.5
De Bilt	30.1	72	6 37	+ 8	11 51	+15	14.9	17.4
De Bilt	120.3	44	—	—	e 38 8	?SR ₁	e 61.7	—

Andalgala gives $MN = +21.7m.$

Sept. 7d. Records also at 1h. (Athens), 11h. (14° from La Paz), 17h. (Rocca di Papa), 20h. (Azores), 21h. (Helwan).

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Sept. 8d. 4h. 8m. 0s. Epicentre $18^{\circ}0'N$. $97^{\circ}0'E$. (as on 1917 April 12d.).

$$A = -.116, B = +.944, C = +.309; \quad D = +.993, E = +.122;$$

$$G = -.038, H = +.307, K = -.951.$$

The Batavia observations suggest an epicentre some $2^{\circ}0'S$., and it must then be further West to suit Calcutta and Manila. But the material is so slight that this old epicentre has been retained.

	Δ	Az.	P.	O-C.	S.	O-C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Calcutta	9.3	300	2 30	+10	—	—	7.6	—
Colombo	20.1	239	11 18	?L	—	—	(11.3)	12.5
Manila	23.2	87	e 5 36	+17	—	—	12.7	14.5
Taihoku	23.8	69	14 19	?L	—	—	(14.3)	—
Zi-ka-wei	25.7	55	—	—	—	—	e 13.8	—
Batavia	26.0	158	e 5 19	-29	9 36	-46	—	12.3
Helwan	60.4	295	34 0	?L	—	—	(34.0)	—
De Bilt	E. 77.0	321	—	—	—	—	e 52.0	52.7
	N. 77.0	321	—	—	—	—	e 47.0	47.7

Manila gives MN = +15.0m. Helwan PN = +41m.0s.

Sept. 8d. 14h. 4m. 10s. Epicentre $24^{\circ}0'N$. $120^{\circ}0'E$. (as on Sept. 7d.).

$$A = -.457, B = +.792, C = +.407.$$

	Δ	Az.	P.	O-C.	S.	O-C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Taihoku	1.8	53	0 28	0	—	—	—	—
Zi-ka-wei	7.3	10	—	—	e 3 34	+16	—	—
Manila	9.5	172	2 30	+7	—	—	—	—
De Bilt	85.2	326	—	—	—	—	e 46.8	48.2

Sept. 8d. Records also at 1h. (Manila), 2h., 3h., 4h., 5h., and 7h. (Azores), 8h. (Mizusawa), 9h. (San Fernando), 11h. (Azores), 16h. (Milan), 17h. (Lick), 18h. (Zurich), 19h., 20h., and 23h. (Azores).

Sept. 9d. Records at 5h. (La Paz, Apia, and Tokyo), 17h. (near Mizusawa), 18h. (San Fernando), 19h. (Azores and near La Paz), 21h. and 22h. (Azores).

Sept. 10d. 10h. 40m. 0s. Epicentre $41^{\circ}5'N$. $7^{\circ}0'W$. (as on 1918 Dec. 25d.).

$$A = +.744, B = -.091, C = +.663; \quad D = -.122, E = -.992,$$

$$G = +.658, H = -.081, K = -.749.$$

There is some difficulty in separating this shock from that following. Possibly Coimbra observes the latter, though an error of 3 minutes seems more likely, and has been assumed in the columns O-C.

	Δ	Az.	P.	O-C.	S.	O-C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Coimbra	1.7	220	(3) 18	(- 8)	(3) 58	(+10)	—	4.5
Granada	5.1	148	i 1 20	+ 1	i 1 50	-30	—	—
San Fernando	5.1	173	2 16	?S	(2 16)	- 4	3.5	4.0
Tortosa	5.7	94	1 22	- 6	—	—	2.3	2.8
Barcelona	6.8	87	1 36	- 8	—	—	2.3	3.8
Algiers	9.1	118	1 56	-22	—	—	—	4.7
Marseilles	9.3	75	e 3 25	?S	(e 3 25)	-45	—	—
Moncalieri	11.2	67	e 2 40	- 7	5 18	+19	6.7	7.9
Zurich	12.5	57	e 3 23	+17	e 6 36	+64	—	—
Rocca di Papa	14.7	82	.3 36	+ 1	—	—	e 8.3	12.7

Additional records: Coimbra MN = +4.2m. San Fernando Milne machines
 PN = +3m.0s., PE = +3m.30s., M = +4m.0s.

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Sept. 10d. 10h. 44m. 30s. Epicentre 44°·0N. 2°·5E. (as on 1918 Feb. 5d.).

A = +·719, B = +·031, C = +·695.

	Δ	P.	O-C.	S.	O-C.	L.	M.
	°	m. s.	s.	m. s.	s.	m.	m.
Besancon	4·0	1 33	+31	2 45	+55	6·5	—
Paris	4·9	e 0 40	-36	e 2 6	- 8	2·5	3·0
Strasbourg	5·8	e 2 0	+30	—	—	e 3·3	—
Uccle	6·9	e 1 54	+ 9	e 3 4	- 3	e 4·8	5·3
Oxford	8·2	1 3 4	+60	3 36	- 6	—	4·9
De Bilt	8·3	—	—	e 3 49	+ 4	4·2	6·3
Hamburg	10·8	—	—	e 6 15	+85	e 22·5	24·0
Edinburgh	12·5	5 30	?S	(5 30)	- 2	—	7·5

Additional records: Paris ePV = +0m.55s. The printed record is PN. The Hamburg record for L and M probably refer to the next shock, and the S record is then probably L.

Sept. 10d. 10h. 56m. 5s. Epicentre 41°·5N. 7°·0W. (as at 10h.40m.).

It is assumed as before that Coimbra is 3m. in error.

	Δ	Az.	P.	O-C.	S.	O-C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Coimbra	1·7	220	e (3) 19	- 7	i (4) 3	+15	—	4·6
Granada	5·1	148	1 36	+17	—	—	—	—
San Fernando	5·1	173	2 25	?S	(2 25)	+ 5	3·5	3·7
Tortosa	5·7	94	1 30	+ 2	—	—	2·3	2·9
Barcelona	6·8	87	1 45	+ 1	—	—	2·5	3·8
Algiers	9·1	118	2 3	-15	4 3	- 3	4·5	—
Marselles	9·3	75	e 3 53	?S	(e 3 53)	-17	—	—
Oxford	11·0	19	—	—	—	—	8·3	9·2
Strasbourg	12·5	50	—	—	e 4 35	-57	e 8·1	—
Helwan	32·9	98	5 55	-61	—	—	—	—

The above shock appears to be followed by another at the second epicentre 44 minutes later, as before; to facilitate comparison the precise interval, 4m.30s., has been retained. Coimbra MN = +4·3m.

Sept. 10d. 11h. 0m. 35s. Epicentre 44°·0N. 2°·5E. (as at 10h.44m.).

	Δ	P.	O-C.	S.	O-C.	L.	M.
	°	m. s.	s.	m. s.	s.	m.	m.
Besancon	4·0	1 23?	+21	2 38	+48	3·4	—
Paris	4·9	e 0 51	-25	e 2 18	+ 4	3·4	3·4
Strasbourg	5·8	e 0 5	?	—	—	e 3·5	—
Uccle	6·9	2 1	+16	e 3 11	+ 4	—	—
De Bilt	8·3	—	—	—	—	4·3	4·7
Edinburgh	12·5	5 55	?S	(5 55)	+23	—	7·3

De Bilt gives MN = +6·4m.

Sept. 10d. 11h. 58m. 30s. Epicentre 41°·5N. 7°·0W. (as at 10h.56m.5s.).

It is assumed, as before, that Coimbra is 3m. in error.

	Δ	Az.	P.	O-C.	S.	O-C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Coimbra	1·7	220	e (3) 46	+20	(4) 19	+31	—	—
Granada	5·1	148	1 27	+ 8	—	—	—	—
Tortosa	5·7	94	1 19	+ 0	—	—	2·1	2·6
Barcelona	6·8	87	e 2 54	?S	(2 54)	-11	3·1	3·7
Oxford	11·0	19	—	—	—	—	—	8·9
Helwan	32·9	98	11 30	?S	(11 30)	-52	—	—

Sept. 10d. 12h. 3m. 0s. Epicentre 44°·0N. 2°·5E. (as at 11h.0m.). The only indications are De Bilt eL = +4·1m., ME = +4·6m., MN = +6·2m.; but these are in such good accordance with former records that the possibility seems worth recording.

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Sept. 10d. 14h. 21m. 50s. Epicentre 41°·5N. 7°·0W. (as at 11h.58m.).
(Coimbra 3m. in error, as before).

	Δ	Az.	P.	O-C.	S.	O-C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Coimbra	1·7	220	e (3) 50	+24	(4) 16	+28	4·7	—
Grañada	5·1	148	1 32	+13	—	—	—	2·9
Tortosa	5·7	94	1 32	+4	—	—	2·3	—
Barcelona	6·8	87	e 2 32	?S	(2 32)	-33	3·5	4·3
Helwan	32·9	98	31 10	?	—	—	—	—

Coimbra gives iSN = +4m.14s.

Sept. 10d. 14h. 26m. 20s. Epicentre 44°·0N. 2°·5E. (as at 12h.3m.).
(It is assumed that this follows 4m.30s. later as before).

	Δ	S.	O-C.	L.	M.
	°	m. s.	s.	m.	m.
Paris	4·9	e 2 22	+ 8	3·7	3·7
Uccle	6·9	e 3 34	+27	—	—
De Bilt	E. 8·3	—	—	e 4·8	6·4
	N. 8·3	—	—	e 5·2	6·4

Note to the foregoing. The suggestion is that a shock under the epicentre 41°·5N. 7°·0W., are followed (in each of four cases) after an interval of 4m.30s. by a shock under the epicentre 44°·0N. 2°·5E., approximately. The material is scarcely good enough to define the latter with great precision, and its place has been adopted from a former occasion (1918 Feb. 5). The distance between the adopted epicentres is 7°·4, so that if one shock is caused by the other it must be by the L waves. The times adopted are:

	h.	m.	s.	m.	h.	m.	s.
	10	40	0	+4·9	10	44	30
	10	56	5	0·0	11	0	35
	11	58	30	-0·6	12	3	0
	14	21	50	-4·3	14	26	20

The middle column represents deviations from a series of multiples of 21·0m.

Sept. 10d. 16h. 57m. 20s. Epicentre 43°·0N. 12°·5E. (as on 1917 May 11d.).

A = +·714, B = +·158, C = +·682; D = +·216, E = -·976;
G = +·666, H = +·148, K = -·731.

	Δ	Az.	P.	O-C.	S.	O-C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Florence	1·2	311	0 17	- 1	—	—	—	0·7
Rocca di Papa	1·3	173	0 19	- 1	—	—	—	1·3
Pola	2·1	27	e 0 38	+ 5	—	—	e 1·0	1·9
Pompeii	2·7	147	0 50	+ 8	1 29	+15	—	2·2
Milan	3·4	316	0 59	+ 6	1 45	+11	—	3·9
Moncalieri	4·0	302	0 50	-12	1 38	-12	—	2·5
Marsilles	5·2	276	1 3	-17	—	—	4·6	—
Zurich	5·2	329	e 1 13	- 7	1 2 46	+24	—	3·0
Vienna	5·9	26	1 29	- 2	3 26	+37	3·0	3·6
Besancon	6·2	315	1 26	- 9	—	—	—	—
Budapest	6·4	44	0 58	-40	—	—	—	—
Strasbourg	6·5	330	e 1 31	- 8	—	—	—	e 3·4
Barcelona	7·8	263	—	—	e 3 40	+ 9	e 3·9	5·2
Paris	9·0	313	e 2 33	+17	e 4 20	+17	4·9	5·7
Tortosa	9·5	261	2 17	- 6	—	—	3·6	7·6
Uccle	9·6	327	e 2 10	-14	—	—	e 4·7	—
Algiers	9·6	232	—	—	e 3 40	-38	12·7	—
De Bilt	10·3	334	—	—	e 4 53	+16	5·5	6·2
Hamburg	10·7	352	—	—	e 4 40	- 8	—	7·1
Kew	12·1	319	—	—	—	—	—	7·7
Oxford	12·8	318	—	—	—	—	6·5	7·7
San Fernando	15·7	252	7 40	?L	—	—	(7·7)	9·7
Coimbra	15·8	267	—	—	—	—	e 9·1	10·3
Edinburgh	16·3	328	8 22	?L	—	—	(8·4)	9·6

Eskdalemuir ($\Delta = 16^\circ 0'$) records simply 17h.5m. to 17h.8m. Additional records Rocca di Papa C inst., iP = +0m.19s., ME = +1·2m., MN = +1·5m. Pola MN = +1·5m. Zurich iPE = +1m.33s., MN = +3·1m. Paris ePN = +2m.27s. Tortosa gives its P 10m. early. De Bilt MN = +6·4m. Hamburg MN = +9·0m., MZ = +8·0m. San Fernando Milne insts. agree except PN (=LN?) = +7m.40s. Coimbra LN = +7·7m.

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Sept. 10d. Records also at 4h. (San Fernando and Manila, 12h. (La Paz), 15h. Azores (2)), 17h., 18m. 50s. (close to Zurich, which gives ePE = +5s., ePN = +8s., iS = +10s. Pompeii P = +7m. 39s.), 17h. 24m. 10s. (again close to Zurich, which gives eP = +3s., iS = +15s., iME = +16s., M = +23s., Rocca di Papa IP = +44s., M = +2m. 8s.), 18h. 16m. 0s. (close to Azores P = +6s., M = +2.0m.), 18h. 17m. 20s. (close to Osaka, PS = +16s., ME = +0.9m., MN = +1.0m.), 19h. (San Fernando), 22h. (San Fernando).

Sept. 11d. 0h. 38m. 0s. Further repetition from 41° 5N. 7° 0W., as on Sept. 10d.? Coimbra (still 3m. in error?), eP = +(3)m. 36s., S = +(4)m. 6s. Granada P = +1m. 12s. Tortosa P = +1m. 24s., L = +2.1m., M = +2.5m.

Sept. 11d. 5h. 31m. 0s. Epicentre 24° 5N. 143° 5E. (as on 1917 July 1d.).

$$A = -.732, B = +.541, C = +.415; \quad D = +.595, E = +.804; \\ G = -.333, H = +.247, K = -.910.$$

	Δ	Az.	P.	O-C.	S.	O-C.	M.
	°	°	m. s.	s.	m. s.	s.	m.
Tokyo	11.6	345	2 43	-10	5 6	- 3	—
Osaka	12.3	327	3 31	+23	—	—	6.7
Mizusawa	14.9	355	4 10	+32	7 11	+41	—
La Paz	149.3	100	19 32	[-22]	—	—	—

If the La Paz record really belongs to this shock, it is remarkable that there should be no records from intermediate stations.

Sept. 11d. 13h. 47m. 50s. Epicentre 11° 5N. 144° 0E. (as on 1918 Jan. 12d.).

$$A = -.793, B = +.576, C = +.199.$$

(Very uncertain: perhaps further south).

	Δ	Az.	P.	O-C.	S.	O-C.	L.
	°	°	m. s.	s.	m. s.	s.	m.
Manila	22.7	280	—	—	e 10 10	+51	—
Tokyo	24.5	352	5 17	-16	10 4	+10	—
Nagasaki	24.9	331	13 30	?L	—	—	(13.5)
La Paz	148.4	103	—	—	24 2	?PR ₁	—

Sept. 11d. 13h. 49m. 30s. Epicentre 19° 0N. 68° 0W. (as on 1917 July 27d.).

$$A = +.354, B = -.877, C = +.326; \quad D = -.927, E = -.375;$$

$$G = +.122, H = -.302, K = -.946.$$

	Δ	Az.	P.	O-C.	S.	O-C.	L.	M.	
	°	°	m. s.	s.	m. s.	s.	m.	m.	
Vieques	E.	2.6	107	0 43	+ 2	—	—	1.0	1.3
	N.	2.6	107	0 40	- 1	—	—	1.1	1.4
Chicago		28.2	323	11 10	?S	(11 10)	+ 7	(14.1)	—
La Paz		35.5	180	e 12 52	?S	(e 12 52)	-11	43.6	44.9
De Bilt	N.	64.8	40	—	—	—	e 29.5	57.4	—

Chicago gives S as P and L as S, also L = +16.2m. and 19.6m. It seems clear that the La Paz record does not belong to this (comparatively near) epicentre, but possibly to the preceding shock across the globe.

Sept. 11d. 14h. 11m. 30s. Repetition from 19° 0N. 68° 0W. (as at 13h. 49m.?). Vieques gives PE = +31s., PN = +30s., LE = +37s., LN = +36s., ME = +1.2m., MN = +1.3m. De Bilt ($\Delta = 64.8$) gives eLE = +29.5m., agreeing with eLN for former shock. The interval between the two is 22.0m.

Sept. 11d. Records also at 0h. (Zurich), 1h. 45m., 2h. 6m., 2h. 29m. (Azores: the intervals are close to 21m.), 10h. (Athens), 12h. (Batavia), 14h. (Helwan), 19h. (San Fernando), 21h. (Tucson and Berkeley), 22h. (De Bilt).

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Sept. 12d. 6h. 5m. 40s. Epicentre 42°·0S. 178°·0E. (as on 1918 July 24d.).

A = -·743, B = +·026, C = -·669; D = +·035, E = +·999;
G = +·669, H = -·023, K = -·743.

	Δ	Az.	P.	O-C.	S.	O-C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Sydney	22·6	282	5 2	-10	9 8	- 9	11·6	12·3
Riverview	22·6	282	15 15	+ 3	e 9 16	- 1	e 10·5	12·4
Melbourne	25·5	268	5 38	- 5	11 2	+49	15·6	16·8
Apia	29·5	20	—	—	(11 20)	- 6	11·3	—
Adelaide	31·3	272	—	—	11 50	- 6	17·3	19·8
Batavia	71·9	279	e 11 40	+11	20 58	+ 9	38·9	—
Manila	77·1	305	e 12 0	- 2	—	—	—	—
Mendoza	83·5	130	—	—	—	—	—	54·1
Taihoku	84·9	312	—	—	e 31 20	?SR ₁	—	—
Andalgala	88·6	129	—	—	—	—	—	63·6
La Paz	94·6	120	—	—	27 16	+134	46·2	49·2
Colombo	100·7	270	48 20	?L	—	—	(48·3)	54·3
Helwan	150·6	256	43 20	?L	—	—	(43·3)	—
Edinburgh	166·1	3	—	—	—	—	89·3	111·3
Bidston	168·5	3	84 38	?L	88 44	?	(84·6)	96·3
De Bilt	168·8	337	e 29 2	?	e 45 14	?SR ₁	e 79·3	85·6
Moncalieri	172·4	296	e 24 36	?PR ₁	45 36	?	89·8	—
Tortosa	177·8	238	22 20	—	—	—	107·3	110·6

Eskdalemuir ($\Delta = 166^\circ \cdot 6$) gives simply 6h.40m. to 8h.26m. Additional records: Riverview gives IP = +5m.32s., iPS = +9m.27s., T₀ = 6h.5m.37s. Melbourne SR₁ = +13m.26s. Adelaide PR = +9m.20s., SR = +12m.56s. La Paz gives T₀ = 6h.9m.18s. Helwan PN = +45m.20s. = LN? De Bilt eE = +31m.50s.

Sept. 12d. 6h. 57m. 30s. A shock is recorded at several stations, but it is difficult to assign the epicentre. The time is taken from Kodakkanal, which records P = +5m.48s., L = +14·1m., M = +16·6m., indicating $\Delta = 28^\circ$. But Coimbra gives eL = +36·2m.; Edinburgh L = +37·5m., M = +59·5m.; Paris eL = +41·5m.; Algiers eL = +45·5m., M = +50·0m.; and San Fernando P = +51·5m., and these are not accordant enough to identify the epicentre.

Sept. 12d. 12h. 23m. 40s. Epicentre 42°·0S. 178°·0E. (as at 6h.).

	Δ	Az.	P.	O-C.	S.	O-C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Sydney	22·6	282	4 50	-22	—	—	11·1	11·9
Riverview	22·6	282	e 5 19	+ 7	—	—	e 11·0	12·1
Melbourne	25·5	268	—	—	11 20	+67	15·7	16·8
Adelaide	29·5	20	—	—	11 44	+18	17·2	19·5

Additional records: Riverview MN = +12·0m. Melbourne SR = +13m.38s. Adelaide SR = +13m.50s.

Sept. 12d. 13h. 49m. 40s. Epicentre 48°·0N. 148°·0E.

A = -·567, B = +·355, C = +·743; D = +·530, E = +·848;
G = -·630, H = +·394, K = -·669.

It seems possible that there were two shocks; for instance, the Moncalieri observations can scarcely be explained otherwise.

	Δ	Az.	P.	O-C.	S.	O-C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Ootomari	3·8	249	1 33	+34	(1 33)	-11	2·9	3·0
Mizusawa	E. 10·1	211	2 5	-26	3 48	-44	—	—
	N. 10·1	211	2 11	-20	3 51	-41	—	—
Tokyo	13·8	209	5 50	?S	6 12	+ 9	12·2	—
Osaka	16·3	220	4 36	+40	—	—	—	11·3
Zi-ka-wei	26·3	240	—	—	e 12 0	+92	—	—
Taihoku	31·0	231	—	—	e 13 20	+89	—	—
Manila	40·2	224	10 20	?PR ₁	—	—	—	—
Honolulu	50·4	102	—	—	—	—	e 27·3	32·8
Hamburg	72·4	337	—	—	—	—	e 40·3	45·4

Continued on next page.

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	Δ	Az.	P.	O-C.	S.	O-C.	L.	M.
			m. s.	s.	m. s.	s.	m.	m.
De Bilt	N.	75.0	339	—	—	e 21 44	+18 e 43.3	48.3
	E.	75.0	339	—	—	—	e 41.3	46.2
Vienna	Z.	75.0	330	i 11 52	+ 3	—	e 43.3	—
Uccle		76.4	339	e 11 50	- 7	—	—	52.3
Kew		76.9	342	—	—	—	—	50.3
Strasbourg		77.5	334	e 12 30	+26	—	—	45.8
Chicago		77.7	40	11 35	-30	19 52	-125	33.3
Paris		78.6	340	i 12 10	- 1	e 22 24	+17	43.3
Moncalieri		80.7	333	e 8 39	-224	16 40	-351	40.8
Rocca di Papa		81.9	329	e 12 8	-22	22 44	- 1	53.7
Barcelona		85.6	336	—	—	—	e 50.0	52.4
Coimbra		89.3	344	—	—	—	e 54.4	—
Algiers		89.6	332	—	—	—	—	50.3

Eskdalemuir gives simply 14h. to 15h.30m. Additional records: Osaka
 MN = +11.0m. Hamburg MN = +43.3m. Chicago L = +47.3m.
 T₁ = 13h.51m.1s. Rocca di Papa S = +18m.56s., L = +55.7m. Helwan
 gives PE = +1m.20s., PN = +9m.20s.

Sept. 12d. 14h. 26m. 37s. Epicentre 72°0N. 2°8W. (as on Feb. 2d.).

A = +.309, B = -.015, C = +.951; D = -.049, E = -.999;
 G = +.950, H = -.046, K = -.309.

	Δ	Az.	P.	O-C.	S.	O-C.	L.	M.
			m. s.	s.	m. s.	s.	m.	m.
Edinburgh		16.1	184	3 47	- 6	6 59	+ 2	9.4
Bidston		18.6	180	1 53	?	7 41	-12	—
Florence		29.0	159	5 23	-55	—	—	11.9
San Fernando		35.6	184	18 23	?L	—	—	(18.4)
Colombo		81.2	96	11 23	-63	—	—	—

Is it possible that the Edinburgh records are 1m. in error, and that T₁ should be diminished by 1m. ? It is curious that other stations are silent.

Sept. 12d. 14h. 52m. 20s. Epicentre 36°1N. 137°3E. (as on 1918 Nov. 11d.).

A = -.594, B = +.548, C = +.589.

	Δ	Az.	P.	O-C.	S.	O-C.	L.	M.
			m. s.	s.	m. s.	s.	m.	m.
Tokyo		2.0	100	0 52	+21	1 58	+63	3.6
Osaka		2.1	218	2 35	?	—	—	8.2
Mizusawa		4.3	45	1 10	+ 3	1 48	-10	—
Otomari		11.3	19	1 56	?	—	—	3.0
Zi-ka-wei		14.1	254	9 41	?	—	—	—
Vienna	Z.	80.7	325	i 12 25	+ 2	—	—	—
De Bilt		82.5	332	—	—	—	e 39.7	44.6
Strasbourg		84.3	329	—	—	—	—	50.7
Paris		86.1	332	—	—	—	e 45.7	—
Algiers		95.7	324	—	—	(e 25 40)	+27	e 25.7
La Paz		150.1	56	18 51	[-65]	—	—	—

Osaka gives MN = +7.6m. De Bilt eLN = +42.7m., MN = +53.5m.

Sept. 12d. Records also at 1h. (Batavia and De Bilt), 2h. (Tokyo and Azores), 4h. (La Paz), 13h. (De Bilt and Bidston), 16h.17m. (close to Rocca di Papa), 17h. (Taihoku), 19h. (Helwan and Paris), 21h. (Helwan and De Bilt).

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1919. Sept. 13d. 12h. 19m. 10s. (I) } Epicentre 15°2S. 61°0W.
20m. 8s. (II) } But see note at end.

A = +468, B = -844, C = -262; D = -875, E = -485;
 G = -127, H = +229, K = -965.

	Δ	Az.	P.	O-C.	S.	O-C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
La Paz	7.0	258	1 38	- 8	—	—	3.4	3.7
Andalgala	13.3	201	12 38	(-39)	15 38	(-13)	—	16.6
Pilar	E. 16.7	188	3 56	- 5	—	—	8.9	13.0
	N. 16.7	188	7 32	?S	(7 32)	+21	8.9	15.1
Rio de Janeiro	18.5	117	6 14	+111	11 38	?	16.7	19.8
Mendoza	18.9	200	8 8	?S	(8 8)	+ 8	—	11.1
Cipolletti	24.6	193	8 2	+148	(10 20)	+25	10.3	13.8
Vieques	33.6	354	12 50	?S	(12 50)	+16	—	19.5
Washington	56.1	347	9 47	0	17 32	- 3	34.8	—
Georgetown	56.1	347	e 9 48	+ 1	i 17 36	+ 1	35.6	—
Ithaca	59.4	350	11 5	+57	19 7	+51	i 32.8	—
Ann Arbor	61.2	344	—	—	—	—	30.8	—
Toronto	61.2	347	7 8	?	—	—	25.9	38.2
Chicago	62.0	340	10 5	-20	19 12	+24	32.2	—
Ottawa	62.1	350	i 10 30	+ 4	i 18 54	+ 5	30.8	—
Cape Town	73.0	122	22 56	?S	(22 56)	+114	46.9	52.5
San Fernando	73.0	45	11 50	+14	—	—	—	50.8
Colmbra	73.9	40	12 33	+52	23 1	+108	37.5	50.3
Granada	75.1	45	13 24	+94	23 55	+148	—	—
Algiers	79.6	48	—	—	e 23 32	+73	25.3	54.8
Tortosa	79.8	43	13 10	+52	23 40	+79	40.4	52.7
Barcelona	81.2	44	14 15	+109	23 44	+7	e 37.2	47.2
Victoria	84.2	325	13 20	+37	22 11	-59	34.5	52.2
Bidston	84.5	31	14 14	?	—	—	—	51.5
Oxford	84.6	33	i 13 25	+39	23 52	+37	—	50.4
Kew	84.9	33	—	—	—	—	—	52.8
Paris	85.1	37	13 26	+37	i 24 1	+41	43.8	52.8
Eskdalemuir	85.5	30	—	—	i 24 1	+36	42.8	—
Edinburgh	85.9	30	13 30	+37	23 58	+29	44.8	53.5
Moncalleri	86.4	42	13 33	+38	23 41	+ 7	37.3	57.8
Uccle	87.1	36	e 13 34	+34	24 12	+30	e 41.8	55.8
Strasbourg	88.0	40	e 13 44	+39	—	—	e 40.8	52.8
De Bilt	88.3	35	13 41	+34	24 22	+27	e 49.8	55.1
Rocca di Papa	88.4	47	e 13 51	+44	e 24 21	+25	e 54.5	—
Pompei	89.3	49	16 50	?PR ₁	24 30	+24	—	—
Hamburg	91.4	35	e 14 26	+63	i 24 38	+10	e 47.8	55.8
Vienna	z. 93.1	40	18 15	?PR ₁	—	—	e 45.8	60.3
Helwan	99.5	62	20 44	?PR ₁	—	—	—	69.8
Honolulu	101.9	290	—	—	—	—	22.8	24.8
Bombay	135.8	79	19 8	[-24]	—	—	—	27.1
Kodaikanal	139.2	90	—	—	—	—	31.5	31.8
Colombo	140.7	96	23 50	?PR ₁	—	—	—	30.8
Calcutta	150.1	70	19 38	[-18]	—	—	22.0	—
Manila	178.0	252	—	—	e 31 50	?	—	—

Additional records: La Paz T₁=12h.18m.58s. Andalgala: In forming O-C. an error of 10min. has been assumed; MN = +16.4m. Pilar, S is entered as PN. Washington T₁=12h.19m.17s. Georgetown records also i at +22m.27s. and +35m.36s. Ithaca iN = +19m.8s. Toronto two early records at i=12h.19m.6s. and i=12h.20m.48s., and several L records +15.2m., +19.3m., +34.7m., and eL = +36.6m. Chicago L = +39.3m., T₁=12h.18m.7s. Ottawa, P is entered as iN and S as iE; also iV = +2m.30s., eLE = +25.8m., L = +36.8m. San Fernando, Milne machine gives P = +12m.38s. Colmbra SR₁ = +28m.2s., MN = +47.6m., T₁=12h.19m.13s. Barcelona MN = +55.0m. Paris PR₁ = +17m.12s., MN = +43.8m., T₁=12h.19m.58s. Edinburgh PR₁ = +17m.2s., PR₂ = +19m.10s., SR₁ = +29m.58s. Uccle T₁=12h.20m.4s. De Bilt PR₁ = +17m.33s., eSN = +25m.4s., e = +28m.28s., MN = +52.2m., T₁=12h.19m.22s. Hamburg T₁=12h.21m.24s. Helwan PN = +21m.2s., MN = +65.9m.

There seems to have been several shocks. One, earlier than those tabulated, near Toronto and Ottawa; see the notes to those stations. Possibly one later than those tabulated, as shown in the Table by Rio de Janeiro, Mendoza, and Cipolletti. The double shock indicated at head seems to be a case where a larger shock follows a smaller, the smaller being caught at the near stations.

Continued on next page.

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while only the larger reaches the distant ones. The records have all been referred to $T_0(t) = 12h.19m.10s.$, and those which show the later shock are presumed to be

	Δ	P.	S.		Δ	P.	S.
	s.	s.	s.		s.	s.	s.
Ithaca	59.4	+ 57	+ 51	Moncalieri	86.4	+38	+ 7
Coimbra	73.9	+ 52	+108	Uccle	87.1	+34	+30
Granada	75.1	+ 94	+148	Strasbourg	88.0	+39	—
Algiers	79.6	—	+ 73	De Bilt	88.3	+34	+27
Tortosa	79.8	+ 52	+ 79	Rocca di Papa	88.4	+44	+25
Barcelona	81.2	+109	+ 67	Hamburg	91.4	+63	+10
Paris	85.1	+ 83	+ 41				
Edinburgh	85.9	+ 37	+ 29	Mean		+57	+53

The range of these residuals is considerable, and the mean values cannot be regarded very seriously; but part of the discordance may be due to the errors of the Tables near $\Delta = 90^\circ$. The general accordance of P and S suggests that the epicentre is correct, and the testimony of La Paz, Pilar, Washington, Georgetown, and Ottawa seems sufficient to establish the earlier shock.

Sept. 13d. 17h. 29m. 10s. Epicentre $16^\circ 2S. 61^\circ 0W.$ (as at 12h.).

	Δ	Az.	P.	O-C.	S.	O-C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
La Paz	7.0	258	11 40	- 6	2 45	-25	3.2	4.8
Andalgala	13.3	201	—	—	16 2	(+11)	—	16.6
Pilar	16.7	188	9 8	?	—	—	14.7	15.3
Mendoza	18.9	200	6 38	+130	7 38	-22	—	8.2
Cipolletti	24.6	193	10 8	?S	(10 8)	+13	—	23.0
Uccle	87.1	36	—	—	e 24 8	+26	—	55.8
De Bilt	88.3	35	—	—	e 24 20	+25	e 50.8	52.5

De Bilt eN = +25m.2s., MN = +53.4m. Andalgala has been again assumed to be 10min. in error, and generally the residuals, though not always small, accord with those of the shock at 12h. MN = +16.3m. We may note that the interval 17h.29m.10s. - 12h.19m.10s. = 310m. = 15 X 21m. - 5m.

Sept. 13d. 18h. 11m. (30s.). Epicentre $44^\circ 0N. 20^\circ 0W.$ (as on 1918 Jan. 14d.).

A = +.676, B = -.246, C = +.695.

Edinburgh ($\Delta = 16^\circ 0$) P = +7m.30s. = L?. Paris ($\Delta = 16^\circ 2$) eL = +7.5m.
 Strasbourg ($\Delta = 19^\circ 6$) L = +10.5m. Hamburg ($\Delta = 21^\circ 7$) eL = +11.5m.
 Helwan ($\Delta = 42^\circ 6$) PE = +17m.30s., PN = +12m.30s.
 Colombo ($\Delta = 92^\circ 2$) P = +43.5m. = L?.

Sept. 13d. 21h. 49m. 10s. Epicentre $18^\circ 2N. 68^\circ 2W.$ (as on 1918 Nov. 12d.).

A = +.353, B = -.882, C = +.312.

	Δ	Az.	P.	O-C.	L.	M.
	°	°	m. s.	s.	m.	m.
Vieques	E. 2.6	89	0 42	+ 1	1.0	1.3
N.	2.6	89	0 41	0	1.2	1.3
La Paz	E. 34.7	179	e 9 30	+139	21.2	23.3
De Bilt	E. 65.6	39	—	—	e 30.8	35.5
Helwan	88.9	58	55 50	?	—	—
Colombo	139.7	54	85 50	?L	(85.8)	—

Sept. 13d. Records also at 0h. (Batavia), 1h. (Colombo), 5h. (Mizusawa (2)), 6h. (San Fernando), 9h. (Barcelona and La Paz), 10h. (Vienna and Rocca di Papa), 11h. (Colombo, Uccle, De Bilt, Strasbourg, Hamburg, Paris, Helwan, Algiers, and Toronto), 13h. (Melbourne, La Quiaca, Zi-ka-wai, Mizusawa, Colombo, Kodakanal, and Manila), 14h. (Toronto, La Paz, and Azores), 16h. (Helwan), 17h. (Aplia), 18h. (near La Quiaca), 21h. (Paris).

Sept. 14d. 1h. 43m. 0s. Repetition from $15^\circ 2S. 61^\circ 0W.$ (as on Sept. 13d. 12h. and 17h.). La Paz gives P = +1m.52s., S = +3m.2s., L = +3.3m., M = +4.7m.

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Sept. 14d. 3h. 40m. 30s. Further repetition from 15°-2S. 61°-0W. La Paz gives P = +1m.45s.

We may compare the intervals between these repetitions with multiples of 21min., as follows (adding that to follow on Sept. 16d.).

Even Date	Multiple	Observed	O-C
d. h. m.		h. m. s.	m.
13 12 19	0	12 19 10	+0.2
13 17 34	15	17 29 10	-4.8
14 1 37	38	1 43 0	+6.0
14 3 43	44	3 40 30	-2.5
16 11 43	20½	11 48 0	+5.0

Sept. 14d. 6h. 17m. 30s.? Repetition from 18°-2N. 68°-2W. (as on 13d. 21h.).
 La Paz ($\Delta = 34^\circ.7$) P = +7m.39s., L = +20.5m., M = +23.6m. Uccle
 ($\Delta = 65^\circ.0$) e(S) = +17m.0s., eL = +25.5m. De Bilt ($\Delta = 65^\circ.6$)
 e = +17m.23s., ME = +32.5m., MN = +35.7m. The interval 14d.
 6h. 17m. 30s. - 13d. 21h. 49m. 10s. = 24 X 21m. + 4.3m.

Sept. 14d. Records also at 4h. (Helwan), 6h. (Bidston and Rio Tinto), 8h. (Apia),
 9h.56m. (near Edinburgh), 9h.58m. (close to De Bilt and apparently
 not same as former), 12h. (Dehra Dun), 13h. (Apia, Helwan, and Batavia),
 14h. (near De Bilt), 15h. (Helwan), 16h. (Taihoku), 23h. (La Paz (2) and
 Rocca di Papa).

Sept. 15d. 17h. 30m. 55s. Epicentre 21°-0N. 106°-5W. (as on 1917 June 29d.).

A = -265, B = -895, C = +358; D = -959, E = +284;
 G = -102, H = -344, K = -934.

	Δ	Az.	P.	O-C.	S.	O-C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Tucson	11.9	342	5 20	?S	(5 20)	+ 3	6.4	7.6
Berkeley	21.7	324	e 5 10	+ 9				
Chicago	26.2	33	5 50	0	10 20	- 6	14.4	16.6
Victoria	30.6	338	15 25	?	16 24	?	13.2	19.8
Georgetown	30.9	48	6 29	- 8	17 2	?L	(17.0)	
Washington	30.9	48	6 31	- 6	11 9	-41	20.9	17.6
Cheltenham (U.S.)	31.0	48	16 36	?L			19.9	20.3
Toronto	31.9	39			13 29	+82	e 17.9	21.6
Ithaca	33.0	44					i 18.3	
Ottawa	35.1	39	i 8 19	+65			e 18.4	
Honolulu	47.8	280	e 19 5	?SR ₁			21.9	27.1
La Paz	53.1	132	i 9 39	+12	19 1	+124	30.4	33.4
Edinburgh	79.9	34					43.1	47.6
Eskdalemuir	80.0	34	22 33	?S	(22 33)	+10	40.1	48.4
Bidston	80.8	38	30 17	?SR ₁				47.6
Coimbra	82.5	50			e 22 43	- 9	e 46.4	49.7
Oxford	82.6	39						48.6
Kew	83.2	39						49.1
Rio Tinto	84.7	52	43 5	?L			(43.1)	53.1
San Fernando	85.4	53	49 5	?L			(49.1)	53.1
De Bilt	85.9	35			23 35	+ 6	e 49.1	51.7
Paris	86.0	39	e 12 55	+ 2	e 23 19	-11	e 46.1	50.1
Uccle	86.1	37	e 12 53	- 1	e 23 23	- 8	e 41.1	50.1
Hamburg	87.7	31					e 47.1	58.8
Strasbourg	89.1	38					e 44.1	57.1
Moncalieri	91.0	40	e 18 23	?	i 25 19	+55	44.5	
Rocca di Papa	95.8	40	e 13 2	-46				13.8
Helwan	114.9	40			30 5	+116		

Additional records: Chicago T₀ = 17h.31m.5s. Victoria probably another
 shock. Georgetown IPV = +6m.32s., SN = +17m.4s., SV = +17m.33s.
 Washington e = +18m.35s. (=L?), T₀ = 17h.31m.30s. Cheltenham LN =
 +18.9m., MN = +19.3m. La Paz T₀ = 17h.29m.11s. Eskdalemuir
 MN = +47.4m. Coimbra SN = +34m.27s. (=L?), eLN = +47.7m., MN =
 +49.7m. San Fernando MN = +52.1m. De Bilt MN = +50.8m.
 Paris T₀ = 17h.31m.23s. Uccle T₀ = 17h.31m.18s. Hamburg MN =
 +53.1m.

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Sept. 15d. Records also at 0h. (Apia and San Fernando), 2h. (Zurich and Tokyo (2)), 3h. (Honolulu), 4h. (Berkeley, Helwan, and De Bilt), 6h. (Mizusawa, Ootomari, Helwan, and Zurich), 7h.31m. (near Coimbra and Granada), 9h. (Apia), 11h. and 13h. (Helwan), 16h. (Denver), 17h. (Ann Arbor), 22h. (Helwan).

Sept. 16d. 2h. 18m. 37s. Epicentre 46°4N. 10°0E. (as on 1918 April 24d.).

$$A = +.4679, B = +.120, C = +.724.$$

	Δ	P.	O-C.	S.	O-C.	M.
	°	m. s.	s.	m. s.	s.	m.
Chur	0.5	0 5	-3	0 11	-3	—
Zurich	E. 1.4	e 0 22	+1	i 0 40	+1	0.8
Strasbourg	2.7	0 50	+8	e 1 9	-5	—

Additional records: Zurich ePN and ePV as ePE, iSV = +0m.42s., iMN = +0.7m. Strasbourg eV = +1m.28s.

Sept. 16d. 11h. 48m. 0s. Repetition from 15°2S. 61°0W. (as on Sept. 14d.).

$$A = +.468, B = -.844, C = -.262.$$

Uncertain, but the apparent uncertainty is increased by certain errors (such as that at Andalgala), which appear also on Sept. 13d. 12h.

	Δ	Az.	P.	O-C.	S.	O-C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
La Paz	7.0	258	11 45	-1	—	—	3.0	3.2
Andalgala	E. 13.3	201	—	—	—	—	15.6	16.3
	N. 13.3	201	—	—	—	—	15.0	18.1
Pilar	E. 16.7	188	—	—	—	—	—	18.0
Mendoza	18.9	200	7 30	?S	(8 0)	0	8.0	12.9
Chicago	62.0	340	16 22	+357	20 53	+125	27.0	—
Bidston	84.5	31	47 6	?L	—	—	(47.1)	53.7
Paris	85.1	37	—	—	—	—	e 51.0	—
Uccle	87.1	36	—	—	—	—	—	52.0
Strasbourg	88.0	40	—	—	—	—	—	53.0
De Bilt	88.3	35	—	—	e 27 0	+185	e 51.0	54.1
Helwan	E. 99.5	62	52 0	?L	—	—	(52.0)	—
	N. 99.5	62	56 0	?L	—	—	(56.0)	—
Colombo	140.7	96	74 0	?L	—	—	(74.0)	—

Chicago gives L = +34.0m. and +42.0m. De Bilt MN = +54.7m.

Sept. 16d. Records also at 0h. (Helwan), 9h. (Taihoku), 12h.37m.40s. (close to La Quiaca, which gives PE = +8s., L = +14s., M = +2.4m.), 15h.56m.0s. (close to Osaka, which gives PS = +18s., L = +37s., M = +48s.), 16h. (Simla), 18h.33m.18s. (close to Osaka, which gives PS = +18s., L = +37s., MN = +53s.), 19h. (San Fernando), 21h. (Manila), 23h. (near Lick).

Sept. 17d. Records at 9h. (Helwan and Manila), 12h.30m. (close to Mizusawa), 13h.12m. (close to Mizusawa), 19h. (San Fernando).

Sept. 18d. Records at 5h. (Helwan), 7h. (Helwan), 11h. (Helwan), 12h. (Algiers and Lemberg), 14h. (Honolulu), 16h. (Helwan), 19h. (close to Lick (2)), 20h. (Taihoku and Zi-ka-wei), 21h. (Helwan and San Fernando). For note on Helwan records see introduction to this number of the Summary, p. 86.

Sept. 19d. 3h. 13m. 40s. Epicentre 69°2N. 151°0W. (as on 1919 Aug. 31d.).

$$A = -.448, B = -.248, C = +.859.$$

Very uncertain. It appears to be impossible to reconcile the records as they stand. The present solution assumed that La Paz is about 5m. in error.

	Δ	Az.	P.	O-C.	S.	O-C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Victoria	19.4	111	—	—	—	—	—	26.5
Berkeley	28.2	126	—	—	e 11 20	+17	—	—
Tucson	38.0	117	13 50	?S	(13 50)	+12	15.3	16.3
Chicago	42.0	85	8 39	+28	14 25	-10	19.6	—
Toronto	44.8	77	—	—	(15 2)	-10	17.7	—
Ottawa	45.4	73	—	—	e 15 20	0	e 26.3	—
La Paz	100.6	104	e 10 43	-210	e 20 38	-323	33.5	36.0

Toronto gives S as an L.

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Sept. 19d. Records also at 0h. (Helwan), 2h. (Hamburg), 4h. (Helwan, Melbourne, Riverview, Adelaide, and La Paz), 5h. (close to Rocca di Papa, De Bilt, and Moncalieri), 5h.43m. (Helwan, Bidston, and Uccle), 6h. (Strasbourg and Paris), 8h. (La Paz, Helwan, Uccle, and De Bilt), 9h. (Manila), 11h. (La Paz), 12h.40m. (Vienna, Helwan, Hamburg, Bidston, De Bilt, and Uccle), 13h. (Uccle, Strasbourg, Eskdalemuir, and Kew), 15h. (Melbourne and Riverview), 16h. (Helwan), 17h. (Tortosa and Barcelona), 19h. (San Fernando), 20h. (Apia), 21h. (Taihoku), 22h. (Taihoku), 23h. (Tokyo).

Sept. 20d. 8h. 52m. 48s. Epicentre 44°·5N, 11°·5E. (as on 1918 Mar. 11d.).

$$A = +.699, B = +.142, C = +.701.$$

	Δ	P.	O-C.	S.	O-C.	L.	M.
	°	m. s.	s.	m. s.	s.	m.	m.
Florence	0·7	(0 0)	-11	—	—	—	(0·2)
Moncalieri	2·7	0 43	+ 1	1 16	+ 2	—	—
Rocca di Papa	2·8	e 0 37	- 7	—	—	—	1·3
Zurich	3·5	e 1 0	+ 5	1 2 3	+26	—	—
Vienna	5·0	e 1 54	+37	—	—	1 2·8	3·4

Florence records P at 8h.51m.48s. and M at 51m.58s., earlier than the adopted T₀; these have been increased by 1m. for entry in the table. But even then they seem too early. Zurich gives ePN = +0m.54s., eP = +0m.56s., i = +1m.14s., iSN = +2m.5s.

Sept. 20d. Records also at 3h. (San Fernando), 4h. (Sydney), 10h. (Helwan), 11h. (Apia), 14h. (Colombo), 15h. (Manila).

Sept. 21d. Records at 0h. (San Fernando), 4h. (Manila, Batavia, and Zi-ka-wei), 6h. (La Paz), 10h. (De Bilt and Paris), 11h. (Strasbourg, Edinburgh, Uccle, and De Bilt), 12h. (Helwan), 14h. (La Paz), 16h. (Colombo), 20h. (Apia and Riverview), 21h. (Batavia and Helwan), 22h. (Manila), 23h. (Apia).

Sept. 22d. Records at 1h. (Manila), 5h. (Manila, Helwan, La Paz, and near Taihoku), 6h. (Manila and Zi-ka-wei), 7h. (San Fernando), 9h. (near Mizusawa), 11h. (Toronto, Victoria, and Apia), 12h. (Manila), 14h. (Apia), 18h. (near Tokyo), 22h. and 23h. (Manila).

Sept. 23d. 20h. 40m. 35s. Epicentre 48°·6S, 113°·3W.

$$A = -.262, B = -.608, C = -.750; D = -.918, E = +.396; G = +.297, H = +.689, K = -.661.$$

	Δ	Az.	P.	O-C.	S.	O-C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Cipolletti	33·5	91	12 31	?S	(12 31)	-1	15·5	18·0
Mendoza	36·9	84	9 13	?	—	—	—	13·8
La Paz	48·7	68	8 58	0	16 2	0	23·7	24·8
Melbourne	69·3	236	—	—	—	—	e 34·4	37·9
Bidston	137·6	58	68 1	?L	—	—	(68·0)	73·6
Uccle	140·9	63	—	—	—	—	e 70·4	—
De Bilt	141·8	61	—	—	—	—	e 71·4	74·6
Helwan	147·3	112	74 25	?L	—	—	(74·4)	—

Additional records: De Bilt gives MN = +74·1m. Helwan PN = +75m.25s.

Sept. 23d. Records also at 0h. (Helwan), 1h. (La Paz), 2h. (Helwan), 3h. (Helwan and San Fernando), 8h., 10h. (2), 13h., and 14h. (near Manila), 15h. (Tokyo), 19h. (Taihoku), 20h. (Manila (2)), 21h. (La Paz).

Sept. 24d. Records at 2h. (Helwan), 4h. (San Fernando), 5h. (La Paz), 7h. (Apia), 10h. (Colombo), 11h. (Taihoku), 13h. (near Algiers), 14h. (La Paz), 15h. (Melbourne and near Lick), 18h. (La Paz), 19h. (Lick and Manila).

Sept. 25d. Records at 1h. (Algiers), 3h. (San Fernando), 4h. (La Paz), 10h. (Helwan), 15h. (near Tortos), 16h. (La Paz (2), Helwan, Rocca di Papa, and near Vieques), 17h. (Coimbra, Port-au-Prince, La Paz, Mendoza, Pilar, and Andalgalá, evidently from some origin in South America, but the records do not give a determination), 20h. (Rocca di Papa), 22h. (San Fernando).

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Sept. 26d. 6h. 25m. 34s. Epicentre 22°·5N. 116°·5E.

A = -·412, B = +·827, C = +·383.

	Δ	Az.	P.	O-C.	S.	O-C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Hokoto	3·0	71	0 23	-24	—	—	0·9	—
Taihoku	5·4	57	1 25	+ 2	—	—	2·0	2·2
Manila	9·0	151	—	—	e 4 4	+ 1	—	—
Zi-ka-wei	9·8	26	—	—	e 4 20	- 3	—	—

Sept. 26d. 7h. 20m. (30s.). An anticipation of the shock at 9h. from Epicentre 17°·3N. 120°·5E. ? . Osaka gives P = +5m.15s., ME = +14·6m., MN = +15·5m., Tokyo gives P = +7m.54s., S = +9m.27s. (one or other of which may be S), and L = +10·8m. Mizusawa PE = +3m.30s., PN = +9m.0s. (?S). Helwan P = +30m.30s. (?SR).

1919. Sept. 26d. 9h. 6m. 50s. Epicentre 17°·3N. 120°·5E.

(as on 1919 June 24d.).

A = -·485, B = +·823, C = +·297 ; D = +·862, E = +·508 ;
G = -·151, H = +·256, K = -·955.

	Δ	Az.	P.	O-C.	S.	O-C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Manila	2·8	170	e 0 44	0	—	—	—	—
Hokoto	6·3	352	0 12	?	—	—	—	—
Taihoku	7·8	7	1 57	- 1	4 52	+ 81	8·8	9·5
Zi-ka-wei	14·0	3	e 3 20	- 6	e 6 10	+ 2	—	11·3
Kobe	21·8	34	4 59	- 4	—	—	8·7	9·5
Osaka	21·9	35	4 56	- 3	—	—	9·1	11·6
Tokyo	25·1	39	5 36	- 3	8 44	- 81	10·7	—
Batavia	27·1	211	5 46	- 13	—	—	—	11·8
Mizusawa	28·3	36	5 56	- 15	10 41	- 23	—	—
E. N.	28·3	36	5 52	- 19	10 38	- 26	—	—
Calcutta	30·7	286	6 10	- 25	—	—	—	—
Otomari	34·7	27	6 46	- 25	—	—	—	—
Colombo	41·0	261	10 10	?	—	—	13·4	13·9
Sima	41·6	298	13 52	?S	(13 52)	- 37	23·4	26·3
Kodalkanal	42·8	268	8 34	+ 17	—	—	—	26·0
Riverview	58·9	150	—	—	e 18 16	+ 6	—	30·5
Honolulu	76·1	73	21 58	?S	(21 58)	+ 20	31·7	49·2
Helwan	80·8	299	20 10	+	—	—	—	—
Budapest	84·8	318	i 12 53	+ 6	—	—	—	—
Vienna	86·2	320	12 44	- 10	23 17	- 15	40·2	55·2
Hamburg	87·7	327	i 12 50	- 13	e 23 22	- 27	e 45·2	57·2
Pola	89·1	317	26 16	?	—	—	49·1	53·2
Pompei	90·3	313	13 3	- 15	23 40	- 37	—	—
De Bilt	91·0	326	—	—	23 44	- 40	e 45·2	51·8
Roca di Papa	91·2	315	13 6	- 16	e 24 4	- 22	e 55·2	62·0
Strasbourg	91·3	322	13 3	- 20	—	—	e 47·2	51·6
Florence	91·3	317	23 39	?S	(23 39)	- 48	43·2	50·2
Uccle	92·1	325	e 13 10	- 18	e 22 4	- 152	e 46·2	51·2
Moualiéri	93·0	319	13 14	- 18	23 44	- 61	38·0?	55·4
Eskalemuir	93·3	332	24 2	?S	(24 2)	- 46	48·2	54·4
Kew	94·1	329	27 10	?	—	—	—	57·2
Paris	94·2	325	i 17 10	?PR ₁	—	—	50·2	62·2
Bidston	94·4	330	24 47	?S	(24 47)	- 13	—	54·6
Oxford	94·6	328	—	—	—	—	—	57·9
Algiers	100·1	314	—	—	—	—	59·2	62·7
Colmbra	105·5	322	e 25 48	?S	(25 48)	- 59	54·4	—
Rio Tinto	105·9	319	—	—	26 10	- 41	—	64·2
San Fernando	106·4	320	58 10	?L	—	—	61·2	64·2
Chicago	115·5	23	19 36	?PR ₁	29 6	?	e 43·2	—
Ottawa	115·7	13	1 19 30	?PR ₁	—	—	e 59·2	—
Toronto	116·7	16	21 34	?	—	—	30·3	—
Washington	121·3	16	20 20	?PR ₁	—	—	—	—
Georgetown	121·3	16	19 51	?PR ₁	—	—	—	—
La Paz	171·6	86	20 19	[+ 3] i 29 41	?	—	—	—

Manila assigns epicentre adopted. Zi-ka-wei gives MN = +13·8m., T = 9h.40s. Kobe MN = +8·9m. Osaka MN = +10·3m. Batavia MN = +10·9m. Calcutta PN = +6m.18s. Riverview MN = +25·9m. Vienna PR₁ = +16m.8s. Hamburg MN = +49·6m., T = 9h.7m.6s. De Bilt eLN = +44·2m., MN = +51·5m. Uccle MN = +51·0m. Moualiéri MN = +53s., T = 9h.7m.31s. Bidston S = +32m.34s. Colmbra ePN = +37m.48s., L = +56·1m. San Fernando (Milne) P = +61m.10s., L = +65·2m., MN = +67·7m. Both instruments MN = +37·7m. Chicago L = +65·3m. Ottawa L = +69·2m. Toronto L = +33·9m. ? Georgetown records have been diminished by 1h., eN = +20m.29s.

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1919. Sept. 26d. 19h. 39m. 20s. Epicentre 6°3N. 123°2E.
(as given by Manila and De Bilt).

A = -544, B = +832, C = +110; D = +837, E = +548;
G = -060, H = +092, K = -994.

The epicentre of 1917 Nov. 16d.22h., viz., 6°0N. 125°0E., was first tried, and the residuals indicated a change to 7°2N. 124°0E., i.e., in the direction of the Manila epicentre in both co-ordinates, though not by the appropriate amounts. The Manila epicentre was therefore adopted. The La Paz and Coimbra records suggest that the focus is higher than normal, but on trial the stations near the epicentre did not support this hypothesis.

	Δ	Az.	P.	O-C.	S.	O-C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Manila	8.6	346	e 2 40	+30	—	—	—	—
Taihoku	18.8	355	4 40	+13	8 8	+10	10.6	—
Batavia	20.6	233	i 5 6	+18	9 11	+35	e 13.3	22.8
Zi-ka-wei	25.0	356	e 4 34	-64	e 9 58	-5	—	16.0
Kobe	30.5	21	6 47	+14	—	—	14.1	16.7
Osaka	30.6	21	6 1	-33	11 13	-31	15.6	19.6
Mizusawa	36.5	25	7 15	-11	12 46	-31	—	—
	36.5	25	7 19	-7	12 52	-25	—	—
Calcutta	37.3	300	7 46	+14	—	—	—	—
Perth	38.9	189	—	—	13 15	-36	19.8	—
Colombo	43.0	273	8 34	+16	10 34	?PR ₁	14.4	31.7
Adelaide	43.8	161	8 34	+10	15 4	+5	21.3	29.0
Kodaikanal	45.5	278	10 22	+105	—	—	15.1	35.1
Riverview	48.1	148	e 8 54	-1	e 15 58	+3	e 23.1	29.8
Sydney	48.1	148	8 58	+3	15 58	+3	23.1	30.4
Melbourne	48.5	157	8 58	+1	16 10	+10	21.7	22.0
Simla	49.7	309	16 22	?S	(16 22)	+7	—	32.8
Bombay	50.1	290	9 23	+15	—	—	—	—
Apia	67.6	107	e 11 28	+26	e 20 40	+43	38.7	—
Honolulu	77.3	70	12 40	+37	—	—	e 36.8	52.1
Helwan	88.4	300	13 40	+33	—	—	—	68.4
Budapest	94.7	320	e 12 23	-79	—	—	—	—
Vienna	96.3	321	17 21	?PR ₁	—	—	e 35.7	58.7
Hamburg	98.2	326	18 4	?PR ₁	—	—	e 44.7	55.7
Victoria	100.4	38	—	—	(25 30)	-30	25.5	34.4
Rocca di Papa	100.8	314	e 14 15	+1	—	—	e 52.5	62.7
Florence	101.2	317	—	—	22 10	?0	—	36.7
Strasbourg	101.5	321	—	—	e 25 40	-30	e 50.7	63.4
De Bilt	101.6	325	—	—	e 24 57	-74	50.7	61.7
Uccle	102.6	325	—	—	33 5	?SR ₁	46.7	66.8
Paris	104.5	323	e 14 31	-1	e 25 10	-88	51.7	57.7
Kew	104.8	328	43 40	?L	—	—	(43.7)	69.7
Berkeley	104.9	48	—	—	e 38 40	?0	—	—
Oxford	105.2	328	—	—	—	—	e 52.2	60.7
Lick	105.6	48	—	—	—	—	e 48.7	—
Algiers	109.5	311	—	—	—	—	e 31.7	81.7
Moncalieri	103.0	318	13 48	-37	24 57	-87	38.0	70.0
Capetown	105.7	235	25 4	?S	(25 4)	-105	—	—
Coimbra	115.9	320	18 56	[+15]	29 53	+96	e 43.6	—
San Fernando	116.2	315	—	—	33 40	?0	73.7	79.7
Chicago	124.3	27	21 8	?PR ₁	30 50	?0	86.7	—
Washington	131.0	19	e 21 30	?PR ₁	—	—	—	—
La Paz	165.0	134	20 30	[+18]	35 33	?0	77.2	84.1

Eskdalemuir (Δ = 114°·2) gives simply 20h.20m. to 21h.50m. Ottawa (Δ = 125°·6) gives eL = 20h.36m. to 42m., L = 20h.47m. to 55m., L = 21h.0m. to 5m., L = 21h.7m. to 16m., L = 21h.20m. to 25m. Toronto (Δ = 126°·0) gives L = 21h.0m.12s., 21h.7m.48s., eL = 21h.10m.0s., M = 20h.11m.24s., L = 20h.25m.36s.

Additional records: Batavia MP = +7m.37s., S - iP = 3m.42s. (from which S above has been inferred), MS = +9m.11s., T₀ = 19h.39m.19s. Zi-ka-wei MN = +16.4m. Perth PR = +10m.11s., SR = +16m.34s. Adelaide PR = +10m.16s., SR = +18m.4s. Riverview SR₁ = +19m.41s., MN = +30.2m. MZ = +31.7m., T₀ = 19h.39m.14s. Melbourne SR₁ = +19m.22s. Apia gives e₁ (taken as P) e₂ (taken as S), and e₂ = +32m.40s. Helwan PN = +17m.16s., MN = +65.6m. Uccle PR₁ = +24m.52s. = S? MN = +58.9m. De Bilt e(SR₁) = +33m.3s., eLN = +48.7m., MN = +53.0m. Moncalieri MN = +62.1m., T₀ = 19h.39m.54s. San Fernando MN = +84.7m.

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The following appear to be repetitions from the same epicentre. The intervals from the first shock are 1h.58.7m. = 3 X 21m. - 7.3m. and 3h.9.0m. = 9 X 21.0m. exactly.

Sept. 26d. 21h. 38m. 0s. Epicentre 6°-3N. 123°-2E. (as at 19h.).

	Δ	Az.	P.	O-C.	S.	O-C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Manila	8.6	346	e 3 36	?S	(e 3 36)	-17	—	—
Taihoku	18.8	355	8 2	?S	(8 2)	+4	—	—
Batavia	20.6	233	e 5 1	+13	9 5	+29	e 12.0	—
Zi-ka-wei	25.0	356	e 5 40	+2	e 10 2	-1	—	—
Osaka	30.6	21	6 37	+3	—	—	—	11.6
Colombo	43.0	273	—	—	14 0	-48	—	32.0
Kodalkanal	45.5	278	17 54	?SR ₁	—	—	—	—
Riverview	48.1	148	—	—	e 15 54	-1	e 26.3	38.7
Strasbourg	101.5	321	—	—	—	—	64.0	—
De Bilt	101.6	325	—	—	—	—	e 55.0	64.3
Uccle	102.6	325	—	—	—	—	—	59.0
Moncalieri	112.6	318	—	—	31 26	?	65.2	—

Additional records: Batavia gives T₀ = 21h.37m.55s. Zi-ka-wei gives T₀ = 21h.38m.10s. Osaka MN = +16.9m. Kodalkanal gives also P = +29m.12s. (?L). Riverview eSR₁ = +19m.31s., MN = +43.2m. Strasbourg +57m.0s. De Bilt eLN = +53.0m., MN = +58.1m.

Sept. 26d. 22h. 48m. 20s. Further repetition from 6°-3N. 123°-2E.

	Δ	Az.	P.	O-C.	S.	O-C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Manila	8.6	346	e 2 52	+42	—	—	—	—
Taihoku	18.8	355	e 7 59	?S	(7 59)	+1	—	—
Batavia	20.6	233	e 4 58	+10	8 54	+18	e 13.7	—
Zi-ka-wei	25.0	356	e 5 31	-7	e 9 54	-9	—	—
Osaka	30.6	21	5 58	-36	—	—	—	17.4
Riverview	48.1	148	—	—	e 15 44	-11	—	36.5
Pompeii	99.8	312	55 37	?L	—	—	(55.6)	—
Rocca di Papa	100.8	314	e 55 3	?L	—	—	(55.1)	56.9
Strasbourg	101.5	321	58 40	?L	—	—	(58.7)	—
De Bilt	101.6	325	—	—	—	—	—	55.7
Uccle	102.6	325	—	—	—	—	e 57.7	—
Moncalieri	112.6	318	—	—	—	—	e 64.9	—

Additional records: Batavia gives T₀ = 22h.48m.23s. Osaka MN = +16.9m. Riverview eSR₁ = +19m.16s., MN = +34.5m. Zi-ka-wei T₀ = 22h.48m.20s. The records at Pompeii and Rocca di Papa may belong to a local shock. De Bilt eLN = +53.7m., MN = +58.2m.

Sept. 26d. Additional record at 1h. (Bidston), 8h. (Riverview), 10h. and 11h. (Manila).

Sept. 27d. 3h. 33m. 50s. Epicentre 7°-0N. 82°-5W.

A = +130, B = -984, C = +122; D = -991, E = -131;
G = +016, H = -121, K = -992.

	Δ	Az.	P.	O-C.	S.	O-C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Balboa Hts.	E. 3.5	55	1 30	+35	—	—	2.8	3.1
	N. 3.5	55	1 34	+39	—	—	2.8	3.1
La Paz	27.4	149	6 5	+3	10 45	-3	14.2	17.0
Washington	32.3	8	e 6 5	-46	—	—	—	—
Georgetown	32.3	8	—	—	—	—	e 18.2	—
Chicago	35.1	353	7 27	+13	11 50	-67	e 18.2	—
Ann Arbor	35.3	359	—	—	—	—	26.2	—
Toronto	36.7	4	i 17 28	?L	—	—	19.0	23.9
Ottawa	38.8	7	8 6	+22	e 13 58	+9	e 21.2	—
Honolulu	74.1	291	—	—	—	—	36.2	41.5
Uccle	82.6	40	e 23 22	?S	(23 22)	+29	e 40.2	—
De Bilt	83.0	40	e 23 52	?S	(23 52)	+55	e 41.2	44.9
Helwan	106.8	56	35 10	?SR ₁	—	—	—	—

Additional records: La Paz gives T₀ = 3h.34m.2s. Georgetown gives eLE₁ = +14m.51s. = SR₁?. Chicago gives T₀ = 3h.34m.30s. Toronto gives another eL at +20.0m. Ottawa gives PR₁ = +9m.46s., LE = +26.2m., L = +46.2m., T₀ = 3h.34m.32s. De Bilt eLN = +39.2m.

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Sept. 27d. Records also at 0h. (Manila), 1h. (Helwan), 5h. (Rocca di Papa), 6h. (Batavia and Manila), 7h. (Helwan), 8h. (Paris), 9h. (Helwan), 10h.56m.20s. (Batavia P = +3m.23s., S = +6m.5s., M = +7.3m. Manila P = +6m.0s., Taihoku, Chicago P = +17m.10s., S = +25m.38s.), 11h.30m.? (Cheltenham, Washington, Georgetown, and Ithaca), 12h. (Rocca di Papa), 13h. (La Paz), 19h. (Moncalieri), 22h. (Apia), 23h. (Apia and Kodaikanal).

Sept. 28d. Records at 0h. (Taihoku (2)), 1h.39m. (close to Taihoku), 4h.39m. (close to Mizusawa, recorded also at Tokyo), 7h.33m. (close to Mizusawa, recorded also at Osaka), 8h. (San Fernando), 11h. (Manila), 17h. (near Tokyo), 19h.18m. (close to Taihoku), 19h. (San Fernando).

Sept. 29d. 13h. 41m. 20s. Epicentre 25° 0N. 123° 0E. (as on 1918 Mar. 27d.).

A = -494, B = +760, C = +423; D = +839, E = +545;
G = -230, H = +354, K = -906.

	Δ	Az.	P.	O-C.	S.	O-C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Taihoku	1.3	274	0 17	-3	—	—	0.4	0.8
Hokoto	3.5	245	0 25	-30	—	—	1.0	—
Zi-ka-wei	6.3	348	e 1 27	-9	e 2 59	+ 7	—	4.3
Manila	10.6	191	2 33	-5	—	—	—	—
Osaka	14.5	45	6 10	18	(6 10)	-10	10.0	13.0
Tokyo	17.9	50	3 34	-42	10 23	?L	13.8	—

Additional records: Zi-ka-wei gives MN = +3.7m. Osaka gives MN = 12.4m. Mizusawa ($\Delta = 20^\circ.8$) gives EN = +18m.40s., E = +19m.16s.; both records probably belong to some other shock.

Sept. 29d. Records also at 4h. (Athens (2)), 12h. (Helwan, Vienna, Apia, and Honolulu), 13h. (Manila, Apia, Honolulu, and Paris), 14h. (Bidston, De Bilt, and Uccle), 18h. (Taihoku and Zi-ka-wei), 19h. (Mizusawa and Tokyo), 21h. (Ootomari), 22h. (San Fernando).

Sept. 30d. 7h. 37m. 8s. Epicentre 28° 0N. 112° 5W.

A = -338, B = -816, C = +469; D = -924, E = +383;
G = -180, H = -434, K = -883.

	Δ	Az.	P.	O-C.	S.	O-C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Tucson	4.5	19	1 20	+10	—	—	2.0	2.8
Lick	12.1	323	e 3 56	+56	—	—	—	—
Berkeley	12.9	323	e 3 3	-9	—	—	—	5.7
Chicago	24.5	49	5 27	-6	9 50	-4	12.7	—
Toronto	30.8	51	8 44	+128	—	—	10.7	12.2
Honolulu	41.7	271	—	—	—	—	19.4	22.4

Additional records: Berkeley MN = +6.6m. Toronto L = +16.4m., which may belong to following shock.

Sept. 30d. 7h. 52m. 32s. Epicentre 38° 0N. 82° 5W.

A = +103, B = -781, C = +616.

	Δ	Az.	P.	O-C.	S.	O-C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Washington	4.3	76	—	—	e 1 58	0	3.1	—
Cheltenham	E. 4.4	78	1 14	+6	—	—	5.1	6.6
	N. 4.4	78	1 10	+2	(2 8)	+ 7	2.1	2.2
Ithaca	6.3	43	e 2 43	+67	e 3 20	+28	—	—
Northfield	9.6	49	—	—	e 4 28	+10	—	—
Point Loma	28.7	268	7 28	1PR ₁	—	—	—	—

This epicentre is 27° from the last, and an L wave would just about reach it in the interval.

Sept. 30d. Records also at 1h. (Batavia and Manila), 2h. (Helwan), 4h. (Helwan), 9h. (Apia, Helwan), 10h. (Tokyo), 14h. (Tokyo), 16h. (Apia, Helwan, and Riverview), 18h. (Apia), 17h. (Helwan and Uccle), 19h.54m. (close to Tokyo), 23h. (Lick).

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TABLE.

De- grees.	P sec.	S sec.	S - P sec.	De- grees.	P sec.	S sec.	S - P sec.	De- grees.	P sec.	S sec.	S - P sec.
1	15	28	13	51	553	991	438	101	855	1565	710
2	31	55	24	52	560	1004	444	102	860	1575	715
3	47	83	36	53	566	1016	450	103	865	1584	719
4	62	110	48	54	573	1029	456	104	870	1593	723
5	77	137	60	55	579	1041	462	105	874	1602	728
6	92	164	72	56	586	1054	468	106	879	1612	733
7	106	190	84	57	592	1066	474	107	884	1621	737
8	121	217	96	58	599	1079	480	108	888	1630	742
9	136	243	107	59	605	1091	486	109	893	1639	746
10	150	269	119	60	612	1103	491	110	897	1648	751
11	164	294	130	61	619	1116	497	111	902	1657	755
12	179	319	140	62	625	1128	503	112	907	1666	759
13	193	344	151	63	632	1141	509	113	911	1674	763
14	206	368	162	64	638	1153	515	114	916	1682	766
15	219	392	173	65	645	1165	520	115	920	1690	770
16	232	415	183	66	651	1177	526	116	925	1698	773
17	245	438	193	67	658	1190	532	117	929	1706	777
18	257	460	203	68	664	1202	538	118	934	1714	780
19	269	482	213	69	671	1214	543	119	938	1722	784
20	281	503	222	70	677	1226	549	120	942	1729	787
21	293	524	231	71	683	1238	555	121	947	1737	790
22	305	545	240	72	690	1250	560	122	952	1744	792
23	317	565	248	73	696	1262	566	123	957	1752	795
24	328	584	256	74	702	1274	572	124	961	1759	798
25	338	603	265	75	709	1286	577	125	966	1766	800
26	348	622	274	76	715	1297	582	126	970	1773	803
27	358	641	283	77	721	1309	588	127	974	1780	806
28	368	659	291	78	727	1320	593	128	978	1787	809
29	378	677	299	79	733	1332	599	129	983	1794	811
30	388	694	306	80	739	1343	604	130	988	1801	813
31	398	711	313	81	745	1355	610	131	992	1807	815
32	407	728	321	82	750	1366	616	132	996	1814	818
33	416	744	328	83	756	1377	621	133	1001	1821	820
34	425	760	335	84	762	1388	626	134	1005	1827	822
35	433	775	342	85	768	1399	631	135	1009	1833	824
36	442	790	348	86	773	1410	637	136	1014	1840	826
37	450	804	354	87	779	1421	642	137	1018	1846	828
38	458	818	360	88	785	1432	647	138	1023	1852	829
39	466	832	366	89	790	1443	653	139	1027	1858	831
40	475	847	372	90	796	1454	658	140	1031	1864	833
41	483	861	378	91	801	1464	663	141	1035	1869	834
42	491	875	384	92	807	1475	668	142	1039	1875	836
43	498	888	390	93	812	1485	673	143	1043	1881	838
44	506	902	396	94	818	1496	678	144	1047	1886	839
45	513	915	402	95	823	1506	683	145	1051	1892	841
46	520	928	408	96	829	1516	687	146	1055	1897	842
47	527	941	414	97	834	1526	692	147	1059	1902	843
48	534	954	420	98	840	1536	696	148	1063	1907	844
49	540	966	426	99	845	1546	701	149	1067	1912	845
50	547	979	432	100	851	1556	705	150	1071	1917	846