The International Seismological Summary for 1918

(Continued).

FORMERLY THE BULLETIN OF THE BRITISH ASSOCIATION SEISMOLOGY COMMITTEE.

The present number contains the information for October, November, and December 1918, and thus concludes the first year of the International Summary—the successor to the Shide and Oxford Bulletins.

It seems desirable to repeat some of the information as to procedure, but this will be more conveniently placed at the end of the year. Hence the reader is referred to the Notes at the end of this number for such information; also for some records which arrived too late for inclusion in the earlier numbers, and for discussions of some points of interest, such as the laws governing the repetition of shocks from the same focus.

It is doubtful whether a final or standard method of presentation of the results has yet been reached. As the work progresses, and new light is thrown on the whole subject, it is inevitable that more should be possible by way of inference than at first. This is chiefly true of the shocks only imperfectly recorded. At first there was no guidance for them, except the actual records, which were inconclusive; but a number of epicentres have now been recognised from which repetitions may be expected; so that, to put an extreme supposition, if the imperfect information about a new shock only suffices to refer it vaguely to a large area which nevertheless contains an old epicentre (and only one), the new shock may be confidently attributed (as a first approximation, at any rate) to this known position. On the other hand, there seem to be also *preliminary* feeble shocks which herald much greater ones. For the latter a good epicentre can readily be determined; and it is then possible to return to the rough determination of the feebler shock formerly adventured and to give it precision. Experience suggests that a good deal of revision of earlier results in this way might be advantageous; but it seems better for the present to press forward to the years 1919-1922, for which the material is already accumulated.

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University Observatory, Oxford,
1923 October 23rd.

1918 OCTOBER, NOVEMBER, & DECEMBER.

Oct. 1d. 0h. 20m. 15s. Epicentre 30°·0N. 174°·0W.

A = −·861, B = −·091, C = +·500; D = −·104, E = +·995;
G = −·497, H = −·052, K = −·866.

Both this and the following determination are very unsatisfactory, but they may serve to show the difficulties in reconciling all the records on the hypothesis of a single shock.

	Δ	Az.	P.	O−C.	S.	O−C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Honolulu	16·7	117	(3 3)	−58	—	—	3·0	12·6
Tokyo	38·9	290	7 46	+ 1	13 52	+ 1	17·7	—
Victoria	42·4	50	—	—	—	—	59·5	65·9
Riverview	71·9	210	—	—	e 34 45	?	e 39·6	45·0
Toronto	72·8	50	—	—	—	—	e 78·2	84·9
Melbourne	77·9	212	—	--	—	—	37·8	40·0
Adelaide	78·9	219	—	—	—	—	—	40·9
Batavia	83·8	261	38 41	?L	38 54	?L	(38·7)	40·8
Colombo	100·4	283	74 45	?L	—	—	(74·8)	80·8
Cape Town	168·7	246	100 45	?L	—	—	(100·8)	101·8

Additional records: Honolulu gives its records under 1h. instead of 0h., also e = +1m.45s. Riverview MN = +46·0m. Toronto eL = +81·8m.

Oct. 1d. 1h. 9m. 30s. Epicentre 14°·0S. 85°·0E.

A = +·085, B = +·966, C = −·242; D = +·996, E = −·087;
G = −·021, H = −·241, K = −·970.

	Δ	Az.	P.	O−C.	S.	O−C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Kodaikanal	25·4	342	6 24	+42	—	—	20·7	20·7
Mauritius	26·5	253	10 42	?S	(10 42)	+10	—	—
Bombay	35·0	340	12 55	?S	(12 55)	0	—	17·2
Calcutta N.	36·7	7	15 12	?SR_1	18 12	?L	(18·2)	—
Dehra Dun	44·8	352	9 30	+58	—	—	—	—
Simla	45·7	351	e 10 18	?PR_1	—	—	—	13·3
Zi-ka-wei	57·2	39	9 57	+ 4	e 17 48	− 1	e 32·1	35·8
Helwan	67·8	313	21 48	?S	(21 48)	+108	—	28·3
Zagreb	86·0	321	e 12 29	−24	e 22 38	+52	51·8	—
Rocca di Papa	86·6	316	12 55	− 2	—	—	—	13·6
Moncalieri	91·1	318	—	—	e 21 3	−202	36·0	—
De Bilt	94·9	323	—	—	e 21 30	−215	e 33·5	36·6
Uccle	95·0	322	e 12 0	−103	—	—	—	39·5
Paris	95·9	320	—	—	e 21 58	−197	37·5	—
Shide	98·4	321	—	—	e 21 41	?	38·6	45·3
Stonyhurst	99·8	322	e 21 48	?	e 29 54	?	e 41·6	43·6
Edinburgh	100·5	325	15 30	+77	—	—	—	44·5

No additional records.

Oct. 1d. Records also at 0h. (Ottawa), 8h. (Kodaikanal), 12h. (Batavia), 21h. (San Fernando), 23h. (Lick).

Oct. 2d. 0h. 20m. 10s. Epicentre 5°·0S. 142°·0E.

$A = -·785$, $B = +·613$, $C = -·087$; $D = +·616$, $E = +·788$; $G = +·069$, $H = -·054$, $K = -·996$.

On direct comparison with 1918 July 3d. (adopted epicentre 3°·5S. 142°·0E.), some stations agree so well as to suggest identical origin; but others differ considerably.

	Δ	Az.	P.	O−C.	S.	O−C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Riverview	30·1	166	e 6 28	− 1	i 11 34	− 2	e 13·9	14·7
Adelaide	30·1	185	6 25	− 4	10 30	−66	14·6	17·8
Sydney	30·1	166	4 50	?	10 20	−76	14·1	15·3
Melbourne	32·9	176	—	—	13 14	+52	20·6	21·6
Batavia	35·0	268	4 50	?	—	—	—	14·8
Perth, W.A.	36·4	220	7 26	+ 1	13 3	−11	21·5	24·1
Osaka	40·1	350	7 40	−16	(13 48)	−20	13·8	15·0
Kobe	40·2	350	e 7 43	−14	—	—	12·4	14·7
Zi-ka-wei	41·2	332	i 8 0	− 5	—	—	—	—
Mizusawa E.	44·1	358	8 6	−21	14 39	−24	—	—
N.	44·1	358	8 4	−23	14 40	−23	—	—
Honolulu	64·3	61	e 11 38	+58	18 32	−45	25·7	36·3
Mauritius	82·7	250	44 44	?L	—	—	(44·7)	48·0
Victoria	96·8	41	25 14?	?S	(25 14?)	−10	—	61·6
Helwan	110·4	300	19 50	?PR_1	—	—	—	—
Cape Town	114·1	229	60 50	?L	—	—	(60·8)	63·3
De Bilt	121·0	331	—	—	29 50	+53	e 59·8	61·9
Rocca di Papa	121·9	319	i 18 56	?	32 20?	?	e 76·2	—
Edinburgh	122·1	340	28 50	?S	(28 50)	−15	—	—
Eskdalemuir	122·5	339	—	—	—	—	57·8	—
Stonyhurst	123·3	335	—	—	—	—	—	68·2
Bidston	123·8	335	49 50	?L	—	—	(49·8)	61·8
Paris	124·8	330	—	—	e 34 50	?SR_1	63·8	—
Toronto	126·9	36	—	—	—	—	76·9?	—
La Paz	143·2	126	19 24	[−21]	—	—	—	—

Additional records: Riverview gives i = +6m.37s., MN = +15·1m., MZ = +18·9m., T_o = 0h.20m.11s. Adelaide SR_1 = +11m.55s. Melbourne SR_1 = +16m.20s. Osaka MN = +14·9m. Mizusawa T_o = 0h.19m.55s.

Oct. 2d. 13h. 22m. 27s. Epicentre 13°·0N. 123°·0E. (as on 1917 Sept. 7d.).

$A = -·531$, $B = +·817$, $C = +·225$; $D = +·839$, $E = +·545$; $G = +·123$, $H = -·189$, $K = -·974$.

	Δ	Az.	P.	O−C.	S.	O−C.	M.
	°	°	m. s.	s.	m. s.	s.	m.
Manila	2·6	309	i 0 47	+ 6	—	—	—
Zi-ka-wei	18·2	356	i 4 17	− 2	i 7 44	0	—
Osaka	24·4	26	5 35	+ 3	—	—	13·5
Batavia	25·1	221	e 5 33	− 6	—	—	10·6

Osaka gives MN = +12·8m.

Oct. 2d. Records also at 7h. (De Bilt and Athens), 11h. (Athens and La Paz), 14h. (Denver), 22h. (San Fernando).

Oct. 3d. Records at 0h. (Helwan), 1h. (Mizusawa and Tokyo), 7h. (Riverview and Melbourne), 8h. (Helwan, Rocca di Papa, Pompeii, Edinburgh, and Taihoku), 9h. (Zi-ka-wei), 14h. (Manila and Monte Cassino), 22h. (San Fernando).

Oct. 4d. Records at 1h. (Eskdalemuir, Edinburgh, and De Bilt), 2h. (Algiers, Osaka, Kew, Helwan, Tokyo, Stonyhurst, Mizusawa, and Kobe), 4h. (Melbourne, La Paz, and Riverview), 6h. (Taihoku and Helwan), 7h. (Mauritius), 8h. (La Paz), 9h. (Georgetown, Washington, Lawrence, St. Louis, Ithaca, and Cheltenham), 14h. (La Paz), 21h. (San Fernando).

Oct. 5d. Records at 4h. (Bidston), 6h. (Rocca di Papa (2)), 10h. (Batavia), 21h. (Colombo), 22h. (San Fernando).

Oct. 6d. Records at 0h. (La Paz), 2h. (Melbourne, Perth, W.A., and Riverview), 3h. (San Fernando and Helwan), 12h. (Manila and San Fernando), 15h. (La Paz), 20h. (Honolulu and Mizusawa), 21h. (Nagasaki).

Oct. 7d. Records at 8h. (Monte Cassino), 10h. (Manila), 12h. (Tokyo), 14h. (La Paz).

Oct. 8d. Records at 1h. (Zi-ka-wei, Taihoku, and San Fernando), 6h. (Mizusawa), 8h. (Mizusawa and Tokyo), 11h. (Rocca di Papa and Monte Cassino), 21h. (Mizusawa).

Oct. 9d. 9h. 17m. 40s. Epicentre 7°·5S. 121°·5E.

$A = -\cdot518$, $B = +\cdot846$, $C = -\cdot130$; $D = +\cdot853$, $E = +\cdot522$; $G = +\cdot068$, $H = -\cdot111$, $K = -\cdot991$.

The residuals suggest that the shock was nearer Batavia, Riverview, and Zi-ka-wei, Azimuths 274°, 138°, and 0°,—which no surface displacement will effect. The focus may be deep, but the only anticentric residual, −6s. for La Paz [P], does not confirm this.

		Δ	Az.	P.	O−C.	S.	O−C.	L.	M.
		°	°	m. s.	s.	m. s.	s.	m.	m.
Batavia		14·6	274	i 3 10	−24	5 39?	−43	—	6·3
Manila		22·1	359	e 5 14	+ 8	9 20	+13	10·4	10·5
Adelaide		31·6	152	—	—	11 18	−43	14·3	18·1
Melbourne		37·8	148	12 26	?S	(12 26)	−69	23·1	23·4
Riverview		38·0	138	e 7 22	−16	i 13 12	−26	e 17·4	20·9
Sydney		38·0	138	7 44	+ 6	—	—	23·3	26·1
Zi-ka-wei		38·7	0	7 34	−10	i 13 28	−20	—	—
Colombo		44·0	289	—	—	—	—	—	26·4
Kobe		44·1	19	9 43	?PR_1	—	—	13·8	—
Osaka		44·2	19	9 1	+34	—	—	—	23·2
Calcutta	N.	44·2	315	8 8	−19	15 14	+ 9	—	—
	E.	44·2	315	8 14	−13	14 26	−39	—	—
Kodaikanal		47·3	291	14 20	?S	(14 20)	−85	—	—
Mizusawa	E.	50·0	20	9 11	+ 4	16 17	− 2	—	—
	N.	50·0	20	9 20	+13	16 16	− 3	—	—
Honolulu		84·0	68	i 23 8	?S	(i 23 8)	0	e 44·8	47·3
Helwan		93·9	300	13 20	−17	—	—	—	—
De Bilt	N.	111·9	324	—	—	e 35 35	?SR_1	e 52·3	63·2
	E.	111·9	324	—	—	e 28 54	+69	44·0	63·6
Victoria		112·1	39	—	—	—	—	—	28·9
Edinburgh		115·1	329	61 20	?L	—	—	(61·3)	—
Bidston		116·1	325	26 20	?S	35 56	?SR_1	—	61·9
La Paz		154·2	158	19 55	[− 6]	—	—	—	—

Additional records: Batavia T_e =9h.17m.46s. Manila MN = +10·6m., T_e =9h.17m.46s. Melbourne S = +18m.20s., SR_1 = +20m.20s. Riverview PR_1 = +9m.2s., SR_1 = +15m.56s. and +16m.17s., MN = +20·6m., MZ = +20·2m., T_e =9h.17m.40s. Colombo P =9h.16m.48s. and M = 9h.38m.24s., in addition to the M given above. Kobe appears to have misprinted 19 days for 9 days. Osaka MN = +23·5m. De Bilt gives 8°·0S., 119°·6E. for epicentre. This seems too far west. Eskdalemuir (Δ =115°·3) records from 9h.44m. to 10h.40m.

Oct. 9d. Records also at 0h. (San Fernando), 1h. (Taihoku), 2h. (Taihoku and Rocca di Papa), 3h. (Mizusawa), 6h. (Kobe and Osaka), 13h. (Mauritius), 21h. (Tokyo).

Oct. 10d. Records at 0h. (San Fernando), 2h. (Manila), 4h. (Stonyhurst and Colombo), 15h. (San Fernando, Algiers, Tortosa, and Milan), 16h. (Eskdalemuir, Barcelona, Kew, Paris, Algiers, Helwan, and De Bilt), 17h. (Algiers, Ootomari, and Mizusawa), 21h. (Manila), 22h. (Athens).

1918. Oct. 11d. 14h. 14m. 25s. Epicentre **18°·5N. 68°·0W.**

(as on 1916 April 24d. 4h.).

$A = +\cdot355$, $B = -\cdot879$, $C = +\cdot317$; $D = -\cdot927$, $E = -\cdot375$; $G = +\cdot119$, $H = -\cdot294$, $K = -\cdot948$.

The above epicentre was adopted from 1916 April 24, but 19°·0N. 68°·0W. was adopted on 1917 July 27d. 1h. and direct comparison of the observations on this latter date with those below shows good accordance. The Bull. Seism. Soc. Amer. for 1922 Dec. assigns an epicentre 15km. W. of the N.W. corner of Porto Rico, or about 18°·5N. 67°·5E.

Station and Component.	Machine.	Δ	Azimuth.	P.	O−C.	S.	O−C.	L.	M.
		°	°	M. S.	S.	M. S.	S.	M.	M.
Vieques	B.O.	2·5	98	0 42	+ 3	—	—	0·8	—
Port au Prince	B.O.	4·1	271	i 1 25	+21	1 42	−11	2·5	2·6
Balboa Hts. E.	B.O.	14·7	231	4 42	+67	—	—	7·7	8·0
N.	B.O.	14·7	231	4 43	+68	—	—	7·9	8·1
Cheltenham E.	B.O.	21·7	341	5 4	+ 3	9 13	+14	13·0	15·8
N.	B.O.	21·7	341	—	—	9 20	+21	11·7	16·1
Georgetown	—	21·9	341	i 4 54	−10	9 3	+ 0	10·2	16·0
Washington	Mar.	21·9	341	5 2	− 2	9 4	+ 1	10·4	16·1
Harvard N.	B.O.	24·0	354	5 16	−12	9 42	− 2	—	—
E.	B.O.	24·0	354	e 5 46	+18	9 26	− 8	e 10·9	13·9
Ithaca	B.O.	25·0	345	5 34	− 4	10 7	+ 4	—	19·1
Northfield	B.O.	26·0	352	5 54	+ 6	10 28	+ 6	12·5	20·1
Halifax N.	Ma.	26·3	5	5 49	− 2	10 38	+10	13·6	—
Toronto	M.	28·9	342	6 17	+20	i 10 59	+20	i 15·4	20·2
Ann Arbor E.	B.	27·3	334	5 59	− 2	10 41	− 5	—	—
N.	B.	27·3	334	5 53	− 8	10 35	−11	13·6	—
E.	W.	27·3	334	5 59	− 2	10 35	−11	14·3	20·6
N.	W.	27·3	334	5 53	− 8	10 35	−11	14·3	21·1
Ottawa N.	—	27·7	348	5 59	− 6	10 56	+ 2	13·6	19·6
Z.	—	27·7	348	6 13	+ 8	e 11 35	+41	e 14·6	—
St. Louis N.	W.	27·9	321	6 5	− 2	11 5	+ 8	13·4	17·1
E.	W.	27·9	321	—	—	10 59	+ 2	13·1	18·2
Tacubaya	—	29·5	277	5 43	−40	—	—	—	15·6
Lawrence N.	W.	31·2	320	i 7 35	+55	12 49?	+55	17·3?	19·1
E.	W.	31·2	320	e 7 36	+56	11 53	− 1	17·1?	22·8
La Paz	Bi.	35·0	180	i 7 6	− 7	i 12 46	− 9	19·9	21·9
La Quiaca E.	M.	40·7	177	18 11	? L	—	—	(18·2)	43·4
N.	M.	40·7	177	17 53	? L	—	—	(17·9)	40·9
Tucson N.	B.O.	40·8	298	8 1	0	14 22	+ 4	19·8	28·1
E.	B.O.	40·8	298	7 57	− 4	14 27	+ 9	—	33·8
Saskatoon	Ma.	44·6	328	8 46	+16	15 27	+17	22·6?	—
Andalgala E.	M.	46·1	178	22 23	? L	—	—	(22·4)	46·4
N.	M.	46·1	178	21 35	? L	—	—	(21·6)	46·2
Rio de Janeiro E.	B.O.	47·9	150	9 11	+18	18 59	? SR_1	24·7	35·1
Lick N.	W.	50·2	303	e 9 15	+ 7	e 16 43	+22	—	30·1
Z.	W.	50·2	303	e 9 18	+10	e 16 43	+22	—	31·7
Pilar E.	M.	50·3	177	10 5	+56	32 11	? L	(32·2)	36·4
N.	M.	50·3	177	9 23	+14	33 11	? L	(33·2)	34·6
Berkeley E.	—	50·8	304	e 9 18	+ 6	e 16 44	+15	e 24·2?	36·4
N.	—	50·8	304	e 9 37	+25	e 16 43	+14	e 23·7?	33·8
Victoria	M.	53·5	317	9 13	−17	16 36	−27	28·4	36·8
Z.	W.	53·5	317	9 35	+ 5	17 17	+14	30·3	36·0
Chacarita	M.	53·8	170	9 23	− 9	(17 5)	− 1	(33·4)	35·4
Coimbra N.	—	55·2	53	9 43	+ 3	17 1	−23	22·9	25·6
E.	—	55·2	53	—	—	17 3	−21	24·3	26·4
San Fernando	—	56·7	58	9 59	+ 9	17 47	+ 5	26·1	30·8
Cork	—	56·9	40	10 35	+44	18 5	+20	22·1	39·1
Cipolletti	M.	57·4	180	9 47	− 8	18 41	+50	—	41·0
Granada	C.	58·8	56	i 11 12	+68	i 19 23	+74	—	—
Ascension	M.	59·1	111	9 35	−31	—	—	—	—
Bidston	M.S.	60·4	38	11 2?	+47	18 54	+26	—	27·3
Eskdalemuir	G.	60·6	36	10 26	+10	18 32	+ 1	—	—
Edinburgh	M.	60·7	36	—	—	—	—	—	39·6
Stonyhurst	M.	60·8	38	(i 9 59)	−19	(i 18 5)	−28	i 18·1	30·8

Continued on next page.

Station and Component.	Machine.	Δ	Azimuth.	P.	O—C.	S.	O—C.	L.	M.
		°	°	M. S.	S.	M. S.	S.	M.	M.
Shide	M.B.	61·1	42	10 41	+21	18 46	+ 9	—	—
	M.S.	61·1	42	10 32	+12	18 43	+ 6	28·7	30·4
Oxford	M.S.	61·2	40	10 43	+23	19 9	+31	—	—
Dyce N.	Ma.	61·5	34	i 10 51	+29	18 57	+15	22·4	34·2
E.	Ma.	61·5	34	i 10 39	+17	18 57	+15	—	—
Kew	M.	61·8	41	9 35	−49	—	—	—	39·6
Tortosa	—	62·0	51	10 33	+ 8	18 55	+ 7	26·0	36·6
Sitka E.	B.O.	62·3	326	10 49	+22	—	—	e 34·6	40·7
N.	B.O.	62·3	326	—	—	e 19 15	+23	e 33·1	35·9
Barcelona	—	63·2	52	10 47	+14	19 8	+ 5	—	34·0
Paris	—	63·5	43	e 10 45	+10	19 21	+14	26·6	26·6
Algiers	B.M.	64·1	59	10 44	+ 5	19 22	+ 8	27·1	32·6
Uccle	—	64·7	41	e 10 45	+ 2	19 30	+ 9	26·9	29·0
De Bilt	—	65·2	40	10 54	+ 8	19 39	+12	27·0	29·8
	—	65·2	40	10 56	+10	i 19 49	+22	28·4	28·6
Besançon	—	65·8	46	10 56	+ 6	19 56	+21	30·6	—
Moncalieri	S.	67·0	48	11 2	+ 4	19 53	+ 3	27·4	41·3
Zurich	—	67·5	45	e 11 8	+ 7	20 22	+26	—	—
Milan	Ag.	68·1	44	11 32	+27	—	—	—	21·3
Rocca di Papa	Ag.	71·0	51	11 31	+ 8	20 50	+12	e 28·9	38·5
Pola	W.	71·4	46	e 11 50	+24	e 20 56	+13	e 32·7	39·2
Monte Cassino	Ag.	71·9	52	11 37	+ 8	—	—	—	11·9
Pompeii	O.A.	72·5	52	i 11 9	−24	i 20 35	−21	30·6	37·6
Zagreb	W.	72·7	47	e 11 40	+ 6	i 21 2	+ 4	42·6	45·6
Budapest	—	74·5	43	12 1	+15	—	—	—	—
Lemberg	B.O.	77·3	41	i 12 28	+25	i 22 13	+21	e 36·3	41·6
Athens	—	80·1	53	e 12 19	− 1	22 23	− 1	e 38·1	43·0
Honolulu	M.	83·4	290	12 59	+21	23 17	+16	40·6	54·9
Helwan	M.	88·6	59	12 59	− 9	—	—	—	59·8
Cape Town	M.	97·4	125	—	—	24 53	−37	43·9	46·9
Apia	W.	107·1	259	e 18 59?	? PR_1	e 28 29?	?	44·6	49·6
Ootomari	O.	109·1	333	e 19 12	? PR_1	—	—	—	—
Simla	O.E.	120·2	30	e 20 17	? PR_1	e 37 5	? SR_1	53·5	56·8
Kobe	O.	122·4	337	—	—	26 23	−164	60·1	73·1
Osaka	O.	122·4	337	19 28	[+29]	36 18	? SR_1	54·2	69·5
Bombay	O.E.	126·3	42	19 29	[+20]	—	—	—	65·4
Mauritius N.	M.	129·2	98	34 41	?	54 35	?	66·8	70·5
E.	M.	129·2	98	21 53	? PR_1	53 5	?	62·6	64·3
Zi-ka-wei	—	129·5	350	e 19 23	[+ 6]	—	—	—	74·3
Calcutta N.	O.E.	132·9	31	22 23	? PR_1	23 11	?	—	—
Kodaikanal	M.	135·4	48	23 35	? PR_1	—	—	82·3	88·4
Taihoku	O.	135·5	346	e 22 17	? PR_1	—	—	—	—
Colombo	M.	139·3	50	23 5	? PR_1	32 59	+119	62·1	100·1
Riverview	—	141·9	238	e 19 35	[− 8]	e 33 46	+152	e 60·5	64·9
Melbourne	M.	145·4	230	20 29	[+40]	—	—	—	87·6
Manila	W.	145·8	344	e 19 57	[+ 7]	34 27	?	68·7	79·9
Adelaide	M.	151·3	230	20 41	[+43]	34 1	?	—	85·4
Batavia	W.	166·7	23	20 33	[+20]	—	—	e 61·6	77·6

Additional records: Washington gives M = +9·9m. Georgetown iSN = +9m.9s., MN = +15·9m., T_e = 14h.14m.24s. Harvard PSE = +8m.15s., T_e = 14h.14m.14s. Ithaca iN = +6m.26s., MN = +19·2m., T_e = 14h.14m.16s. Northfield MN = +18·6m., T_e = 14h.14m.35s. Halifax T_e = 14h.14m.10s. Toronto iP = +6m.47s., L = +11·8m., T_e = 14h.14m.46s. Ottawa T_e = 14h.14m.10s. La Paz i = +13m.54s. and +17m.12s., T_e = 14h.14m.22s. La Quiaca PE = +27m.35s., PN = +27m.11s., SE = +40m.59s., SN = +40m.5s. These seem to belong to a different shock. Saskatoon SR_1 = +18m.45s., T_e = 14h.14m.44s. Andalgala PE = +32m.23s., PN = +32m.41s., SE = +42m.5s., SN = +43m.47s., and several other Ms. Rio de Janerio LN = +25·4m., MN = +27·4m., T_eN = 14h.13m.36s., T_eE = 14h.13m.0s. Lick T_e = 14h.14m.18s. Berkeley T_e = 14h.14m.23s. Chacarita gives S as another P and L as S. Tucson PR_1E = +9m.58s., SR_1N = +17m.24s., T_e = 14h.14m.16s. Coimbra PR_1N = +12m.23s., iN = +17m.45s., iE = +17m.51s., T_e = 14h.14m.56s. San Fernando MN = +33·8m. Eskdalemuir PR_1 = +13m.16s., PR_2 = +14m.7s., T_e = 14h.14m.48s. Edinburgh P = 14h.10m.0s. Stonyhurst M = +35·6m. The true P is given as S and eP = +47s. is recorded. Barcelona PS? = +9m.25s., SR_1? = +26m.52s., MN = +28·7m., M_i = +38·9m.,

Notes continued on next page.

T_0=14h.14m.53s. Paris PR_1=+14m.55s., SR_1=+23m.32s., T_0=14h.14m.35s. Algiers LM=+30·6m., T_0=14h.14m.32s. Uccle i=+11m.4s., SR_1=+23m.38s., T_0=14h.14m.26s. De Bilt eSR_1E=+23m.53s., T_0=14h.14m.35s. Marseilles (△=65°·5) gives records at 14h. and 15h. Moncalieri MN=+39·8m., T_0=14h.14m.37s. Pola MN=+33·7m., T_0=14h.15m.9s. Zagreb iP=+11m.46s., iPR_2NW=+16m.58s., iPR_2NE=+17m.7s., iNW=+21m.10s., iNE=+21m.15s., SR_1NW=+26m.24s. Athens MN=+43·3m., T_0=14h.14m.38s. Cape Town P=14h.4m.0s. Apia e_3?=+25m.29s., e_4=+34m.35s. Kobe MN=+74·4m. Osaka MN=+74·3m. Zi-ka-wei MN=+74·4m. Riverview ePR_1=+23m.0s. and +23m.46s., PS?=+34m.40s., eSR_3?=+42m.22s., MN=+60·8m., MZ=+82·6m. Manila MN=+83·0m. Adelaide PR_1=+24m.11s. M is given at 14h. instead of 15h. Batavia records an M at 14h.47m.0s.

1918. Oct. 11d. 17h. 3m. 34s. Epicentre 18°·5N. 68°·0W.

(as at 14h.).

A=+·355, B=−·879, C=+·317; D=−·927, E=−·375; G=+·119, H=−·294, K=−·948.

The interval from 14h.14m.25s. is 169m.9s., which is close to 8×21m., but does not seem to be related to Dr. Jeans's periods of 125·8m. and 222·0m.

Station and Component.	Machine.	△	Azimuth.	P.	O−C.	S.	O−C.	L.	M.
		°	°	M. S.	S.	M. S.	S.	M.	M.
Vieques N.	B.O.	2·5	98	0 44	+ 5	—	—	1·0	1·6
E.	B.O.	2·5	98	0 42	+ 3	—	—	0·9	3·1
Port au Prince	B.O.	4·1	271	i 1 36	+32	1 51	− 2	2·8	2·9
Balboa Heights	B.O.	14·7	231	—	—	5 26	−59	—	—
Cheltenham N.	B.O.	21·7	341	i 5 6	+ 5	9 10	+11	12·8	15·1
Georgetown E.	—	21·9	341	5 7	+ 3	i 9 9	+ 6	e 10·4	—
N.	—	21·9	341	5 5	+ 1	9 17	+14	e 10·4	—
Z.	—	21·9	341	5 9	+ 5	9 0	− 3	e 10·2	—
Washington	Mar.	21·9	341	5 7	+ 3	9 8	+ 5	10·5	—
Harvard N.	B.O.	24·0	354	5 15	−13	(e 9 34)	−10	e 9·6	12·6
E.	B.O.	24·0	354	6 15	+47	e 10 5	+21	e 11·2	—
Ithaca N.	B.O.	25·0	345	5 34	− 4	10 5	+ 2	12·0	—
Northfield	B.O.	26·0	352	10 26	?S	(10 26)	+ 4	e 12·4	—
Halifax N.	—	26·3	5	i 5 51	0	e 10 40	+12	e 13·4	—
Toronto	M.	26·9	342	—	—	—	—	13·9	21·5
Ann Arbor E.	W.	27·3	334	5 56	− 5	—	—	13·4	20·4
N.	W.	27·3	334	5 56	− 5	—	—	14·4	19·4
Ottawa	—	27·7	348	e 6 0	− 5	i 10 41	−13	e 12·4	—
St. Louis N.	W.	27·9	321	i 6 2	− 5	12 26	?L	17·0	—
La Paz	Bi.	35·0	180	7 31	+18	—	—	18·7	22·7
Saskatoon	Ma.	44·6	328	i 8 48	+18	—	—	e 25·4	—
Andalgala	M.	46·1	178	—	—	—	—	—	44·7
Tortosa	—	62·0	51	10 23	− 2	18 55	+ 7	—	29·4
Barcelona	—	63·2	52	—	—	—	—	e 25·6	30·6
Algiers	B.M.	64·1	59	—	—	—	—	e 30·4	33·4
Uccle	—	64·7	41	e 10 44	+ 1	e 19 26	+ 5	—	29·4
De Bilt N.	—	65·2	40	—	—	—	—	28·4	29·5
E.	—	65·2	40	—	—	—	—	31·4	32·6
Hohenheim	B.O.	67·9	44	11 8	+ 5	—	—	—	—
Rocca di Papa	Ag.	71·0	51	11 29	+ 6	—	—	—	11·8
Graz	W.	72·2	45	e 11 32	+ 1	—	—	—	—
Zagreb	W.	72·7	47	11 39	+ 5	21 3	+ 5	40·4	—
Manila	W.	145·8	344	e 20 26	[+36]	—	—	—	—

Additional records: Cheltenham gives SE=+9m.7s., T=7h.3m.38s. Georgetown LE=+14·9m., LN=+13·5m., LZ=+12·7m., T_0=17h.3m.34s. Harvard SE=+8m.37s. and +8m.51s., T_0=17h.4m.48s. Halifax eLE=+11·9m. Toronto eL=+16·5m. Ann Arbor gives the records in the table from its Wiechert; it also gives from the Bosch. PE=+6m.2s., PN=+5m.50s., M=+19·4m. Ottawa eE=+4m.41s. La Paz M=+25·4m. Saskatoon i=+20m.57s. Andalgala MN=+45·4m. Zagreb SNE=+21m.19s.

Oct. 11d. Records also at 0h. (Athens), 7h. (Pa Paz), 8h. (Algiers), 11h. (Sydney), 12h. (La Paz), 14h. (Port au Prince (3)), 15h. (Port au Prince (3) and Vieques), 16h. (Vieques, Port au Prince, and Mobile), 17h. (Port au Prince (2) and Vieques (2)), 18h. (Mobile, Port au Prince (2), Rocca di Papa, and Vieques), 19h. (Port au Prince (3) and Vieques), 20h. (Port au Prince, Vieques, Edinburgh, De Bilt, and Washington), 21h. (Helwan and Vieques), 22h. (Port au Prince), 23h. (Vieques (3), Helwan, and Port au Prince).

Oct. 12d. 0h. 15m. 30s. Epicentre 18°·5N. 68°·0W. (as on 1918 Oct. 11d.).

A = +·355, B = −·879, C = +·317 ; D = −·927, E = −·375 ;
G = +·119, H = −·294, K = −·948.

		Δ	Az.	P.	O−C.	S.	O−C.	L.	M.
		°	°	m. s.	s.	m. s.	s.	m.	m.
Vieques		2·5	98	0 40	+ 1	—	—	1·1	1·4
Port au Prince		4·1	271	e 1 41	?S	(e 1 41)	−12	(2·1)	3·3
Georgetown		21·9	341	e 5 12	+ 8	9 57?	+54	20·3	—
Washington		21·9	341	5 20	+16	9 22	+19	15·0	—
Harvard		24·0	354	5 29	+ 1	10 42	?SR_1	14·7?	16·7
Ottawa		27·7	348	—	—	e 9 30?	?	e 21·5	—
Edinburgh		60·7	36	4 30	?	—	—	—	40·5
De Bilt	N.	65·2	40	—	—	—	—	28·5	29·5

Additional records: Georgetown gives ePN = +5m.18s. Harvard T_o = 0h.14m.23s. Ottawa e = +14m.6s. De Bilt eLE = +32·5m.

Oct. 12d. 8h. 19m. 37s. Epicentre 18°·5N. 68°·0W. (as on October 11d. 14h. and 17h. and Oct. 12d. 0h.).

A = +·355, B = −·879, C = +·317 ; D = −·927, E = −·375 ;
G = +·119, H = −·294, K = −·948.

		Δ	Az.	P.	O−C.	S.	O−C.	L.	M.
		°	°	m. s.	s.	m. s.	s.	m.	m.
Vieques	N.	2·5	98	0 2	−37	—	—	0·4	0·8
Port au Prince		4·1	271	e 1 58	+54	2 27	+34	3·0	3·3
Cheltenham		21·7	341	i 5 6	+ 5	—	—	14·7	15·2
Georgetown	E.	21·9	341	5 7	+ 3	9 15	+12	14·8	—
	N.	21·9	341	5 2	− 2	9 4	+ 1	14·8	—
Washington		21·9	341	5 3	− 1	9 3	0	14·6	—
Harvard	E.	24·0	354	e 5 40	+12	10 2	+18	e 11·4	—
	N.	24·0	354	i 5 16	−12	9 32	−12	12·6	—
Ithaca	N.	25·0	345	e 5 26	−12	e 10 8	+ 5	12·7	—
Ottawa		27·7	348	e 10 23?	?	e 12 29	+95	e 15·2	—
La Paz		35·0	180	7 38	+25	—	—	21·4	24·2
Edinburgh		60·7	36	3 23	?	—	—	—	41·4
Stonyhurst		60·8	38	—	—	—	—	—	33·4
Kew		61·8	41	—	—	—	—	—	44·4
De Bilt	E.	65·2	40	—	—	—	—	30·4	31·8
	N.	65·2	40	—	—	—	—	e 28·4	29·0
Rocca di Papa		71·0	51	e 10 54	−29	—	—	—	12·0
		71·0	51	e 11 16	− 7	—	—	—	36·3

Additional records: Vieques gives PE = −0m.3s., LE = +0·2m., ME = +1·0m. Harvard LN = +15·9m.. T_o = 8h.19m.31s. Eskdalemuir gives 8h.37m. to 9h.20m.

Oct. 12d. Records also at 0h. (Washington (2), Vieques (3), Port au Prince (3), and San Fernando), 1h. (Port au Prince, Georgetown, Harvard, and Vieques), 2h. (San Fernando), 4h. (Vieques (2) and Port au Prince), 5h. (Port au Prince), 6h. (Vieques), 7h. (Zi-ka-wei and Port au Prince), 8h. (Port au Prince (2) and Vieques), 13h. (Eskdalemuir, Rocca di Papa, Kew, Bidston, Zagreb, Paris, De Bilt, and Ootomari), 21h. (San Fernando).

Oct. 13d. 4h. 51m. 30s. Epicentre 18°·5N. 68°·0W. (as at 0h. and 8h., &c.).

		Δ	Az.	P.	O−C.	S.	O−C.	L.	M.
		°	°	m. s.	s.	m. s.	s.	m.	m.
Vieques	E.	2·5	98	e 0 41	+ 2	—	—	0·7	1·5
	N.	2·5	98	e 0 49	+10	—	—	1·2	2·8
Port au Prince	N.E.	4·1	271	e 1 10	+ 6	1 45	− 8	2·1	2·4
	N.W.	4·1	271	e 1 17	+13	1 50	− 3	2·1	2·3
Cheltenham		21·7	341	5 30	+29	—	—	15·1	15·8
Georgetown		21·9	341	e 5 4	0	9 7?	+ 4	e 11·1?	—
Washington		21·9	341	5 2	− 2	9 4	+ 1	14·5	—
La Paz		35·0	180	7 5	− 8	—	—	—	—
De Bilt	E.	65·2	40	—	—	—	—	e 31·5	41·9
	N.	65·2	40	—	—	—	—	e 29·5	37·8

Additional records : Georgetown gives LE = +15·0m., LN = +15·1m.

Oct. 13d. 12h. 39m. 20s. Epicentre 19°·0S. 177°·0W. ? ? (as on 1918 June 4d. 17h.), but very doubtful. Possibly it is from the epicentre of 14d. 12h., but there is not good accordance.

A = −·944, B = −·049, C = −·326 ; D = −·052, E = +·999 ;
G = +·325, H = +·017, K = −·946.

	Δ	Az.	P.	O−C.	S.	O−C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Apia	7·3	45	e 1 52	+ 1	—	—	3·6	4·7
Riverview	31·9	236	e 6 43	− 3	e 10 33	−94	e 12·6	16·9
Melbourne	38·5	232	—	—	—	—	17·7	20·7
Honolulu	44·4	26	18 28	?SR_1	21 34	?	22·7	27·7
Perth, W.A.	60·7	243	30 44	?L	—	—	(30·7)	—
Manila	69·7	294	e 12 40	+85	—	—	—	—
Batavia	74·9	269	e 10 40	−68	—	—	—	—
Victoria	82·7	33	—	—	—	—	—	46·6
Toronto	108·4	49	—	—	—	—	73·1	—
Edinburgh	143·0	6	80 40	?L	—	—	(80·7)	—
De Bilt N.	146·9	358	—	—	e 34 22	?	e 77·7	84·0
E.	146·9	358	—	—	e 62 22	?	e 76·7	85·2
Helwan	152·1	298	42 40	?SR_1	—	—	—	—

Additional records : Riverview MN = +15·4m., T_o12h.41m.15s. If we accept this T_o there must have been a separate shock near Apia. Port au Prince (Δ = 109°·4), eP = +6m.50s., M = +7·4m., which probably refers to another shock close to Port au Prince.

Oct. 13d. Records also at 1h. (De Bilt and Helwan), 2h. (De Bilt, Lick, Berkeley, Port au Prince, and Victoria), 3h. (De Bilt, Toronto, and Eskdalemuir), 5h. (Toronto, La Paz, Port au Prince, and Helwan), 6h. (San Fernando), 14h. (La Paz and Manila), 15h. (La Paz), 17h. (Port au Prince and Edinburgh), 18h. (La Paz and Vieques), 20h. (Vieques and Port au Prince), 22h. (Georgetown and Harvard).

Oct. 14d. 0h. 24m. 20s. Epicentre 18°·5N. 68°·0W. (as on Oct. 11d. and 12d.).

A = +·355, B = −·879, C = +·317 ; D = −·927, E = −·375 ;
G = +·119, H = −·294, K = −·948.

		Δ	Az.	P.	O−C.	S.	O−C.	L.	M.
		°	°	m. s.	s.	m. s.	s.	m.	m.
Vieques	N.	2·5	98	0 58	?S	(0 58)	−11	1·4	1·8
Port au Prince		4·1	271	e 1 25	+21	1 51	− 2	2·5	2·7
Balboa Heights		14·7	231	5 40	?S	(5 40)	−45	—	—
Cheltenham	N.	21·7	341	e 6 6	+65	—	—	e 15·2	16·0
Washington		21·9	341	5 11	+ 7	9 15	+12	14·5	—
Georgetown	N.	21·9	341	i 5 13	+ 9	e 9 22	+19	e 10·4	—
	E.	21·9	341	i 5 15	+11	i 9 20	+17	14·7	—
Harvard	N.	24·0	354	e 5 23	− 5	9 34	−10	e 11·5	16·5
	E.	24·0	354	e 5 36	+ 8	8 59	−45	e 12·6	16·4
Ithaca	N.	25·0	345	5 45	+ 7	10 11	+ 8	e 12·9	—
Toronto		26·9	342	—	—	(10 10)	−29	e 15·9	17·0
Ottawa		27·7	348	5 40	−25	—	—	e 11·7	—

Continued on next page.

		Δ	Az.	P.	O−C.	S.	O−C.	L.	M.
		°	°	m. s.	s.	m. s.	s.	m.	m.
La Paz		35·0	180	7 14	+ 1	13 1	+ 6	21·0	22·0
Victoria		53·5	317	—	—	—	—	—	38·1
Rio Tinto		56·4	56	31 40	?L	—	—	(31·7)	38·7
San Fernando		56·7	58	29 40	?L	—	—	(29·7)	—
Edinburgh		60·7	36	18 40	?S	(18 40)	+ 8	—	37·7
Stonyhurst		60·8	38	e 19 10	?S	(19 10)	+37	—	33·9
Shide		61·1	42	30 38	?L	—	—	(30·6)	—
Kew		61·8	41	—	—	—	—	—	46·7
De Bilt	E.	65·2	40	—	—	e 20 7	+40	e 30·7	34·5
	N.	65·2	40	—	—	—	—	e 27·7	29·4
Graz		72·2	45	e 11 38	+ 7	—	—	—	—
Helwan		88·6	59	25 40	?S	(25 40)	+101	—	—
Ootomari		109·1	333	e 67 31	?L	—	—	(e 67·5)	—

Additional records: Vieques ME = +1·7m. Cheltenham gives PE = +6m.7s. Georgetown LN = +15·0m., T_0 = 0h.24m.24s. Harvard T_0 = 0h.25m.14s. Toronto records S as an L. Eskdalemuir (Δ = 60°·6) 0h.41m. to 1h.21m. Stonyhurst M = 36·7m. Paris (Δ = 63°·5) gives a record at 1h. Graz gives its record as 23 or 0h.

Oct. 14d. 2h. 15m. 20s. Epicentre 18°·5N. 68°·0W. (as at 0h.).

		Δ	Az.	P.	O−C.	S.	O−C.	L.	M.
		°	°	m. s.	s.	m. s.	s.	m.	m.
Vieques	N.	2·5	98	1 0	?S	(1 0)	− 9	1·5	2·7
	E.	2·5	98	1 2	?S	(1 2)	− 7	1·4	1·7
Port au Prince		4·1	271	1 47	+43	2 8	+15	2·6	2·8
Georgetown		21·9	341	—	—	—	—	15·1	—
Washington		21·9	341	5 10	+ 6	9 15	+12	14·7	—
Harvard		24·0	354	—	—	—	—	15·3	—
La Paz		35·0	180	7 40	+27	—	—	(18·6)	—
Edinburgh		60·7	36	34 40	?L	—	—	(34·7)	—
De Bilt		65·2	40	—	—	—	—	e 34·7	—

Washington T_0 = 2h.15m.23s. The La Paz L is given as the P of a second shock.

1918. Oct. 14d. 12h. 0m. 20s. Epicentre 19°·5S. 174°·2W.

A = −·938, B = −·095, C = −·334 ; D = −·101, E = +·995 ;
G = +·332, H = +·034, K = −·943.

The Australian residuals suggest an epicentre nearer Australia, but this would not suit the Apia observation, unless we assume a deep focus, for which the anticentric residuals give some evidence.

Station and Component.	Machine.	Δ	Azimuth.	P.	O−C.	S.	O−C.	L.	M.
		°	°	M. S.	S.	M. S.	S.	M.	M.
Apia	W.	6·1	23	1 35	+ 2	—	—	2·9	—
Riverview	—	33·9	238	e 6 30	−34	e 11 37	−62	e 14·3	17·6
Sydney	M.	33·9	238	7 34	+30	11 58	−41	17·5	19·9
Melbourne	M.	39·8	233	7 46	+ 7	13 40	−23	22·9	24·1
Honolulu	M.	43·8	21	14 58	?S	(14 58)	− 1	21·7	26·2
Adelaide	M.	44·3	239	6 51	−97	14 21	−45	21·5?	27·2
Mizusawa	E.	72·9	325	11 19	−11	20 46	− 4	—	—
	N.	72·0	325	11 20	−10	20 43	− 7	—	—
Manila	W.	72·3	292	e 11 34	+ 2	(20 51)	− 3	20·8	21·8
Osaka	O.	72·3	319	11 36	+ 4	20 59	+ 5	30·7	43·1
Berkeley	—	75·3	40	e 11 38	−13	—	—	—	—
Taihoku	O.	76·8	304	—	—	e 21 44	− 3	—	—
Batavia	W.	77·5	270	e 11 40	−24	(21 40)	−15	39·7	42·7
Tucson	B.O.	79·7	50	—	—	—	—	e 36·9	40·7
Zi-ka-wei	—	79·9	310	e 12 28	+10	e 21 42	−40	—	—
Victoria	M.	81·7	31	33 33	?	—	—	38·6	43·9
Cipolletti	M.	89·6	134	23 34	?S	(23 34)	−36	(45·7)	47·0
Andalgalá	M.	95·6	124	38 18	?	—	—	—	49·6
La Paz	Bi.	99·9	111	13 48	−17	25 3?	−42	45·4	47·6

Continued on next page.

Station and Component.	Machine.	Δ.	Azimuth.	P.	O−C.	S.	O−C.	L.	M.
		°	°	M. S.	S.	M. S.	S.	M.	M.
Toronto	M.	106·7	48	—	—	27 58?	+60	54·1	60·6
Colombo	M.	107·3	270	33 40	?SR_1	—	—	—	75·7
Ithaca N.	B.O.	108·6	50	16 2	+71	e 27 39	+24	—	—
E.	B.O.	108·6	50	e 18 47	?PR_1	e 28 18	+63	e 54·7	—
Ottawa	—	109·6	48	19 40?	?PR_1	(27 40?)	+16	e 27·7?	—
Harvard N.	B.O.	112·5	51	—	—	e 25 22	−148	50·4	—
E.	B.O.	112·5	51	e 15 39	+30	26 51	−59	54·0	61·7?
Mauritius E.	M.	115·4	238	—	—	—	—	56·8	58·9
Edinburgh	M.	143·0	9	20 40	[+55]	—	—	—	92·2
Eskdalemuir	G.	143·6	9	i 17 56	+31	i 21 27	?PR_1	67·7	—
Stonyhurst	M.	145·1	10	—	—	e 61 40	?	i 78·5	88·7
Bidston	M.S.	145·4	10	36 52	?	44 40	?SR_1	—	75·2
De Bilt	—	147·4	0	19 38	[−14]	42 15	?	e 73·7	72·4
Kew	M.	147·7	10	—	—	—	—	—	89·7
Shide	M.S.	148·3	10	—	—	—	—	77·9	85·4
Uccle	—	148·7	0	e 19 33	[−21]	—	—	—	81·7
Hohenheim	—	150·6	355	19 55?	[− 2]	—	—	—	—
Paris	—	150·6	4	e 19 42	[−15]	—	—	81·7	—
Zagreb	W.	152·4	345	19 43	[−16]	—	—	77·7	83·7
Moncalieri	S.	154·5	357	e 36 40	?	—	—	73·8	—
Helwan	M.	154·7	300	19 58	[− 4]	—	—	—	123·2
Rocca di Papa	Ag.	157·0	347	19 46	[−19]	—	—	77·6	88·1
San Fernando	—	160·1	29	19 40	[−28]	39 10	?	—	90·7
Algiers	B.M.	162·6	7	—	—	—	—	e 82·7	88·7

Additional records: Riverview gives ePR_1 = +7m.42s. and +7m.54s., iPS = +11m.52s. and +12m. 10s., MN = +15·7m., MZ = +18·6m., T_o = 12h.0m.23s. Honolulu S = +18m.52s. (?SR_1). Adelaide PR_1 = +10m.26s., SR_1 = +18m.1s. Andalgala PE = +59m.28s., SE = +62m.28s., SN = +63m.46s. Manila S = +17m.2s., MN = +22·4m. Batavia says M = +21m.40s.; possibly a misprint for S. Cipolletti gives P = +42m.22s., S = +45m.40s., perhaps Ls. Toronto eL = +56·1m. Harvard SN = +28m.12s., eE = +40m.51s., eN = +42m.4s., LE = +55·7m., T_o = 12h.2m.41s. and 12h.2m.48s. Eskdalemuir i = +53m.11s. De Bilt eLN = +70·7m., Epicentre 22°·3S. 177°·2W. Zagreb iPNW = +19m.50s., iPNE = +20m.3s., MNW = +87·7m.

Oct. 14d. 14h. 6m. 5s. Epicentre 33°·0N. 22°·0E.

A = +·778, B = +·314, C = +·545.

	Δ	Az.	P.	O−C.	S.	O−C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Rocca di Papa	11·4	323	e 2 31	−19	9 43?	?	—	—
Pola	13·4	334	e 8 24	?	—	—	e 9·3	9·5
Zagreb	13·6	342	e 3 25	+ 4	—	—	i7·6	8·2
Budapest	14·6	352	6 25	?S	(6 25)	+ 3	—	—
Moncalieri	16·3	322	3 53	− 3	8 15	?L	11·3	13·2
Hohenheim	18·8	333	e 4 26	− 1	7 56	− 2	—	—
Uccle	22·0	329	—	—	—	—	e 12·9	—
De Bilt	22·6	332	—	—	e 9 25	+ 8	e 12·8	15·3

Additional records: Rocca di Papa gives also P = +3m.37s. Pola MN = +9·4m. Budapest P = +14m.1s. Graz (Δ = 14°·9) gives eP = 14h.4m., eS = 14h.8m., no seconds being given in either case.

Oct. 14d. Records also at 1h. (Mizusawa), 4h. (Vieques and Port au Prince (2)), 6h. (Mizusawa), 10h. (Manila), 19h. (Batavia.

Oct. 15d. 23h. 29m. 40s. Epicentre 46°·0N. 130°·6W. (as on 1918 April 17d. 2h.).

A = −·447, B = −·532, C = +·719.

	Δ	Az.	P.	O−C.	S.	O−C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Victoria	5·2	59	1 39	+19	—	—	3·2	4·1
Berkeley	9·9	133	—	—	e 3 53	−31	—	—
Toronto	36·5	75	—	—	—	—	19·3	21·2
Ottawa	37·1	71	—	—	—	—	e 18·3	—

Ottawa gives also eN = +20m.32s., eL = +22·3m.

Oct. 15d. Records also at 0h. (Port au Prince (2) and Vieques), 1h. (Mizusawa and Batavia), 2h. (San Fernando), 3h. (Vieques, Mizusawa, Osaka, Kobe, Tokyo, La Paz, and Port au Prince), 4h. (Mizusawa (2) and Tokyo (2)), 7h. (De Bilt), 10h. (Riverview and Sydney), 13h. (Mizusawa, Tokyo, and De Bilt), 18h. (De Bilt, Helwan, Eskdalemuir, Athens, and Algiers), 19h. (Mizusawa), 22h. (De Bilt, Eskdalemuir, Edinburgh, and Zurich (2)).

Oct. 16d. 20h. 4m. 35s. Epicentre 8°·5S. 125°·5E.

$A = -\cdot574$, $B = +\cdot805$, $C = -\cdot148$; $D = +\cdot814$, $E = +\cdot581$; $G = +\cdot086$, $H = -\cdot120$, $K = -\cdot989$.

		Δ	Az.	P.	O−C.	S.	O−C.	L.	M.
		°	°	m. s.	s.	m. s.	s.	m.	m.
Manila		23·5	349	e 5 30	+ 7	—	—	6·1	6·2
Perth, W.A.		25·1	200	(5 28)	−11	9 42	−23	15·5	—
Adelaide		29·0	157	6 26	+ 8	11 6	−11	14·6	18·8
Melbourne		34·1	152	(7 7)	+ 1	12 25	−17	21·2	22·0
Riverview		34·6	141	e 7 12	+ 2	i12 46	− 3	e 14·6	20·2
Zi-ka-wei		39·9	358	7 33	−21	—	—	—	—
Kobe		44·1	10	8 31	+ 4	—	—	e 19·3	19·5
Osaka		44·2	10	8 29	+ 2	—	—	—	19·6
Colombo		48·1	287	14 25	?	—	—	—	31·4
Mizusawa	E.	49·8	14	9 10	+ 4	16 11	− 5	—	—
	N.	49·8	14	9 14	+ 8	16 10	− 6	—	—
Kodaikanal		51·3	291	21 19	?L	—	—	(21·3)	—
Bombay		58·7	300	10 8	+ 5	—	—	—	—
Mauritius	E.	66·1	252	20 49	?S	(20 49)	+71	33·0	35·4
Honolulu		80·7	65	—	—	e 22 55	+24	41·4	49·2
Helwan		97·8	300	21 25	?	—	—	—	—
Zagreb		109·7	316	e 19 1	?PR_1	26 19?	−66	35·4	—
De Bilt	N.	115·1	324	—	—	e 28 33	+22	e 59·4	61·2
	E.	115·1	324	—	—	e 29 37	+86	e 56·4	61·4
Moncalieri		115·5	318	e 20 39	?PR_1	—	—	29·5	—
Uccle		116·0	322	e 19 49	?PR_1	e 30 25	+127	—	—
Edinburgh		118·0	330	19 25	?PR_1	—	—	—	—
Eskdalemuir		118·3	330	20 8	?PR_1	31 6	+150	54·4	—
Kew		118·4	326	—	—	—	—	—	31·4
Stonyhurst		118·6	328	20 25	?PR_1	—	—	—	70·6
Bidston		119·1	328	20 1	?PR_1	30 55	+132	—	49·2
Shide		119·3	325	20 29	?PR_1	—	—	—	—
La Paz		151·6	152	20 16	[+18]	32 58?	?	85·4	88·9

Additional records: Perth records P as PR_1. Melbourne gives also $SR_1 = +16m.13s.$, $SR_2 = +17m.7s.$; P is recorded as PR_1. Riverview $PR_1 = +8m.41s.$, $iS = +12m.51s.$, $PS = +13m.0s.$, $MZ = +19·7m.$, $MN = +20·7m.$, $T_o = 20h.4m.46s.$ Kobe $MN = +20·1m.$ Osaka $MN = +19·4m.$ Colombo $M = +20·9m.$ De Bilt $ePR_1E = +19m.58s.$, $m = +30m.47s.$

Oct. 16d. Records also at 0h. (Edinburgh, Eskdalemuir, and De Bilt), 1h. (La Paz and San Fernando), 5h. (San Fernando), 8h. (Helwan, Tokyo, and Colombo), 10h. (Helwan, Zagreb, and Athens), 19h. (Port au Prince, Batavia, and Vieques).

Oct. 17d. 8h. 19m. 3s. Epicentre 18°·5N. 68°·0W. (as on 1918 Oct. 14d. 2h. and previously).

$A = +\cdot355$, $B = -\cdot879$, $C = +\cdot317$.

		Δ	Az.	P.	O−C.	L.	M.
		°	°	m. s.	s.	m.	m.
Vieques	N.	2·5	98	0 37	− 2	1·0	1·7
	E.	2·5	98	0 36	− 3	0·9	1·2
Port au Prince		4·1	271	e 1 4	0	—	2·5
La Paz		35·0	180	7 42	+29	—	—
De Bilt	E.	65·2	40	—	—	e 33·8	—

De Bilt gives $eLN = +28·4m.$

Oct. 17d. Records also at 1h. (San Fernando), 9h. (Mizusawa and Tokyo), 12h. (Mizusawa (2)), 16h. (De Bilt), 18h. (Mizusawa), 19h. (San Fernando), 21h. (Vieques).

1918. Oct. 18d. 21h. 33m. 35s. Epicentre **18°·5N. 68°·0W.**
(as on 1918 Oct. 17d. 8h. and previously).

A = +·355, B = −·879, C = +·317; D = −·927, E = −·375;
G = +·119, H = −·294, K = −·948.

Station and Component.		Machine.	△	Azimuth.	P.	O−C.	S.	O−C.	L.	M.
			°	°	M. S.	s.	M. S.	s.	M.	M.
Vieques	N.	B.O.	2·5	98	0 42	+ 3	—	—	1·0	2·3
	E.	B.O.	2·5	98	0 38	− 1	—	—	1·1	1·4
Port au Prince		B.O.	4·1	271	e 1 39	+35	2 7	+14	2·5	2·9
Cheltenham	N.	B.O.	21·7	341	5 6	+ 5	9 5	+ 6	12·6	15·9
Georgetown	E.	—	21·9	341	e 5 9	+ 5	9 23	+20	15·0	—
	N.	—	21·9	341	e 5 0	− 4	9 14	+11	14·6	—
Washington		Mar.	21·9	341	4 57	− 7	8 57	− 6	12·4	—
Harvard	N.	B.O.	24·0	354	—	—	7 55	−109	e 11·2	—
	E.	B.O.	24·0	354	—	—	8 16	−88	12·8	—
Ithaca		B.O.	25·0	345	e 6 23	+45	e 11 5	+62	13·0	—
Toronto		M.	26·9	342	—	—	10 55	+16	12·8	19·9
Ann Arbor	E.	W.	27·3	334	3 25	?	10 7	−39	14·8	20·4
	N.	W.	27·3	334	3 37	?	9 25	−81	14·6	20·4
Ottawa		—	27·7	348	e 5 58?	− 7	10 33?	−21	e 14·4	—
La Paz		Bi.	35·0	180	e 6 55	−18	—	—	21·4	22·2
Victoria		M.	53·5	317	—	—	—	—	28·2	36·7
Coimbra		—	55·2	53	—	—	e 18 41	+77	e 26·4	—
San Fernando		—	56·7	58	16 55	?S	(16 55)	−47	—	—
Eskdalemuir		G.	60·6	36	18 28	?S	(18 28)	− 3	30·9	—
Edinburgh		M.	60·7	36	18 25	?S	(18 25)	− 7	—	37·9
Shide		M.S.	61·1	42	—	—	18 36	− 1	32·2	—
Kew		M.	61·8	41	—	—	—	—	—	40·4
De Bilt	E.	—	65·2	40	10 51	+ 5	—	—	30·4	34·6
	N.	—	65·2	40	—	—	19 27	0	e 28·4	29·4
Helwan		M.	88·6	59	48 25	?L	—	—	(48·4)	—

Additional records: Georgetown gives eL? = +10·5m., T_0 = 21h.33m.17s. Harvard eLE = +10·8m., T_0 = 21h.30m.13s. Ithaca eSE = +10m.58s., T_0 = 21h.34m.12s. Toronto eL = +15·9m. La Paz iP = +7m.32s. Victoria L = +33·2m. De Bilt T_0 = 21h.33m.51s.

Oct. 18d. Records also at 0h. (Tokyo), 3h. (Rocca di Papa, Monte Cassino, and Mauritius), 4h. (Monte Cassino and Rocca di Papa), 10h. (Manila), 12h. (Taihoku and Colombo), 19h. (Port au Prince and Vieques).

Oct. 19d. 2h. 0m. 20s. Epicentre 15°·0N. 97°·0W. (as on 1917 Dec. 29d. 22h.).

A = −·118, B = −·959, C = +·259; D = −·993, E = +·122;
G = −·032, H = −·257, K = −·966.

Very doubtful. There is no complete observation of S and P to give a trustworthy T_0, since the Tucson (N.) observations would indicate conditions irreconcilable with the Tacubaya observations, and although these have been altered by 12h. the alteration is confirmed by the records of the shock at 3h.

		△	Az.	P.	O−C.	S.	O−C.	L.	M.
		°	°	m. s.	s.	m. s.	s.	m.	m.
Tacubaya		4·9	334	1 29	+13	—	—	—	4·4
Tucson	E.	21·4	326	e 6 53	+115	—	—	e 7·6	8·7
	N.	21·4	326	e 8 24	+206	—	—	e 9·7	12·7
Lawrence		24·0	3	5 17	−11	—	—	9·4	12·5
Washington		29·6	33	—	—	—	—	17·7	—
Georgetown		29·6	33	—	—	—	—	17·7	—
Toronto		32·4	24	—	—	—	—	e 18·5	19·8
Ithaca		32·5	29	—	—	e 16 10	+234	e 19·3	—
Ottawa		35·3	26	—	—	e 13 10	+10	e 19·7	—
Harvard		35·3	34	—	—	—	—	18·2	—
La Paz		42·5	137	e 9 30	+75	—	—	24·1	27·8
Edinburgh		79·8	35	28 40	?	—	—	—	132·7
Eskdalemuir		79·8	35	22 53	?S	(22 53)	+32	38·2	—
Bidston		80·3	38	23 34	?S	(23 34)	+67	(34·8)	43·4
De Bilt		85·5	37	—	—	e 23 55	+30	e 41·7	43·1

Additional records: Lawrence MN = +17·7m. Tacubaya—a correction of 12h. has been made as at 3h. Harvard L = +21·0m. Ottawa L = +24·7m. De Bilt e = +36m.24s.

1918. Oct. 19d. 3h. 22m. 45s. Epicentre 14°·5N. 91°·0W.
(as on 1917 June 8d.).

A = −·017, B = −·968, C = +·250; D = −1·000, E = +·018;
G = −·004, H = −·250, K = −·968.

Station and Component.	Machine.	Δ	Azimuth.	P.	O−C.	S.	O−C.	L.	M.
		°	°	M. S.	S.	M. S.	S.	M.	M.
Tacubaya	—	9·3	304	2 1	−19	—	—	—	4·8
Balboa Hts. E.	B.O.	12·5	115	4 1	+55	—	—	8·0	9·3
N.	B.O.	12·5	115	4 9	+63	—	—	—	8·4
St. Louis E.	W.	24·2	4	—	—	10 45	+57	e 18·0	—
N.	W.	24·2	4	5 33	+ 3	10 3	+15	11·9	17·4
Vieques E.	B.O.	24·8	78	6 14	+38	—	—	12·7	17·2
N.	B.O.	24·8	78	5 27	− 9	—	—	12·7	14·5
Lawrence	W.	24·8	356	5 40	+ 4	—	—	10·0	10·9
Tucson N.	B.O.	25·4	318	e 5 55	+13	10 24	+13	16·1	17·6
E.	B.O.	25·4	318	e 6 2	+20	10 46	+35	16·2	18·0
Cheltenham E.	B.O.	27·3	25	e 6 5	+ 4	—	—	—	—
N.	B.O.	27·3	25	e 5 57	− 4	e 10 42	− 4	e 16·3	19·6
Washington	Mar.	27·3	24	6 0	− 1	10 48	+ 2	16·8	—
Georgetown	—	27·3	24	6 3	+ 2	10 49	+ 3	e 12·8?	15·8
Ann Arbor E.	W.	28·5	12	6 21	+ 8	11 3	− 5	15·8	19·4
N.	W.	28·5	12	6 15	+ 2	11 3	− 5	—	19·2
Ithaca	B.O.	30·7	23	7 2	+27	12 35	+49	—	—
Toronto	M.	30·8	17	5 57	−39	11 39	− 9	i 18·4	26·6
Northfield	B.O.	31·0	25	e 8 5	+87	—	—	20·8	—
Harvard E.	B.O.	32·8	28	7 35	+40	12 25?	+ 4	e 16·3	21·8
N.	B.O.	32·8	28	6 31	−24	11 39?	−42	e 16·4	21·8
Ottawa	—	33·5	20	i 6 54	− 7	i 10 19	−133	e 15·6	—
Lick	W.	35·4	315	7 14	− 3	—	—	—	23·4
Berkeley	—	36·2	316	e 7 16	− 8	e 13 5	− 8	—	24·4
La Paz	Bi.	38·3	143	i 7 30	−10	i 13 31	−11	18·4	21·2
Victoria	M.	43·1	329	7 36	−43	14 59	+10	23·8	31·7
Andalgala E.	M.	48·4	149	14 57	?S	(14 57)	−62	(25·8)	27·6
Cipolletti	M.	57·6	159	16 27	?S	(16 27)	−87	27·8	31·8
Chacarita	M.	58·0	149	—	—	—	—	—	38·2
Honolulu	M.	63·7	287	11 21	+45	20 3	+54	32·2	35·0
Coimbra	—	75·2	52	e 10 48	−62	e 20 32	−58	35·2	44·9
Rio Tinto	M.	76·8	55	39 15	?L	—	—	(39·2)	56·2
Eskdalemuir	G.	76·8	36	12 5	+ 5	21 50	+ 3	39·8	47·1
Bidston	M.S.	77·2	38	12 27	+25	22 3	+12	—	51·2
San Fernando	—	77·3	55	21 45	?S	(21 45)	− 7	42·2	46·2
Stonyhurst	M.	77·5	37	e 22 9	?S	(e 22 9)	+14	—	48·6
Shide	M.S.	78·7	40	—	—	22 6	− 2	38·8	49·1
Kew	M.	79·2	39	—	—	—	—	—	56·2
Paris	—	81·4	42	e 12 51	+24	—	—	35·2	40·2
Uccle	—	82·2	40	e 12 45	+14	e 23 15	+27	e 35·2	50·2
De Bilt E.	—	82·5	38	e 12 36	+ 3	22 47	− 5	e 39·2	40·3
N.	—	82·5	38	e 12 43	+10	—	—	—	41·3
Barcelona	—	82·8	49	—	—	—	—	e 39·5	47·8
Algiers	B.M.	84·6	53	—	—	e 23 36	+21	47·2	—
Apia	W.	84·7	256	—	—	—	—	39·2	—
Moncalieri	S.	85·8	45	e 13 8	+16	23 17?	−11	40·6	55·8
Zagreb	W.	91·0	42	e 15 15?	+114	24 6	−18	45·2	54·2
Cape Town	M.	114·0	121	19 15	[+41]	35 15	?	60·2	62·7
Riverview	—	120·9	238	e 31 57?	?	—	—	e 56·2	58·1
Zi-ka-wei	—	124·7	324	—	—	e 66 53	?L	(e 66·9)	—
Melbourne	M.	125·6	234	—	—	—	—	61·4	69·2
Adelaide	M.	131·1	235	—	—	—	—	—	70·4
Manila	W.	137·1	311	e 19 43	[+ 9]	—	—	—	—
Perth, W.A.	M.	149·9	230	—	—	—	—	76·6	—

The Tacubaya records for this and the preceding shock have been diminished by 12h.

Notes continued on next page.

Additional records: Lawrence gives LN? = 10·1m., MN = +10·2m. Ann Arbor, Bosch instrument, PE = +7m.15s., PN = +6m.33s., SE = +10m.51s., SN = +11m.9s., M = +17·2m. Ithaca SN = +12m.36s., T_0 = 3h.22m.48s. Toronto iL = +20·6m., T_0 = 3h.21m.30s. Harvard T_0? = 3h.22m.7s. from L − P. Ottawa, vertical eL? = +16·2m., L = +21·2m., T_0 = 3h.22m.49s. Lick MN = +22·0m., MV = +22·2m. San Fernando MN = +48·2m. Andalgala PE = +18m.51s., SN = +19m.27s., MN = +20·4m. Eskdalemuir SR_1 = +27m.22s., T_0 = 3h.23m.3s. De Bilt eSR_1E = +28m.43s., eE = +32m.8s., eN = +36m.5s., T_0 = 3h.23m.8s. Riverview e = +37m.33s., e? = +39m.51s., e = +44m.3s., MN = +64·1m.

Oct. 19d. Records also at 0h. (Lick), 3h. (Helwan), 5h. (Port au Prince, Mobile, and Manila), 7h. (Rio Tinto and Vieques), 11h. (Manila), 14h. and 15h. (Tacubaya), 21h. (Helwan), 23h. (Tokyo).

Oct. 20d. 5h. 44m. 55s. Epicentre 72°·0N. 2°·8W. (as on 1917 Aug. 21d. 10h.).

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 35	−18	—	—	—	10·6
Eskdalemuir	16·7	184	3 52	− 9	7 29	+18	8·1	—
Bidston	18·6	184	4 35	+11	—	—	—	9·5
De Bilt	20·2	166	—	—	—	—	e 12·1	14·0
Kew	20·6	180	—	—	—	—	—	11·1
Paris	23·3	174	—	—	—	—	12·1	—

Eskdalemuir gives T_0 = 5h.44m.17s.

Oct. 20d. Records also at 1h. (San Fernando), 4h. (Riverview), 7h. (Nagasaki), 15h. (Uccle, Moncalieri, Edinburgh, Eskdalemuir, Shide, Bidston, De Bilt, Kew, Paris, and Rocca di Papa), 18h. (Zagreb), 20h. (Port au Prince).

Oct. 21d. Records at 0h. (San Fernando), 4h. (Nagasaki), 6h. (Vieques (2)), 9h. (Cipolletti), 11h. (Tokyo), 13h. (Port au Prince and Vieques), 18h. (Paris, Bidston, Shide, Edinburgh, Zagreb, Moncalieri, De Bilt, Uccle, Eskdalemuir, and Kew), 19h. (Tokyo), 22h. (Riverview and San Fernando), 23h. (Honolulu).

Oct. 22d. 8h. 7m. 30s. Epicentre 2°·1N. 127°·8E.

A = −·612, B = +·790, C = +·037.

On trying 5°·4N. 125°·2E. as on several days in August it was found that this shock cannot have been from this origin.

	Δ	Az.	P.	O−C.	S.	O−C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Manila	14·2	332	e 3 30	+ 1	—	—	6·1	6·2
Batavia	22·5	248	5 10	− 1	9 13	− 2	—	10·5
Riverview	42·1	150	—	—	e 15 12	+36	—	18·9
Helwan	94·5	300	24 30	?S	(24 30)	−31	—	—
De Bilt	107·6	326	—	—	e 24 48	−138	e 54·5	—
Edinburgh	109·7	334	50 0	?L	—	—	(50·0)	—

Additional records: Manila gives MN = +6·3m. Batavia T_0 = 8h.7m.36s. Riverview MN = +17·4m.

Oct. 22d. Records also at 5h. (Zagreb), 9h. (Honolulu), 10h. (Honolulu, Perth, W.A., and Riverview), 11h. (Edinburgh and De Bilt), 15h. (Zagreb and Rocca di Papa), 18h. (De Bilt), 19h. (San Fernando, Mauritius, Colombo, and Helwan), 20h. (De Bilt), 21h. (Helwan and Zi-ka-wei), 23h. (Tokyo).

Oct. 23d. Records at 11h. (Tokyo), 14h. (Vieques and Port au Prince), 20h. (Taihoku), 21h. (Coimbra).

Oct. 24d. 19h. 13m. 20s. Epicentre 0°·3S. 138°·8E. (as on 1914 May 26d.).

A = −·756, B = +·659, C = −·005; D = +·659, E = +·752; G = +·004, H = −·003, K = −1·000.

		Δ	Az.	P.	O−C.	S.	O−C.	L.	M.
		°	°	m. s.	s.	m. s.	s.	m.	m.
Manila		23·2	311	e 9 18	?S	(e 9 18)	−11	—	11·7
Sydney		35·5	162	13 10	?S	(13 10)	+ 7	17·0	18·0
Riverview		35·5	162	—	—	e 13 1	− 2	e 17·1	18·2
Melbourne		37·9	172	—	—	14 40	+63	20·3	21·2
Honolulu		65·2	66	e 19 40	?S	(e 19 40)	+13	32·7	37·7
De Bilt	E.	115·3	330	—	—	e 24 7	?	e 63·7	86·8
	N.	115·3	330	—	—	—	—	e 66·7	87·1
San Fernando		131·5	322	32 40	?S	(32 40)	+149	—	—

Additional records: Manila gives MN = +11·6m. Sydney gives S = +15m.10s. (?SR_1). Riverview PR_1? = +8m.57s., eS = +12m.58s., eSR_1? = +14m.33s., MN = +22·0m. Melbourne SR_1 = +17m.34s.

Oct. 24d. Records also at 3h. (De Bilt), 7h., 9h., and 10h. (Manila), 16h. (Tokyo), 18h. (Rocca di Papa), 19h. and 21h. (Manila), 22h. (Vieques), 23h. (Port au Prince).

1918. Oct. 25d. 3h. 42m. 50s. Epicentre 18°·5N. 68°·0W.

(as on 1918 Oct. 11d. to 18d.).

A = +·355, B = −·879, C = +·317; D = −·927, E = −·375; G = +·119, H = −·294, K = −·948.

Station and Component.	Machine.	Δ	Azimuth.	P.	O−C.	S.	O−C.	L.	M.
		°	°	M. S.	S.	M. S.	S.	M.	M.
Vieques E.	B.O.	2·5	98	0 39	0	—	—	0·7	1·2
Port au Prince	B.O.	4·1	271	i 1 22	+18	1 29	−24	1·8	2·4
Balboa Hts. E.	B.O.	14·7	231	3 42	+ 7	—	—	6·7	6·9
Cheltenham N.	B.O.	21·7	341	5 37	+36	9 38	+39	e 13·5	18·0
Georgetown E.	—	21·9	341	5 8	+ 4	9 26	+23	e 10·9	—
N.	—	21·9	341	i 5 8	+ 4	9 19	+16	e 11·0	—
Washington	Mar.	21·9	341	5 6	+ 2	9 4	+ 1	10·4	—
Harvard E.	B.O.	24·0	354	5 30	+ 2	9 45	+ 1	10·9	—
N.	B.O.	24·0	354	i 5 57	+29	10 19	+35	e 12·7	14·2
Ithaca	B.O.	25·0	345	5 53	+15	10 21	+18	12·2	—
Northfield	B.O.	26·0	352	5 30	−18	10 17	− 5	12·2	—
Toronto	M.	26·9	342	e 6 28	+31	e 11 16	+37	e 12·7	20·8
Ann Arbor E.	B.	27·3	334	5 40	−21	10 28	−18	12·9	20·2
N.	B.	27·3	334	5 52	− 9	10 34	−12	13·2	21·2
Ottawa	—	27·7	348	6 0	− 5	e 10 46	− 8	e 12·2	—
St. Louis N.	W.	27·9	321	6 4	− 3	10 52	− 5	13·3	20·2
La Quiaca E.	M.	40·7	177	—	—	28 34	? L	(28·6)	43·7
N.	M.	40·7	177	—	—	28 46	? L	(28·8)	38·3
Tucson N.	B.O.	40·8	298	9 44	? PR_1	—	—	24·2	30·7
E.	B.O.	40·8	298	9 59	? PR_1	—	—	23·2	35·3
Pilar E.	M.	50·3	177	14 34	?	—	—	—	35·0
N.	M.	50·3	177	9 28	+19	—	—	—	36·3
Berkeley	—	50·8	304	e 8 0	?	—	—	—	—
Victoria	M.	53·5	317	9 28	− 2	17 11	+ 8	28·7	36·7
Chacarita	M.	53·8	170	—	—	31 52	? L	(31·9)	34·2
Coimbra	—	55·2	53	9 32	− 8	17 20	− 4	25·0	27·0
San Fernando	—	56·7	58	9 58	+ 8	17 10	−32	29·9	36·2
Cipolletti	M.	57·4	180	17 40	?S	(17 40)	−11	(34·2)	40·6
Bidston	M.S.	60·4	38	10 27	+12	19 13?	+45	—	27·2
Eskdalemuir	G.	60·6	36	10 20	+ 4	18 28	− 3	28·2	32·7
Edinburgh	M.	60·7	36	10 10	− 7	—	—	—	41·2
Stonyhurst	M.	60·8	38	i 19 52	?S	(i 19 52)	+79	i 31·9	35·9
Shide	M.S.	61·1	42	10 21	+ 1	18 38	+ 1	29·1	31·8
Oxford	M.S.	61·2	40	10 20	+ 0	18 37	− 1	—	—

Continued on next page.

Station and Component.	Machine.	Δ	Azimuth.	P.	O−C.	S.	O−C.	L.	M.
		°	°	M. S.	S.	M. S.	S.	M.	M.
Dyce	Ma.	61·5	34	10 10?	−12	18 49	+ 7	—	—
Kew	M.	61·8	41	19 10	?S	(19 10)	+24	—	40·2
Tortosa	—	62·0	51	10 30	+ 5	18 50	+ 2	29·8	36·7
Barcelona	—	63·2	52	e 10 26	− 7	i 19 0	− 3	—	32·3
Paris	—	63·5	43	i 10 40	+ 5	i 19 6	− 1	26·2	26·2
Algiers	B.M.	64·1	59	e 10 41	+ 2	19 11	− 3	27·2	—
Uccle	—	64·7	41	e 10 43	0	e 19 22	+ 1	e 26·2	29·0
De Bilt N.	—	65·2	40	10 52	+ 6	19 31	+ 4	e 28·2	29·9
E.	—	65·2	40	—	—	—	—	e 29·6	34·3
Moncalieri	S.	67·0	48	10 50	− 8	i 19 54	+ 4	27·6	—
Zurich	—	67·5	45	e 11 5	+ 4	19 57	+ 1	—	—
Rocca di Papa	Ag.	71·0	51	11 24	+ 1	20 39	+ 1	e 32·8	35·6
Zagreb	W.	72·7	47	e 11 35	+ 1	i 20 55	− 3	32·2	46·2
Honolulu	M.	83·4	290	e 12 10	−28	i 23 10	+ 9	40·2	51·4
Helwan	M.	88·6	59	13 4	− 4	—	—	—	67·6
Cape Town	M.	97·4	125	25 58	?S	(25 58)	+28	—	52·5
Mauritius	M.	129·2	98	32 10	?S	—	—	64·6	69·7
Zi-ka-wei	—	129·5	350	e 22 23	?PR_1	—	—	—	—
Melbourne	M.	145·4	230	—	—	—	—	72·8	83·2
Manila	W.	145·8	344	e 19 50	[0]	—	—	—	—

Additional records: Vieques gives ePN = +0m.36s. Balboa Heights LN = +6·9m., MN = +7·1m. Georgetown LE = +12·6m., LN = +14·4m., T_0 = 3h.42m.44s. Washington L = +14·2m., T_0 = 3h.42m.58s. Harvard eN = +6m.53s., eN? = +10m.27s., LE = +14·4m., LE = +18·8m., MN = +21·6m., T_0 = 3h.42m.59s. Ithaca SE = +10m.22s., T_0 = 3h.43m.7s. Northfield L = +15·2m., T_0 = 3h.42m.19s. Toronto eL = +17·0m., T_0 = 3h.43m.12s. Ottawa e = +11m.50s., L = +20·2m., T_0 = 3h.42m.50s. San Fernando MN = +32·4m., T_0 = 3h.43m.45s. Cipolletti records S and L waves as P and S respectively. Stonyhurst gives eP = +11m.28s. and iS = +23m.46s. Barcelona MN = +28·4m., T_0 = 3h.42m.43s. De Bilt T_0 = 3h.43m.4s. Moncalieri S = +19m.35s., T_0 = 3h.42m.56s. Zagreb iP = +11m.38s., i = +13m.38s., MNW = +43·2m.

Oct. 25d. 19h. 3m. 35s. Epicentre 5°·4N. 125°·2E. (as on 1918 Aug. 21d. 0h.).

A = −·574, B = +·813, C = +·094; D = +·817, E = +·576; G = −·054, H = +·077, K = −·996.

	Δ	Az.	P.	O−C.	S.	O−C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Manila	10·1	336	e 2 41	+10	—	—	6·2	7·4
Batavia	21·7	238	e 4 57	− 4	8 52	− 7	—	11·4
Zi-ka-wei	26·0	353	e 17 1	?L	e 21 25	?L	(e 17·0)	—
Colombo	45·2	274	31 25	?	—	—	—	—
Riverview	46·3	150	—	—	—	—	e 18·4	19·7
Helwan	90·7	298	26 25	?S	(26 25)	+124	—	—
De Bilt E.	103·4	327	—	—	e 41 1	?	e 54·4	57·1
N.	103·4	327	—	—	e 48 49	?L	(e 48·8)	57·3
Eskdalemuir	105·9	331	—	—	—	—	50·4	—

Additional records: Manila gives MN = +7·0m. Batavia T_0 = 19h.3m.38s. Riverview MN = +19·0m.

Oct. 25d. Records also at 1h. (Tokyo), 3h. (Pompeii), 5h. (Colombo and Kodaikanal), 6h. (Mobile), 14h. (Tokyo), 17h. (Denver), 21h. (San Fernando), 22h. (Rocca di Papa), 23h. (Zi-ka-wei).

Oct. 26d. 2h. 13m. 30s. At 72°·0N. 2°·8W. (as on 1918 Oct. 20d. 5h.).
A = +·309, B = −·015, C = +·951; D = −·049, E = −·999;
G = +·950, H = −·046, K = −·309.
(Very doubtful.)

	Δ	Az.	P.	O−C.	S.	O−C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Bidston	18·6	184	4 18	− 6	—	—	—	9·7
De Bilt	20·2	166	—	—	—	—	e 9·6	11·5
Kew	20·6	180	—	—	—	—	—	10·5
Shide	21·7	177	—	—	8 36	−23	9·8	10·7
Paris	23·3	174	—	—	e 8 52	−39	11·5	12·5
Graz	26·3	151	e 6 30?	+39	—	—	—	—
Moncalieri	27·5	164	7 14	+71	—	—	14·0	—
Zagreb	27·6	151	—	—	—	—	25·5	27·0
Rocca di Papa	31·2	157	e 7 45	+65	—	—	17·4	—
Rio Tinto	34·3	185	9 30	+143	—	—	—	9·5
Helwan	45·9	138	29 30	?L	—	—	(29·5)	—

Eskdalemuir (Δ = 16°·7) gives simply 2h.19m.30s. to 2h.40m.0s.

Oct. 26d. 16h. 58m. 40s. Epicentre 5°·4N. 125°·2E. (as on Oct. 25d.).
A = −·574, B = +·813, C = +·094.

	Δ	Az.	P.	O−C.	S.	O−C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Manila	10·1	336	e 2 36	+ 5	4 2	−30	4·9	7·6
Batavia	21·7	238	e 4 20	−41	—	—	—	9·3
Zi-ka-wei	26·0	353	e 5 46	− 2	e 10 4	−18	—	—
Helwan	90·7	298	60 20	?L	—	—	(60·3)	—
De Bilt E.	103·4	327	—	—	—	—	e 54·3	58·6
N.	103·4	327	—	—	—	—	e 56·3	58·7
Eskdalemuir	105·9	331	—	—	—	—	23·3	—

Manila gives MN = +6·7m.

Oct. 26d. Records also at 0h. (Algiers), 6h. (Helwan and Tokyo), 7h. (Tokyo), 12h. (Tacubaya (2)), 18h. (Manila), 23h. (De Bilt).

1918. Oct. 27d. 15h. 27m. 10s. Epicentre 10°·5S. 161°·0E.

(as on 1917 Nov. 30.).

A = −·930, B = +·320, C = −·182; D = +·326, E = +·946;
G = +·172, H = −·059, K = −·983.

Station and Component.	Machine.	Δ	Azimuth.	P.	O−C.	S.	O−C.	L.	M.
		°	°	m. s.	s.	m. s.	s.	m.	m.
Riverview	—	25·0	199	e 5 28	−10	i 9 52	−11	e 12·1	14·6
Sydney	M.	25·0	199	5 20	−18	9 50	−13	12·3	14·6
Apia	W.	26·8	100	5 37	−19	9 50	−47	10·8	12·8
Melbourne	M.	30·9	204	6 2	−35	11 38	−12	17·7	18·8
Adelaide	M.	31·9	216	5 29	−77	10 59	−68	14·7	17·8
Manila	W.	47·0	302	e 8 57	+10	15 26	−15	20·8	21·0
Tokyo	O.	50·3	338	9 9	0	16 15	− 8	22·8	—
Honolulu	M.	51·3	52	1 9 50	+35	i 16 32	− 3	23·9	31·3
Osaka	O.	51·3	334	9 7	− 8	16 17	−18	22·5	27·7
Kobe	O.	51·4	334	e 10 30	+74	—	—	28·6	25·7
Taihoku	O.	52·4	315	16 14	?S	(16 14)	−35	26·6	27·4
Misusawa E.	O.	53·0	341	9 21	− 5	16 41	−15	—	—
N.	O.	53·0	341	9 25	− 1	16 46	−10	—	—
Batavia	W.	53·7	270	e 9 31	0	17 1	− 4	e 28·8	17·8
Zi-ka-wei	—	58·4	319	e 11 44	?PR,	e 17 32	− 7	—	—
Ootomari	O.	59·4	344	e 18 23	?S	(e 18 23)	+ 7	—	—
Calcutta E.	O.E.	78·4	297	12 8	− 1	22 8	+ 3	—	—
Colombo	M.	82·4	278	22 14	?S	(22 14)	−36	—	32·4
Kodaikanal	M.	85·7	281	22 38	?S	(22 38)	−49	57·5	60·5
Berkeley	—	86·2	50	e 12 44	−10	—	—	e 35·4	—

Continued on next page.

Station and Component.	Machine.	Δ	Azimuth.	P.	O—C.	S.	O—C.	L.	M.
		°	°	M. S.	S.	M. S.	S.	M.	M.
Victoria	M.	88·6	40	23 55	?S	(23 55)	− 4	40·2	53·5
Bombay	O.E.	91·8	290	23 34	?S	(23 34)	−59	—	50·5
Tucson	B.O.	94·0	58	—	—	—	—	e 43·3	47·3
Mauritius N.	M.	98·5	248	12 50	−73	—	—	—	55·3
E.	M.	98·5	248	19 14	?PR_1	—	—	53·2	56·2
Cipolletti	M.	112·6	139	60 20	?L	—	—	(60·3)	66·9
Ann Arbor E.	B.	115·7	47	—	—	27 26	−50	56·8	—
Toronto	M.	118·5	46	29 8?	?S	(29 8?)	+30	57·6	71·6
Ottawa	—	120·5	42	—	—	(e 28 13)	−40	e 61·8	—
Ithaca	B.O.	120·8	46	e 21 20	?PR_1	e 27 20	−95	e 57·8	—
Cheltenham	B.O.	121·2	50	—	—	—	—	e 67·8	—
Georgetown	—	121·3	50	—	—	e 34 10	?SR_1	59·2	—
Washington	Mar.	121·3	50	—	—	—	—	e 63·8	—
Cape Town	M.	123·1	218	20 44	?PR_1	—	—	—	63·7
Harvard	B.O.	124·6	44	—	—	32 50?	?	e 59·0?	—
Helwan	M.	129·8	300	21 26	?PR_1	—	—	—	—
Budapest	—	131·1	328	22 36	?PR_1	—	—	—	—
Dyce N.	Ma.	131·5	350	i 22 52	?PR_1	—	—	—	69·7
Edinburgh	M.	132·9	349	22 50	?PR_1	—	—	—	—
Athens	—	133·0	315	e 22 46	?PR_1	—	—	—	—
Graz N.	W.	133·3	330	21 50	?PR_1	33 50?	?	—	—
Zagreb	W.	133·8	329	e 19 25	[− 2]	—	—	67·8	76·8
De Bilt E.	—	134·0	339	(e 22 2)	?PR_1	—	—	e 59·8	62·9
N.	—	134·0	339	e 22 51	?PR_1	—	—	e 66·8	67·4
Stonyhurst	M.	134·7	348	i 23 2	?PR_1	57 32	?	e 71·7	84·6
Hohenheim	—	135·0	335	e 19 19	[−11]	—	—	—	—
Bidston	M.S.	135·2	348	46 20	?	—	—	—	67·8
Uccle	—	135·4	340	e 19 25	[− 6]	—	—	e 67·8	73·8
Pola	W.	135·6	329	—	—	e 70 30	?L	e 82·5	83·7
Kew	M.	136·3	345	71 50	?L	—	—	(71·8)	90·8
Shide	M.S.	137·2	344	—	—	—	—	64·2	80·4
Paris	—	137·7	340	e 22 14	?PR_1	—	—	61·8	75·8
Rocca di Papa	Ag.	138·2	323	e 22 23	?PR_1	—	—	e 76·6	—
	Ag.	138·2	323	e 22 19	?PR_1	—	—	e 70·2	86·0
Moncalieri	S.	138·6	331	e 22 40?	?PR_1	32 10	+74	46·0	79·4
Barcelona	—	143·9	332	e 22 46	?PR_1	—	—	e 66·8	86·7
Tortosa	—	145·1	334	19 42	[− 6]	—	—	62·8	88·7
Algiers	B.M.	147·0	324	19 45	[− 6]	—	—	62·8	84·8
Coimbra	—	148·9	346	19 58	[+ 4]	32 57?	+65	71·8	83·6
Rio Tinto	M.	150·6	340	34 50	?S	(34 50)	?	—	—
San Fernando	—	151·6	338	21 50	?PR_1	—	—	—	89·8

Additional records: Riverview gives iP = +5m.30s., i = +5m.43s., PS = +10m.17s., MN = +13·4m., MZ = +13·3m., T_e = 15h.26m.58s., Epicentre 11°·5S. 162°·5E. Apia gives its records as 16h. instead of 15h. Melbourne SR_1 = +14m.20s., SR_2 = +15m.26s. Adelaide SR_1 = +13m.39s., M = +19·9m. Manila MN = +21·9m. Osaka MN = +28·6m., T_e = 15h.27m.16s. Kobe MN = +25·0m. Taihoku S = +22m.12s. Batavia T_e = 15h.27m.17s. Colombo M = +65·4m. Victoria gives S = +29m.52s., possibly SR_1. Ann Arbor SN = +26m.50s. Toronto e = 15h.29m.48s. Perhaps intended for a T_e. e = +23m.8s. and +42m.8s., L = +59·3m., eL = +61·6m. Ottawa records S as PR_1, and gives eS = +36m.33s., L = +75·8m. Ithaca e = +30m.5s. and +36m.50s. Georgetown LN = +61·2m. Harvard eE = +37m.9s. and +46m.9s., LE = +61·4m. Athens eN = +22m.55s. Zagreb i = +22m.47s. and +23m.48s., eNE = +55m.50s., MNW = +69·8m. Stonyhurst eP = +46m.2s. Paris iPE = +53·3m. (given one hour early). Coimbra eLN = +48·3m., LE = +59·8m., MN = +85·8m. San Fernando MN = +95·8m.

1918. Oct. 27d. 17h. 6m. 30s. Epicentre 1°·2S. 149°·5E.

(as on 1918 June 24d.).

$A = -\cdot862$, $B = +\cdot508$, $C = -\cdot021$; $D = +\cdot508$, $E = +\cdot862$; $G = +\cdot011$, $H = -\cdot018$, $K = -1\cdot000$.

T_0 is chosen to suit the mean values of S−P, but it makes the mean residuals of P and S both negative. This might be due to deep focus, but there is no indication of this in the anticentric residuals: nor again do they suggest a diminution of T_0.

Station and Component.	Machine.	Δ	Azimuth.	P.	O—C.	S.	O—C.	L.	M.
		°	°	M. S.	S.	M. S.	S.	M.	M.
Manila	W.	32·4	302	e 6 47	− 5	12 8	− 6	14·9	18·9
Riverview	—	32·7	178	e 6 57	+ 3	i 12 32	+13	e 16·5	21·5
Sydney	M.	32·7	178	11 54	?S	(11 54)	−25	17·0	18·5
Adelaide	M.	35·3	195	6 49	−27	12 44	−16	17·0	21·5
Melbourne	M.	36·8	188	13 0	?S	(13 0)	−21	22·5	23·0
Taihoku	O.	37·7	318	e 6 52	−44	12 38	−56	14·8	18·8
Tokyo	O.	38·0	349	7 48	+10	9 6	?PR_1	16·5	—
Osaka	O.	38·2	342	7 39	− 1	13 3	−38	16·1	16·4
Kobe	O.	38·3	342	e 8 25	?PR_1	—	—	—	16·3
Apia	W.	40·4	110	8 11	+13	e 14 42	+29	22·5	63·5
Mizusawa	O.	41·1	351	7 59	− 5	13 47	−35	—	—
Zi-ka-wei E.	—	42·0	323	8 2	− 9	14 17	−18	19·5	23·1
N.	—	42·0	323	—	—	—	—	19·6	24·0
Batavia	W.	42·9	264	8 7	−10	—	—	—	17·5
Ootomari	O.	48·3	354	8 50	− 6	—	—	—	—
Honolulu	M.	55·9	63	e 12 48	?PR_1	i 18 12	+39	e 25·0	34·5
Calcutta E.	O.E.	64·1	296	10 48	+ 9	19 18	+ 4	—	—
Colombo	M.	70·0	278	10 42?	−35	(20 18)	− 8	20·3	34·4
Kodaikanal	M.	72·7	281	20 30	?S	(20 30)	−28	34·5	55·4
Simla	O.E.	75·7	304	e 11 54	+ 1	21 18	−16	e 29·0	—
Bombay	O.E.	77·8	290	12 19	+13	—	—	—	43·9
Berkeley	—	89·0	51	—	—	e 22 57	−66	—	—
Victoria	M.	89·1	41	23 31	?S	(23 31)	−33	38·8	52·0
Mauritius N.	M.	91·1	250	—	—	—	—	28·1	35·1
E.	M.	91·1	250	12 48	−34	—	—	27·5	39·9
Tucson	B.O.	98·9	57	—	—	—	—	e 54·3	68·2
Lemberg	B.O.	112·9	325	e 19 48	?PR_1	e 29 18	+85	e 58·7	64·5
Helwan	M.	114·8	303	—	—	—	—	—	77·3
Budapest E.	—	116·9	325	20 20	?PR_1	29 30	+65	—	—
Ann Arbor E.	B.	117·2	40	—	—	20 36?	?PR_1	54·5	65·5
N.	B.	117·2	40	—	—	20 30?	?PR_1	54·0	66·5
E.	W.	117·2	40	10 24	?	—	—	55·5	65·5
N.	W.	117·2	40	—	—	20 42?	?PR_1	54·5	68·5
Athens	—	118·2	315	e 20 16	?PR_1	e 31 0	+144	e 60·2	—
Graz	W.	119·2	327	e 20 28	?PR_1	i 30 26	+103	—	—
Toronto	M.	119·3	38	—	—	—	—	48·8	82·4
Dyce N.	Ma.	119·6	344	e 20 34	?PR_1	i 30 22	+96	—	63·4
Zagreb	W.	120·3	325	e 20 11	?PR_1	e 36 30	?SR_1	62·5	67·5
Ottawa	—	120·6	34	e 20 51	?PR_1	e 30 41	+107	e 59·4	—
De Bilt	—	121·0	335	(e 19 57)	?PR_1	30 37	+100	e 58·5	63·6
Edinburgh	M.	121·0	344	—	—	—	—	—	74·0
Pola	W.	121·4	325	e 21 10	?PR_1	(e 32 10)	?	e 32·2	79·3
Hohenheim	—	121·5	330	19 0	[+ 4]	30 45?	+104	—	—
Ithaca	B.O.	121·8	37	—	—	e 29 30	+27	e 58·0	—
Uccle	—	122·3	334	e 19 0	[+ 1]	30 48	+102	e 58·5	77·5
Stonyhurst	M.	122·4	340	—	—	—	—	—	75·6
Zurich	—	122·7	330	e 19 31	[+31]	—	—	—	—
Bidston	M.S.	123·0	340	36 30	?	45 30	?	—	72·5
Georgetown	—	123·2	41	e 21 6	?PR_1	25 52?	?	—	—
Washington	Mar.	123·2	41	22 30?	?PR_1	25 57?	?	e 63·5?	—
Kew	M.	123·6	339	65 30?	?L	—	—	(65·5)	81·5
Rocca di Papa	Ag.	123·9	321	e 21 11	?PR_1	e 28 45	−33	e 71·1	81·5
Paris	—	124·5	334	e 21 5	?PR_1	i 31 9	+106	62·5	63·5
Shide	M.S.	124·6	339	—	—	—	—	59·5	74·3
Moncalieri	S.	124·7	329	21 14	?PR_1	i 33 14	?	51·4	76·2
Harvard E.	B.O.	125·1	35	e 15 53	−13	21 45	?PR_1	e 25·4	—
E.	B.O.	125·1	35	e 16 23	+17	21 45	?PR_1	25·4	—
Cipolletti	M.	127·0	141	66 30	?L	72 6	?	(66·5)	89·6
Barcelona	—	130·1	329	e 21 27	?PR_1	—	—	e 60·3	74·3
Tortosa	—	131·4	330	19 45	[+23]	—	—	54·8	78·1
Algiers	B.M.	132·8	322	21 59	?PR_1	32 10	+110	54·5	70·5
Coimbra N.	—	136·1	337	22 20	?PR_1	34 17?	?	e 57·0	76·0
E.	—	136·1	337	21 0	?PR_1	i 41 3	?SR_1	—	70·1
Rio Tinto	M.	137·3	331	—	—	—	—	—	87·5

For Notes see next page.

NOTES TO OCT. 27d. 17h. 6m. 30s.

Additional records: Manila gives also MN = +18·1m. Riverview i = +7m.9s., iPR_1 = +8m.26s., PS = +13m.5s., T_0 = 17h.6m.25s. Sydney S = +15m.18s. Adelaide PR_1 = +8m.39s., SR_1 = +15m.29s., M = +25·2m. Melbourne S = +18m.54s., SR_1 = +20m.18s., SR_2 = +20m.48s. Osaka MN = +20·9m., T_0 = 17h.7m.21s. Kobe MN = +21·8m. Apia gives its records as 18h. instead of 17h. Mizusawa T_0 = 17h.7m.10s. Zi-ka-wei SR_1N = +17m.44s., SR_1E = +17m.46s. Colombo M = +36·1m. Toronto gives L = +54·7m., eL = +71·3m., and L = +76·1m. Zagreb iNE = +20m.37s., and +26m.10s., MNW = +72·5m. Ottawa L = +83·5m. and +93·5m. De Bilt eSR_1 = +37m.16s. Edinburgh M = 79·2m. Uccle e = +39m.24s. Washington L? = +78·5m., L = +86·5m. Rocca di Papa eP = +20m.31s., L = +72·4m., M = +80·5m. Paris PR_2 = +28m.8s., SR_1 = +38m.9s. Moncalieri MN = +77·0m. Harvard gives several other records. T_0 = 7h.12m.16s. and 17h.22m.36s. Barcelona MN = +67·0m., M_2 = +77·6m.

Oct. 27d. Records also at 0h. (San Fernando), 8h. (De Bilt, Zagreb, and Athens), 10h. (Tokyo), 16h. (Tokyo), 19h. (Toronto, Pompeii, and Victoria).

Oct. 28d. Records at 1h. (Denver and San Fernando), 11h. (Athens), 12h. (Sydney and Riverview), 13h. (Manila, Colombo, and Melbourne), 14h. (Manila, Helwan, and De Bilt), 17h. (De Bilt), 22h. (San Fernando).

Oct. 29d. 12h. 26m. 0s. Epicentre 8°·0N. 84°·0W. (as on 1917 June 30d.).

A = +·104, B = −·985, C = +·139; D = −·995, E = −·105; G = +·015, H = −·138, K = −·990.

The values of S−P for Washington and Ottawa give △ = 18°·2 and 31°·3, with closely accordant T_0 = 12h.27m.2s. But these stations are only 6° apart, so that one of the △s must be wrong. Further the T_0 is later than the record at Balboa Heights, so that *both* are probably in error. The solution given is a compromise.

	△	Az.	P.	O−C.	S.	O−C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Balboa Heights	4·5	78	0 54	−16	—	—	3·4	3·8
Cheltenham	31·4	10	e 7 55	?PR_1	—	—	e 16·0	18·0
Washington	31·5	10	5 22	−81	8 47	?	16·0	—
Ithaca	35·0	10	e 11 20	?S	(e 11 20)	−95	e 17·5	—
Toronto	35·9	6	—	—	—	—	17·8	21·0
Ottawa	38·1	10	7 41	+ 2	e 12 56	−43	20·0	—
Victoria	52·3	328	—	—	—	—	24·8	33·2
Honolulu	72·3	290	—	—	—	—	e 33·0	36·0
San Fernando	75·4	54	26 0	?SR_1	—	—	(36·0)	49·0
Eskdalemuir	78·1	35	—	—	—	—	34·0	—
Edinburgh	78·3	34	35 0	?L	—	—	(35·0)	49·5
Kew	79·8	39	—	—	—	—	—	29·0
Paris	81·7	42	—	—	—	—	e 32·0	—
De Bilt E.	83·2	38	—	—	22 57	− 2	e 42·0	43·0
N.	83·2	38	—	—	—	—	e 40·0	40·6
Graz	90·6	42	—	—	—	—	e 50·0	—
Helwan	107·4	55	28 0	?S	(28 0)	+55	—	—

Additional records: Balboa Heights gives PN = +53s., MN = +5·9m. Ithaca e = +15m.0s. Ottawa eN = +11m.0s., e = +14m.26s., eN = +17m.0s., L = +29·0m., and +40·0m. San Fernando MN = +44·0m. The L is given as another P.

Oct. 29d. Records also at 5h. (Mizusawa), 11h. (Ann Arbor), 15h. (Tokyo), 17h. (De Bilt and Manila), 18h. (Rocca di Papa), 20h. (San Fernando).

Oct. 30d. Records at 12h. (Harvard and Georgetown), 13h. (Coimbra), 22h. (San Fernando).

Oct. 31d. Records at 7h. (Kobe), 8h. (Mizusawa), 9h. (Taihoku), 10h. (Zagreb), 13h. (Mizusawa), 17h. (De Bilt and Taihoku), 18h. (Kobe and Osaka), 20h. (Mizusawa), 23h. (San Fernando).

Nov. 1d. Records at 1h. (Mizusawa and Tokyo), 2h. (Manila), 15h. (Riverview), 16h. (Helwan), 17h. (Tokyo), 18h. (Manila), 19h. (Tokyo), 20h. (Colombo), 23h. (San Fernando).

Nov. 2d. 10h. 1m. 10s. Epicentre Isle of Hawaii, 19°·4N. 155°·3W.

A = −·857, B = −·395, C = +·333.

		Δ	Az.	P.	O−C.	S.	O−C.	L.	M.
		°	°	m. s.	s.	m. s.	s.	m.	m.
Honolulu		3·3	306	(0 50)	− 2	—	—	0·8	2·7
Berkeley		34·0	49	—	—	e 12 40	0	—	—
Ann Arbor	E.	63·6	51	—	—	26 20	?SR_1	34·4	35·8
	N.	63·6	51	—	—	23 50	?SR_1	33·9	35·8
Toronto		66·6	49	—	—	—	—	44·2	—
Georgetown		69·0	54	—	—	—	—	32·8	—
Washington		69·0	54	—	—	e 32 2	?	33·0	—
Ottawa		69·1	47	—	—	e 27 14?	?SR_1	36·8	—
Cheltenham		69·1	55	—	—	—	—	37·3	39·3
Manila		79·5	281	e 12 16	0	—	—	—	—
Cipolletti		100·0	129	53 32	?L	—	—	(53·5)	59·3
Edinburgh		101·0	14	27 50	?S	(27 50)	+105	—	62·3
Helwan		130·3	353	100 50	?L	—	—	(100·8)	—

Additional records: Toronto gives L = +53·2m. Georgetown LE = +36·8m.
Ottawa eN? = +32m.20s., e = +33m.50s.

Nov. 2d. Records also at 0h. (Batavia), 3h. (Taihoku, Hokoto, and Manila), 7h. (Manila), 12h. (Rocca di Papa and La Paz), 13h. (La Paz), 20h. (Manila), 23h. (San Fernando).

1918. Nov. 3d. 11h. 13m. 50s. Epicentre 48°·2S. 165°·8E.

A = −·646, B = +·164, C = −·745; D = +·245, E = +·969;
G = +·723, H = −·183, K = −·666.

Station and Component.	Machine.	Δ	Azimuth.	P.	O−C.	S.	O−C.	L.	M.
		°	°	m. s.	s.	m. s.	s.	m.	m.
Riverview	—	18·0	318	i 4 22	+ 5	e 7 53	+13	e 8·7	10·0
Sydney	M.	18·0	318	4 22	+ 5	(7 40)	0	7·7	8·2
Melbourne	M.	18·3	297	i 4 10	−11	7 28	−19	8·7	8·2
Adelaide	M.	24·1	294	5 33	+ 4	9 43	− 3	10·5	13·3
Apia	W.	39·1	38	e 7 46	− 1	i 14 4	+11	e 18·4	—
Batavia	W.	64·9	290	10 41	− 3	19 17	− 7	e 34·2	37·2
Manila	W.	74·3	317	e 11 45	+ 1	—	—	—	—
Honolulu	M.	76·7	35	—	—	e 40 4	?L	42·3	46·7
Cipolletti	M.	80·6	141	20 46	?S	(20 46)	−104	43·2	47·3
Zi-ka-wei	—	88·7	324	e 12 56	−13	—	—	—	—
Colombo	M.	92·4	278	23 40	?S	(23 40)	−59	—	30·2
Cape Town	M.	92·8	209	29 10	?SR_1	—	—	—	43·7
Kodaikanal	M.	96·5	279	18 10	?PR_1	—	—	—	—
La Paz	Bi.	99·5	130	e 14 6	− 2	24 41	−70	47·2	49·5
Berkeley	—	107·2	50	—	—	—	—	e 46·7	—
Victoria	M.	114·4	43	29 44	?S	(29 44)	+99	52·7	70·2
Ann Arbor	B.	132·4	70	—	—	—	—	66·2	72·2
Washington	Mar.	134·9	77	e 22 10	?PR_1	—	—	—	—
Georgetown	—	134·9	77	—	—	—	—	74·2	—
Toronto	M.	135·8	70	—	—	—	—	71·4	77·0
Ithaca	B.O.	137·0	73	—	—	—	—	e 73·2	—
Ottawa	—	139·0	70	e 22 40	?PR_1	—	—	e 67·2	—
Harvard	B.O.	140·5	75	—	—	e 55 22	?	e 76·3	—
Helwan	M.	140·9	260	22 10	?PR_1	—	—	—	—

Continued on next page.

Station and Component.	Machine.	Δ	Azimuth.	P.	O−C.	S.	O−C.	L.	M.
		°	°	M. S.	S.	M. S.	S.	M.	M.
Zagreb	W.	159·4	275	e 20 44	[+37]	—	—	82·2	122·2
Graz	W.	160·0	278	e 20 56	[+48]	—	—	—	—
Algiers	B.M.	163·0	234	e 24 37	? PR_1	32 22	?	92·2	110·2
Moncalieri	S.	164·6	266	20 14	[+ 2]	30 48	?	82·1	—
San Fernando	—	166·9	209	50 58	?	—	—	96·7	98·7
De Bilt	E.	167·0	295	20 52	[+39]	e 38 52	?	e 79·2	80·3
	N.	167·0	295	21 12	[+59]	e 37 27	?	—	89·7
Uccle	—	167·7	289	—	—	—	—	e 92·2	112·2
Rio Tinto	M.	168·2	210	89 10	? L	—	—	(89·2)	115·7
Paris	—	168·9	280	27 10	?	—	—	100·2	107·2
Edinburgh	M.	169·7	322	21 10	[+55]	—	—	—	109·7
Eskdalemuir	G.	170·2	320	i 20 13	[− 2]	i 35 52	?	46·2	—
	Z.	170·2	320	i 19 54	[−21]	i 25 3	? PR_1	—	—
Kew	M.	170·4	295	—	—	—	—	—	111·2
Oxford	M.S.	171·0	298	—	—	32 24	?	—	—
Coimbra	—	171·0	209	e 24 10	? PR_1	37 38	?	e 88·2	—
Bidston	M.S.	171·2	310	19 10	[−65]	—	—	—	98·2
Shide	M.S.	171·2	292	—	—	32 24	—	—	—

Additional records: Riverview gives eP = +4m.21s., iPR_2 = +5m.36s., iS = +7m.59s., PS = +8m.14s., MN = +9·4m., MZ = +9·9m., T_o = 11h.13m.47s. Adelaide PR_1 = +6m.28s., SR_1 = +10m.3s. Batavia records an M at +21·2m. Colombo M = +62·7m. Victoria S = +40m.10s., eL = +65·2m. Toronto L = +74·8m. Ottawa e? = +41m.10s., eN? = +61m.10s., L = +75·2m. Harvard gives two complete sets of records, and says that they refer to a shock in the Sandwich Islands. Zagreb iNW = +20m.52s., MNW = +120·2m. San Fernando MN = +95·7m. De Bilt eE = +46m.46s., and +52m.46s., mE = +53m.8s. Epicentre 52°·0N. 164°·0E. Eskdalemuir gives four other i's.

Nov. 3d. Records also at 3h. (Helwan), 7h. (Tokyo), 12h. (Manila (2) and Batavia), 17h. (Zagreb), 18h. (Melbourne and Riverview), 19h. (Riverview), 21h. (Melbourne, Sydney, and Riverview), 23h. (Helwan).

Nov. 4d. Records at 2h. (Riverview), 3h. (Helwan), 6h. (Helwan), 7h. (Paris), 11h. (Tacubaya), 13h. (Helwan, Taihoku, and Paris), 18h. (Harvard), 21h. (Zagreb).

Nov. 5d. 22h. 39m. 0s. Epicentre 12°·0N. 95°·5W. (as on 1918 Jan 25d.).

A = −·094, B = −·974, C = +·208; D = −·995, E = +·096; G = −·020, H = −·207, K = −·978.

		Δ	Az.	P.	O−C.	S.	O−C.	L.	M.
		°	°	m. s.	s.	m. s.	s.	m.	m.
Balboa Heights	E.	16·0	99	3 16	−36	—	—	5·3	5·9
	N.	16·0	99	3 18	−34	—	—	5·3	6·0
Washington		31·5	28	6 48	+ 5	11 58	− 2	17·3	—
Toronto		34·5	21	—	—	—	—	19·5	23·5
Harvard		37·1	30	7 27	− 4	—	—	e 19·9	23·6
Ottawa		37·4	23	i 9 29	+116	—	—	e 20·0	—
La Paz		39·3	136	7 58	+ 9	14 0	+ 4	19·0	21·3
Edinburgh		81·4	34	38 0	? L	—	—	(38·0)	49·5
Eskdalemuir		81·5	34	—	—	—	—	38·0	—
San Fernando		82·4	54	33 30	? L	—	—	(33·5)	—
Kew		83·9	39	—	—	—	—	—	51·0
De Bilt		87·0	37	—	—	—	—	e 40·0	46·0
Helwan		113·9	49	64 0	? L	—	—	(64·0)	—

Additional records: Toronto gives iL = +21·8m. Harvard LN = +21·0m. La Paz T_o = 22h.39m.20s. De Bilt MN = +46·5m.

Nov. 5d. Records also at 0h. (Adelaide and Riverview), 1h. (Riverview and Manila), 3h. (San Fernando), 5h. (Riverview, Manila, and Apia), 8h. (Helwan), 10h. (Riverview), 13h. (Athens (3)), 16h. (Batavia).

Nov. 6d. 19h. 26m. 0s. Epicentre 44°·6N. 13°·3E.

A = +·693, B = +·164, C = +·702; D = +·230, E = −·973; G = +·683, H = +·162, K = −·712.

	Δ	Az.	P.	O−C.	S.	O−C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Zagreb	2·2	69	e 0 43	+ 9	i 1 11	+11	—	1·4
Graz	2·9	33	i 0 52	+ 7	—	—	—	—
Rocca di Papa	2·9	189	e 1 2	+17	(2 2)	?L	(2·0)	3·2
Monte Cassino	2·9	170	1 36	?L	—	—	(1·6)	3·9
Milan	3·0	286	1 46	?L	—	—	(1·8)	2·9
Moncalieri	4·0	276	1 29	+27	2 5	+15	2·5	2·9
Zurich	4·3	312	1 3	− 4	i 1 56	− 2	—	2·0
Budapest	4·9	52	1 28	+12	—	—	—	—
Hohenheim	5·0	328	i 1 6	−11	—	—	—	—
Neuchâtel	5·1	300	1 16	− 3	2 30	+10	—	—
Besancon	5·7	300	1 28	0	2 51	?L	(2·9)	—
Paris	8·5	304	e 2 47	+38	e 3 49	− 1	4·3	5·0
Uccle	8·7	319	e 2 0	−12	e 3 48	− 8	—	—
De Bilt	9·3	327	e 2 20	0	e 3 44	−26	4·5	5·3
Tortosa	10·1	253	5 24	?L	—	—	6·5	7·5
Shide	11·6	307	6 1	?L	—	—	(6·0)	—

Additional records: Zagreb gives iP = +0m.46s., i = +55s. and +1m.12s., MNW = +1·3m. Rocca di Papa. The record taken for S is given as another P, SN = +1m.42s., and SN is taken for L, MN = +3·5m. Zurich iPN = +1m.10s., iPE and V = +1m.11s., MN = +2·3m. Neuchâtel P = +1m.30s. De Bilt MN = +4·6m.

Nov. 6d. Records also at 1h. (La Paz), 3h. (Helwan), 19h. (Mizusawa), 20h. (Zagreb), 21h. (Riverview), 22h. (Batavia, Manila, Rocca di Papa, and Zagreb).

Nov. 7d. Records at 1h. (Manila), 9h. (Vieques), 13h. (Barcelona), 16h. (Lick), 17h. (Manila (2)), 18h. and 19h. (La Paz), 20h. (Manila), 21h. (Mizusawa and Tokyo).

1918. Nov. 8d. 4h. 38m. 0s. Epicentre 44°·9N. 151°·4E.

A = −·622, B = +·339, C = +·706; D = +·479, E = +·878; G = −·620, H = +·338, K = −·708.

Direct comparison with Sept. 8d. 5h. 40m. 30s., epicentre 46°·5N. 151°·4E., shows systematic differences. Hence the above solution, quite independently computed, is allowed to stand.

Station and Component.	Machine.	Δ	Azimuth.	P.	O−C.	S.	O−C.	L.	M.
		°	°	M. S.	S.	M. S.	S.	M.	M.
Ootomari	O.	6·3	289	2 45	?S	(2 45)	− 7	3·2	—
Mizusawa	O.	9·6	236	2 21	− 3	4 17	− 1	—	—
Tokyo	O.	12·8	228	3 10	0	4 37	−62	5·3	—
Osaka	O.	15·9	235	3 55	+ 4	—	—	7·6	8·8
Kobe	O.	16·1	236	i 4 0	+ 7	—	—	7·4	10·9
Zi-ka-wei	—	27·1	250	5 54	− 5	e 10 38	− 5	—	—
Taihoku	O.	31·2	241	6 25	−15	9 11	−163	11·5	—
Manila	W.	39·7	231	7 38	−14	14 0	− 2	20·0	21·8
Sitka	B.O.	45·3	47	8 22	−13	—	—	e 22·5	27·8
Honolulu	M.	47·5	102	7 36	−75	15 0	−48	e 24·8	27·0
Calcutta E.	O.E.	55·5	271	9 48	+ 5	17 42	+14	23·0	34·3
Victoria M.	M.	55·5	52	9 25	−18	15 22	−126	25·8	42·5
Z.	—	55·5	52	9 0	−43	15 45	−103	26·7	44·1
Simla	O.E.	58·0	284	9 30	−29	17 36	−23	27·2	29·2
Berkeley N.	—	62·0	62	e 10 24	− 1	e 18 42?	− 6	e 25·9	29·5
E.	—	62·0	62	e 10 23	− 2	e 18 50	+ 2	e 25·6	29·7
Z.	—	62·0	62	e 10 20	− 5	—	—	—	—
Saskatoon	Ma.	62·7	41	11 22	+52	19 56	+59	28·0?	—
Lick N.	W.	63·0	62	e 10 31	− 1	e 19 7	+ 6	—	31·8
E.	W.	63·0	62	e 10 34	+ 2	e 19 2	+ 1	—	31·4
Z.	W.	63·0	62	e 10 24	− 8	—	—	—	—
Batavia	W.	64·8	231	10 44	0	19 36	+13	e 29·0	50·0

Continued on next page.

Station and Component.	Machine.	Δ	Azimuth.	P.	O−C.	S.	O−C.	L.	M.
		°	°	M. S.	S.	M. S.	S.	M.	M.
Apia	W.	67·5	140	11 5	+ 4	i 20 6	+10	i 27·5?	36·0
Bombay	O.E.	68·9	277	11 11	+ 1	—	—	—	38·2
Kodaikanal	M.	71·5	269	12 0	+33	(21 6)	+22	21·1	50·8
Colombo	M.	72·2	265	10 18	−73	20 0	−52	42·0	59·6
Tucson N.	B.O.	72·8	60	11 34	− 1	21 11	+11	35·4	36·1
E.	B.O.	72·8	60	11 34	− 1	21 10	+10	37·0	44·2
Lemberg	B.O.	74·8	329	e 11 54	+ 6	i 21 33	+ 9	e 38·3	49·3
Edinburgh	M.	77·0	347	12 0	− 1	—	—	—	62·0
Lawrence E.	W.	77·0	47	i 11 56	− 5	21 49	0	31·1	44·7
N.	W.	77·0	47	i 11 57	− 4	22 6	+17	31·2	49·7
Eskdalemuir	G.	77·5	347	(12 4)	0	12 4	?P	—	—
Sydney	M.	78·7	180	13 0	+49	22 12	+ 4	33·6	43·5
De Bilt	—	78·8	340	12 17	+ 5	22 16	+ 6	e 36·0	37·1
Riverview	—	78·8	180	i 12 9	− 3	i 22 2	− 8	e 32·7	33·3
Bidston	M.S.	79·3	346	12 24	+ 9	22 12	− 3	—	49·0
Ann Arbor E.	B.	79·9	39	11 18	−60	21 0	−82	37·8	43·3
N.	B.	79·9	39	11 12	−66	21 0	−82	37·0	51·5
St. Louis N.	W.	79·9	45	12 12	− 6	22 18	− 4	38·2	43·2
West Bromwich	M.S.	80·0	345	12 16	− 3	22 26	+ 3	—	—
Uccle	—	80·1	340	i 12 26	+ 6	22 30	+ 6	38·0	52·8
Ottawa	—	80·5	30	i 12 20	− 2	e 21 49	−40	e 36·5	—
Oxford	M.S.	80·5	345	12 30	+ 8	22 35	+ 6	—	—
Kew	M.	80·6	344	12 0	−23	—	—	—	22·0
Toronto	M.	80·6	34	e 12 48	+25	e 22 36	+ 6	i 36·4	51·0
Adelaide	M.	80·7	191	13 17	+54	21 52	−39	33·7	38·9
Zagreb	W.	81·1	330	i 12 27	+ 1	i 22 39	+ 3	46·5	—
Shide	M.S.	81·5	344	12 36	+ 8	22 46	+ 5	36·8	56·5
Cork	M.	81·7	349	—	—	22 0	−43	42·5	47·5
Zurich	—	82·1	335	i 12 37	+ 6	i 22 53	+ 7	—	—
Paris	—	82·4	340	i 12 36	+ 4	i 22 55	+ 5	37·0	41·0
Northfield	B.O.	82·7	29	12 32	− 2	22 57	+ 3	42·5	—
Pola	W.	82·7	331	e 12 30	− 4	e 22 30	−24	e 39·5	49·9
Ithaca E.	B.O.	82·8	33	12 45	+10	23 14	+19	38·1	50·2
N.	B.O.	82·8	33	12 46	+11	23 6	+11	38·6	—
Melbourne	M.	82·9	186	12 18	−17	22 54	− 2	38·8	55·5
Milan	—	83·6	334	12 47	+ 7	23 7	+ 2	41·0	24·2?
Moncalieri	S.	84·5	335	12 44	− 1	i 23 14	0	29·9	50·9
Athens	—	84·8	321	i 12 50	+ 3	23 19	+ 2	29·3	43·9
Harvard N.	B.O.	84·8	30	12 21	−26	22 48	−29	e 38·0	—
E.	B.O.	84·8	30	13 8	+21	22 19	−58	e 38·0	40·9
Halifax	Ma.	85·3	24	13 8	+18	23 37	+15	36·5?	—
Georgetown N.	—	85·5	36	12 47	− 4	23 25	0	e 39·8	51·2
E.	—	85·5	36	12 47	− 4	23 34	+ 9	e 39·0	51·5
Z.	—	85·5	36	12 41	−10	—	—	e 39·4	—
Washington	Mar.	85·5	36	12 40	−11	23 12	−13	42·0	—
Cheltenham N.	B.O.	85·7	36	13 0	+ 8	23 37	+10	41·2	62·8
Monte Cassino	Ag.	85·7	330	12 41	−11	—	—	—	13·6
Rocca di Papa	Ag.	85·9	330	12 42	−11	23 11	−18	41·4	54·8
Marseilles	Ma.	86·8	337	12 56	− 2	i 23 42	+ 3	43·0	56·0
Helwan	M.	87·5	311	13 0	− 2	—	—	—	61·7
Tacubaya	—	89·3	63	12 24	−48	—	—	—	45·1
Barcelona	—	89·4	338	i 13 5	− 7	i 23 40	−27	39·4 /	48·1
Tortosa	—	90·4	339	13 11	− 7	23 48	−30	39·6	54·0
Coimbra	—	93·0	346	13 26	− 6	23 55	−50	41·1	50·3
Algiers	B.M.	93·5	334	13 15	−20	24 0	−51	47·0	60·2
Rio Tinto	M.	95·0	343	14 0	+17	—	—	—	62·0
San Fernando	—	96·2	342	13 42	− 8	25 30	+12	49·2	63·0
Vieques N.	—	108·6	36	18 58	? PR_1	34 34	? SR_1	57·4	68·8
E.	—	108·6	36	19 0	? PR_1	34 37	? SR_1	57·5	58·1
Balboa Heights	B.O.	109·4	52	19 0	? PR_1	—	—	—	—
La Paz	Bi.	136·4	60	i 19 34	[+ 1]	33 28	?	58·7	67·5
Cape Town	M.	142·6	272	11 6	?	20 0	[+16]	67·6	81·4
Andalgala N.	M.	145·4	70	19 0	[−49]	—	—	—	86·8
E.	M.	145·4	70	18 48	[−61]	—	—	69·1	82·8
Pilar E.	M.	149·6	74	20 18	[+23]	—	—	76·6	124·3
N.	M.	149·6	74	20 24	[+29]	—	—	76·7	110·8
Cipolletti	M.	150·3	92	17 54	+ 2	—	—	68·8	92·7
Chacarita	M.	155·0	76	24 12	? PR_1	—	—	—	30·9

For Notes see next page.

NOTES TO NOV. 8d. 4h. 38m. 0s.

Additional records: Mizusawa gives SN = +4m.15s. Osaka MN = +9·3m. Kobe MN = +8·7m. Manila iN = +9m.48s., iE = +10m.6s., MN = +20·2m., T_0 = 4h.37m.35s. Sitka MN = +27·4m. Berkeley T_0 = 4h.37m.51s. Saskatoon T_0 = 4h.38m.49s. Lick T_0 = 4h.37m.47s. Batavia M = +21·0m., e = +34m.24s., M = +41·0m., T_0 = 4h.37m.52s. Apia i = +14m.0s. Lemberg eSR_1 = +26m.54s., +29m.48s., and +31m.48s. Eskdalemuir P = +6m.42s. Sydney SR_1 = +27m.48s. De Bilt SR_1 = +27m.48s., m = +28m.34s., T_0 = 4h.38m.16s. Riverview eP = +12m.2s., iP = +13m.16s., PS = +22m.51s., and +23m.16s., SR_1 = +26m.15s., SR_2 = +27m.23s., MN = +33·8m., T_0 = 4h.37m.59s. St. Louis LN = +37·2m., MN = +47·1m., T_0 = 4h.38m.4s. Uccle eP = +12m.13s., iSR_1 = +28m.17s., MN = +46·8m., MZ = +56·7m., T_0 = 4h.38m.6s. Ottawa ePR_1 = +15m.25s., eSR_1 = +27m.54s., L = +47·0m., T_0 = 4h.38m.50s. Toronto iP = +16m.0s., iS = +27m.54s., iL = +33·0m. and +46·6m. Adelaide PR_1 = +15m.2s., SR_1 = +25m.47s. Zagreb eP = +12m.22s., i = +12m.32s., i = +22m.41s. Zurich eP = +12m.24s., T_0 = 4h.37m.54s. Paris eP = +12m.27s., T_0 = 4h.37m.57s. Pola MN = +53·6m., T_0 = 4h.37m.30s. Ithaca PR_1 = +16m.8s., T_0 = 4h.38m.22s. Melbourne PR_1 = +15m.6s., PR_2 = +17m.12s., SR_1 = +28m.12s., SR_2 = +31m.42s. Moncalieri iP = +12m.51s., MN = +54·8m., T_0 = 4h.38m.12s. Athens eP = +12m.42s., LN = +29·4m., MN = +56·4m., T_0 = 4h.38m.2s. Harvard iE = +23m.41s., eE = +24m.50s., eE = +25m.19s., T_0 = 4h.38m.21s. Halifax T_0 = 4h.38m.36s. Georgetown iZ = +13m.3s., T_0 = 4h.38m.7s. Cheltenham LE = +45·7m., ME = 54·6m., T_0 = 4h.38m.20s. Rocca di Papa eL = +30·0m., MN = +59·9m. Barcelona L = +29·5m., MN = +45·4m., T_0 = 4h.38m.28s. Coimbra PR_1 = +17m.19s., iN = +25m.49s. and +26m.7s., LN = +45·7m., MN = +47·9m., T_0 = 4h.38m.53s. San Fernando MN = +65·2m., T_0 = 4h.37m.45s. La Paz eP = +19m.30s., PR_1N = +22m.18s., PR_1E = +22m.25s. or +25m.35s., LN = +58·6m.

Nov. 8d. Records also at 2h. (Mizusawa), 5h. and 7h. (Batavia), 12h. (Tokyo), 14h. (De Bilt), 16h. (Tokyo), 17h. (Algiers).

Nov. 9d. Records at 0h. (Washington and Ottawa), 3h. (San Fernando), 4h. (Dehra Dun), 5h. (Tokyo), 19h. and 20h. (Manila), 23h. (La Paz, San Fernando, and Rocca di Papa).

Nov. 10d. 15h. 11m. 40s. Epicentre 45°·0N. 11°·5E.

A = +·693, B = +·141, C = +·707; D = +·199, E = −·980; G = +·693, H = +·141, K = −·707.

The epicentre is apparently not the same as on November 6d. The residuals are not satisfactory, being chiefly positive; but it does not seem possible to alter T_0 or the epicentre without introducing other unsatisfactory features.

	Δ	Az.	P.	O−C.	S.	O−C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Pola	1·7	95	—	—	—	—	e 0·6	1·8
Milan	1·7	286	0 56	+30	1 31?	+43	—	—
Moncalieri	2·7	271	1 16	+34	1 58	?L	(2·0)	2·6
Zurich E.	3·1	322	e 1 21	+32	i 2 36	?L	(2·6)	3·5
Z.	3·1	322	1 21	+32	i 2 30	?L	(2·5)	3·0
Zagreb	3·3	74	e 1 9	+17	i 2 0	+29	—	2·6
Rocca di Papa	3·4	164	i 0 48	− 5	1 28	− 6	—	1·7
Graz	3·5	52	1 16	+21	2 37	?L	(2·6)	—
Monte Cassino	3·9	146	1 3	+ 2	—	—	—	2·3
Hohenheim	4·1	339	1 33	+29	2 50	?L	(2·8)	—
Besancon	4·4	303	1 32	+24	3 12	?L	(3·2)	—
Marseilles	4·7	251	i 1 34	+21	i 2 42	+33	—	3·2
Pompeii	4·8	151	1 25	+11	2 11	0	—	3·5
Budapest	5·8	62	3 20	?L	—	—	(3·3)	—
Paris	7·2	306	e 1 20	−29	e 2 46	−29	3·3	5·3
Uccle	7·5	323	2 19	+25	—	—	e 4·7	—
Barcelona	7·7	246	e 2 56	+59	—	—	e 3·2	6·2
De Bilt	8·2	332	3 5	+61	—	—	5·2	5·8
Tortosa	9·0	247	2 15	− 1	4 11	+ 8	4·6	6·5
Kew	10·1	314	—	—	—	—	—	8·3
Shide	10·3	308	—	—	—	—	5·7	—
Algiers	10·4	221	e 2 36	0	4 40	0	5·8	—

Continued on next page.

	Δ	Az.	P.	O−C.	S.	O−C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Athens	11·6	123	e 3 3	+10	4 44	−25	i 5·8	6·5
Bidston	12·7	317	—	—	—	—	—	9·8
Eskdalemuir	13·9	323	—	—	—	—	7·3	—
Edinburgh	14·3	325	8 20	?L	—	—	(8·3)	11·3
Rio Tinto	15·4	248	8 20	?L	—	—	(8·3)	12·3
Coimbra	15·4	258	3 57	+13	6 51	+10	9·3	9·9
San Fernando	15·9	244	5 50	+119	(7 20)	+27	—	10·3
Helwan	21·7	127	9 20	?S	(9 20)	+21	—	—
Ottawa	58·2	304	—	—	—	—	e 35·3	—

Additional records: Moncalieri gives M = +2·8m. Zagreb ePNW = +1m.11s., iPNE = +1m.17s., i = +1m.41s. Rocca di Papa iP = +0m.52s., ME = +1·8m. Barcelona MN = +8·1m. Athens iE = +5m.27s., iN = +5m.54s., MN = +7·5m. Bidston P = 15h.0m.12s. Coimbra MN = +9·7m. San Fernando MN = +10·1m.

Nov. 10d. 17h. 58m. 3s. Epicentre 34°·6N. 140°·7E.

A = −·637, B = +·521, C = +·568.

	Δ	Az.	P.	O−C.	S.	O−C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Tokyo	1·3	324	0 46	+26	1 11	+35	—	—
Osaka	4·3	272	1 5	− 2	—	—	1·9	2·9
Mizusawa	4·5	358	1 10	0	2 4	0	—	—
Kobe N.	4·6	272	e 1 21	+10	—	—	—	—
Nagasaki	9·2	263	4 13	?S	(4 8)	− 0	—	—
Zi-ka-wei	16·5	264	e 3 51	− 8	e 8 13	?L	(e 8·2)	—
Taihoku	19·2	245	—	—	11 50	?L	(11·8)	—
Kodaikanal	62·3	263	28 21	?L	—	—	(28·4)	—
La Paz	148·5	62	[20 6]	[+12]	—	—	—	—

Osaka gives MN = +2·8m., and Mizusawa SN = +2m.7s.

Nov. 10d. Records also at 8h. (Helwan), 9h. (Nagasaki and Zi-ka-wei), 13h. (Ottawa, Tacubaya, and Saskatoon), 16h. (Zi-ka-wei, Rocca di Papa, Zagreb, Manila, Colombo, Hokoto, and Taihoku), 17h. (Zagreb (2), Rocca di Papa, Kodaikanal, and Kobe), 18h. (Osaka, Hokoto, Mizusawa, Kodaikanal, Tokyo, Zi-ka-wei, and Taihoku), 19h. (Taihoku, Nagasaki, Zi-ka-wei, Rocca di Papa, and Zagreb), 20h. (Athens), 23h. (Helwan).

Nov. 11d. 7h. 3m. 0s. Epicentre 36°·1N. 137°·3E. (as on 1917 Feb. 21d. 15h.).

A = −·594, B = +·548, C = +·589; D = +·678, E = +·735;
G = −·433, H = +·400, K = −·808.

	Δ	Az.	P.	O−C.	S.	O−C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Tokyo	2·0	100	0 41	+10	1 8	+13	—	—
Osaka	2·1	218	—	—	0 54	− 4	1·7	2·1
Kobe	2·3	231	—	—	1 4	+ 1	1·8	1·9
Mizusawa E.	4·3	45	1 10	+ 3	2 6	+ 8	—	—
N.	4·3	45	1 11	+ 4	2 1	+ 3	—	—
Ootomari	11·3	19	2 53	+ 4	—	—	5·4	8·7
Zi-ka-wei	14·1	254	3 40	+13	e 6 40	+30	—	9·8
Manila	26·0	218	e 6 14	+26	e 10 12	−10	12·0	13·1
Bombay	58·7	272	—	—	—	—	—	39·6
Kodaikanal	59·8	262	41 18	?	—	—	—	—
Colombo	59·9	259	39 0	?L	—	—	(39·0)	—
Graz	81·9	325	e 13 0	+30	—	—	—	—
Edinburgh	82·1	339	44 0	?L	—	—	(44·0)	58·0
De Bilt	82·5	332	—	—	—	—	e 41·0	45·8
Eskdalemuir	82·6	339	—	—	—	—	44·0	—
Zagreb	82·6	322	—	—	—	—	42·0	53·0
Kew	84·9	336	—	—	—	—	—	53·0
Moncalieri	87·0	327	e 41 10	?	45 15	?	47·5	57·0
Rocca di Papa	87·2	321	e 12 4	−56	e 17 4	?PR$_1$	e 49·1	—
Barcelona	92·3	327	—	—	—	—	e 51·5	56·8
Ottawa	93·2	22	—	—	—	—	e 61·0	—
Toronto	93·5	25	—	—	—	—	54·4	—
Coimbra	97·5	333	e 46 0	?	—	—	54·4	—
Rio Tinto	98·9	331	55 0	?L	—	—	(55·0)	60·0
San Fernando	100·0	330	24 0	?S	(24 0)	−116	(55·0)	60·0
La Paz	150·1	56	20 9	[+13]	—	—	—	—

Additional records: Osaka gives MN = +1·9m. Kobe MN = +2·0m. Zi-ka-wei MN = +9·7m. Manila MN = +13·4m. Zagreb MNW = +48·0m. Paris (Δ = +86°·1) records 7h.5m. to 8h. Moncalieri probably records a different shock. Toronto L = +59·8m. San Fernando MN = +65·0m.

Nov. 11d. Records also at 2h. (Zagreb (3), Rocca di Papa (3), Zi-ka-wei, Tokyo, and Taihoku), 3h. (Zagreb and Rocca di Papa), 4h. (Zagreb, Rocca di Papa, Taihoku, Hokoto, and Manila), 11h. (Rocca di Papa and Zagreb), 13h. (Manila, Zi-ka-wei, Nagasaki, Tokyo, Mizusawa, and Osaka), 15h. (Mizusawa, Tokyo, Osaka, and Taihoku), 21h. (Manila).

Nov. 12d. 12h. 1m. 35s. Epicentre 18°·5N. 68°·8W.

A = +·343, B = −·884, C = +·317.

Possibly the epicentre is the same as at 21h., but the solution was made independently.

		Δ	Az.	P.	O−C.	S.	O−C.	L.	M.
		°	°	m. s.	s.	m. s.	s.	m.	m.
Vieques	N.	3·2	98	0 52	+ 2	—	—	1·3	1·5
	E.	3·2	98	0 49	− 1	—	—	1·2	1·5
Port au Prince		3·3	271	e 0 52	0	1 32	+ 1	1·8	2·2
La Paz		35·0	180	e 7 12	− 1	—	—	22·1	24·0
De Bilt		65·7	40	—	—	—	—	34·4	36·4

De Bilt gives eLN = +28·4m.

1918. Nov. 12d. 21h. 44m. 32s. Epicentre 18°·2N. 68°·2W.

A = +·353, B = −·882, C = +·312; D = −·929, E = −·371;
G = +·116, H = −·290, K = −·950.

The residuals would be improved by increasing T_0 by a few seconds—say 6sec.

Station and Component.		Machine.	Δ	Azimuth.	P.	O−C.	S.	O−C.	L.	M.
			°	°	M. S.	S.	M. S.	S.	M.	M.
Vieques	N.	B.O.	2·6	89	0 41	0	—	—	1·0	1·5
	E.	B.O.	2·6	89	0 43	+ 2	—	—	1·0	1·5
Port au Prince		B.O.	3·9	276	i 0 47	−14	1 5	−42	1·8	2·3
Balboa Hts.	E.	B.O.	14·4	232	3 30	− 2	—	—	6·5	7·0
	N.	B.O.	14·4	232	3 34	+ 2	—	—	6·8	6·7
Cheltenham	N.	B.O.	21·9	342	5 5	+ 1	9 10	+ 7	11·2	15·3
Georgetown	N.	—	22·1	341	i 5 15	+ 9	i 9 20	+13	e 11·3	—
Washington		Mar.	22·1	341	5 11	+ 5	9 16	+ 9	11·1	—
Harvard	N.	B.O.	24·3	355	i 5 8	−23	9 27	−23	e 11·2	—
	E.	B.O.	24·3	355	—	—	9 37	−13	e 11·0	13·4
Ithaca	N.	B.O.	25·3	345	e 5 41	0	10 9	0	12·2	—
	E.	B.O.	25·3	345	e 5 43	+ 2	10 7	− 2	11·9	—
Northfield		B.O.	26·2	353	6 6	+16	10 10	−13	13·5	—
Toronto		M.	27·1	342	6 22	+23	11 4	+21	13·3	20·7
Ann Arbor	E.	B.	27·5	335	6 22	+19	10 46	− 4	13·2	18·5
	N.	B.	27·5	335	6 28	+25	10 48	− 4	13·1	—
Ottawa		—	27·9	349	e 6 13	+ 6	e 10 47	−10	e 13·5	—
St. Louis		W.	28·0	321	e 6 10	+ 2	11 16	+17	13·8	—
Lawrence	N.	W.	31·4	317	6 37	− 5	—	—	16·0	—
	E.	W.	31·4	317	6 40	− 2	—	—	18·4	22·2
La Paz		Bi.	34·7	179	i 7 8	− 3	i 12 36	−15	19·7	22·5
La Quiaca	E.	M.	40·4	177	5 28	−150	(13 52)	−21	13·9	33·3
	N.	M.	40·4	177	5 52	−126	(13 58)	−15	14·0	23·3
Tucson	E.	B.O.	40·8	299	9 48	?PR_1	—	—	28·1	30·6
Andalgala	E.	M.	45·8	178	—	—	—	—	28·3	30·1
	N.	M.	45·8	178	—	—	—	—	28·8	32·0
Pilar	E.	M.	50·0	175	—	—	—	—	31·1	36·9
Berkeley		—	50·8	304	e 10 33	+81	—	—	—	—
Chacarita		M.	53·6	170	—	—	—	—	33·6	34·6
Victoria		M.	53·6	317	9 42	+12	17 36	+32	28·3	35·9
Rio Tinto		M.	56·7	54	16 28	?S	(16 28)	−74	—	37·5
San Fernando		—	57·1	56	17 16	?S	(17 16)	−31	31·0	35·0
Eskdalemuir		G.	60·9	35	10 21	+ 3	18 27	− 8	—	33·2
Edinburgh		M.	61·1	35	9 48	−32	—	—	—	39·5

Continued on next page.

Station and Component.	Machine.	Δ	Azimuth.	P.	O−C.	S.	O−C.	L.	M.
		°	°	M. S.	s.	M. S.	s.	M.	M.
Shide	M.S.	61·5	41	18 41	?S	(18 41)	− 1	—	36·5
Kew	M.	62·2	40	—	—	—	—	—	41·5
Tortosa	—	62·3	53	10 36	+ 9	18 55	+ 3	26·2	33·0
Barcelona	—	63·5	50	e 10 49	+14	19 8?	+ 1	26·0	32·8
Algiers	B.M.	64·5	57	e 10 40	− 2	19 14	− 5	26·5	32·5
Uccle	—	65·0	40	e 10 45	0	e 20 16	+51	e 26·5	37·5
De Bilt E.	—	65·6	39	10 52	+ 3	19 31	− 1	e 30·5	35·5
N.	—	65·6	39	—	—	—	—	e 28·5	32·3
Moncalieri	S.	67·4	46	11 2	+ 2	i 19 56	+ 1	34·8	43·6
Zurich	—	67·9	44	e 11 6	+ 3	—	—	—	—
Hohenheim	B.O.	68·3	42	e 10 41	−25	—	—	—	—
Rocca di Papa	Ag.	71·4	49	e 11 24	− 2	—	—	—	11·9
Pompeii	O.A.	72·8	50	11 50	+15	21 24	+24	35·6	40·6
Zagreb	W.	73·1	44	e 11 40	+ 3	e 20 58	− 5	38·5	46·5
Honolulu	M.	83·4	290	e 13 58	+80	—	—	41·3	51·8
Helwan	M.	88·9	58	13 28	+18	—	—	—	59·7
Zi-ka-wei	—	129·8	349	e 22 45	?PR_1	—	—	—	—
Kodaikanal	M.	135·7	53	83 46	?L	—	—	(83·8)	—
Riverview	—	141·6	239	—	—	e 35 18	+245	e 72·8	78·0
Manila	W.	146·0	345	e 20 6	[+16]	—	—	—	—

Additional records: Port au Prince gives SNE = +52s. Cheltenham PE = +5m.4s., T_0 = 21h.44m.30s. Georgetown iSE = +9m.28s. Harvard iPR_1 = +5m.20s., ePRE = +5m.37s., T_0 = 21h.44m.24s. Toronto L = +15·5m. and eL = +16·6m., T_0 = 21h.45m.0s. Ottawa L = +20·5m., and +37·5m., T_0 = 21h.45m.0s. La Paz P = +7m.5s., T_0 = 21h.44m.39s. Pilar MN = +34·9m. San Fernando MN = +34·0m. De Bilt i = +11m.7s., eSR_1E = +23m.46s., T_0 = 21h.44m.46s. Zagreb MNW = +44·5m.

Nov. 12d. Records also at 0h. (San Fernando), 3h. (Helwan), 4h. (Tokyo), 5h. (Helwan), 11h. (Zurich, Rocca di Papa, Zagreb, Pompeii, and La Paz), 13h. (Zagreb (2), Rocca di Papa (2), Zurich, Tokyo, and Osaka), 15h. (Tokyo), 18h. (Osaka and Tokyo), 19h. (Bidston and Zagreb), 22h. (Melbourne), 23h. (La Paz).

Nov. 13d. 10h. 13m. 27s. Epicentre 37°·5N. 27°·5E.

A = +·704, B = +·366, C = +·609; D = +·462, E = −·887; G = +·540, H = +·281, K = −·793.

In some ways 39°·0N. 27°·0E., the epicentre of 1918 June 13d. and 19d., would suit the observations better.

	Δ	Az.	P.	O−C.	S.	O−C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Athens	3·0	278	e 0 47	0	e 1 23	0	i 1·7	2·0
Pompeii	10·5	294	2 39	+ 2	5 9	?L	13·6	—
Budapest	11·7	331	3 33	+38	—	—	—	—
Zagreb	11·9	318	e 3 15	+17	5 24	+ 7	—	6·6
Rocca di Papa	12·1	295	e 2 45	−15	6 12	?L	e 8·6	3·8
Lemberg	12·6	350	—	—	—	—	e 6·8	7·6
Moncalieri	16·6	303	e 4 29	+29	7 9	0	9·7	—
Uccle	21·1	316	—	—	—	—	e 11·2	11·6
Paris	21·3	310	—	—	e 8 38	−12	11·6	15·6
De Bilt	21·4	320	—	—	e 8 28	−25	e 10·4	11·7
Bidston	26·4	318	1 15	?	8 21	−129	—	20·0
Edinburgh	27·5	322	15 3	?L	—	—	(15·0)	—

Additional records: Zagreb gives MNW = +7·0m. Rocca di Papa M_2 = +8·0m. Eskdalemuir (Δ = 27°·3) records +9m.33s. to +30m.33s.

Nov. 13d. Records also at 0h. (San Fernando), 2h. (Tokyo (2)), 2h., 6h., and 9h. (Helwan), 20h. (Zurich), 21h. (Riverview and Melbourne), 22h. (San Fernando).

Nov. 14d. 12h. 52m. 35s. Epicentre 1°·3S. 143°·4E. (as on 1918 July 29d. 16h.).

A = −·803, B = +·596, C = −·023; D = +·596, E = +·803; G = +·018, H = −·014, K = −1·000.

Probably the Adelaide records are 10 minutes in error; but the solution is unsatisfactory because it leaves unexplained the absence of Japanese and Indian observations, and the European records are too large. If we put the epicentre south of Australia (say at 66°·0S. 145°·0E) the La Paz observation cannot be explained, though the European records are then in better accord.

		Δ	Az.	P.	O−C.	S.	O−C.	L.	M.
		°	°	m. s.	s.	m. s.	s.	m.	m.
Riverview		33·3	168	e 7 1?	+ 2	e 12 9?	−20	e 16·7	20·8
Sydney		33·3	168	11 37	?S	(11 37)	−52	18·9	20·8
Adelaide		33·9	187	17 10	?	21 50	?	25·9	29·1
Melbourne		36·5	178	—	—	—	—	22·8	24·7
Helwan		109·8	301	51 25	?L	—	—	(51·4)	—
De Bilt	E.	118·5	332	—	—	—	—	e 88·4	e 91·6
	N.	118·5	332	—	—	—	—	e 89·4	98·4
Edinburgh		119·1	340	70 25	?L	—	—	(70·4)	—
Bidston		121·0	337	—	—	—	—	—	(107·4)
Kew		121·3	334	—	—	—	—	—	(112·4)
La Paz		144·1	122	19 44	[− 3]	—	—	—	—

Additional records: Riverview gives +12m.38s. and MN = +19·1m. Adelaide PR$_1$ = +19m.0s., SR$_1$ = +23m.35s. Eskdalemuir (Δ = 119°·6) records 14h.14m. to 15h.0m.

Nov. 14d. 16h. 6m. 50s. Epicentre 47°·0N. 158°·0E.

A = −·632, B = +·256, C = +·731; D = +·375, E = +·927. G = −·678, H = +·274, K = −·682.

	Δ	Az.	P.	O−C.	S.	O−C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Osaka	20·8	242	4 46	− 5	—	—	—	11·3
Honolulu	43·7	111	e 15 16	?S	(e 15 16)	+18	26·5	30·2
Edinburgh	75·9	351	37 10	?L	—	—	(37·2)	65·7
Eskdalemuir	76·4	351	21 43	?S	(21 43)	+ 1	35·2	—
De Bilt	78·2	345	—	—	e 21 58	− 4	41·2	42·4
Uccle	79·6	345	—	—	—	—	—	48·2
Zagreb	81·3	334	—	—	—	—	39·2	—
Paris	81·8	346	—	—	—	—	e 47·2	54·2
Rocca di Papa	86·0	337	e 36 22	?	—	—	—	59·4
Barcelona	89·0	342	—	—	—	—	e 47·0	55·0
Helwan	89·3	317	50 10	?L	—	—	(50·2)	—

Additional records: Osaka MN = +11·8m. De Bilt eSR$_1$N = +27m.33s. Paris MN = +57·2m.

Nov. 14d. Records also at 0h. (Port au Prince), 2h. (Helwan), 8h. (Helwan and La Paz), 10h. (Riverview), 18h. (Helwan), 21h. (San Fernando).

Nov. 15d. Records at 1h. (De Bilt), 3h. and 9h. (Helwan), 12h. (De Bilt), 15h. (Melbourne and Riverview), 16h. (De Bilt and Ootomari), 18h. (De Bilt).

Nov. 16d. 5h. 56m. 30s. Epicentre 12°·0N. 95°·5W. (as on 1918 Nov. 5d.).

A = −·094, B = −·974, C = +·208; D = −·995, E = +·096; G = −·020, H = −·207, K = −·978.

		Δ	Az.	P.	O−C.	S.	O−C.	L.	M.
		°	°	m. s.	s.	m. s.	s.	m.	m.
Tucson	E.	24·7	328	9 39	?S	(9 39)	−18	14·8	15·7
Toronto		34·5	21	—	—	—	—	18·3	—
Ottawa		37·4	23	—	—	—	—	e 18·5	—
La Paz		39·3	136	8 19	+30	—	—	26·9	32·0
Victoria		43·2	333	17 34	?SR$_1$	—	—	22·5	24·0
Eskdalemuir		81·4	34	38 30	?L	—	—	(38·5)	—
Uccle		86·8	39	e 13 0	+ 2	—	—	—	—
De Bilt		87·0	37	—	—	e 23 33	− 8	e 40·5	49·7

Additional records: Tucson gives SE = +12m.42s. (=LE?), SN = +12m.40s. (=LN?), MN = +15·2m. De Bilt eLN = +42·5m.

Nov. 16d. Records also at 4h. (San Fernando), 5h. (Mizusawa), 16h. (San Fernando), 17h. (De Bilt and Tacubaya), 19h. (Taihoku and Zi-ka-wei), 21h. (Mizusawa and Tokyo), 22h. (De Bilt), 23h. (De Bilt (2)).

Nov. 17d. Records at 9h. and 16h. (La Paz), 20h. (Mizusawa (2)), 22h. (St. Louis and La Paz), 23h. (Edinburgh).

1918. Nov. 18d. 18h. 41m. 45s. Epicentre 8°·0S. 127°·5E.

A = −·603, B = +·786, C = −·139; D = +·793, E = +·609; G = +·085, H = −·110, K = −·990.

Direct comparison of the records of this earthquake with that of Nov. 23d. 22h. suggests that they have the same origin. A focal depth 0·030 below normal has therefore been assumed, as also for the same epicentre on Nov. 23d. 22h., though the evidence of the anticentric stations is not clear. The residuals suggest that the epicentre is further east, say at 129°·0, but the material is not quite good enough to give a secure determination.

Station and Component.	Machine.	Corr. for Focus	Δ	Azimuth.	P.	O—C.	S.	O—C.	L.	M.
		°	°	°	M. S.	S.	M. S.	S.	M.	M.
Batavia	W.	−1·2	20·6	274	i 4 55	+21	i 8 54	+44	—	10·2
Manila	W.	−1·5	23·5	344	i 5 1	− 4	—	—	5·4	6·4
Perth	M.	−1·7	26·3	203	(5 46)	+12	5 46	? P	10·0	10·9
Adelaide	M.	−1·9	28·8	161	5 55	− 2	11 5	+26	13·8	15·9
Hokoto	O.	−2·2	33·2	10	5 53	−45	—	—	—	—
Taihoku	O.	−2·2	33·5	350	5 28	−73	8 20	−216	10·8	16·5
Melbourne	M.	−2·2	33·7	156	i 6 33	−10	11 33	−27	14·4	16·1
Riverview	W.	−2·2	33·8	142	e 6 29	−14	i 11 44	−17	e 14·2	15·6
Sydney E.	M.	−2·2	33·9	142	6 21	−23	12 9	+ 6	17·0	19·4
Zi-ka-wei	—	−2·5	39·6	352	i 7 21	−10	12 55	−30	16·6	17·6
Kobe	O.	−2·7	43·2	10	7 48	−11	—	—	17·4	19·7
Osaka	O.	−2·7	43·3	10	7 57	− 3	14 6	− 9	20·7	22·5
Tokyo	O.	−2·8	45·1	14	8 1	−12	10 3	−276	14·4	—
Mizusawa E.	O.	−3·0	48·8	15	8 31	− 8	15 19	− 6	—	—
N.	O.	−3·0	48·8	15	8 30	− 9	15 7	−18	—	—
Calcutta E.	O.	−3·1	49·0	310	8 51	+12	15 51	+24	22·8	29·3
Colombo	M.	−3·1	49·8	286	8 33	−12	(15 3)	−34	15·0	36·8
Kodaikanal	M.	−3·3	53·1	290	8 51	−15	(16 51)	+35	16·8	32·2
Ootomari	O.	−3·4	56·3	13	10 33	+68	18 3	+68	24·0	28·9
Apia	W.	−3·6	59·8	101	i 9 52	+ 5	i 17 15	−21	29·2	—
Bombay	O.E.	−3·6	60·2	299	10 21	+31	—	—	—	36·6
Dehra Dun	O.	−3·6	61·0	312	10 15	+20	—	—	—	—
Simla	O.E.	−3·6	62·0	312	9 39	−22	17 57	− 7	e 28·8	30·2
Mauritius N.	M.	−3·8	68·2	252	10 33	− 8	(20 15)	+57	20·2	41·7
E.	M.	−3·8	68·2	252	10 21	−20	(20 15)	+57	20·2	42·2
Honolulu	M.	−4·0	78·7	68	12 3	+16	21 3	−19	35·2	46·3
Helwan	M.	−4·4	99·4	300	13 45	+ 2	17 57	? PR_1	—	66·0
Sitka	B.O.	−4·4	100·6	35	e 17 20	? PR_1	23 37	−91	e 31·7	31·9
Cape Town	M.	−4·4	101·0	234	13 33	−19	24 3	−79	32·0	32·8
Lemberg	B.O.	−4·5	104·8	320	e 14 15	+ 3	i 24 47	−72	e 58·9	65·2
Athens	—	−4·5	106·2	308	e 13 9	−70	i 24 42	−90	46·2	55·1
Budapest	—	−4·6	108·4	317	15 3	+34	28 15	+104	—	—
Victoria	M.	−4·6	108·9	41	13 29	−62	17 55	?	26·3	62·6
Z.	—	−4·6	108·9	41	—	—	18 33	?	25·9	62·8
Zagreb	W.	−4·6	110·7	315	e 14 30	−10	i 26 41	−12	60·2	65·2
Graz	W.	−4·6	110·8	318	14 32	− 8	28 47	+113	—	—
Berkeley Z.	—	−4·6	110·8	50	e 14 22	−18	e 28 8?	+74	—	—
Lick	W.	−4·6	111·4	51	18 59	? PR_1	—	—	—	—
Pola	W.	−4·6	112·6	315	i 19 8	? PR_1	i 25 13	−117	i 28·9	68·4
Pompeii	O.A.	−4·6	112·7	310	e 18 56	? PR_1	e 24 21?	−170	44·2	54·2
Rocca di Papa	Ag.	−4·7	113·8	311	18 6	[−27]	24 39	−161	e 51·7	71·2
Hohenheim	B.O.	−4·7	114·4	320	19 38	? PR_1	30 3	+158	—	—
Zurich	—	−4·7	115·4	317	18 40	[+ 1]	i 25 23	−131	—	—
De Bilt	G.	−4·7	115·8	322	14 55	− 8	e 29 11	+93	e 59·2	60·8
Moncalieri	S.	−4·7	116·6	316	15 0	− 7	i 29 45	+120	47·5	73·9
Uccle	G.	−4·7	116·7	321	e 15 0	− 7	—	—	e 55·2	62·2
Besançon	—	−4·7	117·2	317	19 58	? PR_1	29 32	+102	—	—
Dyce	Ma.	−4·8	117·6	330	20 6	? PR_1	i 29 36	+104	59·1	60·7
Edinburgh	M.	−4·8	118·6	329	15 15	0	—	—	—	85·2
Paris	G.	−4·8	118·6	320	e 18 48	[− 3]	i 25 35	−145	56·2	63·2

Continued on next page.

Station and Component.	Machine.	Corr. for Focus	Δ	Azimuth.	P.	O−C.	S.	O−C.	L.	M.
		°	°	°	M. S.	S.	M. S.	S.	M.	M.
Eskdalemuir	G.	−4·8	118·8	329	15 4	−12	29 49	+107	—	—
Marseilles	Ma.	−4·8	118·9	313	i 20 6	? PR_1	i 29 55	+112	67·2	—
Kew	M.	−4·8	119·1	323	19 15	? PR_1	—	—	—	38·2
Oxford	M.S.	−4·8	119·6	323	15 8	−11	(38 15)	?	—	—
West Bromwich	M.S.	−4·8	119·6	324	20 14	? PR_1	—	—	—	—
Bidston	M.S.	−4·8	119.7	325	19 27	? PR_1	25 33	−156	—	80·2
Shide	M.S.	−4·8	120·1	321	15 16	−26	30 5	+113	60·6	67·9
Tucson E.	B.O.	−4·8	120·8	54	20 6	? PR_1	27 2	−76	54·2	69·2
Barcelona	—	−4·8	121·4	313	e 18 51	[− 5]	30 17	+114	53·7	76·2
Tortosa	—	−4·9	122·8	313	18 56	[− 4]	31 50	?	52·5	71·3
Rio Tinto	M.	−5·0	129·1	312	22 15	? PR_1	—	—	—	38·2
San Fernando	—	−5·0	129·2	311	18 57	[−19]	—	—	—	—
Lawrence	W.	−5·0	130·7	42	e 19 2	[−18]	21 9?	? PR_1	22·3	22·5
St. Louis	W.	—	134·3	40	—	—	i 22 36	? PR_1	—	—
Ann Arbor E.	B.	—	135·9	32	19 3	[−29]	—	—	58·2	64·2
Chacarita	M.	—	137·0	173	46 15	?[L]	—	—	66·0	88·0
Toronto	M.	—	137·3	30	18 15	+75	i 23 3	? PR_1	i 65·8	85·0
Ottawa	—	—	137·6	25	i 19 16	[−19]	i 22 47	? PR_1	e 68·2	—
Pilar E.	M.	—	138·9	168	23 3	? PR_1	(46 27)	?[L]	76·0	95·0
N.	M.	—	138·9	168	22 51	? PR_1	(46 57)	?[L]	76·0	77·0
Ithaca E.	B.O.	—	139·6	27	e 20 24	[+45]	e 32 22	+80	e 56·9	—
N.	B.O.	—	139·6	27	e 20 22	[+43]	e 32 59	+117	—	—
Northfield	B.O.	—	139·8	21	19 14	[−25]	22 53	? PR_1	55·2	—
Andalgala E.	M.	—	141·7	160	20 27	[−15]	—	—	80·4	83·5
N.	—	—	141·7	160	20 3	[−39]	—	—	78·9	82·0
Harvard E.	B.O.	—	141·9	22	i 17 50	+31	—	—	—	—
N.	B.O.	—	141·9	22	e 19 1	[−42]	i 31 33	+19	e 69·3	72·3
Washington	Mar.	—	142·0	31	19 15	[−28]	—	—	62·2	—
Georgetown E.	—	—	142·0	31	19 23	[−20]	32 10?	+55	61·0	—
N.	—	—	142·0	31	19 23	[−20]	32 25	+70	62·2	—
Cheltenham N.	B.O.	—	142·2	31	19 22	[−21]	23 8	? PR_1	33·2	63·6
La Quiaca E.	M.	—	147·6	158	15 27	−134	—	—	—	54·6
La Paz	Bi.	—	151·0	149	19 50	[− 7]	33 55	?	71·1	78·6
Balboa Hts. E.	B.O.	—	153·2	86	19 43	[−17]	—	—	42·5?	—
N.	B.O.	—	153·2	86	19 51	[− 9]	—	—	42·9?	43·0
Vieques E.	B.O.	—	163·8	50	20 40	[+29]	—	—	65·4	81·4
N.	B.O.	—	163·8	50	20 5	[− 6]	—	—	76·2	83·4

Additional records: Batavia ML = +46·2m., T_0 = 18h.41m.39s. Manila MN = +6·0m., T_0 = 18h.40m.46s. But the Manila records probably refer to another shock at about 14°·8N. 124°·5E. (as in the U.S. Weather Bureau, Philippine Catalogue), with T_0 = 18h.45m.0s., and the Taihoku records seem also to refer to this shock. Adelaide PR_1 = +7m.45s. Riverview iP = +6m.31s., i = +6m.49s., PR_1 = +8m.4s., PS = +12m.14s., T_0 = 18h.41m.55s. Sydney SR_1 = +13m.39s. Zi-ka-wei PSE = +13m.21s., PSN = +13m.49s., SR_1E = +14m.44s., SR_2E = +15m.37s., SRN = +15m.43s., SR_2E = +16m.11s., MN = +25·4m. Apia i_1 = +18m.15s., i_3 = +19m.45s., i_3 = +21m.33s., i_4 = +24m.33s. Sitka ePE = +17m.33s., ME = +27·1m. Lemberg ME = +18·8m. and +25·0m. Athens ePE = +13m.13s., MN = +53·2m., T_0 = 18h.41m.14s. Zagreb iPR_1 = +19m.11s., iNE = +24m.54s., i = +26m.8s., e = +44m.15s., T_0 = 18h.41m.52s. Berkeley eSE = +28m.3s. Pola MN = +62·1m. Pompeii L = +50·2m. Rocca di Papa MN = +63·2m. De Bilt iPR_1E = +19m.48s., iPR_1N = +19m.50s., iE = +22m.19s., i = +25m.24s. Epicentre 10°·0S. 130°·0E. Moncalieri i = +19m.42s., MN = +76·6m. Uccle iPR_1 = +18m.40s., e_1 = +19m.45s., i_1 = +22m.15s. Dyce i = +25m.38s., i = +31m.6s. Paris i = +20m.8s., SR_1 = +30m.2s. Eskdalemuir PR_1 = +20m.0s., PR_2 = +25m.32s. Oxford PR_1 = +20m.15s. Shide PR_1 = +20m.19s. Tucson PN = +20m.35s. Barcelona i = +20m.26s., PR_2? = +25m.43s. Lawrence ePN = +19m.4s.? Ann Arbor SN = +19m.9s., MN = +70·2m. Toronto eL = +33·4m., +81·0m. and 124·2m., M = 42·5m. Ottawa i = +21m.55s., E? = +41m.33s., eL = +57·2m. Ithaca iN = +24m.7s., iE = +24m.8s. Harvard PR_1E = +19m.33s., PR_1N = +19m.45s., PR_1N = +22m.40s., PR_1E = +23m.16s., SR_1 = +41m.20s., SR_2 = +47m.31s., T_0 = 18h.41m.55s. Washington PR_1 = +22m.20s. Georgetown iN = +22m.59s., iE = +23m.3s., and +40m.43s. Cheltenham PE = +19m.15s., SE = +23m.5s. La Quiaca PN = +15m.21s., MN = +90·7m. La Paz iPN = +19m.51s., PR_1N = +23m.36s., SR_1N = +39m.46s., LN = +67·2m.

Nov. 18d. Records also at 1h. (Manila), 3h. (Taihoku and Zi-ka-wei), 4h. (De Bilt), 6h. (Athens), 8h. (Edinburgh), 9h. (Mizusawa), 11h. (Tokyo), 13h. (Taihoku, Algiers, and Mizusawa), 15h. (Zurich), 17h. (Ascension), 18h. (Coimbra), 19h. (Pompeii), 21h. (Zi-ka-wei), 22h. (De Bilt).

Nov. 19d. Records at 1h. (Batavia), 4h. (Batavia), 5h. (Batavia, Tokyo, Helwan, Zi-ka-wei and Manila), 6h. (Colombo), 7h. (Paris), 8h. (Manila), 20h. (Batavia), 21h. (Tokyo).

Nov. 20d. 7h. 33m. 0s. Epicentre 40°·0N. 20°·0E. (as on 1917 Oct. 18d.).

$A = +\cdot720$, $B = +\cdot262$, $C = +\cdot643$; $D = +\cdot342$, $E = -\cdot940$; $G = +\cdot604$, $H = +\cdot220$, $K = -\cdot766$.

		Δ	Az.	P.	O−C.	S.	O−C.	L.	M.
		°	°	m. s.	s.	m. s.	s.	m.	m.
Athens		3·6	123	e 0 55	− 1	1 37	− 2	1·8	2·2
Rocca di Papa		5·8	291	e 1 41	+11	—	—	—	4·3
Zagreb		6·5	335	e 1 43	+ 4	i 3 6	+ 9	3·7	4·2
Budapest		7·5	355	e 2 30	+36	—	—	—	—
Graz		7·8	344	e 2 16	+18	—	—	—	—
Moncalieri		10·3	303	—	—	—	—	6·8	—
De Bilt	E.	15·8	325	—	—	—	—	e 9·5	12·9
	N.	15·8	325	—	—	—	—	e 9·2	11·1
Edinburgh		22·0	333	4 30	−35	—	—	—	—

Additional records: Athens gives iP = +1m.3s., M = +2·0m., MN = +2·5m., T_0 = 7h.33m.3s. Zagreb eNE = +1m.56s., i = +2m.21s., +2m.50s., and +3m.20s.

Nov. 20d. Records also at 0h. (Tokyo), 1h. (La Paz and Manila), 4h. (Helwan), 5h. (San Fernando), 6h. (Victoria), 8h. (Pompeii), 16h. (Lick).

Nov. 21d. Records at 0h. (Zi-ka-wei and Manila), 1h. (Osaka, Batavia, Helwan, De Bilt, and Eskdalemuir), 3h. (Manila (2)), 6h. (Mizusawa), 7h. (Rio Tinto, San Fernando, and Vieques), 9h. (Tokyo), 16h. (Simla and La Paz). 18h. (Lick), 21h. (Taihoku (2)), 22h. (La Paz), 23h. (Helwan and San Fernando).

1918. Nov. 22d. 15h. 48m. 30s. Epicentre 46°·5N. 151°·4E.

(as on 1918 Sept. 8d.).

A = −·604, B = +·330, C = +·725; D = +·479, E = +·878; G = −·637, H = +·347, K = −·688.

Station and Component.	Machine.	Δ	Azimuth.	P.	O−C.	S.	O−C.	L.	M.
		°	°	M. S.	S.	M. S.	S.	M.	M.
Ootomari	O.	5·9	285	2 0	+29	--	—	3·6	4·5
Mizusawa E.	O.	10·5	229	2 49	+12	4 52	+ 9	—	—
N.	O.	10·5	229	2 54	+17	4 47	+ 4	—	—
Osaka	O.	16·8	231	3 33	−29	—	—	8·0	10·6
Zi-ka-wei	—	27·6	247	e 6 10	+ 6	e 10 54	+ 2	—	—
Taihoku	O.	32·0	238	—	—	12 17	+ 9	—	—
Manila	W.	40·8	229	e 7 50	−11	—	—	—	—
Honolulu	M.	47·9	104	14 54	?S	(14 54)	−59	26·5	30·7
Victoria	M.	54·6	54	16 30	?S	(16 30)	−46	--	41·0
Bombay	O.E.	68·7	275	36 33	?L	—	—	(36·6)	44·9
Kodaikanal	M.	71·6	265	47 36	?L	—	—	(47·6)	--
Colombo	M.	72·3	261	48 30	?L	—	—	(48·5)	54·5
Edinburgh	M.	75·4	346	21 30	?S	(21 30)	0	—	65·5
Eskdalemuir	G.	75·9	345	12 3	+ 9	21 47	+11	37·5	—
De Bilt	—	77·3	340	12 8	+ 5	22 0	+ 8	e 35·5	37·1
Bidston	M.S.	77·7	345	21 48	?S	(21 48)	− 9	—	54·5
Uccle	—	78·9	340	e 11 6	−66	—	—	e 42·5	48·5
Kew	M.	79·0	342	—	—	—	—	—	49·5
Ottawa	—	79·2	32	—	—	e 42 30	?L	e 49·5	—
Toronto	M.	79·3	35	—	—	—	—	45·0	55·0
Zagreb	W.	79·7	330	e 12 19	+ 2	e 22 12	− 8	45·5	53·5
Shide	M.S.	79·9	343	18 43	?	—	—	43·2	--
Paris	—	80·9	340	—	—	—	—	e 44·5	54·5
Hohenheim	—	82·1	336	—	--	—	—	54·2	--
Moncalieri	S.	83·1	335	e 12 43?	+ 6	23 2?	+ 4	39·8	53·2
Georgetown	—	84·2	36	e 41 30	?L	—	--	(e 41·5)	—
Rocca di Papa	Ag.	84·4	330	e 46 5	?L	--	—	54·6	59·0
Helwan	M.	86·4	311	23 30	?S	(23 30)	− 4	—	—
Barcelona	—	87·9	337	—	--	—	—	e 47·9	56·5
San Fernando	—	94·7	342	56 30	?L	—	—	(56·5)	64·5
La Paz	Bi.	135·7	61	e 19 44	[+13]	—	—	75·5	82·2
Cape Town	M.	142·5	273	49 48	?	—	—	—	92·8

Additional records: Ootomari gives MN = +4·2m. Osaka MN = +12·3m. De Bilt eSR_1N = +27m.34s., eLN = +41·5m., T_0 = 15h.48m.44s. Bidston S = +29m.30s. ($?SR_1$). Ottawa L = +55·5m. Toronto L = +49·1m. Zagreb MNW = +51·5m., T_0 = 15h.48m.54s. Moncalieri MN = +50·4m., T_0 = 15h.48m.52s. Georgetown eLN? = +49·9m., eLE? = +49·5m. San Fernando MN = +62·0m. La Paz iP = +22m.59s. ($?PR_1$).

Nov. 22d. Records also at 13h. (Pompeii), 18h. (Zi-ka-wei and Barcelona), 21h. (Taihoku and Helwan), 22h. (Manila, La Paz, and Batavia).

1918. Nov. 23d. 22h. 57m. 45s. Epicentre **8°·0S. 127°·5E.**
(as on 1918 Nov. 18d. 18h.).

A = −·603, B = +·786, C = −·139; D = +·793, E = +·609;
G = +·085, H = −·110, K = −·990.

A focal depth 0·030 has been assumed.

Station and Component.	Machine.	Corr. for Focus	Δ	Azimuth.	P.	O—C.	S.	O—C.	L.	M.
		°	°	°	M. S.	S.	M. S.	S.	M.	M.
Batavia	W.	−1·2	20·6	274	i 5 56	+82	—	—	—	11·2
Milan	Ag.	−1·5	23·5	344	5 1	− 4	i 8 9	−56	i 9·2	9·2
Perth	M.	−1·7	26·3	203	6 28	+50	10 25	+30	10·4	—
Adelaide	M.	−1·9	28·8	161	6 7	+10	10 37	− 2	13·8	16·4
Taihoku	O.	−2·2	33·5	350	7 25	+44	—	—	11·5	14·8
Melbourne	M.	−2·2	33·7	156	6 27	−16	11 51?	− 9	—	—
Riverview	—	−2·2	33·8	142	i 6 41	− 2	i 11 56	− 5	13·2	18·0
Sydney E.	M.	−2·2	33·9	142	4 51	−113	12 3	0	18·2	19·0
Kobe	O.	−2·7	43·2	10	6 48	−79	—	—	13·0	16·2
Osaka	O.	−2·7	43·3	10	7 57	− 3	—	—	13·9	17·4
Tokyo	O.	−2·8	45·1	14	8 18	+ 5	14 9	−30	16·2	—
Mizusawa E.	O.	−3·0	48·8	15	8 26	−13	15 2	−23	—	—
N.	O.	−3·0	48·8	15	8 29	−10	15 5	−20	—	—
Calcutta	O.E.	−3·1	49·0	310	8 51	+12	15 51	+24	21·6	—
Colombo	M.	−3·1	49·8	286	8 9	−36	10 33	? PR_1	16·0	31·8
Kodaikanal	M.	−3·3	53·1	290	8 51	−15	—	—	12·2	37·4
Ootomari	O.	−3·5	56·3	13	63 31	?	—	—	70·8	72·1
Apia	W.	−3·6	59·8	101	9 55	+ 8	17 51	+15	25·8	—
Simla	O.E.	−3·6	62·0	312	9 45	−16	17 57	− 7	29·0	29·8
Mauritius	M.	−3·8	68·2	252	11 27	+46	(19 3)	−15	19·0	36·0
Honolulu	M.	−4·0	78·7	68	e 12 39	+52	21 33	+11	36·0	48·4
Helwan	M.	−4·4	99·4	300	14 3	+20	18 27	? PR_1	—	63·6
Cape Town	M.	−4·4	101·0	234	24 9	? S	(24 9)	−73	—	60·0
Victoria	M.	−4·6	108·9	41	23 51	? S	32 42	? SR_1	44·0	69·1
Zagreb	W.	−4·8	110·7	315	e 14 22	−18	i 26 33	−20	62·2	70·2
Berkeley	—	−4·6	110·8	50	—	—	e 24 42	−132	—	—
Rocca di Papa	Ag.	−4·7	113·8	311	e 18 39	? PR_1	—	—	—	75·4
De Bilt E.	—	−4·7	115·8	322	(25 17)	?	i 26 31	−67	e 59·2	59·8
N.	—	−4·7	115·8	322	(19 50)	? PR_1	e 27 8	−30	e 58·2	60·2
Moncalieri	S.	−4·7	116·6	316	18 45	[+ 2]	28 39	+54	47·0	68·3
Uccle	—	−4·7	116·7	321	e 17 33	+146	e 26 15	−91	e 46·2	60·2
Edinburgh	M.	−4·8	118·6	329	16 15	+60	—	—	—	—
Eskdalemuir	G.	−4·8	118·8	329	20 7	? PR_1	30 43	+161	49·2	61·1
Kew	M.	−4·8	119·1	323	—	—	—	—	—	68·2
Stonyhurst	M.	−4·8	119·2	325	i 19 57	? PR_1	i 30 39	+154	—	72·4
Bidston	M.S.	−4·8	119·7	325	19 15	[+24]	29 45	+96	—	64·2
Shide	M.S.	−4·8	120·1	321	19 56	? PR_1	26 54	−78	43·4	67·7
Barcelona	—	−4·8	121·4	313	e 20 3	? PR_1	31 16	+173	e 50·3	67·9
Algiers	B.M.	−4·8	122·1	308	20 29	? PR_1	31 25	+177	56·2	74·2
Tortosa	—	−4·9	122·8	313	18 55	[− 6]	—	—	51·4	64·5
Rio Tinto	M.	−5·0	129·1	312	25 15	?	—	—	—	31·2
San Fernando	—	−5·0	129·2	311	23 15	?	—	—	76·2	82·2
Coimbra	—	−5·0	129·3	316	21 20	? PR_1	31 24	+123	e 52·8	67·8
Toronto	M.	—	137·3	30	27 57	?	38 33	? SR_1	e 80·2	84·8
Ottawa	—	—	137·6	25	i 22 35	? PR_1	e 33 45	?	82·2	—
Pilar N.	M.	—	138·9	168	—	—	—	—	73·8	87·8
Northfield	B.O.	—	139·8	21	e 18 25	?	—	—	—	—
Andalgala E.	M.	—	141·7	160	—	—	—	—	—	84·0
Harvard	B.O.	—	141·9	22	e 11 46	?	19 17	[−26]	41·6	—
Washington	Mar.	—	142·0	31	e 19 28	[−15]	22 25	? PR_1	41·2	—
Cheltenham N.	B.O.	—	142·2	31	22 15	? PR_1	—	—	74·8	79·2
La Paz	Bi.	—	151·0	148	e 19 50	[− 7]	33 51	?	63·2	78·6
Balboa Heights	B.O.	—	153·2	86	20 15	[+15]	—	—	—	—

For Notes see next page.

NOTES TO Nov. 23d. 22h. 57m. 45s.

Additional records: Manila gives iE = +5m.35s., iN = +6m.3s., iE = +7m.2s., iN = +7m.19s. Adelaide PR_1 = +6m.59s., SR_1 = +12m.52s. Riverview eP = +6m.36s., PR_1 = +8m.1s., iS = +11m.47s., PS = +12m.4s., MN = +18·2m., MZ = +18·0m., T_0 = +22h.57m.48s. Sydney SR_1 = +13m.15s., Mauritius MN = +21·2m. Victoria E = +30m.29s., L = +48·4m. Zagreb iNE = +19m.16s., MNW = +67·2m., T_0 = 22h.57m.46s. Moncalieri i = +19m.48s., MN = +60·1m. Shide SR_1 = +31m.20s. Barcelona MN = +70·8m. Coimbra i = +38m.28s. Toronto L = +48·8m. Ottawa i = +22m.50s. and +23m.29s., L? = +67·2m. Andalgala MN = +83·6m. Harvard iE = +12m.6s. and +29m.12s?, eLE = +36·9m., eLN = +40·7m., T_0 = 22h.52m.11s. Cheltenham PE = +23m.5s. La Paz L = +71·4m.

Nov. 23d. Records also at 0h. (Manila and Batavia), 1h. (San Fernando, Manila, Colombo, and Helwan), 5h. (Mizusawa (2)), 6h. (Helwan and Paris), 17h. (Tacubaya), 18h. (Zi-ka-wei), 19h. (Zi-ka-wei and Taihoku), 21h. (San Fernando), 22h. (Zi-ka-wei).

Nov. 24d. 19h. 56m. 35s. Epicentre 36°·0N. 138°·0E. (as on 1915 Oct. 8d.).

A = −·601, B = +·541, C = +·588.

		Δ	P.	O−C.	S.	O−C.	M.	M.
		°	m. s.	s.	m. s.	s.	m.	m.
Tokyo		1·5	0 16	− 7	0 44	+ 2	—	—
Osaka		2·5	0 39	0	—	—	1·4	1·8
Kobe		2·7	i 0 40	− 2	—	—	1·3	1·7
Mizusawa	E.	4·0	0 55	− 7	1 55	+ 5	—	—
	N.	4·0	1 1	− 1	1 52	+ 2	—	—

Kobe gives MN = +1·5m.

Nov. 24d. Records also at 0h. (Cheltenham and Washington), 3h. (Tokyo), 8h. (Mizusawa), 9h. (Zi-ka-wei), 10h. (Osaka and Nagasaki), 11h. (De Bilt, Manila, and Eskdalemuir), 12h. (La Paz and La Quiaca), 13h. (Rocca di Papa), 17h. (Batavia and Manila), 23h. (Bombay).

Nov. 25d. 2h. 14m. 7s. Epicentre 46°·5N. 28°·3W.

A = +·606, B = −·326, C = +·725; D = −·474, E = −·880; G = +·639, H = −·344, K = −·688.

	Δ	Az.	P.	O−C.	S.	O−C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Coimbra	15·7	106	3 56	+ 8	5 29	−79	7·1	8·5
Bidston	17·5	58	2 53	?	8 35	?L	(8·6)	11·4
Eskdalemuir	17·9	52	4 15	− 1	7 38	0	8·6	—
Stonyhurst	18·0	56	4 23	+ 6	—	—	9·1	10·4
Shide	18·2	67	4 20	+ 1	—	—	8·5	14·0
Edinburgh	18·2	50	4 23	+ 4	—	—	—	10·4
Kew	18·9	64	—	—	—	—	—	11·9
San Fernando	19·3	114	8 53	?L	—	—	(8·9)	11·9
Tortosa	21·5	95	5 3	+ 4	—	—	9·9	11·2
Uccle	21·8	67	3 53	−70	e 7 53	−68	e 9·9	—
Barcelona	22·3	92	e 5 8	− 1	9 15	+ 4	10·2	13·1
De Bilt	22·3	63	5 8	− 1	9 5	− 6	10·5	12·4
Moncalieri	24·9	80	5 33	− 4	—	—	12·1	—
Zurich	24·9	74	e 5 36	− 1	—	—	—	—
Algiers	25·2	101	e 5 31	− 9	—	—	12·4	13·2
Rocca di Papa	29·4	84	. —	—	e 11 8	−16	—	17·5
Graz	29·6	73	6 13	−11	—	—	—	—
Zagreb	30·2	75	e 6 29	− 1	—	—	e 12·9	16·9
Ottawa	32·5	286	—	—	e 13 11	+55	e 16·4	—
Toronto	35·6	284	—	—	—	—	13·2	22·2
Helwan	48·5	88	16 53	?S	(16 53)	+53	—	—

Additional records: Coimbra gives LN = +7·0m., MN = +8·2m., T_0 = 2h.16m.9s. San Fernando PN = +8m.23s. (?LN). Barcelona MN = +11·8m., T_0 = 2h.14m.6s. De Bilt MN = +11·9m., T_0 = 2h.14m.18s. Epicentre 46°·9N. 28°·8W. Zagreb MNW = +19·9m. Ottawa LE = +18·9m., LN = +20·9m. Toronto eL = +21·2m.

Nov. 25d. 12h. 38m. 48s. Epicentre 36°·4N. 27°·5E.

A = +·714, B = +·372, C = +·593; D = +·462, E = −·887; G = +·526, H = +·274, K = −·805.

	Δ	Az.	P.	O−C.	S.	O−C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Athens	3·4	299	e 0 53	0	1 34	0	1·8	2·2
Rocca di Papa	12·7	300	3 6	− 3	—	—	(e 6·8)	8·9
Zagreb	12·8	321	e 3 12	+ 2	—	—	e 7·2	8·9
Graz	13·9	324	e 3 24	− 1	—	—	—	—
Uccle	22·0	318	e 4 48	−17	—	—	—	—
De Bilt	22·3	322	4 56	−13	—	—	e 14·2	15·4

Additional records: Athens gives MN = +2·6m. Rocca di Papa M = +3·8m. The L and M given are recorded as a second shock.

Nov. 25d. Records also at 2h. (La Paz), 7h. (Taihoku), 12h. (Manila, Helwan, Tokyo, and Edinburgh).

Nov. 26d. Records at 0h. (San Fernando), 2h. (Tokyo and Osaka), 4h. (Taihoku), 7h. (Osaka and Tokyo), 8h. (Osaka and Tokyo), 11h. (Rocca di Papa and Zagreb), 13h. (Mizusawa and Tokyo), 14h. (Rocca di Papa).

Nov. 27d. Records at 1h. (Helwan, De Bilt, Riverview, Adelaide, and Perth), 2h. (Helwan and San Fernando), 7h. and 8h. (La Paz), 9h. (Rocca di Papa), 10h. (Helwan), 12h. (Athens), 19h. (Batavia).

Nov. 28d. 2h. 43m. 2s. Epicentre 36°·4N. 27°·5E. (as on 1918 Nov. 25d. 12h.).

A = +·714, B = +·372, C = +·593.

	Δ	P.	O−C.	S.	O−C.	L.	M.
	°	m. s.	s.	m. s.	s.	m.	m.
Athens	3·4	e 0 56	+ 3	1 32	− 2	1·8	2·0
Helwan	7·2	3 58	?L	—	—	(4·0)	—
Zagreb	12·8	3 7	− 3	—	—	—	9·6
Graz	13·9	e 3 25	0	—	—	—	—
De Bilt	22·3	—	—	—	—	e 12·7	—

No additional records.

Nov. 28d. 5h. 21m. 17s. Epicentre 31°·0S. 179°·0E.

A = −·857, B = +·015, C = −·515; D = +·017, E = +1·000; G = +·515, H = −·009, K = −·857.

	Δ	Az.	P.	O−C.	S.	O−C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Apia	19·2	28	4 29	− 2	8 7	+ 1	—	—
Riverview	23·6	256	i 5 25	+ 1	9 32	− 4	10·9	15·1
Adelaide	33·9	256	(7 7)	+ 3	10 32	−127	11·7	14·2
Perth	53·1	255	9 55	+28	—	—	—	—
Batavia	71·5	276	e 11 43	+16	—	—	—	22·7
Manila	72·0	301	e 11 29	− 1	—	—	—	20·4
Osaka	77·4	326	17 41	?PR_2	—	—	—	22·3
La Paz	100·0	118	e 14 55	+44	24 3	−113	46·7	—
Colombo	101·4	274	28 7	?S	(28 7)	+118	—	—
Helwan	152·2	276	23 43	?PR_1	—	—	—	—
Edinburgh	154·9	3	43 23	?SR_1	—	—	—	—
Eskdalemuir	155·6	3	—	—	30 43	?	—	—
Bidston	157·5	3	23 55	?PR_1	35 43	?	—	81·2
De Bilt	158·4	350	e 24 13	?PR_1	e 30 49	?	e 49·7	51·8
Graz	159·5	326	e 20 46	[+38]	—	—	—	—
Kew	159·5	359	—	—	—	—	—	44·7
Zagreb	160·2	323	e 19 55	[−13]	—	—	45·7	—
Rio Tinto	171·8	33	22 43	?	—	—	—	47·7
San Fernando	173·1	37	18 43	?	—	—	—	45·7

Additional records: Riverview gives iP = +5m.31s., ePR_1? = +6m.7s., +6m.23s. and +7m.31s., PS? = +9m.54s., MN = +14·9m. Adelaide P = +5m.52s., the P given in the table is recorded as PR_1. La Paz PR_1 = +18m.50s. De Bilt eN = +35m.50s. and +39m.2s., eE = +44m.11s. and +45m.37s.

Nov. 28d. Records also at 0h. (San Fernando and La Paz), 1h. (La Paz), 2h. (Batavia), 5h. (Manila), 9h. (Kodaikanal), 14h. (Zante and Mizusawa), 19h. (Mizusawa, Tokyo, and Osaka), 20h. (Batavia, Colombo, Zi-ka-wei, and Helwan), 22h. (San Fernando).

Nov. 29d. 10h. 41m. 50s. Epicentre 30°·0N. 71°·0E. (as on 1917 Dec. 1d. 9h.).
A = +·282, B = +·819, C = +·500; D = +·946, E = −·326;
G = +·163, H = +·473, K = −·866.

	Δ	Az.	P.	O−C.	S.	O−C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Simla	5·5	76	1 10	−15	2 4	−27	2·6	2·8
Bombay	11·2	171	5 19	?S	(5 19)	+20	—	8·0
Calcutta	17·3	112	1 58	?	9 58	?L	(10·0)	—
Kodaikanal	20·7	161	12 16	?L	—	—	(12·3)	—
Colombo	24·5	158	13 40	?L	—	—	(13·7)	18·7
Lemberg	40·2	313	e 9 10	+73	—	—	—	21·6
Zi-ka-wei	43·0	75	e 14 37	?S	(e 14 37)	−11	—	—
Budapest	43·2	310	e 12 26	?	—	—	—	—
Taihoku	44·8	83	19 10	?SR_1	—	—	—	—
Zagreb	45·2	309	e 10 10	+96	—	—	23·2	27·2
Graz	45·6	310	e 7 0	−97	—	—	—	—
Rocca di Papa	47·8	301	e 12 40	?	—	—	23·0	26·1
Manila	48·3	98	—	—	e 14 10	−108	25·5	27·0
Hohenheim	49·8	312	—	—	e 18 36	?	—	—
De Bilt	52·2	315	—	—	e 16 43	− 3	22·2	25·1
Uccle	52·8	314	—	—	—	—	e 24·2	—
Paris	54·2	311	—	—	—	—	e 23·2	31·2
Barcelona	55·6	303	—	—	—	—	e 27·0	—
Kew	55·7	315	—	—	—	—	—	28·2
Edinburgh	56·9	320	24 10	?L	—	—	(24·2)	33·7
Eskdalemuir	57·0	319	—	—	—	—	23·2	—
Bidston	57·1	317	21 46	?	27 22	?L	(27·4)	34·2
Rio Tinto	63·1	300	30 10	?L	—	—	(30·2)	38·2
San Fernando	63·2	299	32 22	?L	—	—	(32·4)	36·7

Additional records: Zagreb gives MNW = +24·2m. Paris MN = +27·2m.
San Fernando MN = +36·2m.

Nov. 29d. Records at 0h. (Colombo), 2h. (Helwan), 3h. (San Fernando), 4h. (Balboa Heights and La Paz), 7h. (Manila and Shide), 8h. (Zagreb), 9h. (Athens), 10h. (La Paz), 16h. (Zagreb), 18h. (Balboa Heights).

Nov. 30d. 1h. 33m. 30s. Epicentre 22°·0N. 151°·0E.
A = −·811, B = +·450, C = +·375.

	Δ	Az.	P.	O−C.	S.	O−C.
	°	°	m. s.	s.	m. s.	s.
Mizusawa	19·1	336	4 35	+ 5	8 13	+ 9
Zi-ka-wei	27·9	295	e 5 57	−10	10 41	−16
Manila	29·4	261	e 6 30	+ 8	—	—
La Paz	142·8	88	i 19 40	[− 5]	—	—

Mizusawa SN = +8m.14s. La Paz also gives eP = +18m.54s.

Nov. 30d. 6h. 48m. 31s. Epicentre 70°·1N. 132°·0E. (suggested by De Bilt).
A = −·228, B = +·253, C = +·940; D = +·743, E = +·669;
G = −·629, H = +·699, K = −·340.

	Δ	Az.	P.	O−C.	S.	O−C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Ootomari	24·0	164	10 16	?S	(10 16)	+32	—	—
Mizusawa E.	31·3	168	6 42	+ 1	11 55	− 1	—	—
N.	31·3	168	6 39	− 2	11 57	+ 1	—	—
Kobe	35·5	178	e 8 49	?PR_1	—	—	22·8	24·1
Osaka	35·5	176	7 40	+22	—	—	—	23·3
Zi-ka-wei	39·4	193	e 7 46	− 4	e 13 50	− 7	—	26·6
Taihoku	45·5	192	23 59	?L	—	—	(24·0)	—
Lemberg	49·4	308	—	—	e 15 29	−42	—	27·5
Victoria	49·8	58	—	—	20 32	?SR_1	28·2	33·6
Edinburgh	50·0	330	16 29	?S	(16 29)	+10	—	34·0
Eskdalemuir	50·5	330	—	—	16 29	+ 4	—	—
De Bilt	52·0	322	9 19	− 1	16 43	− 1	e 26·5	29·1

Continued on next page.

	Δ	Az.	P.	O−C.	S.	O−C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Bidston	52·3	328	17 5	?S	(17 5)	+17	(26·4)	37·0
Budapest	52·9	310	e 9 44	+19	—	—	—	—
Uccle	53·3	322	e 9 23	− 5	—	—	e 32·5	—
Kew	53·7	327	—	—	—	—	—	36·5
Zagreb N.W.	55·2	311	e 10 44	+64	—	—	—	—
Paris	55·6	322	—	—	e 19 29	?SR_1	30·5	—
Manila	55·9	192	—	—	—	—	e 24·5	—
Moncalieri	58·1	317	13 30	?PR_1	22 8	?SR_1	30·0	34·5
Rocca di Papa	59·9	312	e 10 13	+ 2	—	—	e 33·7	41·2
Marseilles	60·2	319	—	—	—	—	36·5	—
Bombay	62·0	248	—	—	—	—	—	39·3
Ottawa	62·7	21	—	—	—	—	e 28·8	—
Honolulu	63·2	102	—	—	—	—	e 26·5	31·5
Toronto	64·0	26	—	—	—	—	e 35·3	39·9
Ann Arbor	64·6	30	—	—	27 29	?	—	42·5
Harvard	66·3	20	6 35?	?	—	—	e 32·8	—
Algiers	67·0	319	—	—	—	—	e 39·5	45·5
Rio Tinto	68·0	328	28 29	?L	—	—	(28:5)	34·5
Kodaikanal	68·8	240	—	—	—	—	37·7	37·9
Georgetown	68·9	26	—	—	—	—	37·5	—
Washington	68·9	26	—	—	e 39 29	?L	43·5	—
San Fernando	69·3	327	—	—	—	—	—	47·0
Colombo	71·3	237	36 29	?L	—	—	(36·5)	49·5
Batavia	78·2	208	—	—	—	—	e 43·5	—
La Paz	125·0	27	—	—	—	—	67·5	83·0

Additional records: Kobe gives MN = +24·0m. Osaka MN = +22·5m. De Bilt T_o = 6h.48m.33s. Epicentre 70°·1N. 132°·0E., as adopted. Bidston records S as P and L as S. Ottawa LE = +33·5m., L = +36·5m. Toronto L = +87·9m. Ann Arbor MN = +43·5m. Harvard LE = +35·1m., LN = +40·2m. Georgetown LN = +42·5m.

Nov. 30d. Records also at 3h. (Helwan and San Fernando), 9h. (Manila and Mizusawa), 10h. (Mizusawa), 11h. (Batavia and Zurich), 12h. (Helwan), 13h. (Zurich), 20h. and 21h. (Simla), 23h. (Mizusawa).

1918. Dec. 1d. 2h. 35m. 4s. Epicentre 39°·0N. 73°·0E.

A = +·227, B = +·743, C = +·629; D = +·956, E = −·292; G = +·184, H = +·602, K = −·777.

On 1917 April 21d. an epicentre 37°·2N. 70°·4E. was ultimately adopted, with focus at a depth 0·03 below normal (see Bull. for Mar. and Apr. 1917, p. 6). Direct comparison of the observations on that date with those given below shows an essential difference between the two cases.

Station and Component.	Machine.	Δ	Azimuth.	P.	O−C.	S.	O−C.	L.	M.
		°	°	M. S.	S.	M. S.	S.	M.	M.
Simla	O.E.	8·6	156	1 38	−32	(3 56)	+ 3	3·9	4·4
Dehra Dun	O.	9·6	153	2 26	+ 2	—	—	—	—
Bombay	O.E.	20·1	181	4 41	− 1	8 20	− 5	—	11·1
Calcutta E.	O.E.	21·0	137	4 50	− 3	8 50	+ 6	11·4	12·8
N.	O.E.	21·0	137	4 44	− 9	8 44	0	11·3	13·5
Kodaikanal	M.	29·1	171	11 2	?S	(11 2)	−17	15·1	16·0
Colombo	M.	32·7	167	11 8	?	12 38	+19	15·3	19·9
Helwan	M.	35·2	268	6 50	−25	8 32	?PR_1	—	25·6
Lemberg	B.O.	35 9	304	i 7 19	− 2	—	—	19·3	24·6
Athens E.	—	38·1	282	7 34	− 5	13 29	−10	e 19·4	26·9
N.	—	38·1	282	7 35	− 4	13 31	− 8	—	24·7
Budapest	—	39·4	302	9 26	?PR_1	—	—	—	—
Zi-ka-wei	—	39·9	85	e 7 42	−12	14 46	+41	—	27·2
Zagreb	W.	41·7	299	i 8 6	− 3	14 24	− 7	i 19·5	28·8
Taihoku	O.	42·9	92	—	—	e 18 8	?SR_1	e 23·6	—
Pola	W.	43·4	299	e 8 16	− 5	e 17 46	?SR_1	e 25·1	28·0
Pompeii	O.A.	44·1	291	8 24	− 3	—	—	—	—
Rocca di Papa	Ag.	45·1	295	8 32	− 2	e 15 5	−11	e 23·2	33·7

Continued on next page.

Station and Component.	Machine.	Δ	Azimuth.	P.	O−C.	S.	O−C.	L.	M.
		°	°	M. S.	S.	M. S.	S.	M.	M.
Zurich	—	46·4	304	e 8 39	− 4	—	—	—	—
De Bilt E.	—	47·4	310	8 49	− 1	15 50	+ 4	e 25·9	27·5
N.	—	47·4	310	8 56	+ 6	15 49	+ 3	e 21·9	27·9
Moncalieri	S.	47·6	299	8 49	− 2	15 50	+ 1	20·0	31·7
Besançon	—	48·1	304	8 46	− 9	—	—	—	—
Uccle	—	48·2	309	e 8 55	0	e 15 56	0	e 23·9	—
Manila	W.	48·5	104	e 8 52	− 5	14 18	−102	18·4	19·9
Osaka	O.	49·2	73	9 8	+ 7	18 6	+117	26·2	33·2
Marseilles	Ma.	49·7	299	i 9 8	+ 3	—	—	e 29·9	34·9
Paris	—	49·9	307	i 9 8	− 2	i 16 23	+ 5	23·9	26·9
Kew	M.	50·8	311	—	—	—	—	—	34·9
Edinburgh	M.	51·3	317	8 56	−19	—	—	—	33·4
Eskdalemuir E.	G.	51·5	316	i 9 24	+ 7	i 16 38	0	24·0	29·7
N.	G.	51·5	316	i 9 29	+12	i 16 37	− 1	—	—
West Bromwich	M.S.	51·5	312	9 17	0	—	—	—	20·8
Shide	M.S.	51·6	310	9 19	+ 2	16 58	+19	—	34·4
Bidston	M.S.	51·9	312	9 32	+13	16 50	+ 7	—	26·4
Tokyo	O.	51·9	72	9 28	+ 9	18 0	+77	24·2	—
Barcelona	—	52·6	298	i 9 28	+ 4	16 58	+ 7	e 28·1	37·6
Algiers	B.M.	53·9	290	e 9 32	0	17 6	− 2	25·9	36·9
Tortosa	—	54·3	298	9 34	− 1	17 18	+ 5	27·4	36·2
Batavia	W.	54·9	136	e 8 56	−42	—	—	—	21·9
Rio Tinto	M.	60·2	295	8 56	−77	—	—	—	43·9
Coimbra	—	60·4	299	10 30	+15	18 51	+23	30·3	36·4
San Fernando	—	60·6	293	18 8	?S	(18 8)	−23	36·7	39·4
Mauritius E.	M.	60·7	195	24 56	?	—	—	—	33·6
N.	M.	60·7	195	24 26	?	—	—	32·0	35·1
Cape Town	M.	88·6	222	40 20	?L	—	—	(40·3)	53·8
Ottawa	—	91·0	339	—	—	i 23 52	−32	44·9	—
Victoria	M.	91·4	10	38 5?	?	42 30	?L	49·4	55·4
Harvard	B.O.	92·4	334	—	—	i 24 40?	+ 1	49·8	—
Toronto	M.	93·7	340	39 20	?	—	—	47·3	67·7
Washington	Mar.	97·3	336	—	—	i 24 29	−60	e 54·9	—
Georgetown	—	97·3	336	—	—	e 24 28	−63	e 55·0	—
Cheltenham N.	B.O.	97·5	336	—	—	—	—	58·4	59·1
E.	B.O.	97·5	336	—	—	—	—	57·3	59·3
Melbourne	M.	101·3	131	24 56	?S	(24 56)	−72	64·1	67·1
Berkeley	—	101·8	11	—	—	—	—	e 49·7	—
Riverview	—	102·6	126	—	—	e 32 12	?SR_1	48·8	51·5
Honolulu	M.	103·0	49	e 36 56	?	—	—	49·9	53·4
La Paz	Bi.	139·4	293	19 44	[+ 6]	33 24?	?	68·9	80·2

Additional records: Lemberg gives i = +8m.36s. Athens PR_1N = +8m.54s., PR_1E = +8m.56s., PR_2N = +9m.19s., SR_1 = +15m.25s. Zi-ka-wei MN = +26·5m. Zagreb eP = +8m.1s., iPR_1 = +9m.11s., iNE = +9m.47s., iPS = +13m.38s., iSR_1 = +17m.30s., MNW = +26·3m. Pola MN = 27·4m. De Bilt SR_1N = +19m.8s., eE = +19m.38s., T_0 = 2h.35m.4s., epicentre 37·1N. 71°·8E. Moncalieri MN = +31·1m., T_0 = 2h.35m.3s. Uccle PR_1 = +10m.47s., SR_1 = +19m.44s., T_0 = 2h.35m.6s. Manila MN = +20·4m. Osaka MN = +32·7m., T_0 = 2h.33m.14s. Paris PR_1 = +11m.3s., SR_1 = +19m.2s., T_0 = 2h.35m.6s. Barcelona PS = +17m.25s., T_0 = 2h.35m.8s. Coimbra LN = +28·9m., T_0 = 2h.35m.15s. Ottawa eLE? = +39·7m., L = +52·9m. and +62·9m. Harvard iN = +25m.36s., eN = +37m.47s., LN = +52·0m. Toronto E = +46m.20s., eL = +57·3m. and +62·6m. Washington L = +57·9m. Georgetown LE = +58·1m., LN = +58·6m. Riverview e = +36m.56s., MN = +51·7m. La Paz PR_1 = +23m.18s.

Dec. 1d. Records also at 1h. (Manila), 3h. (Ootomari and Manila), 5h. (Harvard), 7h. (La Paz), 9h. (Besançon), 10h. (Stonyhurst and Manila), 13h. (Osaka), 16h. (La Paz), 17h. (La Paz (2)).

1918. Dec. 2d. 9h. 47m. 21s. Epicentre 10°·5N. 44°·2W.

A = +·705, B = −·686, C = +·182 ; D = −·697, E = −·717 ;
G = +·131, H = −·127, K = −·983.

Station and Component.	Machine.	Δ	Azimuth.	P.	O−C.	S.	O−C.	L.	M.
		°	°	M. S.	S.	M. S.	S.	M.	M.
Vieques N.	B.O.	21·9	293	5 29	+25	9 31	+28	—	10·9
E.	B.O.	21·9	293	5 23	+19	9 31	+28	—	10·5
Rio de Janeiro N.	B.O.	33·4	179	8 51	?PR$_1$	12 45	+15	14·0	19·4
E.	B.O.	33·4	179	8 51	?PR$_1$	12 33	+ 3	13·8	17·0
Balboa Heights	B.O.	34·9	270	7 25	+13	—	—	—	—
La Paz	Bi.	35·9	222	i 7 22	+ 1	13 5	− 4	17·8	20·1
La Quiaca E.	M.	38·8	211	8 45	+61	—	—	21·3	29·8
N.	M.	38·8	211	8 39	+55	—	—	21·2	23·6
Harvard E.	B.O.	39·6	328	8 0	+ 9	14 0	0	e 17·0	—
N.	B.O.	39·6	328	8 3	+12	13 35	−25	—	—
Cheltenham N.	B.O.	40·6	320	8 15	+15	14 25	+10	—	14·6
E.	B.O.	40·6	320	8 15	+15	14 34	+19	—	20·0
Georgetown E.	—	40·8	320	8 0	− 1	14 18	0	e 19·6	—
Z.	—	40·8	320	e 8 8	+ 7	—	—	e 19·4	—
Washington	Mar.	40·8	320	i 8 0	− 1	14 14	− 4	18·3	—
Northfield	B.O.	41·7	329	e 8 6	− 3	14 23	− 8	17·6	—
Ithaca E.	B.O.	42·6	323	e 3 58	?	10 26	?PR$_1$	15·8	—
N.	B.O.	42·6	323	e 4 2	?	10 27	?PR$_1$	15·7	16·6
San Fernando	—	43·0	48	8 3	−15	14 9	−39	22·6	24·6
Rio Tinto	M.	43·3	47	7 39	−41	—	—	—	28·6
Coimbra	—	43·4	42	8 7	−14	14 29	−25	19·1	19·7
Andalgala E.	M.	43·7	210	14 39	?S	(14 39)	−19	23·4	28·0
N.	M.	43·7	210	14 27	?S	(14 27)	−31	23·2	28·4
Ottawa	—	44·1	329	i 8 24	− 3	i 14 55	− 8	21·6	—
Toronto	M.	45·0	323	8 39	+ 6	i 15 33	+18	21·4	22·5
Mobile	W.	45·5	305	—	—	e 15 39	+18	—	—
Ann Arbor E.	B.O.	46·9	320	8 39	− 7	15 33	− 7	22·4	23·8
N.	B.O.	46·9	320	—	—	15 27	−13	22·6	23·6
E.	W.	46·9	320	8 33	−13	15 27	−13	22·4	23·6
N.	W.	46·9	320	8 39	− 7	15 27	−13	22·6	23·2
Tortosa	—	49·3	46	8 55	− 7	15 57	−13	21·9	23·9
St. Louis	W.	49·6	312	9 27	+23	e 16 21	+ 7	e 18·8	21·8
Algiers	B.M.	50·0	52	8 57	−10	16 2	−17	22·2	25·6
Barcelona	—	51·0	46	e 9 4	− 9	16 16	−15	e 22·5	26·4
Shide	M.S.	53·4	32	9 23	− 6	16 46	−15	—	27·2
Marseilles	Ma.	53·9	42	i 9 31	− 1	i 17 0	− 8	e 26·6	31·6
Bidston	M.S.	54·0	30	9 39	+ 6	17 3	− 6	—	27·2
Kew	M.	54·3	32	—	—	—	—	—	32·6
Paris	—	54·5	37	e 9 31	− 5	i 17 4	−11	24·6	27·6
Eskdalemuir	G.	55·1	28	9 36	− 4	17 14	− 8	26·6	—
Edinburgh	M.	55·5	28	9 39	− 4	—	—	—	31·2
Besançon	—	55·9	39	9 42	− 3	17 29	− 4	—	—
Moncalieri	S.	56·1	43	i 9 41	− 6	i 16 57	−38	23·2	31·3
Uccle	—	56·5	36	e 9 44	− 5	i 17 31	− 9	25·6	28·5
Milan	Ag.	57·3	43	10 54	+60	—	—	26·6	26·6
De Bilt E.	—	57·5	35	9 55	− 1	17 52	− 1	26·6	26·9
N.	—	57·5	35	9 56	0	—	—	23·6	26·1
Zurich	—	57·5	41	e 9 49	− 7	e 17 47	− 6	—	—
Rocca di Papa	Ag.	58·6	48	9 40	−23	18 1	− 5	e 27·2	33·6
Pompeii E.	O.A.	59·6	49	i 10 19	+10	i 18 30	+12	28·8	35·8
Pola	W.	60·2	44	e 10 33	+20	e 17 3	−83	e 26·0	31·5
Zagreb N.E.	W.	61·9	44	e 10 24	0	i 18 45	− 2	30·6	35·6
N.W.	W.	61·9	44	e 10 27	+ 3	i 18 48	+ 1	—	31·6
Tucson E.	B.O.	64·8	301	—	—	—	—	33·6	38·0
Athens	—	66·3	52	e 10 51	− 3	19 36	− 5	31·3	35·4
Lemberg	B.O.	68·1	41	e 11 9	+ 4	e 20 3	0	e 33·0	35·8
Helwan	M.	72·4	61	11 33	+ 1	—	—	—	45·2
Lick	W.	73·8	308	e 11 15	−26	—	—	—	—

Continued on next page.

Station and Component.	Machine.	Δ	Azimuth.	P.	O−C.	S.	O−C.	L.	M.
		°	°	M. S.	S.	M. S.	S.	M.	M.
Berkeley	—	74·2	309	e 13 54	+131	—	—	—	—
Cape Town	M.	74·2	130	14 3	+140	20 9	−67	35·4	39·0
Victoria	M.	75·0	319	20 9	?S	(20 9)	−77	34·6	50·6
Mauritius N.	M.	104·8	110	32 3	?SR_1	—	—	48·4	54·4
E.	M.	104·8	110	26 57	?S	(26 57)	+17	50·6	55·0
Honolulu	M.	107·7	298	24 57	?	28 33	+86	32·6	35·8
Simla	O.E.	110·2	49	e 28 3	?S	(e 28 3)	+33	56·4	58·0
Bombay	O.E.	111·4	63	18 34	?	—	—	—	67·0
Kodaikanal	M.	118·4	70	31 21	?S	(31 21)	+164	61·0	71·6
Colombo	M.	121·6	75	25 51	?	37 9	?SR_1	56·4	78·4
Zi-ka-wei	—	136·1	14	e 21 9	?PR_1	—	—	—	77·2
Manila	W.	150·9	31	e 20 9	[+12]	—	—	e 63·6	85·4
Batavia	W.	151·0	84	20 26	[+29]	—	—	e 75·6	77·6
Melbourne	M.	151·5	195	i 42 57	?SR_1	—	—	—	84·0
Perth	M.	151·8	142	24 36	?PR_1	—	—	—	—
Riverview	—	152·7	209	e 17 51	?	e 34 5	+113	e 60·6	64·9

For La Quiaca it is assumed that standard time 4h. 0m. 0s. from Greenwich is used, in spite of the printed statement that Cordoba time (4h. 16m.48s.) is used.

Additional records: Georgetown gives SN = +14m.17s. Northfield L = +33·6m. San Fernando MN = +24·2m., T_0 = 9h.47m.42s. Coimbra PR_1 = +9m.38s., iN = +14m.38s., iE = +14m.40s., LN = +17·7m., MN = +20·5m., T_0 = 9h.47m.25s. Andalgala PE = +18m.15s., Ottawa eL = +18·2m., L = +29·6m., and +44·6m., T_0 = 9h.47m.30s. Toronto L = +18·2m., T_0 = 9h.47m.18s. Ann Arbor T_0 = 9h.47m.24s. Eskdalemuir PR_1 = +11m.58s., PR_2 = +12m.42s. Besançon gives the records in the table as on the previous day. Moncalieri MN = +30·7m. Uccle PR_1 = +12m.39s., T_0 = 9h.47m.23s. De Bilt m = +17m.58s., eSR_1 = +21m.36s., T_0 = 9h.47m.23s. Epicentre 10°·5N. 44°·0W. Rocca di Papa MN = +37·2m. Pola MN = +30·6m. Zagreb iPNE = +10m.29s., iPNW = +10m.33s., eSNE = +18m.30s., iSR_1 = +22m.33s., T_0 = 9h.47m.42s. Athens LN = +32·0m., MN = +36·9m. Victoria S = +25m.9s. Honolulu eL = +60·2m., M = 65·0m., Zi-ka-wei MN = +79·3m. Manila MN = +87·0m. Riverview MN = +65·2m.

Dec. 2d. Records also at 0h. (Algiers), 3h. (La Paz and Perth), 6h. (Athens and Zagreb), 8h. (Manila), 10h. (Manila (2)), 11h. (Taihoku and Mizusawa), 12h. (Honolulu and Mizusawa), 14h. (Colombo and Denver), 22h. (San Fernando and La Paz).

Dec. 3d. 17h. 51m. 0s. Epicentre 10°·0S. 108°·0E.
A = −·304, B = +·937, C = −·174.

	Δ	Az.	P.	O−C.	S.	O−C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Batavia	4·0	343	e 1 0	− 2	—	—	—	5·0
Perth	23·1	163	—	—	9 29	+ 2	13·7	—
Manila	27·8	28	e 3 35	−151	—	—	5·0	—
Melbourne	43·3	136	13 0	+280	17 18	+146	19·4	19·6
Riverview	46·1	128	e 8 44	+ 3	e 15 22	− 7	e 17·2	19·1
Sydney	46·1	128	10 30	?PR_1	—	—	16·2	20·1
La Paz	153·2	188	18 14	?	—	—	—	—

Riverview gives PS = +16m.3s., MN = +17·7m.

Dec. 3d. 23h. 6m. 52s. Epicentre 16°·0N. 148°·0E.
A = −·815, B = +·509, C = +·276.

		Δ	Az.	P.	O−C.	S.	O−C.	L.	M.
		°	°	m. s.	s.	m. s.	s.	m.	m.
Mizusawa	E.	23·9	347	5 27	0	9 47	+ 5	—	—
	N.	23·9	347	5 28	+ 1	9 42	0	—	—
Manila		26·2	271	e 5 54	+ 4	—	—	—	—
Zi-ka-wei		28·6	307	e 6 8	− 6	—	—	—	—
Honolulu		51·1	75	—	—	—	—	e 24·3	32·6

Dec. 3d. Records also at 4h. (Andalgala), 6h. (Colombo), 8h. (La Paz), 12h. (Bidston, Accra, and Manila), 17h. (Tokyo), 20h. (Colombo), 22h. (La Paz and San Fernando), 23h. (La Paz).

1918. Dec. 4d. 11h. 47m. 44s. Epicentre 26°·5S. 70°·5W.

A = +·299, B = −·844, C = −·446; D = −·943, E = −·334; G = −·149, H = +·421, K = −·895.

Compare with 1918 May 20d., Epicentre 29°·6S., 71°·5W. This main shock was apparently followed by a long series of repetitions, chiefly recorded only at La Paz. See note at end of this bulletin.

Station and Component.	Machine.	Δ	Azimuth.	P.	O—C.	S.	O—C.	L.	M.
		°	°	M. S.	S.	M. S.	S.	M.	M.
Andalgala	M.	3·9	107	0 28	−33	(1 10)	−37	1·2	4·6
La Quiaca E.	M.	6·1	46	2 4	+31	—	—	3·1	4·8
N.	M.	6·1	46	1 58	+25	—	—	3·1	4·5
La Paz	Bi.	10·2	13	i 2 22	−11	4 30	− 5	5·0	6·3
Cipolletti	M.	12·6	171	3 52	+45	(5 52)	+18	5·9	6·9
Balboa Hts. E.	B.O.	36·5	348	7 24	− 2	—	—	14·0	16·4
N.	B.O.	36·5	348	7 32	+ 6	—	—	14·4	26·2
Vieques N.	B.O.	44·9	7	8 15	−17	16 8	+54	24·6	31·3
E.	B.O.	44·9	7	8 28	− 4	22 46	? L	26·8	26·8
Tacubaya	—	53·7	326	9 18	−13	—	—	—	30·0
Ascension	M.	56·3	82	9 23	−25	16 46	−52	—	—
Mobile	W.	59·6	346	e 10 6	− 3	18 1	−17	—	—
Cheltenham N.	B.O.	65·5	355	10 46	− 2	20 13	+42	38·0	42·4
E.	B.O.	65·5	355	10 46	− 2	19 16	−15	40·9	42·8
Georgetown E.	—	65·7	354	10 38	−11	19 23	−10	e 30·0	32·2
N.	—	65·7	354	10 43	− 6	19 23	−10	—	42·3
Washington	Mar.	65·7	354	10 40	− 9	19 11	−22	41·3	—
St. Louis	W.	67·7	346	i 10 58	− 4	e 20 40	+42	31·3?	—
Harvard N.	B.O.	68·9	0	10 51	−19	19 48	−25	e 34·8	37·2
E.	B.O.	68·9	0	11 9	− 1	20 11	− 2	—	41·0
Ithaca N.	B.O.	69·1	355	e 12 3	+51	e 20 59	+44	—	46·4
E.	B.O.	69·1	355	e 12 41	+89	e 21 6	+51	—	46·6
Lawrence E.	W.	69·4	340	e 10 57	−16	e 20 7	−12	28·6	29·2
N.	W.	69·4	340	—	—	19 59	−20	29·2	29·4
Ann Arbor E.	B.O.	69·9	351	10 46	−30	19 34	−51	30·9	32·3
N.	B.O.	69·9	351	10 40	−36	20 4	−21	30·7	40·3
E.	W.	69·9	351	10 52	−24	19 34	−51	31·0	32·3
N.	W.	69·9	351	10 46	−30	20 4	−21	31·3	40·3
Tucson N.	B.O.	70·2	324	10 16	−62	20 38	+10	36·3	38·8
E.	B.O.	70·2	324	11 39	+21	—	—	28·3	38·8
Toronto	M.	70·6	353	e 11 52	+31	i 21 4	+31	31·9	51·2
Northfield	B.O.	70·7	359	11 10	−11	20 21	−13	e 28·6	—
Ottawa	—	72·1	356	e 11 20	−11	e 20 40	−11	e 31·6	—
Cape Town	M.	74·8	121	9 46	?	12 16	? P	21·8	40·1
Lick	W.	79·7	322	e 12 20	+ 3	e 22 14	− 6	—	43·8
Berkeley N.	—	80·5	322	e 12 18	− 6	e 22 16	−13	—	42·2
E.	—	80·5	322	e 12 20	− 2	e 22 36?	+ 7	—	44·8
San Fernando	—	87·3	47	13 4	+ 3	24 16	+32	43·3	55·3
Rio Tinto	M.	87·8	45	12 16	−48	—	—	—	52·3
Coimbra	—	88·2	42	13 3	− 3	23 45	− 9	39·4	44·8
Victoria	M.	88·6	328	13 12	+ 4	23 48	−11	41·1	55·2
Z.	—	88·6	328	13 0	− 8	22 56	−63	41·3	53·3
Algiers	B.M.	93·7	50	e 13 15	−21	24 2	−51	35·3	43·3
Apia	W.	93·7	257	13 39	+ 3	24 10	−43	43·9	47·3
Tortosa	—	93·8	46	13 20	−17	24 2	−52	41·0	55·3
Barcelona	—	95·5	46	e 13 35	−11	24 23	−48	37·6	46·2
Honolulu	M.	97·3	290	15 40	+104	25 28	− 1	46·0	53·6
Shide	M.S.	98·3	37	14 43	+41	24 16	−83	40·4	53·8
Marseilles	Ma.	98·5	46	13 56	− 7	25 5	−36	50·3	59·3
Bidston	M.S.	98·8	34	14 58	+54	26 28	+44	—	51·9
West Bromwich	—	98·9	35	—	—	24 37	−68	—	—
Kew	M.	99·2	36	—	—	—	—	—	62·3
Paris	—	99·4	40	e 14 41	+34	e 24 31	−79	44·3	49·3
Stonyhurst	M.	99·4	35	i 28 40?	?	i 36 40	?	i 53·7	62·3

Continued on next page.

Station and Component.	Machine.	Δ	Azimuth.	P.	O−C.	S.	O−C.	L.	M.
		°	°	M. S.	S.	M. S.	S.	M.	M.
Sitka	B.O.	99·6	330	—	—	—	—	e 68·3	73·3
Eskdalemuir	G.	99·8	32	14 17	+ 7	26 22	+28	—	—
Edinburgh	M.	100·1	32	13 46	−25	—	—	—	57·3
Besançon	—	100·7	42	—	—	28 4	+122	—	—
Moncalieri	S.	100·8	45	e 13 22	−52	23 39	−144	36·7	—
Uccle	—	101·4	38	e 13 52	−25	e 24 40	−89	43·3	53·0
Dyce	Ma.	101·4	31	—	—	19 12	?PR_1	29·5	47·8
Milan	—	101·9	46	14 1	−19	—	—	48·3	88·0
Zurich	—	102·3	43	e 14 10	−12	e 28 23	+125	e 51·3	—
De Bilt E.	—	102·5	38	e 14 30	+ 7	25 43	−37	e 44·3	51·0
N.	—	102·5	38	e 14 41	+18	25 44	−36	—	47·8
Rocca di Papa	Ag.	102·6	49	e 13 46	−37	e 24 52	−88	44·5	60·0
Pompeii	O.A.	103·4	51	e 17 17	?	e 28 16	+108	36·3	61·3
Pola	W.	104·6	47	18 31	?PR_1	(e 25 11)	−87	25·2	49·3
Zagreb N.W.	W.	106·4	47	e 14 15	−26	i 25 16	−100	48·3	63·3
N.E.	W.	106·4	47	e 14 5	−36	i 25 1	−115	—	61·3
Melbourne	M.	107·7	209	19 52	?PR_1	25 34	−93	30·3	31·6
Sydney	M.	107·9	216	14 52	+ 4	25 40	−89	45·8	55·5
Riverview	—	108·0	215	e 15 28	+40	25 6	−124	e 46·1	56·3
Budapest	—	108·9	45	8 30	?	19 10	?PR_1	—	—
Athens N.	—	109·2	56	e 13 43	−71	e 25 32	−109	e 48·4	63·0
E.	—	109·2	56	—	—	e 25 30	−111	e 48·2	58·9
Mauritius N.	M.	111·7	128	19 22	?PR_1	27 22	−21	29·3	56·2
E.	M.	111·7	128	19 52	?PR_1	26 46	−57	29·6	57·2
Helwan	M.	112·4	67	15 28	+19	20 40	?PR_1	—	71·2
Adelaide	M.	112·8	206	26 24	?S	34 44	?SR_1	51·2	57·7
Lemberg	B.O.	112·8	44	e 19 34	?PR_1	e 26 28	−84	e 29·9	43·5
Perth	M.	121·3	186	21 32	?PR_1	37 20	?SR_1	60·0	74·0
Bombay	O.E.	145·4	93	19 33	[−16]	34 19	?SR_1	—	76·2
Colombo	M.	145·6	119	20 22	[+33]	—	—	78·1	89·5
Kodaikanal	M.	145·6	112	20 34	[+45]	—	—	73·0	90·4
Ootomari	O.	146·9	317	20 2	[+11]	—	—	—	—
Batavia	W.	147·2	175	e 20 2	[+11]	i 21 7	?	48·3	65·3
Mizusawa E.	O.	150·8	304	19 59	[+ 2]	42 48	?SR_1	—	—
N.	O.	150·8	304	20 1	[+ 4]	42 54	?SR_1	—	—
Simla	O.E.	151·4	73	e 19 52	[− 6]	—	—	e 70·0	70·6
Tokyo	O.	152·6	297	20 10	[+10]	30 38	?	46·1	—
Osaka	O.	156·3	296	20 45	[+41]	39 53	?	58·7	76·4
Kobe	O.	156·5	297	e 20 20	[+16]	—	—	—	47·9
Calcutta E.	O.E.	160·4	97	20 22	[+14]	—	—	88·4	92·6
N.	O.E.	160·4	97	20 16	[+ 8]	—	—	89·3	103·3
Manila	W.	164·0	224	20 20	[+ 9]	e 36 36	?	e 77·5	81·5
Zi-ka-wei	—	168·6	297	e 20 32	[+18]	e 32 6	?	e 52·4	84·0
Taihoku	O.	169·1	265	21 25	[+71]	—	—	47·1	48·5

For La Quiaca it has been assumed (in spite of the printed statement that Cordoba time is used, which implies an addition of 4h.16m.48s.) that standard time 4h. from Greenwich is really used : i.e., the addition is only 4h.0m.0s. Additional records : La Paz i = +4m.48s., T_o = 11h.47m.29s. Epicentre 26·5S. 70°·5W. Mobile PR_1 = +12m.36s. Washington L = +28·3m. and + 56·3m. St. Louis L = +28·3m. and +42·2m. Harvard T_oN = 11h.47m.37s., T_oE = 11h.47m.30s. Ithaca iE = +22m.1s. Lawrence eSE = +19m.59s. Northfield L = +46·3m. Ottawa L = +42·3m. and +48·3m., T_o = 11h.47m.43s. Lick MN = +44·6m., T_o = 11h.48m.8s. Berkley T_o = 11h.47m.58s. Coimbra iN = +24m.11s., iE = +24m.21s., LN = +38·4m., MN = +43·3m., T_o = 11h.48m.2s. Victoria gives also S = +23m.30s. Apia e_1 = +17m.24s., i_1 = +26m.28s., i_1 = +30m.40s. Barcelona PR_1 = +17m.58s., PS = +25m.26s., T_o = 11h.48m.28s. San-Fernando MN = +54·3m., T_o = 11h.47m.31s. Paris PR_1 = +18m.34s., eSN = +34m.38s. Eskdalemuir PR_1 = +18m.35s., T_o = 11h.47m.44s. Uccle PR_1 = +17m.46s., i = +28m.5s., T_o = 11h.48m.42s. De Bilt PR_1 = +19m.5s., e = +28m.15s., m = +28m.28s., Epicentre 26°·5S. 70°·5W. Rocca di Papa eL? = +28·5m., MN = +62·3m. Zagreb i = +16m.39s., +18m.45s., and 19m.43s., T_o = 7h.48m.57s. Sydney PS = +25m.16s., SR_1 = +34m.16s. Riverview PS = +26m.11s., i = +29m.10s., e = +34m.19s. and +35m.33s., MN = +46·5m., MZ = +51·6m. Athens PR_1 = +19m.10s., PSE = +26m.11s., iE = +29m.20s., T_o = 11h.47m.29s. Adelaide PR_1 = +28m.4s., SR_1 = +39m.44s. Perth PR_1 = +31m.26s., SR_1 = +43m.45s. Osaka MN = +96·9m. Kobe MN = +47·8m. Manila iE = +22m.20s., iN = +23m.19s., MN = +81·8m. Zi-ka-wei SR_1N = +47m.10s., SR_1E = +48m.38s., MN = +87·1m.

Dec. 4d. 17h. 41m. 40s. Epicentre 26°·5S. 70°·5W. (as at 11h.).

A = +·299, B = −·844, C = −·446 ; D = −·943, E = −·334 ;
G = −·149, H = +·421, K = −·895.

For note on other repetitions see note at end of this bulletin.

		Δ	Az.	P.	O−C.	S.	O−C.	L.	M.
		°	°	m. s.	s.	m. s.	s.	m.	m.
Andalgala	N.	3·9	107	0 20	−41	(1 8)	−39	1·1	1·7
La Quiaca	E.	6·1	46	0 14	−79	(1 44)	−62	1·7	4·3
	N.	6·1	46	0 20	−73	(1 38)	−68	1·6	2·7
La Paz		10·2	13	2 30	− 3	4 38	+ 3	5·7	6·3
Cipolletti		12·6	171	2 38	−29	(3 50)	−104	3·8	5·6
Harvard		68·9	0	—	—	—	—	34·4	—
Toronto		70·6	353	—	—	—	—	e 40·5	41·5
Capetown		74·8	121	21 20	?S	(21 20)	− 4	—	46·8
San Fernando		87·3	47	53 20	?L	—	—	(53·3)	57·3
Rio Tinto		87·8	45	13 20	+16	—	—	—	54·3
Coimbra		88·2	42	23 33	?S	(23 33)	−21	e 46·4	—
Algiers		93·7	50	—	—	—	—	e 39·7	57·3
Bidston		98·8	34	27 32	?S	(27 32)	+108	—	46·6
Paris		99·4	40	—	—	—	—	e 55·3	63·3
Edinburgh		100·1	32	53 20	?L	—	—	(53·3)	63·3
De Bilt		102·5	38	—	—	e 27 22	+62	e 55·3	56·0
Riverview		108·0	215	—	—	e 48 40	?	e 52·6	58·1
Colombo		145·6	119	80 20	?L	—	—	(80·3)	91·8
Kodaikanal		145·6	112	83 2	?L	—	—	(83·0)	—
Manila		164·0	224	e 20 20	[+9]	—	—	—	—

For La Quiaca it is assumed that standard time 4h. 0m. 0s. from Greenwich is used, not Cordoba time (4h.16m.48s.) as printed.

Additional records: La Paz gives T_o = 17h.41m.33s. Harvard LN = +37·5m. San Fernando PN = +52m.20s., MN = +55·3m.

Dec. 4d. Records also at 0h. (Rocca di Papa and Victoria), 1h. (Mizusawa and Helwan), 2h. (Zagreb), 3h. (Simla), 4h. (Manila and La Paz), 7h. (Kodaikanal), 9h. (Mizusawa), 11h. (Denver), 12h. (Batavia and Melbourne), 13h. (St. Louis, Andalgala, La Quiaca, and La Paz (3)), 14h. (Batavia and La Paz), 15h. (La Quiaca, La Paz (3), and Balboa Heights), 16h. (La Paz (3)), 17h. (La Paz, Rocca di Papa, and Balboa Heights), 18h. (La Paz, Victoria, and Rocca di Papa), 19h. (Rocca di Papa, La Paz (3), and Athens), 20h. (La Paz (5)), 21h. (La Paz and Batavia), 23h. (La Paz (2) and Helwan).

Dec. 5d. Records at 1h. (Cipolletti, La Quiaca, La Paz (3), Andalgala, and San Fernando), 2h. (Rocca di Papa), 5h. (La Paz (3)), 7h. (La Paz (3)), 8h. (La Paz), 9h. (La Paz and Manila), 12h. (La Paz (2), Cipolletti, and Dehra Dun), 13h. and 14h. (La Paz), 18h. (La Paz (2), Helwan, and Tortosa), 19h. (Barcelona and La Paz), 20h. (La Paz (2), Athens, and Cipolletti (2)), 21h. (Pa Paz, Helwan, and San Fernando), 22h. (La Paz (2), Pilar, La Quiaca, and Andalgala), 23h. (La Paz, Helwan, and Edinburgh).

Dec. 6d. 7h. 21m. 52s. Epicentre 26°·5S. 70°·5W. (as on 1918 Dec. 4d.).

A = +·299, B = −·844, C = −·446 ; D = −·943, E = −·334 ;
G = −·149, H = +·421, H = −·895.

For note on other repetitions see note at end of this bulletin.

		Δ	Az.	P.	O−C.	S.	O−C.	L.	M.
		°	°	m. s.	s.	m. s.	s.	m.	m.
Andalgala		3·9	107	28 56	?	—	—	29·3	31·3
Pilar	E.	7·8	133	1 56	− 2	(3 20)	−11	3·3	4·9
	N.	7·8	133	1 56	− 2	(3 26)	− 5	3·4	4·7
La Paz		10·2	13	2 31	− 2	4 38	+ 3	5·1	5·7
Cipolletti		12·6	171	4 20	+73	(5 20)	−14	5·3	7·1
Georgetown		65·7	354	—	—	e 19 18	−15	—	—
Toronto		70·6	353	—	—	—	—	25·5	—
Ottawa		72·1	356	—	—	i 20 36	−15	e 43·9	—
Capetown		74·8	121	22 38	?S	(22 38)	+74	—	45·1
San Fernando		87·3	47	23 8	?S	(23 8)	−36	(49·2)	—

Continued on next page.

	Δ	Az.	P.	O−C.	S.	O−C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Coimbra	88·2	42	e 40 45	?L	—	—	52·3	—
Victoria	88·6	328	42 26	?L	—	—	(42·4)	50·5
Algiers	93·7	50	—	—	e 23 40	−73	46·1	—
Honolulu	97·3	290	—	—	e 31 20	−?SR_1	45·3	52·1
Paris	99·4	40	—	—	e 48 8	?L	54·1	62·1
Edinburgh	100·1	32	29 8	?SR_1	—	—	—	118·1
Uccle	101·4	38	—	—	—	—	—	58·1
De Bilt	102·5	38	—	—	e 27 23	+63	e 51·1	52·3
Rocca di Papa	102·6	49	—	—	e 24 14	−126	e 51·6	65·3
Graz	106·5	46	e 24 50	?S	(e 24 50)	−127	—	—
Mauritius	111·7	128	53 14	?L	—	—	(53·2)	—
Colombo	145·6	119	82 8	?L	—	—	(82·1)	88·1
Kodaikanal	145·6	112	81 26	?L	—	—	(81·4)	—
Batavia	147·2	175	e 20 8	[+17]	—	—	—	22·1
Manila	164·0	224	e 20 8	[− 3]	—	—	—	—
Taihoku	169·1	265	e 78 8	?L	—	—	(e 78·1)	—

Additional records: Andalgala gives a set of North component records, but these, like the other set, are difficult to understand. The time correction is probably not the right one to apply in reducing to G.M.T. La Paz gives T_0 = 7h.21m.47s. Mauritius PN = +54m.26s.

1918. Dec. 6d. 8h. 41m. 3s. Epicentre 49°·0N. 124°·0W.

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

Station and Component.	Machine.	Δ	Azimuth.	P.	O−C.	S.	O−C.	L.	M.
		°	°	M. S.	S.	M. S.	S.	M.	M.
Victoria	M.	0·8	141	0 36	+24	—	—	1·4	2·2
Z.	—	0·8	141	0 41	+29	—	—	1·4	1·6
Sitka E.	B.O.	10·5	324	2 12	−25	e 4 7	−36	4·5	5·2
N.	B.O.	10·5	324	e 2 20	−17	e 4 9	−34	4·6	5·7
Berkeley E.	—	11·2	173	e 2 58	+11	5 19	+20	e 6·5	9·6
N.	—	11·2	173	e 2 58	+11	5 18	+19	i 5·7	8·0
Saskatoon	Ma.	12·0	69	3 2	+ 3	5 35	+16	6·6	—
Lick E.	W.	12·1	171	e 3 9	+ 9	e 5 47	+26	e 6·8	7·2
N.	W.	12·1	171	e 3 8	+ 8	i 5 41	+20	e 6·9	8·2
Z.	W.	12·1	171	e 3 8	+ 8	e 5 42	+21	e 6·8	8·6
Denver	W.	16·4	117	1 57	?	—	—	8·0	9·0
Tucson E.	B.O.	19·4	145	4 49	+15	8 50	+49	10·2	14·5
N.	B.O.	19·4	145	5 47	+73	9 52	+102	13·1	14·4
Lawrence E.	W.	22·8	105	5 21	+ 6	9 46	+25	12·9	13·5
N.	W.	22·8	105	5 23	+ 8	9 48	+27	13·0	13·6
St. Louis E.	W.	26·2	101	i 5 57	+ 7	e 10 45	+19	14·8	15·4
N.	W.	26·2	101	—	—	10 57	+31	14·6	15·2
Ann Arbor E.	B.O.	28·6	88	5 27	−47	10 33	−37	12·8	16·6
N.	B.O.	28·6	88	5 21	−53	10 27	−43	12·6	16·4
Toronto	M.	30·8	82	6 51	+15	12 9	+21	14·0	20·4
Ottawa	—	32·5	78	6 47	− 6	12 13	− 3	e 14·0	19·0
Mobile E.	W.	32·6	110	e 6 47	− 6	i 12 25	+ 7	20·0	21·3
N.	W.	32·6	110	—	—	—	—	19·8	20·3
Ithaca E.	B.O.	33·2	82	7 30	+32	e 13 0	+33	—	20·1
N.	B.O.	33·2	82	7 32	+34	e 12 59	+32	—	20·2
Georgetown E.	—	34·7	89	i 7 8	− 3	12 54	+ 3	e 16·4	19·7
Z.	—	34·7	89	7 51	+40	e 12 26	−25	e 15·4	19·8
Washington	Mar.	34·7	89	i 7 7	− 4	12 51	0	16·6	20·9
Northfield	B.O.	34·8	78	6 54	−17	12 52	0	18·0	—
Cheltenham N.	B.O.	34·9	89	7 12	0	13 0	+ 6	17·6	19·6
E.	B.O.	34·9	89	7 15	+ 3	13 3	+ 9	19·0	20·0
Tacubaya	—	35·7	137	7 0	−19	—	—	—	24·8
Harvard	B.O.	38·8	80	i 7 4	−24	12 47	−34	e 18·7	21·0
Honolulu	M.	38·6	236	e 7 21	−22	e 13 3	−43	e 17·4	22·0
Halifax	—	39·9	72	7 52	− 2	14 19	+ 5	—	—
Balboa Heights	B.O.	54·6	121	9 57	+20	—	—	—	—

Continued on next page:

Station and Component.	Machine.	Δ	Azimuth.	P.	O−C.	S.	O−C.	L.	M.
		°	°	M. S.	S.	M. S.	S.	M.	M.
Vieques N.	B.O.	55·9	101	10 29	+44	18 5	+32	28·8	35·0
E.	B.O.	55·9	101	—	—	17 59	+26	28·1	35·5
Dyce	Ma.	63·0	30	10 45	+13	i 19 45	+44	32·8	39·0
Eskdalemuir	G.	65·7	32	10 55	+ 6	i 19 29	− 4	31·4	35·8
Bidston	M.S.	66·1	35	11 39	+47	20 9	+31	—	42·0
Kew	M.	68·7	35	—	—	—	—	—	44·0
Shide	M.S.	68·9	35	10 22	−48	20 11	− 2	34·8	41·4
De Bilt	—	70·1	29	11 24	+ 6	20 37	+10	e 35·0	36·8
Osaka	O.	70·7	301	11 15	− 6	—	—	—	—
Uccle	—	70·9	31	e 11 23	+ 1	—	—	e 34·0	41·0
Paris	—	71·9	34	—	—	e 19 57	−52	30·0	55·0
Coimbra	—	74·3	45	21 22	?S	(21 22)	+ 4	37·1	39·9
Moncalieri	S.	77·0	32	e 9 25	?	21 57	+ 8	36·1	48·3
Lemberg	B.O.	77·4	20	—	—	e 21 51	− 2	42·0	51·8
Marseilles	Ma.	77·6	35	—	—	—	—	e 40·8	—
Tortosa	—	77·8	40	12 12	+ 6	21 55	− 3	33·1	47·7
Barcelona	—	77·9	38	—	—	e 22 22	+23	e 33·1	47·0
San Fernando	—	78·4	47	—	—	—	—	40·0	46·0
Zi-ka-wei	—	80·9	310	—	—	e 22 8	−26	—	—
Rocca di Papa	Ag.	81·6	30	e 12 27	− 1	e 22 37	− 5	e 40·6	53·6
La Paz	Bi.	82·1	129	e 12 33	+ 2	i 22 54	+ 7	38·6	41·3
Monte Cassino	—	82·2	30	12 37	+ 6	—	—	—	—
Algiers	B.M.	82·3	40	12 25	− 7	22 49	0	43·0	47·4
Pompeii	O.A.	83·2	29	e 13 46	+69	e 19 0	−239	44·5	49·3
Manila	W.	94·5	299	e 12 57	−44	—	—	—	—
Simla	O.E.	97·7	341	10 21	?	—	—	—	49·6
Cipolletti	M.	100·9	140	—	—	—	—	53·0	64·0
Bombay	O.E.	110·5	342	—	—	—	—	—	63·2
Riverview	—	111·8	244	—	—	e 26 39	−65	46·1	52·2
Kodaikanal	M.	117·9	337	2 15	?	—	—	—	—
Melbourne	M.	118·2	245	—	—	—	—	61·4	69·0
Colombo	M.	120·3	333	2 57	?	—	—	—	78·0
Perth	M.	132·8	270	—	—	38 17	?SR_1	—	—
Cape Town	M.	148·5	76	65 27	?L	—	—	(65·4)	89·0
Mauritius E.	M.	151·0	356	77 27	?L	—	—	(77·4)	97·8
N.	M.	151·0	356	72 51	?L	—	—	(72·8)	85·0

Additional records: Berkeley eLN? = +7·1m., T_0 = 8h.41m.8s. Saskatoon T_0 = 8h.40m.56s. Lick T_0 = 8h.41m.2s. Ann Arbor T_0 = 8h.40m.42s. Toronto e = +9m.15s., iL = +17·0m., T_0 = 8h.41m.12s. Epicentre 49°·32N. 127°·0W. Mobile SR_1 = +18m.17s. Ithaca M = +19·5m. Harvard eLE = +20·2m., T_0 = 8h.40m.54s. Halifax T_0 = 8h.40m.57s. Eskdalemuir M = +36·5m., T_0 = 8h.41m.25s. De Bilt MN = +37·2m., T_0 = 8h.41m.13s. Graz T_0 = 8h.41m.23s. Paris MN = +48·0m. Coimbra MN = +41·0m. Marseilles a record at +55m.49s. Riverview eSR_1 = +34m.39s., MN = +54·1m. Colombo M = +9·0m. This may be 1h. in error, but the observations at Simla, Kodaikanal, and Colombo may refer to another shock in India. For note on other repetitions see note at end of this bulletin.

Dec. 6d. 11h. 27m. 40s. At 26°·5S. 70°·5W. (as at 7h. 21m.).

		Δ	Az.	P.	O−C.	S.	O−C.	L.	M.
		°	°	m. s.	s.	m. s.	s.	m.	m.
Andalgala	E.	3·9	107	1 38	+37	—	—	2·5	3·5
La Quiaca		6·1	46	0 50	−43	—	—	1·5	2·1
Pilar		7·8	133	4 56	?S	(4 56)	+85	5·6	6·6
La Paz		10·2	13	2 35	+ 2	—	—	7·7	8·7
Cipolletti		12·6	171	7 8	?	—	—	7·4	10·4

Andalgala gives also MN = +3·0m. For La Quiaca standard time 4h.0m.0s. has been assumed, as on Dec. 4d. 11h. and 17h., etc. Pilar LN = +5·4m., MN = +6·1m.

Dec. 6d. 12h. 3m. 0s. Epicentre 49°·0N. 124°·0W. (as at 8h.).

(Some of the more distinct observations may refer to another shock near Cheltenham).

		Δ	Az.	P.	O−C.	S.	O−C.	L.	M.
		°	°	m. s.	s.	m. s.	s.	m.	m.
Victoria		0·8	141	−0 9	−21	0 21	− 1	—	1·3
	Z.	0·8	141	0 32	+20	1 8	+46	—	1·4
Sitka	E.	10·5	324	e 4 9	?S	(e 4 9)	−34	e 4·8	—
	N.	10·5	324	e 4 24	?S	(e 4 24)	−19	e 5·0	—
Berkeley		11·2	173	e 3 5	+18	—	—	—	—
Lick		12·1	171	e 2 12	−48	—	—	—	—
Lawrence	E.	22·8	105	5 17	+ 2	9 48	+27	12·9	—
	N.	22·8	105	5 19	+ 4	9 52	+31	13·0	—
St. Louis		26·2	101	7 54	+124	—	—	e 14·6	—
Ann Arbor		28·6	88	—	—	12 0	+50	15·5	16·0
Toronto		30·8	82	—	—	—	—	15·5	18·7
Ottawa		32·5	78	e 10 44	+231	12 0	−16	e 16·6	19·0
Mobile		32·6	110	—	—	—	—	e 18·3	—
Ithaca		33·2	82	—	—	—	—	e 16·0	19·3
Washington		34·7	89	—	—	—	—	e 17·0	19·7
Georgetown	E.	34·7	89	e 10 45	?S	18 34	?L	(18·6)	—
	N.	34·7	89	e 11 29	?S	18 34	?L	(18·6)	—
Northfield		34·8	78	—	—	—	—	18·0	—
Cheltenham		34·9	89	18 28	?L	19 40	?	22·0	22·8
Tacubaya		35·7	137	17 57	?L	—	—	(18·0)	18·8
Harvard	N.	36·8	80	e 15 43	?SR_1	—	—	e 19·3	—
	E.	36·8	80	19 14	?L	—	—	20·9	21·2
De Bilt		70·1	29	—	—	e 24 12	?SR_1	e 37·0	38·9

Additional records: St. Louis iE = +14m.48s., eE = +17m.12s. Ithaca LE = +21·7m. Georgetown i = +9m.21s. Cheltenham PE? = +19m.8s.

Dec. 6d. Records also at 0h. (La Paz), 4h. (La Paz), 6h. (Colombo and Rio Tinto), 8h. (Zagreb), 10h. (La Paz and Taihoku), 11h. (Rocca di Papa and Honolulu), 16h. (Zi-ka-wei), 21h. (Manila (2) and San Fernando), 22h. (Mizusawa), 23h. (La Paz).

Dec. 7d. 12h. 39m. 35s. Epicentre 26°·5S. 70°·5W. (as on Dec. 6d. 11h., etc.).

A = +·299, B = −·844, C = −·446.

		Δ	Az.	P.	O−C.	S.	O−C.	L.	M.
		°	°	m. s.	s.	m. s.	s.	m.	m.
Andalgala	E.	3·9	107	0 55	− 6	—	—	1·7	2·2
	N.	3·9	107	1 7	+ 6	—	—	—	1·9
La Quiaca		6·1	46	1 31	− 2	(2 7)	−39	2·1	2·6
Pilar		7·8	133	—	—	—	—	4·5	5·4
La Paz		10·2	13	2 30	− 3	4 41	+ 6	5·4	6·3
Cipolletti		12·6	171	6 37	?L	—	—	7·3	7·8
Edinburgh		100·1	32	30 25	?SR_1	—	—	—	—
Helwan		112·4	67	66 25	?L	—	—	(66·4)	—

For La Quiaca standard time for 4h.0m.0s. west of Greenwich has been assumed as on previous days.

Dec. 7d. Records also at 1h. (Riverview), 8h. (Helwan), 12h. (Manila), 19h. (La Paz), 22h. (Manila, Lick, and Colombo), 23h. (Batavia).

Dec. 8d. Records at 0h. (San Fernando), 1h. (Eskdalemuir), 4h. (Helwan), 9h. (Taihoku, La Paz, and Copolletti), 10h. (Helwan and Edinburgh), 12h. (Andalgala), 18h. (Athens), 19h. (Melbourne), 20h. (Helwan), 23h. (Batavia),

Dec. 9d. 1h. 12m. 30s. Epicentre 46°·7N. 145°·8E.

$A = -\cdot567$, $B = +\cdot386$, $C = +\cdot728$; $D = +\cdot562$, $E = +\cdot827$; $G = -\cdot602$, $H = +\cdot409$, $K = -\cdot686$.

Compare with 1918 May 31d., 45°·1N. 147°·2E. The evidence is against identity of the two.

		Δ	Az.	P.	O−C.	S.	O−C.	L.	M.
		°	°	m. s.	s.	m. s.	s.	m.	m.
Mizusawa	E.	8·3	206	2 4	− 2	3 45	—	—	—
	N.	8·3	206	2 12	+ 6	3 47	+ 2	—	—
Zi-ka-wei		24·3	239	e 5 35	+ 4	—	—	—	—
Honolulu		51·7	99	—	—	—	—	e 26·1	30·5
De Bilt		75·6	336	—	—	—	—	e 43·5	44·0
Graz		76·6	328	11 54	− 5	—	—	—	—
Rocca di Papa		82·2	326	e 12 23	− 8	—	—	—	12·7
Helwan		83·4	308	51 30	?L	—	—	(51·5)	—

Additional records: De Bilt gives eLN = +44·5m. Rocca di Papa M = +14·4m.

Dec. 9d. 4h. 8m. 22s. Epicentre 5°·7S. 151°·8E.

$A = -\cdot877$, $B = +\cdot470$, $C = -\cdot099$.

	Δ	Az.	P.	O−C.	S.	O−C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Riverview	28·2	181	e 6 10	0	e 11 3	0	e 14·7	15·7
Manila	36·7	305	7 27	− 1	—	—	—	—
Perth	42·6	228	—	—	14 54	+11	—	—
Zi-ka-wei	46·9	324	e 8 43	− 3	e 15 47	+ 7	—	—
Honolulu	56·1	59	—	—	—	—	e 23·6	35·6
Victoria	90·8	41	43 25	?	48 20	?	55·8	57·2
Helwan	119·1	302	27 38	?	—	—	—	—
Toronto	121·3	40	—	—	—	—	e 72·2	75·0
De Bilt	126·1	335	—	—	—	—	e 64·6	66·1
Eskdalemuir	126·5	341	—	—	—	—	65·6	—
La Paz	134·7	121	19 43	[+14]	i 24 15	?PR_1	—	—
Rocca di Papa	141·4	321	i 19 25	[−17]	—	—	—	—

Additional records: Riverview gives $PR_1 = +7$m.17s., iS = +11m.7s., PS = +11m.38s., MN = +15·6m., MZ = +17·4m.

Dec. 9d. 10h. 58m. 30s. Epicentre 26°·5S. 70°·5W. (as on Dec. 6d. 11h., etc.).

$A = +\cdot299$, $B = -\cdot844$, $C = -\cdot446$.

But it seems doubtful whether the epicentre is really the same.

	Δ	Az.	P.	O−C.	S.	O−C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Andalgala	3·9	107	0 48	−13	(2 30)	+43	2·5	3·6
La Quiaca	6·1	46	4 0	+147	—	—	5·3	6·2
La Paz	10·2	13	3 34	+61	e 6 3	+88	6·8	7·6
Cipolletti	12·6	171	7 6	+239	—	—	7·6	8·6

Andalgala gives also PN = +1m.6s., LN = +1m.54s., MN = +2·6m. For La Quiaca standard time 4h.0m.0s. has been assumed as previously in December. But the residuals suggest some error (or series of errors) of whole minutes at one or more of the stations.

1918. Dec. 9d. 18h. 3m. 45s. (I)
18h. 52m. 47s. (II) } Epicentre **52°·0N. 178°·0W.**

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

These are reduced with the same epicentre for convenience of reference, but the residuals indicate that the second shock was nearer Manila (and Victoria?) and further from De Bilt, Graz, and Zagreb. If so, further south.

Station and Component.	Machine.	△	Azimuth.	P.	O—C.	S.	O—C.	L.	M.
		°	°	M. S.	S.	M. S.	S.	M.	M.
(II) Tokyo	O.	33·9	259	e 8 12	+68	16 58	?L	(17·0)	—
(I) Honolulu	M.	34·4	146	e 12 33	?S	(e 12 33)	−13	e 17·9	21·2
(II)	M.	34·4	146	e 8 13	?PR_1	i 14 1	?SR_1	19·2	23·2
(I) Victoria	M.	34·4	76	6 19	−49	(12 13)	−33	12·2	21·6
(II)	M.	34·4	76	—	—	(11 54)	−52	11·9	23·8
(II) Kobe	O.	37·3	262	(e 7 20)	−12	(13 13)	−15	13·2	18·4
(I) Berkeley	—	40·8	90	—	—	—	—	e 19·8	—
(I) Zi-ka-wei	—	48·2	271	e 8 36	−19	e 15 28	−28	—	—
(II)	—	48·2	271	e 8 52	− 3	e 15 50	− 6	—	—
(II) Tucson E.	B.O.	51·5	85	28 33	?L	—	—	(28·6)	53·4
(I) Taihoku	O.	52·5	265	e 6 15	?	—	—	—	—
(I) St. Louis	W.	59·3	67	—	—	e 18 15	0	e 31·8	—
(II)	W.	59·3	67	i 10 13	+ 6	e 18 22	+ 7	33·2	—
(I) Ann Arbor E.	B.O.	60·2	59	—	—	28 51	?	33·2	37·2
(I) N.	B.O.	60·2	59	—	—	28 45	?	32·2	36·2
(I) E.	W.	60·2	59	—	—	28 33	?	31·6	36·7
(II) E.	B.O.	60·2	59	—	—	—	—	31·2	35·2
(II) E.	W.	60·2	59	—	—	—	—	29·2	34·2
(I) Manila	W.	60·8	259	e 10 19	+ 1	—	—	—	—
(II)	W.	60·8	259	e 10 3	−15	—	—	18·4	20·0
(I) Toronto	M.	61·5	55	—	—	—	—	31·4	40·4
(II)	M.	61·5	55	—	—	—	—	38·8	40·3
(I) Ottawa	—	62·0	51	—	—	e 26 45	?	e 31·8?	—
(II)	—	62·0	51	—	—	—	—	32·2	—
(I) Ithaca	B.O.	63·8	54	—	—	—	—	e 36·2	—
(II)	B.O.	63·8	54	19 13	?S	(19 13)	+ 2	e 34·5	—
(I) Georgetown	—	66·1	58	—	—	—	—	e 37·7	—
(II)	—	66·1	58	—	—	—	—	e 33·2	—
(I) Washington	Mar.	66·1	58	—	—	e 37 15	?L	40·8	—
(II)	Mar.	66·1	58	10 47	− 5	24 49	?SR_1	e 34·8	—
(I) Cheltenham N.	B.O.	66·4	59	—	—	—	—	41·1	44·2
(II) N.	B.O.	66·4	59	—	—	—	—	35·6	44·4
(I) Harvard	B.O.	66·5	50	e 17 15	?	—	—	e 30·3	41·3
(II)	B.O.	66·5	50	e 27 41?	?SR_1	—	—	e 31·2	38·6
(I) Edinburgh	M.	72·0	3	21 15	?S	(21 15)	+25	—	—
(II)	M.	72·0	3	—	—	—	—	—	53·7
(I) Eskdalemuir	G.	72·5	3	—	—	i 20 56	0	46·2	—
(I) Bidston	M.S.	74·5	2	21 27	?S	(21 27)	+ 7	—	40·0
(I) De Bilt	—	75·8	357	e 12 9	+15	e 22 3	+28	e 38·2	39·9
(II)	—	75·8	357	—	—	22 34	+59	e 38·2	39·9
(II) Kew	M.	76·5	2	—	—	—	—	—	53·2
(I) Paris	—	79·2	0	—	—	—	—	e 48·2	—
(II)	—	79·2	0	—	—	—	—	—	55·2
(I) Budapest E.	—	79·5	350	—	—	—	—	46·2	—
(I) Graz	W.	80·2	352	e 12 15	− 5	22 15	−10	—	—
(II)	W.	80·2	352	i 12 27	+ 7	22 44	+19	—	—
(I) Zagreb	W.	81·4	351	12 21	− 6	e 22 32	− 7	48·2	55·2
(II)	W.	81·4	351	12 35	+ 8	22 53	+14	48·2	57·2
(I) Moncalieri	S.	82·9	357	—	—	—	—	53·3	—
(II) Batavia	W.	85·8	258	e 13 13	+21	—	—	—	25·2
(I) Rocca di Papa	Ag.	85·8	352	12 36	−16	—	—	e 52·9	62·2
(II)	Ag.	85·8	352	12 54	+ 2	e 23 26	− 2	e 58·6	60·9

Continued on next page.

Station and Component.	Machine.	Δ	Azimuth.	P.	O−C.	S.	O−C.	L.	M.
		°	°	M. S.	S.	M. S.	S.	M.	M.
(II) Barcelona	—	86·5	0	e 52 9	?L	—	--	e 54·7	59·1
(I) Rio Tinto	M.	89·9	7	50 15	?L	—	—	(50·2)	--
(II)	M.	89·9	7	—	—	—	—	—	63·2
(I) Riverview	—	90·0	205	e 20 11	?	—	—	—	50·1
(II)	—	90·0	205	e 13 17	+ 1	e 23 30	−44	—	51·4
(I) Kodaikanal	M.	90·7	290	48 45	?L	—	—	(48·8)	—
(I) Algiers	B.M.	91·2	359	—	—	e 25 15	+49	64·2	—
(II)	B.M.	91·2	359	—	—	—	—	—	64·2
(I) San Fernando	—	91·3	6	51 45	?L	—	—	(51·8)	—
(II)	—	91·3	6	—	—	—	—	—	64·7
(I) Colombo	M.	91·9	285	54 15	?L	—	—	(54·2)	—
(II)	M.	91·9	285	—	—	—	—	—	66·2
(I) Helwan	M.	94·2	335	25 15	?S	(25 15)	+17	—	—
(I) La Paz	Bi.	115·1	89	e 19 59?	?PR$_1$	—	—	74·1	82·1
(II) Cape Town	M.	158·3	320	38 49	?S	(38 49)	?	—	101·8

Additional records: Honolulu (I) gives iS = +14m.39s., ?iSR$_1$. Victoria (I) S = +8m.46s., ?PR$_1$. Kobe (II) S = +10m.45s. (?PR$_1$), MN = +19·0m. Tucson L = +50·5m. Ann Arbor (II) LN = +30·2m., MN = +37·2m., and +38·2m. Manila (II) MN = +20·3m. Toronto and Ottawa record several other L's. Ithaca (II) LE = +37·2m. Georgetown (I) and (II) records several L's on both horizontal components. Washington (II) L = +38·7m. Cheltenham (I) LE = +40·8m., (II) LE = +38·1m., ME = +43·5m. Harvard (I) LE = +36·3m., MN = +40·4m., (II) LE = +32·3m., MN = +42·1m. Eskdalemuir (I) i = +20m.56s., +23m.51s., and +25m.46s. Bidston gives S = 26m.39s. (?SR$_1$). Zagreb (I) MNW = +49·2m., (II) MNW = +52°2m. Rocca di Papa (I) M = +13·3m., (II) eL = +53·8m. Riverview (I) ePR$_2$? = +24m.54s., MN = +44·3m., (II) MN = +51·2m. San Fernando (II) MN = +65·2m.

Dec. 9d. Records also at 1h. (Taihoku), 5h. (Tokyo (5)), 12h. (Helwan), 15h. (Athens), 17h. (Osaka), 18h. (Zi-ka-wei, Osaka, and Kobe), 20h. (Manila).

Dec. 10d. Records at 0h. (Helwan and Rocca di Papa), 1h. (Athens and La Paz), 9h. (Calcutta, Rocca di Papa, and Simla), 10h. (Rocca di Papa and Riverview), 16h. (Tokyo), 17h. (Riverview, La Paz, Manila, Honolulu, and Perth), 19h. and 21h. (La Paz).

Dec. 11d. 17h. 46m. 42s. Epicentre 0°·5N. 82°·0W. (as on 1917 May 3d.).

A = +·139, B = −·990, C = +·009; D = −·990, E = −·139;
G = +·001, H = −·009, K = −1·000.

		Δ	Az.	P.	O−C.	S.	O−C.	L.	M.
		°	°	m. s.	s.	m. s.	s.	m.	m.
Balboa Heights	N.	8·8	16	2 8	− 5	—	—	5·7	5·9
	E.	8·8	16	2 32	+19	—	—	4·1	4·2
La Paz		21·8	142	5 4	+ 1	9 3	+ 2	11·5	14·9
La Quiaca	E.	27·7	146	13 48	?L	—	—	14·8	15·8
Andalgala	E.	31·9	152	16 36	?L	—	—	17·6	18·4
Pilar	E.	36·5	152	—	—	—	—	21·8	22·9
Cipolletti		41·5	164	—	—	—	—	22·8	26·7
Rio de Janeiro	E.	44·4	125	—	—	e 20 30	?	21·6	21·8
	E.	44·4	125	—	—	e 20 30	?	22·0	22·1
Edinburgh		83·3	34	46 18	?L	—	←	(46·3)	—
De Bilt		87·8	38	—	—	—	—	e 40·3	—
Helwan		109·8	58	65 18	?L	—	—	(65·3)	—

Additional records: La Paz gives i = +11m.43s. and +12m.12s. T_o = 7h.46m.48s. La Quiaca PN = 13m.54s., MN = +14·8m. For La Quiaca it is assumed that standard time 4h. 0m. 0s. is used as before.

Dec. 11d. Records also at 2h. (Kobe), 7h. (Perth), 9h. (Dehra Dun), 10h. (Manila), 13h. (Osaka), 14h. (Manila), 19h. (Batavia), 20h. (San Fernando), 21h. (Melbourne), 22h. (La Paz).

Dec. 12d. Records at 3h. (Harvard), 8h. (Balboa Heights), 10h. (Helwan), 12h. (La Paz (2)), 14h. (La Paz), 16h. (Manila), 23h. (San Fernando and La Paz).

Dec. 13d. 1h. 18m. 40s. Epicentre 26°·5S. 70°·5W. (as on 1918 Dec. 9d. 10h., etc.).

$A = +\cdot299$, $B = -\cdot844$, $C = -\cdot446$.

	Δ	Az.	P.	O−C.	S.	O−C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Andalgala	3·9	107	−1 10	−131	—	—	−0·2	0·6
La Quiaca	6·1	46	—	—	—	—	4·3	4·8
Pilar	7·9	133	—	—	—	—	4·1	7·6
La Paz	10·2	13	e 2 34	+ 1	4 34	− 1	5·3	6·0
Cipolletti	12·6	171	6 26	?L	—	—	6·7	7·7
Helwan	112·4	67	13 20	−109	—	—	—	—

Andalgala gives P at 1h.17m.30s. and L at 1h.18m.32s. For La Quiaca standard time 4h.0m.0s. west of Greenwich is assumed as before. Pilar gives LN = +4·2m., MN = +7·4m.

Dec. 13d. Records also at 0h. (Cipolletti), 1h. (La Paz), 2h. and 3h. (Helwan), 10h. (Monte Cassino), 11h. (La Paz), 12h. (La Paz and Perth), 15h. (Tokyo), 19h. (Manila), 21h. (Athens, Mizusawa, Osaka, and Ootomari), 22h. (De Bilt and Manila).

Dec. 14d. 18h. 39m. 15s. Epicentre 13°·0S. 166°·8E. (as on 1918 March 20d. 1h.).

$A = -\cdot949$, $B = +\cdot222$, $C = -\cdot225$; $D = +\cdot228$, $E = +\cdot974$; $G = +\cdot219$, $H = -\cdot051$, $K = -\cdot974$.

The antipodal stations suggest a deep focus, and the evidence of Apia and Batavia in opposite azimuths supports this view. Hence a focal depth of 0·030 radius below normal has been adopted. Possibly the same supposition is applicable on 1918 Mar. 20d., but the material is not sufficiently decisive.

Station and Component.	Corr. for Focus	Δ	Az.	P.	O−C.	S.	O−C.	L.	M.
	°	°	°	M. S.	S.	M. S.	S.	M.	M.
Apia	−1·2	20·8	95	i 4 38	+ 2	—	—	9·2	—
Riverview	−1·6	24·8	213	e 5 17	− 2	i 9 26	− 3	e 10·8	11·0
Perth	−3·1	50·3	239	11 44	?PR_1	15 54	+10	17·2	—
Manila	−3·3	53·2	300	e 9 11	+ 5	(16 27)	+ 9	16·4	17·0
Batavia	−3·6	59·4	270	e 9 47	+ 2	—	—	—	19·8
Victoria	−4·2	86·9	36	—	—	—	—	20·3	51·0
Colombo	−4·2	88·7	277	22 45	?S	(22 45)	−29	—	—
Toronto	−4·7	116·1	47	—	—	(23 33)	?	58·6	71·0
La Paz	−4·7	118·1	117	e 20 0	?PR_1	(30 50)	+173	30·8	—
Harvard	−4·8	122·3	48	—	—	—	—	62·2	—
Helwan	—	135·6	300	22 45	?PR_1	—	—	—	—
De Bilt	—	138·2	343	e 22 53	?PR_1	—	—	—	—
Graz	—	138·3	330	22 36	?PR_1	e 47 27	?	—	—
Zagreb	—	139·0	328	19 6	[−32]	—	—	—	22·8
Rocca di Papa	—	143·5	326	19 17	[−29]	—	—	—	19·5
Tortosa	—	149·7	339	19 38	[−17]	—	—	20·5	20·9
San Fernando	—	155·7	346	44 45	?SR_1	—	—	—	110·2

Additional records: Riverview gives PS = +9m.45s. Victoria M = +24·2m. Harvard eLE = +60·8m. De Bilt eN = +23m.0s.

Dec. 14d. Records also at 0h. (San Fernando), 4h. (Helwan), 8h. (Tokyo), 14h. (La Paz), 15h. (Melbourne), 16h. (Manila and Riverview), 19h. (Zagreb, Rocca di Papa, and Tortosa), 21h. (La Paz, Andalgala, La Quiaca, Cipolletti, and Pilar), 22h. (Helwan).

Dec. 15d. Records at 3h. (Monte Cassino), 8h. (Manila), 11h. (Tokyo), 21h. (Perth).

Dec. 16d. 3h. 3m. 20s. Epicentre 12°·0N. 95°·0E (as on 1918 Jan. 18d.).

A = −·085, B = +·974, C = +·208; D = +·996, E = +·087; G = −·018, H = +·207, K = −·978.

		Δ	Az.	P.	O−C.	S.	O−C.	L.	M.
		°	°	m. s.	s.	m. s.	s.	m.	m.
Colombo		15·8	252	3 52	+ 3	—	—	9·1	10·7
Batavia		21·6	150	—	—	e 8 40	−17	—	15·7
Manila		25·5	83	—	—	e 11 3	+50	—	—
Mauritius	E.	48·6	229	6 52	−126	—	—	—	10·7
	N.	48·6	229	8 52	− 6	—	—	—	11·5
Helwan		61·3	298	16 40	?	—	—	—	—
Riverview		70·4	133	e 17 16	?PR_1	—	—	e 43·1	51·4
Zagreb		73·9	314	i 11 49	+ 8	—	—	—	—
Rocca di Papa		76·3	312	11 43	−14	(20 28)	−73	e 20·5	21·6
Capetown		85·8	234	28 16	?SR_1	—	—	—	33·3
San Fernando	E.	91·7	310	54 40	?L	—	—	(54·7)	—
La Paz		163·1	253	20 11	[+ 1]	—	—	72·0	76·2

Riverview gives MN = +47·1m.

Dec. 16d. 10h. 11m. 20s. Epicentre 26°·3N. 121°·5E.

A = −·468, B = +·764, C = +·443; D = +·853, E = +·522; G = −·231, H = +·378, K = −·896.

		Δ	Az.	P.	O−C.	L.	M.
		°	°	m. s.	s.	m.	m.
Taihoku		1·3	179	0 16	− 4	—	—
Zi-ka-wei		4·9	359	e 1 19	+ 3	—	—
Manila		11·7	182	e 2 57	+ 2	—	—
Helwan		77·4	297	17 40	?PR_1	—	—
Hohenheim		83·7	321	e 13 55	+75	—	—
De Bilt	E.	84·0	326	e 13 6	+24	15·7	16·1
	N.	84·0	326	e 13 13	+31	—	16·6
Uccle		85·1	325	—	—	—	35·5
Rocca di Papa		85·4	315	—	—	e 16·0	17·7
Eskdalemuir		85·8	331	(18 40)	?PR_1	18·7	—

Zi-ka-wei gives its record 10m. too soon.

Dec. 16d. 20h. 20m. 10s. Epicentre 14°·0N. 60°·0E (as on 1917 Dec. 5d.).

A = +·485, B = +·840, C = +·242.

	Δ	P.	O−C.	S.	O−C.	L.	M.
	°	m. s.	s.	m. s.	s.	m.	m.
Colombo	20·7	4 50	+ 1	—	—	—	—
Helwan	30·8	6 50	+14	—	—	—	—
De Bilt	57·7	12 38	?PR_1	—	—	e 15·5	16·1
Paris	58·3	—	—	17 50	−13	—	—
Shide	61·1	—	—	19 25	+48	—	—

Eskdalemuir (Δ = 85°·8) gives 20h. 34m. to 20h. 49m.

Dec. 16d. Records also at 1h. (Rocca di Papa and Zagreb), 4h. (Zagreb), 8h. (Tokyo), 10h. (La Paz and Rocca di Papa), 20h. (Graz and Rocca di Papa), 21h. (Manila, Melbourne, and Riverview).

Dec. 17d. Records at 0h. and 2h. (San Fernando), 8h. (Helwan), 13h. (Kobe), 14h. (Mizusawa), 23h. (San Fernando).

Dec. 18d. 17h. 15m. 55s. Epicentre 25°·0N. 119°·5E. (as on 1918 Jan. 15d.).

A = −·446, B = +·789, C = +·423.

	Δ	Az.	P.	O−C.	S.	O−C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Hokoto	1·5	179	0 25	+ 2	—	—	—	—
Taihoku	1·9	89	—	—	0 55	+ 2	1·3	—
Zi-ka-wei	6·4	15	e 1 58	+20	—	—	—	5·1
Manila	10·5	172	e 2 29	− 8	—	—	4·2	4·7
De Bilt	84·1	326	—	—	—	—	e 48·1	—
Bidston	87·2	330	—	—	—	—	—	49·1

Dec. 18d. Records also at 6h. (Riverview), 11h. (Helwan), 12h. (Tokyo), 15h. (Manila), 16h. (La Paz), 21h. (Batavia, Colombo, Zi-ka-wei, Kodaikanal, and Manila), 22h. (Helwan and San Fernando).

Dec. 19d. 19h. 23m. 0s. Epicentre 11°·0S. 165°·0E. (as on 1918 Aug. 23d.).
A = −·948, B = +·254, C = −·191; D = +·259, E = +·966; G = +·184, H = −·049, K = −·982.

		Δ	Az.	P.	O−C.	S.	O−C.	L.	M.
		°	°	m. s.	s.	m. s.	s.	m.	m.
Apia		22·8	100	—	—	—	—	7·0	—
Riverview		26·1	207	—	—	e 10 12	−12	e 14·0	17·8
Melbourne		32·3	210	—	—	13 0	+47	18·4	20·8
Adelaide		33·9	221	—	—	—	—	—	24·0
Perth		49·8	237	—	—	15 48	−28	—	—
Victoria		86·5	39	—	—	—	—	48·0	57·4
Colombo		86·6	277	65 0	?L	—	—	(65·0)	70·0
Kodaikanal		89·6	280	67 0?	?L	—	—	(67·0?)	—
Toronto		115·9	46	—	—	—	—	61·0	—
Ottawa	E.	118·1	44	—	—	—	—	e 77·0	—
Andalgala	E.	117·1	129	44 36	?L	—	—	(44·6)	57·6
Helwan		133·1	301	89 0	?L	—	—	(89·0)	—
San Fernando		153·4	344	93 0	?L	—	—	(93·0)	—

Additional records: Riverview gives MN = +15.2m. San Fernando PN = +92m.0s.

Dec. 19d. Records also at 4h. (Tokyo), 5h. (San Fernando), 7h. (La Paz), 12h. (Rocca di Papa and Manila).

Dec. 20d. Records at 0h. (Manila), 2h. (La Paz), 4h. (Tokyo), 6h. (Kodaikanal), 7h. (Apia), 9h. (La Paz), 10h. (Helwan), 22h. (Kobe).

Dec. 21d. 9h. 24m. 40s. Epicentre 1°·0N. 70°·0W. (as on 1918 Mar. 16d.).
A = +·342, B = −·940, C = +·018; D = −·940, E = −·342; G = +·006, H = −·016, K = −1·000.

		Δ	Az.	P.	O−C.	S.	O−C.	L.	M.
		°	°	m. s.	s.	m. s.	s.	m.	m.
Balboa Heights	E.	12·4	311	3 6	+ 1	—	—	5·2	5·2
	N.	12·4	311	3 9	+ 4	—	—	5·2	5·3
La Paz		17·6	174	i 4 3	− 9	i 7 13	−18	8·1	8·3
Port au Prince		17·7	353	e 4 59	+46	—	—	—	5·3
Vieques		17·7	14	(5 14)	+61	—	—	5·8	12·5
La Quiaca	E.	23·6	172	5 20	− 4	(9 8)	−28	9·1	9·6
Andalgala	E.	28·8	173	—	—	11 38	+25	(11·6)	12·6
Pilar	N.	33·2	170	11 50	?S	(11 50)	−37	—	13·9
Georgetown	N.	38·4	352	7 41	0	—	—	e 17·4	—
	E.	38·4	352	7 44	+ 3	13 43	− 1	22·3	—
Washington		38·4	352	7 40	− 1	13 12	−32	22·3	—
Cipolletti		39·6	177	12 56	?S	(12 56)	−64	14·7	16·0
Harvard	N.	41·4	359	i 8 1	− 5	(e 9 59)	?	e 10·0	—
Ithaca		41·8	354	e 8 46	+37	14 34	+ 2	19·6	—
Ann Arbor		43·1	345	8 20	+ 1	—	—	—	—
Toronto		43·4	350	—	—	15 2	+ 8	e 22·8	24·9
Ottawa		44·7	354	8 34	+ 3	15 12	+ 1	e 20·8	—
Victoria		65·8	324	13 53	?PR_1	18 19	−76	27·6	38·5
Coimbra		68·0	46	10 46	−18	20 2	0	34·0	—
San Fernando	E.	68·6	51	20 50	?S	(20 50)	+41	—	—
Eskdalemuir		76·1	33	—	—	21 20	−18	—	—
Edinburgh		76·4	32	16 50	?	—	—	—	23·8
Kew		76·7	37	—	—	—	—	—	23·3
De Bilt	E.	80·1	37	—	—	22 52	+28	39·3	42·4
	N.	80·1	37	—	—	e 23 20	+56	37·8	38·4
Rocca di Papa		83·9	48	—	—	(e 23 32)	+ 24	e 23·5	28·5
Graz		86·2	42	e 16 54	?PR_1	i 23 32	0	—	—
Zagreb		86·5	44	e 16 59	?PR_1	—	—	—	23·6
Helwan		99·3	60	24 20	?S	(24 20)	−32	—	—

Additional records: Vieques gives MN = +10·4m. For La Quiaca standard time 4h.0m.0s. has been assumed as before. Andalgala MN = +13·1m. Pilar PE = +11m.38s. Georgetown iN = +8m.16s., T_e = 9h.24m.44s. Harvard eN = +8m.42s., iN = +8m.48s., eE = +16m.6s., eN = +17m.54s., T_e = 9h.21m.12s. Ithaca e = +17m.50s. Ottawa LN = +26·3m., T_e = 9h.24m.51s. Coimbra LN = +31·6m., T_e = 9h.24m.9s. San Fernando PN = +21m.20s. De Bilt ePR_1E = +16m.28s.

Dec. 21d. Records also at 2h. (Helwan), 4h. (Batavia and Manila), 9h. (Osaka), 10h. (Mizusawa and Tokyo), 12h. (Denver), 15h. (Batavia), 17h. (Fordham and Batavia), 19h. (Manila), 20h. (Batavia), 21h. (Fordham), 23h. (San Fernando).

Dec. 22d. 21h. 2m. 13s. Epicentre 38·°5N. 142°·5E.

A = −·621, B = +·476, C = +·623.

	Δ	P.	O−C.	S.	O−C.	L.	M.
	°	m. s.	s.	m. s.	s.	m.	m.
Mizusawa	1·2	0 17	− 1	0 31	− 2	—	—
Tokyo	3·6	0 52	− 4	1 29	−10	—	—
Osaka	6·8	2 7	+23	(3 13)	+ 8	3·2	5·0
Kobe	7·1	1 56	+ 8	(3 18)	+ 5	3·3	3·8
De Bilt	82·1	—	—	—	—	e 46·8	51·8
Helwan	86·3	56 47	?L	—	—	(56·8)	—
San Fernando	99·7	54 47	?L	—	—	(54·8)	—

Additional records : Mizusawa gives PN = +18s.

Dec. 22d. Records also at 1h. and 8h. (Helwan), 17h. (Manila and La Paz).

Dec. 23d. 19h. 40m. 15s. Epicentre 33°·6N. 116°·4W. (as on 1918 April 21d.).

A = −·370, B = −·746, C = +·553 ; D = −·896, E = +·445 ;
G = −·246, H = −·496, K = −·883.

		Δ	Az.	P.	O−C.	S.	O−C.	L.	M.
		°	°	m. s.	s.	m. s.	s.	m.	m.
Tucson	E.	4·8	104	14 20	?	—	—	19·2	20·5
Berkeley		6·4	313	e 21 15	?	—	—	—	—
Victoria		15·7	343	—	—	—	—	—	32·0
Ann Arbor	E.	27·0	62	—	—	14 57	?L	18·8	24·8
Toronto		30·3	60	12 33	?S	18 27	?L	(18·4)	22·0
Georgetown		31·9	69	e 16 49	?L	18 25	?	(16·8)	—
Washington		31·9	69	e 18 10	?L	—	—	e 19·1	—
Cheltenham	E.	32·0	69	15 31	?	—	—	19·6	20·0
	N.	32·0	69	14 36	?	—	—	19·2	20·0
Ithaca	E.	32·3	62	—	—	e 14 0	+107	18·9	—
Ottawa		33·1	57	—	—	e 15 45	?L	e 19·8	—
Balboa Heights		41·8	117	6 45	−84	—	—	—	—
Vieques	E.	47·8	94	9 16	+23	—	—	19·9	20·2
	N.	47·8	94	9 25	+32	15 35	−16	20·1	—
La Paz		68·0	130	e 10 55	− 9	e 20 19	+17	34·2	36·3
Bidston		75·6	34	—	—	—	—	—	42·8
De Bilt		80·3	32	—	—	—	—	e 48·8	51·1
San Fernando		84·4	49	40 55	?L	—	—	(40·9)	—
Helwan		109·5	29	66 45	?L	—	—	(66·8)	—
Cape Town		142·8	103	64 27	?L	—	—	(64·4)	70·0

Additional records : Toronto gives e = +5m.45s. and +11m.3s., eL = +20·0m. and + 20·8m., T_o = 19h.45m.18s. Georgetown SN? = +18m.23s. Ottawa L = +29·8m. La Paz iP = +11m.5s., T_o = 19h.39m.44s. San Fernando PN = +33m.15s.

Dec. 23d. Records also at 0h. (Taihoku), 3h. (Helwan, La Paz, Manila (2), and Batavia), 4h. (Manila), 5h. (Helwan), 7h. (Rio Tinto), 9h. (Batavia and Colombo), 10h. (Helwan), 12h. (Taihoku), 13h. (Helwan), 20h. (Honolulu).

Dec. 24d. Records at 0h. (San Fernando and Tokyo), 1h. (Helwan), 5h. (Mauritius), 7h. (Rio Tinto), 12h. (Zi-ka-wei), 13h. (De Bilt), 14h. (San Fernando), 19h. (Helwan), 21h. (Batavia), 22h. (Kobe).

1918. Dec. 25d. 10h. 21m. 10s. Epicentre 7°·0S. 153°·0E.

A = −·884, B = +·451, C = −·122; D = +·454, E = +·891;
G = +·109, H = −·055, K = −·992.

Although there is no direct evidence from antipodal stations, a focal depth 0·070 has been assumed: see Note at end for the argument.

Station and Component.	Machine.	Corr. for Focus	Δ	Azimuth.	P.	O−C.	S.	O−C.	L.	M.
		°	°	°	M. S.	S.	M. S.	S.	M.	M.
Riverview	—	−3·8	26·9	183	e 5 6	−12	i 9 6	−21	e 11·2	11·5
Sydney	M.	−3·8	26·9	183	—	—	9 8	−19	11·5	12·0
Adelaide	M.	−4·3	30·9	201	10 21	?S	(10 21)	−12	15·8	16·8
Melbourne	M.	−4·4	31·6	192	—	—	10 14	−31	12·9	17·1
Manila	W.	−5·2	38·4	306	e 6 50	− 8	—	—	—	—
Taihoku	O.	−5·7	44·3	320	—	—	—	—	—	13·9
Tokyo	O.	−5·8	44·4	347	7 43	0	13 30	−16	—	—
Osaka	O.	−5·8	44·8	342	7 42	− 4	(13 47)	− 5	13·8	16·2
Batavia	W.	−5·8	45·8	271	7 57	+ 2	—	—	—	18·8
Mizusawa	O.	−5·9	47·4	350	7 56	−11	14 9	−19	—	—
Zi-ka-wei	—	−6·0	48·7	324	8 15	− 1	i 14 53	+ 9	—	—
Honolulu	M.	−6·4	55·7	60	8 2	−60	i 15 14	−56	e 28·0	31·7
Calcutta E.	O.E.	−7·5	69·8	299	10 2	−25	19 26	+34	—	—
Colombo	M.	−7·9	74·3	280	10 50	− 4	(19 50)	+ 8	19·8	21·3
Kodaikanal	M.	−8·1	77·2	283	20 56	?S	(20 56)	+41	—	—
Bombay	O.E.	−8·3	83·0	291	13 21	+94	—	—	—	21·6
Victoria	M.	−8·6	91·1	42	—	—	—	—	28·9	55·0
Mauritius	M.	−8·7	92·3	250	46 26	?L	—	—	(46·4)	50·0
Cipolletti	M.	—	120·4	144	27 56	?S	(27 56)	−56	29·9	37·3
Cape Town	M.	—	120·6	223	20 32	?PR$_1$	—	—	—	67·5
Toronto	M.	—	121·5	40	—	—	—	—	63·0	—
Ottawa	—	—	123·2	39	e 38 30	?SR$_1$	—	—	e 62·8	—
Graz	W.	—	125·9	324	e 20 18	?PR$_1$	—	—	—	—
Zagreb	W.	—	126·4	323	e 19 14	[+ 5]	e 31 30	+114	—	—
Edinburgh	M.	—	127·6	342	23 50	?	—	—	—	36·8
De Bilt N.	—	—	127·8	335	e 26 15	?	37 22	?SR$_1$	e 61·8	66·6
E.	—	—	127·8	335	e 24 53	?	37 21	?SR$_1$	e 57·8	66·9
Uccle	—	—	129·0	334	21 4	?PR$_1$	e 31 50	+116	—	—
Bidston	M.S.	—	129·6	340	23 2	?PR$_1$	—	—	—	46·0
Rocca di Papa	Ag.	—	130·6	321	i 21 13	?PR$_1$	—	—	e 37·6	39·5
Paris	—	—	131·3	334	27 7	?	—	—	37·8	39·8
Moncalieri	S.	—	131·6	328	e 20 57	?PR$_1$	30 11	0	38·1	—
La Paz	Bi.	—	133·0	120	28 27	?S	(28 27)	?	—	—
Coimbra	—	—	142·8	337	—	—	e 31 31	+11	59·5	—

Additional records: Riverview gives PR$_1$ = +6m.13s., i (PR$_1$) = +7m.10s., MN = +21·8m., MZ = +16·8m. Adelaide S = +12m.56s. (?SR$_1$). Osaka MN = +16·0m. Batavia S? = +8m.39s., M = +10·7m. Toronto L = +70·2m. and +71·2m. Graz SR$_1$ = +37m.5s. La Paz S = +31m.24s. (?SR$_1$). De Bilt e = +39m.43s. Paris MN = +41·8m. Rocca di Papa M = +21·3m., 2sec. after P.

It seems desirable to give the evidence for deep focus in detail. Taking T_0 = 25d.10h.21m.10s., we have the following accordant determinations of Δ.

	P.	S.	Δ from P.	Δ from S.
	m. s.	m. s.	°	°
Riverview	5 6	9 6	22·1	22·1
Tokyo	7 43	13 30	38·6	37·4
Mizusawa	7 56	14 9	40·1	40·1
Zi-ka-wei	8 15	14 53	42·6	43·3

Two other stations, Honolulu and Calcutta, would favour a different T_0. Using the value adopted we get

	P.	S.	Δ from P.	Δ from S.
	m. s.	m. s.	°	°
Honolulu	8 2	15 14	40·9	44·9
Calcutta	10 2	19 26	58·5	65·1

But the determinations of T_0 would differ sensibly in the two cases. There does not seem sufficient reason to modify the value of T_0 above adopted. Using it we may add the following value of $\triangle$ from observed single records :

	P.	S.	$\triangle$ from P.	$\triangle$ from S.
	m. s.	m. s.	°	°
Sydney	—	9 8	—	22·1
Melbourne	—	10 14	—	25·6
Adelaide	—	10 17	—	25·7
Manila	6 50	—	32·2	—
Osaka	7 42	—	38·5	—
Batavia	7 57	—	40·2	—

Now the fundamental difficulty in satisfying these observations without the hypothesis of a deep focus is shown by the first two stations, Riverview and Tokyo. The sum of their observed values of $\triangle$ is at most 60°·7, whereas the distance between them is 70°·3. Two sides of a triangle are considerably less than the third. And this difficulty arises in other cases. We have four consistent Australian stations south of the Epicentre and 4 Japanese stations to the north, besides Manila and Batavia. Taking a southern station (say Adelaide) and a northern (say Mizusawa), the sum of the observed distances is 65°·8, whereas the direct distance Adelaide-Mizusawa is 74°·1. To make a solution we must suppose the observed distances effectively diminished. Unfortunately in this instance we do not get any help from the antipodal stations, and must adopt a focal depth by trial and error. The minimum focal depth which will suit the pairs of stations quoted is that which just makes the sums of the corrected distances equal to the distance between stations with focal depths, as below.

			Sum.	Corr. to sum for depths. ·030	·040	·050	·060	Corr. Required.
	°	°	°	°	°	°	°	°
Riverview to Tokyo	22·1	+38·0	=60·1	4·1	5·5	7·0	8·5	9·6
Adelaide to Manila	25·7	+40·1	=65·8	4·6	6·2	7·4	8·8	8·3

It will be seen that a depth of 0·060 at least is required to make up the difference between the sum of the separate $\triangle$s, as corrected, and the direct arc between stations. The depth adopted is a little greater, viz., 0·070 ; and since the residuals are still negative on the whole, we certainly have not gone too far. It will be seen that the assumption of an error of 1min. in both P and S will bring the Honolulu observations into line.

Dec. 25d. 10h. 31m. 45s. Epicentre 41°·5N. 7°·0W.

$A = +·744$, $B = -·091$, $C = +·663$.

	$\triangle$	Az.	P.	O−C.	S.	O−C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Coimbra	1·7	220	0 23	− 3	—	—	0·8	0·9
San Fernando	5·1	173	3 3	?L	—	—	(3·0)	—
Granada	5·1	148	2 23	?S	4 16	?	—	—
Tortosa	5·7	94	1 28	0	—	—	3·0	3·2

No additional records.

Dec. 25d. Records also at 0h. (San Fernando), 1h. (Batavia), 6h. (Harvard), 7h. (San Fernando), 10h. (Helwan), 15h. (Tokyo), 20h. (Helwan), 21h. (Kobe, Athens (2), and De Bilt). (Harvard records at 6h. an explosion at Maynard Mass.).

Dec. 26d. Records at 2h. (La Paz), 3h. (San Fernando), 8h. (Ottawa, Athens, and La Paz), 9h. (De Bilt and Helwan), 19h. and 21h. (San Fernando), 22h. (La Paz).

Dec. 27d. Records at 1h. (Taihoku), 2h. (La Paz and Helwan), 5h. (Bidston), 8h. (Balboa Heights), 9h. (Mizusawa), 16h. (Simla), 20h. (San Fernando), 21h. (Tokyo and Mizusawa), 23h. (Colombo).

Dec. 28d. 8h. 9m. 20s. Epicentre 13°·0S. 136°·0E. (as on 1918 Mar. 10d.).

A = −·701, B = +·677, C = −·225; D = +·695, E = +·719; G = +·162, H = −·156, K = −·974.

	Δ	Az.	P.	O−C.	S.	O−C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Riverview	25·0	149	e 5 38	0	e 10 2?	− 1	e 10·8	12·5
Sydney	25·0	149	e 4 58	−40	—	—	11·1	12·2
Melbourne	26·0	164	(5 58)	+10	—	—	6·0	13·0
Perth	26·5	221	—	—	11 0	+28	—	—
Colombo	59·2	286	22 40	?SR_1	—	—	—	25·7
Helwan	109·1	297	53 40	?L	—	—	(53·7)	—
La Paz	142·1	140	23 49	?PR_1	—	—	—	—

Riverview gives e = +7m.57s.

Dec. 28d. 18h. 3m. 10s. Epicentre 3°·3S. 12°·0W.

A = +·976, B = −·208, C = −·058; D = −·208, E = −·978; G = −·056, H = +·012, K = −·998.

		Δ	Az.	P.	O−C.	S.	O−C.	L.	M.
		°	°	m. s.	s.	m. s.	s.	m.	m.
San Fernando	E.	40·1	9	—	—	—	—	20·3	21·8
Rio Tinto		41·4	8	16 50	?SR_1	—	—	—	23·8
Cape Town		41·7	143	14 38	? S	(14 38)	+ 7	—	24·0
Algiers		42·5	21	e 8 9	− 6	14 30	−12	21·8	23·3
Coimbra		43·7	5	8 4	−20	14 34	−24	21·0	24·6
Tortosa		45·6	12	8 15	−22	—	—	23·8	28·1
Barcelona		46·6	15	10 25	?PR_1	—	—	e 21·7	27·8
Rocca di Papa		50·4	25	e 9 17	+ 8	16 14	−10	e 25·9	28·6
Moncalieri		51·4	19	e 8 52?	−24	i 16 38	+ 2	24·2	27·6
Paris		53·7	11	—	—	e 17 0	− 5	25·8	28·8
Shide		54·8	8	—	—	21 6	?SR_1	—	—
Kew		55·7	9	—	—	—	—	—	31·8
Uccle		55·9	13	—	—	e 17 26	− 7	e 27·8	—
La Paz		56·6	254	9 48	− 2	i 17 35	− 6	26·5	27·4
Bidston		57·2	8	17 32	?S	(17 32)	−17	—	31·4
De Bilt	N.	57·3	13	—	—	17 53	+ 3	e 25·8	29·2
	E.	57·3	13	—	—	—	—	e 24·8	29·8
Eskdalemuir		59·1	7	i 18 12	?S	(i 18 12)	0	23·8	—

Additional records: San Fernando gives PE = 17h.52m.30s., belonging to an earlier shock. The North component records are each one minute earlier than the corresponding East record, MN = +20·8m. Coimbra MN = +23·7m., T_o = 18h.3m.1s. Rocca di Papa e = 17h.59m.48s. (earlier shock), P = +9m.5s. and eL = +26·8m. Moncalieri MN = +31·0m. All these records are given as 17h. instead of 18h., T_o = 18h.2m.21s. Paris gives S as e_2, also e_1 = 17h.59m.23s., MN = +31·8m. La Paz gives 1°·8S. 13°·3W., T_o = 18h.3m.15s.

Dec. 28d. Records also at 4h. (Riverview and San Fernando), 8h. (Batavia and Manila), 9h. (Colombo), 16h. (La Paz and Moncalieri), 17h. (Edinburgh and Helwan), 18h. (De Bilt), 20h. (Taihoku), 21h. (Fordham), 23h. (Mizusawa and Rocca di Papa).

Dec. 29d. Record at 0h. (Athens), 1h. (La Paz), 2h. and 5h. (Colombo), 6h. (Riverview), 13h. (Tokyo), 22h. (Fordham).

Dec. 30d. 7h. 11m. 45s. Epicentre 4°·5S. 152°·0E. (as on 1918 July 23d.).

A = −·880, B = +·468, C = −·079 ; D = +·470, E = +·883 ;
G = +·069, H = −·037, K = −·997.

	Δ	Az.	P.	O−C.	S.	O−C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Riverview	29·2	182	e 6 17	− 3	11 22	+ 2	e 14·7	17·6
Sydney	29·2	182	6 15	− 5	—	—	15·0	17·8
Adelaide	32·8	200	13 33	?S	(13 33)	+72	17·5	18·8
Melbourne	33·9	190	—	—	16 21	?L	19·2	22·2
Manila	36·2	302	—	—	e 13 15	+ 2	—	—
Batavia	44·9	266	e 9 15	+43	—	—	—	—
Honolulu	55·3	60	e 24 39	?L	—	—	31·0	36·2
Helwan	118·7	302	70 15	?L	—	—	(70·2)	—
De Bilt	125·1	336	—	—	—	—	e 61·2	—

Additional records : Riverview gives MN = +17·8m. Sydney gives P at 8m. instead of 18m. Corrected above by comparison with Riverview. Adelaide S = +15m.58s. (?SR_1). Taihoku (Δ = 41°·8) gives e = 7h.10m.0s.

Dec. 30d. Records also at 1h. (Perth), 5h. (Kobe), 16h. and 23h. (Lick).

Dec. 31d. Records at 0h. (Zurich), 1h. (Mauritius), 2h. (Riverview and Helwan), 3h. (Denver), 5h. (Helwan, Osaka, Mizusawa, and Tokyo), 7h. (Helwan), 8h. (Kodaikanal), 10h. (Taihoku), 19h. (La Paz), 22h. (Manila).

APPENDICES TO INT. SEIS. SUM. FOR 1918.

(α) REPETITIONS OF THE CHILE EARTHQUAKE OF 1918 DEC. 4.

The Earthquake of December 4, destructive at Copiapo, was followed by several well-established repetitions from the same focus (or near it). Besides these a number of shocks were registered at La Paz which *may* be from the same focus, though in many cases this is only a presumption. It may be convenient to give here a complete list of the La Paz records of P, so that hypotheses as to the nature of repetition may be readily tested. The intervals by which S, or L, follow P are also given. The columns N, C, and P−C are explained below.

La Paz records which may be repetitions.

	P.			S.		L.	N.	C.	P−C.
	d.	h.	m.	s.	m.	s.	m.		m.	m.
Dec.	4	4	36	8	+2	7	—	0	36	+ 0·1
,,	4	11	50	6	+2	8	+2·6	21	57	− 6·9
,,	4	13	24	38	—		—	25	21	+ 3·6
,,	4	13	48	36	—		—	26	42	+ 6·6
,,	4	13	58	10	+2	9	+2·8	27	3	− 4·8
,,	4	15	36	14	+2	13	+3·2	31	27	+ 9·2
,,	4	15	51	34	—		+2·8	32	48	+ 3·6
,,	4	16	33	30	—		—	34	30	+ 3·5
,,	4	16	38	0	+1	58	+2·7	34	30	+ 8·0
,,	4	16	46	5	—		—	35	51	− 4·9
,,	4	17	23	30	—		—	37	33	− 9·5
,,	4	17	44	10	+2	8	+3·2	38	54	− 9·8
,,	4	18	40	0	+2	17	+3·0	40	36	+ 4·0
,,	4	19	17	30	—		—	42	18	− 0·5
,,	4	19	25	0	—		—	42	18	+ 7·0
,,	4	19	28	25	+2	10	+2·6	42	18	+10·4
,,	4	20	2	15	—		—	44	0	+ 2·3
,,	4	20	18	40	—		—	45	21	− 2·3
,,	4	20	25	14	—		—	45	21	+ 4·2
,,	4	20	34	38	—		—	46	42	− 7·4
,,	4	20	42	20	—		—	46	42	+ 0·3
,,	4	21	34	45	—		—	48	24	+10·8
,,	4	23	17	45	—		—	53	9	+ 8·8
,,	4	23	25	7	—		—	54	30	− 4·9
,,	5	1	10	25	—		—	59	15	− 4·6
,,	5	1	15	55	—		—	59	15	+ 0·9
,,	5	1	21	10	+2	13	+3·3	59	15	+ 6·2
,,	5	5	25	37	—		—	71	27	− 1·4
,,	5	5	31	30	—		—	71	27	+ 4·5
,,	5	5	48	7	+2	12	+2·9	72	48	+ 0·1
,,	5	7	1	0	—		—	75	51	+10·0
,,	5	7	37	25	—		—	77	33	+ 4·4
,,	5	7	47	18	—		—	78	54	− 6·7
,,	5	8	1	30	—		—	78	54	+ 7·5
,,	5	9	14	30	—		+3·5	82	18	− 3·5
,,	5	12	38	15	—		—	92	48	− 9·7
,,	5	12	41	50	+2	5	+2·8	92	48	− 6·2
,,	5	13	45	0	—		—	95	51	− 6·0
,,	5	14	56	45	—		—	98	54	+ 2·8
,,	5	18	(15 | 30)	—		+3·0	108	24	− 8·5
,,	5	18	26	10	+2	1	+2·6	108	24	+ 2·2
,,	5	19	2	20	—		—	110	6	− 3·7
,,	5	20	11	50	+2	6	+2·9	113	9	+ 2·8
,,	5	20	29	25	+2	12	+2·9	114	30	− 0·6
,,	5	21	39	50	—		—	117	33	+ 6·8
,,	5	22	17	3	+0	55	+1·6	119	15	+ 2·0
,,	5	22	48	53	+2	16	+3·1	121	57	− 8·1
,,	5	23	8	22	+2	17	+3·5	122	18	− 9·6
,,	6	0	13	31	—		—	125	21	− 7·5
,,	6	4	28	36	—		—	137	33	− 4·4

Continued on next page.

La Paz Records which may be repetitions.

		P.			S.		L.	N.	C.	P−C.
	d.	h.	m.	s.	m.	s.	m.		m.	m.
Dec.	6	7	24	23	+2	7	+2·6	145	21	+ 3·4
,,	6	23	35	10	—		+3·3	191	27	+ 8·2
,,	7	12	42	5	+2	11	+2·9	229	45	− 2·9
,,	7	19	1	23	+2	10	—	247	3	− 1·6
,,	8	9	45	0	+2	9	+3·0	289	45	0·0
,,	9	11	2	4	+2	29	+3·3	361	57	+ 5·1
,,	10	1	51	37	—		—	404	60	− 8·4
,,	10	17	22	22	—		—	448	24	− 1·6
,,	10	19	44	54	—		—	455	51	− 6·1
,,	10	21	28	19	—		—	460	36	− 7·7
,,	12	14	18	11	—		—	576	12	+ 6·2
,,	12	23	59	11	—		+2·4	604	60	− 0·8
,,	13	1	21	14	+2	0	+2·8	608	24	− 2·8
,,	13	1	58	17	—		—	610	66	− 7·7
,,	13	11	30	55	—		—	637	33	− 2·1
,,	13	12	10	15	—		—	639	15	− 4·7
,,	14	21	54	10	+2	2	+3·2	735	51	+ 3·2
,,	16	10	23	12	+2	0	+3·1	839	15	+ 8·2
,,	18	16	36	11	—		+2·5	994	30	+ 6·2
,,	19	7	41	44	—		—	1037	33	+ 8·7
,,	20	2	21	56	—		—	1091	27	− 5·1
,,	20	9	38	0	+2	15	+2·9	1111	48	−10·0

In previous numbers of this Summary and in the Geoph. Sup. to the Mon. Not. R.A.S., a periodicity of just over 21min. has been suggested for the recurrence of earthquakes. To test its applicability in the present instance the records of P are compared with the nearest multiple of 21·0min. from the first record (neglecting the seconds). The column N shows the number of multiples of 21min. elapsed, and the column C gives the minutes of the calculated epoch: thus, N = 21 corresponds to an interval 21 × 21min. = 7h.21m. since 4d.4h.36·0m., *i.e.*, to 4d.11h.57m. The 4d.11h. can be inferred from the column P: the 57m. is given in column C, and P − C = 50·1m. − 57·0m. = −6·9m. The values of P − C should cluster about zero if the repetitions follow the main shock after multiples of 21min., but they show no such tendency. Collecting them under each minute as below:—

Minute	0	1	2	3	4	5	6	7	8	9	10	
Pos.	5	0	5	5	4	1	5	2	5	1	} 4	
Neg.	3	3	4	2	6	1	5	4	3	4	}	
Sum.	8	3	9	7	10	2	10	6	8	5		(8)

The second line gives the numbers of positive residuals and the third the number of negative. In the fourth they are added together, as this process has previously been found effective. But it is seen that there is no clustering of any importance. It may be that we ought to limit attention to those cases where there is an S or L record confirming the P, thus:—

Min.	0	1	2	3	4	5	6	7	8	9	10	
Pos.	3	0	3	3	1	1	2	0	3	1	} 2	
Neg.	2	1	2	1	1	0	2	0	2	2	}	
Sum.	5	1	5	4	2	1	4	0	5	3		(4)

but again there is no appreciable clustering.

It will be noticed that the second shock follows the first by 7h. 14m., which is sensibly not a multiple of 21m. Now the second shock was much greater than the first, and it may be that we ought to have reckoned from it as starting point. But the clustering would then have appeared near the minute—7m. If it is only slight, we may have obscured it in adding together positive and negative residuals. Re-writing with −7min. as zero we should get—

Min.	0	1	2	3	4	5	6	7	8	9	10	
Pos.	5	1	6	2	4	3	3	5	0	5	} 5	
Neg.	4	3	4	4	1	5	2	5	1	4	}	
Sum.	9	4	10	6	5	8	5	10	1	9		(10)

The numbers near 0min. are now slightly larger than the others, but no importance can be attached to the excess.

Some success was also obtained by assuming a slight alteration to period, taking it for instance as 20·8min., but this seems inconsistent with other results.

There are difficulties in testing Dr. Jeans's periods of 125·8m. and 222m. owing to the number of quite short intervals, which seem to require some additional hypothesis for fitting these long periods.

Attention may also be drawn to the series of shocks from 18°·5N. 68°·0W., as follows :—

	T_0 d.	h.	m.	s.	N.	C. m.	$T_0 - C$. m.
Oct.	11	14	14	25	0	14·0	+ 0·4
,,	11	17	3	34	8	2·0	+ 1·6
,,	12	0	15	30	29	23·0	− 7·5
,,	12	8	19	37	52	26·1	− 6·5
,,	13	4	51	30	110	44·1	+ 7·5
,,	14	0	24	20	166	20·2	+ 4·1
,,	14	2	15	20	172	26·2	−10·9
,,	17	8	19	3	395	29·5	−10·4
,,	18	21	33	35	501	35·7	− 2·1
,,	25	3	42	50	930	45·3	− 2·5
Nov.	12	12	1	35	2188	5·0	− 3·4
,,	12	21	44	32	2216	53·0	− 8·5

Since the later multiples are large, the more accurate value of the period 21·00136608min. (Geop. Sup. M.N.I. p. 98) has been used in column C. There is some tendency to cluster about −1·5min. and −8·5min., but the evidence could only be of value in conjunction with other evidence. Recurring now to the case of the Chile earthquake something of the same kind is observed if we exclude the early repetitions. It seems quite possible that, after a severe shock, waves of various kinds may persist for some time, causing a complex of subsequent shocks which may be difficult to analyse; so that a regular pulsation, if it exists, will only get a chance to declare itself after these miscellaneous shocks have subsided. If, therefore, we exclude values of N less than 80 say (80 x 21min. =28 hours) then the La Paz records analyse as below :—

Min.	0	1	2	3	4	5	6	7	8	9	10
Pos.	1	0	4	2	0	1	3	0	3	0	1
Neg.	2	2	3	2	2	1	3	3	3	2	

and we see again a slight clustering, about −2 and −7 in this case. Rearranging with −4 as zero we get—

Min.	0	1	2	3	4	5	6	7	8	9	10
Pos.	2	2	3	1	3	1	0	4	2	0	1
Neg.	1	3	3	3	2	1	0	3	0	3	
Sum.	3	5	6	4	5	2	0	7	2	3	(2)

which gives a small indication of clustering of a type previously noticed, viz., with a double maximum.

(β) BELATED RECORDS.

Records for Ootomari and Tokyo for 1918 were not received until a portion of the year had already been printed. The following observations were accordingly omitted from their proper place, but may be inserted in MS. :—

Ootomari (46°39′N. 142°46′E.).

Constants A = −·546, B = +·415, C = +·727.

Observations not received until the solutions for 1918 Jan.-June had been printed.

Date. d.	h.	Epicentre. °	°	Δ °	P. m.	s.	O−C. s.	S. m.	s.	O−C. s.	L. m.	M. m.
Jan. 30	21	47·5N.	129·0E.	9·4	1	30	−52	—		—	2·4	—
Feb. 4	17	29·6N.	87·8E.	45·4	17	21	?S	(17	21)	+120	23·0	23·4
Feb. 7	5	6·5N.	127·0E.	42·4*	7	59	+ 2	14	19	+ 9	17·4	17·5
Feb. 9	20	25·6N.	134·1E.	22·2	2	27	−160	—		—	4·2	4·3
Feb. 13	6	24·0N.	116·5E.	30·9	6	47	+10	11	47	− 3	14·2	15·4
Apr. 10	2	44·0N.	131·0E.	8·7†	2	34	+31	—		—	4·3	4·4
May 20	14	7·4N.	35·2W.	125·8	21	13	?PR_1	—		—	—	—
May 20	18	29·6S.	71·5W.	151·5	16	34	−83	—		—	—	—
May 22	6	17·0S.	177·5W.	73·0‡	11	7	+ 9	—		—	20·1	—
May 31	8	45·1N.	147·2E.	3·5	1	22	+27	—		—	2·6	—
June 1	8	38·5N.	146·0E.	8·5	3	46	?S	(3	46)	− 4	—	—

Tokyo (35°41′N. 139°45′E. included in list).

Jan. 18	10	12·0N.	95·0E.	46·7	—		—	e 18	44	−113	—	—
Jan. 25	1	12·0N.	95·5W.	109·4	31	23	?	31	44	?	local	?
Jan. 30	21	47·5N.	129·0E.	14·3	2	27	−63	—		—	—	5·3
Feb. 7	5	6·5N.	127·0E.	31·4*	e 6	30	− 4	e 7	52	?	—	—
Feb. 9	20	25·6N.	134·1E.	11·2	2	21	−26	4	2	−57	—	4·6
Feb. 13	6	24·0N.	116·5E.	23·2	5	36	+17	7	57	−92	10·0	13·8
Mar 23	0	49·0N.	144·0E.	13·7	e 5	12	−49	—		—	—	—

* Correction for deep focus −2°·2 for Ootomari, −1°·8 for Tokyo.
† Correction for deep focus −0°·6. ‡ Correction for deep focus −6°·0.

(γ) CORRECTED EPICENTRES.

This additional information from Ootomari and Tokyo has suggested revision of adopted epicentres in three cases.

On 1918 Jan. 30d. 21h. 18m. 27s., both Ootomari and Tokyo give large negative residuals (−52s. and −63s.), thus confirming the other Japanese stations, and making it clear that a solution with focus at normal depth will not work. We must assume a focal depth of about 0·050. The only available confirmation from the antipodes is provided by the La Paz observation, △ = 145°·9, iP = +18m.6s. If this is a true P the residual is +31s., as in the text. But possibly it is [P] with residual −106s., or −46s. if we may assume an error of 1min., as suggested by the repetition on Feb. 9 below. The revised solution would give the following residuals for some representative stations :—

1918 Jan. 30d. 21h. 18m. 27s. Epicentre 45°·0N. 135°·0E.
A = −·500, B = +·500, C = +·707 ; D = +·707, E = +·707 ;
G = −·500, H = +·500, K = −·707.

	Corr. for Focus	△	Az.	New Residls. P.	New Residls. S.	Old Residls. P.	Old Residls. S.
	°	°	°	s.	s.	s.	s.
Ootomari	+0·2	5·6	70	0	—	−52	—
Mizusawa	0·0	7·4	220	− 3	—	−71	—
Tokyo	−0·6	10·0	157	+ 5	—	−63	—
Kobe	−0·6	10·3	179	+ 9	—	−46	—
Osaka	−0·6	10·3	178	+12	—	−44	—
Zi-ka-wei	−1·6	17·4	222	+12	−17	− 8	−52
Taihoku	−2·3	22·7	213	+10	—	−27	—
Manila	−3·4	32·6	207	− 3	− 3	−44	−77
Calcutta	−4·4	45·0	258	− 3	− 9	− 5	−14
Simla	−4·5	46·5	275	+ 4	+ 4	+ 1	− 1
Bombay	−5·3	57·6	266	+ 6	+22	− 2	+ 6
Batavia	−5·3	57·1	214	+12	—	−24	—
Honolulu	−5·5	59·0	89	+15	+30	−48	−89
Lemberg	−5·8	67·7	320	+19	+31	+11	+17
Berkeley	−5·9	71·8	53	+ 1	+ 2	−49	−91
Lick	−6·0	72·6	53	+ 1	+ 5	−49	−89
De Bilt	−6·0	73·8	330	+11	+16	0	− 3
Eskdalemuir	−6·0	73·7	338	+ 8	+19	− 5	− 4
Uccle	−6·0	75·1	330	+ 5	+12	− 5	− 9
Athens	−6·0	76·1	311	+10	+21	0	0
Paris	−6·1	77·4	330	+ 8	+12	− 4	− 9
Milan	−6·1	77·6	325	− 1	+10	−12	−12
Perth	−6·2	78·7	197	+29	—	−19	—
Adelaide	−6·2	80·2	178	—	+ 7	—	−95
Riverview	−6·2	80·9	167	− 4	+133	−57	+29
Sydney	−6·2	80·9	167	—	− 7	—	−111
Ottawa	−6·4	85·7	20	− 6	−18	−37	−78
Northfield	−6·4	87·5	19	− 1	−26	−30	−84
Georgetown	−6·5	91·3	24	−11	−44	−44	−106
Washington	−6·5	91·3	24	−12	−44	−44	−106

1918. Feb. 9d. 20h. 46m. 18s. Epicentre adopted in the text as 25°·6N. 134°·1E. ; but this seems to be possibly a repetition of the above from the same deep focus, thus :—

Feb. 9d. 20h. 46m. 10s. Epicentre 45°·0N. 135°·0E.
Focal depth 0·050.

	Corr.	△	Az.	P.	O−C.	S.	O−C.
	°	°	°	m. s.	s.	m. s.	s.
Ootomari	+0·2	5·6	70	2 35	?S	(2 35)	− 4
Mizusawa	0·0	7·4	220	2 13	+21	3 48	+27
Tokyo	−0·6	10·0	157	2 29	+ 7	4 10	− 3
Kobe	−0·6	10·3	179	2 18	− 8	(3 50)	−31
Osaka	−0·6	10·3	178	2 25	− 1	—	—
Zi-ka-wei	−1·6	17·4	222	3 13	−36	5 37	−73
Manila	−3·4	32·6	207	(5 38)	−42	5 38	?P
Batavia	−5·3	57·1	214	—	—	14 50	−111
Zagreb	−6·0	74·4	321	11 6	− 1	—	—
Milan	−6·1	77·6	325	11 17	−10	—	—
Monte Cassino	−6·2	78·8	320	11 32	− 2	—	—
Rocca di Papa	−6·2	79·1	321	11 30	− 5	14 51	?PR_1
La Paz	—	145·9	44	19 9	[−56]	—	—

The observations at Zi-ka-wei, Manila, and Batavia are discordant, but otherwise the fit is fairly satisfactory.

Mar. 23d. 0h. 11m. 50s. The Epicentre 49°·0N. 144°·0E. seems clearly erroneous, but it is not clear what change should be made. Apparently this is not a further repetition from 45°·0N. 135°·0E. above. The epicentre seems to be nearer that of April 10, viz., 44°N. 131°E., but without a deep focus. The best solution obtained was 42°N. 129°E., but it is necessary to assume one or two mistakes of minutes.

(δ) METHODS OF PROCEDURE.

Since the volume for 1918 begins a new series of this publication, it seems desirable to repeat here the explanation of the procedure formerly given in Appendix II to the Large Earthquakes of 1916.

If δ and λ be the latitude (North) and longitude (East) of an epicentre, then the following constants are usually printed for each epicentre :

$$\begin{array}{lll} A = \cos\delta\cos\lambda & B = \cos\delta\sin\lambda & C = \sin\delta \\ D = \quad\sin\lambda & E = -\cos\lambda & \\ G = \sin\delta\cos\lambda & H = \sin\delta\sin\lambda & K = -\cos\delta \end{array}$$

With A, B, C, it is easy to find Δ for any station, and with either D, E, *or* G, H, K, to find Z, the azimuth of the station round the Epicentre (from North to East). For if d and l be the latitude (N) and longitude (E) of the station, and

$$a = \cos d\cos l, \qquad b = \cos d\sin l, \qquad c = \sin d,$$

then (see M.N.R.A.S. LXXV., p. 530).

$$\begin{aligned} 2\ \text{versin}\ \Delta &= (a-A)^2 + (b-B)^2 + (c-C)^2 \\ 2 + 2\sin\Delta\sin Z &= (a-D)^2 + (b-E)^2 + c^2 \\ 2 + 2\sin\Delta\cos Z &= (a-G)^2 + (b-H)^2 + (c-K)^2 \end{aligned}$$

The values of a, b, c for the stations are printed in a list which has been distributed.

For finding Δ from the first equation a table is given at the end of the paper cited. The Azimuth is usually found from both 2nd and 3rd equations, when Δ is less than 30°: but beyond 30° is often read from a globe, as it is not required with great accuracy.

Useful checks on the signs and values of the constants are

$$A = +KE, \quad B = -KD, \quad G = -CE, \quad H = +CD.$$

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