British Association for the Advancement of Science.—Seismological Committee.

All correspondence to
Prof. H. H. TURNER,
University Observatory,
OXFORD.

Bulletin for Jan. and Feb., 1917.

For the large Earthquakes an attempt is here made to compare the readings with theoretical values, as explained in the Nineteenth Report of the Committee to the British Association. The position of the epicentre is determined at Oxford, unless otherwise stated; and the tables of times for P and S are those given by Galitzin in his "Vorlesungen über Seismometrie," p. 137, or by G. W. Walker on p. 54 of his "Modern Seismology." It is shown in the above Report that these tables are sensibly erroneous: but the precise values of the corrections are under discussion, and it seems better to await the definitive corrections than to introduce provisional tables. The tables are reproduced in an expanded form on Page 2 of this Bulletin. The time of the earthquake at the epicentre is deduced from the best records; and applying the tabular times for the distances in the third column (calculated and also measured from a large globe specially made for the purpose), the errors O − C of the observed times are found.

Observers are requested to send a copy of their Registers to Oxford *each month*, in order that this collated information may be published as early as possible. It is hoped to make up the arrears rapidly, now war conditions are receding.

For the large earthquakes the stations are arranged in the prder of distance from epicentre, as shown in the 3rd column. The azimuth in the 4th column is also calculated; and is the azimuth at the epicentre measured from N. towards E., in which the observing station lies. The Earthquake Chart formerly given has been discontinued in favour of brief notes for the smaller earthquakes.

The letters in the 2nd column stand for: A. = Alfani; Ag. = Agamennone; B. = Bosch; Bi. = Bifilar; B.M. = Bosch-Mainka; B.O. = Bosch-Omori; C. = Cartuja; Ca. = Cancani; Cd. = Conrad; C.O. = Cartuja-Omori; G. = Galitzin; L. = Luckmann; M. = Milne; Ma. = Mainka; M.S. = Milne-Shaw; O. = Omori; O.A. = Omori-Alfani; O.E. = Omori-Ewing; R.H. = Rebeur-Hecker; S. = Strattesi; S.C. = S. Calixto; V. = Vincentini; W. = Wiechert.

Riverview has two W. and one Ma.; it is not generally specified from which machine the readings were obtained.

TABLE.

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

THE LARGE EARTHQUAKES OF 1917.

INTRODUCTORY NOTE.

During the War inter-communication between stations was delayed or prevented. It was not until quite recently that records of different observatories were received in anything approaching a complete state, and the collation of results has therefore necessarily been delayed. Meantime the head-quarters formerly at Shide have been transferred to Oxford.

Several changes have been made in the adopted form of presentation. The most important of these is that the adopted time at origin T_o has been subtracted from all the printed records. It was not without much hesitation that this step was taken, for the figures thus given are no longer directly comparable with the times published by the Observatory. But the process of adding T_o is not a serious one; and to interpret the records this subtraction must always be made.

To prevent misunderstanding, when figures for which this subtraction has been made are quoted in the text, a plus sign is prefixed. Thus in the first entry for Jan. 3rd, the phrase "Rocca di Papa gives P = +12s." means that the time recorded was actually T_o + 12s. = Jan. 3d. 1h. 35m. 38s. + 12s. = Jan. 3d. 1hr. 35m. 50s. Without the + sign prefixed it might have been supposed that the integral number of hours, or hours and minutes, had been dropped.

This change has two advantages: Firstly, economy of printing and, secondly, help to the eye in following the run of the figures. This is especially the case with the phase L, which (with M) has been expressed in minutes. Reasons have been given (in the discussion of the South American Earthquakes of Feb. 15th and Feb. 21st) for proposing the closely approximate rule "halve Δ: the result is minutes for L": so that without any tables the eye can follow the accordance of the observed L without much trouble.

The tables with which P and S are compared remain as before, as no definitive corrections can yet be proposed.

University Observatory,
Oxford,
1921, Aug. 28th.

H. H. TURNER.

1917, JANUARY.

Jan. 3d. 1h. 35m. (38s.). Rocca di Papa gives P = +12s., S = +22s., M = +31s. Monte Cassino P = + 7s., M = + 19s. Zagreb gives eP = + 65s., i = +78s., M = +2·4m.

Jan. 4d. 16h. 50m. 6s. 24°·0N. 120°·0E.: separately computed.

Jan. 6d. 18h. 8m. (50s.) Between Zi-ka-wei and Manila? Adopted epicentre 22°·0N. 121°·0E. gives—

	Δ	Az.	P.	O−C.	S.	O−C.
	°	°	m. s.	s.	m. s.	s.
Manila	7·4	186	e 1 42	−10	—	—
Zi-ka-wei	9·2	6	2 14	− 5	3 42	+25

But the Pulkovo (Δ = 71°·4) records e = +29m.10s., L = + 34·2m., and M = +37·4m. do not fit this supposition. Feeble records Paris, Edinburgh, and Eskdalemuir.

Jan. 7d. 4h. 12m. —. N. of Formosa? Recorded at Manila and Zi-ka-wei. Also at Pulkovo, Eskdalemuir.

Jan. 7d. 5h. 1m. 5s. Near Moncalieri: P = +15s., S = +29s. Feeble movement at Paris, Helwan, Edinburgh.

Jan. 7d. 15h. 54m. (40s.). Near Moncalieri: P = +25s., S = +43s. Recorded at Helwan (?) P = +45m.20s.

Jan. 10d. 13h. 19m. 40s. Adopted Epicentre 10°·0N. 121°·0E. gives—

	Δ	Az.	P.	O−C.	S.	O−C.	L.
	°	°	m. s.	s.	m. s.	s.	m.
Manila	4·6	359	1 25	+14	—	—	2·3
Zi-ka-wei	21·2	1	5 0	+ 5	—	—	—
Batavia	21·5	221	4 56	− 3	6 13	−163	—
Pulkovo	81·7	329	12 17	−11	22 38	− 5	35·3

Recorded also at Helwan, Eskdalemuir, Edinburgh.

Jan. 11d. 11h. 43m. 44s. Adopted epicentre 8°·0S. 135°·0E. gives—

	Δ	Az.	P.	O−C.	S.	O−C.
	°	°	m. s.	s.	m. s.	s.
Manila	26·6	328	5 53	− 1	—	—
Adelaide	27·1	174	(10 46)	—	10 46	+ 3
Melbourne	29·3	163	(11 10)	—	11 10	−11
Riverview	30·2	153	6 34	+ 4	11 34	− 3
Pulkovo	104·3	330	(18 42)	0	(33 40)	+ 8

In the case of Pulkovo the records are for PR_1 and SR_1 (not P and S), and have been calculated from the double time for half the arc. A record for Batavia (Δ = 28°·0) at + 9m.1s. will not fit in with either P (+6m.8s.) or S (+10m.59s.)

Jan. 12d. 12h. 16m. —s. Small quake near Rocca di Papa and Monte Cassino.

Jan. 12d. 21h. 8m. —s. Destructive quake near Batavia; not recorded elsewhere.

Jan. 13d. 22h. 50m. 30s. Adopted epicentre 39°·0N. 23°·0E. gives—

	Δ	Az.	P.	O−C.	S.	O−C.	L.
	°	°	m. s.	s.	m. s.	s.	m.
Athens	1·2	147	0 40	+22	—	—	1·2
Rocca di Papa	8·3	293	1 49	−16	—	—	—
Zagreb	8·6	326	2 12	+ 2	3 45	− 8	—
Graz	9·8	329	2 27	0	—	—	—
Moncalieri	12·8	303	e 4 32	?	—	—	7·7
Pulkovo	21·3	10	4 53	− 4	8 48	− 2	11·5
Edinburgh	24·2	323	—	—	—	—	13·8

Jan. 14d. 19h. 18m. (5s.). About 18°·0 from Riverview. Recorded at Sydney, Melbourne, Pulkovo, Uccle, de Bilt.

1917. January 4d. 16h. 50m. 6s.

Epicentre **24°·0N. 120°·0E.**

A = −·457, B = +·792, C = +·407; D = +·866, E = +·500;
G = −·204, H = +·352, K = −·914.

Station and Component.		Machine.	△	Azimuth.	P.	O−C.	S.	O−C.	L.	M.
			°	°	M. S.	S.	M. S.	S.	M.	M.
Zi-ka-wei		W.	7.3	10	—	—	3 0	−19	4·2	6.1
Manila		W.	9·5	172	e 2 28	+ 5	4 29	+13	6·4	—
Osaka		O.	17·2	48	e 4 52	+45	—	—	8·6	14·2
Mizusawa	N.	O.	23·4	45	4 54	−27	—	—	11·1	—
	E.	O.	23·4	45	4 52	−29	—	—	9·9	—
Calcutta	N.	O.E.	29·1	273	6 12	− 7	13 12	+113	19·0	20·1
	E.	O.E.	29·1	273	6 12	− 7	—	—	19·0	20·3
Batavia		W.	32·8	205	i 6 33	−21	—	—	—	—
Colombo	N.	M.	42·1	252	18 42	? L	—	—	(18·7)	31·5
Bombay	E.	M.	44·1	273	14 50	? S	(14 50)	(−13)	—	31·4
Sydney	E.	M.	65·0	152	21 24	? S	(21 24)	+119	—	37·2
Pulkovo		G.	69·3	327	11 10	− 3	? 20 19	+ 1	32·9	38·6
Helwan	E.	M.	77·2	297	21 54	? S	(21 54)	(+ 3)	—	54·1
Graz		W.	81·9	318	e 12 24	− 6	—	—	—	—
De Bilt		G.	85·2	326	—	—	e 23 17	− 4	e 43·9	47·8
Rocca di Papa		Ag.	86·1	314	i 12 45	− 9	—	—	—	—
Edinburgh		M.	86·8	332	23 24	? S	(23 24)	−15	—	—
Moncalieri		S.	87·6	319	e 23 30	? S	(23 30)	−18	44·5	51·7
Stonyhurst		M.	87·8	330	e 14 30	+86	e 27 24	+214	43·4	49·2

Doubtful or erroneous records also from Azores, Barcelona, Coimbra, Eskdalemuir, Honolulu, Kew, Kodaikanal, La Paz, Mauritius, Melbourne, Paris, Rio Tinto, San Fernando.

The following times are perhaps to be accepted as L readings:—
Eskdalemuir (87°·2) 44m. 54s.; Paris (88°·3) L = 47·1m.; Barcelona (92°·9) L = 48·2m.; Coimbra (99°·8) L = 50·9m.; San Fernando (101°·1) L = 56·2m.; Azores (148°·1) L = 60·4m.

La Paz (169°·3) gives P = 20m. 14s. and 27m. 16s.

Zi-ka-wei gives 15h. An error of 1h. has been assumed. It is also assumed that the P and S records are really S and L respectively.

Manila gives ME = +7·4m., MN = +9·9m.

Pulkovo remarks "S masked by microseisms."

Rocca di Papa gives eL = 50·4m., L = +52·8m., L = +56·1m.

Edinburgh gives M = +50·9m., M = +56·7m.

Osaka's record is ePS = +4m. 52s.

Jan. 16d. 23h. 28m. 23s. About 22°·0 from Zi-ka-wei. Recorded at Mizusawa (P = +1m.39s.: giving △ = 6°·5), Osaka (P = +2m.55s.: giving △ = 11°·7), Adelaide (P = +11m.13s.: giving △ = 69°·2), Say 46°·0N. 143°·0E. ? But this does not fit Adelaide.

Jan. 17d. 2h. 41m. —s. The Batavia record (P = +1m.32s. S = +2m.30s.) would put the epicentre only 4°·7 away; but this does not accord with the Manila record (P = +1m.51s.), which would be too early for △ > 29°·6. Records at Riverview, Sydney, Melbourne, and Pulkovo do not help us much. Records also at Kodaikanal (P = +14m.24s.), Colombo (P = +14m.0s.), Helwan (P = +22m.0s.), Eskdalemuir (+49m. to 84m.), and de Bilt (eL = +53·0m.).

Jan. 18d. 17h. 23m. (40s.). Mizusawa records P +0m.6s. and L +0·6m.

Jan. 18d. 17h. 39m. 50s. Close to Athens, which records eP +0m.41s., iS +1m.11s., L +1·3m. The Pulkovo record is iP = +4m.52s., S = +9m.6s. Moncalieri gives eL = −7·6m.

Jan. 19d. 22h. 55m. (57s.). Riverview gives eP = +7m.39s., S = +13m.40s., L = +17·4m., M = +19·2m. Melbourne eL = +19·5m., M = +21·6m. Honolulu L = +32·0m., M = +36·1m. Malta P(?) = +41m.3s. Manila eP = +50m.59s. Query two shocks ?

Jan. 20d. 17h. 38m. (48s.). Mizusawa records P = +28s., L = +1·0m. (also another P = +5m.48s.). Osaka gives P = +119s., L = +3·2m., M = +3·6m.

Jan. 20d. 23h. 11m. 34s. Adopted 7°·0S., 116°·0E., separately computed.

Jan. 20d. 23h. 48m. 44s. Adopted 12°·0N., 95°·0E., which gives—

	△	Az.	P.	O−C.	S.	O−C.	L.
	°	°	m. s.	s.	m. s.	s.	m.
Batavia	21·6	150	4 12	−48	—	—	—
Manila	25·5	83	5 46	+ 3	—	—	11·5
Mizusawa	48·9	48	9 12	+11	16 27	+22	—
Zagreb	73·9	314	11 46	+ 5	21 22	+ 9	—
Uccle	81·1	320	12 29	+ 3	22 36	0	—
Paris	82·6	318	—	—	22 49	− 4	32·3
Barcelona	83·3	311	—	—	23 8	+ 8	26·4
Algiers	84·4	306	12 43	− 1	22 54	−18	34·3
Tortosa	85·9	311	12 43	− 9	23 5	−24	36·4
La Paz	163·1	253	19 52	—	29 57	—	42·3

Query: Recorded also at Rocca di Papa △ = 76°·3, i + 11m.54s., M = +11·9m., and Moncalieri △ = 80°·1, iP = +21m.6s., M = +21·3m.; or do these refer to another local shock ?

Jan. 21d. 22h. +. Melbourne and Riverview record disturbance beginning +30m.12s. La Paz gives L = +65·0m. De Bilt +75m.58s.

Jan. 21d. 23h. 27m. (20s.). Query at 10°·0E. 3°·0S ? San Fernando (△ = 42°·2) records PN + 8m.10s., SE + 14m.40s., L = +21·2m. Helwan (△ = 38°·7) P = +7m.40s. Coimbra (△ = 46°·4) L = +14·7m., which may be S. Rio Tinto (△ = 43°·5) +21m.40s. would be L, not P. De Bilt (and perhaps others) is confused with previous record. Pulkovo (△ = 64°·5) gives L_1 = +32·7m., M_1 = +37·4m., M_2 + 40·4m. Edinburgh (△ = 59°·8) P = +29m.22s., M = +35·2m. Stonyhurst gives S + 19m40s., and Eskdalemuir +40s. to 47m.40s.

Jan. 24d. 0h. 48m. 12s. At 31°·0N. 114°·0E, separately computed.

Jan. 25d. 2h. (51m.) Manila gives P = 2h.53m.22s. (and also eP = 3h.29m.24s., L = 3h.30m.14s., M = 3h.30m.33s.). Pulkovo e = 3h.2m.30s., L = 3h.27m.0s., M = 3h.36m.12s. and 23s. Zi-ka-wei gives eP = 3h.2m.43s. MZ = 3h.21m.8s. Edinburgh P = 3h.16m.30s., M = 3h.46m.48s. Helwan P = 3h.35m.0s. Moncalieri L = 3h.39m.30s. Colombo P = 3h.42m.0s. Rio Tinto P = 3h.52m.0s., M = 3h.56m.0s. Do the later records refer to second shock recorded by Manila ?

Jan. 26d. 5h. 9m. 0s. Adopted 52°·0N. 161°·0E. gives—

	△	Az.	P.	O−C.	S.	O−C.	L.
	°	°	m. s.	s.	m. s.	s.	m.
Mizusawa	18·8	235	4 51	+24	8 43	+45	—
Osaka	25·1	236	6 13	+34	10 22	+17	14·4
Zi-ka-wei	35·5	250	7 20	+ 2	13 2	− 1	16·7
Manila	49·1	235	10 28	+87	—	—	—
Pulkovo	61·5	334	10 24	+ 2	18 42	0	31·0
Rio Tinto	89·7	350	—	—	25 0	+49	—
San Fernando	90·9	349	23 0	? S	(23 0)	−83	53·0

Recorded also at Victoria, Kew, Colombo, Moncalieri, Bombay, Kodaikanal, Toronto, and Honolulu.

Jan. 27d. 14h. 52m. 0s. Adopted 26°·0N. 114°·0E. gives—

	△	Az.	P.	O−C.	S.	O−C.	L.
	°	°	m. s.	s.	m. s.	s.	m.
Zi-ka-wei	8·4	50	2 8	+ 1	3 47	+ 1	4·4
Manila	13·2	148	3 38	+22	6 6	+17	11·2
Osaka	20·4	60	—	—	8 14	−17	—
Pulkovo	64·7	326	(10) 6	−37	(18) 39	−42	34·0

In forming O−C. for Pulkovo it is assumed that the recorded times are 10m. too large. Recorded also at Helwan, Moncalieri, Kew, Eskdalemuir (+45m. to +57m.), and Edinburgh.

Jan. 27d. 23h. 47m. (10s.). Riverview gives eP = +5m.14s., eS = +9m.20s., eL = +10·1m., MN = +11·3m. Sydney P = +5m.2s., S = +8m.38s., L = +10·6m., M = +11·6m. Melbourne L = +6·6m. (is this S ?), M = +9·7m. Batavia e = +10m.43s., M = +19·7m. San Fernando P = +8m.50s., L = +88·8m., M = +91·3m.

[Riverview gave Jan. 28d., but the Sydney record makes the error clear.]

1917. January 20d. 23h. 11m. 34s.

Epicentre **7°·0**S. **116°·0**E.

A = −·435, B = +·893, C = −·122; D = +·899, E = +·438;
G = +·053, H = −·110, K = −·993.

Station and Component.	Machine.	△	Azimuth.	P.	O−C.	S.	O−C.	L.	M.
		°	°	M. S.	S.	M. S.	S.	M.	M.
Batavia	W.	9·2	275	i 2 21	+ 2	4 28	+20	—	7·1
Manila	W.	22·2	13	e 5 26	−19	9 33	+24	13·1	15·2
Adelaide E.	M.	34·8	147	6 56	−15	—	—	12·5	20·3
Zi-ka-wei	W.	38·6	7	7 45	+ 2	13 55	+ 9	—	28·3
Colombo E.	M.	38·7	290	8 44	PR_1	—	—	13·2	27·1
Calcutta N.	O.E.	40·1	318	8 2	+ 6	17 20	?	26·8	32·9
Melbourne	—	40·5	144	7 26	−33	13 56	−18	21·4	—
Kodaikanal	M.	42·1	294	14 14	? S	(14 14)	−22	20·7	27·0
Riverview	W.	42·2	134	i 7 59	−13	e 14 20	−18	23·3	23·8
Sydney E.	M.	42·2	134	−2 52	?	6 8	?	19·1	22·6
Osaka N.	O.	45·6	23	8 45	+ 8	15 27	+ 4	21·0	27·5
Bombay	M.	49·9	302	? 9 1	− 5	15 46	−32	—	33·3
Mizusawa E.	O.	51·7	25	9 26	+ 8	16 54	+14	—	—
Simla	O.E.	53·2	318	9 8	−19	21 20	?	31·1	32·0
Mauritius	—	57·5	251	—	—	—	—	—	25·5
Honolulu	M.	88·8	68	24 8	? S	? 24 8	+ 6	42·3	58·5
Helwan	M.	88·8	300	12 26	−43	—	—	—	56·6
Cape Town E.	M.	92·1	236	24 14	? S	? 24 14	−22	—	27·0
Pulkovo	G.	93·9	330	i 13 29	− 7	24 43	−12	—	—
Zagreb	W.	102·0	316	e 18 1	+221	e 24 17	−118	—	—
Moncalieri	S.	107·8	315	18 34	+227	29 5	+117	49·7	68·6
De Bilt	G.	108·2	323	e 19 8	+259	e 25 14	−118	—	66·3
Paris	—	110·6	320	e 22 34	+454	—	—	—	—
Kew	M.	111·6	323	24 26	+560	—	—	—	73·9
Edinburgh	M.	111·8	328	19 32	+265	? 29 38	+114	—	77·8
Eskdalemuir	G.	112·1	328	19 45	+278	i 27 20	−27	—	64·6
Stonyhurst	M.	112·2	326	e 20 56	+348	i 30 38	+170	—	82·1
Barcelona	Ma.	112·4	312	e 28 26	? S	? 28 26	+37	—	40·4
Algiers	—	112·4	307	e 19 42	+273	23 26	−263	—	33·9
Victoria, B.C.	M.	115·3	41	36 32	? SR_1	44 26	?	—	67·2
San Fernando N.	M.	119·8	318	30 56	? S	? 30 56	+127	—	73·4
E.	M.	119·8	318	40 26	? SR_1	—	—	—	84·9
Coimbra	W.	120·4	313	e 24 26	+522	—	—	68·4	—
La Paz	Bi.	156·1	350	e 20 10	(+115)	30 54	(−93)	43·5	45·3

The following stations record PR_1: Melbourne = +9m. 2s. (−18s.); Riverview = +9m. 33s. (−15s.); Colombo = +8m. 44s. (−24s.); Pulkovo = +17m. 21s. (−13s.); La Paz = +23m. 32s. (−44s.). The records for P for some stations between Zagreb and Algiers may really be PR_1. The stations giving small residuals on this supposition are as follow:— Zagreb = +18m. 17s. (−9s.); Moncalieri = +18m. 34s. (−30s.); De Bilt = +19m. 8s. (0); Edinburgh = +19m. 32s. (+2s.); Eskdalemuir = +19m. 45s. (+13s.); Stonyhurst = +20m. 56s. (+82s.); Algiers = +19m. 42s. (+8s.).

The records for Batavia for this and the following shock are recorded one hour wrong: 0h. instead of 23h., &c.

Eskdalemuir gives e = +25m. 26s., i = +27m. 20s., i = +29m. 1s., M = +64·6m. +68·8m.

After the above figures were in type (and correction would have involved much delay and disturbance), Vol. No. 7 of Kon. Mag·en Met. Obs. te Batavia, 1909–1919 (published in 1921), was received, giving an origin at 9°·0S. 115°·8E. from researches by Dr. Kemmerling. This epicentre certainly suits the observations better and indicates a T_o = 23h. 11m. 26s. That used, 7°·0S. 116°·0E., was adopted from Pulkovo.

1917. January 24d. 0h. 48m. 12s.

Epicentre **31°·0**N. **114°·0**E.

A = −·349, B = +·783, C = +·515; D = +·914, E = +·407;
G = −·210, H = +·471, K = −·857.

Station and Component.	Machine.	△	Azimuth.	P.	O−C.	S.	O−C.	L.	M.
		°	°	M. S.	S.	M. S.	S.	M.	M.
Zi-ka-wei	W.	6·3	87	1 23	−13	2 40	−12	—	—
Taihoku	O.	8·9	130	e 2 42	+27	3 38	−22	4·5	4·8
Manila	W.	17·5	157	e 4 25	+14	7 45	+16	11·5	N 13·4
Osaka	O.	18·3	73	e 3 55	−26	—	—	8·9	N 11·6
Mizusawa	O.	23·5	62	e 5 35	+12	9 32	− 2	12·7	—
Calcutta	O.E.	24·4	256	6 48	—	12 24	—	16·6	17·6
Batavia	W.	37·8	192	e 9 38	—	—	—	—	25·2
Kodaikanal	M.	39·8	246	22 6	? L	—	—	(22·1)	—
Colombo	M.	40·1	240	16 36	? S	(16 36)	?	23·8	24·8
Pulkovo	G.	60·6	325	? 10 39	+23	? 18 54	+23	27·8	34·3
Helwan	M.	69·4	293	20 48	? S	(20 48)	+29	—	—
Riverview	W.	73·7	148	e 24 36	? S	(e 24 36)	?	—	—
De Bilt	G.	76·4	323	—	—	e 22 12	+30	e 37·8	—
Edinburgh	M.	78·1	329	23 18	? S	(23 18)	(+77)	—	46·3
Eskdalemuir	G.	78·4	329	e 22 19	? S	(22 19)	(+14)	37·5	44·0
Moncalieri	S.	78·8	316	—	—	30 38	?	41·5	46·0
Stonyhurst	M.	79·0	327	e 26 48	? S	(26 48)	(+276)	39·6	44·1
Kew	M.	79·5	325	43 48	? L	—	—	(43·8)	50·3
Paris	—	79·6	321	e 19 22	? S	(19 22)	(−176)	41·8	42·8
Barcelona	Ma.	84·2	316	—	—	—	—	44·0	48·8
Victoria, B.C.	M.	85·6	34	48 30	? L	—	—	(48·5)	53·0
Coimbra	W.	91·1	320	—	—	—	—	46·8	51·3
Rio Tinto	M.	91·7	317	47 48	? L	—	—	(47·8)	62·8
San Fernando	M.	92·3	316	47 48	? L	—	—	(47·8)	57·8
Toronto	M.	104·3	10	—	—	—	—	57·8	61·6
La Paz	Bi.	165·4	8	e 63 48	? L	—	—	94·8	102·3

Calcutta P = PR_1 = +6m. 48s. (+44s.), S = L + 12·4m. (−49s.).
Batavia e = PR_1 = +9m. 38s. (+42s.).
De Bilt gives largest M for N component at +43·3m. and for E at +43·5m.; and the epicentre as 31°·0N. 116°·0E.

Jan. 28d. 0h. (50m.). Helwan P = 0h.53m.0s. Moncalieri L = 1h.11m.26s. Rio Tinto P = 1h.16m.0s., M = 1h.27m.0s. Edinburgh P = 1h.19m.0s. Pulkovo L = 1h.0m.0s., M = 1h.3m.54s.

Jan. 28d. 10h. 15m. (15s.). Zi-ka-wei eP = +1m.19s., SZ = +2m.21s., MZ = +2·8m. Manila e = +2m.28s. Pulkovo L = +30·8m., M = +42·8m.

Jan. 28d. 13h. 54m. (39s.). Zi-ka-wei P = +1m.48s., S = +3m.14s., ME = +3·9m. MN = +4·2m. Manila e = +3m.6s.

Jan. 28d. 14h. 7m. Pulkovo gives i = 14h. 15m. 6s., L = 14h. 29m. 0s., M = 14h.38m.36s. Zi-ka-wei e = 14h.20m.38s. Edinburgh P = 14h.42m.42s., M = 14h.51m.30s.

Jan. 28d. 23h. (17m.). Zi-ka-wei e = 23h.17m.5s. Manila e = 23h.20m.38s.

Jan. 29d. 8h. 22m. 55s. Only about 0°·3 from Zagreb. Adopted 45°·6N. 16°·4E. separately computed.

1917. January 29d. 8h. 22m. 55s.

Epicentre **45°·6**N. **16°·4**E.

A = +·671, B = +·198, C = +·715; D = +·282, E = −·959;
G = +·685, H = +·202, K = −·700.

Station and Component.		Machine.	△	Azimuth.	P.	O−C.	S.	O−C.	L.	M.
			°	°	M. S.	S.	M. S.	S.	M.	M.
Zagreb		W.	0·3	300	i 0 5	− 3	—	—	—	—
Graz		—	1·6	338	i 0 19	− 1	—	—	—	—
Vienna		—	2·6	0	0 42	+ 1	—	—	—	—
Monte Cassino		Ag.	4·5	202	1 30	+20	—	—	—	3·3
Rocca di Papa		Ag.	4·7	212	1 9	− 4	1 40	−29	—	N 3·1
Moncalieri		S.	6·2	265	1 38	+ 3	2 48	− 1	3·3	4·6
Besancon		Ma.	7·3	285	2 12	+21	3 47	+29	—	—
Marseilles		Ma.	8·2	356	i 3 20	+76	4 40	+68	—	5·7
Uccle		—	9·6	307	e 2 35	+11	e 4 23	+ 4	—	5·2
De Bilt	E.	—	9·8	315	—	—	e 4 6	−18	4·6	5·6
Paris		—	10·0	293	e 4 7	+97	e 4 50	+21	5·3	7·1
Barcelona		Ma.	11·1	72	—	—	—	—	e 1·7	7·5
Tortosa		V.	12·8	73	(6 29)	?	(7 41)	?	7·9	9·6
Edinburgh		M.	16·0	317	8 41	? L	—	—	(8·7)	9·8
Pulkovo		G.	16·4	26	i 3 54	− 3	7 10	+ 6	8·1	10·7
Rio Tinto		M.	18·8	252	(10 5)	? L	—	—	(10·1)	14·1
Coimbra		W.	18·9	261	—	—	—	—	9·8	12·2

San Fernando (△ = 19°·2, Az. 248) gives P at −1m. 55s., L = +10·8m., M = +13·1m.; Uccle also gives MN +5·9m.
Pulkovo gives epicentre 44°·8N. 15°·8E.

Jan. 29d. 10h. 29m. 28s. From same epicentre as preceding ? Comparison of similar phases at different stations is as follows :—

	△	Az.	8h.	10h.	10h. − 8h.
	°	°	m. s.	m. s.	s.
Zagreb	0·3	300	P 0 5	P −0 3	− 8
Monte Cassino	4·5	202	P 1 30	P 1 34	+ 4
	,,	,,	M 3 16	M 2 55	−21
Rocca di Papa	4·7	212	P 1 9	P 1 14	+ 5
	,,	,,	M 3 5	M 3 9	+ 4
Moncalieri	6·2	265	P 1 38	P 1 56	+18
	,,	,,	S 2 48	S 3 3	+15
Edinburgh	16·0	317	P 8 41	P 9 2	+21
Pulkovo	16·4	26	P 3 54	P 3 49	− 5
	,,	,,	S 7 10	S 7 11	+ 1
	,,	,,	L 8 5	L 8 32	+27
	,,	,,	M 10 42	M 10 9	−23

The Edinburgh phases are recorded as P in both cases, but are probably L. A correction of 8s. or 10s. is indicated to the mean difference in T_c, but is not supported by the Zagreb or Pulkovo observations.

Jan. 30d. 2h. 45m. 25s. At 54°·5N. 164°·0E. separately computed.

Jan. 31d. 3h. 59m. 55s. at 6°·0N. 125°·0E. separately computed.

1917. January 30d. 2h. 45m. 25s.

Epicentre **54°·5**N. **164°·0**E.

A = −·558, B = +·160, C = +·814; D = +·276, E = +·961;
G = −·782, H = +·225, K = −581.

Station and Component.		Machine.	△	Azimuth.	P.	O−C.	S.	O−C.	L.	M.
			°	°	M. S.	S.	M. S.	S.	M.	M.
Mizusawa	N.	O.	21·7	234	5 9	+ 7	9 17	+18	—	—
	E.	O.	21·7	234	5 9	+ 7	9 24	+25	—	—
Osaka		O.	28·0	237	6 13	+ 5	11 18	+19	17·1	—
Zi-ka-wei		W.	38·0	250	7 29	− 9	e 13 27	−11	17·6	—
Taihoku		O.	43·0	244	8 12	− 6	14 44	− 4	—	22·6
Victoria, B.C.		M.	43·6	67	7 47	−36	14 47	− 9	19·4	26·2
Berkeley	V.	W.	51·1	77	e 9 18	+ 5	e 16 50	+18	e 22·6	29·6
	N.	W.	51·1	77	e 9 19	+ 6	e 16 40	+ 8	e 22·1	22·6
Lick		W.	52·0	78	e 9 20	0	e 16 51	+ 7	e 22·1	26·9
Manila		W.	52·0	237	e 9 29	+ 9	16 11	−33	22·8	39·0
Pulkovo		G.	59·9	335	10 6	− 6	18 15	− 7	25·6	28·7
Simla		O.E.	63·4	287	10 29	− 5	18 47	−19	23·6	46·3
Calcutta	E.	O.E.	63·6	274	10 41	+ 6	e 19 11	+ 3	e 29·2	—
	N.	O.E.	63·6	274	10 47	+12	19 17	+ 9	26·8	—
Dyce	E.	Ma.	67·7	352	e 11 22	+19	20 2	+ 4	28·0	50·0
	N.	Ma.	67·7	352	e 11 22	+19	20 22	+24	32·4	47·6
Ottawa		B.	68·0	41	11 9	+ 5	20 1	− 1	30·6	38·6
Toronto		M.	68·0	44	11 11	+ 7	20 5	+ 3	28·6	38·8
Edinburgh		M.	69·1	352	11 35	+24	—	—	—	57·3
Eskdalemuir		G.	69·7	352	11 12	− 3	20 19	− 3	—	—
Stonyhurst		M.	71·1	352	—	—	18 17	−142	—	40·9
Bidston		M.S.	71·5	352	11 27	+ 1	—	—	—	—
De Bilt	E.	G.	72·0	347	11 30	0	20 41	− 9	40·8	46·3
West Bromwich		M.S.	72·3	351	11 32	0	21 0	+ 6	—	—
Washington	E.	W.	73·0	45	e 11 37	+ 1	20 57	− 5	e 32·6	41·1
	N.	B.O.	73·0	45	e 11 35	− 1	21 3	+ 1	32·6	49·3
	V.	—	73·0	45	11 33	− 3	—	—	38·6	45·4
Kew		M.	73·2	350	11 35	− 2	—	—	—	52·1
Uccle		—	73·2	347	11 33	− 4	21 1	− 3	—	—
Shide		M.B.	74·0	350	11 57	+15	21 12	− 2	32·9	44·9
Bombay		M.	75·4	282	11 59	+ 8	21 25	− 5	—	—
Paris		—	75·5	347	e 11 48	− 4	i 21 24	− 8	e 31·6	41·6
Zagreb		W.	76·0	338	e 11 49	− 6	i 21 23	−14	41·6	43·6
Besancon		Ma.	76·6	345	11 55	− 4	21 15	−29	—	—
Batavia		W.	77·0	239	i 12 8	+ 7	21 55	+ 6	—	56·6
Moncalieri		S.	78·5	343	i 12 13	+ 3	22 4	− 2	32·0	59·4
Kodaikanal		M.	79·7	273	12 23	+ 6	22 10	−10	36·6	56·1
Marseilles		Ma.	80·5	344	i 12 22	0	i 22 41	+12	e 46·6	50·2
Rocca di Papa		Ag.	80·6	339	12 21	− 2	22 32	+ 2	32·4	52·6
Monte Cassino	N.	Ag.	80·6	338	11 57	−26	—	—	—	53·9
Colombo		M.	81·0	269	11 41	−44	21 41	−54	—	50·6
Athens		Ma.	81·5	329	e 12 19	− 8	22 29	−12	—	48·8
Barcelona		Ma.	82·8	346	12 33	− 2	22 42	−13	e 33·8	61·6
Tortosa		V.	83·7	348	12 35	− 5	23 5	0	32·4	52·8
Coimbra	N.	W.	85·1	354	12 42	− 7	23 7	−13	40·8	57·3
	E.	W.	85·1	354	12 43	− 6	23 5	−15	41·3	61·0
Algiers		—	87·3	345	12 51	−10	23 22	−22	42·6	49·6
Azores		M.	87·4	8	13 47	+46	—	—	—	82·6
San Fernando		M.	88·6	352	13 5	− 3	23 5	−54	45·1	62·1
Riverview		W.	89·0	191	i 13 17	+ 7	i 24 12	+ 9	e 38·0	42·6
Sydney	E.	M.	89·0	191	—	—	24 5	+ 2	37·1	46·6
Adelaide	E.	M.	92·1	201	17 35	? PR_1	24 11	−25	—	24·9
Port-au-Prince		B.O.	92·6	52	11 25	−124	25 12	+31	49·9	—
La Paz		Bi.	124·9	293	e 19 19	+194	33 5	+220	55·6	62·6
Cape Town		M.	148·4	296	19 41	+116	27 17	−272	82·7	91·7

For Notes see next page.

NOTES TO JAN. 30d. 2h. 45m. 25s.

Osaka gives P as PS, S as L, L as M.
Taihoku gives S = +11m. 33s., L = +14·7m., M = +22·7m.
Uccle records ME = +52·8m., MN = +58·3m., MZ = +52·6m.
Kodaikanal gives S = +26·6m., L = +22·0m., M = +56·8m., which do not accord; the above S, L, and M are read from a copy of the film received.
Colombo give their times as S, L, and M.
Sydney's time given as P is S.
Port-au-Prince readings are one hour wrong throughout.
The following stations record PR_1: Pulkovo = +12m. 24s. (−32s.); Eskdalemuir = +14m. 17s. (−7s.); La Paz = +21m. 8s. (+10s.); Helwan = +16m. 53s. (−15s. recorded as S); Riverview = +16m. 58s. (−2s.); Adelaide = +17m. 35s. (+15s. recorded as P).
Melbourne △ = 93°·7 records PR_1 at + 21m. 47s., S = + 28m. 59s., L = +55·3m., M = +59·0m.; PR_2 as +24m. 35s. is S, giving O −C = +18s.
Rio Tinto △ = 87°·4 gives P = +17m. 35s., M = +69·6m. Seychelles P = +22m. 35s., L = +27·6m., M = +66·6m.
Epicentres recorded from De Bilt 55°·1 157°·6E.; Coimbra 57°·0 160°·1E.; Pulkovo 54°·5N. 159°·7E.; Zi-ka-wei 42°·20′N. 167°·26′E.; Ottawa 56°·0N. 162°·7E.

1917. January 31d. 3h. 59m. 55s.

Epicentre 6°·0N. 125°·0E.

A = −·571, B = +·815, C = +·104; D = +·819, E = +·574: G = −·060, H = +·085, K = −·995.

Station and Component.		Machine.	△	Azimuth.	P.	O−C.	S.	O−C.	L.	M.
			°	°	M. S.	S.	M. S.	S.	M.	M.
Manila		W.	9·5	335	e 2 47	+23	—	—	5·6	7·0
Taihoku		O.	19·4	350	e 4 46	+12	8 24	+14	e 11·2	13·6
Batavia		W.	22·0	237	i 5 14	+ 9	? 9 21	+16	—	—
Zi-ka-wei		O.	25·5	352	5 46	+ 3	e 10 16	+ 3	e 12·0	—
Osaka		O.	30·4	17	6 53	+21	—	—	13·1	—
Mizusawa	N.	O.	36·2	21	7 22	− 2	12 56	− 7	—	—
	E.	O.	36·2	21	7 25	+ 1	13 4	− 9	—	—
Calcutta	N.	O.E.	39·1	299	7 53	+ 6	—	—	—	—
Colombo	E.	M.	45·0	274	8 5	−28	15 41	+26	—	28·6
Riverview		W.	46·9	150	i 8 42	− 4	i 15 25	−15	e 25·3	30·1
Sydney	E.	M.	46·9	150	8 35	−11	—	—	27·1	30·1
Kodaikanal		M.	47·2	278	8 5	−43	14 47	−57	23·1	34·0
Bombay		M.	52·4	289	9 15	− 8	—	—	—	36·1
Pulkovo		G.	87·3	330	i 13 3	+ 2	i 23 36	− 8	37·1	50·8
Helwan	E.	M.	90·2	300	13 5	−12	—	—	—	65·9
Moncalieri		S.	104·5	320	i? 15 1	+29	25 13	−85	33·1	69·2
Eskdalemuir		G.	105·4	332	e 18 54	PR_1	? 28 21	+95	—	55·7
La Paz		Bi.	163·4	131	20 27	+102	34 10	+65	75·1	81·1

Manila gives S = +5m. 35s., L = +6·2m., MN = +7·0m., ME = +8·0m.
Batavia is one hour wrong throughout.
Osaka records L = +13·1m., MN = +16·7m., ME = +14·0m.
Calcutta records S = +17m. 18s., L = +27·4m., M = +29·0m.
Colombo gives P as S, S as L.
The following stations record PR_1: Zi-ka-wei = +6m. 15s. (−3s.); Riverview = +10m. 32s. (−14s.); Pulkovo = +16m. 35s. (−11s.); Eskdalemuir = +18m. 54s. (+6s.); La Paz = +25m. 20s. (+24s.); Zagreb = +18m. 3s. (−3s.); Adelaide = +9m. 41s. (−17s.)
Doubtful or erroneous records also from Barcelona, Rocca di Papa, Paris, Mauritius, San Fernando, Rio Tinto, Washington, Coimbra, Ottawa, Victoria, Kew, Zagreb, Edinburgh, Simla, Uccle.
Epicentres recorded: 5°·6N. 124°·8E. (Philippines) and 5°·1N. 126°·0E. (Batavia)

1917, FEBRUARY.

Feb. 1d. 0h. (25m.). La Paz records P = +6m.45s., L = +15·0m. San Fernando P = +10m.

Feb. 1d. 3h. (22m.). Pulkovo records P = +10m.6s., L = +31m. Also Eskdalemuir, Osaka, Zi-ka-wei.

Feb. 1d. 12h. Melbourne eL = 12h.15m.0s., M = 12h.17m.24s. Pulkovo e = 12h.15m.12s., L = 13h.0m.0s. Edinburgh P = 13h.6m. Eskdalemuir 13h.6m. to 13h.20m. Helwan P = 13h.33m.

Feb. 4d. 9h. 41m. (16s.). Query 3°·0N. 105°·0E.? Batavia P = +2m.27s., S = +4m.25s. Melbourne P = +21m.14s. (= L?), M = +28m. Manila e = +8m.33s. (= S?). Batavia suggests repetition of Jan. 20d. 23h.: see above, especially footnote.

Feb. 4d. 10h. 28m. (36s.). Manila eP = +1m.46s., L = +3·4m., suggests S.E. Mindanao 8°·0N. 126°·0E. Zi-ka-wei gives eP = 10h.23m.10s., an earlier quake? Batavia P = +4m.1s., S = +5m.5s. Melbourne P = +13m.48s., M = +27·1m. Pulkovo i = +22m.12s., L = +40·4m. Helwan P = +11m.24s. De Bilt +52·4m. Possibly several small shocks.

Feb. 5d. 12h. 18m. 52s. Adopt 15°·0N. 111°·0E.

	△	Az.	P.	O−C	S.	O−C	L.
	°	°	m. s.	s.	m. s.	s.	m.
Manila	9·6	91	2 26	+ 2	+4 17	− 2	6·5
Zi-ka-wei	18·8	29	—	—	—	—	10·6
Batavia	21·6	191	4 34	−26	—	—	—
Melbourne	61·7	150	14 37	?	18 7	−37	19·9
La Paz	178·3	209	17 8	—	—	—	—

But records from Sydney (△ = 62°·1), P = +4m.8s., L = +15·6m. Pulkovo (△ = 72°·4), L = 45·1m., and Honolulu (△ = 85°·5), L = 30·9m. will not fit. Something is to be said for the same epicentre as for Feb. 4d. 10h. 28m..

Feb. 12d. 9h. 3m. 30s. 22°·0S. 170°·0E.

	△	Az.	P.	O−C	S.	O−C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Sydney	20·4	230	4 30	−16	8 48	+17	11·1	12·0
Melbourne	26·7	228	5 36	−19	(10 30)	− 5	—	18·2
Honolulu	53·5	38	9 42	+12	17 24	+22	24·3	28·7
Manila	60·4	303	9 18	−57	(17 30)	−58	—	—
Batavia	62·8	274	9 13	?	—	—	—	19·7
Victoria	92·1	38	24 12	? S	(24 12)	−24	—	51·4
Colombo	92·8	276	22 30	? S	(22 30)	−133	—	55·5
Kodaikanal	96·2	279	23 12	? S	(23 12)	−126	—	—
Mauritius	101·4	243	22 30	?	—	—	—	51·6
La Paz	111·3	119	—	—	—	—	52·5	57·0
Toronto	119·7	51	—	—	—	—	59·0	71·6
Ottawa	122·3	49	34 50	? S	(34 50)	—	61·5	—
Pulkovo	132·9	334	(18 59)	+139	—	—	58·5	68·3
Edinburgh	145·7	353	38 12	? S	(38 12)	—	—	94·5
Eskdalemuir	146·4	353	18 59	+82	—	—	—	—
De Bilt	147·7	343	(19 6)	+84	(41 0)	—	68·5	80·4
Paris	151·5	343	19 15	+78	—	—	76·5	80·5
Coimbra	161·8	356	42 30	? S	(42 30)	—	79·5	—
San Fernando	165·2	348	27 0	—	—	—	90·5	110·5

Melbourne S recorded as L.
Manila S recorded as L. Query Manila time 1m. wrong.
Pulkovo e = +18m.59s., i_1 = +19m.29s., i_2 = +21m.57s.
De Bilt figures entered for P and S above recorded e simply.
MN = 80·6m., ME = 85·7m.
Mizusawa records P = 9h.4m.3s., L = 9h.4m.27s., which must be a local shock? The distance of Honolulu from Mizusawa is 54°·5, so that the Honolulu records would approximately fit either shock.

Feb. 14d. (5h.). Several observatories record disturbances. La Paz gives P = 4h.56m.3s., S = 5h.3m.48s., L = 5h.11m.0s., which would give (from S − P), T_0 = 4h.46m.20s. But this seems too early for most of the records. Chacarita gives P = 5h.0m.18s., Sydney P = 5h.16m.42s., L = 5h.19m.48s., M = 5h.21m.30s. Melbourne L = 5h.22m.0s., M = 5h.26m.18s. Mauritius, Victoria, Toronto, Helwan (P = 5h.30m.0s.), Colombo, Eskdalemuir, Bombay, De Bilt.

Feb. 15d. 0h. 48m. 9s. 26°·0S. 80°·0W. Separately computed.

1917. February 15d. 0h. 48m. 9s.

Epicentre 26°·0S. 80°·0W.

A = +·156, B = −·886, C = −·438; D = −·985, E = −·174;
G = −·076, H = +·431, K = −·899.

Station and Component.	Machine.	△	Azimuth.	P.	O−C.	S.	O−C.	L.	M.
		°	°	m. s.	s.	m. s.	s.	m.	m.
La Paz	Bi.	14·5	52	3 31	−1	6 20	0	8·8	9·2
Chacarita	M.	20·5	120	5 3	+16	—	—	—	—
Washington	—	64·9	2	11 21	+37	20 53	+89	36·0	—
Toronto	M.	69·6	0	11 27	+22	20 21	0	38·2	56·8
Ottawa	B.	71·5	3	12 7	+41	21 18	+64	37·8	—
Cape Town	M.	82·3	124	22 9	? S	(22 9)	−40	—	—
Accra	M.	83·4	80	20 51	? S	(20 51)	−130	—	43·3
Victoria, B.C.	M.	83·9	333	24 45	? S	(24 45)	+98	37·6	61·0
Honolulu	M.	89·2	294	18 51	? PR_1	32 39	?	45·4	50·4
San Fernando	M.	93·3	51	24 3	? S	(24 3)	−45	46·4	58·8
Rio Tinto	M.	93·8	49	14 51	+74	—	—	—	56·8
Coimbra	W.	93·8	47	13 16	−21	23 51	−63	48·3	51·2
Algiers	—	100·1	54	e 14 4	−7	24 39	−78	41·8	55·8
Barcelona	Ma.	101·4	49	e 24 35	? S	(24 35)	−94	34·4	56·8
Sydney	M.	102·9	222	41 33	? L	47 21	? L	51·2	53·4
Shide	M.S.	103·2	40	—	—	25 12	−74	—	—
Melbourne	—	103·6	215	47 39	? L	—	—	51·4	56·0
Eskdalemuir	G.	104·1	35	14 14	−16	25 14	−80	45·4	60·6
Kew	M.	104·1	39	50 51	? L	—	—	(50·8)	62·8
Paris	—	104·6	42	e 25 14	? S	(25 14)	−84	49·8	60·8
Moncalieri N.	S.	106·6	48	i 25 16	? S	(25 16)	−101	38·4	60·4
De Bilt N.	G.	107·4	40	—	—	e 25 26	−99	51·8	64·0
Malta	M.	108·3	58	50 51	? L	—	—	(50·8)	66·8
Rocca di Papa	Ag.	108·9	52	e 17 3	+131	—	—	57·4	—
Zagreb N.E.	W.	112·3	48	e 19 25	+257	28 58	+70	57·8	72·3
Mauritius N.	—	118·6	134	25 9	? S	(25 9)	−210	—	52·2
Helwan	M.	120·2	68	20 9	+266	30 9	+78	—	72·4
Pulkovo	G.	122·4	34	15 56	+2	28 41	−26	51·8	65·9
Batavia	W.	147·1	193	e 18 50	+71	—	—	—	25·8
Osaka N.	O.	148·6	294	e 22 48	+303	—	—	—	83·1
Colombo E.	M.	152·9	131	33 21	? S	(33 21)	+69	70·3	84·6
Kodaikanal E.	M.	153·7	122	71 51	? L	—	—	76·6	106·0
Bombay	M.	153·9	100	19 59	+109	—	—	—	80·4
Zi-ka-wei	—	160·7	292	e 20 28	+114	—	—	—	—

Berkeley (△ =75°·2) gives e =41m. 51s. ±

Victoria gives S = + 30m. 15s. Eskdalemuir gives PR_1 = + 18m. 29s. Moncalieri gives also ME = +58·1m. De Bilt gives also ePR_1 = +19m. 9s., eE = +28m. 0s., eN = +28m. 22s., and ME = +61·3m. Rocca di Papa gives other Ls at +61·2m., +68·0m., +71·3m. Zagreb gives also eSNW = +28m. 31s. Pulkovo gives PR_1 = +20m. 43s., i = +26m. 23s., PS = +30m. 25s., SR_1 = +37m. 27s. with origin 21°·0S. 72°·0W. Osaka gives also ME = +81·6m.

Epicentre from Ottawa 31°·5S. 67°·5W.

Feb. 16d. 2h. 12m. (10s.). Repetition from 26°·0S. 80°·0W.? The material is scanty and uncertain, but, as will be seen better in the case of Feb. 21, which is also apparently a repetition from the same focus, much can be learnt by comparison of records at the same stations, even though they be faulty. Thus we have—

Station.	△	Az.	Feb. 16	Feb. 15	16—15
	°	°	m. s.	m. s.	s.
La Paz	14·5	52	3 27	P 3 31	− 4
			6 27	S 6 20	+ 7
			8 32	L 8 51	− 19
			9 2	M 9 15	− 13
De Bilt	107·4	40	61 15	MN 64 0	− 45
			62 33	ME 61 18	− 45
Pulkovo	122·4	34	62 50	L 51 51	+659

Eskdalemuir (△ =104°·1) only records "3h.11m. to 3h.30m." for Feb. 16. De Bilt gives eN =3h.11m.18s. and eE 3h.12m.54s., which will not fit anything on Feb. 15. Helwan and Edinburgh give records on Feb. 16, but not on Feb. 15 (though they have records on Feb. 21, and, as shewn below, it seems probable that this is also a repetition from same focus). The evidence cannot be regarded as conclusive, but it is interesting to see how much is possible by way of inference.

Feb. 17d. 22h. 48m. 1s. Epicentre 21°·0N. 120°·0E. gives—

	△	P.	O−C.	S.	O−C.	L.	M.
	°	m. s.	s.	m. s.	s.	m.	m.
Taihoku	4·3	1 8	+ 2	2 0	+ 2	3·0	—
Manila	6·4	1 21	−17	(2 29)	−26	2·5	—
Zi-ka-wei	10·3	2 23	−11	—	—	—	—
Pulkovo	71·9	11 28	− 1	20 43	− 6	39·0	46·2
Edinburgh	89·5	50 41	? L	—	—	—	59·0

Pulkovo records PR_2 = +15m.50s. Observed also at Eskdalemuir (+49m. to +61m.). Batavia (△ =30°·0) records i at 22h.22m.48s., M = 22h.23m.7s., which probably refer to a local shock. De Bilt gives e = +49m. and several Ms.

Feb. 18d. 1h. 23m. 0s. 11°·0N. 122°·0E.

	△	Az.	P.	O−C.	S.	O−C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Manila	3·7	345	1 34	+37	—	—	2·9	4·6
Zi-ka-wei E.	20·2	358	4 38	− 5	8 27	0	—	—
Batavia	22·9	222	5 1	−15	—	—	—	7·4
Osaka	26·7	26	5 55	0	(10 49)	+14	10·8	13·7
Mizusawa	32·9	28	6 14	−41	11 7	−75	—	—
Calcutta	34·1	294	7 18	+12	12 54	+13	—	—
Colombo	41·8	268	—	—	—	—	15·0	16·0
Kodaikanal	43·7	273	15 6	? S	(15 6)	+ 8	—	—
Melbourne	51·7	156	i 15 42	? S	(15 42)	−58	—	—
Honolulu	76·8	71	—	—	—	—	33·0	41·0
Pulkovo	81·4	329	i 12 8	−19	i 22 18	−21	41·0	47·4
Helwan	85·1	300	14 0	+71	—	—	—	—
De Bilt N.	97·0	326	—	—	24 48	−38	51·0	55·2
Moncalieri	98·6	319	—	—	—	—	54·2	—
Edinburgh	99·2	332	i 25 6	? S	(25 6)	−42	—	60·0
Eskdalemuir	99·5	332	—	—	25 6	−45	—	—
Rio Tinto	111·5	318	39 0	?	—	—	—	77·0
La Paz	168·8	120	e 19 43	—	—	—	—	—

Manila gives ME = +4·6m., MN = +4·9m. Zi-ka-wei gives PRN = +4m.58s., PRZ = +5m.2s., PSN = +8m.37s., SRE = +9m.18s. Osaka: the P reading above is marked PS.

Honolulu gives also L = +21·0m., M = +22·3m.

Pulkovo gives also i = +12m.36s., PR_1 = +15m.30s., PR_2 = +17m.28s., PR_3 = +18·9m., PS = +23m.10s., SR_1 = +27m.36s., SR_2 = +31m.48s.

De Bilt gives also eE = +25m.10s., ME = +57·8m.

Moncalieri gives also e = +36m.36s. San Fernando △ =112°·0 gives P = +4m.30s., which does not accord.

La Paz gives also i = +24m.1s. The record for P so near the anti-centre is noteworthy.

Feb. 20d. 19h. 29m. 32s. At 19°·0N. 80°·0W. separately computed.

1917. February 20d. 19h. 29m. 32s.

Epicentre **19°·0N. 80°·0W.**

A = +·164, B = −·931, C = +·326; D = −·985, E = −·174;
G = +·057, H = −·321, K = −·946.

Station and Component.	Machine.	△	Azimuth.	P.	O−C.	S.	O−C.	L.	M.
		°	°	M. S.	S.	M. S.	S.	M.	M.
Washington	W.								
Toronto	M.	24·6	1	? 6 28	+54	9 52	− 3	12·8	15·5
Ottawa	B.	26·6	7	i 5 46	− 8	10 22	−11	e 14·2	15·8
La Paz	Bi.	37·4	161	i 7 29	− 4	13 4	−26	18·1	21·0
Lick	W.	40·5	305	e 8 13	+14	e ? 14 59	+45	e 25·6 ?	26·3
Berkeley E.	W.	41·1	306	e 8 14	+ 9	14 40	+18	26·2	29·7
N.	W.	41·1	306	e 8 16	+11	e 14 35	+13	e 26·7 ?	27·7
V.	W.	41·1	306	e 8 14	+ 9	14 37	+15	—	30·1
Victoria, B.C.	M.	45·5	320	? 7 28	−69	15 52	+30	26·6	33·2
Cork E.	M.	63·6	40	—	—	18 28	−40	29·0	31·5
Coimbra	W.	64·0	54	10 44	+ 6	19 4	− 9	27·1	27·8
Rio Tinto	M.	65·6	56	11 28	+39	—	—	—	35·5
San Fernando	M.	66·0	58	10 58	+ 7	19 28	− 9	27·5	31·0
Edinburgh	M.	67·0	36	11 10	+12	—	—	—	42·5
Eskdalemuir	G.	67·0	37	11 3	+ 5	19 49	− 1	—	28·6
Stonyhurst	M.	67·4	39	e 11 34	+34	i 19 58	+ 3	—	33·5
West Bromwich	M.	67·8	40	11 9	+ 6	19 49	−11	—	—
Shide	M.S.	68·3	42	11 17	+11	20 2	− 4	—	—
Kew	M.	68·9	41	18 28	? S	18 28	−105	—	42·5
Tortosa	V.	70·3	53	11 26	+ 7	20 27	− 3	31·1	34·0
Paris	—	70·9	44	i 11 27	+ 5	i 20 34	− 3	28·5	31·5
Barcelona	Ma.	71·8	51	i 11 29	+ 2	i 20 44	− 4	29·5	32·5
Uccle	—	71·8	41	11 30	+ 1	20 45	− 3	28·5	32·8
De Bilt	—	72·2	40	11 37	+ 6	20 50	− 2	28·3	29·1
Algiers	—	73·3	56	11 41	+ 3	20 58	− 8	—	33·0
Besancon	Ma.	73·4	45	11 42	+ 4	20 44	−23	—	—
Marseilles	Ma.	73·8	49	11 43	+ 2	21 16	+ 4	32·5	37·5
Moncalieri	S.	75·1	47	11 53	+ 3	21 24	− 3	30·5	33·8
Rocca di Papa	Ag.	79·4	49	12 10	− 5	22 8	− 8	32·4	36·6
Zagreb	W.	80·5	45	12 18	− 4	i 22 16	−13	32·5	37·5
Pulkovo	G.	83·2	28	i 12 36	− 1	i 22 48	−11	34·5	42·2
Helwan	M.	97·8	55	20 46	?	—	—	—	68·5
Cape Town	M.	107·3	121	28 4	? S	(28 4)	+60	—	—
Osaka	O.	116·6	328	36 14	? SR_1	—	—	—	75·0
Zi-ka-wei	W.	125·7	337	e 21 28	PR_1 ?	—	—	—	67·1
Bombay	M.	133·6	37	20 14	PR_1 ?	—	—	—	92·4
Mauritius	M.	140·4	99	34 40	? S	(34 40)	+219	—	75·5
Manila	W.	140·5	327	e 36 52	SR_1 ?	—	—	—	89·0?
Kodaikanal	M.	143·3	39	40 58	SR_1 ?	—	—	72·9	88·6
Colombo	M.	147·3	39	42 16	SR_1 ?	—	—	75·5	93·2
Batavia	W.	165·6	332	e 20 58	+125	—	—	—	33·0

The following stations give PR_1: La Paz = +8m. 53s. +3; Pulkovo = +15m. 44s. −32; Zi-ka-wei = +21m. 28s. +26.

Cork record P and S, which accord with S and L.

Mizusawa gives PE = +33m. 22s., PN = +34m. 28s.; this may be SR_1.

Melbourne gives P = +65m. 10s., S = +71m. 10s., L = 74m. 8s., M = 79·0m.

Epicentres from Ottawa 19°·5N. 78°·45′W.; Pulkovo 21°·0N. 79°·0W.

Feb. 21d. 9h. 41m. 22s. 26°·0S. 80°·0W. This seems to be a repetition from epicentre of Feb. 15 and Feb. 16. The evidence is most clearly presented by comparing records of the same station on Feb. 15 and 21. Even when these are defective or erroneous the defects are liable to repetition. The following comparison gives all the pairs of results which fit. At Coimbra, Eskdalemuir, and Helwan S is recorded on Feb. 21 as P, but the Feb. 15 record indicates the error. At Honolulu something is recorded for S which is not S—possibly SR_1—but the same mistake is made on both occasions; and so on. In the last column of the Table the error of Feb. 15 is shown in minutes and tenths on the assumption that the phase is as indicated by the following letter. For L the standard adopted is 0·5m. to 1°·0 of △, as will be explained later.

Comparison of Feb. 15 and Feb. 21 with adopted epicentre 26°·0S. 80°·0W. for both :—

Station	△	Az.	Recorded Feb. 15	Recorded Feb. 21	Diff. 21 − 15	O − C. Feb. 15
	°	°	m. s.	m. s.	s.	m.
La Paz	14·5	52	P 3 31	P 3 29	− 2	0·0P
,,	,,	,,	S 6 20	S 6 25	+ 5	0·0S
,,	,,	,,	L 8 51	L 8 52	+ 1	+1·5L
,,	,,	,,	M 9 15	M 9 11	− 4	—
Toronto	69·6	0	S 20 21	S 20 32	+11	0·0S
Honolulu	89·2	294	S 32 39	S 32 38	− 1	+8·6S
,,	,,	,,	L 45 21	L 45 8	−13	+0·8L
,,	,,	,,	M 50 21	M 50 8	−13	—
Coimbra	93·8	47	S 23 51	P 23 14	−37	−1·0S
,,	,,	,,	L 48 16	L 47 18	−58	+1·4L
,,	,,	,,	M 51 11	M 51 8	− 3	—
Melbourne	103·6	215	L 51 21	L 50 26	−55	−0·4L
,,	,,	,,	M 55 57	M 54 38	−79	—
Eskdalemuir	104·1	35	S 25 14	P 24 35	−39	−1·3S
,,	,,	,,	L 45 21	L 45 53	+32	−0·6L
,,	,,	,,	M 60 35	M 59 53	−42	—
Paris	104·6	42	M 59 51	M 59 38	−13	—
Moncalieri	106·6	48	P 25 16	P 24 52	−24	−1·7S
,,	,,	,,	S 32 48	S 31 51	−57	+5·8S
,,	,,	,,	M 60 24	M 61 53	+89	—
Mauritius	118·6	134	L 49 33	P 49 26	− 7	−9·8L
Helwan	120·2	68	S 30 9	P 29 38	−31	+1·3S
,,	,,	,,	M 72 27	M 72 26	− 1	—
Pulkovo	122·4	34	PR_1 20 43	P 20 22	−21	—
,,	,,	,,	PS 30 25	S 30 32	+ 7	—
Kodaikanal	153·7	122	L 76 39	P 75 56	−43	−0·2L
Bombay	153·9	100	P 19 59	P 19 49	−10	—
,,	,,	,,	M 80 22	M 80 7	−15	—

It will be noticed that even the M readings are in fair accordance, excepting only that for Moncalieri.

What can we learn as to any difference of epicentre on the two days?

Consider first the azimuth of La Paz, which is also that of the majority of stations. La Paz itself has a difference S − P = 7s., which would mean a displacement of the epicentre 0°·6 further from La Paz. Pulkovo has a difference for PS − PR, of the same positive sign, Helwan for M − P, and Eskdalemuir for L − S, but other stations go the other way. If we take the simple mean differences for Coimbra, Eskdalemuir, Paris, Moncalieri, and Helwan, we get −33s. and −28s. for S, L respectively, which would accord with a + displacement. On the other hand Melbourne differing 163°·0 in azimuth indicates a negative displacement, and so does Honolulu differing 242°·0 in azimuth. We can scarcely base any very exact conclusion on the evidence, but a displacement of about 0°·5 would about fit the facts. In the transverse direction we have scarcely enough to go upon, but no more serious change is suggested. In any case, however, we shall have a mean difference of about −30s., which cannot be attributed to change in epicentre, but must be ascribed to a wrong clock error at La Paz for one or other of the days. (T_0 was adopted to fit La Paz).

Attention may be drawn to the two P readings at Bombay (△ = 153°·9), which seem to be genuine. It is well known that when △ exceeds 90°·0 the readings of P become precarious, but it has more than once been suggested that they may gather strength again near the anti-centre, and we have here evidence in support of this view. See also La Paz on Feb. 18.

For completeness we must add discordant readings, though there may be good ways of explaining them.

	△	Az.	L(15)	L(21)	M(15)	M(21)
	°	°	m.	m.	m.	m.
Toronto	69·6	0	38·2	45·5	—	—
Victoria	83·9	333	37·6	48·1	61·0	52·1
Rio Tinto	93·8	49	—	—	56·8	50·6
Barcelona	101·4	49	44·4	54·0	56·8	60·6
Kew	104·1	39	—	—	62·8	64·6
Paris	104·6	42	49·8	53·6	59·8	59·6
Moncalieri	106·6	48	38·4	53·1	60·4	61·9
Rocca di Papa	108·9	52	57·4	63·7	—	—
Mauritius	118·6	134	—	—	52·2	53·4
Pulkovo	122·4	34	51·8	58·6	65·9	72·4
Batavia	147·1	193	—	—	25·8	82·2
Colombo	152·9	131	70·4	75·6	84·6	87·1

It is noteworthy that in all these cases L is recorded later (by several minutes) on Feb. 21. (That it is, nevertheless, possible to get accordant readings on the two days we have already seen).

A natural supposition would be that in the case of the feebler shock of Feb. 21 the beginning of L had been overlooked, but, curiously enough, the later readings seem to be preferable. The velocity of L is subject to some uncertainty. Its theoretical value is quoted in Walker's *Modern Seismology* (p. 50) as 3·69 km/sec, and adopted values are usually smaller than this. Thus Galitzin found 3·53 km/sec from the Messina Earthquake, and Zöppritz favours 3·42 km/sec (see diagram on p. 54 loccit). But Dr. Otto Klotz has already remarked in his Seismological Tables (Dom. Obs. Ottawa, Vol. III., p. 22) that observed velocities are usually higher than this, and all the velocities above indicated are *greater* than the theoretical, not *smaller*. Thus the accordant values of L for Kodaikanal give 153°·7 for 76·3m., which is 1°·0 in 29·8s., or 0°·0336 = 3·73 km/sec, greater even than the theoretical 3·69 km/sec. A value of 2°·0 per minute, which is close to this, is easy to remember and work with: we need only divide △ by 2 to get the minutes of L. When we halve △ in this way in the above table we see that except for Toronto and Rocca di Papa, the readings headed L(15) are all too small (giving much higher velocities still), and those headed L(21) are about right. If we add together the values of △ and L for the seven observatories which give L on both dates (excluding the two above named) the sums are respectively 80°·7, 349·8, 406·3, giving for the value of one degree 0·433m. on Feb. 15 and 0·503m. on Feb. 21, which latter is precisely the theoretical value. Recurring now to the main comparison of Feb. 15 and Feb. 21, the last column shows errors of L on the hypothesis of 0·5m. to 1°·0, and we see that there are five observed values out of seven which fit this hypothesis, viz. :—

	m.	m.	m.	m.	m.		m.
O − C	+ 1·5	− 0·8	+ 1·4	− 0·4	− 0·2	Total	+ 3·1
at △	14°·5	89°·2	93°·8	103°·6	153°·7	Total	454°·8

The mean of these thus gives 1°·0 = 0·507. Of the remaining residuals − 6·6m. and − 9·8m. all that can be said is that they must refer to some other phenomenon. [It seems just possible that there is an error of 10m. in each case ?] If two phenomena are liable to be thus confused we can understand how Dr. Klotz arrives at his adopted value of 3·8km per second, or 0·487m. per degree.

Feb. 21d. 14h. (0m.). Batavia records e = + 8m.39s., M = + 15·1m. "Felt in Atjeh." Melbourne gives P = 14·5m., L = + 18·6m.. M = + 19·5m. Honolulu gives L = + 26·3, M = + 30·1m

Feb. 21d. 15h. 45m. (10s.). At 36°·1N. 137°·3E.

	△	Az.	P.	O − C.	S.	O − C.	L
	°	°	m. s.	s.	m.	s.	m.
Osaka	2·1	218	0 34	+ 1	—	—	1·1
Mizusawa	4·3	45	1 10	+ 3	—	—	2·2
Zi-ka-wei	14·1	14	5 35	? S	(5·35)	− 34	—
La Paz	150·1	56	15 20	—	—	—	19·8

Feb. 21d. 19h. 36m. (0s.). Close to Mizusawa, which records P = + 0m.20s., L = + 0·9m.

Feb. 22d. 2h. 12m. (40s.). Near Zi-ka-wei, which records P = + 1m.32s., S = + 2m.42s., M = + 2m.56s. Pulkovo L = − 31·3m., M = + 34·1m. Edinburgh gives P = + 41m.50s. (?L). M = + 46·3m. Eskdalemuir 2h.54m. to 3h.7m. (Helwan P = 3h.7m.36s., M = 3h.8m.6s. : Another disturbance ?)

Feb. 22d. 9h. 12m. 20s. Repetition from 26°·0S. 80°·0W. as on Feb. 15, 16, and 21. As before the evidence is best presented by differential comparison with Feb. 15, after subtraction of the values adopted for T_0. For convenience of inspection the azimuths near La Paz are put first. It will suffice to give differences only, in seconds for P. and S. in minutes for L. and M.

Comparison of Feb. 22 and Feb. 15.

	△	Az.	P.	S.	L.	M.
	°	°	s.	s.	m.	m.
La Paz	14·5	52	− 14	+ 17	0·0	+ 0·4
Coimbra	93·8	47	—	− 35	− 1·6	+ 1·5
Eskdalemuir	104·1	35	—	—	+ 0·1	− 0·8
Paris	104·6	42	—	− 46	+ 3·8	− 1·2
Moncalieri	106·6	48	—	− 33	+ 2·4	+ 1·0
De Bilt	107·4	40	—	− 37	+ 1·8	− 0·4
Malta	108·3	58	—	—	+ 0·8	+ 2·8
Zagreb	112·3	48	− 37	− 44	+ 0·8	+ 0·3
Helwan	120·2	68	—	(− 113)	—	− 0·9
Pulkovo	122·4	34	− 43	− 26	+ 2·8	+ 6·7
Mean		47	− 40	− 37	+ 1·4	+ 1·1
Accra	83·4	80	—	—	—	− 1·7
Mauritius	118·6	134	—	+ 103	—	+ 1·5
Kodaikanal	153·7	122	—	—	+ 1·5	—
Bombay	153·9	100	—	—	—	− 0·9
Melbourne	103·6	215	—	—	− 2·1	− 0·7
Honolulu	89·2	294	—	(− 59)	− 1·0	− 1·3
Zi-ka-wei	160·7	290	− 34	—	—	—

The records for Honolulu refer to some phase later than S, perhaps SR. The results for Victoria, San Fernando, Rio Tinto, Barcelona, Kew, Rocca di Papa, and Colombo are discordant.

It will be seen that the P and S differences for azimuths near that of La Paz do not suggest any serious error in the assumed distance of the epicentre: (In the transverse direction the evidence is insufficient): but the discordance in T_0 (if this is the true seat of it) is even more marked than before, and in the same direction. But the La Paz S is discordant, and if we disregard it we could correct the T_0, even at La Paz, by some 15s., leaving an additional correction of about 20s. as between other stations and La Paz, agreeing with Feb. 21—Feb. 15.

The general conclusion is therefore that the epicentres on Feb. 15, 16, 21, and 22 were closely the same, and the differences tabulated above are chiefly due to defective clock errors at La Paz, and perhaps one faulty reading of S at La Paz on Feb. 22.

Feb. 22d. 18h. 27m. (16s.). Query repetition from 36·1N. 137·3E. as on Feb. 21d. 15h. 45m. ? Osaka gives P = + 34s., L = + 1·5m., M = + 2·2m. Mizusawa P = + 1m.10s., L = + 2·6m. Zi-ka-wei P = + 2m.10s., M = + 6·8m.

Feb. 23d. 17h. 56m. Rocca di Papa and Moncalieri record a local shock.

Feb. 25d. 5h. 20m. 16s.
Feb. 25d. 5h. 45m. 52s. } From same epicentre 13°·5N. 125°·0E.

First shock T_0 = 5h.20m.16s.

	△	Az.	P.	O − C	S.	O − C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Manila	4·1	285	e 1 18	+ 14	—	—	2·4	3·8
Zi-ka-wei	18·0	350	4 25	+ 6	7 55	+ 15	8·7	10·4
Osaka	23·2	22	5 16	− 3	- -	—	9·3	10·0
Nagoya	24·2	24	5 25	− 5	- -	—	—	—
Batavia	26·7	224	5 54	− 1	—	—	- -	14·0
Mizusawa	29·2	26	6 6	− 14	10 58	− 22	- -	—
Colombo	45·0	266	14 14	? S	(14 14)	(− 61)	—	—
Kodaikanal	46·6	271	18 56	? L	—	—	—	—
Bombay	50·3	284	9 5	− 4	16 26	+ 3	—	32·5
Melbourne	54·6	161	16 56	? S	(16 56)	(− 20)	—	71·2
Honolulu	73·2	72	21 8	? S	(21 8)	(+ 4)	40·2	43·0
Pulkovo	80·7	329	12 24	+ 1	22 31	0	39·7	76·7
Helwan	86·4	300	23 44	? S	(23 44)	(+ 10)	—	—
De Bilt	96·5	328	—	—	24 19	− 62	52·7	—
Edinburgh	98·3	333	26 2	? S	(26 2)	(+ 23)	—	59·7
Eskdalemuir	98·6	333	—	—	24 23	− 79	47·5	—
Paris	99·7	326	33 54	?	—	—	—	—
Rio Tinto	111·6	320	33 44	?	—	—	—	74·7
La Paz	166·9	105	20 17	+ 77	28 27	− 295	—	—

Recorded also at Kew and Toronto.

Feb. 25d. Second shock T_o =5h.45m.52s.

	△	Az.	P.	O−C.	S.	O−C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Manila	4·1	285	1 18	+14	—	—	2·2	3·0
Zi-ka-wei	18·0	350	4 23	+ 6	7 53	+13	8·8	10·3
Osaka	23·2	22	5 21	+ 2	—	—	9·4	9·8
Nagoya	24·2	24	5 22	− 8	—	—	—	—
Batavia	26·7	224	—	—	—	—	—	12·5
Mizusawa	29·2	26	6 10	−10	10 57	−23	—	—
Bombay	50·3	284	9 19	+10	16 42	+19	—	32·7
Pulkovo	80·7	329	12 25	− 2	—	—	38·1	51·7
Zagreb	93·1	319	13 2	−31	23 58	−48	45·1	52·1
De Bilt	96·5	328	—	—	24 17	−64	—	—
Rocca di Papa	96·9	316	16 27	+143	—	—	—	18·2
Moncalieri	98·6	320	17 48	+225	23 43	−119	37·8	—
La Paz	166·9	105	20 24	+84	—	—	93·2	98·9

Feb. 25d. 10h. 7m. (15s.). Manila gives P = +64s., L = +1·9m., M = 2·4m. Nagoya P = +5m.5s. Osaka P = +5m.9s. De Bilt eL = +52·8m., and many maxima.

Feb. 25d. 10h. 34m. (0s.). Manila gives 18°·3N. 121°·0E., with P = +38s., L = +1·2m., M = +1·5m.

Feb. 26d. 1h. 9m. (38s.). Zagreb gives △ =1°·0, P = +14s., M = +32s. Rocca di Papa gives eP = +61s., M = +2·5m.

Feb. 26d. 3h. 54m. (56s.). La Paz gives P = +8m.5s., S = +14m.25s.

Feb. 26d. 4h. 21m. (7s.). Rocca di Papa gives P = +2s., M = +17s.

Feb. 26d. 6h. 17m. (20s.). Rocca di Papa gives P = +19s., S = +36s., M = +46s. Monte Cassino gives P = +3s., M = +12s.

Feb. 26d. 7h. 43m. (53s.). Rocca di Papa gives P = +19s., S = +34s., M = +43s. Monte Cassino gives P = +3s., M = +40s.

Feb. 26d. 9h. (0m.). Sydney records P = +5·5m., L = +13·5m., M = +16·0m. Melbourne P = 12m., S = 14·5m., L = 18·7m., M = +20·9m. Honolulu L = +20·5m., M = +22·8m. La Paz L = +50m., M = +51·3m. Moncalieri eL = +44·6m. West Bromwich P = 40·5m., S = +43·1m. Some of these may refer to a European shock.

Feb. 26d. 9h. 59m. (30s.). About 2°·0N. 107°·0E. Batavia iP = +88s., S = +149s. M = +10·5m. Manila eP = +116s., L = +5·6m., M = +6·3m. Moncalieri e = +36·2m., L = +48·0m. Helwan P(?S) = 27·5m. Bombay +10m. to +14m. San Fernando P = +28·5m., MN = +56m., ME = +55m. La Paz iP = +30·5m., L = +31·3m.

Feb. 27d. 10h. 27m. 20s. Near Mizusawa which gives P = +21s., L = +63s. Osaka gives (PS) = +120s., L = +2·9m., M = +3·6m. La Paz gives P = +19m.25s.

Feb. 27d. 10h. 57m. (15s.). Osaka gives PS = +32s., L = +1·5m., M = +1·9m. La Paz P = +16m.48s.

Feb. 27d. 14h. 55m. (30s.). Mizusawa gives P = +21s., L = +1·2m. Osaka (PS) = +25s., L = +1·4m. MN = +2·3m., ME = +1·7m.

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British Association for the Advancement of Science.—Seismological Committee.

All correspondence to
Prof. H. H. TURNER,
University Observatory,
OXFORD.

Bulletin for March and April, 1917.

For the large Earthquakes an attempt is here made to compare the readings with theoretical values, as explained in the Nineteenth Report of the Committee to the British Association. The position of the epicentre is determined at Oxford, unless otherwise stated; and the tables of times for P and S are those given by Galitzin in his "Vorlesungen über Seismometrie," p. 137, or by G. W. Walker on p. 54 of his "Modern Seismology." It is shown in the above Report that these tables are sensibly erroneous: but the precise values of the corrections are under discussion, and it seems better to await the definitive corrections than to introduce provisional tables. The tables are reproduced in an expanded form on Page 2 of this Bulletin. The time of the earthquake at the epicentre is deduced from the best records; and applying the tabular times for the distances in the third column (calculated and also measured from a large globe specially made for the purpose), the errors O − C of the observed times are found.

Observers are requested to send a copy of their Registers to Oxford *each month*, in order that this collated information may be published as early as possible. It is hoped to make up the arrears rapidly, now war conditions are receding.

For the large earthquakes the stations are arranged in the order of distance from epicentre, as shown in the 3rd column. The azimuth in the 4th column is also calculated; and is the azimuth at the epicentre measured from N. towards E., in which the observing station lies. The Earthquake Chart formerly given has been discontinued in favour of brief notes for the smaller earthquakes.

The letters in the 2nd column stand for: A.=Alfani; Ag.=Agamennone; B.=Bosch; Bi.=Bifilar; B.M.=Bosch-Mainka; B.O.=Bosch-Omori; C.=Cartuja; Ca.=Cancani; Cd.=Conrad; C.O.=Cartuja-Omori; G.=Galitzin; L.=Luckmann; M.=Milne; Ma.=Mainka; M.S.=Milne-Shaw; O.=Omori; O.A.=Omori-Alfani; O.E.=Omori-Ewing; R.H.=Rebeur-Hecker; S.=Strattesi; S.C.=S. Calixto; V.=Vicentini; W.=Wiechert.

Riverview has two W. and one Ma.; it is not generally specified from which machine the readings were obtained.

TABLE.

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

THE LARGE EARTHQUAKES
OF 1917.

SECOND INTRODUCTORY NOTE.

It has been the practice hitherto to confine attention to the largest and best observed earthquakes; but in the preceding Bulletin (January and February, 1917) brief notes were made of smaller shocks, and in the interests of completeness it seems desirable to continue this practice, if it does not delay the work too much. The smaller earthquakes, when the observational material is somewhat scanty, are, however, apt to consume a good deal of time. A good instance of the difficulties met with is given rather fully for March 26 below.

Some time has also been spent in studying the question whether there is any evidence for an exceptionally deep-seated focus, and as there is apparently evidence of this kind for the earthquake of April 21 it seems appropriate to give some account of it here. In the regular sequence will be found (see p. 23) a solution of the usual kind; the residuals are not very large, but one defect is clear at a glance—those for P are chiefly positive and those for S chiefly negative. So consistent a systematic difference can scarcely be accidental and calls for a sensible change in T_0. For if T_0 is correct the only available error is one in epicentre, which will affect P and S in the *same* direction, with amounts (δP and δS say) approximately in the ratio 1 to 1·8. In fact, from a given δ (S−P) we can infer the correct δP and δS separately by the equation $\delta S = 1{\cdot}8\delta P$, which may be written

$$\delta P = 1{\cdot}25\ \delta(S-P) \qquad \delta S = 2{\cdot}25\ \delta(S-P).$$

Consider, for instance, the Pulkovo residuals $\delta P = -1$s. and $\delta S = -22$s., giving $\delta(S-P) = -21$s.

The correct theoretical values deduced from this are $\delta P = -26$s. and $\delta S = -47$s., calling for a change in T_0 of +25s. If we make similar calculations for other stations we get—

Suggested Corrections to T_0 for 1917, April 21.

	s.		s.		s.		s.
Calcutta N.	+20	Rocca	+18	Dyce	+54	Osaka	+11
Calcutta E.	+32	Moncalieri	+27	Shide	+24	Algiers	+21
Pulkovo	+25	De Bilt	+16	Edinburgh	+19	Tortosa	+20
Zagreb	+ 9	Uccle	+18	Eskdalemuir	+20	Coimbra	+27
Zi-ka-wei	+21	Paris	+15	Barcelona	+17	San Fernando	(−54)
Mean	+21	Mean	+19	Mean	+27	Mean	+20

The suggestion for correction is very consistent, if Stonyhurst and San Fernando (both Milne machines) be disregarded, and the mean value is +23s., making T_0 0h.49m.41s., and all the residuals smaller by 23s. They will thus nearly all be negative, *i.e.*, all the calculated Δ's will be too large, and as the stations are well distributed round the epicentre (Japan, &c., being in azimuth 80°, India in 150°, and Europe in 310°), we have the paradoxical result that the epicentre must be displaced in opposite directions. The alternatives are thus—

(a) To accept the records more or less as printed (on p. 23 below), with the errors of P and S pointing opposite ways, and thus compensating one another.

(b) To accept this new value of T_0 with residuals for P and S consistent, but calling for changes in the epicentre which cannot be made so long as it remains on the surface.

But we can get over the last-named difficulty by supposing the origin of disturbance at a depth below the surface. It is easy to see in a general way what the effect of this would be. Excluding for the moment a certain region round the epicentre, the waves would reach more distant stations earlier than expected, giving the impression that the epicentre was closer than it really is. So long as the observing stations are collected chiefly in one azimuth, this effect can be met by displacing the epicentre on the earth's surface towards that azimuth, leaving little trace of the real cause (viz., deep-seated focus), but, of course, assigning an erroneous location to the epicentre. A study of records which is being made with special reference to this question of depth of focus shows how often this may have occurred in the past without its having been suspected. For instance, when an earthquake is distant from Europe, all the European observatories will lie near one azimuthal direction and (may) claim an erroneous epicentre. The testimony of one or two other stations in different azimuths may have seemed conflicting, but there would be a tendency to disregard them in favour of Pulkovo and similar well-equipped stations in Europe, and to allow their residuals to be unduly large. Moreover, the other stations may also be collected chiefly near some other azimuth, say B (and let us denote the European Azimuth by A). Then, owing really to the depth of focus, the European stations call for a displacement towards azimuth A and the others towards azimuth B. But there may be no difficulty in meeting both these calls, *e.g.*, when A and B are in directions at right angles, so that the calls are independent. If A and B happen to be separated by 180°, *then* the calls become directly at variance; or if we have stations

in at least three azimuths, A, B, and J, well distributed round the epicentre, *then* we may be unable to escape noticing something unusual. But in the past such cases have been comparatively rare. The gradual multiplication of stations promises to render them less rare in the future; and, even as regards the past, something may be gained by revision in the light of these possibilities. For instance, it seems possible that the well distributed Milne machines have been too lightly disregarded when their records seemed inconsistent with European indications. These pioneer machines have undoubted defects, but it will be seen below that their indications are sometimes in good accord with the best machines.

The present example belongs to the type of three good azimuths, A, B, and J (or Europe, India, and Japan-with-others). In the course of several preliminary attempts solutions were found which would fairly satisfy two of these, but left the third quite anomalous.

The above are general considerations which were carried roughly into figures by elementary reasoning before it was realised that Professor C. G. Knott had given us the means of assessing the effects of depth of focus with precision. The results come almost immediately from tables in his paper, "The Propagation of Earthquake Waves Through the Earth and Connected Problems (Proc. R.S.E. XXXIX, Part II, No. 14, Session 1918-9), in which he has not only traced the paths of P and S waves through the Earth, but given the times of arrival at points on the rays. It is, for instance, quite easy to compare the residuals of the present earthquake with the following supposition:—

(1) That the tables in use correspond to cases where the focus is close to the surface.

(2) That the focus for 1917, April 21, was at a depth 0·03 of the earth's radius (=120 miles) below the surface.

Of these the first is probably not correct, and should be modified so far that the tables correspond to an unknown depth d: in which case, if the focus for April 21 were at depth $d+0{\cdot}03$ the equivalent corrections would not be very different, unless d is large. It seems quite possible that Professor Knott has given us the means of determining d through this differential variation, which depends on d. But such points require careful investigation and the study of numerous cases, which is proceeding. For the present we must be content to show that the results of the two above suppositions are not far from the facts of observation.

Below are given the results for April 21, reduced to the new T_0 indicated above and a slightly modified epicentre. Some anomalous stations have been omitted for brevity, but the indications of three Milne machines have been retained (in brackets) to show that their accordance is quite good.

1917. April 21d. 0h. 49m. 41s.

Epicentre **37°·2N. 70°·4E.**

A = +·267, B = +·750, C = +·605.

Station.	Inst.	Az.	Δ	O−C.	Focus Corr.	Sum.	Az. Corr.	Sum.
		°	°	°	°			
Simla	O.E.	137	8·3	−0·8	+0·1	−0·7	+0·4	−0·3
Bombay	M.	173	18·5	(−3·0)	+1·0	(−2·0)	+0·4	(−1·6)
Calcutta	O.E.	129	21·3	−1·7	+1·3	−0·4	+0·4	0·0
Pulkovo	G.	324	34·0	−0·9	+2·3	+1·4	−0·4	+1·0
Zagreb	W.	300	40·8	−3·3	+2·7	−0·6	−0·4	−1·0
Zi-ka-wei	—	83	42·2	−3·4	+2·7	−0·7	+0·2	−0·5
Monte Cassino	—	294	43·2	−2·9	+2·8	−0·1	−0·4	−0·5
Rocca di Papa	Ag.	294	44·0	−3·5	+2·9	−0·6	−0·4	−1·0
Moncalieri	S.	300	46·7	−3·0	+3·0	0·0	−0·4	−0·4
De Bilt	—	310	47·0	−2·7	+3·0	+0·3	−0·4	−0·1
Uccle	—	308	47·7	−3·2	+3·0	−0·2	−0·4	−0·6
Paris	—	306	49·3	−3·2	+3·1	−0·1	−0·4	−0·5
Manila	W.	103	50·1	−1·9	+3·2	+1·3	+0·3	+1·6
Dyce	Ma.	318	50·3	−0·5	+3·2	+2·7	−0·4	+2·3
Edinburgh	M.	316	51·1	(−1·8)	+3·3	(+1·5)	−0·4	(+1·1)
Shide	M.S.	309	51·2	−2·8	+3·3	+0·5	−0·4	+0·1
Eskdalemuir	G.	315	51·3	−2·8	+3·3	+0·5	−0·4	+0·1
Barcelona	Ma.	297	51·6	−2·2	+3·3	+1·1	−0·4	+0·7
Osaka	O.	72	51·7	−3·2	+3·3	+0·1	+0·1	+0·2
Algiers	B.M.	291	52·6	−3·2	+3·3	+0·1	−0·4	−0·3
Tortosa	—	297	53·3	−3·2	+3·3	+0·1	−0·4	−0·3
Mizusawa	O.	65	54·2	−3·5	+3·4	−0·1	+0·1	0·0
Coimbra	W.	299	59·5	−2·0	+3·6	+1·6	−0·4	+1·2
San Fernando	—	294	59·7	(−2·5)	+3·6	(+1·1)	−0·4	(+0·7)
Ottawa	B.	337	92·0	−7·9	+4·2	−3·7	−0·4	—
Harvard	B.O.	333	93·0	−4·7	+4·2	−0·5	−0·4	—
Washington	—	335	98·2	−11·1	+4·2	−6·9	−0·4	—
La Paz	Bi.	289	138·1	—	—	—	—	—

The first four columns require no explanation, except that, while Δ is, of course, referred to the new epicentre, it has not been thought necessary to recalculate the azimuth which is reproduced from p. 23. In the fifth column the residuals for P and S have been converted into an equivalent change in Δ, by means of the adopted tables.

The correction given in the sixth column is derived from the parabola

$$(\Delta-7)\times 0^\circ{\cdot}10 - (\Delta-7)^2\times 0^\circ{\cdot}0006,$$

which was found to represent the apparent corrections to epicentre for a focal depth of 0·03 as above, by direct use of Professor Knott's tables. A fuller explanation is reserved for the more complete discussion. The mean residuals of the

seventh column may be exhibited as in the second column below. The final columns will be mentioned presently.

Limits of Δ	Mean Resid.	No. of Obs.	After Az. Corrn.
° °	°		°
8 – 35	+0·1	3	+0·2
40 – 45	−0·5	4	−0·8
46 – 50	0·0	4	−0·4
50 – 52	+1·0	6	+0·8
52 – 60	+0·4	4	+0·2

If the positive character of the later residuals is real it signifies that the correction is too large, *i.e.*, the depth is not so great as 0·03, which is quite likely. But the reduction cannot be serious. The three negative residuals for $\Delta > 90°$ are almost certainly due to errors of the tables, especially in S.

The case of La Paz is important, but we will return to it in a moment. Let us first examine the condition that the residuals should not show a systematic error in azimuth, which is a necessary part of the condition that they should be due to focal depth. Analysis indicated a term

$$0°{\cdot}4 \text{ as } (\text{Az.} - 320°),$$

which is given in the eighth column and applied in the ninth, but the numerical sum of the residuals is not reduced materially by the application (±132 to ±127), and it seems doubtful whether any essential improvement can be made in the location of the epicentre. But it may be noted that the corrected residuals, when grouped again in Δ, give the means shown in the fourth column of the above table.

Too much stress must not be laid on this single example; we may suspend judgment until others have been found and studied. Meanwhile one final point may be made. If the focus is more deep-seated than the average, the P wave should arrive at La Paz near the hypocentre ($\Delta = 138°{\cdot}1$) distinctly earlier than usual. Now an extended study of the times of arrival of P (?) at stations near the hypocentre has suggested the *average* formula

$$\text{P}(?) = 20\text{m}.27\text{s}. - (180 - \Delta)^2 \times 0{\cdot}0235.$$

This formula is equivalent to the following table, which is in provisional use, but is not yet to be regarded as definitive.

Time of arrival of P(?) at stations near Hypocentre.

Δ	0	1	2	3	4	5	6	7	8	9
°	m. s.	s.	s.	s.	s.	s.	s.	s.	s.	s.
120	19 2	5	8	11	13	16	18	21	24	26
130	19 28	31	33	35	37	40	42	44	46	48
140	19 49	51	53	55	57	58	60	61	63	64
150	20 6	7	9	10	11	12	13	15	16	17
160	20 18	19	19	20	21	22	22	23	24	24
170	20 25	25	25	26	26	26	27	27	27	27

The table is given from 120°, but at present its applicability is not intended for $\Delta > 130°$.

Now, the P (?) record at La Paz is at 1h.8m.56s. = 0h.49m.41s. +19m.15s., whereas the time of transmission for $\Delta = 138°{\cdot}1$ is, according to the above table, 19m.46s., which is 31s. greater than 19m.15s. Hence the waves arrive at La Paz 31s. earlier than expectation, which accords with the view of a deep-seated focus. It is also approximately of the right magnitude. Professor Knott does not give the time of travel to a vertical distance 0·03 below the surface directly, but it can be closely inferred (from the times for paths at inclinations which approach the vertical) to be 24s. The difference between this and the observed 31s. is not large, and it even seems probable that the 7s. difference is actually due as a correction to the table and formula just given, for the following reason: We noticed at the outset of the study of this earthquake that the adopted T_0 was probably wrong, because the residuals for P and S had been made to compensate each other. Now this is not the only case. Once this possibility of deep-seated focus is realised it is easy to see by inspection of past records that other solutions are affected in a similar manner and will require correction. (There might, of course, be a number of exceptionally *shallow* foci to balance the deep one, but the first rough survey is decidedly opposed to this view, *i.e.*, the anomalous cases are chiefly *deeper seated* than is contemplated in the tables.) The corrections to T_0 will not usually be so large as +23s., but they tend to be positive, and the numbers of the above formula and table will thus require diminution by a constant, which the first revision has put at about 7s. Hence it seems quite possible that the estimates of depth of focus derived independently from the stations near the epicentre and those near the hypocentre will prove to be in close accord, at $0{\cdot}03 + d$, where d is the focal depth corresponding to the adopted tables.

1917, MARCH & APRIL.

Mar. 1d. 2h. 24m. (20)s. La Paz gives iP = +84s., S = +150s., L = +2·8m., M = +3·0m. Helwan P (?L) +65·7m.

Mar. 1d. 4h. 56m. (40)s. La Paz gives eP = +12m.50s., L = +42·4m., M = +44·8m. Honolulu L = +43·7m., M = +46·6m. Bombay 5h.59m. to 6h.2m. Pulkovo L = +87·3m., M = +91·3m. Eskdalemuir 6h.27m. to 6h.51m. Stonyhurst P (?L) = +84·7m., M = +97·6m. De Bilt eN = +88·2m., eE = +89·4m., ME = +100·8m., MN = 103·8m.

Mar. 1d. 9h. (0)m. Manila eP = +3m.54s. Colombo M = +22·5m.
At 14h. a shock was recorded at La Paz and Rocca di Papa.

Mar. 2d. 2h. 38m. 22s. At 11°·5N. 114°·0E.? A = −·398, B = +·895, C = +·199.

	△	P.	O−C.	S.		O−C.	L.	M.
	°	m. s.	s.	m. s.		s.	m.	m.
Manila	7·5	e 1 49	−5	—	—		2·6	3·1
Batavia	19·1	e 4 35	+5	—	—		—	13·6
Zi-ka-wei	20·9	4 52	0	e 6 16	?		8·4	13·0
Pulkovo	76·9	—	—	—	—		41·6	—

On March 2 also records at 0h. (Manila and Zagreb), 3h. (De Bilt), 4h. (Colombo), 7h. (Monte Cassino), 9h. (Athens), 10h. (Rocca di Papa), 12h. (Athens), 14h. (Athens and Monte Cassino), 19h. (Helwan).

Mar. 3d. 6h. (53m.). Rocca di Papa gives eP = +1m.1s., M = +2·8m. Zagreb eNE = +2m.6s., iNE = +2·3m., e = +2m.56s., i = +3m.7s.

Mar. 3d. 7h. 44m. 30s. Uccle gives eP = +7m.12s., eL = +14·5m. Pulkovo ?e = −8m.11s., S = +14m.35s., L = +18·5m., M = +23·7m. De Bilt iN +11m.33s., eLN = +13·7m., MN = +15·2m. Edinburgh M = +13·5m. Moncalieri e = +13·5m., L = +16·2m. Paris e = +10m.18s., L = +14·5m., M = +14·5m. to 15·5m. Zagreb L = +18·5m., M = +19·5m.

Mar. 3d. 10h. 14m. 3s. At 55°·0N. 35°·0W. Separately computed.

Mar. 3d. 12h. 51m. 0s. Osaka PS = +1m.14s., L = +2·4m., MN = +3·2m. Zi-ka-wei e = +3m.52s., M = +12·2m. Pulkovo e = +36m.0s., L = +39·0m. Mizusawa P = 0m.0s., L = +0·7m.

Mar. 3d. Records also at 3h. (Athens), 5h. (Melbourne), 8h. (Manila), 17h. (Uccle).

Mar. 4d. 5h. (50m.). Manila e = +6m.53s. Zi-ka-wei e = +8m.14s., MZ = +22·0m. Pulkovo e = +24·5m., L = +50·0m., M = +58·2m. Honolulu L = +30·7m., M = +33·8m. Rocca di Papa e = +63·3m.

Mar. 4d. Records also from 1h. (Azores), 2h. (La Paz), 8h. (Athens), 9h. (Athens), 13h. (Manila), 17h. (Zagreb).

Mar. 5d. 3h. 5m. 7s. At 17°·0N. 97°·0W. A = −·117, B = −·949, C = +·292.

	△	P.	O−C.	S.	O−C.	L.	M.
	°	m. s.	s.	m. s.	s.	m.	m.
Port au Prince	23·6	e 5 22	−2	9 36	0	19·6	—
Harvard	33·7	? 7 6	+4	12 34	−2	21·6	—
Paris	83·4	—	—	—	—	44·9	46·9

Also records at 2h. (San Fernando), 3h. (Jamaica), 4h. (Manila), 5h. (Manila and La Paz), 7h. (Manila), 16h. (Azores), 17h. (La Paz), 21h. (La Paz and San Fernando).

Mar. 6d. 3h. 5m. 33s. At 16°·0N. 96°·0W. Separately computed.

Mar. 6d. Records at 4h. (Taihoku), 5h. (Taihoku), 6h. (Batavia), 11h. (La Paz), 12h. (Zagreb), 23h. (Helwan, Pulkovo, and La Paz).

Mar. 7d. 0h. La Paz P = +20m.30s. San Fernando P = +40m.0s.

Mar. 7d. 3h. Zi-ka-wei e = +27m.34s.

1917. March 3d. 10h. 14m. 0s.

Epicentre **55°·0N. 35°·0W.**

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

Station and Component.		Machine.	△	Azimuth.	P.	O−C.	S.	O−C.	L.	M.
			°	°	M. s.	s.	M. s.	s.	M.	M.
Edinburgh		M.	17·9	75	—	—	—	—	—	11·0
Eskdalemuir		G.	18·0	76	4 18	+1	7 47	+7	9·0	10·4
Kew		M.	20·9	84	—	—	—	—	—	10·0
De Bilt	N.	G.	23·7	80	e 5 28	+3	9 39	+3	10·2	10·9
Uccle		G.	23·8	83	5 17	−9	—	—	9·7	—
Harvard	N.	B.O.	26·6	257	e 5 42	−12	? 10 42	+9	14·0	—
	E.	B.O.	26·6	257	e 5 38	−16	10 16	−17	14·6	—
San Fernando	N.	—	27·0	58	—	—	10 45	+4	—	12·0
Tortosa		—	27·0	74	5 42	−16	—	—	10·2	15·6
Ottawa	N.	B.	27·3	266	6 1	0	10 32	−14	17·0	—
	E.	B.	27·3	266	6 4	+3	10 37	−9	—	—
Moncalieri		S.	28·7	86	—	—	—	—	e 12·4	—
Toronto		M.	30·5	266	—	—	—	—	12·9	18·1
Zagreb	N.W.	W.	33·0	84	6 54	−2	—	—	14·0	17·8
Rocca di Papa		Ag.	33·5	92	e 4 48	−132	—	—	—	4·9
Victoria, B.C.		M.	51·4	302	—	—	—	—	11·1	28·4
La Paz		Bi.	76·9	213	e 12 2	+2	—	—	36·0	42·7
Honolulu		M.	89·6	309	—	—	—	—	38·2	40·1

The residuals suggest a reduction of T_0 by 4s.

Paris (△ = 23°·6, Az. 90°) records the quakes from 10h. 27m. to 10h. 42m. San Fernando gives for E, L = +11·5m., M = +15·0m. Washington (△ = 32°·3, Az. 257°), eP +9m. 26s. (+156s.), S = +15m. 32s. (+199s.), L = +20·3m. Pulkovo (△ = 34°·1, Az. = 55°), ?P = −35s., S = +8m. 11s., SR_1 = +12m. 25s., L = +16·0m., M = +17·7m. Helwan (△ = 52°·6, Az. = 88°), P = +31·0m., ?L.

Mar. 7d. 9h. 45m. 40s. La Paz (△ = 17°·7) P = +4m.14s., S = +7m.34s., L_1 = +9·9m., M = +10·8m. Pulkovo eP = +17m.50s. Helwan P = +69·3m.

Mar. 7d. 21h. Zi-ka-wei e = +5m.18s. Pulkovo L = +48·0m.

Mar. 8d. 5h. 43m. 55s. La Paz (△ = 17°·7), P = +4m.14s., S = +7m.34s., L = +9·8m., M = +10·8m.
May be a repetition of the quake of Mar. 7d. 9h. 45m. 40s.

Mar. 8d. 9h. 31m. 13s. Near Batavia (△ = 1°·5), P = +23s., S = +42s., M = +59s.

Mar. 8d. 14h. (20m.). La Paz P = +3m.0s., L = +6·0m., M = +6·4m.

Mar. 8d. 16h. (30m.). Manila e = +10m.2s. Zi-ka-wei e = 13m.10s., M = +16·4m. Pulkovo L = +46·0m. Taihoku e = +9·0m.

Mar. 8d. 22h. 24m. 37s. Rocca di Papa ?eP = +26s., i = +43s., S = +51s., M = 1·9m.

Mar. 8d. Also record at 21h. (Manila).

Mar. 9d. 12h. 2m. 32s. Batavia gives iP = +1m.19s., S = +2m.21s., M = +4·5m., △ = 5°. Direction E28°S. Manila eP = +1m.13s., S = +2m.42s., L = 4·9m., MN = +5·2m., ME = +5·0m. But if these refer to the same shock the epicentre must be at least 10° from Manila and Batavia, so that S must be misread in each case.

Mar. 9d. 23h. 2m. 0s. Manila eP = +1m.10s., L = +2·2m., MN = +3·0m., ME = +3·4m. (Batanes Islands, Basco). Pulkovo eL = +43·0m. Epicentre 20°·3N. 122°·0E. Taihoku e = +1m.38s.

Mar. 9d. Also records at 0h. (La Paz), 2h. (San Fernando).

1917. March 6d. 3h. 5m. 43s.

Epicentre **16°·0**N. **96°·0**W.

A = −·100, B = −·956, C = +·276; D = −·995, E = +·105;
G = −·029, H = −·274, K = −·961.

Station and Component.	Machine.	△	Azimuth.	P.	O−C.	S.	O−C.	L.	M.
		°	°	M. S.	S.	M. S.	S.	M.	M.
Tucson N.	B.O.	21·0	323	5 27	+34	9 40	+56	12·9	15·1
Washington N.	—	28·2	33	e 6 41	+31	? 13 6	+123	e 20·7	—
E.	—	28·2	33	e 6 41	+31	? 13 2	+119	e 20·6	—
Lick N.	—	30·9	318	e 6 44	+ 7	—	—	e 16·3	22·4
Berkeley E.	—	31·8	318	e 6 48	+ 3	e 12 15	+10	e 16·8	23·0
V.	—	31·8	318	e 7 2	+17	e 12 22	+21	—	24·4
Ottawa	B.	33·9	26	6 53	−11	12 41	+ 3	16·6	—
Victoria, B.C.	M.	39·4	331	? 13 59	? S	(13 59)	(+ 1)	21·9	27·4
La Paz	Bi.	42·6	138	8 1	−14	14 31	−12	23·3	25·7
Coimbra	W.	77·9	51	—	—	i 22 8	+ 9	38·7	—
Edinburgh	M.	78·4	35	? 11 29	−40	? 22 23	+18	—	50·3
Stonyhurst	M.	79·2	37	i 22 41	? S	(i 22 41)	(+27)	—	28·6
San Fernando N.	—	80·3	55	13 17	+56	—	—	—	47·3
Kew	M.	81·0	39	21 17	? S	(21 17)	(−78)	—	54·3
Tortosa	—	84·1	49	12 51	+ 9	—	—	37·6	49·9
De Bilt N.	G.	84·0	37	—	—	23 21	+13	e 37·3	E 41·6
Moncalieri	S.	88·1	43	e? 13 2	− 4	i 23 50	− 3	36·1	49·5
Pulkovo	G.	92·8	24	i 13 33	+ 2	i 24 10	−33	41·3	49·5
Zagreb	W.	93·0	40	e 13 30	− 2	i 24 41	− 4	49·3	54·3
Manila	W.	132·4	308	e 19 26	+168	—	—	—	—
Batavia	W.	155·4	291	e 19 11	+59	—	—	—	23·3

Toronto (△ = 31°·0, Az. 24°), L = +10·3m., M = +20·6m. Victoria gives S = ? +17m. 27s., SV = +8m. 17s., LV = +22·3m. Honolulu (△ = 58°·7, Az. 286°), S ?P = 11m. 17s. (O − C = +74s.), L ?S = +19m. 17s. (+70s.). Eskdalemuir (△ = 78°·4, Az. 36°), duration of quake 3h. 28m. to 4h. 15m. Pulkovo also gives PR_1 = +17m. 18s., SR_1 = +30m. 47s. Zagreb has iP = +13m. 38s., i = +13m. 51s. Helwan (△ = 111°·6., Az. 48°), P = +29m. 17s., ?L. Melbourne (△ = 122°·5, Az. 235°), eL = +66·3m., M = +76·5m. Bombay (△ = 143°·4, Az. 18°), M = +88·8m. Other epicentres: 14°·0N. 96°50′W. (Ottawa), 27°·0N. 104°·0W. (Pulkovo).

Mar. 10d. 12h. 15m. 55s. Pulkovo gives iP = +10m.35s., e = +18m.34s., S = +19m.8s., L = +29·1m. Epicentre 48°·N. 156°·E. (Kuriles); felt also in Petropavlovsk. Zagreb e? = +12m.3s., M = +12·3m.

Mar. 10d. 19h. 52m. 40s. Batavia P = +23s., S = +42s., M = +48s.

Mar. 10d. Records also at 0h. (San Fernando) and 17h. (Algiers).

Mar. 11d. Records at 9h. (Moncalieri) and 10h. (Algiers).

Mar. 12d. 9h. 7m. (25s.). Manila P = +35s., L = +1·0m., MN = +1·4m., ME = +1·5m. Helwan P = +24m.35s.

Mar. 12d. Other records at 0h. (Manila and San Fernando), 4h. (Colombo), 5h. (Helwan), 7h. (Helwan), 15h. (Stonyhurst), 19h. (Pulkovo), 22h. (Pulkovo)

Mar. 13d. 3h. 40m. 46s. La Paz (△ = 12°·0) P = +2m.59s., S = +5m.19s., L = +7·5m.

Mar. 13d. 6h. 40m. (0s.). Mizusawa P = +6s., L = +17s.

Mar. 13d. 15h. 4m. 0s. Lick eP = +5s., eL = +13s., MN = +25s., ME = +17s. Berkeley ePN = +17s., ePE = +18s., ?eL = +32s., MN = +34s., ME = +36s.

Mar. 13d. 15h. 44m. 41s. La Paz (△ = 25°·9) P = +5m.48s., S = +10m.21s., L = +15·5m., M = +18·0m.

Mar. 13d. 19h. 57m. (30s.). Mizusawa PE = +25s., LE = +0·9m. Osaka PS = +81s., L = +2·3m., MN = +2·5m. Record also at 14h. (Manila).

1917. March 14d. 18h. 13m. 7s.

Epicentre **38°·5**N. **22°·5**E.

A = +·723, B = +·299, C = +·623; D = +·383, E = −·924;
G = +·575, H = +·238, K = −·783.

Station and Component.	Machine.	△	Azimuth.	P.	O−C.	S.	O−C.	L.	M.
		°	°	M. S.	S.	M. S.	S.	M.	M.
Athens	Ma.	1·2	116	0 20	+ 2	0 50	+17	1·1	1·3
Monte Cassino	—	7·2	296	1 46	− 3	—	—	—	3·9
Rocca di Papa	Ag.	8·1	296	1 53	− 9	—	—	—	4·7
Zagreb	W.	8·7	329	e 2 3	− 9	i 3 30	−25	—	NE 4·9
Moncalieri	S.	12·7	305	3 3	− 6	6 29	? L	(6·5)	N 8·6
Paris	—	17·6	312	e_1 7 15	? S	(7 15)	(−16)	(9·4)	12·9
Uccle	G.	17·7	320	e 4 6	− 7	e 8 29	—	e 9·6	—
De Bilt E.	G.	18·1	324	4 17	− 1	7 28	−14	9·0	12·0
Pulkovo	G.	21·8	9	i 5 7	+ 4	i 9 1	0	10·9	13·5
Edinburgh	M.	24·3	324	13 59	? L	—	—	(14·0)	15·4

Pulkovo gives the epicentre as 39°·7N. 20°·9E. The residuals show that this would suit the observations rather better. A revised solution would give T_0 = 18h. 13m. 19s.; 39°·4N. 21°·3E. Zagreb also gives M (NW) = +6·8m. Helwan (△ = 11°·3, Az. 137°), P = +7m. 53s. Moncalieri, L = +7·9m., ME = +9·8m. Paris, e_2 = +9m. 26s. = ?L. De Bilt, LN = +8·8m., MN = +11·3m. Kew (△ = 20°·5, Az. 316°), M = +11·9m. Eskdalemuir (△ +24°·0, Az. 323°) records the quake from 18h. 22m. to 18h. 45m.

Mar. 14d. 1h. (10m.). Colombo P = +1m.0s., M = +3·5m. De Bilt e = +46·0m. Pulkovo eL = +35·0m.

Mar. 14d. 5h. 40m. (50s.). Batavia P = +17s., S = +32s., M = +0·6m. Malabar S − P = 19s. Also felt in West Java.

Mar. 14d. 11h. 55m. De Bilt eN = +39·0m., MN = +57·1m. Pulkovo e_1 = +10m.0s., e_2 = +18m.6s., L = +31·0m., M = +35·1m. Felt in Petropavlovsk.

Mar. 14d. 18h. 13m. 7s. Epicentre 38°·5N. 22°·5E., separately computed (see also 1916, Sept. 27d. 15h.).

Mar. 14d. Records also at 5h. (San Fernando), 6h. (Athens), 20h. (Zagreb), 21h. (Zagreb).

Mar. 15d. 0h. 14m. 6s. Epicentre 38°·5N. 144°·5E. Separately computed.

Mar. 15d. 20h. 41m. 40s. At 46°·6N. 25°·7E. given by Pulkovo which records iP = +3m.17s., iS = +5m.53s., L = +6·8m., M = +8·9m., De Bilt e = +6m.8s., eLN = 7·1m., MN = +8·3m. Zagreb eP = +1m.29s., i = +2m.15s., MN = +3·9m.

Mar. 15d. Mizusawa gives records of 19 short quakes between 0h.45m. and 13h.30m. There also records at 9h. (Taihoku), 18h. (Moncalieri).

Mar. 16d. 10h. 4m. 34s. Epicentre 1°·0S. 18°·0W. Separately computed.

Mar. 16d. Records also at 1h. (Mizusawa and Honolulu), 2h. (La Paz), 5h. (Mizusawa), 9h. (Azores), 11h. (La Paz), 12h. (Mizusawa), 14h. (Mizusawa and Zagreb), 17h. (Manila), 19h. (San Fernando), 21h. (Helwan and La Paz), 22h. (Mizusawa), 23h. (Mizusawa).

Mar. 17d. 0h. 24m. (20s.). Mizusawa PN = +16s., PE = +6s., ?SE = +26s.

Mar. 17d. 7h. 45m. (0s.) Zi-ka-wei e = +3m.4s., MZ_1 = +6·3m., MZ_2 = +7·4m. Taihoku ePS = +2m.10s. Pulkovo e = +40·5m.

Mar. 17d. Records also at 6h. (Zi-ka-wei), 21h. (San Fernando), 22h. and 23h. (Zi-ka-wei).

1917. March 15d. 0h. 14m. 6s.

Epicentre **38°·5**N. **144°·5**E.

A = −·637, B = +·455, C = +·623; D = +·581, E = +·814;
G = −·507, H = +·362, K = −783.

Station and Component.	Machine.	△	Azimuth.	P.	O−C.	S.	O−C.	L.	M.
		°	°	M. S.	s.	M. S.	s.	M.	M.
Mizusawa E.	O.	2·7	282	0 42	0	—	—	N 1·2	—
Osaka	O.	8·2	245	2 11	+ 7	—	—	3·9	N 5·0
Zi-ka-wei	—	20·2	256	4 44	+ 1	e 8 22	− 5	—	N 13·7
Taihoku	O.	23·6	242	5 21	− 3	9 32	− 4	12·9	14·7
Manila	W.	31·7	227	e 6 54	+10	13 10	+67	19·3	N 25·1
Calcutta N.	O.E.	50·1	270	9 12	+ 4	16 24	− 4	29·1	36·2
E.	O.E.	50·1	270	9 0	− 8	16 18	− 2	29·1	35·9
Honolulu	M.	51·8	90	9 48	+29	? 17 12	+31	30·5	35·0
Simla	O.E.	54·5	270	9 6	−30	—	—	—	33·4
Victoria, B.C.	M.	63·5	48	—	—	(18 37)	(−30)	—	44·9
Bombay E.	M.	64·3	274	10 38	− 2	—	—	—	41·0
Colombo E.	M.	66·0	259	—	—	20 54	+77	—	40·0
Pulkovo	G.	67·9	330	i 11 6	+ 3	19 59	− 2	32·9	42·6
Lick	—	70·6	58	—	—	e 20 37	+ 4	—	—
Edinburgh	M.	81·6	342	17 36	?PR_1	? 22 24	−18	—	57·9
Eskdalemuir	G.	82·2	342	12 29	− 2	22 37	−11	39·2	49·0
De Bilt E.	G.	82·7	336	12 33	− 1	22 41	−13	e 38·9	47·8
Stonyhurst	M.	83·3	341	e 11 0	−98	i 21 30	−90	—	48·1
Zagreb N.E.	W.	83·9	327	e 12 34	− 7	e 22 39	−29	42·9	54·0
N.W.	W.	83·9	327	i 12 53	+12	i 22 53	−45	—	51·9
Uccle	G.	84·1	336	e 12 37	− 6	e 22 54	−15	43·9	—
Kew	M.	84·9	337	21 54	? S	(21 54)	(−84)	—	53·4
Shide	M.S.	85·8	339	12 47	− 5	23 12	−16	—	—
Paris	—	86·4	336	e 12 56	+ 1	i 23 14	−20	42·9	48·9
Helwan E.	M.	87·4	307	12 54	− 7	—	—	—	—
Moncalieri	S.	87·9	331	12 59	− 5	i 23 20	−31	—	E 51·5
Rocca di Papa	Ag.	88·5	324	e 16 22	?PR_1	—	—	e 46·9	50·9
Barcelona	Ma.	92·9	333	—	—	—	—	e46·0	52·9
Harvard E.	B.O.	92·9	26	—	—	—	—	e 47·6	55·1

Zi-ka-wei PR_1 (E) = +5m.7s., PS (N) = 8m. 53s., SR (E) = 9m. 13s., ME = 13·4m. Pulkovo iPR_1 = +13m. 35s., PS = +20m. 20s., SR_1 = +24m. 12s. Edinburgh P (?PR_1) = +17m. 36s. Eskdalemuir PR_1 (?) = +15m. 49s., SR_1 = +28m. 19s. De Bilt PR_1 = +15m. 40s., SR_1 = +27m. 33s., MN = +52·8m. Moncalieri L (?SR_1) = +30·5m. Paris iP = +13m. 5s.

Besides the above we have also :

Berkeley (△ = 69°·6, Az. = 57°), e = +18m. 54s. Barely perceptible trace of distant earthquake. Athens (△ = 86°·3), eL = +46·0m. Ottawa (△ = 88°·6, Az. 27°), P (?S) = +27m. 8s., S = +35m. 44s., L = +47·9m. Toronto (△ = 88°·7, Az. = 30°), P (?S) = +23m. 24s., S = +35m. 42s., L = +45·2m., M = +57·7m. Marseilles e = +50·0m., M = +50·9m. Washington (△ = 93°·7, Az. = 31°), e = +47m. 15s., eL = +57·9m. Algiers (△ = 96°·8), L = +52·9m., M = +54·4m. Coimbra (△ = 97°·5, Az. = 338°), e (?PR_1) = +17m. 34s., P (= S?) + 24m. 14s. S (= SR_1?) = 31m. 36s., L = +48·9m., ME = +62·8m., MN = +65·4m. San Fernando (△ = 100°·2, Az. = 336°), P = +23m. 54s., L = +56·4m., M = +64·9m. La Paz (△ = 143°·9, Az. = 62°), P = +19m. 59s., in close accord with new formula and table on p. 7, PR_1 = +23m. 58s., SR_1 = +42m. 9s., L = +71·9m., M = +91·6m.

Other suggestions for epicentre are by Pulkovo 37°·7N. 140°·1E.; by Ottawa 38°·0N. 143°·5E.

Study of the residuals suggests as a slight improvement T_0 = 0h. 14m. 11s., epicentre 39°·7N. 144°·1E.

1917. March 16d. 10h. 4m. 34s.

Epicentre **1°·0**S. **18°·0**W.

A = +·951, B = −·309, C = −·018; D = −·309, E = −·951;
G = −·017, H = +·005, K = −1·000.

Station and Component.	Machine.	△	Azimuth.	P.	O−C.	S.	O−C.	L.	M.
		°	°	M. S.	s.	M. S.	s.	M.	M.
Coimbra	W.	42·2	11	8 0	−12	14 20	−18	19·8	—
Algiers	B.M.	42·5	25	—	—	—	—	22·1	27·1
Rocca di Papa	Ag.	51·1	29	8 32	−42	i 16 32	0	e 25·6	28·2
Moncalieri	S.	51·4	23	? 6 2	−194	16 41	+ 5	25·0	27·4
La Paz	Bi.	51·7	250	9 15	− 3	16 20	−20	23·4	25·6
Paris	—	52·9	17	16 53	? S	(16 53)	(− 2)	23·4	E 27·4
Uccle	G.	55·2	17	e 9 37	− 3	e 17 26	+ 2	26·4	—
Zagreb	W.	55·6	28	9 47	+ 4	e 17 8	−21	28·4	31·7
						i 17 30	+ 1		
Stonyhurst	M.	56·3	11	—	—	17 56	+18	—	33·1
De Bilt	G.	56·6	17	—	—	17 44	+ 3	e 24·4	E 30·5
Eskdalemuir	G.	57·6	10	—	—	? 17 52	− 2	24·2	—
Edinburgh	M.	58·2	10	23 2	? L	—	—	(23·0)	28·4
Toronto	M.	70·5	318	—	—	—	—	37·4	40·2
Pulkovo	G.	71·4	23	i 11 26	0	20 44	+ 1	32·4	37·6
Mauritius N.	M.	76·4	111	30 50	? L	—	—	(30·8)	34·8

Epicentre adopted from De Bilt.

San Fernando (△ = 39°·1, Az. = 15°) records P = +12m. 26s., L = +22·4m., MN = +25·9m., ME = +24·9m. Stonyhurst eP = −3m. 4s. De Bilt MN = +32·6m. Helwan E (△ = 56°·2, Az. = 52°), P = +17m. 26s., M = +32·9m. Mauritius E. P = +21m. 20s., M = +25·1m. Colombo (△ = 97°·8, Az. = 83°), P = +53m. 26s. Pulkovo iPR_1 = +13m. 54s., SR_1 = +25m. 14s. Paris MN = +33·4m.

Mar. 18d., 17h. 39m. 0s. Epicentre 41°·0N. 36°·5E. (See 1916 Jan. 24). A = +·607, B = +·449, C = +·656.

	△	Az.	P.	O−C.	S.	O−C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Athens	11·3	252	i 2 36	−13	i 5 20	+18	—	6·6
Helwan	11·8	204	5 0	?S	(5 0)	−15	—	12·5
Zagreb, N.W.	15·6	296	3 39	− 8	i 7 31	+47	—	10·4
N.E.	15·6	—	3 48	+ 1	—	—	—	9·1
Rocca di Papa	17·8	280	e 4 30	+16	i 7 38	+ 2	—	10·9
Pulkovo	19·2	350	i 4 31	0	i 8 5	−1	10·0	14·5
Moncalieri	21·3	291	5 0	+ 3	8 56	+ 6	12·2	15·8
De Bilt N.	24·0	305	—	—	9 43	—	11·2	15·0
E.	24·0	—	—	—	—	—	11·8	20·3
Uccle	24·5	306	5 24	− 9	e 9 54	0	—	—
Paris	25·1	300	—	—	—	—	e 14·0	—
Kew	27·2	305	—	—	—	—	—	21·0
Edinburgh	29·6	313	11 18	?S	(11 18)	− 9	—	—
Mizusawa	74·6	50	(27 10)	—	—	—	(27·7)	—

Helwan gives S = +10m. 24s., but the true S is probably the +5m. 0s. recorded for P.

Zagreb has also i = +4m. 11s. and i = +4m. 51s.

Moncalieri. The M record is MN, ME is 16·8m. T_0 stated to be 17h. 39m. 5s.

The records for Mizusawa have been inserted in the table to show that they must belong to a different shock close to Mizusawa.

Pulkovo give epicentre at 41°·1N. 24°·3E., which will not fit.

Mar. 18d. Records also at 2h. (Mizusawa), 4h. (Batavia), 10h. (Algiers), 17h. (Eskdalemuir), 18h. (Algiers, De Bilt, Edinburgh, La Paz, Mizusawa), 19h. (Pulkovo, Mizusawa), 20h. (Mizusawa).

Mar. 19. Records at 0h. (San Fernando), 3h. (Taihoku), 10h. (Rocca di Papa), 12h. and 13h. (Mizusawa), 15h. (La Paz and Osaka), 16h. (Port au Prince), 17h. Manila, 22h. (San Fernando).

Mar. 20d. 1h. 37m. (20s.). Mizusawa P = +33s., L = +1·0m. Zi-ka-wei eL = +12·3m., M = +13·8m.

Mar. 20d. Records also at 2h. (Mizusawa), 4h. (Helwan), 12h. (Zi-ka-wei), 15h. (Manila gives epicentre 9°·5N. 126°·5E.), 18h. (Manila), 20h. (Zi-ka-wei), 23h. (Manila).

Mar. 21d. 0h. 29m. (51s.). Rocca di Papa eP = +23s., S = +42s., M = +1·0m. Monte Cassino P = +39s., M = +1·2m. Zagreb eP = +68s., P = +71s., ME = +2·3m., MN = +2·2m.

Mar. 21d. Records also at 2h. (San Fernando), 3h. (Bombay), 8h. (Honolulu), 13h. (Manila), 14h. (De Bilt, Helwan, and Batavia), 16h. (Moncalieri), 20h. (Taihoku), 22h. (La Paz and Rocca di Papa), and 23h. (La Paz).

Mar. 22d. 2h. 36m. 34s. as deduced from the La Paz observations, but beyond this the material is not capable of giving a precise epicentre. The European stations suggest an unfamiliar position in the Antarctic, if we may presume that they are chiefly records of L, though entered as P. Adopting as epicentre 73°·0S. 120°·0W. (A = −·146, B = −·253, C = −·956), we have for La Paz (△ = 63°·6), P = +10m. 31s., S = 18m. 58s. O − C = −5s. and −10s.), L = +26·4m., M = 29·4m. Andalgala (△ = 53°·3), e = +14m. 20s. not readily identifiable. Pulkovo (△ = 162·5), e = +32m. 50s. De Bilt (△ = 149°·1), eP = +44m. 26s., probably SR, (+42m. 52s.). Other observations all of L (and M) as below :—

	△	L.	M.
	°	m.	m.
Melbourne	55·6	e 30·1	34·1
Cape Town	69·4	57·2	—
Helwan	134·3	64·4	84·6
San Fernando	131·5	72·4	99·9
Moncalieri	143·4	68·5	—
		or 73·5	—
Paris	145·4	74·4	113·4
De Bilt	149·1	e 73·5	74·5
Edinburgh	150·0	75·3	—
Pulkovo	162·5	81·4	85·9

Mauritius (△ = 86°·9) records M = +54·4m.

Mar. 22d. Records also at 0h. (San Fernando), 3h. (Eskdalemuir and Melbourne), 5h. (Taihoku), 7h. (Rocca di Papa), 13h. (La Paz), 14h. (Monte Cassino), 19h. (Melbourne and Manila), 22h. (San Fernando).

Mar. 23d. 12h. 28m. (15s.). Rocca di Papa eP = +3s., S = +6s., M = +0·2m. Monte Cassino P = +45s.

Mar. 23d. 14h. 22m. (55s.). Rocca di Papa P = +19s., S = +32s., M = +0·6m. Monte Cassino P = +5s.

Mar. 23d. Records also at 1h. (Lick), 2h. (Osaka), 16h.–21h. (Monte Cassino), 18h. (Lick), 23h. (San Fernando).

Mar. 24d. 0h. 40m. (53s.). La Paz P = +6m. 8s., L = +14·1m., M = +17·4m. Chacarita P = +10m. 25s.

Mar. 24d. Records also at 1h. (De Bilt and Helwan), 4h. (Rocca di Papa), 5h. (Mizusawa), 6h. (Monte Cassino), 11h. (Mizusawa), 13h. (Zi-ka-wei), 14h. (Bombay), 17h. (Melbourne), 18h. (Helwan), 19h. (La Paz), 21h. (San Fernando).

Mar. 25d. Records at 0h. (Edinburgh), 2h. (Zi-ka-wei), 4h. (Osaka), 6h. (Stonyhurst), 11h., 16h., and 17h. (Helwan), 21h. (Monte Cassino and San Fernando).

Mar. 26d. 14h. We have here one of those puzzles which require much expenditure of time to solve ; and yet it seems unsatisfactory not to attempt some solution when so many facts are clear. Two shocks following at an interval of 24m. are recorded by Harvard, Ottawa, Tucson, and Washington, so that we have an extra check on these records. The epicentre for both is clearly not far from Tucson, which records :

PE	PN	ME	MN
14h. 4m. 9s.	4m. 16s.	5m. 4s.	5m. 20s.
28m 47s.	28m. 58s.	29m 56s.	29m. 54s.

Limiting attention to the first shock the greatest (latest) value for T_0 is 14h. 4m. 9s., on the supposition that Tucson is actually the epicentre.

Washington (distant 28°·1 from Tucson) records :

e = 14h. 12m. 20s. (E), 40s. (N) S = 14h. 16m. 46s. L = 14h. 19m. 32s.
e = 36m. 42s. S = 14h. 41s. 22s. [(E), 40s. (N)

Now the S wave arrives at Washington at $T_0 + Sw$, where Sw is the time of transmission of S from the epicentre to Washington. For △ = 28°·1, Sw = 11m. 1s., so that on above assumption $T_0 + Sw$ = 14h. 4m. 9s. + 11m. 1s. = 14h. 15m. 10s.

But this is much too small, observation giving 14h. 16m. 46s. Hence we must increase either T_0 or Sw or both. Now we cannot increase T_0 as already remarked ; we can only diminish it : and this gives us an additional reason for increasing Sw. To increase Sw as much as possible we must move the epicentre away from Tucson on the side directly away from Washington. Suppose we take three suppositions, making Δt the distance from Tucson, 5°, 10°, 20° in turn :

Δt	T_0	Δw	Sw	$T_0 + Sw$
°	h. m. s.	°	m. s.	h. m. s.
0	14 4 9	28·1	11 1	14 15 10
+ 5	2 52	33·1	12 26	15 18
10	1 39	38·1	13 39	15 18
20	13 59 28	48·1	15 55	15 23

It is useless to consider greater alterations than these, for we have already gone beyond what the observations of L and M will countenance. It thus appears that if the Tucson record is correct the Washington observation at 14h. 16m. 46s. cannot be S ; or if the Washington is S, there must be an error in the Tucson record. We must suppose *some* error.

The simplest supposition is that of an error of 2 minutes in the Tucson record. With assumed epicentre at Tucson itself as before, we have now T_0 = 14h. 6m. 9s., and $T_0 + Sw$ = 14h. 6m. 9s. + 11m. 1s. = 14h. 17m. 10s. as compared with 14h. 16m. 46s. observed. We now require a *diminution*, which is quite easily made, for by moving the epicentre nearer Washington we diminish both T_0 and Sw. We have seen already that when △ is near 35° they change about equally, and hence we need only diminish each by half the 34s. required, moving the epicentre less than a degree east from Tucson : say to 32°·5N. 110°·0W.

But before suggesting any change let us tabulate the records on this crude hypothesis T_0 = 14h. 6m. 9s., epicentre Tucson 32°·3N. 110°·8W.

	△	P.	O − C	S.	O − C	L.	M.
	°	m. s.	s.	m. s.	s.	m.	m.
Victoria B.C.	18·6	4 28	+ 4	—	—	7·4	9·8
Washington	28·1	6 11?	+ 2	10 37	−24	13·4	—
Ottawa	30·1	—	—	e 12 5	+29	13·5	—
Harvard	32·9	13 21	?S	(13 21)	+59	17·2	—
Honolulu	43·2	—	—	—	—	16·8	18·3

We thus see the difficulties of making any improvement ; for

(a) Moving the epicentre nearer Washington as suggested above makes the residuals for Ottawa (and perhaps Harvard) worse. Honolulu also with L = 16·8m. seems to have already too large a △, which would be still further increased by moving the epicentre nearer Washington (though if we assume that L should be S we could get over this difficulty). Finally T_0 would be necessarily diminished, and therefore all the residuals, already chiefly positive, would be increased.

(b) We could increase T_0 by altering the assumption of error at Tucson—say to 3m. instead of 2m. But we can scarcely make any alteration less than 1m. unless we discard Tucson altogether (which seems a strong measure in view of the double quake), and so large a change involves large changes in △ for other stations.

Now assume that the hypothesis of an error in Tucson is unworkable, and the alternative is some error in Washington. Let us then accept Tucson as correct, and for the moment exclude Washington. We must increase all the above times and residuals by 2m. The Victoria record cannot any longer be P unless we are prepared to move the epicentre 10°, which is scarcely consistent with the Tucson record. Treating it as S we get an approximate △ = 14°, which would call for moving the epicentre some 4° from Tucson, and a consequent further decrease of 62s. in T_0. Only about half of this change however is required as the △ of Victoria will then increase to meet it. Ottawa and Harvard observations would now refer to L instead of S. We can only make the Washington observations mean anything by also moving the epicentre nearer Washington and supposing that the first of them refers to S and the second to L. **Thus the alterations required are more numerous than in the former case.**

Mar. 26d. Records also at 5h. (La Paz), 16h. (Cape Town).

Mar. 27d. Records at 0h. (Manila), 6h. (Monte Cassino), 7h. (San Fernando), 9h. 7m. (epicentre given in Philippine Catalogue as 11°·1N. 125°·2E.), 17h. (Stonyhurst), 19h. (Lick), 23h. (La Paz).

Mar. 28d. 5h. 9m. (20s.). Melbourne iP = +4m. 4s., L = +8·0m., M = +11·4m. Honolulu P = +10m. 52s., ?S = +16m. 16s., L = +20·9m., M = +24·0m., Helwan P = +30m. 40s.

Mar. 28d. Records also at 0h. (San Fernando), 3h. (La Paz), 6h. (De Bilt and Helwan), 11h. (Monte Cassino), 17h. (Helwan), 18h. (Mizusawa), 21h. (Moncalieri).

Mar. 29d. 2h. 0m. 52s. : 2°·7S. 83°·3W. The epicentre has been adopted from a determination made at De Bilt by comparison of the La Paz and Vieques records ; but it does not satisfy the observations at Washington and Honolulu. If it were moved to 2°·0N. 78°·0W. it would suit Washington, San Fernando, and Pulkovo better.

	△	P.	O−C	S.	O−C	L.	M.
	°	m. s.	s.	m. s.	s.	m.	m.
La Paz	20·3	i 4 51	+ 7	8 36	+ 7	12·0	14·0
Washington	42·0	e 7 31	−40	10 31	?PR$_1$	e 15·5	—
Harvard	46·4	—	—	17 1	+88	e 19·3	27·2
Toronto	46·6	20 8	?	24 50	?L	(24·8)	30·4
Victoria B.C.	61·8	32 35	?L	35 4	?	(32·6)	41·0
Honolulu	76·9	19 50	?S	(19 50)	(−118)	41·4	45·1
San Fernando	81·3	22 8	?S	(22 8)	−30	44·4	47·6
Edinburgh	86·7	25 14	?S	(25 14)	+96	—	52·1
Stonyhurst	86·8	—	—	i23 38	− 1	40·2	46·8
Paris	89·3	—	—	—	—	e 53·1	—
De Bilt	91·2	—	—	24 23	− 3	e 43·1	47·7
Moncalieri	92·7	e 27 12	?S	(27 12)	+150	41·7	50·2
Pulkovo	104·0	e 22 38	?	25 26	−67	45·1	55·7
Helwan	112·6	33 8	?	—	—	—	—

Colombo records P(?L) +86m. 8s., M = +93·4m., Eskdalemuir from 2h. 30m. to 3h. 14m., Kew M = +64·1m., Edinburgh S = +29m. 18s., Honolulu S = +26m. 50s. (?SR$_1$).

Mar. 29d. Records also at 1h. (Zagreb), 21h. (Monte Cassino and Rocca di Papa), 23h. (Lick and Tortosa).

Mar. 30d. Records at 0h. (Athens, La Paz, San Fernando), 1h. (Athens), 6h. (Lick), 12h. (Rocca di Papa : Epicentre in Perugia.?), 16h. (Lick).

Mar. 31d. Records at 3h. (La Paz), 4h. (Baltimore, La Paz, and San Fernando), 8h. (Helwan), 9h. (Helwan and La Paz), 11h. (Batavia), 17h. (Bombay), 18h. (Mizusawa), 23h. (Lick).

April 1d. Records at 1h. (Mizusawa and Osaka), 2h. (Azores), 11h. (Algiers), 16h. (Manila and Monte Cassino).

April 2d. 2h. 3m. (40s.). Athens eP = +39s., eS = +1m. 8s., L = +1·5m., M = +1·8m. Zagreb, eNW = +2m. 2s., L = +5·3m., M N.E. = +6·4m. Pulkovo iP = +3m. 54s., S = +7m. 46s., L = +9·3m., M = +11·4m. Moncalieri i = +5m. 56s., L = +8·7m. De Bilt eL = +10·2m., M = +10·9m. San Fernando P? = +25m. 20s. Zagreb eNW = +2m. 2s., L = +5·3m., MNE = +5·7m., MNW = +6·4m.

April 2d. 7h. 54m. (0). Batavia P = +1m. 28s., S = +3m. 3s., M = +5·7m. Manila eP = +3m. 33s., S = +5m. 48s., L = +7·7m., MN = +8·2m., ME = +8·6m. Melbourne P = +19m. 12s., L = +20·3m., M = +21·6m. Pulkovo e = +14m. 36s., L = +42m., MN = +52·8m.

April 2d. 14h. 57m. 13s. Batavia P = +1m. 2s., S = +1m. 50s., M = +3·3m. (near Sumatra). Colombo P = +11m. 47s. Pulkovo e = +30m. 47s. Azores P = +36m. 35s.

April 2d. 17h. 23m. 0s. Rocca di Papa e = +3s., P = +8s., S = +14s., M = +20s. Monte Cassino P = +6s., M = +0·2s. La Paz P = +24m. 28s., L = +27·5m., M = +28·8m.

April 2d. Records also at 4h. (Colombo), 5h. (La Paz and Stonyhurst), 7h. (Moncalieri), 9h. (Berkeley and La Paz), 10h. (Stonyhurst), 11h. (Cape, Colombo, and Moncalieri), 18h. (Pulkovo), 19h. (Batavia), 20h. (Pulkovo), 23h. (Lick).

April 3d. 12h. 32m. (0)s. Epicentre 34°·0S. 80°·0E.
A = +143, B = +·816, C = −·559.

	△	P.	O−C.	S.	O−C.	L.	M.
	°	m. s.	s.	m. s.	s.	m.	m.
Batavia	37·2	7 41	+ 9	—	—	—	14·0
Colombo	40·9	—	—	14 42	+22	18·5	20·0
Kodaikanal	44·3	16 12	?S	(16 12)	+66	20·8	22·0
Cape Town	50·2	—	—	—	—	—	21·5
Melbourne	51·6	21 0	?SR$_1$	24 0	?	25·3	27·5
Bombay	53·4	18 7	?S	(18 7)	+66	—	27·1
Manila	62·3	e 10 13	−14	—	—	—	—
Simla	65·2	19 54	?S	(19 54)	+27	—	E 32·0
Zi-ka-wei	75·9	e 12 0	+ 6	—	—	—	42·7
Algiers	100·7	—	—	—	—	e 50·0	61·0
Pulkovo	102·0	? 14 8	−12	26 0	−15	48·0	53·4
Moncalieri	102·1	e 57 35	?	—	—	63·4	—
San Fernando	N 106·7	34 0	SR$_1$	—	—	55·5	58·5
De Bilt	N. 107·9	—	—	—	—	N 60·0	E 64·3
Kew	110·5	67 0	?	—	—	—	79·0
Edinburgh	114·0	23 36	?	—	—	—	—
La Paz	121·0	—	—	—	—	59·0	71·3
Honolulu	127·7	53 18	?	—	—	65·6	74·6

Pulkovo records PR$_1$ =18m. 27s., i =24m. 37s., PS =27m. 35s., SR$_1$ = 33m. 24s.
Eskdalemuir records 13h. 34m. to 13h. 53m.

April 3d. Records also at 0h. (San Fernando), 1h. (La Paz), 3h. (Monte Cassino), 11h. (Edinburgh), 14h. (Moncalieri, Pulkovo, and Toronto), 15h. (Manila), 18h. (Monte Cassino), 22h. (Batavia).

April 4d. 13h. 39m. 30s. Pulkovo gives an epicentre 43°·0N. 28°·0E. (Balkans), using this the following results are obtained for this local quake :

	△	P.	O−C.	S.	O−C.	L.	M.
	°	m. s.	s.	m. s.	s.	m.	m.
Athens	N. 6·0	e 1 19	−13	2 48	+ 4	—	3·5
Zagreb	9·0	e 1 58	−18	5 58	+115	—	6·9
Monte Cassino	10·6	7 12	?L	—	—	7·2	—
Rocca di Papa	11·3	7 21	?L	—	—	7·4	8·5
Moncalieri	14·7	e? 4 3	+28	7 24	+ 59	9·0	12·0
Pulkovo	16·8	i 4 7	+ 4	7 20	+ 7	8·0	13·7
De Bilt	17·7	e 12 10	?	—	—	—	—
Uccle	17·8	e 4 30	+15	—	—	—	e 11·5
Kew	20·8	—	—	—	—	—	15·5

Athens has e = +2m. 5s., eE = +3m. 10s., ME = +3·9m. Uccle e = +11m. 30s. Eskdalemuir 13h. 50m. to 14h. 10m.

April 4d. Records also at 0h. (San Fernando), 2h. (La Paz), 4h. (La Paz), 5h. (De Bilt), 7h. (De Bilt, Pulkovo, and Monte Cassino), 9h. (Monte Cassino), 14h. (Monte Cassino), 17h. (Monte Cassino).

April 5d. (4h.). Honolulu L = +35·0m., M = +42·3m. Pulkovo e = +41m. 17s., i = +42m. 38s., L = +85·0m., M = +88·8m. De Bilt eL = +91·0m., M = +93·3m. Eskdalemuir from 5h. 28m. to 5h. 46m. Paris from 5h. 37m. to 5h. 45m. Stonyhurst M = +97·0m.

April 5d. Records also at 9h. (Rocca di Papa), 11h. (La Paz), 15h. (Melbourne), 20h. (La Paz).

April 6d. Records at 1h. (San Fernando), 7h. (Zagreb △ =0°·3 : P and M 5s. apart), 14h. (La Paz), 16h. (Again 0°·3 from Zagreb).

April 7d. 3h. 51m. 27s. Batavia P = +55s., S = +96s., M = +3·3m.

April 7d. 8h. 34m. 54s. Batavia P = +55s., S = +95s., M = +3·7m. (Repetition of above ?). Mizusawa PE = +20m. 47s., L = +21·2m. Monte Cassino P = +46·6m ?

April 7d. Records also at 0h. (San Fernando), 20h. (Moncalieri).

April 8d. Records at 0h. (Mizusawa), 1h. (Monte Cassino), 2h. (San Fernando), 12h. (Osaka), 23h. (San Fernando).

1917. April 12d. 2h. 54m. 35s.

Epicentre **18°·0**N. **97°·0**E.

A = −·116, B = +·944, C = +·309; D = +·993, E = +·122; G = −·038, H = +·307, K = −·951.

Station and Component.		Machine.	△	Azimuth.	P.	O−C.	S.	O−C.	L.	M.
			°	°	M. S.	S.	M. S.	S.	M.	M.
Calcutta	N.	O.E.	9·3	300	2 25	+ 5	—	—	4·0	5·0
	E.	O.E.	9·3	300	2 19	− 1	—	—	3·9	4·8
Colombo	E.	M.	20·1	239	5 1	+19	9 25	+60	13·6	15·7
Kodaikanal	E.	M.	20·5	250	4 37	− 9	—	—	9·7	19·1
Simla		O.E.	22·2	310	4 55	−12	—	—	—	10·6
Bombay	E.	M.	23·0	277	5 39	+26	—	—	—	15·5
Manila		W.	23·2	87	e 6 41	+82	11 43	+134	16·3	17·8
Taihoku		O.	23·8	69	e 5 18	− 8	9 44	+ 4	15·1	16·2
Zi-ka-wei		—	25·7	55	e 6 9	+24	e 10 57	+41	—	16·5
Batavia		W.	26·0	158	e 7 21	+93	10 9	−13	—	22·4
Pulkovo		G.	62·9	329	i 10 25	− 6	i 18 12	−49	28·4	N 31·2
Zagreb		W.	71·0	313	11 29	+ 6	i 20 20	−18	34·4	—
Rocca di Papa		Ag.	74·0	309	e 11 11	−31	—	—	—	—
Moncalieri		S.	76·9	313	e 20 29	? S	(e 20 29)	(−79)	(29·7)	(40·3)
De Bilt		G.	77·0	321	—	—	—	—	(37·4)	N 40·2
Paris		—	79·4	318	—	—	—	—	e 41·4	46·9
Kew		M.	80·4	321	—	—	—	—	—	(54·4)
Edinburgh		M.	80·7	326	24 25	? SR_1	—	—	—	47·4
Stonyhurst		M.	80·9	324	i 21 13	? S	(i 21 13)	(−81)	—	48·9
Honolulu		M.	96·7	65	46 13	? L	—	—	(46·2)	61·4
Toronto		M.	118·2	356	—	—	—	—	68·9	—

Simla also has M = +14m. 13s. Manila, P = ?PR_1 (+5s.), S = ?SR_1 (+85s.). Batavia, P = ?PR_1 (+55s.). Pulkovo also gives iP_2 = +10m. 43s. (+12s.), PR_1 = +12m. 35s (−51s.), PR_3 = +14m. 7s. (+41s.), iS_2 = +18m. 29s. (−30s.), SR_1 = +22m. 25s. (−95s.), SR_2 = +24m. 43s., (+43s.), SR_3 = +25m. 43s. (+103s.). Zagreb gives eS = +19m. 49s. (−49s.), L = ?M. Rocca di Papa has M = +13m. 1s. = ?PR_1 (−1m. 59s.). Moncalieri, S (?L) = +29m. 41s., L (?M) = +40m. 25s. Edinburgh, P (?S or SR_1). Eskdalemuir (△ = 80°·9), from 3h. 30m. to 4h. 0m. Stonyhurst, P = ?S, S + 30m. 25s. = ?SR_1. Honolulu gives L = +55m. 31s. De Bilt has eE = +26m. 55s. = ?SR_1, ME = +47·2m. Mizusawa (△ = 47°·6) has P = +5m. 13s., and P (?S) = +14m. 18s.

Pulkovo gives an epicentre 35°·0N. 111°·0E.; this does not suit the above records so well as that adopted. There seems to be some error in the S for Pulkovo, but it is not easy to suggest an improved solution.

La Paz (△ = 165°·7) records P = 2h. (?3h.) 6m. 5s., L = 3h. 21m. 0s., M = 3h. 34m. 20s., but these must belong to some other shock?

April 9d. 5h. 15m. 28s. eP = +1m. 0s. L = +1·3m. M = 1·4m.
11h. 11m. 11s. eP = +1m. 0s. L = +1·6m.
11h. 21m. 20s. eP = +1m. 0s. L = +1·9m. M = 2·0m.
15h. 51m. 30s. eP = +1m. 0s. L = +1·9m.

The above are Manila records for a series of shocks located by the Philippine weather Bureau at 18°·2N. 120°·7E., in N.W. Luzon.

La Paz records P = 11h. 16m. 31s., L = 11h. 19m. 18s., M = 11h. 19m. 53s., but these can scarcely refer to the Manila shocks.

April 9d. Records also at 22h. (Lick) and 23h. (Monte Cassino).

April 10d. 2h. 14m. 3s. Zagreb (△ = 0°·3), iP = +4s., iS = +9s., M = +44s. Rocca di Papa eP = +1m. 40s., S(?) = +2m. 56s., M = +3·0m.

April 10d. 13h. 34m. (15s.). Manila eP = +43s., L = +1·5m., M = +1·8m. Philippine Weather Bureau gives 10°·6N. 122°·5E.; and state that local quakes at 16h. 43m. 27s., eP = +43s., L = +1·4m., M = +1·8m. were from same origin.

April 10d. 18h. 13m. 44s. Batavia eP = +1m. 53s., S = +3m. 24s., M = +5·2m. Felt in Bali and Lombok.

April 10d. Other records at 0h. (Monte Cassino), 1h. (San Fernando and Simla), 2h. (Pulkovo), 17h. (Mizusawa), 19h. (Azores), 20h. (San Fernando).

April 11d. 22h. 2m. 0s. Manila eP = +6s., L = +0·9m., MN = +1·5m. Probable origin 18°·7N. 121°·8E. N. Luzon (Phil. W. B.). Pulkovo e = +40·0m.

April 11d. Records also at 1h. (Monte Cassino), 2h. (Rocca di Papa), 6h. (Lick), 9h. (Pulkovo and Zagreb).

April 12d. Records at 0h. (La Paz), 1h. (San Fernando), 2h. (Mizusawa), 11h. (Mizusawa), 15h. (Monte Cassino).

April 13d. 13h. 15m. 15s. Monte Cassino P = +5s., M = 0·2m. Rocca di Papa P = +15s., eS = +28s., M = +0·7m.

April 13d. Records also at 6h. (Berkeley), 20h. (La Paz), 21h. (La Paz), 22h. (San Fernando), 23h. (La Paz).

April 14d. Records at 4h. (Bombay), 11h. (Batavia and Manila), 14h. (Zagreb), 15h. (Zagreb), 15h. (Stonyhurst).

April 15d. 3h. 29m. (5s.). La Paz P = +2m. 9s., S = +3m. 51s., M = +4·6m.

April 15d. Records also at 0h. (San Fernando), 3h. (Rocca di Papa), 9h. (Colombo), 10h. (Mizusawa), 11h. (Zagreb), 12h. (La Paz and Honolulu), 13h. (Mizusawa), 18h. (La Paz), 19h. (Berkeley and Lick).

April 16d. Records at 1h. (Batavia and La Paz), 3h. (San Fernando), 5h. (Monte Cassino), 15h. (La Paz and Osaka), 16h. (La Paz), 17h. (Athens).

April 17d. 13h. 31m. 45s. Epicentre 18°·0N. 84°·0E.

A = +100, B = +946, C = +309.

		△	P.	O−C.	S.	O−C.	L.	M.
		°	m. s.	s.	m. s.	s.	m.	m.
Calcutta	N.	6·0	1 33	+ 1	2 33	−11	4·5	5·1
	E.	6·0	1 33	+ 1	2 33	−11	—	7·1
Simla		14·4	6 15	?S	(6 15)	− 3	—	—
Batavia		33·1	e 12 16	?S	(12 16)	−10	—	15·2
Taihoku		35·4	e 8 29	PR_1	—	—	12·1	—
Manila		35·6	e 6 4	−74	—	—	13·3	14·4
Zi-ka-wei		36·3	e 7 52	+28	e 11 11	—	—	—
Pulkovo		56·6	—	—	—	—	31·2	35·7
De Bilt		69·1	e 21 21	?	27 57	?	42·3	42·7
Edinburgh		73·6	35 33	?L	—	—	35·6	45·2

Eskdalemuir records the quake from 14h. 9m. to 14h. 32m.

April 17d. Records also at 0h. (Cape Town and San Fernando), 3h. (San Fernando), 10h. (Mizusawa), 16h. (Rocca di Papa), 17h. (Lick), 18h. (Colombo and Kodaikanal), 19h. (Manila), 22h. (Lick).

April 18d. Records at 1h. (San Fernando), 5h. (Mizusawa), 11h. (Colombo), 12h. (Manila), 14h. (Pulkovo), 18h. (De Bilt).

1917. April 16d. 18h. 44m. 26s.

Epicentre 6°·0S. 99°·0E.

A = −·156, B = +·982, C = −·105; D = +·988, E = +·156
G = +·016, H = −·103, K = −·995.

Station and Component.	Machine.	△	Azimuth.	P.	O−C.	S.	O−C.	L.	M.
		°	°	M. S.	S.	M. S.	S.	M.	M.
Batavia	W.	7·7	91	i 1 53	− 4	3 36	+ 7	—	7·4
Manila	W.	30·0	47	e 6 34	+ 6	11 24	−10	18·0	18·4
Bombay E.	M.	35·9	315	16 59	? L	—	—	(17·0)	20·0
Taihoku	O.	38·0	34	e 16 26	? SR_1	—	—	20·5	—
Mauritius E.	M.	42·3	247	15 34	? S	(15 34)	+55	—	22·7
Melbourne	M.	52·3	134	e 17 52	? S	(e 17 52)	+64	40·7	45·8
Pulkovo	G.	84·8	332	i 12 59	+12	i 23 4	−13	39·6	46·9
De Bilt	G.	94·3	322	—	—	25 32	+33	eN 54·6	E 65·1
Stonyhurst	M.	101·6	324	—	--	—	—	—	70·7
Edinburgh	M.	101·8	326	53 28	? L	—	—	(53·5)	71·6
Honolulu	M.	104·3	70	46 22	? L	—	—	(46·4)	64·6
San Fernando	—	105·8	306	55 4	? L	—	—	(55·1)	—
La Paz	Bi.	154·0	210	20 50	+164	—	—	—	—

Mauritius also gives PN (?S) = + 17m. 10s. De Bilt, MN = + 57·6m. Pulkovo, PR_1 = +16m.4s., SR_1 = +28m.22s., SR_2 = +32m.16s. Honolulu gives L = +58·5m.

The Manila and Pulkovo observations suggest an addition of about 15s. to T_0. If we adopt this, the residuals suggest moving the epicentre about 2° further north and 1°E. to 4°·0S. 100°·0E.

April 19d. Records at 0h. (San Fernando), 4h. (Batavia, Manila, and Pulkovo), 5h. (Zagreb), 17h. (Barcelona and Tortosa), 18h. (Zagreb).

April 20d. 9h. 56m. 48s. (?) Epicentre 51°·0N. 34°·0W. (?).

A = +·521, B = +·352, C = +·777.

	△	Az.	P.	O−C.	S.	O−C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Edinburgh	18·3	63·0	2 0	−141	9 18	+91	—	10·2
Coimbra N.	20·8	116·4	5 20	+29	11 54	+194	—	—
E.	20·8	116·4	4 54	+ 3	11 36	+176	—	—
Kew	21·0	74·6	—	—	—	—	—	11·7
Paris	23·4	80·3	5 32	+11	9 50	+17	12·2	14·7
Uccle	23·9	75·3	5 31	+ 4	—	—	13·2	—
De Bilt N.	24·1	71·6	9 45	?S	(9 45)	− 1	11·2	14·8
E.	24·1	71·6	9 49	—	(9 49)	+ 3	11·2	14·1
San Fernando	24·6	116·3	8 42	?S	(8 42)	−73	14·7	16·7
Tortosa	25·8	99·1	6 8	+22	10 1	−17	—	—
Barcelona	26·5	98·1	—	—	—	—	—	19·2
Moncalieri	28·2	84·6	4 3	−127	—	—	15·3	17·4
Zagreb	33·0	78·2	7 0	+ 4	—	—	19·2	—
Pulkovo	36·0	50·3	—	—	(13 12)	+ 2	13·2	18·2

Eskdalemuir records from 10h. 5m. to 10h. 19m. Algiers eL = +15·2m., M = +27·2m.

April 20d. Records also at 9h. 18m. 6s. (Zagreb), and eP =10h. 11m. 23s. (Uccle). Also at 0h. (La Paz), 4h. (Moncalieri), 11h. (Moncalieri and Bombay), 17h. (Batavia), 22h. (La Paz).

April 21d. 0h. 49m. 18s. Separately computed.

April 21d. 3h. 52m. 40s. 40°·0N. 144°·5E.

A = −·624, B = +·445, C = +·643.

	△	P.	O−C.	S.	O−C.	L.	M.
	°	m. s.	s.	m. s.	s.	m.	m.
Mizusawa	2·8	0 42	− 2	—	—	1·3	—
Osaka	8·9	2 40	+25	—	—	4·6	5·3
Zi-ka-wei	20·7	e 4 44	− 5	e 8 39	+ 1	—	14·0
Pulkovo	66·6	e 11 0	+ 5	e_2 19 40	− 5	29·7	38·0

April 21d. 17h. 5m. 38s. La Paz (△ =1°·7), iP = +26s., i = +47s., L = +86s., M = +92s.

April 21d. 22h. 48m. 30s. Batavia (△ =4°·4), iP = +68s., S = +120s., M = +2·8m.

April 21d. Records also at 3h. 20m. (La Paz), 4h. (De Bilt, Eskdalemuir, Edinburgh, Kew, Moncalieri, Paris, Zagreb), 6h. (Zagreb), 10h. (Cape Town), 11h. (Manila), 12h. (La Paz and Mizusawa), 16h. (Moncalieri and Monte Cassino), 21h. (Barcelona), 23h. (San Fernando).

April 22d. 6h. 14m. 30s. Epicentre 21°·0S. 67°·0W.

A = +·365, B = −·860, C = −·358.

	△	Az.	P.	O−C.	S.	O−C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
La Paz	4·6	348	i 1 18	+ 7	—	—	1·9	2·0
Washington	60·6	348	e 10 11	− 5	—	—	—	—
Coimbra	82·0	38	12 30	0	22 42	− 4	33·5	—
Stonyhurst	93·1	30	—	—	—	—	—	49·1
Paris	93·2	36	13 33	0	(24 30)	−17	24·5	—
Eskdalemuir	93·4	29	—	—	(23 48)	(−61)	38·0	—
De Bilt N.	96·1	32	—	—	24 8	−69	40·9	50·0
E.	—	—	—	—	—	—	42·2	42·8
Zagreb N.E.	100·2	44	18 10	?PR_1	24 29	—	—	—
N.W.	—	—	—	—	24 31	—	28·0	—
Pulkovo	111·7	28	14 55	—	26 57	—	45·5	—
Mizusawa	149·8	305	20 0	+131	—	—	20·6	—
Manila	170·1	239	e 20 30	—	—	—	—	—

The azimuths are approximate only. Stonyhurst records M at +25·1m. Paris gives the hour as 5h. Zagreb gives the day as April 21. Eskdalemuir records P = +23m.48s., PR_1 = +25m.41s., PR_2 = +26m.13s., S = +30m.43s. It seems probable that P should be S and S should be SR_1. Pulkovo records PR_1 = +19m. 30s., i_1 = +25m. 18s., i_2 = +26m. 15s. P_1S_1 = +28m. 52s., P_2S_2 = +29m. 45s. Also P_2 = +15m. 20s., S_2 = +27m. 51s.

1917. April 21d. 0h. 49m. 18s.

Epicentre **37°·5N. 70°·5E.**

A = +·265, B = +·748, C = +·609; D = +·943, E = −·334;
G = +·203, H = +·574, K = −·793.

Station and Component.		Machine.	△	Azimuth.	P.	O−C.	S.	O−C.	L.	M.
			°	°	M. S.	s.	M. S.	s.	M.	M.
Simla		—	8·4	137	2 18	+11	—	—	—	3·6
Bombay	E.	M.	18·7	173	4 23	− 2	—	—	—	7·4
Calcutta	N.	O.E.	21·4	129	4 54	− 4	8 30	−23	13·0	13·8
	E.	O.E.	21·4	129	5 6	+ 8	8 42	−11	—	—
Kodaikanal	E.	M.	28·0	166	—	—	10 12	−47	—	15·8
Colombo		M.	31·8	162	—	—	11 6	−59	17·2	18·2
Pulkovo		G.	33·8	324	i 7 2	− 1	i 12 16	− 22	14·2	14·5
Zagreb	E.	—	40·8	300	i 7 54	− 7	i 13 58	−20	—	17·7
Zi-ka-wei		W.	42·0	83	8 8	− 3	14 13	−22	—	—
Monte Cassino	N.	V.	43·1	294	8 19	0	—	—	—	17·8
Rocca di Papa		Aga.	43·9	294	8 22	− 3	14 41	−20	28·2	—
Moncalieri		S.	46·6	300	i 8 46	+ 2	i 15 18	−18	21·2	N 21·7
De Bilt		—	46·8	310	i 8 48	+ 2	i 15 29	− 9	—	N 26·6
Uccle		—	47·6	308	8 51	0	i 15 35	−14	19·7	—
Paris		—	49·1	306	i 9 2	+ 1	i 15 57	−10	19·7	21·7
Manila		W.	50·1	103	e 9 18	+10	—	—	—	—
Dyce	N.	Ma.	50·3	318	e ? 9 33	+24	16 23	0	20·3	21·6
Kew		—	50·3	310	14 42	? S	14 42	−101	—	29·7
Edinburgh		M.	51·0	316	9 24	+11	16 35	+ 5	—	38·7
Stonyhurst		M.	51·0	313	(i 8 12)	−61	(15 0)	−91	—	21·7
Shide		M.S.	51·1	309	9 19	+ 5	16 22	−10	—	—
Eskdalemuir		G.	51·2	315	9 19	+ 5	16 27	− 7	24·7	21·9
Barcelona		Ma.	51·5	297	9 18	+ 1	i 16 26	−12	20·1	—
Osaka		O.	51·5	72	9 20	− 3	18 24	−14	27·5	N 31·5
Algiers		—	52·6	291	9 26	+ 2	16 38	−13	20·4	—
Tortosa		—	53·3	297	9 29	+ 1	16 46	−14	23·0	23·1
Mizusawa	E.	O.	54·0	65	9 35	+ 2	19 1	+112	—	—
	N.	O.	54·0	65	9 33	0	18 57	+108	—	—
Batavia		W.	55·3	134	e 10 22	+41	—	—	—	25·7
Coimbra		W.	59·4	299	e 10 19	+11	i 18 14	− 2	24·4	—
San Fernando		M.	59·4	294	9 42	−26	18 12	− 4	24·9	E 26·7
Cape Town	E.	M.	86·3	319	23 0	? S	23 0	−33	—	23·2
Ottawa		B.	91·7	337	i 23 32	? S	23 32	−60	—	—
Harvard	E.	B.O.	92·8	333	i 23 37	?	24 19	−24	40·5	—
Washington		—	98·0	335	e ? 15 56	−110	i 24 4	−92	—	—
Honolulu		M.	105·6	46	33 54	? SR_1	—	—	44·6	46·2
La Paz		—	138·1	289	19 38	+155	—	—	38·8	40·3

The following record PR_1: Pulkovo +7m. 48s. (O−C = −16s.); Zagreb, i = +9m. 35s. (+3s.); De Bilt +10m. 35s. (−7s.); Eskdalemuir, 11m. 20s. (−8s.).

Kodaikanal records 10m. 12s. (taken as S above) as L. Zi-ka-wei gives i = +17·7m. (=SR_1?). Rocca di Papa, SZ = +17·9m. (=SR_1?). De Bilt, eE = +19·3m. (=SR_1?). Uccle records iSR_1 = +18·3m. Stonyhurst gives eP before T_0 (= −1m. 12s.), iS = +8m. 12s. (taken as P) and L = +15·0m. (taken above as S). Eskdalemuir gives SR_1 = +20·2m. (O−C = −0·3m.).

De Bilt gives epicentre 38°·6N. 68°·2E? Pulkovo gives 40°·0N. 69°·1E.

April 22d. 22h. 0m. 45s. Athens eP = +41s., eS = +73s., L = +1·5m., MN = +1·7m. Mizusawa P = +43m. 33s. Zagreb eNE = +1m. 57s., iNE = +2m. 25s., i = +3m. 28s., MNE = +4·5m.

April 22d. Records also at 3h (Monte Cassino) 4h. (Monte Cassino), 17h. (Zagreb), 23h. (Monte Cassino and Zagreb).

April 23d. 20h. 33m. 8s. at 15°·8N. 122°·0E. Manila eP = +28s., L = 0·9m., M = 1·0m.

April 23d. Records at 0h. (Honolulu, Manila, Pulkovo, and San Fernando), 1h. (De Bilt and Toronto), 5h. (La Paz), 6h. (Colombo and Tortosa).

April 24d. Records at 1h. (Manila), 3h. (Bombay), 4h. (Colombo), 13h. (La Paz and Monte Cassino), 14h. (Simla), 15h. (La Paz), 18h. (Monte Cassino (2) and Rocca di Papa (2)), 19h. (Monte Cassino (2) and Rocca di Papa (1)), 20h. (Monte Cassino (4), Rocca (1), and San Fernando (1)), 21h. (Monte Cassino), 22h. (Rocca di Papa).

April 25d. Eleven local shocks recorded at Monte Cassino (0h., 2h., 4h., 5h., 21h., 22h.). Also records at 0h. (San Fernando), 2h. (Zagreb), 3h. (Tortosa), 5h. (Rocca di Papa), 7h. (Batavia and Manila), 8h. (Colombo, De Bilt, La Paz, Pulkovo), 14h. (Manila), 15h. (Mizusawa), 21h. (Manila), 22h. (Athens).

April 26d. Besides the shock at 13h. 14m. 30s. near Athens, recorded as below at a number of stations, some 30 or 40 minor shocks were recorded at Rocca di Papa and Monte Cassino, some of them also at Zagreb. The three chief centres of activity seem to be as below, but it is to be remarked that the S observation at Rocca di Papa is clearly discordant in the case of the Athens earthquake, and that there may possibly be other cases of discordance. Values of T_0 have been inferred from the general rule that for stations near the epicentre the interval M − T_0 is double P − T_0. When the hours exceed 24 in T_0 the record refers to April 27. From 41°·0N. 14°·0E. we have:

T_0			Rocca di Papa.			Monte Cassino.	Zagreb.		
			P.	S.	M.	P.	P.	S.	M.
h.	m.	s.	s.	s.	s.	s.	s.	s.	s.
3	35	4	16	27	32	9	92	—	—
4	25	4	19	—	38	—	92	—	—
5	5	6	17	—	21	0	—	—	—
5	5	39	15	—	—	0	—	—	—
5	13	18	14	24	28	7	—	—	—
5	20	17	17	—	—	2	—	—	—
6	59	21	17	—	27	0	—	—	—
11	32	55	16	30	35	9	—	—	—
12	1	21	14	26	33	23	—	—	—
19	27	18	10	19	24	3	—	—	—
19	31	47	12	20	25	0	—	—	—
22	12	37	15	28	35	11	—	—	—
(25)	59	30	12	—	24	16	—	—	—
(31)	22	54	18	—	36	25	—	—	—

From 43°·5N. 11°·5E. we have:

3	28	4	28	—	56	22	—	—	—
3	59	46	28	—	56	50	—	—	—
10	27	22	25	45	56	68	63	—	120
11	11	54	30	—	60	—	60	—	120
(45)	16	20	32	57	73	—	46	—	120

From 43°·9N. 9°·5E. we have:

9	5	0	48	80	96	—	81	—	143
9	30	42	42	—	84	58	—	—	—
9	32	16	40	61	80	44?	77	—	133
9	35	45	45	79	117	63	76	137	145
(36)	55	2	39	69	82	54	73	—	122

April 26d. Records also at 0h. (San Fernando), 1h. (La Paz), 6h. (Algiers), 8h. (Edinburgh), 9h. and 11h. (La Paz), 17h. (Manila), 19h. (San Fernando), 23h. (Manila).

1917. April 26d. 9h. 35m. 59s.

Epicentre 43°·0N. 12°·5E.

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

Station and Component.	Machine.	Δ	Azimuth.	P.	O−C.	S.	O−C.	L.	M.
		°	°	M. S.	S.	M. S.	S.	M.	M.
Rocca di Papa	Ag.	1·3	173	i 0 31	+11	1 5	+29	—	1·7
Monte Cassino N.	A.	1·8	150	e 0 49	+21	—	—	—	2·3
Zagreb N.E.	W.	3·8	40	i 1 1	+ 2	i 1 33	−12	2·0	2·1
N.W.	W.	3·8	40	i 1 3	+ 4	i 1 46	+ 1	—	2·2
Moncalieri	St.	4·0	302	1 0	− 2	1 38	−12	2·1	E 2·6
Marseilles	Ma.	5·2	276	i 1 37	+17	i 3 20	? L	(3·3)	N 3·6
Besançon	—	6·2	315	2 0	+25	2 34	−15	—	—
Barcelona	Ma.	7·8	263	e 1 49	− 9	—	—	e 3·5	5·7
Paris	—	9·0	313	i 2 18	+ 2	(4 25)	(+22)	—	5·0
Tortosa	V.	9·5	261	2 16	− 7	4 0	−14	5·2	6·4
Algiers	—	9·6	232	e 2 36	+12	4 24	+ 8	5·5	7·4
Uccle	G.	9·6	327	e 2 16	− 8	—	—	e 5·0	—
Athens E.	Ma.	10·0	117	e 2 32	+ 2	e 4 33	+ 4	e 5·1	6·7
De Bilt	G.	10·3	334	—	—	4 40	+ 2	5·3	6·5
Kew	M.	12·1	319	6 1	? S	(6 1)	(+39)	—	8·0
West Bromwich	M.S.	1 :·6	320	3 18	− 3	6 11	+13	? 7·7	9·2
San Fernando N.	M.	15·7	252	—	—	—	—	8·0	10·0
Coimbra N.	W.	15·8	272	e 4 21	+32	? 6 31	−19	8·0	9·7
E.	W.	15·8	272	3 36	−13	6 51	+ 1	9·6	10·9
Eskdalemuir	G.	16·0	326	e 5 40	+108	8 35	? L	? 8·6	(9·8)
Edinburgh	M.	16·3	327	8 43	? L	—	—	(8·7)	—
Dyce N.	Ma.	16·9	332	i 7 11	? S	(7 11)	(− 5)	9·9	10·8
E.	Ma.	16·9	332	7 26	? S	(7 26)	(+10)	9·8	11·3
Pulkovo	G.	20·0	27	i 4 37	− 4	i 8 13	−10	10·0	E 11·4
	G.	20·0	27	i 4 48	+ 7	i 8 30	+ 7	—	Z 13·4

Rocca di Papa notes "disastrous in province of Arezzo." Zagreb has also i(NW) = +1m. 9s., iP(NE) = +1m. 13s. (direction S45°W), i = +1m. 20s., Moncalieri gives MN = +3·4m. Marseilles M(E) = +5m. 13s. Athens: L is given as e(E); also i(E) = +6·6m. Barcelona eL = +3m. 30s. (?S). Paris eP = +2m. 22s. (= PR_4?). De Bilt M(N) = +8·3m.; gives epicentre as 43°28·2′N. 12°7·7′E. (from the *Boll. Soc. Sism. Ital.*), which is the Arezzo locality. San Fernando gives L(E) = +9·0m. West Bromwich: the records for P, S, and L are given as doubtful. Eskdalemuir: the recorded eP and S do not fit as they stand; query an error of 2min. Dyce: all phases doubtful owing to microseisms. Edinburgh gives P = +8m. 43s. Pulkovo (as also Zagreb?) declares two quakes with epicentres 43°·0N. 15°·0E., direction 36°S.W.; and 42°0N. 16°·0E., direction 32°S.W. It is assumed that at other observatories the records refer to the earlier quake. At West Bromwich the later readings were originally given, but on revision those printed were substituted. Study of the residuals suggests for this the revised elements—

T_0 = 9h. 36m. 9s., 43°·6N. 12°·0E.

It may be remarked that the epicentres determined (independently) for April 26–27 lie approximately on the line

E. long. = 97°·5 − 2 (N. lat.)

The errors of longitude calculated from this formula are shown below:

lat.	long.	error.	lat.	long.	error.
36°·0	21°·5	−4°·0	43°·0	12°·5	+1°·0
39·8	20·5	+2·6	43·5	11·5	+1·0
41·0	14·0	−1·5	43·9	9·5	−0·2

Errors of latitude would of course appear as just half these amounts.

1917. April 26d. 13h. 14m. 30s.

Epicentre 40°·0N. 20°·0E.

A = +·720, B = +·262, C = +·643; D = +·342, E = −·940;
G = +·604, H = +·220, K = −·766.

Station and Component.	Machine.	Δ	Azimuth.	P.	O−C.	S.	O−C.	L.	M.
		°	°	M. S.	S.	M. S.	S.	M.	M.
Athens	Ma.	3·6	123	0 51	− 7	e 1 23	−16	E 1·7	E 2·2
Monte Cassino	A.	4·9	290	1 19	+ 4	—	—	—	3·1
Rocca di Papa	Ag.	5·8	291	1 25	− 4	3 22	+43	—	4·4
Zagreb	W.	6·5	335	e 1 41	+ 2	i 3 6	+ 8	4·5	4·8
Moncalieri	S.	10·3	303	e 2 46	+12	4 44	+ 7	6·0	N 8·3
Barcelona	Ma.	13·6	282	—	—	—	—	e 6·2	11·5
Algiers	—	13·7	261	—	—	e 5 55	— 4	—	10·5
Paris	—	15·2	311	e 3 44	+ 4	e 6 43	+ 7	8·5	10·5
Uccle	—	15·3	320	e 3 30	− 3	—	—	e 9·0	—
De Bilt E.	G.	15·8	325	—	—	7 3	+13	e 8·8	10·7
Kew	M.	18·1	316	—	—	—	—	—	12·5
Pulkovo	G.	20·8	15	i 4 44	− 7	8 41	+ 1	11·5	11·8
Edinburgh	M.	22·0	324	9 36	? S	(9 36)	(+31)	—	—

Athens also gives P = +0m. 44s. (−14s.), M = +1m. 0s., MN = +2·0m. Zagreb also gives i(NE) = +2m. 9s. = PR_4? (+25s. O−C), i = +2m. 21s., i = +4m. 0s. (?S), S = +3m. 43s. (+45s.), MNE = +5·7m. Moncalieri MN = +8·3m. De Bilt gives eN = +7m. 12s., ME = +10·7m. Eskdalemuir (Δ = 21°·7), duration from +12m. 30s. to +45m. 30s. La Paz (Δ = 99°·2), P (?L) = +29·7m. Study of the residuals suggests that the epicentre might perhaps be put 0°·5 further east and a little south, say at 39°·8N. 20°·5E.

April 27d. The small shocks near Rocca di Papa, etc., still continued, and have been added to the results for April 26, when they are in approximate accord. For the second group the hour (45) is doubtful. Rocca di Papa gives 27d. 21h., and Zagreb 27d. 22h. For the last shock in the third group Moncalieri gives also eP? = +83s., S? = +131s.

One other shock has an epicentre apparently near Athens. The records at Rocca di Papa and Zagreb however indicate a T_0 which differs sensibly from that given by Athens. It seems probable that the Athens times are 1m. in error. The following would then be the approximate solution:

T_0 = April 27d. 19h. 42m. 33s. Epicentre 36°·0N. 21°·5E.

A = +·753, B = +·297, C = +·588.

	Δ	P.	O−C.	S.	O−C.	L.	M.
	°	m. s.	s.	m. s.	s.	m.	m.
Athens	2·6	1 45	+64	1 27	+15	2·5	3·3
Rocca di Papa	9·0	2 17	+ 1	4 5	+ 2	—	4·8
Zagreb	10·8	2 39	− 2	4 33	−16	—	5·8
Moncalieri	13·8	—	—	—	—	(7·4)	—
De Bilt	19·9	—	—	—	—	(10·3)	—

Moncalieri records e = +7m. 23s. (taken as L), L = +7m. 51s. De Bilt records e = +10m. 21s. (taken as L).

April 27d. Records also at 0h. (Pulkovo and Melbourne), 2h. (Monte Cassino), 9h. (Algiers), 11h. (Algiers), 14h. (Taihoku), 17h. (Zagreb).

April 28d. 13h. 53m. 42s. Epicentre 46°·0N. 149°·0E.

A = −·596, B = +·358, C = +·719; D = +·515, E = +·857;
G = −·617, H = +·370, K = −·695.

Station and Component.	Machine.	△	Az.	P.	O−C.	S.	O−C.	L.	M.
		°	°	m. s.	s.	m. s.	s.	m.	m.
Mizusawa N.	O.	8·9	223	2 30	+14	4 6	+ 5	—	—
E.	O.	8·9	223	2 16	0	4 5	+ 4	—	—
Zi-ka-wei	—	25·9	245	e 5 41	− 6	—	—	—	20·0
Manila	W.	39·2	226	e 7 18	−30	—	—	—	—
Honolulu	M.	49·3	102	—	—	—	—	25·1	27·1
Pulkovo	G.	63·1	330	i 10 33	−11	i 19 13	+11	31·3	N 34·7
De Bilt	—	77·2	335	—	—	21 55	+ 4	E 37·5	E 44·4
Uccle	G.	78·5	335	e 12 6	− 4	e 22 0	− 6	—	—
Zagreb N.E.	W.	79·3	328	e 12 17	+ 2	22 16	+ 1	44·3	—
Paris	—	80·8	335	i 12 15	− 9	22 32	− 1	44·3	—
Moncalieri	S.	82·9	333	—	—	—	—	e 48·3	—
Monte Cassino	—	83·9	323	24 21	? S	(24 21)	+74	—	—
Rocca di Papa	Ag.	84·1	327	12 32	−11	—	—	—	—
La Paz	Bi.	137·3	53	19 12	+132	—	—	—	—

Pulkovo also gives PR_1 = +12m. 55s., PR_2 = +14m. 34s., SR_1 = +23m. 30s., and epicentre 47°·0N. 158°·0E.

Zagreb gives eP (N.W.) = +12m. 10s., iP = +12m. 23s., i = +21m. 39s.

De Bilt gives as epicentre 41°·4N. 136°·3E.

Honolulu has P = +19m. 18s., probably SR_1 (+19m. 52s.).

Rocca di Papa has M = +13·2m.

Monte Cassino has M = +24·5m.

April 28d. Records also at 6h. (Monte Cassino), 12h. (Batavia), 13h. (Pulkovo), 16h. (De Bilt, Eskdalemuir, Ottawa, Pulkovo, Toronto, Washington), 18h. (Moncalieri), 19h. (Monte Cassino and Rocca di Papa), 22h. (Monte Cassino).

April 29d. Records also at 8h. (Berkeley, Manila, Ottawa), 11h. (Manila and Pulkovo), 15h. (La Paz, Manila, Pulkovo, Zi-ka-wei), 16h. (De Bilt, Honolulu, Melbourne, San Fernando), 17h. (Colombo, De Bilt, Eskdalemuir, Moncalieri, Paris, Pulkovo, Stonyhurst), 22h. (Colombo).

April 30d. 5h. 45m. 15s. Adopting 40°·0N. 20°·0E. from April 26d. 13h.

		△	P.	O−C.	S.	O−C.	L.	M.
		°	s.	s.	m. s.	s.	m.	m.
Athens		3·6	e 41	−15	1 12	−27	1·4	1·6
Monte Cassino		4·9	—	—	(2 54)	+40	—	—
Rocca di Papa		5·8	e 71	−19	—	—	—	3·6
Zagreb	N.E.	6·5	e 128	+29	—	—	—	i 4·6
	N.W.	6·5	e 104	+ 5	—	—	—	—

The epicentre is thus not quite the same, but the material for correction is scanty.

April 30d. Records also at 4h. (Rocca di Papa), 5h. (De Bilt and Zagreb), 9h (Batavia and Manila), 10h. (Rocca di Papa), 15h. (Monte Cassino), 17h. Cape Town and Lick), 21h. (La Paz and Rocca), 23h. (Osaka).

1917. April 29d. 11h. 55m. 24s.

Epicentre **56°·0N. 115°·0E.**

A = −·236, B = +·507, C = +·829; D = +·906, E = +·423;
G = −·350, H = +·751, K = −·559.

Station and Component.	Machine.	△	Azimuth.	P.	O−C.	S.	O−C.	L.	M.
		°	°	m. s.	s.	m. s.	s.	m.	m.
Zi-ka-wei	—	25·2	167	e 5 38	− 2	e 10 0	− 7	—	N 17·0
Taihoku	O.	31·4	169	—	—	—	—	18·0	18·5
Simla	O.E.	36·0	243	—	—	e 12 24	−46	-	22·6
Manila	W.	41·7	171	e 8 5	− 4	14 12	−19	23·5	N 27·2
Pulkovo	G.	42·1	312	i 7 59	−13	i 14 16	−20	19·6	E 26·8
Bombay E.	M.	48·7	238	17 48	? S	(17 48)	(+106)	—	28·5
Kodaikanal E.	M.	54·3	228	18 18	? S	(18 18)	(+65)	29·8	34·8
Colombo E.	M.	56·4	223	9 36	−12	17 36	− 3	30·6	40·1
De Bilt	—	57·5	317	10 0	+ 4	17 55	+ 2	30·6	N 37·6
Zagreb N.E.	W.	57·8	305	i 9 58	0	i 18 0	+ 4	—	37·6
Eskdalemuir	G.	57·9	324	e 9 56	− 2	18 2	+ 4	28·6	37·3
Uccle	G.	58·8	316	e 10 3	− 1	e 18 6	− 3	—	38·5
Kew	M.	60·0	319	—	—	—	—	—	41·1
Shide	M.S.	61·0	320	10 22	+ 3	18 37	− 1	30·9	40·7
Paris	—	61·1	316	i 10 22	+ 2	i 18 40	+ 3	24·6	39·1
Moncalieri	S.	62·1	310	e 10 34	+ 8	i? 25 34	? SR_1	35·2	E 40·9
Monte Cassino	V.	62·1	304	10 36	+10	—	—	—	—
Rocca di Papa	Ag.	62·4	304	10 33	+ 5	—	—	e 35·0	41·0
Batavia	W.	62·5	189	e 19 6	? S	(19 6)	(+11)	(34·6)	34·6
Barcelona	Ma.	67·3	312	11 2	+ 2	19 59	+ 5	e 27·6	43·6
Tortosa	V.	68·7	313	11 11	+ 2	20 12	+ 2	28·2	42·9
Algiers	—	70·8	308	11 24	+ 2	20 36	0	40·6	54·6
Coimbra E.	W.	72·6	318	e 10 40	−54	21 4	+ 7	41·1	48·0
San Fernando N.	M.	74·9	314	10 36	−72	29 36	? SR_1	48·1	49·1
E.	M.	74·9	314	—	—	30 6	? SR_1	45·1	57·6
Ottawa N.	B.	78·1	8	e? 12 5	− 3	e? 21 58	− 3	51·6	—
Toronto	M.	79·6	11	—	—	—	—	42·9	47·5
Washington E.	—	84·6	10	—	—	—	—	50·2	—
Mauritius N.	M.	89·9	232	e 49 54	? L	—	—	(49·9)	52·6

Zi-ka-wei gives P(Z) as +5m. 34s. (+2s.). Taihoku has PS = +13m. 29s. Manila, ME = +27·9m. Pulkovo gives the epicentre as 58°.5N. 116°·2E., N.E. of Lake Baikal, also records iP_2 = +8m. 9s. (−3s.), iPR_1 = +9m.39s. (−7s.), iPR_2 = +10m. 33s., iS_2 = +15m. 26s., SR_1 = +17m. 24s. (−4s.), M_1 = +23h. 58m. = ?L. Zagreb has eP(NE) = +9m. 45s. (−13s.) De Bilt, ME = +37·7m. Batavia, P = S, M = ?L. Coimbra has S(N) = +21m. 1s. (+4s.), L(N) = +44·1m., M(N) = +48·4m. Ottawa gives ?e(E) = +9m. 52s., ?e(N) = +10m. 6s., ?e = P, and ?eS = S, L = +44·6m. to +48·6m., L(N) = +51m. 36s.

The following records seem doubtful: Osaka (△ = 25°·5, Az. = 138°), eP = −9m. 44s. S = +1m. 13s., L = +11m. 6s., probably = SR_1 (−12s.), M(Z) = +16·3m., M(E) = +20·5m. Manila, eP = −8m.50s. Colombo *times have been increased by 3min.* Edinburgh (△ = 57°·4, Az. = 324°) has P = +20m. 24s., and M = +37·6m. Stonyhurst (△ = 58°·9, Az. = 322°), eP = +0m. 54s., M = +40·9m. Honolulu (△ = 70°·8, Az. = 80°), P(?L) = +32m. 24s., M = +46·6m. Melbourne (△ = 95°·4, Az. = 156°), assuming the records are one hour wrong, P = +29m. 30s. L = +32·1m., M = +34·7m. La Paz (△ = 140°·4, Az. = 5°), P = +20m. 0s. Marseilles has e = +32·6m. = ?L.

Ottawa gives epicentre 38°·0N. 93°·5S., and T_0 = 11h. 55·5m.

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British Association for the Advancement of Science.—Seismological Committee.

All correspondence to
Prof. H. H. TURNER,
University Observatory,
OXFORD.

Bulletin for May, 1917.

In the Bulletins for January-February, 1917, and for March-April, 1917, instead of confining attention to the largest earthquakes, an attempt was made to summarise all the available information. This attempt has been followed up and further developed in the present Bulletin. Whether it can be continued depends largely on the decisions of the forthcoming Conference at Rome (May 2-10, 1917).

The following points, some of which are repeated from the two previous Bulletins, are conveniently set down here :—

(1) At stations near the hypocentre a well defined phenomenon occurs nearly according to the formula

$$20\text{m.}\,17\text{s.} - (180 - \Delta)^2 \times 0^{\text{s}}\cdot 0235,$$

or according to the following table :—

Δ	0°	1°	2°	3°	4°	5°	6°	7°	8°	9°
°	m. s.	s.	s.	s.	s.	s.	s.	s.	s.	s.
130	19 18	21	23	25	28	30	32	34	36	38
140	19 39	41	43	45	47	48	50	51	53	54
150	19 56	57	59	60	61	62	63	65	66	67
160	20 8	9	9	10	11	12	12	13	14	14
170	20 15	15	16	16	16	16	17	17	17	17

This phenomenon is probably not P and has been written [P]. Residuals from the formula, when not headed by the symbol [P] are enclosed within square brackets. There is probably a corresponding phenomenon [S], but it has not yet been tabulated.

Dr. S. W. Visser, in his valuable memoir " On the Distribution of Earthquakes in the Netherlands East Indian Archipelago, 1909-1919 " (Batavia, Javasche, Boekhandel, 1921), being No. 7 of the Batavia publications, refers to these phenomena as P and S modified by the action of a central nucleus of the earth. It seems perhaps a little early to adopt this hypothesis as fully justified, but it is certainly worth attention. Meanwhile the use of the formula has been explained briefly in the last Bulletin,

and more fully in a paper just printed as Vol. 1 No. 1 of a Geophysical Supplement to the Monthly Notices of the Royal Astronomical Society. For any given earthquake the residuals from the formula are liable to be systematic, and the mean value is assumed to indicate the depth of the focus below the earth's surface (at the epicentre). The provisional depth is assessed (by use of Knott's calculations) as ·0013 of the earth's radius for every second of time by which the formula is anticipated at the hypocentre. An example occurs on May 1.

(2) The effect of an unusual depth of focus (*i.e.*, a depth below that which corresponds to the Tables in use, at present unknown and denoted by *d*) is given in the following table, which is quite provisional, but has been deduced from Prof. C. G. Knott's curves :—

Values of $\Delta_F - \Delta_E$ *for Different Focal Depths.*

Δ_E	0·010	0·015	0·020	0·030	0·040	0·050	0·060
°	°	°	°	°	°	°	°
0	−0·3	+0·4	+0·6	+1·0	+1·5	+2·0	+2·6
5	0·0	0·0	0·0	0·0	+0·1	+0·3	+0·5
10	−0·1	−0·2	−0·2	−0·4	−0·5	−0·6	−0·7
15	−0·2	−0·4	−0·5	−0·8	−1·0	−1·3	−1·6
20	−0·4	−0·6	−0·8	−1·2	−1·6	−2·0	−2·4
25	−0·5	−0·8	−1·1	−1·6	−2·1	−2·6	−3·1
30	−0·7	−1·0	−1·4	−2·0	−2·6	−3·2	−3·7
35	−0·8	−1·2	−1·6	−2·3	−3·0	−3·6	−4·2
40	−0·8	−1·3	−1·7	−2·5	−3·3	−4·0	−4·7
45	−0·9	−1·4	−1·9	−2·8	−3·6	−4·4	−5·1
50	−1·0	−1·5	−2·1	−3·1	−4·0	−4·8	−5·5
55	−1·1	−1·7	−2·3	−3·4	−4·4	−5·2	−5·9
60	−1·2	−1·8	−2·4	−3·6	−4·6	−5·5	−6·2
65	−1·2	−1·9	−2·5	−3·7	−4·7	−5·7	−6·5
70	−1·3	−2·0	−2·6	−3·8	−4·9	−5·9	−6·8
75	−1·3	−2·0	−2·6	−3·9	−5·0	−6·0	−7·0
80	−1·3	−2·1	−2·7	−4·0	−5·1	−6·2	−7·2
85	−1·4	−2·1	−2·7	−4·1	−5·3	−6·4	−7·4
90	−1·4	−2·1	−2·8	−4·2	−5·4	−6·5	−7·5

The focal depth (earth's radius=1) is given at the head of each column : and on the left is given Δ measured round the surface from the epicentre in the usual way.

Here E is the epicentre ; F the focus below it ; Δ_E is the distance measured round the surface in the usual way, Δ_F the effective distance, always smaller, except close to the epicentre.

Only occasionally is the material available sufficient to warrant a correction of this kind. We must have, first a good set of stations near the epicentre, so that T_0 is well determined from them ; secondly, a good set of stations near the hypocentre, giving a well determined deviation from the formula, which can be converted into focal depth as above.

(3) In the pages which follow there are a number of cases of repetition from the same epicentre. Possibly such cases were really just as frequent in the past, but were not so noticeable from the omission of the smaller earthquakes. It is not intended to assert that the epicentre remains precisely the same; but it is almost as convenient, even in cases of slight difference, to have the two sets of records *referred* to the same epicentre in order that the differences, if any, may appear. Or later, when the series of repetitions seems to be complete, for a time at any rate, the whole set of residuals may easily be compared.

(4) The behaviour of L near the hypocentre is worth noting. A set of L waves seems to be started by the arrival of [P] at the hypocentre. Taking the rate of L as 2°·0 per 1·0min., these hypocentric waves, which we may call [L], will arrive at various points, as below :—

△	=	180°	170°	160°	150°	140°	130°	120°	110°
		m.	m.	m.	m.	m.	m.	m.	m.
L	=	90·0	85·0	80·0	75·0	70·0	65·0	60·0	55·0
[L]	=	20·3	25·3	30·3	35·3	40·3	45·3	50·3	55·3

Hence [L] is easily distinguished from L when △ exceeds 115°.

The velocities of L have been discussed for the "Large Earthquakes of 1916," and a mean formula obtained which shows an acceleration. But this is probably illusory, and is therefore not yet set down. The fact is that the zero point from which L starts seems to vary with the earthquake, as is quite reasonable, and this may very easily cause an appearance of acceleration which is quite spurious. The investigation is proceeding.

1922, April 27. H.H.T.

1917. May 1d. 18h. 26m. 46s.

Epicentre **29°·2**S. **177°·0**W. (See also May 2.)

A = −·872, B = +·046, C = −·488; D = −·052, E = +·999; G = +·487, H = +·026, K = −·873.

From the hypocentric station results (see below) a focal depth of ·00182 of the earth's radius (below that corresponding to the tables) is inferred. The effective corrections to △ for this extra depth are shown in the second column. In the next column is shown the ordinary distance △ from the epicentre. In forming O−C the sum of the two has been used.

		Corr. for Focus	△	Az.	P.	O−C.	S.	O−C.	L.	M.
		°	°	°	M. S.	S.	M. S.	S.	M.	M.
Riverview		−1·1	27·5	251	e 5 20	−32	i 10 49	+19	e 12·3	14·7
Melbourne		−1·3	32·7	244	6 2	−40	11 50	− 8	16·5	17·3
Adelaide	E.	−1·4	37·8	249	7 20	− 5	—	—	14·2	—
Honolulu		−2·0	53·8	22	9 8	−11	--	—	17·2	32·0
Batavia		−2·4	74·9	271	12 2	+29	—	—	26·2	23·2
Manila		−2·4	74·2	297	e 11 26	− 2	22 23	+95	34·4	E 41·0
Osaka		−2·5	78·1	322	11 57	+ 4	21 48	+15	33·0	E 55·4
Mizusawa		−2·5	78·7	328	11 55	− 1	21 45	+ 6	—	—
Taihoku		−2·5	80·2	306	12 14	+ 9	—	—	22·6	E 43·9
Lick		−2·6	84·1	41	e 12 42	+14	e 22 58	+17	e 38·4	E 46·2
Zi-ka-wei		−2·6	84·2	311	e 12 22	− 6	e 22 42	0	e 36·1	E 41·9
Berkeley	E.	−2·6	84·3	40	e 12 36	+ 7	e 22 40	− 3	—	45·5
	N.	−2·6	84·3	40	e 12 26	− 3	e 22 55	+12	—	N 44·5
Tucson		−2·7	87·8	51	12 52	+ 3	23 19	− 1	36·1	E 63·1
Victoria		−2·8	91·3	32	12 42	−26	23 8	−50	—	—
La Paz		−2·8	97·6	114	13 50	+ 8	24 17	−47	34·7	37·8
Calcutta	N.	−2·9	104·6	288	16 50	+91	24 50	−82	28·1	74·5
	E.	−2·9	104·6	288	17 2	—	24 38	—	27·6	—
Colombo		−2·9	104·7	270	14 56	+37	27 26	+73	—	34·2
Mauritius	N.	−2·9	107·7	234	13 38	−55	24 44	−116	—	51·6
	E.	−2·9	104·6	234	14 2	—	25 2	—	—	52·3
Toronto		−3·0	114·8	52	15 20	+14	26 38	+66	54·7	—
Washington	E.	−3·0	115·0	58	e 19 20	? PR_1	29 24	+98	e 35·4	63·0
Cape Town	E.	−3·0	115·2	194	18 56	? PR_1	—	—	26·1	29·5
Bombay	E.	−3·0	116·3	278	e 15 22	+ 9	—	—	—	68·8
Simla		−3·0	117·1	292	e 18 8	? PR_1	e 30 2	+119	—	66·3
Ottawa		−3·0	117·8	51	e 15 14	− 5	i 28 12	+ 4	e 56·8	68·2
Pulkovo		−3·0	144·3	337	16 55	−22	30 57	−14	—	—
Cork	E.	—	155·4	18	18 52	?	—	—	—	—
De Bilt	N.	—	157·1	357	18 9	?	(24 11)	?	—	85·8
Paris		—	160·4	1	19 36	?	—	—	—	—
Zagreb		—	160·5	332	19 38	?	34 4	?	—	—

Riverview records PR_1 = +6m.55s. (+9s.), epicentre as 27°·0S.171°·0W. Melbourne records PR_1 = +7m.50s. (−2s.), SR_1 = +14m.8s. (0), PS = +10m.38s., SR_2 = +14m.50s. Batavia gives ML = +43·2m. Osaka records MN = +42·8m., T_o = 18h.26m.50s. Lick gives MN = +48·5m. Berkeley gives ME = +45·5m. estimate for T_o = 18h.26m.49s. Zi-ka-wei records PZ = +12m.9s., PSE = +24m.4s., PSN = +24m.8s., SRN_1 = +29m.2s., SRE = +29m.13s., SRN_2 = +32m.38s., eLN = +35·7m. Tucson gives MN = +41·9m. Victoria records P at +4m.46s., which is too early; probably S and L are really P and S · M at 19h.15m.1s. to 19h.18m.9s. La Paz records PR_1 = +15m.13s., PR_2 = +18m.7s., SR_1 = +26m.23s., SR_2 = +29m.38s. S is recorded as iP. Toronto records Pi = +19m.38s., Si = +28m.2s., Si = +29m.44s., Li = +36·3m., Li = +58·7m., Li = +60·7m., M = +65·0m. to +70·5m. Washington gives SN = +29m.40s., eLN = +35·5m., MN = +67·5m. Ottawa records eE = −29m.42s., iN = +30m.8s., LN = +57·2m. estimate for T_o = 18h.27m.0s. Pulkovo records eP? = +16m.36s., eP = +19m.10s. and +19m.15s., iP = +19m.46s., iPR_1 = +22m.45s. and 58s., PS = +33m.7s., SR_1 = +41m.28s., SR_2 = +46m.54s. Epicentre 30°·0S. 180°·0. Cork records are assumed to be 1h. wrong. De Bilt records eE = +19m.50s., iN = +19m.57s., eE = +44m.3s., eE = +48m.35s., eN = +50m.21s., ME = +50·4m., MN = +50·6m. Paris records PR = +23m.24s. Zagreb records eNE = +20m.14s., iNE = +24m.29s., iNW = +24m.38s., iS = +34m.42s., MNW = +98·2m.

It seems possible that true P and even S can be traced as far as $\Delta = 160°$ as above: but they become faint and uncertain beyond 130°; there is undoubtedly a much better marked phenomenon which is denoted [P] below and is compared with the formula [P] = 20m.17s. $-(180 - \Delta)^2 \times 0^s.0235$. The mean value of O−C from the best stations is assessed as 14s. and taken to indicate a focal depth d +·00182 when d is the depth corresponding to the tables. The column [L] indicates the time of an L wave from the hypocentre, which is started on the arrival of [P] at 20m.17s. −14s. = 20·1m., and then travels outwards in all directions at the usual rate of L(2° per 1m.)

	Δ	Az.	[P.]	O−C.	[L.]	O−C.	L.	M.
	°	°	M. S.	S.	M.	M.	M.	M.
St. Helena	134·1	168	22 14	?	—	—	—	115·2
Pulkovo	144·3	337	i 19 33	−14	i 35·3	+1·4	63·2	73·2
Dyce N.	151·7	7	e 19 51	−10	34·0	−0·3	56·2	98·7
Edinburgh	152·9	8	20 8	+ 8	32·7	−1·4	—	88·2
Eskdalemuir	153·5	8	19 26	−35	34·2	+0·9	—	—
Azores	154·7	63	20 20	+18	—	—	—	95·0
Stonyhurst	155·1	6	i 23 38	?	i 27·3	−5·3	85·3	91·5
Cork	155·4	18	(18 52)	?	33·0	+0·6	—	—
Helwan	155·4	278	19 56	− 6	—	—	—	90·7
West Bromwich	156·4	6	20 23	+20	31·3	−0·6	—	—
De Bilt	157·1	357	19 41	−24	34·4	+2·8	66·2	92·7
Kew	157·6	6	19 44	−22	—	—	—	92·7
Uccle	158·4	358	19 36	−30	34·6	+3·7	60·8	115·1
Paris	160·4	1	(19 36)	(−32)	31·4	+1·5	67·2	—
Zagreb	160·5	332	i 19 56	−11	28·3	−1·6	—	98·6
Athens	160·7	302	20 4	− 5	31·5	+1·8	—	97·2
Besancon	161·9	354	19 58	−11	(27·5)	(+8·3)	—	—
Moncalieri	163·8	348	i 20 7	− 4	(37·8)	(+9·6)	—	93·9
Monte Cassino E.	164·9	327	20 1	−11	—	—	—	98·2
Rocca di Papa	165·2	331	19 56	−16	28·9	+1·4	—	91·5
Coimbra	165·5	37	20 6	− 6	35·6	(+8·4)	—	—
Marseilles	165·8	353	i 19 50	−22	e 35·6	(+8·4)	77·2	99·2
Barcelona	167·7	3	20 5	− 9	27·7	+1·5	—	80·6
Tortosa	168·1	11	19 57	−17	32·2	(+6·1)	—	98·6
Rio Tinto	168·3	41	20 14	0	—	—	—	112·2
San Fernando	169·4	44	20 8	− 6	—	—	80·7	97·2
Algiers	172·4	0	20 2	−13	30·8	(+6·9)	52·5	86·2

Edinburgh records the quake as 6h. Eskdalemuir gives i = +23m.51s., i = +27m.10s. Stonyhurst gives an L at +47·2m. and M = +48·3m. Cork records S as PR_1, S = +44m.14s., L = +81·2m. Uccle records PR_1 = +24m.8s., e = +43m.56s., MZ = +86·6m., MN = +96·1m. Athens records i = +20m.59s., i = +22m.4s., e = +46m.11s., M_1 = +88·2m. Besancon records are 1h. wrong. Moncalieri gives L = +48·4m., MN = +91·3m. Rocca di Papa records eL = +38·5m., MN = +87·7m. Coimbra records L? = +45·4m., ME = +45·9m., MN = +45·9m. Barcelona gives S? = +25m.4s., iE = +45m.44s., LE = +47·6m., MN = +47·9m. Tortosa gives L = +57·6m. San Fernando gives S = +46m.2s. Accra records P = +2m.44s., M = +19·2m.

May 1d. Also records 1h. (Helwan and Batavia), 2h. (Colombo), 6h. (Rocca di Papa), 9h. (La Paz), 10h. (Manila), 11h. (Manila, De Bilt, and Athens), 12h. (Zagreb), 14h. (Zi-ka-wei and Taihoku), 16h. (Manila), 17h. (Helwan), 20h. (Manila, La Paz, Mizusawa, Osaka, and Batavia), 21h. (Pulkovo, Batavia, Osaka, Mizusawa, and Manila).

1917. May 2d. { **1h. 2m. 13s.** (I); **1h. 21m. 33s.** (II); **2h. 56m. 23s.** (III); **4h. 22m. 19s.** (IV); **14h. 10m. 46s.** (V) } Epicentre **29°·2**S. **177°·0**W., as on May 1d. 18h. 26m. 46s.

These seem to be a series of repetitions from the May 1 epicentre. The first is recorded only at Pulkovo, and may not belong to the series. The T, has been assigned from the Pulkovo record, adjusting the mean of all so that the hypocentric residuals agree sensibly with those of May 1. It is assumed that the same correction for focal depth as on May 1 is applicable.

	Corr. for Focus.	Δ	Az.	P.	O−C.	S.	O−C.	L.	M.
	°	°	°	M. S.	S.	M. S.	S.	M.	M.
(I) Riverview	−1·2	27·5	251	e 5 47	− 4	—	—	—	19·2
(II) ,,	,,	,,	,,	e 5 39	−12	e 11 39	+71	e 13·1	15.0
(III) ,,	,,	,,	,,	e 6 25	+34	—	—	e 14·1	16·1
(IV) ,,	,,	,,	,,	e 5 47	− 4	—	—	e 14·3	18·5
(V) ,,	,,	,,	,,	e 5 44	− 7	11 3	+35	e 13·5	18·8
(II) Melbourne	−1·3	32·7	244	—	—	12 15	+17	17·0	21·6
(V) ,,	,,	,,	,,	7 32	+50	13 26	+88	18·0	19·6
(II) Adelaide	−1·4	37·8	249	—	—	—	—	—	29·9
(III) ,,	,,	,,	,,	—	—	—	—	—	25·7
(IV) ,,	,,	,,	,,	—	—	—	—	—	25·7
(V) ,,	,,	,,	,,	8 38	+73	13 8	− 8	—	24·3
(II) Honolulu	−2·0	53·8	22	16 39	? S	(16 39)	− 2	26·5	30·8
(III) ,,	,,	,,	,,	—	—	—	—	25·1	30·6
(IV) ,,	,,	,,	,,	16 41	? S	(16 41)	0	27·5	30·8
(V) ,,	,,	,,	,,	—	—	(16 26)	−15	(16·4)	28·5
(V) Batavia	−2·4	74·9	271	e 12 14	+41	—	—	—	—
(II) Zi-ka-wei	−2·6	84·2	311	e 12 23	− 5	—	—	—	51·8
(III) ,,	,,	,,	,,	e 12 22	− 6	—	—	—	43·8
(IV) ,,	,,	,,	,,	e 12 23	− 5	—	—	—	42·0
(V) ,,	,,	,,	,,	e 12 23	− 5	e 23 52	+70	e 39·8	41·5
(II) Berkeley	−2·6	84·3	40	e 30 20	? SR_1	—	—	—	—
(II) Victoria	−2·8	91·3	32	—	—	29 49	? SR_1	—	49·2
(III) ,,	,,	,,	,,	—	—	—	—	45·1	—
(IV) ,,	,,	,,	,,	—	—	—	—	—	49·9
(V) ,,	,,	,,	,,	—	—	—	—	44·1	52·0
(II) Pilar	−2·8	92·1	128	—	—	—	—	55·1	—
(III) ,,	,,	,,	,,	—	—	—	—	59·1	—
(IV) ,,	,,	,,	,,	—	—	—	—	60·5	—
(V) ,,	,,	,,	,,	—	—	—	—	52·8	—
(II) Andalagala	−2·8	92·7	124	—	—	—	—	53·8	—
(V) ,,	—	—	,,	—	—	—	—	53·7	—
(II) La Paz	−2·8	97·6	114	13 54	+12	—	—	45·6	76·2
(III) ,,	,,	,,	—	—	—	—	—	e 53·8	62·3
(IV) ,,	,,	,,	,,	—	—	—	—	e 48·7	53·0
(V) ,,	,,	,,	,,	—	—	e 24 21	−43	e 45·2	46·0
(II) Colombo	−2·9	104·7	270	33 27	? SR_1	—	—	—	61·5
(V) Mauritius	−2·9	107·7	234	46 8	?	—	—	—	52·0
(II) Toronto	−3·0	114·8	52	—	—	—	—	} 60·0	66·3
								} 64·1	—
(III) ,,	,,	,,	—	—	—	—	—	63·3	76·0
(IV) ,,	,,	,,	—	—	—	—	—	e 64·2	67·0
(V) ,,	,,	,,	—	—	—	28 44	+60	51·3	66·6
(II) Bombay	−3·0	116·3	278	—	—	—	—	—	70·3
(II) Ottawa	−3·0	117·8	51	—	—	—	—	e 66·4	—
(III) ,,	,,	,,	,,	—	—	—	—	e 64·6	—
(V) ,,	,,	,,	,,	—	—	—	—	e 57·5	—

The hypocentric stations are as follows. The correction for deep focus is omitted as unknown at present.

	△	Az.	[P.]	O−C.	L.	M.
	°	°	M. S.	S.	M.	M.
(I) Pulkovo	144·3	337	i 19 19	−28	—	—
(II) ,,	,,	,,	i 19 21	−26	61·5	85·8
(III) ,,	,,	,,	i 19 21	−26	60·6	85·4
(IV) ,,	,,	,,	...	—	—	79·5
(V) ,,	,,	,,	i 19 21	−26	63·2	86·0
(V) Edinburgh	152·9	8	45 2	?	—	—
(V) Eskdalemuir	153·5	8	e 19 43	−18	—	—
(II) Stonyhurst	155·1	6	43 57	?	—	—
(V) ,,	,,	,,	44 26	?	—	86·7
(II) West Bromwich	166·4	6	—	—	—	80·5
(III) ,,	,,	,,	—	—	—	83·6
(V) De Bilt	157·1	357	e 20 1	− 4	76·2	E 89·0
(II) Kew	157·6	6	—	—	—	99·4
(V) ,,	,,	,,	—	—	—	97·2
(V) Uccle	158·4	358	e 19 44	−22	—	87·9
(II) Graz	159·7	335	e 20 31	+23	—	—
(II) Paris	160·4	1	—	—	e 88·5	92·5
(III) ,,	,,	1	—	—	e 89·6	91·6
(IV) ,,	,,	,,	—	—	e 90·7	—
(V) ,,	,,	,,	20 53	+45	e 82·2	88·9
(II) Zagreb	160·5	332	e 19 57	−12	—	93·5
(III) ,,	,,	,,	e 20 25	+16	—	93·6
(IV) ,,	,,	,,	e 19 59	−10	—	—
(V) ,,	,,	,,	e 19 32	−37	—	—
(II) Moncalieri	163·8	348	—	—	86·8	—
(III) ,,	,,	,,	—	—	77·9	—
(V) ,,	,,	,,	e 19 57	−14	84·0	—
(II) Coimbra	165·5	37	e 27 27	?	—	—
(V) ,,	,,	,,	—	—	e 81·7	—
(II) Rio Tinto	168·3	41	32 27	? S	—	—
(II) San Fernando N.	169·4	44	21 57	+103	93·0	100·5
(II) ,, E.	,,	,,	,,	,,	89·5	100·5
(V) ,, N.	,,	,,	e 32 14	? S	94·7	104·2
(V) ,, E.	,,	,,	e 34 44	? S	91·2	109·7

On May 2 there seem to be no observations recorded as L which are reflected from the hypocentre, but Zagreb (II) records S = +31m.51s., which may be [L] and Moncalieri (II) records S = +29m.58s., which may be [L]. Moncalieri (V) also records e = +35m.25s., and San Fernando (II) records S = +46m.27s.

May 2d. Records also at 2h. (De Bilt and Eskdalemuir), 3h. (Graz), 4h. (Graz and Berkeley), 5h. (Zagreb and La Paz), 6h. (Pulkovo), 8h. (Toronto), 10h. (Paris), 11h. (Paris and Pulkovo), 12h. (Helwan), 13h. (Rocca di Papa and Monte Cassino), 14h. (Berkeley), 15h. (Paris), 18h. (Rocca di Papa), 21h. (La Paz and Monte Cassino).

May 3d. On this day several Melbourne records are associated with records in Europe, especially at Pulkovo, but there is some difficulty in interpreting the details. Let us first take the Melbourne and Pulkovo records as they stand. For shock (I) we can infer $T_\circ$ from P and S; and then, assuming that (II), (III), (IV) come from the same epicentre, we can infer $T_\circ$ for them, assuming △ = 19°·3.

		Melbourne records.				Pulkovo.	
	$T_\circ$	P.	S.	L.	M.	P.	M.
	h. m. s.	m. s.	m. s.	m.	m.	m. s.	m.
(I)	5 21 9	+4 33	+ 8 9	+ 9·1	+10·8	+ 9 5	+78·7
(II)	6 54 51	+4 33	—	+10·3	+11·2	—	—
(III)	11 32 39	+4 33	—	—	+11·8	+ 8 46	+79·1
(IV)	20 27 (0)	—	—	+ 9·2	+12·4	+13 18	—

The idea of repetition is borne out in the case of (I) and (III); but the lateness of M for Pulkovo does not correspond to the time for P. We must clearly reduce $T_\circ$ by several minutes, in which case the Melbourne records cannot be correct. A simple supposition is that Melbourne P should really be S, and S possibly SR_1. This would make △

for Melbourne about 48°, and calls for a diminution of $T_\circ$ by 11m.21s. The Pulkovo records thus follow $T_\circ$ by about 20m.20s., indicating that Pulkovo is near the hypocentre which accords with the revised value for M = 90m.: but renders it difficult to locate the epicentre more closely. For (I) De Bilt gives e = 5h.40m.42s. and 5h.51m.36s., or +30·9m. and +41·8m. from revised $T_\circ$. An Antarctic origin (such as 60°·0S. and 145°·0W. is not improbable, and is supported by Riverview records received later.

Shock (II) above seems to differ somewhat from the others. It is not recorded at Pulkovo, but the following European stations give records near this time.

	h. m. s.		h. m. s.
Stonyhurst	6 34 5	Kew	6 43 0
Eskdalemuir	6 36 —	Moncalieri	6 55 56
San Fernando	6 37 30	(Melbourne	6 59 24)
Paris	6 41 0		

If these refer to a single shock the origin must be nearer Europe than Melbourne. But this would not suit the L and M for Melbourne which accord well with the idea of repetition from the same focus as (I) and (III), at $T_\circ$ = 6h.54m.51s. −11m.21s. = 6h.43m.30s. It seems probable that there was an earlier shock nearer Europe.

Near shock (III) we have Helwan P = 11h.19m.0s., which anticipates the revised time for (III), viz., $T_\circ$ = 11h.32m.39s. −11m.21s. = 11h.21m.18s.

We have also a shock with origin close to Monte Cassino and Rocca di Papa, probably at $T_\circ$ = May 3d. 11h.48m.22s., epicentre 41·°0N. 13°·4E. (Rocca).

	P.	S.	M.
	s.		m.
Monte Cassino	+10	—	+0·3
Rocca di Papa	i+15	i+26	+0·5
Zagreb	e+84	—	+2·7

May 3d. 12h. 40m. 54s. Epicentre 0°·5N. 82°·0W. as on 1916, June 30d.3h. ? There is little to guide us beyond the La Paz records, but the S records at De Bilt and Paris seem to support this hypothesis, though the P records are puzzling.

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

	△	Az.	P.	O−C.	S.	O−C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
La Paz	21·8	142	i 5 3	0	9 1	0	13·2	14·6
Washington	38·6	6	—	—	—	—	18·1	—
Toronto	43·2	3	20 42	?L	—	—	24·1	25·4
Ottawa	45·2	6	—	—	(e 15 6)	− 12	27·1	—
Victoria	59·7	329	—	—	—	—	—	37·2
Honolulu	76·8	292	—	—	—	—	36·6	41·0
Edinburgh	83·3	34	11 18	− 80	—	—	—	—
Paris	86·0	41	e 11 6	−107	i 23 31	+ 1	—	—
Uccle	87·3	36	e 13 0	− 1	—	—	—	—
De Bilt	87·8	38	e 10 40	−144	i 23 40	− 10	33·1	E 50·0
Moncalieri	89·4	45	—	—	20 5	−242	32·5	—
Rocca-di-Papa	93·2	48	e 16 52	?PR_1	—	—	—	—
Zagreb	95·2	43	e 14 30	+ 45	e 22 30	−158	—	—

Ottawa S recorded as eLN.
Rocca di Papa records eP = 12h.57m.46s., M = 12h.58m.42s., which appears to belong to a local shock, but the first record has been entered above to show the relationship. If there was a separate shock near Rocca, other stations may, of course, have been affected.
Uccle records eP = 12h.53m.54s., e(S) = 12h.54m.30s.

May 3d. 14h. 10m. (20)s.? Monte Cassino records P = 14h.10m.28s., possibly a repetition from 41°·0N. 13°·4E., as at 11h. and 17h. ?

May 3d. 17h. 25m. (16)s. ? Possibly another repetition from 41°·0N. and 13°·4E. Monte Cassino P = +8s. Rocca di Papa P = +20s.

May 3d. Records also at 0h.52m. (Colombo), 1h.13m. −1h.30m. (Lick), 2h.13m. (La Paz), 4h.17m. (Helwan), 21h. (Helwan and Lick), 22h. (Lick).

May 4d. 0h. 13m. (38)s. Manila records P = +46s., L = +87s., M = +92s.

1917. May 4d. { **0h. 41m. 30s.** (I) / **0h. 43m. 30s.** (II) / **1h. 17m. 10s.** (III) } Epicentre **27°·0**S. **172°·0**W.

A = −·882, B = −·124, C = −·454 ; D = −·139, E = +·990 ;
G = +·450, H = +·063, K = −·891.

	Machine.	△	Azimuth.	P.	O−C.	S.	O−C.	L.	M.
		°	°	m. s.	s.	m. s.	s.	m.	m.
(II) Apia	W.	13·2	0	3 6	−10	—	...	5·9	—
(I) Melbourne	M.	37·6	242	7 30	− 5	13 42	−10	18·4	21·2
(II) ,,	M.	,,	,,	14 42	? S	(14 42)	+70)	25·9	34·1
(I) Adelaide	...	42·7	247	—	—	14 51	− 7	—	25·8
(II) ,,	—	,,	,,	8 30	+14	—	—	—	—
(II) Honolulu	...	50·2	17	9 24	+16	—	...	15·9	30·5
(II) Manila	...	77·2	294	11 19	−43	—	—	...	—
(II) Osaka	O.	79·2	318	12 3	−11	21 42	−32	32·3	44·9
(II) Batavia	—	79·3	269	e 12 30	+15	...	...	—	50·5
(II) Lick	—	79·6	39	e 22 2	? S	(e 22 2)	(−17)	—	—
(I) Zi-ka-wei	—	86·1	308	—	...	23 26	− 5	41·7	44·8
(II) ,,	...	,,	,,	11 59	−55	—	—	—	—
(II) Victoria	—	87·1	30	23 15?	? S	(23 15)	(−27)	—	58·0
(II) Pilar	M.	89·8	126	e 23 42	? S	(e 23 42)	(−30)	—	—
(II) La Paz	Bi.	94·3	111	13 18	−22	23 50	−69	44·6	52·4
(II) Colombo E.	M.	109·3	270	27 30	? S	(27 30)	(+ 8)	33·5	34·6
(III) Toronto	M.	110·0	50	E 18 44	? PR_1	27 8	−20	37·0	39·0
(III) Washington	—	110·2	57	e 23 45	?	—	—	E 30·1	—
(I) Mauritius N.	M.	112·5	231	28 6	? S	(28 6)	(+16)	—	52·2
E.	M.	112·5	231	24 36	? S	...	...	—	52·2
(III) Ottawa N.	—	113·0	49	16 13	+62	23 0	?	30·4	...
E.	...	113·0	49	16 16	+65	22 56	?	31·2	—
(II) Cape Town E.	M.	118·3	190	34 36	? SR_1	—	—	—	35·8
(I) Bombay	—	120·4	277	—	—	—	—	—	72·6
(III) Simla	O.E.	120·4	292	e 22 50	? PR_1	—	—	—	39·6
(I) Pulkovo	G.	143·9	341	18 21	[−86]	—	—	73·5	89·1
(II) ,,	G.	143·9	341	i 19 0	[−47]	—	—	—	—
(II) Edinburgh	M.	150·0	13	23 18	? PR_1	—	—	—	122·5
(II) Eskdalemuir	G.	150·6	13	e 19 31	[−26]	33 37	[−26]	—	—
(II) Stonyhurst	M.	152·1	15	20 0?	[+ 1]	—	—	—	86·5
(II) Bidston	M.S.	152·4	14	19 36	[−23]	—	—	—	—
(II) Kew	M.	154·8	13	—	...	—	—	—	43·0
(III) ,,	M.	154·8	13	—	—	—	—	—	67·8
(II) De Bilt	—	154·9	2	e 19 39	[−23]	e 33 54	[−18]	e 74·5	e 91·6
(III) ,,	—	154·9	2	e 53 50	? L	...	—	(53·8)	64·1
(II) Uccle	—	156·0	6	19 30	[−33]	—	—	—	—
(III) ,,	...	156·0	6	—	—	—	—	—	—
(II) Paris	—	157·8	10	e_1 24 30	= PR_1	e_2 44 30	= SR_1	e 79·5	E 102·0
(II) Graz	W.	159·1	345	20 0	[− 7]	33 30	—	—	—
(II) Helwan	M.	159·3	283	20 30	[+23]	—	—	—	100·5
(II) Zagreb	W.	160·2	343	i 20 19	[+11]	i 27 50	—	—	—
(II) Coimbra	—	161·0	42	e 19 58	[−11]	? 33 0	—	82·5	—
(II) Moncalieri	S.	162·0	1	19 41	[−28]	32 46	[−38]	48·8	E 112·7
(II) San Fernando	...	164·7	48	22 0	[+108]	—	—	94·5	N 110·5
(II) Rocca di Papa	Ag.	164·8	347	e 21 42	[+90]	—	—	—	—
(II) Barcelona	—	164·8	17	e 20 12	0	—	—	e 37·5	97·5
(II) Tortosa	—	164·9	22	19 52	[−20]	29 42	—	44·1	108·0
(II) Algiers	B.M.	169·4	22	19 44	[−30]	30 55	...	...	—

Melbourne records (I) PR_1 = +9m.12s., SR_1 = +15m.30s., (II) PR_1 = +15m.54s., S = +20m.36s., SR_1 = +22m.54s. Manila records eP = 0h.14m.24s., L = 0h.15m.5s., MN = 0h.15m.10s., which is before either of these three quakes. Osaka MN = +41·7m. Zi-ka-wei records (II) PMZ = +12m.10s. Toronto (II) E = +6m.6s., E = +29m.42s., M = +66·6m. Washington (III) LN? = +29·0m. Pulkovo (II) iPR_1 = +22m.14s. Stonyhurst (II) Pi = +39m.30s., PR = +43m.6s. Bidston (II) PR_1 = +23m.20s. De Bilt (II) eN = +23m.26s. eE = +36m.57s., eE = +43m.24s. Paris (II) MN = +109·1m. Zagreb (II) eP = +19m.42s., iNE = +52·0m. Moncalieri (II) MN = +103·7m. Rocca di Papa (II) ? = +24m.48s. La Paz records iP = 1h.20m.13s., L = 1h.23m.6s., M = 1h.23m.21s. Colombo gives L = 1h.38m.18s., M = 1h.44m.0s., but these do not seem to belong to either of the above quakes.

May 4d. 0h. 25m. (30)s. Monte Cassino P = +1s., M = +2s.

May 4d. 0h. 41m. 30s. (I), 0h. 43m. 30s. (II). Separately computed. The Melbourne records for these earthquakes show a double shock. No other station records a double shock explicitly, though some of the difficulties of interpretation may arise from confusion between the two. As interpreted at Melbourne the records stand as follows :—

	(I) h. m. s.	(II) h. m. s.	(II)−(I) m. s.
P	0 49 0	0 58 12	9 12
PR	0 50 42	0 59 24	8 42
S	0 55 12	1 4 6	8 54
SR	0 57 0	1 6 24	9 24
L	0 59 54	1 9 24	9 30
M	1 2 54	1 17 36	14 42

which gives a reasonably consistent sequence for two shocks at 9m. apart : △ = 38°, and T_S = 0h.41m.22s. for (I) and 0h.50m.34s. for (II). But neither of these will fit the records at other stations. It seems necessary to rearrange the material thus :—

	(I) h. m. s.	(II) h. m. s.	(II)−(I) m. s.
P	0 49 0	0 50 42	1 42
S	0 55 12	—	—
SR_1	0 58 12	0 59 54	1 42

giving △ = 40° and T_S = 0h.41m.5s. for (I) and 0h.42m.47s. for (II). The latter is distinctly small to accord with other stations, which suggest T_S = 0h.43m.30s. ; possibly as above remarked, there is confusion. It seems probable that Adelaide and Zi-ka-wei have recorded the later P and the earlier S.

May 4d. Also records at 1h (Berkeley), 2h. (Kew and Eskdalemuir), 3h. (Paris La Paz, and Toronto), 8h. (Helwan, Pulkovo, De Bilt, Athens, and Zagreb), 10h. (Edinburgh), 11h. (Pulkovo), 12h. (Helwan), 14h. (Pulkovo and Melbourne), 15h. (Helwan, Paris, and Stonyhurst), 18h. (Helwan, Pulkovo, and Melbourne), 19h. (Moncalieri, Stonyhurst, Paris, and San Fernando), 21h. (Berkeley, Lick, and Zagreb), 23h. (Helwan).

May 5d. Records at 0h. (La Paz), 2h. (La Paz, Helwan, and De Bilt), 5h. (Helwan), 8h. (La Paz), 9h. (Stonyhurst), 12h. (Taihoku, Manila, and Zi-ka-wei), 13h. (La Paz), 17h. (Helwan, Pulkovo, and Melbourne), 18h. (Colombo, Edinburgh, and Moncalieri), 19h. (Paris).

May 6d. 22h. 55m. 33s. At 11°·5N. 144°·0E. Separately computed.

May 6d. The following times are also recorded.

		P. h. m. s.	S. h. m. s.	L. h. m. s.	M. h. m. s.
Colombo		0 46 0	—	—	—
Colombo		2 37 0	—	—	—
Osaka		3 16 46	—	3 16 57	N 3 17 36
Mizusawa		3 19 6	—	—	—
La Paz		e 4 14 0	—	—	—
La Paz		7 15 11	—	—	—
Melbourne		13 12 36	13 17 6	13 19 42	13 22 30
Batavia		i 16 20 59	i 16 21 38	—	16 23 0
Zagreb	E.	e 16 24 24	—	—	16 25 43
	W.	16 24 32	—	—	16 25 53
Athens		e 17 3 55	—	17 4 20	17 4 39
La Paz		e 17 57 27	—	—	—
Stonyhurst		22 16 e	—	—	22 26 7
		—	—	—	22 32 4

May 7d. Records at 0h. (La Paz), 1h. (Colombo), 2h. (Pulkovo and Mizusawa), 5h. (Colombo), 6h. (Pulkovo), 8h. (Pulkovo, Manila, Batavia, Melbourne, Honolulu, and Victoria), 9h. (Toronto and Paris), 13h. (Colombo), 17h. (Pulkovo and Manila), 19h. (Stonyhurst), 21h. (Manila), 23h. (Monte Cassino).

May 8d. Records at 0h. (San Fernando), 4h. (Colombo), 7h. (Edinburgh), 9h. (Manila), 14h. (Zagreb), 16h. (Manila), 17h. (Mizusawa), 19h. (Bombay), 23h. (San Fernando).

1917. May 6d. 22h. 55m. 33s.

Epicentre **11°·5**N. **144°·0**E. (See also May 9.)

A = −·793, B = +·576, C = +·199 ; D = +·588, E = +·809 ;
G = −·161, H = +·118, K = −·980.

The epicentre is adopted from May 9, as supported by the observations at Manila, Osaka, Mizusawa, Batavia, Adelaide, and Pulkovo.

Station and Component.		△	Az.	P.	O−C.	S.	O−C.	L.	M.
		°	°	M. S.	S.	M. S.	S.	M.	M.
Manila		22·7	280	e 5 16	+ 3	9 18	− 1	12·4	N 13·1
Osaka		24·5	343	5 32	− 1	—	—	10·0	E 14·9
Taihoku		25·2	306	—	—	(10 13)	(+ 6)	10·2	12·2
Mizusawa	N.	27·8	354	6 6	0	10 48	− 7	—	—
	E.	27·8	354	—	—	10 52	− 3	—	—
Batavia		41·0	247	e 7 49	−14	—	—	—	13·5
Adelaide	E.	46·7	186	14 57	? S	(14 57)	−40	—	25·9
Melbourne		49·3	180	15 21	? S	(15 21)	−49	27·7	28·1
Honolulu		56·2	72	8 27	−80	—	—	28·4	29·5
Colombo	E.	63·5	272	9 27	−68	—	—	—	—
Victoria		83·2	42	—	—	—	—	38·0	48·9
Pulkovo		91·5	332	13 15	− 9	24 4	−26	40·5	N 51·7
Zagreb		106·2	325	e 18 39	+259	i 29 11	+137	—	57·8
De Bilt		107·2	335	—	—	28 18	+75	49·4	N 57·5
Eskdalemuir		107·8	341	—	—	29 26	+138	46·5	58·3
Paris		110·8	334	e 19 31	+270	e 28 47	+72	59·5	N 62·4
Moncalieri		111·1	328	—	—	28 47	+69	55·9	N 74·3
Toronto		112·1	32	—	—	—	—	56·5	71·3
Tortosa		117·8	329	20 27	+294	29 54	+82	44·5	75·4

Osaka gives MN = +16·8m. Taihoku records ePS = 22h.6m.13s., L = S. Adelaide P = S, S = SR_1. Melbourne gives S = +20m.3s., L = +27·7m., M = +28·1m., PR_2 taken as S, PS = +19m.9s. = SR_1, SR_1 = +23m.39s., SR_2 = +24m.27s. Pulkovo records PR_1 = +16m.59s., PS = +25m.24s., MZ = +54·0m., ME = +61·5m. Helwan (△ = 103°·2) gives P = PR_1 = +18m.27s. Zagreb gives iNE = +18m.55s. De Bilt records ePR_1 = +19m.2s., ePRN = +25m.1s., ePRE = +25m.9s., SR_1 = +34m.37s., ME = +56·6m. Epicentre 12°·4N. 143°·7E. Edinburgh gives P = +18m.45s., M = +72·5m. Eskdalemuir gives P = +19m.6s., PR_1 = +24m.51s., SR_1 = +34m.34s. Kew (△ = 109°·9) gives M = −62·5m. Rocca di Papa (△ = 110°·5) gives iP = +17m.53s. Paris gives ME = +69·5m. Moncalieri gives eP = +19m.39s., ME = +69·2m. Toronto gives E = +45m.33s., L = +65·2m., Le = +68·2m. Barcelona (△ = 116°·5) gives (e) = +22m.27s., M = +62·4m. Coimbra (△ = 122°·3) e = +21m.57s., eL = +59·5m. Rio Tinto (△ = 123°·6) P = +32m.27s., M = +81·5m. San Fernando (△ = 124°·5) P = +10m.27s., L = +66·9m., MN = +72·5m, ME = +73·9m. La Paz (△ = 148°·4) P = +19m.58s. Algiers gives e = +22m.34s., e_2 = +36m.55s., L = +60·5m., M = +75·5m. The following were accidentally omitted : Riverview (45°·8, 172°), e = +7m.56s. = P − 42s. +15m.5s. = S − 20s., eL = +21·3m. Simla (64°·3, 299°), e = +19m.15s. = S + 0s., M = +32·3m. Uccle (108°·5, 334°), eL = +55·5m.

1917. May 9d. 15h. 54m. 39s.

Epicentre **11°·5**N. **144°·0**E. (See also May 6.)

A = −·793, B = +·576, C = +·199 ; D = +·588, E = +·809 ;
G = −·161, H = +·118, K = −·980.

Station and Component.		Instrument.	△	Azimuth.	P.	O−C.	S.	O−C.	L.	M.
			°	°	M. S.	S.	M. S.	S.	M.	M.
Manila		—	22·7	280	5 21	+ 8	9 27	+ 8	11·6	E 12·9
Osaka		O.	24·5	343	5 36	+ 3	10 0	+ 6	—	E 14·0
Taihoku		O.	25·2	306	5 35	− 5	10 14	+ 7	—	12·4
Mizusawa	E.	O.	27·8	354	6 7	+ 1	10 58	+ 3	—	—
	N.	O.	27·8	354	6 10	+ 4	10 46	− 9	—	—
Zi-ka-wei	E.	—	28·7	317	6 14	− 1	11 2	−10	13·1	14·9
Batavia		—	41·0	247	7 57	− 6	—	—	—	E 8·3
Adelaide	E.	—	46·7	186	15 15	= S	(15 15)	−22	—	—
Melbourne		M.	49·3	180	13 33	?	19 57	= SR_1	26·2	27·8
Calcutta	N.	O.E.	54·1	290	9 45	+11	17 3	− 7	26·8	31·0
	E.	O.E.	54·1	290	9 51	+17	17 3	− 7	26·6	29·0
Honolulu		—	56·2	72	10 45	+58	19 15	+99	26·2	30·4
Colombo	E.	M.	63·5	272	10 51	+16	—	—	18·8	24·3
Simla		O.E.	64·3	299	11 15	+35	19 51	+34	26·8	35·0
Bombay	E.	—	68·8	286	11 34	+24	20 6	− 6	—	48·5
Victoria		—	83·2	42	13 6	+29	22 53	− 6	—	49·8
Berkeley	E.	—	85·8	52	e 12 51	− 1	i 23 35	+ 7	—	49·0
	N.	—	85·8	52	—	—	i 23 30	+ 2	e 35·5	37·8
Lick		—	86·6	53	e 13 16	+19	e 23 38	+ 1	—	—
Mauritius	E.	M.	90·3	250	20 57	?	—	—	—	31·1
	N.	M.	90·3	250	24 3	= S	(24 3)	−14	—	39·9
Pulkovo		G.	91·5	332	e 13 21	− 3	i 24 16	−14	41·3	47·8
Helwan	E.	M.	103·2	305	15 45	+79	18 39	= PR_1	—	74·3
Dyce	E.	Ma.	105·9	342	19 10	—	29 15	—	53·1	60·2
Zagreb	N.	W.	106·2	325	e 14 36	− 4	e 25 9	−105?	—	57·6
De Bilt		—	107·2	335	14 46	+ 1	28 23	+80	48·3	E 56·4
Edinburgh		M.	107·3	342	18 51	= PR_1	28 15	+71	—	68·3
Eskdalemuir		G.	107·8	341	18 40	= PR_1	28 23	+75	44·3	55·9
Uccle		—	108·5	334	(2) 19 12	= PR_1	(2) 28 33	+79	50·4	E 67·8
Stonyhurst		M.	108·7	340	e 16 33	—	i 18 39	...	27·4	35·4
Bidston		M.	109·3	340	19 5	PR_1	28 40	+78	—	—
West Bromwich		—	109·6	339	19 15	PR_1	28 46	+82	—	—
Kew		M.	109·9	337	17 51	?	—	—	—	62·9
Monte Cassino		—	110·0	322	19 6	PR_1	—	—	—	—
Rocca di Papa		Ag.	110·5	323	e 18 36	—	e 27 45	+13	e 49·7	61·7
Paris		—	110·8	334	i 19 25	PR_1	e 28 46	+71	51·3	61·3
Shide		M.B.	110·9	337	19 31	PR_1	28 46	+70	49·5	60·0
Moncalieri		S.	111·1	328	e 19 22	PR_1	i 29 0	+82	37·0	E 64·5
Ottawa	N.	—	112·8	29	e 19 47	PR_1	29 26	+94	e 44·4	—
Marseilles		Ma.	113·6	328	e 20 18	PR_1?	e 35 18	= SR_1	57·3	—
Barcelona		—	116·5	329	19 53	PR_1	E 29 55	+93	55·6	62·3
Tortosa		—	117·8	329	19 33	PR_1	29 38	+66	45·4	75·7
Algiers		B.M.	119·4	325	20 13	PR_1	30 23	+98	55·3	62·3
Coimbra		W.	122·3	335	20 48	PR_1	33 6	[S]?	55·8	65·1
Rio Tinto		M.	123·6	332	24 21	?	—	—	—	84·4
San Fernando	E.	—	124·5	331	19 51	[+46]	—	—	64·8	73·4
	N.	—	124·5	331	21 21	PR_1	—	—	65·4	79·8
Cape Town	E.	—	125·7	236	23 15	?	—	—	—	32·7
Azores		W.	129·9	350	39 21	? SR_1	—	—	—	—
La Paz		Bi.	148·4	103	i 20 3	[+10]	34 22	[S]?	61·3	75·9

For Notes see next page.

NOTES TO MAY 9d. 15h. 54m. 39s.

Manila gives MN = +12·9m. Osaka, S is given as L. MN = +13·5m. Taihoku, S is recorded as L. Zi-ka-wei gives SN = +11m.4s., MN = +14·6m. Melbourne records PR = +15m.21s., PS = +19m.9s., SR_1 = +23m.27s., SR_2 = +24m.21s. Victoria records P = +5m.10s., S = L, L = S. Berkeley gives ePV = +12m.53s., MV = +48·9m., T_o = 15h.54m.47s. Pulkovo gives iP = +13m.30s., iPR_1 = +17m.4s. Epicentre 13°·6N. 139°·5E. Dyce gives LN = +42·2m., MN = +57·7m. Zagreb records iNE = +18m.58s., iNW = +19m.5s., eNE = +24m.33s. De Bilt records PR_1 = +19m.6s., MN = +57·4m. Eskdalemuir gives PR_1 = +21m.57s., SR_1 = +33m.56s. Uccle gives eP = +17m.57s., e_1 = +25m.21s., MN_1 = +64·1m. West Bromwich records PS = +29m.56s., SR = +35m.16s. T_o = 16h.2m.13s. Paris gives iS = +28m.55s., SR_1 = +34m.39s. Moncalieri gives MN = +63·1m. Barcelona gives SN = +30m.1s. Coimbra records LN = +57·8m., MN = +67·9m. Cork (△112°·2) gives P = 17h.14m.36s., S = 17h.31m.36s., M = 18h.4m.21s. Toronto (△112°·1) gives E = +23m.51s., S? +31m.51s., E = +38m.3s., L = +46·5m., L = +50·5m., Li = +65·3m., Li = +68·3m., M_1 = +71·3m., M_2 = −74·3m. Washington eE = +41m.41s., eN = +41m.51s., eLE = ? +53·1m., eLN = ? +53·1m., LE = +63·0m., LN = +62·5m.

May 9d. 19h.32m.0s. Repetition from 29°·2S. 177°·0W., as on May 1 and 2 ?

	△	P.	O−C.	S.	O−C.	L.	M.
	°	m. s.	s.	m. s.	s.	m.	m.
Riverview	27·5	5 31	− 32	(11 30)	+40	11·5	16·4
Melbourne	32·7	7 24	+ 29	—	—	16·0	18·8
Adelaide	37·8	8 42	+ 66	—	—	—	27·6
Honolulu	53·8	18 6	?S	(18 6)	+60	28·1	31·8
La Paz	97·6	12 7	−111	24 6	−86	48·0	—
Toronto	114·8	—	—	—	—	62·0	—
Pulkovo	144·3	19 21	[− 26]	i 29 39	?	41·0	—
De Bilt	157·1	—	—	43 57	?L	—	—
Graz	159·7	—	—	30 0	—	—	—
Paris	160·4	e 19 0	[− 68]	—	—	—	—
Zagreb	160·5	20 27	[+ 15]	e 27 18	—	—	—
Moncalieri	163·8	20 26	[+ 15]	29 47	—	—	—
Rio Tinto	168·3	—	—	36 0	—	—	—

There seems to be a further repetition though the data are too scanty to give certainty.

A Pulkovo record i = 20h.26m.56s. cannot be identified.

May 9d. 20h. 28m. 40s. From 29°·2S. 177°·0W?.

	△	P.	O−C.	S.	O−C.	L.	M.
	°	m. s.	s.	m. s.	s.	m.	m.
Riverview	27·5	5 51	− 12	11 4	+14	13·2	17·7
Melbourne	32·7	—	—	—	—	16·0	—
Batavia	74·9	12 20	+ 32	—	—	—	—
La Paz	97·6	?	—	—	—	44·3	—
Pulkovo	144·3	19 1	[− 46]	—	—	—	—
Stonyhurst	155·1	18 2	[−120]	25 2	—	—	—
Graz	159·7	18 38	[− 90]	—	—	—	—
Paris	160·4	19 20	[− 48]	—	—	32·4	—
Zagreb	160·5	20 18	[+ 10]	30 50	—	—	—
Moncalieri	163·8	21 4	[+ 53]	—	—	42·3	—
Coimbra	165·5	—	—	—	—	30·4	—
Barcelona	167·7	—	—	29 20	—	34·4	—
San Fernando	169·4	29 50	?S	(29 50)	—	—	—
Algiers	172·4	e 32 20	?S	(32 20)	—	—	—

The La Paz record for P = −2m.27s., and there is probably some error.

May 9d. 21h. 45m. 50s. 34°·2N. 77°·5E.

A = +·179, B = +·808, C = +·562 ; D = +·976, E = −·216 ;
G = +·122, H = +·549, K = −·827.

		△	Az.	P.	O−C.	S.	O−C.	L.	M.
		°	°	m. s.	s.	m. s.	s.	m.	m.
Simla		3·1	185	i 0 52	+ 3	—	—	—	1·5
Calcutta	N.	15·0	138	3 40	+ 1	6 4	−28	8·0	9·4
	E.	15·0	138	,,	,,	6 10	−22	7·9	—
Zi-ka-wei		36·8	82	e 7 33	+ 5	—	—	—	—
Pulkovo		39·8	325	i 7 54	+ 1	i 14 2	− 1	21·2	23·6
Manila		43·7	105	e 7 52	− 32	e 14 42	−16	—	—
Zagreb		47·4	303	e 8 50	0	i 15 45	− 1	—	—
Graz		47·5	305	e 8 51	0	—	—	—	—
Rocca di Papa		50·5	299	e 9 5	− 5	16 25	0	—	—
Moncalieri		53·2	304	e 9 38	+ 11	21 31?	=SR_1	30·6	—
Paris		55·7	310	—	—	—	—	14·2	—
Rio Tinto		65·7	300	8 10	−159	—	—	—	45·2
La Paz		144·6	291	18 12	+ 43	—	—	—	—

Pulkovo records PR_1 = −9m.46s., Epicentre 35°·0N. 79°·0E. Manila S is recorded as an eP. Zagreb gives iSW as +15m.40s. Rocca di Papa gives M = +10·2m.

May 9d. Records also at 0h. (Monte Cassino, Rocca di Papa, and Zagreb), 3h. (Pulkovo,) 4h. (Melbourne), 5h. (Lick), 6h. (Melbourne), 10h. (Rocca di Papa), 15h. (Rocca di Papa and Victoria), 17h. (Batavia), 18h. (Moncalieri), 20h. (Eskdalemuir), 21h. (Victoria), 22h. (Pulkovo).

May 10d. Records at 0h. (La Paz), 1h. (San Fernando), 7h. (Pulkovo and Melbourne), 8h. (Paris and Helwan), 9h. (Rocca di Papa), 10h. (Colombo), 15h. (Athens and Pulkovo), 16h. (Rocca di Papa), 17h. (Helwan and Stonyhurst) 18h. (De Bilt, La Paz, Pulkovo, and Melbourne), 19h. (Edinburgh), 22h. (Honolulu, Rocca di Papa, and Osaka).

May 11d. 17h. 10m. 18s. 43°·0N. 12°·5E. (adopted from April 26).

		△	Az.	P.	O−C.	S.	O−C.	L.	M.
		°	°	m. s.	s.	m. s.	s.	m.	m.
Rocca di Papa		1·3	173	0 17	−3	0 37	+1	—	E 1·8
Monte Cassino		1·8	150	0 30	+2	—	—	—	1·5
Zagreb	N.	3·8	40	e 0 57	−2	i 1 48	+3	—	1·8

Rocca di Papa also records MN = 0·9m. Zagreb iP = +0m.59s., iMW = +1·9m., MW = +1·9m.

May 11d. Records also at 0h. (San Fernando), 1h. (Pulkovo, Helwan, Lick, and Melbourne), 2h. (La Paz, Edinburgh, and De Bilt), 4h. (La Paz), 5h. (La Paz), 6h. (La Paz), 12h. (La Paz), 13h. (Edinburgh, Melbourne, Helwan, and Pulkovo), 14h. (Port au Prince), 15h. (Manila), 16h. (Pulkovo), 18h. (Mizusawa and Paris), 19h. (La Paz), 20h. (Melbourne), 21h. (Pulkovo, Helwan, and Taihoku), 22h. (Berkeley and Lick).

May 12d. 4h. 30m. 35s. At 14°·0N. 126°·0E. A = −·570, B = +·785, C = +·242.

	△	Az.	P.	O−C.	S.	O−C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Manila	4·9	277	1 13	−3	—	—	2·0	3·0
Zi-ka-wei	17·7	347	z 4 13	0	7 42	+9	—	—
Osaka	22·4	21	5 11	+1	—	—	—	12·6
Pulkovo	80·5	330	i 12 17	−5	—	—	36·4	40·3

May 12d. 15h. 34m. 20s. At 42°·3N. 14°·0E. A = +·718, B = +·179, C = +·673.

	△	Az.	P.	O−C.	S.	O−C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Monte Cassino	0·8	190	0 29	? S	(0 29)	(+ 7)	—	1·2
Rocca di Papa	1·1	242	i 0 16	− 1	0 28	− 3	—	0·7
Zagreb	3·8	21	e 1 14	+15	2 11	+26	—	W 2·7
Graz	4·9	12	1 18	+ 2	—	—	—	—
Moncalieri	5·3	303	1 59	+37	—	—	2·8	—
Tortosa	10·2	265	3 55	+82	—	—	4·8	7·0
De Bilt	11·3	331	e 5 51	? SR_1	—	—	6·2	N 7·6
Pulkovo	20·1	24	4 43	+ 1	8 28	+ 3	12·2	—

Zagreb gives i = +1m.17s., i = +1m.42s., i = +1m.48s., iw = +1m.52s., ME = +3·0m. Zagreb and Graz give T_o = 15h.34m.24s.

May 12d. Records also at 0h. (Lick), 1h. (Paris), 2h. (Colombo), 4h. (Pulkovo, Monte Cassino, Zagreb, and De Bilt), 5h. (Helwan), 12h. (Mizusawa), 15h. (Zagreb and Rocca di Papa (2)), 16h. (Rocca di Papa (9), Monte Cassino, Zagreb, and Stonyhurst), 18h. (Rocca di Papa), 19h. (Melbourne), 20h. (Rocca di Papa), 22h. (Batavia (2)), 23h. (San Fernando).

May 13d. Records at 0h. (Melbourne), 2h. (Colombo), 4h. (Colombo), 9h. (Rocca di Papa), 10h. (Melbourne and Pulkovo), 11h. (De Bilt and La Paz), 12h. (Helwan), 13h. (Rocca di Papa), 14h. (Manila), 16h. (Mizusawa), 18h. (De Bilt and La Paz).

May 14d. 6h. 57m. 0s. 72°·0N. 2°·8W; A = +·309, B = −·015, C = +·951.

	△	Az.	P.	O−C.	S.	O−C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Edinburgh	16·1	184	S 12	?L	—	—	8·2	—
Eskdalemuir	16·7	184	—	—	—	—	—	—
Pulkovo	17·8	118	e 4 10	−5	i 7 49	+13	8·5	10·2
De Bilt	20·2	166	N 4 45	+2	E 8 26	− 1	9·8	E 11·1
Kew	20·6	180	—	—	—	—	—	11·0
Uccle	21·4	169	e 4 54	−4	e 9 0	+ 8	—	—
Paris	23·3	174	i 5 19	−1	e 9·25	− 6	12·0	—

Eskdalemuir gives 7h.4m. to 7h.15m.0s. Pulkovo has iP = +4m.18s. (+3s.). De Bilt has MN = +13·6m. Paris has M = +7h.10·11m.

May 14d. 22h. 1m. 0s. At 18°·0S. 167°·0E. Separately computed.

May 14d. Records also at 0h. (Pulkovo, Honolulu, and Melbourne), 1h. (Paris and Helwan), 2h. (Edinburgh), 4h. (Rocca di Papa (2), Monte Cassino), 6h. (Rocca di Papa), 8h. (Athens), 9h. (Athens), 10h. (Barcelona), 14h. (Rocca di Papa), 18h. (Melbourne), 19h. (La Paz).

May 15d. Records at 0h. (Colombo and San Fernando), 4h. (Colombo), 8h. (Pulkovo, Manila, and Colombo), 10h. (La Paz and Edinburgh), 12h. (Mizusawa), 14h. (Mizusawa), 15h. (Cape Town and Helwan), 17h. (La Paz and Colombo), 21h. (Lick), 22h. (Uccle).

May 16d. Records at 0h. (San Fernando and Lick (3)), 2h. (La Paz), 7h. (La Paz), 8h. (Manila), 10h. (La Paz), 13h. (Rocca di Papa), 14h. (Bombay and Taihoku), 15h. (La Paz), 19h. (Barcelona).

May 17d. 19h. 6m. 40s. At 37°·0N. 136°·0E.; A = −·574, B = +·555, C = +·602.

	△	Az.	P.	O−C.	S.	O−C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Osaka	2·4	191	0 36	0	—	—	1·1	1·7
Mizusawa	4·5	61	1 16	+ 6	—	—	2·3	—
Zi-ka-wei	13·4	249	e 2 49	−29	e 6 1	+ 7	—	—
Manila	26·1	215	e 5 36	−13	—	—	—	—
La Paz	29·6	65	6 37	+13	—	—	8·6	9·2
Pulkovo	65·7	328	i 11 0	+11	i 19 58	+25	30·3	—
De Bilt	79·7	327	—	—	—	—	40·3	E 46·3
Moncalieri	80·1	320	—	—	—	—	e 48·0	—
Graz	81·0	320	e 12 21	− 4	—	—	—	—
Zagreb	81·2	322	e 12 26	0	—	—	—	N 46·6

La Paz is assumed to be one hour wrong. San Fernando △89°·2 records P = 19h.9m.0s. De Bilt gives MN 50·4m.

May 17d. Records also at 0h. (Rocca di Papa and Monte Cassino), 1h. (Rocca di Papa), 5h. (Rocca di Papa), 7h. (Pulkovo, De Bilt, and Helwan), 9h. (Rocca di Papa and Monte Cassino), 23h. (Zagreb).

May 18d. Records also at 0h. (Colombo), 1h. (Zagreb), 2h. (La Paz), 4h. (La Paz), 5h. (Helwan, Pulkovo, and Melbourne), 6h. (De Bilt, San Fernando, Moncalieri, Edinburgh, and La Paz), 7h. (La Paz, Edinburgh, and Coimbra), 10h. (Mizusawa), 11h. (Pulkovo), 13h. (Zagreb), 16h. (Zagreb, Colombo, Melbourne, and Pulkovo), 17h. (Colombo and Adelaide), 19h. (De Bilt), 23h. (Manila).

1917. May 14d. 22h. 1m. 0s.

Epicentre 18°·0S. 167°·0E.

A = −·927, B = +·214, C = −·309; D = +·225, E = +·974; G = +·301, H = −·070, K = −·951.

Station and Component.	Machine.	△	Azimuth.	P.	O−C.	S.	O−C.	L.	M.
		°	°	m. s.	s.	m. s.	s.	m.	m.
Melbourne	M.	27·7	220	10 48	? S	(10 48)	(− 6)	14·9	23·6
Adelaide E.	—	30·4	231	11 54	? S	(11 54)	(+12)	—	22·0
Honolulu	--	52·2	43	16 54	? S	(16 54)	(+ 8)	24·6	29·7
Manila	--	55·9	303	e 9 51	+ 6	14 5	—	18·3	N 20·0
Batavia	—	59·8	273	e 10 0	- 11	—	—	—	18·0
Osaka	O.	60·6	330	10 25	+ 9	18 46	+15	26·6	34·1
Zi-ka-wei	--	65·8	318	e 10 43	-- 7	e 19 23	−12	—	z 36·0
Berkeley	--	86·6	48	i 12 40	−17	—	—	--	—
Victoria	—	90·7	39	40 59?	—	—	—	43·4	51·4
Mauritius N.	M.	100·7	245	42 42	? L	—	—	(42·7)	55·7
E.	M.	100·7	245	43 36	? L	—	—	(43·6)	54·7
La Paz	Bi.	115·7	119	39 0	--	—	—	55·0	60·9
Pulkovo	G.	128·0	334	i 18 29	—	—	—	63·0	67·7
Helwan	M.	138·0	295	25 0	—	—	—	—	—
Edinburgh	M.	141·4	351	47 36	—	—	—	—	94·0
Eskdalemuir	G.	142·0	351	e 19 33	[−10]	—	—	54·0	—
De Bilt N.	—	143·1	342	e 19 31	[−14]	—	—	69·0	81·0
Zagreb	W.	143·3	326	e 19 35	[−10]	—	—	—	—
Paris	—	146·7	341	i 19 40	[−11]	—	—	72·0	80·0
Monte Cassino N.	—	147·3	321	79 46	? L	—	—	(79·8)	—
Rocca di Papa	Ag.	147·7	323	19 45	[− 8]	—	—	—	19·9
Moncalieri	S.	148·0	332	19 50	[− 3]	35 18?	--	54·7	—
Coimbra	—	157·4	351	—	—	—	—	e 64·0	—
San Fernando	—	160·6	343	33 30	? S	33 30	—	82·7	E 112·0

Melbourne gives S = +13m.48s. Lick gives iPN = +51m.34s., iLMN = +51m.40s. Toronto has L? = +34·3m., L? = +48·5m., L? = +78·9m. Pulkovo gives iP_3 = +20m.29s., PR_1 = +21m.49s., P_2R_1 = +23m.49s., P_1R_2 = +25m.41s., P_2R_2 = +27m.55s. De Bilt gives e = +23m.18s., eE = +58m.12s., eE = +61m.0s., m = +62·9m. Zagreb has iNW = +22m.22s., i = +24m.15s. San Fernando = MN = +103·0m.

May 18d. 19h. 5m. 0s. At 11°·0S. 170°·0W. Separately computed.

May 19d. 15h. 44m. 43s. At 42°·8N. 12°·3E.; A = +·717, B = +·156, C = +·679.

	△	Az.	P.	O−C.	S.	O−C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Rocca di Papa	1·1	173	0 16	−1	0 32	+1	—	0·7
Monte Cassino	1·8	150	0 30	+2	—	—	—	1·1
Zagreb	4·0	40	1 4	+2	1 49	−1	—	E 2·7

May 19d. Records also at 0h. (Moncalieri), 3h. (La Paz), 7h. (Helwan), 8h. (Zagreb and Athens), 12h. (Rocca di Papa), 15h. (Rocca di Papa and and Zagreb), 23h. (San Fernando).

May 20d. Records at 1h. (La Paz), 2h. (Rocca di Papa), 3h. (Monte Cassino), 4h. (Marseilles), 6h. (Zi-ka-wei), 9h. (Paris), 11h. (Marseilles), 13h. (Barcelona), 14h. (Rocca di Papa), 19h. (La Paz), 20h. (La Paz).

May 21d. 8h. La Paz gives iP = 8h.56m.39s., and the origin as 15°·0S. 77°·0W., for which △ = 8°·7 and T$_s$ would accordingly be 8h.54m.27s.; but it is difficult to reconcile this with the Andalgala (△ = 16°·0) observation e = 9h.9m.48s. Other records are San Fernando P = 9h.6m.30s. Pulkovo e = 9h.20m.17s., L = 9h.46m.0s., M = 9h.48m.41s. Moncalieri e = 9h.25m.57s., L = 9h.36m.52s. Helwan P = 9h.27m.0s. Edinburgh P = 9h.39m.42s., M? = 9h.46m.0s. Honolulu L = 9h.41m.0s., M = 9h.43m.48s. Kew M = 9h.49m.0s. Cape Town M = 9h.59m.12s. De Bilt MN = 9h.38m.54s., ME = 9h.44m.7s.

1917. May 18d. 19h. 5m. 0s.

Epicentre **11°·0**S. **170°·0**W.

A = −·967, B = −·170, C = −·191 ; D = −·174, E = +·985 ;
G = +·188, H = +·033, K = −·982.

Station and Component.	Machine.	△	Azimuth.	P.	O−C.	S.	O−C.	L.	M.
		°	°	M. S.	s.	M. S.	s.	M.	M.
Apia	W.	3·3	212	i 0 46	− 6	—	—	—	—
Honolulu	—	34·4	20	7 12	+ 4	—	—	16·9	25·0
Melbourne	M.	48·3	229	20 30	? L	—	—	(20·5)	27·2
La Paz	Bi.	98·1	109	—	—	—	—	49·0	52·5
Pulkovo	G.	128·9	347	? 17 22	+60	—	—	64·0	74·5
Edinburgh	M.	133·9	10	38 0	? SR_1	—	—	—	90·0
Stonyhurst	M.	136·1	11	—	—	—	—	—	80·0
De Bilt	—	138·7	4	—	—	e 41 56	? SR_1	72·0	85·4
Kew	M.	138·7	10	—	—	—	—	—	91·0
Paris	—	141·7	8	i 20 3	[+21]	—	—	79·0	82·5
Zagreb	W.	144·8	352	e 20 9	[+21]	—	—	—	—
Moncalieri	S.	146·0	1	—	—	—	—	85·1	—
Coimbra	—	146·5	26	—	—	—	—	e 80·0	—
Athens	—	150·3	338	—	—	—	—	77·4	—
San Fernando	—	150·7	27	56 0	—	—	—	80·0	E 91·0
Helwan	M.	152·6	317	26 0	—	—	—	—	—

Pulkovo gives i_1 = +19m.36s., PR_1 = +21m.56s. (+32s.), i_2 = +23m.3s., PR_2 = +24m.40s., e_1 = +28m.50s., e_2 = −32m.2s., SR_1 = +39m.36s. (−3). Eskdalemuir gives L = 20h.20m. to 20h.50m.0s. Athens gives L = +22·8m. P = −26m.36s., L = +26·6m.

May 21d. Records at 2h. (Melbourne), 3h. (Mizusawa), 4h. (Rocca di Papa, Zagreb, and La Paz), 8h. (Mizusawa), 11h. (Pulkovo and La Paz), 12h. (Helwan), 15h. (Colombo), 16h. (Osaka), 20h. (La Paz and Rocca di Papa).

May 22d. Records at 0h. (San Fernando), 2h. (Mizusawa), 3h. (Colombo), 7h. (La Paz and Athens), 8h. (Colombo), 9h. (Ottawa), 14h. (Monte Cassino), 21h. (Zi-ka-wei), 22h. (San Fernando).

May 23d. 5h. 46m.27s. At 39°·3N. 21°·0E. Separately computed.

May 23d. 20h. 0m. 40s. At 35°·0N. 30°·0E. A = +·709, B = +·410, C = +·574.

	△	Az.	P.	O−C.	S.	O−C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Athens	5·9	302	e 1 59	+28	—	—	2·5	E 2·6
Monte Cassino N.	14·2	302	3 26	− 3	—	—	—	4·4
Rocca di Papa	15·1	302	e 4 0	+20	—	—	—	4·9
Zagreb N.	15·1	320	e 3 20	−20	—	—	—	e 6·0
Moncalieri	19·7	307	e 4 35	− 2	—	—	7·0	—
Pulkovo	24·7	0	i 5 27	− 8	? 9 44	−13	11·3	—

Athens gives MN = +2·7m. La Paz △ = 106°·1 gives P = 20h.4m.32s.

May 23d. 21h. 44m. 20s. Epicentre 2°·5S. 138°·0E., as on 1916 Jan. 13.
A = −·742, B = +·668, C = −·044, D = +·669, E = +·743 ;
G = +·032, H = −·029, K = −·999.

	△	Az.	P.	O−C.	S.	O−C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Manila	24·0	316	e 5 58	+30	9 47	+ 3	15·8	N 17·6
Batavia	31·3	262	e 6 40	− 1	—	—	—	17·7
Honolulu	66·9	66	—	—	—	—	8·8	12·8
Pulkovo	101·0	331	e 13 43	−32	e_1 26 19	−14	57·7	(57·7)
Helwan	105·7	300	19 40	PR_1?	—	—	—	—
Graz	113·3	321	e 14 22	−50	—	—	—	—
Zagreb	113·6	320	e 14 22	−52	—	—	—	e 15·1
De Bilt	116·9	330	—	—	e 36 1	SR_1?	54·7	E 57·8
Rocca di Papa	117·4	317	e 14 32	−60	—	—	—	15·9
Edinburgh	118·2	337	35 40	—	—	—	—	80·7
Moncalieri	119·2	322	e 15 20?	−19	22 28?	—	31·4	—
Paris	120·1	328	i 14 18	−74	c 36 41	SR_1	75·7	—

Pulkovo records i = +17m.8s., e_2 = +33m.46s., e3 = +39m.10s. De Bilt gives Ee = −36m.58s., Ee = +41m.28s., MN = +75·8m. La Paz gives eP = 21h.52m.52s., (S) = 22h.3m.17s., L = 22h.30m.2s., M = 22h.31m.24s. Apia iP = 21h.39m.49s. These two must be another quake.

1917. May 23d. 5h. 46m. 27s.

Epicentre **39°·3**N. **21°·0**E.

A = +·722, B = +·277, C = +·633 ; D = +·358, E = −·934 ;
G = +·591, H = +·227, K = −·774.

Station and Component.	Machine.	△	Azimuth.	P.	O−C.	S.	O−C.	L.	M.
		°	°	M. S.	s.	M. S.	s.	M.	M.
Athens	—	2·6	120	0 50	+ 9	1 21	+ 9	e 1·6	E 2·2
Monte Cassino E.	—	5·9	294	1 26	− 4	—	—	—	6·0
Rocca di Papa	Ag.	6·8	294	e 1 29	−14	3 38	+32	—	4·3
Zagreb	W.	7·5	332	e 1 49	− 5	i 3 6	−18	—	E 7·0
Moncalieri	S.	11·3	305	e 3 3	+14	4 55	− 7	5·9	E 7·4
Helwan E.	M.	12·7	135	5 21	? S	(5 21)	(−16)	6·3	14·7
Barcelona	—	14·5	285	e 3 7	−25	—	—	6·6	10·6
Tortosa	—	15·7	283	3 36	−12	6 29	−19	7·3	11·3
Paris E.	—	16·2	312	e 3 55	0	e 7 6	+ 6	8·6	—
Uccle	—	16·4	320	e 3 53	− 4	e 7 9	− 4	e 9·3	—
De Bilt E.	—	16·8	325	4 3	+ 1	7 13	0	8·2	11·6
Kew	M.	19·1	315	—	—	—	—	—	12·6
Pulkovo	G.	21·3	13	i 4 53	− 4	i 8 45	− 5	10·6	13·6
Stonyhurst	M.	21·5	320	—	—	i 11 3	? L	(11·0)	15·6
Rio Tinto	M.	21·6	275	10 33	? L	—	—	(10·6)	22·6
Coimbra	W.	22·5	281	e 5 3	− 8	? 9 0	−15	11·3	—
Eskdalemuir	G.	22·7	323	e 5 0	−13	9 7	−12	10·7	—
Edinburgh	M.	23·0	324	4 57	−20	—	—	—	16·6

Athens records m = +1·1m., MN = +1·9m. Zagreb i = +1m.54s., i = +2m.37s., iM = +4m.14s., i = +4m.33s., MW = +6·5m. Moncalieri MN = +8·6m. Helwan S = L?. Paris eSN = +6m.55s., M = +57m. − 59m. De Bilt SN = −7m.10s., MN = +12·4m. T_o = 5h.46m.38s. Pulkovo eP = +4m.49s., Epicentre 40°·0N. 19°·0E.

May 23d. Also records at 1h. (La Paz), 5h. (Melbourne and Rocca di Papa), 6h. (La Paz (2) and Rocca di Papa (2)), 7h. (La Paz), 10h. (Taihoku), 12h. (Rocca di Papa), 13h. (Rocca di Papa and Manila (3)), 14h. (Manila), 15h. (Monte Cassino), 17h. (Zagreb).

May 24d. 19h. 20m. 30s. At 22°·0S. 180°·0. Separately computed.

May 24d. Other records are 4h. (Rocca di Papa), 7h. (Osaka), 10h. (Manila), 18h. (Manila and Pulkovo), 21h. (Lick), 22h. (Lick and La Paz), 23h. (Pulkovo, Lick, and Honolulu).

May 25d. 14h. (40m.). Tucson NP = +2m.33s., EP = +2m.45s., NM = +3·8m., EM = +4·1m. Berkeley e = +6m.36s. Victoria P = +12m.2s., L = +13·5m., M = +15·0m. Washington e? = +12m.19s., SE = +17m.56s., SN = +17m.49s. Toronto L = +18·5m., M = +21·2m. Ottawa eP? = +19m.10s., eL? = +21·2m. Pulkovo e = +23m.18s., L = +41·0m. Paris eL = +45·0m. Edinburgh P = +33m.12s., M = +47·0m. De Bilt MN = +46·7m., ME = +48·2m.

May 25d. Also records at 0h. (Paris, De Bilt, and Pulkovo), 1h. (Monte Cassino), 6h. (San Fernando), 7h. (La Paz, Zagreb, Rocca di Papa, Batavia, and Manila), 10h. (Manila), 13h. (Edinburgh), 20h. (Taihoku), 21h. (La Paz and Monte Cassino), 23h. (La Paz).

May 26d. 4h. 4m. 16s.? La Paz = P = +7m.56s., L = +21·7m., M = +22·9m. Pulkovo i = +17m.47s., e = +31m.52s., L = +45·7m. San Fernando NP = +41m.14s. Edinburgh M = +51·7m. Honolulu L = +24·7m., M = +31·7m.

May 26d. Also records at 5h. (Mizusawa), 17h. (Edinburgh), 18h. (Melbourne, Pulkovo, Rocca di Papa, and Zagreb), 19h. (Coimbra, Helwan, Paris, San Fernando, and De Bilt, and Eskdalemuir), 21h. (Manila).

1917. May 24d. 19h. 20m. 30s.

Epicentre **22°·0**S. **180°·0**W.

A = −·927, B = ·000, C = −·375 ; D = ·000, E = +1·000 ;
G = +·375, H = ·000, K = −·927.

The hypocentric stations suggest a deep focus, but the epicentric material is scarcely good enough to warrant refinements.

Station and Component.		Machine.	△	Azimuth.	P.	O−C.	S.	O−C.	L.	M.
			°	°	m. s.	s.	m. s.	s.	m.	m.
Adelaide	E.	—	38·3	240	7 36	− 4	15 54	? SR_1	—	23·1
Honolulu		—	48·4	28	16 30	? S	(16 30)	(+31)	28·8	32·3
Manila		—	68·5	297	e 11 10	+ 2	—	—	—	—
Osaka		O.	70·7	322	11 32	+11	—	—	—	—
Batavia		W.	72·1	270	10 59	−32	—	—	—	L 40·5
Victoria		—	86·7	34	42 30?	? L	—	—	50·0 ?	51·5
Colombo	E.	M.	102·0	273	26 30	? S	(26 30)	(+15)	51·0	59·5
La Paz		Bi.	102·9	114	e 14 6	−18	23 41	—	44·5	47·6
Toronto		M.	112·5	50	—	—	—	—	e 64·6	67·2
Pulkovo		G.	136·6	338	i 19 6	[−28]	i 34 10	—	65·5	77·2
Edinburgh		M.	146·0	3	22 30	PR_1 ?	—	—	—	99·5
Eskdalemuir		G.	146·6	4	e 19 17	[−34]	—	—	44·5	—
Stonyhurst		M.	148·1	3	e 44 36	SR_1 ?	—	—	—	89·5
De Bilt		—	149·7	354	—	—	e 31 6	−50	74·5	E 89·5
Kew		M.	150·6	0	—	—	—	—	—	98·5
Helwan	E.	M.	150·9	292	24 30	? PR_1	—	—	—	—
Uccle		—	151·0	353	e 19 24	[−33]	e 34 18	? [S]	84·5	—
Zagreb		W.	152·9	335	19 27	[−33]	31 5	−65	—	—
Paris		—	153·2	356	i 18 32	+28	e 28 33	?	79·5	96·5
Graz	N.	W.	153·3	350	e 20 12	[+12]	e 34 30	? [S]	—	—
Moncalieri		S.	156·2	346	—	—	e 29 8	?	84·3	—
Rocca di Papa		Ag.	157·6	335	e 18 56	+36	—	—	—	20·7
Barcelona		—	160·5	355	—	—	—	—	e 88·5	92·7
Coimbra		—	160·5	19	e 25 40	? PR_1	39 15	?	74·1	79·1
Tortosa		—	161·2	359	19 30	[−39]	29 37	?	49·4	93·8
San Fernando	E.	—	164·6	19	35 30	? [S]	—	—	97·0	99·5
Algiers		—	165·0	351	e 25 37	? PR_1	—	—	30·5	39·5

Honolulu gave S as +22m.30s. Colombo S = SR_1 +32m.30s. = (−32s.) Pulkovo gives PR_1 = +22m.28s. (+16s.) PS = +32m.30s., SR_1 = +40m.46s. (+34s.), SR_2 = +46m.30s., SR_3 = +51m.30s. Epicentre 29°·0S. 183°·0E. De Bilt records eN = +34m.3s., eE = +43m.58s., eN = +50m.47s., MN = +95·0m.

May 27d. Records at 2h. (La Paz), 6h. (San Fernando), 7h. (Colombo), 11h. (Zi-ka-wei), 20h. (Manila and Barcelona), 22h. (Monte Cassino).

May 28d. 12h. 1m. 45s. 13°·0N. 123°·0E. A = −·531, B = +·817, C = +·225.

	△	Az.	P.	O−C.	S.	O−C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Manila	2·6	309	e 0 41	0	—	—	1·1	N 1·4
Osaka	24·4	26	5 19	−13	—	—	10·1	13·3
Batavia	25·1	221	e 4 15	−84	—	—	—	6·2
Pulkovo	80·2	329	i 12 18	− 2	i 22 21	−4	40·2	44·2
De Bilt	95·9	321	—	—	—	—	49·2	E 55·0
Edinburgh	97·8	333	52 15	—	—	—	—	—

Pulkovo gives the epicentre as adopted. De Bilt gives 13°·3N. 122°·9E. MN = +51·6m.

May 28d. Also gives records at 0h. (San Fernando), 1h. (Colombo), 3h. (Athens, De Bilt, Graz, Zagreb, and Monte Cassino), 5h. (Rio Tinto), 6h. (Berkeley, Lick, and Ottawa), 8h. (Manila), 9h. (Osaka, De Bilt, Pulkovo, and Zi-ka-wei), 13h. (Zi-ka-wei and Taihoku), 18h. (Zi-ka-wei and Taihoku), 19h. (Mizusawa), 20h. (La Paz), 21h. (Rocca di Papa), 23h. (San Fernando).

1917. May 29d. 6h. 3m. 42s.

Epicentre **16°·0**S. **168°·0**E.

A = −·940, B = +·200, C = −·276 ; D = +·208, E = +·978 ;
G = +·270, H = −·057, K = −·961.

Station and Component.		Machine.	△	Azimuth.	P.	O−C.	S.	O−C.	L.	M.
			°	°	m. s.	s.	m. s.	s.	m.	m.
Melbourne		M.	29·8	218	11 12	? S	(11 12)	(−19)	17·1	23·4
Honolulu		—	50·1	43	15 42	? S	(15 42)	(−38)	23·2	27·4
Manila		—	55·6	301	e 9 28	−15	—	—	17·3	—
Osaka		O.	59·4	329	10 7	− 1	18 14	− 2	27·3	E 30·5
Batavia		W.	60·6	271	e 10 18	+ 2	—	—	—	18·3
Zi-ka-wei		—	65·0	317	e 10 26	−19	—	—	—	Z 26·3
Berkeley		—	84·6	48	e 28 52	? SR_1	—	—	—	—
Victoria		—	88·5	38	40 53	—	—	—	43·3	48·2
Colombo	E.	M.	90·2	277	50 18	—	—	—	—	54·7
Mauritius	E.	M.	102·4	245	28 42	—	—	—	—	54·9
	N.	M.	102·4	245	32 48	? SR_1	—	—	—	54·4
La Paz		Bi.	115·8	118	e 19 48	? PR_1	32 38	—	59·4	68·1
Toronto		M.	117·2	49	—	—	—	—	56·1	68·8
Pulkovo		G.	126·6	335	15 30?	−42	28 46 ?	−51	64·3	73·4
Edinburgh		M.	139·6	352	40 18	? SR_1	—	—	—	101·3
Eskdalemuir		G.	140·2	352	e 22 3	—	—	—	—	—
De Bilt		—	141·4	343	e 22 19	—	—	—	69·3	F 94·6
Kew		M.	143·4	348	—	—	—	—	—	39·8
Paris		—	145·2	343	e 20 18	[+30]	—	—	73·3	—
Rocca di Papa		Ag.	146·7	325	19 26	[−25]	—	—	—	19·36

Melbourne gives S as +15m.18s. Honolulu gives S as +20m.30s. Osaka MN = +31·9m. Toronto gives an eL = +60·5m. Pulkovo gives i_1 = +18m.49s., PR_1 = +20m.42s., i_2 = +25m.56s., PS = +30m.27s., e = +32m.52s., SR_1 = +35m.48s. De Bilt gives another e = +22m.59s., MN = +79·2m.

May 29d. Also records 2h. (La Paz), 4h. (Pulkovo, Melbourne, Bombay, and Zagreb), 5h. (De Bilt and Helwan), 7h. (San Fernando), 8h. (Manila), 10h. (Algiers (2)), 13h. (Batavia and Simla), 15h. (Athens and Zagreb), 16h. (Monte Cassino), 23h. (Monte Cassino).

May 30d. Records at 0h. (San Fernando), 6h. (La Paz), 10h. (Monte Cassino and Rocca di Papa), 20h. (Mizusawa).

May 31d. 6h. 5m. 22s. At 32°·0N. 147°·5E. A = −·715, B = +·456, C = +·530.

	△	Az.	P.	O−C.	S.	O−C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Mizusawa	8·8	326	2 7	− 6	—	—	3·0	—
Osaka	10·4	288	2 15	−21	—	—	3·4	4·0
Zi-ka-wei	22·1	272	e 4 56	−10	e 9 16	+ 9	—	N 11·2
Pulkovo	74·8	332	i 12 1	+13	i 21 11	−13	34·6	39·9
Edinburgh	88·6	344	45 38	—	—	—	—	—
De Bilt	89·7	338	—	—	23 49	−22	42·6	E 47·9
Kew	91·9	341	—	—	—	—	—	57·6
Paris	93·4	338	—	—	—	—	49·6	—
Moncalieri	94·8	333	—	—	—	—	52·4	—
Rocca di Papa	95·3	328	e 39 8?	—	—	—	—	—

Osaka gives MN = 4·5m. Pulkovo gives PR_1 = +14m.49s., SR_1 = +25m.38s., SR_2 = +29m.38s., De Bilt gives MN = +49·6m. Eskdalemuir records L 6h.48m. to 7h.11m.0s.

1917. May 31d. 8h. 47m. 20s. (See also June 3 & June 7.)

Epicentre **54°·5**N. **160°·0**W.

A = −·546, B = −·199, C = +·814 ; D = −·342, E = +·940 ;
G = −·765, H = −·278, K = −·581.

Station and Component.		Machine.	Δ	Azimuth.	P.	O−C.	S.	O−C.	L.	M.
			°	°	M. S.	s.	M. S.	s.	M.	M.
Victoria	V.	W.	23·4	90	6 34	+7·3	9 28	− 5	10·8	13·7
	E.	M.	23·4	90	6 34	+7·3	i 10 22	+4·9	11·0	14·0
Lick	N.	—	31·4	108	e 7 39	+5·7	e 11 56	− 2	e 14·7	16·1
Honolulu		M.	33·2	176	7 22	+2·4	—	—	12·9	22·4
Tucson	N.	B.O.	40·9	102	8 4	+ 2	14 21	+ 1	17·3	22·6
	E.	B.O.	40·9	102	8 19	+1·7	14 21	+ 1	—	21·1
Mizusawa	E.	O.	41·7	273	8 2	− 7	—	—	14·3	—
	N.	O.	41·7	273	7 57	−1·2	—	—	14·4	—
Osaka		O.	48·1	273	8 56	+ 1	15 55	0	21·4	E 27·5
Toronto		M.	50·9	67	9 10	− 2	16 22	− 8	25·8	34·2
Ottawa		—	51·6	63	9 9	− 8	—	—	28·7	30·2
Washington		—	55·5	70	9 45	+ 3	17 22	− 6	28·3	E 32·7
Zi-ka-wei		—	58·7	281	10 8	+ 5	e 18 20	+1·3	e 24·9	E 27·0
Taihoku		—	63·4	276	10 26	− 8	19 4	− 2	27·3	36·3
Pulkovo		G.	65·4	354	i 10 48	+ 1	i 19 39	+ 9	26·7	E 37·3
Dyce	E.	Ma.	66·9	13	10 54	− 3	19 43	− 6	—	—
Edinburgh		M.	68·0	14	11 16	+1·2	20 10	+ 8	—	43·2
Eskdalemuir		G.	68·6	14	11 10	+ 2	20 21	+1·2	34·4	35·5
Cork		—	70·4	19	10 44	−3·5	20 4	−2·7	—	46·3
Manila		—	71·9	269	e 11 35	+ 6	21 2	+1·3	34·0	N 36·2
Kew		M.	72·7	13	16 10	?	—	—	—	62·7
De Bilt	N.	—	72·7	9	11 34	0	21 0	+ 2	33·7	39·0
Shide		M.S.	73·3	14	11 38	0	21 3	− 3	—	—
Uccle		—	73·9	11	11 37	− 4	i 21 18	+ 5	35·7	E 49·3
Paris	E.	—	75·7	12	i 11 52	− 1	i 21 30	− 4	34·7	36·2
Zagreb		W.	79·7	3	i 12 14	− 3	i 22 11	− 9	—	E 60·4
Azores		M.	79·8	35	22 10	? S	(22 10)	(−11)	—	50·2
Moncalieri		S.	80·0	9	i 12 17	− 2	22 17	− 5	35·1	E 45·2
Simla		O.E.	81·3	313	12 22	− 4	22 22	−1·6	40·2	E 42·8
Marseilles		Ma.	81·4	11	12 39	+1·2	22 39	0	42·7	—
Coimbra	N.	—	82·3	21	12 26	− 6	22 44	− 5	36·7	44·0
	E.	—	82·3	21	—	—	22 41	− 8	39·9	44·9
Barcelona		—	82·8	13	12 29	− 6	22 44	−1·1	38·7	E 41·3
Tortosa		—	83·3	15	12 33	− 5	23 0	0	37·7	60·5
Calcutta	N.	O.E.	83·5	300	12 52	+1·3	23 4	+ 2	47·4	54·0
Rocca di Papa		Ag.	83·6	6	12 36	− 4	22 55	− 9	e 38·3	60·0
Monte Cassino	N.	—	83·9	5	12 39	− 2	—	—	—	58·1
Rio Tinto		M.	85·0	21	17 40	? PR$_1$	—	—	—	74·8
San Fernando	N.	—	86·3	21	12 40	−1·5	22 10	−8·3	44·7	54·2
	E.	—	86·3	21	13 40	+4·5	22 28	−6·5	42·7	56·7
Athens		—	87·6	357	12 54	− 9	23 32	−1·6	—	49·7
Algiers		B.M.	87·6	14	12 52	−1·1	23 32	−1·6	39·7	45·7
Bombay	E.	—	94·0	311	20 7	?	—	—	—	64·1
Helwan	E.	M.	95·0	350	13 40	− 3	—	—	—	70·6
Batavia		—	96·9	269	e 13 40	−1·4	—	—	—	28·7
Riverview		—	97·8	219	e 14 22	+2·3	24 10	−8·4	e 40·4	E 46·4
Colombo	E.	M.	101·1	299	14 10	− 6	24 16	−11·0	53·7	59·8
Melbourne		M.	103·6	222	i 24 28	?	—	—	—	62·1
La Paz		Bi.	104·4	98	e 14 37	+ 5	27 53	+7·6	45·7	53·0
Mauritius		M.	135·4	305	21 10	? PR$_1$	—	—	69·6	81·6
Cape Town	E.	M.	159·4	4	29 34	?	38 34	?	99·6	109·5

For Notes see next page.

NOTES TO MAY 31d. 8h. 47m. 20s.

Victoria gives EPi = PR$_1$ (+31s.) Lick gives ME 15·9m. Toronto gives Se = +19m.28s., Si = +20m.28s., Li = +26·7M. Ottawa gives SR$_1$ = +20m.16s. (−20s.), eL = +24·7m., T$_e$ 8h.47m.23s. Washington gives MN = +35·3m. Zi-ka-wei gives SN = +18m.25s., SE = +18m.24s., SN$_1$ = +22m.22s., SRN$_1$ = +22m.22s. (−26s.), SRE = +22m.35s. (+13s.), SRN$_2$ = +23m.22s. (+34s.) Pulkovo gives PR$_1$ = +13m.7s. (−41s.), SR$_1$ = +23m.34s. (−64s.) MZ = +37·9m., MN = +38·2m., epicentre 53°·0N. 156°·0W. Eskdalemuir has PR$_1$ = +13m.31s. (−43s.), PR$_2$ = +15m.44s. Cork is taken as 1h. wrong. De Bilt gives e(PR$_1$)N = +14m.28s. (−22s.), m = +26m.55s., ME = +37·8m., epicentre 54°·2N. 160°·5W., T$_e$ 8h.47m.27s. Uccle gives SR$_1$ = +26m.16s.(−32s.), MZ = +39·4m., MN = +39·8m. Paris has iPV = +11m.48s. (−5s.) Zagreb has iP = +12m.22s.(+5s.), iNW = +12m.28s., iNE = +12m.35s., i = +15m.40s., eS = +22m.5s.(−15s.), i = +22m.22s., T$_e$ = 8h.47m.35s. Moncalieri has MN = +47·8m. Barcelona = MN = +48·3m. Athens gives eP = +13m.13s.(+10s.), m = +13m.32s., e = +33m.16s. Batavia has MLN = +52·7m., MLE = +60·7m. Riverview gives i = +24m.28s., i = +25m.28s., ? +32m.16s., MN = +48·9m., MZ = +48·7m. La Paz gives P = +14m.43s. (+11s.), i = +24m.51s. Mauritius gives NM as 10h.5m.54s.

May 31d. Also records at 11h. (Adelaide), 12h. (Zagreb and Rocca di Papa), 13h. (Manila), 14h. (Edinburgh), 15h. (Helwan), 18h. (La Paz), 19h. (Toronto, Berkeley, Victoria, Lick, Ottawa, and Washington), 20h. (Pulkovo), 22h. (San Fernando).

TABLE.

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

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British Association for the Advancement of Science.—Seismological Committee.

All correspondence to
Prof. H. H. TURNER,
University Observatory,
OXFORD.

Bulletin for June and July, 1917.

Various circumstances combined to delay the May Bulletin, which was accordingly printed off without awaiting that for June. But MS. is now ready for some months ahead, and it is hoped to accelerate the printing.

At the Rome meeting of the International Geodetic and Geophysical Union (May 2-10, 1922), a Section of Seismology was constituted, with Professor H. H. Turner, of Oxford, as President, and Professor E. Rothé, of Strasbourg, as Secretary. The Central Bureau of the Section was assigned to Strasbourg under Professor Rothé (address, 38 Boulevard d'Anvers), but Professor Turner was requested to continue the bulletins in approximately their present form; and to regard them *from the beginning of 1918* as the official publications of the International Union. A new series will thus be commenced in January 1918.

Reference should be made to the May Bulletin for remarks on the treatment of observations near the hypocentre: and for a tentative method of assigning the depth of focus of an earthquake. Dr. Davison has called attention to the fact that the name hypocentre has been used by many writers to denote the focus of disturbance, which is, of course, under the epicentre, but is not analogous to it. It would seem better to continue to use the name focus for this point, in which case hypocentre is available for the antipodal point below the focus; but it is under consideration whether perhaps the name *anticentre* should not be adopted after all for the antipodal point, seeing that there may arise an ambiguity from the previous use of hypocentre.

Observers are urgently requested to send their records to the above address as soon as possible, in order that the work of collation may not be delayed. In cases where volumes of results are printed, which, of course, entails some delay, *it would be a great help if a MS. copy could be sent in advance.* Some volumes of 1917 results have only just been received, so that of course the observations for January-May cannot now be included with the others.

1922 July 8. H.H.T.

June 1d. 8h. 24m. 59s. At 0°·0, 145°·0E. A = −·819, B = +·574, C = ·000.

		△	Az.	P.	O−C.	S.	O−C.	L.	M.
		°	°	m. s.	s.	m. s.	s.	m.	m.
Manila		27·9	303	e 6 23	+16	—	—	—	—
Melbourne		37·8	180	e 19 19	?L	—	—	25·8	26·7
Zi-ka-wei		38·3	327	e 13 33	?S	(e 13 33)	(−9)	—	—
Batavia		38·6	260	e 7 35	− 8	—	—	—	13·0
Honolulu		59·5	65	—	—	—	—	36·4	43·0
Helwan	E.	110·4	302	66 1	—	—	—	—	—
De Bilt		118·0	333	—	—	—	—	64·0	E 72·2

De Bilt gives MN = +77·5m. Paris (△ = 121°·5) give 9h.44m. to 9h.49m.0s.

June 1d. Also records 0h. (San Fernando), 4h. (Monte Cassino and Rocca di Papa), 12h. (Harvard), 14h. (Stonyhurst), 15h. (Pulkovo), 16h. (Manila, Tucson, and Berkeley), 17h. (Washington and Ottawa), 22h. (Athens).

June 2d. 0h. 28m. 12s. At 38°·0N. 48°·5E. A = +·522, B = +·590, C = +·616.

		△	Az.	P.	O−C.	S.	O−C.	L.	M.
		°	°	m. s.	s.	m. s.	s.	m.	m.
Helwan	E.	16·4	245	5 48	—	—	—	—	—
Athens		19·5	278	e 4 31	− 4	e 8 17	+ 4	—	—
Pulkovo		24·6	338	i 5 21	−13	9 54	− 1	13·8	16·7
Zagreb		25·2	298	e 5 48	+ 8	10 12	+ 5	—	—
Graz		25·7	301	e 5 35	−10	—	—	—	—
Rocca di Papa		27·5	289	e 5 42	−21	—	—	—	6·2
Moncalieri		31·0	296	e 3 26	—	11 33?	−18	21·3	—
De Bilt		33·1	310	—	—	—	—	16·8	E 24·4

Pulkovo records S at 0h.28m.6s., but taken as 38m. Rocca di Papa gives eP = ? +5m.18s. De Bilt gives MN = +21·8m. Bombay EP recorded 0h.13m.0s. to 0h.17m.0s.

June 2d. Also records at 3h. (Melbourne), 4h. (De Bilt, Pulkovo, Helwan, and Edinburgh).

June 3d. 14h. 34m. 40s. At 2°·0S. 122°·0E. A = −·530, B = +·847, C = −·035.

		△	Az.	P.	O−C.	S.	O−C.	L.	M.
		°	°	m. s.	s.	m. s.	s.	m.	m.
Batavia		15·7	255	e 3 42	− 6	—	—	—	10·3
Manila		16·6	357	e 3 56	− 4	7 18?	+ 9	9·6?	—
Melbourne		41·5	152	17 50	SR_1?	—	—	—	27·5
Colombo	E.	43·1	283	12 20	—	—	—	—	25·8
Kodaikanal	E.	46·1	287	23 20	?L	—	—	(23·3)	—
Mauritius	E.	65·1	249	42 23	—	—	—	—	—
Honolulu		81·4	68	—	—	—	—	41·8	47·3
Helwan	E.	91·5	300	18 20	—	—	—	—	—
Pulkovo		92·6	330	e_1 13 14	−16	e_2 24 4	−37	44·3	54·9
De Bilt		107·8	329	—	—	—	—	58·3	E 60·1

De Bilt gives MN = +62·3m. Zi-ka-wei records eS = 14h.23m.35s. Eskdalemuir gives L 15h.34m. to 15h.53m.0s.

June 3d. 19h. 31m. 50s. At 54°·5N. 160°·0W. (As for May 31, and June 5 and 7).
A = −·546, B = −·199, C = +·814.

		△	Az.	P.	O−C.	S.	O−C.	L.	M.
		°	°	m. s.	s.	m. s.	s.	m.	m.
Victoria		23·4	90	9 45	?S	(9 45)	+12	12·2	14·5
Honolulu		33·1	179	—	—	—	—	12·7	20·5
Toronto		50·9	67	16 58?	?S	(16 58?)	+28	27·9	32·4
Ottawa		51·6	63	e 21 46?	SR_1?	—	—	e 29·6	—
Harvard		56·2	63	e 16 28?	—	—	—	E 29·5?	—
Pulkovo		65·5	354	i 10 44	−4	i 19 22	− 9	31·2	35·7
De Bilt	N.	72·7	9	11 31	−3	20 54	− 4	36·2	38·6
Uccle		73·9	10	e 11 (34)	−7	—	—	—	—
Graz		78·4	3	N 12 5	−4	e 21 58	− 7	—	—
Helwan	E.	95·0	350	63 10	—	—	—	—	—

Toronto gives LE = 30·3m. Harvard has e = +21m.21s., e = +22m.3s. Pulkovo gives PR_1 = +13m.13s. (= −37s.), PR_2 = +14m.47s., SR_1 = +23m.10s. Epicentre 54°·4N. 171°·2W. De Bilt gives eE = +21m.2s., ME = +43·1m. Epicentre 55°·1N. 165°·2W. T_o = 19h.31m.57s. Graz gives T_o 19h.32m.0s. Eskdalemuir gives L = 20h.6m. to 20h.16m.0s.

June 3d. Also records at 1h. (Pulkovo), 1h. (Moncalieri), 2h. (San Fernando), 3h. (Rocca di Papa, Monte Cassino, and Zagreb), 6h. (Taihoku, Tucson, and Berkeley), 7h. (Harvard, Ottawa, San Fernando, and De Bilt), 11h. (Tucson and La Paz), 13h. (San Fernando and Ithaca), 16h. (Rocca di Papa), 21h. (Mizusawa).

June 4d. 1h. 9m. 54s. At 37°·0N. 26°·0E. A = +·718, B = +·350, C = +·602.

		Δ	Az.	P.	O−C.	S.	O−C.	L.	M.
		°	°	m. s.	s.	m. s.	s.	m.	m.
Athens		2·0	301	e 0 30	−1	—	—	e 1·1	1·3
Graz	N.	9·1	325	e 2 15	−2	—	—	—	—
Zagreb	E.	11·5	323	—	—	e 4 54	−13	—	—

June 4d. 1h. 13m. 33s. Epicentre as above.

	Δ	Az.	P.	O−C.	S.	O−C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Athens	2·0	301	1 0	+29	—	—	1·3	E 1·7
Rocca di Papa	11·3	299	e 2 16	−33	—	—	—	5·5
Zagreb	11·5	323	e 3 3	+11	e 5 1	− 6	—	—
Moncalieri	15·9	306	e 3 1?	−50	5 56?	−57	8·3	—
De Bilt	21·0	322	—	—	8 8	−36	10·2	E 11·9
Pulkovo	22·9	6	5 19	+ 3	9 22	− 1	11·9	—

Athens gives MN = +1·8m. De Bilt gives MN = +12·3m. Zagreb records eME = 1h.19m.15s., eMW = 1h.19m.18s., ME = 1h.19m.23s., MW = 1h.19m.38s.: it is difficult to say to which of the above quakes these belong. Lick records e1h.18m.8s. Helwan records P = 1h.26m.0s.

1917. June 4d. 1h. 29m. 18s. Epicentre 53°·5N. 159°·0W.

A = −·555, B = −·213, C = +·804; D = −·358, E = +·934; G = −·751, H = −·288, K = −·595.

Station and Component.	Machine.	Δ	Azimuth.	P.	O−C.	S.	O−C.	L.	M.
		°	°	m. s.	s.	m. s.	s.	m.	m.
Victoria	—	22·8	89	3 34	—	6 21	—	9·5	13·4
Berkeley	—	29·5	106	e 6 44	+21	—	—	—	—
Honolulu	M.	32·2	177	12 18	? S	(12 18)	(+ 7)	14·6	19·5
Osaka	O.	48·7	275	8 30	−28	15 42	−20	22·8	27·3
Toronto	M.	50·7	67	7 18?	—	15 36	−51	27·8	32·5
Ottawa E.	—	51·6	63	e 8 0?	—	16 34	− 5	46·7	—
Washington N.	—	55·3	70	9 34	− 7	—	—	29·7	—
Harvard E.	B.O.	56·1	63	e 9 23?	−24	17 13	−22	e 29·6	—
Zi-ka-wei	—	59·4	282	e 10 8	0	e 18 14	− 2	—	—
Pulkovo	G.	66·5	355	i 10 51	− 3	i 19 30	−14	28·7	37·7
Edinburgh	M.	68·8	14	8 12	—	—	—	—	45·7
Manila	—	72·4	270	e 11 42	+10	—	—	—	—
Kew	M.	73·5	14	30 42	? L	—	—	(30·7)	46·7
De Bilt N.	—	73·6	10	11 39	− 1	20 59	−10	(34·7)	38·8
Uccle	—	74·7	11	e 11 45	− 2	e 21 (19)	− 3	36·7	—
Paris	—	76·5	12	e 12 2	+ 4	e 21 43	0	33·7	—
Zagreb	W.	80·6	3	i 12 25	+ 2	i 22 34	+ 4	—	—
Moncalieri	S.	80·8	9	12 24	0	22 26	− 7	32·9	E 49·0
Simla	O.E.	82·4	314	—	—	e 22 0	−50	—	48·6
Coimbra	—	82·9	22	12 36	+ 1	22 50	− 6	N 43·6	N 49·9
Barcelona	—	83·6	14	—	—	e 22 46	−18	e 37·0	48·0
Tortosa	—	83·9	16	12 34	− 7	22 58	− 9	41·0	53·1
Rocca di Papa	Ag.	84·4	6	e 12 36	− 8	—	—	—	12·9
Rio Tinto	M.	85·6	21	28 42	? SR_1	—	—	—	57·7
San Fernando	—	87·0	22	—	—	23 42	+ 1	50·7	E 54·2
Algiers	B.M.	88·4	14	—	—	e 23 36	−20	43·7	50·7
Bombay E.	—	95·0	312	38 28	—	—	—	—	61·9
Colombo E.	M.	102·1	300	53 42	? L	—	—	(53·7)	62·7
Melbourne	M.	103·3	222	25 54	? S	(25 54)	(−33)	—	75·3
La Paz	Bi.	103·7	99	e 19 18	? PR_1	—	—	51·7	55·1
Mauritius E.	M.	136·3	305	68 6	? L	—	—	(68·1)	78·1
N.	M.	136·3	305	68 36	? L	—	—	(68·6)	78·7

For Notes see next page.

NOTES TO JUNE 4d. 1h. 29m. 18s.

Osaka records MN = +28·6m. Toronto gives Li = +31·2m., L = +64·1m. Ottawa gives SN = +16m.47s., L = +27·7m., L = +30·7m., T_o = 1h.26m.45s. Washington gives eE = +8m.42s., LE = +29·7m. Harvard gives L = +33·0m., T_c = 1h.27m.9s. Pulkovo records PR_1 = +13m.24s., PR_2 = +14m.49s., SR_1 = +23m.18s., SR_2 = +26m.42s. Epicentre 54°·0N. 187°·7E. De Bilt gives eE = +21m.4s., SR_1 = +26m.0s., SR_2 = 30m.4s., T_o = 1h.29m.26s. Epicentre 55°·2N. 159°·8W. Zagreb gives eP = +12m.17s., eS = +22m.21s., T_o = 1h.29m.28s. Moncalieri gives MN = +48·8m. Coimbra gives LE = +41·5m. San Fernando gives ME = +54·2m.

June 4d. Also records at 5h. (Manila), 7h. (Manila, Taihoku, and Zi-ka-wei), 8h. (De Bilt, Graz, Victoria, Toronto, Edinburgh, Pulkovo, Zagreb, Paris, Eskdalemuir, and Kew), 12h. (Colombo).

June 5d. 0h. 22m. 50s. Epicentre 54°·5N. 160°·0W. (as for May 31, June 3 and 7).

	Δ	Az.	P.	O−C.	S.	O−C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Pulkovo	65·4	354	i 10 46	− 1	19 25	−5	32·2	—
De Bilt	72·7	9	e 11 41	+ 7	20 52	−6	38·2	N 38·4
Graz	78·4	3	e 12 4	− 5	—	—	—	—
Zagreb	79·7	3	e 12 10	− 7	—	—	—	e 12·5
Rocca di Papa	83·6	6	e 12 28	−12	—	—	—	12·9

Pulkovo also records PR_1 = +13m.27s., SR_1 = +23m.46s. De Bilt gives T_o = 0h.23m.19s. Zagreb gives eMW? = +12·5m. Eskdalemuir gives 0h.58m. to 1h.9m.0s.

June 5d. Also records at 1h. (Zi-ka-wei and Taihoku), 2h. (Monte Cassino), 4h. (Harvard), 11h. (Moncalieri), 16h. (Osaka and Mizusawa), 19h. (Helwan), 20h. (Manila), 21h. (Monte Cassino), 23h. (Monte Cassino, Rocca di Papa, and Zagreb).

1917. June 6d. 3h. 57m. 56s. Epicentre 30°·2S. 177°·7W.

(See June 6d. 15h. & June 9.)

A = −·864, B = −·035, C = −·503; D = −·040, E = +·999; G = +·503, H = +·020, K = −·864.

Station and Component.	Machine.	Δ	Azimuth.	P.	O−C.	S.	O−C.	L.	M.
		°	°	m. s.	s.	m. s.	s.	m.	m.
Sydney	M.	26·5	254	6 16	+23	11 16	+44	14·3	16·5
Melbourne	M.	31·7	246	12 40	? S	(12 40)	(+37)	19·3	20·7
Berkeley	—	85·5	41	—	—	—	—	e 39·2	—
Victoria	—	92·4	33	—	—	—	—	46·3	48·3
La Paz	Bi.	97·7	114	e 15 6	+68	24 36	−57	50·1	52·5
Colombo E.	M.	104·2	270	25 4	? S	(25 4)	(−91)	—	—
Toronto	M.	115·9	53	—	—	—	—	63·5	70·9
Pulkovo	G.	145·0	336	i 19 43	[− 5]	—	—	76·1	—
Edinburgh	M.	154·0	7	37 4	? S	(37 4)	—	—	91·1
Helwan E.	M.	154·9	276	32 4	? S	(32 4)	(−16)	—	—
Stonyhurst	M.	156·0	7	41 34	—	—	—	—	88·2
De Bilt E.	—	158·0	353	e 28 21	—	e 44 7	—	89·0	93·5
Graz	W.	160·3	332	e? 81 4	—	—	—	93·1	—
Paris	—	161·4	0	e 39 4	—	—	—	90·1	—
Moncalieri	S.	164·6	345	e 21 9	—	—	—	—	—
San Fernando	—	170·5	46	—	—	—	—	91·1	101·1

De Bilt records eN = +30m.20s., MN = +113·3m. Paris gives MN = 5h.29–30m., ME = 5h.34–35m. Eskdalemuir records 4h.29m. to 6h.40m.0s.

June 6d. 9h. 29m. 11s. At 6°·5N. 128°·0E.

A = −·612, B = +·783, C = +·113 ; D = +·788, E = +·616 ;
G = −·070, H = +·089, K = −·994.

	△	Az.	P.	O−C.	S.	O−C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Manila	10·7	320	2 47	+7	—	—	4·4	5·3
Batavia	24·7	239	e 5 35	0	—	—	—	11·8
Zi-ka-wei	25·5	346	5 45	+2	e 10 17	+ 4	—	—
Pulkovo	88·3	330	i 13 0	−6	23 45	−10	48·8	—

June 6d. 11h. 3m. (40s.) Sydney P = +6m.8s., L = +13·3m., M = +15·1m., 20·6m. Melbourne P = +15m.20s., M = +25·3m. Pulkovo iP = +19m.27s., PR_1 = +22m.33s., ip_2 = +25m.15s., L = +18·3m. Helwan P = +31m.20s.

1917. June 6d. 15h. 49m. 0s. Epicentre 30°·0S. 177°·7W.

(as for June 6d. 3h. & June 9d. 16h.)

Station and Component.	Machine.	△	Azimuth.	P.	O−C.	S.	O−C.	L.	M.
		°	°	m. s.	s.	m. s.	s.	m.	m.
Melbourne	M.	31·7	246	12 18	? S	12 18	+15	—	19·0
Victoria	—	92·4	33	—	—	33 11	? SR_1	48·4	—
Colombo E.	M.	104·2	270	34 0	? SR_1	—	—	—	—
Toronto	M.	115·9	53	46 30?	—	54 6?	—	65·2	67·8
Harvard E.	B.O.	121·4	56	—	—	56 13?	—	e 66·5	—
Pulkovo	G.	145·0	336	16 41?	−50	e 35 44	—	74·0	—
Edinburgh	M.	154·0	7	50 30	—	—	—	—	101·0
Eskdalemuir	G.	154·5	8	e 20 4	[+ 2]	—	—	—	—
Helwan E.	M.	154·9	276	52 0	—	—	—	—	—
De Bilt E.	—	158·0	354	e 21 0	—	35 8	—	90·0	93·7
Kew	M.	158·6	5	—	—	—	—	—	100·0
Graz	W.	160·3	332	e 21 0	—	e 35 0	—	—	—
Zagreb	W.	161·1	329	e 70 58	—	—	—	—	—

Harvard gives L = +75·2m., T_o = 16h.27m.19s.? Pulkovo ip = +19m.51s., PR_1 = +22m.58s. De Bilt eN = +34m.45s., MN = +99·7m.

June 6d. Also records at 6h. (Kew), 8h. (La Paz), 12h. (Helwan and Colombo), 13h. (La Paz), 14h. (Helwan), 17h. (Paris and San Fernando), 20h. (Rocca di Papa), 22h. (La Paz and Manila).

1917. June 7d. 2h. 47h. 43s. Epicentre 54°·5N. 160°·0W.

(as on May 31 & June 3 & 5.)

A = −·546, B = −·199, C = +·814 ; D = −·342, E = +·940 ;
G = −·765, H = −·278, K = −·581.

Station and Component.	Machine.	△	Azimuth.	P.	O−C.	S.	O−C.	L.	M.
		°	°	m. s.	s.	m. s.	s.	m.	m.
Victoria	—	23·4	90	7 42	?	9 41	+ 8	12·1	13·1
Berkeley	—	30·4	108	e 12 52	? SR_1	—	—	—	—
Honolulu	—	33·2	176	—	—	—	—	14·8	15·7
Toronto	M.	50·9	67	—	—	—	—	26·9	31·3
Washington E.	—	55·4	70	—	—	e 17 18	− 8	—	—
Harvard E.	B.O.	56·2	63	17 30	? S	24 45	—	e 32·9	—
Pulkovo	G.	65·5	354	10 50	+ 2	19 22	− 9	30·4	35·5
Edinburgh	M.	68·0	14	29 5	—	—	—	—	44·3
Eskdalemuir	G.	68·6	14	11 9	+ 1	20 11	+ 2	33·9	40·7
Stonyhurst	M.	70·1	14	19 59	? S	(19 59)	(−28)	—	42·4
De Bilt	—	72·7	9	11 38	+ 4	21 1	+ 3	—	E 45·3
Kew	M.	72·7	13	—	—	—	—	—	45·3
Paris	—	75·7	12	e_1 12 17	+24	e_2 21 17	−17	39·3	—
Zagreb	W.	79·7	3	e 12 17	0	22 17	− 3	—	—
Moncalieri	S.	80·0	9	12 24	+ 5	22 19	− 4	45·8	—
Simla	O.E.	81·3	313	—	—	—	—	e 45·3	—
Coimbra	—	82·3	21	—	—	—	—	e 42·3	—
Tortosa	—	83·3	15	12 35	− 3	22 57	− 3	44·6	52·7
Rocca di Papa	Ag.	83·6	6	e 12 29	−11	—	—	—	13·5
Helwan E.	M.	95·0	350	29 17	—	—	—	—	—
La Paz	Bi.	104·4	98	e 48 17	—	—	—	65·3	69·6

Toronto gives L = +30·0. Washington eN = +17m.33s. Harvard PN = +17m.33s., eLN = +33·1m., LE = +37·8m., T_o = 2h.55m.7s. Pulkovo PR_1 = +13m.28s., PR_2 = +17m.49s., SR_1 = +26m.53s. Epicentre 55°·0N. 185°·2E. De Bilt SR_1 = +26m.1s., MN = +38·7m. T_o = 2h.47m.57s. Rocca di Papa eL = +34·0m., M = +39·8m.

June 7d. Also records at 0h. (La Paz and San Fernando), 1h. (La Paz), 5h. (Batavia), 7h. (Melbourne and La Paz), 8h. (La Paz), 10h. (Mizusawa and La Paz), 11h. (La Paz and Pulkovo), 12h. (La Paz and Helwan), 14h. (Pulkovo, Rocca di Papa, Zagreb, and Graz), 16h. (Manila and Pulkovo), 18h. (Batavia), 19h. (Pulkovo, Batavia, Zagreb, Manila, Rocca di Papa, and De Bilt), 20h. (Helwan, Harvard, and Edinburgh), 21h. (Helwan).

1917. June 8d. 0h. 51m. 28s. Epicentre 14°·5N. 91°·0W.

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

Station and Component.	Machine.	△	Azimuth.	P.	O−C.	S.	O−C.	L.	M.
		°	°	M. S.	S.	M. S.	S.	M.	M.
Tucson N.	B.O.	25·4	316	6 2	+20	10 53	+42	15·4	19·5
Washington E.	—	27·3	24	6 1	0	10 53	+ 7	e 13·5	15·6
Toronto	M.	30·8	17	—	—	11 32	−16	14·5	18·3
Harvard E.	B.O.	32·8	28	6 46	− 8	12 4	−17	e 14·8	18·5
Ottawa	—	33·5	20	e 6 49	−11	i 12 20	−12	e 16·5	18·5
Lick	—	35·4	315	e 12 17	—	—	—	—	23·5
Berkeley E.	—	36·2	316	e 7 34	+10	13 46	+33	18·9	22·0
La Paz	Bi.	38·3	143	i 7 32	− 8	i 13 20	−22	18·0	18·9
Victoria	—	43·1	329	12 48?	—	18 36	—	23·1	28·1
Honolulu	—	63·7	287	—	—	19 8	− 1	29·8	35·0
Coimbra E.	—	75·2	52	e 11 40?	−10	21 27	− 1	34·7	38·4
Edinburgh	M.	76·8	35	12 38	+38	21 56	+ 9	—	48·5
Eskdalemuir	G.	76·8	36	12 9	+ 9	21 41	− 6	36·4	38·4
San Fernando	—	77·3	55	21 2	?S	(21 2)	(−50)	36·8	E 47·0
Stonyhurst	M.	77·5	37	21 56	?S	(21 56)	(+ 1)	38·4	47·3
Kew	M.	79·2	39	21 32	?S	(21 32)	(−42)	—	48·5
Paris	—	81·4	42	e 12 38	+11	e 22 36	− 3	33·5	E 42·1
Tortosa	—	81·7	50	12 37	+ 8	22 40	− 3	40·1	44·0
Uccle	—	82·2	40	e 12 32	+ 1	22 32	−16	38·5	39·5
De Bilt E.	—	82·3	38	e 12 31	− 1	22 48	− 1	38·5	50·4
Barcelona	—	82·8	49	16 32	$=PR_1$	—	—	34·5 ?	43·5
Algiers	B.M.	84·6	53	e 15 51	PR_1?	23 12	− 3	35·5	40·5
Moncalieri	S.	85·8	45	13 17	+25	23 25	− 3	29·1	E 52·8
Rocca di Papa	Ag.	90·3	47	e 14 42	+84	—	—	e 44·8	—
Zagreb	W.	91·0	42	e 13 48	+27	i 24 11	−13	43·5	47·5
Pulkovo	G.	92·1	26	13 29	+ 1	i 24 27	− 9	39·5	50·8
Helwan E.	M.	108·9	51	26 44	?S	(26 44)	−34	—	77·4
Osaka	O.	114·0	319	18 22	-	—	—	50·3	E 82·4
Melbourne	M.	125·6	234	58 20	—	63 2	—	65·7	72·0
Simla	O.E.	133·0	14	e 43 8	—	—	—	—	N 70·1
Manila	—	137·1	311	e 19 32	[− 2]	37 52 ?	—	70·4	E 73·5
Bombay E.	—	143·0	26	—	—	—	—	—	93·2
Mauritius E.	M.	149·8	105	41 50	?SR_1	—	—	—	81·3
N.	M.	149·8	105	67 50	—	—	—	—	78·4
Colombo E.	M.	156·8	24	44 32	?SR_1	—	—	82·7	90·5

Tucson EP = +6m.2s., ES = +11m.3s., L = +15·4m., M = +17·5. Washington N, S = +10m.56s., eLN = 13·6m. Toronto L = +15·5m., L = +16·3m., Li = +17·4m. Harvard N, P = +6m.54s., S = +12m.7s., eLN = 15·1m., T_o = 0h.51m.32s. Ottawa iPN = +6m.57s., L = +23·5m., L = 40·5m. Berkeley ePN = +7m.30s., eSN = +13m.34s., eLN = +19·0m., MN = 22·0m. Victoria Pi = +14m.48s., Coimbra LN = +31·5m., MN = +38·8m. Stonyhurst records Si = +27m.14s., which may be SR_1?. Paris e = +15m.42s., MN = +40·0m. Uccle PR_1 = +15m.44s. De Bilt eSN = +22m.30s., MN = +53·1, T_o = 0h.51m.58s. Rocca di Papa L = +54·4. Zagreb i = +13m.58s., eS = +23m.42s. Pulkovo PR_1 = +17m.21s., PR_2 = +18m.58s., SR_1 = +29m.56s., SR_2 = +34m.20s., i = +23m.59s. Osaka MN = +64·8m. Manila = +72·0m.

June 8d. Also records at 1h. (La Paz), 3h. (Berkeley, La Paz, Washington, Victoria, and Ottawa), 5h. (Osaka), 6h. (La Paz), 10h. (Helwan), 12h. (Osaka), 17h. (Pulkovo and Melbourne), 18h. (Colombo, De Bilt, and Helwan), 20h. (Manila), 21h. (La Paz), 22h. (La Paz).

1917. June 9d. 16h. 57m. 30s. Epicentre 30°·2S. 177°·7W.

(See June 6.)

A = −·864, B = −·035, C = −·503 ; D = −·040, E = +·999 ;
G = +·503, H = +·020, K = −·864.

Station and Component.	Machine.	△	Azimuth.	P.	O−C.	S.	O−C.	L.	M.
		°	°	M. S.	S.	M. S.	S.	M.	M.
Sydney	M.	26·6	254	6 42	PR_1	10 30	− 3	14·0	16·0
Melbourne	M.	31·7	246	6 36	− 8	12 12	+ 9	16·8	20·4
Adelaide E.	—	36·9	251	14 0	?S	(14 0)	+37	—	—
Manila	—	74·1	298	e 12 4	+21	—	—	—	—
Berkeley	—	85·4	41	e 33 40	?	—	—	—	—
Victoria	—	92·4	33	44 1	?	—	—	47.5	50·0
La Paz	Bi.	97·7	114	16 40	?	—	—	59·5	67·0
Colombo E.	M.	104·3	270	33 30	$=SR_1$	—	—	—	61·5
Mauritius	M.	106·6	234	50 54	? L	—	—	—	—
Kodaikanal E.	M.	107·9	272	56 6	? L	—	—	64·4	67·9
Bombay E.	—	115·8	278	6+ 9	? L	—	—	—	71·1
Toronto	M.	115·9	53	—	—	—	—	65·5	67·5
Ottawa N.	—	118·9	52	e 59 48	? L	—	—	e 65·8	—
Harvard E.	B.O.	121·4	58	43 40 ?	—	52 43 ?	—	e 65·9	—
Pulkovo	G.	145·0	336	i 19 51	[+ 3]	33 12	[S]?	87·5	—
Eskdalemuir	G.	154·6	7	? 20 11	[+ 9]	—	—	—	—
Helwan E.	M.	154·9	276	27 30	?	—	—	—	—
Stonyhurst	M.	156·1	9	e 44 42	$=SR_1$	60 48	—	—	90·0
De Bilt	—	158·0	353	e 20 26	[+20]	e 44 26	$=SR_1$	—	E 90·3
Kew	M.	158·6	5	—	—	—	—	—	100·5
Zagreb	W.	161·1	329	e 20 29	[+20]	e 28 28	?	85·5	94·5
Paris	—	161·4	358	e 25 30	PR_1	—	—	87·5	E 91·0
Moncalieri	S.	164·6	345	e 35 42	?[S]	—	—	87·2	—
Rocca di Papa	Ag.	165·7	327	e 21 20	[+68]	—	—	—	58·6
Coimbra	—	166·7	38	e 45 30	?SR_1	—	—	87·5	—
San Fernando E.	—	170·5	46	—	—	—	—	89·5	102·5

The residuals in square brackets are from suggested formula for the hypocentre.

Melbourne records SR_1 = +14m.24s. Adelaide gives M = 9h.26m.6s. Ottawa gives L = +67·5, L = −73·5, L = +85·5. Harvard gives L = +80·0, L = +82·7 to 85·6m. Pulkovo gives PR_1 = +22m.39s., eS = +35m.43s. S is recorded as PS. Epicentre = 28°·0S. 185°·0E. Edinburgh gives P = 16h.25m.18s., M = 17h.39m.0s. De Bilt gives MN = +95·2m. Zagreb gives i = +21m.11s. Paris gives MN = +93·0m. Rocca di Papa gives M = +21·5m., eL? = +22·9m.

June 9d. Records also at 0h. (Mizusawa), 3h. (Mizusawa, Lick, and Berkeley), 6h. (Manila), 7h. (La Paz), 9h. (Kodaikanal), 11h. (Mizusawa), 13h. (Mizusawa), 14h. (Mizusawa), 16h. (La Paz), 21h. (Mizusawa), 22h. (Osaka, Mizusawa, Zi-ka-wei, La Paz, and Pulkovo 40°·1N. 148°·3E.), 23h. (Eskdalemuir, Helwan, and De Bilt).

1917. June 10d. 4h. 32m. 13s. Epicentre 41°·0N. 127°·0W.

A = −·453, B = −·603, C = +·656; D = −·799, E = +·602;
G = −·395, H = −·524, K = −·755.

Station and Component.	Machine.	Δ	Azimuth.	P.	O−C.	S.	O−C.	L.	M.
		°	°	M. S.	S.	M. S.	S.	M.	M.
Berkeley E.	—	4·8	130	2 15	=S	(2 15)	+3	4·0	6·1
Lick	—	5·7	132	—	—	—	—	—	N 8·3
Victoria	—	7·8	17	1 21	−37	—	—	2·3	3·3
Tucson N.	B.O.	15·5	119	4 10	+24	—	—	7·8	10·9
Honolulu	—	32·8	243	5 35	−79	—	—	13·0	20·2
Toronto	M.	34·7	70	13 5	=S	(13 5)	+14	19·8	22·4
Ottawa E.	—	36·9	66	i 7 31	+2	13 15	−8	e 17·8	22·5
Washington E.	—	37·7	77	7 26	−10	13 30	−4	17·5	26·7
Harvard E.	B.O.	40·9	69	8 2	0	14 17	−3	22·0	25·5
Edinburgh	M.	72·0	29	20 35	=S	(20 35)	(−15)	—	41·8
Eskdalemuir	G.	72·4	30	e 11 34	+2	20 54	−1	31·1	—
Osaka	O.	73·1	302	11 14	−23	21 10	+7	29·2	E 37·2
Pulkovo	G.	77·5	11	i 12 3	−1	21 41	−13	32·8	36·2
De Bilt E.	—	78·0	28	12 14	+7	21 54	−6	—	37·1
N.	—	78·0	28	12 16	+9	21 59	−1	—	37·7
Uccle	—	78·7	29	12 10	−1	—	—	33·8	37·8
La Paz	Bi.	79·1	123	12 47	+33	—	—	53·8	56·8
Paris	—	79·7	31	e 12 22	+5	e 22 19	−1	33·8	E 33·9
Zagreb	W.	87·0	25	e 13 2	+3	—	—	—	—
Coimbra	—	81·5	43	—	—	e 21 47	−53	32·8	—
Zi-ka-wei	—	84·1	307	—	—	e 22 16	−53	—	—
Rio Tinto	M.	84·2	43	23 47	=S	(23 47)	+37	—	57·8
Moncalieri	S.	84·9	30	13 18?	+31	23 14	−4	36·1	—
Tortosa	V.	85·3	37	12 49	−1	23 8	−14	41·8	52·5
Barcelona	—	85·5	36	e 19 24	?	—	—	e 35·5	49·8
Rocca di Papa	Ag.	89·4	29	e 5 24	?	13 16	?P	e 18·0	—
Algiers	B.M.	89·7	38	19 24	?	24 1	−10	35·8	52·8
Manila	—	96·3	296	e 22 47	?	—	—	—	—
Simla	O.E.	104·5	339	—	—	—	—	e 51·2	N 61·8
Helwan E.	M.	106·3	20	7 47	—	—	—	—	—
Melbourne	M.	112·5	239	e 51 41	?L	—	—	(51·7)	72·2
Colombo E.	M.	126·2	327	59 47	?L	—	—	(59·8)	—
Mauritius E.	M.	158·7	327	75 23	?L	—	—	(75·4)	—
N.	M.	158·7	327	81 5	?L	—	—	(81·1)	—

Lick records e 4h.26m.13s. Tucson EP = +5m.55s., EM = +11·0m. Toronto Li = +22·1m. Ottawa i = +8m.57s. = PR_1(+11s.), L = +40·8m., L = +57·8m., T_o = 4h.32m.30s. Washington PN = +7m.30s., SN = +13m.31s., LN = +17·5m., MN = +24·0m. Harvard gives T_o = 4h.32m.21s. Edinburgh gives S = +28m.35s. Osaka MN = +39·1m. De Bilt gives T_o = 4h.32m.45s. Epicentre 41°·5N. 125°·0W. Paris MN = +37·0m. Zagreb gives S = +12m.30s., earlier than e. San Fernando MN = +48·8m. Rocca di Papa, L = PR_1(+57s.)

June 10d. Also records at 0h. (Helwan, De Bilt, Pulkovo = 52°·2N. 184°·6E.), 2h. (Monte Cassino, Rocca di Papa, and Zagreb), 4h. (Rocca di Papa), 5h. (Manila, Rocca di Papa), 6h. (Victoria), 14h. (Rocca di Papa), 15h. (Rocca di Papa), 16h. (Helwan), 23h. (San Fernando).

June 11d. Records at 2h. (Monte Cassino), 3h. (Lick), 4h. (Colombo), 5h. (Rocca di Papa), 10h. (La Paz), 11h. (Helwan and Pulkovo), 12h. (La Paz), 16h. (Rocca di Papa, Lick, Zagreb, and Uccle), 21h. (Edinburgh), 23h. (Melbourne).

1917. June 12d. 18h. 42m. 40s. Epicentre 38°·5N. 16°·0E.

A = +·752, B = +·216, C = +·623; D = +·276, E = −·961;
G = +·598, H = +·172, K = −·783.

Station and Component.	Machine.	Δ	Azimuth.	P.	O−C.	S.	O−C.	L.	M.
		°	°	M. S.	S.	M. S.	S.	M.	M.
Monte Cassino E.	—	3·4	331	1 3	+10	—	—	—	2·7
Rocca di Papa	Ag.	4·1	323	e 1 3	0	2 23	+30	9·8	2·8
Athens	—	6·1	91	1 31	−2	2 34	−13	3·1	4·0
Zagreb	W.	7·3	359	1 39	−11	3 11	−8	—	E 4·8
Moncalieri	S.	8·9	320	2 9	−5	4 29	+29	5·9	6·8
Barcelona	—	11·0	289	—	—	—	—	e 5·3	9·3
Paris	—	14·1	320	e 4 20	+53	—	—	8·3	10·2
Uccle	—	14·8	331	e 3 32	−4	—	—	e 7·8	—
Helwan E.	M.	15·3	120	9 20	?L	—	—	(9·3)	—
De Bilt E.	—	15·5	334	3 41	−5	6 45	+1	7·6	9·6
Kew	M.	17·2	324	—	—	—	—	—	9·8
Coimbra	—	18·9	283	e 7 20	?S	(7 20)	(−40)	11·3	—
Pulkovo	G.	23·1	18	i 4 58	−20	i 8 55	−32	11·3	12·6

Athens records e = +1m.55s. Zagreb MW = +4·0m. Moncalieri MN = +8·7m. De Bilt gives SN = +6m.42s., MN = +9·5m., T_o = 18h.42m.36s. Pulkovo gives epicentre 41°·0N. 13°·5E. Eskdalemuir gives 18h.51m. to 19h.12m.0s. Edinburgh gives P = 8h.40m.12s.? M = 19h.2m.0s?

June 12d. 19h. 10m. 23s. Same Epicentre as above.

Station and Component.	Machine.	Δ	Azimuth.	P.	O−C.	S.	O−C.	L.	M.
		°	°	M. S.	S.	M. S.	S.	M.	M.
Monte Cassino E.	—	3·4	331	1 11	+18	—	—	—	—
Rocca di Papa	Ag.	4·1	323	e 1 9	+5	—	—	—	2·9
Zagreb	W.	7·3	359	e 1 53	+2	—	—	—	eE 3·5
Graz	W.	8·6	358	e 2 1	−9	—	—	—	—
De Bilt	—	15·5	334	—	—	—	—	—	9·7

Zagreb gives i = +2m.12s., eMW = +3·6m. De Bilt MN = +9·5m.

June 12d. Records also at 0h. (San Fernando), 2h. (Harvard, Washington, and Ottawa), 5h. (Rocca di Papa and Melbourne), 9h. (Edinburgh), 12h. (Rocca di Papa), 14h. (Helwan), 16h. (De Bilt), 22h. (San Fernando and Helwan).

1917. June 13d. 6h. 41m. 30s. Epicentre 30°·2S. 177°·7W.

A = −·864, B = −·035, C = −·503; D = −·040, E = +·999;
G = +·503, H = +·020, K = −·864.

The hypocentric stations indicate that the focus is above the usual depth *d* by +·020 of the earth's radius: the corresponding corrections are given in the second column. Pulkovo records a repetition 2h.10m.24s. later.

Station and Component.		Corr. for Focus	△	Az.	P.	O−C.	S.	O−C.	L.	M.
		°	°	°	M. S.	S.	M. S.	S.	M.	M.
Apia		+0·5	17·2	19	i 4 13	0	—	—	7·1	—
Sydney		+1·3	26·5	254	6 6	0	10 54	− 1	13·2	15·4
Riverview		+1·3	26·6	254	i 5 58	− 8	i 10 38	−19	e 12·5	E 15·0
Melbourne		+1·6	31·7	246	i 6 54	− 5	12 24	− 5	16·7	19·1
Adelaide	E.	+1·7	36·9	251	7 42	− 1	13 42	− 4		22·1
Honolulu		+2·2	54·9	22	9 30	−23	17 54	+ 7	28·4	32·4
Manila		+2·6	74·1	298	e 12 10	+11	22 20	+35	40·0	E 46·3
Batavia		+2·6	74·4	271	12 1	0	21 43?	− 6	—	23·5
Mizusawa	E.	+2·7	79·2	329	12 18	−12	22 26	−19	—	—
	N.	+2·7	79·2	329	12 20	−10	22 12	−33	—	
Taihoku		+2·7	80·3	307	11 34	−62	27 20	SR_1?	40·0	44·0
Lick		−2·7	85·3	42	e 13 7	+ 2	e 23 32	−20	—	—
Berkeley	E.	+2·7	85·4	41	e 13 6	0	e 23 16	−37	—	46·3
	N.	−2·7	85·4	41	e 13 11	+ 5	e 23 22	−31	—	50·8
Tucson	E.	−2·8	88·9	51	23 51	?S	(23 51)	(−41)		61·1
	N.	+2·8	88·9	51	23 40	?S	(23 40)	(−52)	—	62·3
Victoria		—	92·4	33	23 42	?S	31 39	?SR_1	38·6	50·5
Andalgala		—	92·6	124	—	—	e 33 12	?SR_1	—	—
La Paz		—	97·7	114	14 C?	[2]	i 24 37	−56	44·5	48·6
Colombo	E.	—	104·3	270	18 30	=PR_1	27 42	+66	34·0	60·0
Mauritius	E.	—	106·6	234	—	—	—	—	49·9	52·9
Kodaikanal	E.	—	107·9	272	20 0	=PR_1	—	—	26·2	68·2
Cape Town	E.	—	114·1	195	27 24	?S	(27 24)	−39	—	35·9
Bombay	E.	—	115·9	277	19 7	?PR_1	—	—	—	72·2
Toronto		—	115·9	53	19 12?	?PR_1	29 42	+85	60·5	66·8
Washington	E.	—	116·1	58	e 25 43	?	—	—	57·7	—
Simla		—	116·9	292	e 21 54	?PR_1	—	—	—	E 73·0
Ottawa		—	118·9	52	e 19 55	PR_1	e 30 20	—	e 47·9	73·5
Harvard		—	121·4	56	e 20 24?	=PR_1	30 31	—	37·0	e 69·1

For △ >90° the readings become more uncertain, and the correction to △ has not been accurately determined. But nearer the hypocentre than △ = 130° a new table becomes available for [P] as below.

Pulkovo		—	145·0	336	17 23	?	i 35 43	—	—	61·5	86·3
Edinburgh		—	154·0	7	23 42	=PR_1	—	—	—	—	101·5
Eskdalemuir		—	154·6	7	20 11	[+ 9]	—	—	—	—	44·4
Helwan		—	154·9	275	16 30	—	—	—	—	—	110·5
Azores		—	155·7	64	20 24	[+21]	—	—	—	—	104·0
De Bilt		—	158·0	353	20 21	[+15]	34 59	—	—	—	E 94·3
Kew		—	158·6	5	21 30	?S	(31 30)	—	—	—	94·5
Uccle		—	159·3	355	e 20 14	[+ 7]	—	—	—	e 73·5	95·0
Graz		—	160·3	332	e 20 26	[+18]	—	—	—	—	—
Athens		—	160·7	299	e 20 23	[+14]	e 30 18	—	—	e 50·8	—
Zagreb		—	161·1	329	e 20 25	[+16]	i 32 12	—	—	—	E 98·0
Paris		—	161·4	360	e 20 21	[+12]	e 31 35	—	—	—	91·5
Moncalieri		—	164·6	345	i 20 25	[−13]	33 56?	—	—	75·8	E 110·0
Rocca di Papa		—	165·7	327	20 24	[+12]	24 29	?PR_1	—	43·9	—
Coimbra		—	166·7	38	e 20 30	[+17]	i 46 3?	=SR_1	—	E 80·5	E 92·8
Barcelona		—	168·7	3	e 19 29	?	—	—	—	—	87·2
Tortosa		—	169·3	6	20 31	[+17]	32 1	—	—	49·9	101·3
Rio Tinto		—	169·4	42	21 30	?	—	—	—	—	128·5
San Fernando		—	170·5	46	18 30	?	—	—	—	93·5	E 98·0
Algiers		—	173·4	353	e 20 30	[+14]	31 30	—	—	47·0	87·0

The observations in square brackets give a fairly consistent hypocentric error of some [14]s. which has been interpreted as due to height ·020 of focus.

NOTES TO JUNE 13d. 6h. 41m. 30s.—continued.

Sydney gives PS = +9m.18s. Riverview records PR_1 = +7m.25s., M_1 = +13·6m., MN = +15·1m. Epicentre 27°·0S. 167°·0W., T_0 = 6h.41m.33s. Melbourne gives PR_1 = +8m.0s., SR_1 = +14m.0s. Manila MN = +46·7m. Berkeley gives iP = +12m.58s., eSV = +23m.21s., eLV? +40·0m., MV = +46·1m. Mauritius NL = +50·4m., NM = +53·5m. Washington eN = +25·7m., eLE? = +30·0m., LN = +57·8m. Simla MN = +77·3m. Ottawa gives iSE = +30m.28s., L = +53·5m., M = +68·5m. Harvard gives i = +26m.8s., i = +27m.32s. Pulkovo records PR_1 = +23m.15s., SR_1 = +41m.40s. De Bilt gives (PR_1) = +24m.28s., (eSR_1) = +44m.28s., MN = +100·0m. Zagreb gives i = +21m.5s., MW = +94·7m. Paris PR_1 = +24m.45s. Moncalieri MN = +101·1m. Coimbra LN = +79·5m., MN = +92·3m. San Fernando MN = +106·5m.

June 13d. 12h. 15m. 45s. At 36°·0N. 28°·0E.

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

	△	Az.	P.	O−C.	S.	O−C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Athens	3·9	302	1 5	+ 4	e 1 15	−32	1·8	E 2·5
Zagreb	13·3	321	e 2 45	−32	i 6 4	+13	8·3	—
Graz	14·5	324	e 3 15	−17	—	—	—	—
Paris	22·6	313	e 9 3	= S	(e 9 3)	(−14)	—	—
De Bilt	22·8	322	e 5 9	− 6	e 9 12	− 9	12·2	E 13·2
Pulkovo	23·8	3	i 5 30	+ 4	9 46	+ 6	14·2	16·3
Edinburgh	29·0	323	11 15	= S	(11 15)	(− 2)	—	—

Athens MN = +2·2m. De Bilt MN = +14·1m. T_0 = 12h.15m.50s.

June 13d. 16h. (10m.). A shock about this time is recorded at Lick e = 16h.14m.37s., Sydney P = 16h.32m.0s., L = 16h.37m.30s., Pulkovo i = 16h.42m.26s.

June 13d. 17h. 3m. 10s. A few observations near the epicentre suggest an origin similar to that of 1916, Jan. 1d. 13h. 20m., at 5°·5S. 154°·0E.; but the hypocentric observations are not easily explained on this hypothesis:—

	△	Az.	P.	O−C.	S.	O−C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Sydney	28·5	185	4 8	−125	11 26	+18	(11·4)	17·3
Melbourne	33·3	193	—	—	—	—	17·0	18·3
Manila	38·4	302	e 7 38	− 3	—	—	—	—
Batavia	46·9	268	e 8 50	+ 4	—	—	—	—
Honolulu	54·2	58	26 2	? L	—	—	30·8	34·7
Pulkovo	111·1	333	i_2 19 32	=PR_1	i_3 26 30	−68	38·8	—
Graz	125·3	325	e 20 50	=PR_1	—	—	—	—
Zagreb	125·7	325	e 19 25	PR_1?	—	—	66·8	—
Edinburgh	126·4	344	57 14	? L	—	—	(57·2)	—
De Bilt	126·9	342	e 22 32	PR_1?	—	—	59·8	E 61·1
Stonyhurst	128·0	343	64 51	? L	—	—	(64·8)	79·8
Paris	130·4	336	e 23 0	PR_1?	—	—	79·8	—
La Paz	132·9	118	19 53	PR_1?	i 23 44 ?	—	—	—
Algiers	138·9	315	e 23 21	?PR_1	—	—	—	—

June 13d. Records also at 8h. (Toronto and Sydney), 9h. (Toronto, Pulkovo, Lick, Berkeley, Manila, Melbourne, Victoria, Kodaikanal, and Uccle), 10h. (Simla), 13h. (La Paz and Pulkovo), 15h. (Manila and Helwan), 16h. (De Bilt), 21h. (Algiers).

June 14d. 13h. 20m. 30s. At 38°·5N. 144°·5E. (as on 1917 March 15).

A = −·637, B = +·454, C = +·623; D = +·581, E = +·814;
G = −·507, H = +·361, K = −·783.

	△	Az.	P.	O−C.	S.	O−C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Mizusawa	2·7	283	0 45	+ 3	1 7	− 8	—	—
Nagoya	6·9	243	1 20	−25	—	—	—	—
Osaka	8·2	245	1 58	− 5	—	—	3·2	4·1
Pulkovo	67·9	330	i 11 8	+ 5	20 4	+ 3	34·5	43·4
De Bilt	82·7	336	—	—	—	—	44·5	E 48·2
Helwan	87·5	307	58 30	? L	—	—	—	—
La Paz	143·9	62	30 4	—	—	—	—	—

Monte Cassino (△ = 88°·2) gives P = 13h.20?m.0s.: this must apply to another quake.

June 14d. Records also at 1h. (Pulkovo), 2h. (San Fernando), 3h. (Helwan), 8h. (Rocca di Papa), 9h. (Zagreb and Rocca di Papa (5)), 10h. (Zagreb and Rocca di Papa (2)), 14h. (Helwan and De Bilt), 16h. (Taihoku), 17h. (Victoria), 18h. (Lick and Algiers), 19h. (Rocca di Papa), 20h. (Marseilles), 21h. (Manila and Colombo).

June 15d. Records at 0h. (La Paz), 2h. (Helwan and San Fernando), 4h. (Mizusawa and Pulkovo), 5h. (Zagreb and De Bilt), 9h. (Rocca di Papa and Monte Cassino), 12h. (Algiers), 13h. (Taihoku), 15h. (Lick and De Bilt), 19h. (Rocca di Papa), 21h. (Rocca di Papa and Monte Cassino).

June 16d. 12h. 23m. 0s. At 44°·0N. 20°·0W.

A = +·676, B = −·246, C = +·695 ; D = −·342, E = −·940 ;
G = +·653, H = −·238, K = −·719.

		△	Az.	P.	O−C.	S.	O−C.	L.	M.
		°	°	m. s.	s.	m. s.	s.	m.	m.
Kew		15·1	54	—	—	—	—	—	10·0
Edinburgh		16·0	36	6 0	? S	(6 0)	(−55)	—	—
Uccle		17·7	59	$e_1$4 16	− 3	$c_2$7 24	− 9	—	—
De Bilt	E.	18·5	55	4 25	− 2	7 58	+ 7	9·3	10·7
Graz		24·8	70	5 38	− 2	c 10 18	+19	—	—
Zagreb		25·3	73	5 39	− 2	E 11 52	? SR_1	15·0	—
Pulkovo		33·7	44	e 7 39	+37	—	—	15·0	—
Helwan	E.	42·6	91	31 0	? L	—	—	—	—

Eskdalemuir (△15°·6) gives 12h.29m. to 12h.45m.0s. De Bilt SN = +7m.56s., LN = +8·9m., MN = +10·7m., T_c = 12h.23m.2s. Graz gives T_c12h.22m.45s. Zagreb gives SNW? = +11m.24s. = SR_1?

June 16d. 22h. 41m. 0s. Is this a repetition from the origin of 1917, May 31, June 3, 5, and 7, viz. : 54°·5N. 160°·0W.? The fit is not good.

		△	Az.	P.	O−C.	S.	O−C.	L.	M.
		°	°	m. s.	s.	m. s.	s.	m.	m.
Berkeley		30·4	108	6 7	−25	—	—	—	N 15·1
Honolulu		33·2	177	—	—	—	—	22·0	26·5
Ottawa		51·6	63	—	—	e 16 8	−31	28·3	—
Washington	E.	55·5	70	—	—	e 15 4	−144	29·4	—
Harvard		56·2	63	—	—	e 18 30	+54	30·0	32·2
Pulkovo		65·4	355	i 19 25	=S	e 28 56	?	47·0	—
Edinburgh		68·0	14	48 0	? L	—	—	(48·0)	—
De Bilt	E.	72·7	9	—	—	e 24 0	?	44·0	55·1
	N.	72·7	9	—	—	—	—	46·0	53·2
Moncalieri		80·0	9	26 32	? S	42 38	? L	57·3	—
Rocca di Papa		83·6	6	i 35 41	?	—	—	—	35·8
Monte Cassino		83·9	5	13 55	?	—	—	—	—
San Fernando		86·3	21	50 0	?	—	—	—	—
La Paz		104·4	98	19 34	? PR_1	—	—	—	—

Moncalieri, Rocca di Papa, Monte Cassino, and perhaps San Fernando seem to belong to another (local ?) quake.

June 16d. Records also at 0h. (Athens, San Fernando, and De Bilt), 6h. (Victoria), 11h. (Edinburgh), 15h. (Lick, Washington, Berkeley, Ottawa, and Victoria), 16h. (Lick, De Bilt, Toronto, Harvard, and Rocca di Papa), 18h. (Helwan, Edinburgh, Pulkovo, Bombay, Simla, and De Bilt), 19h. (Mizusawa), 20h. (Rocca di Papa, Monte Cassino, Taihoku, and Zagreb), 21h. (Mizusawa and La Paz).

June 17d. 8h. 34m. 30s. At 34°·0N. 162°·0W. A = −·788, B = −·256, C = +·559.

	△	Az.	P.	O−C.	S.	O−C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Honolulu	13·1	166	—	—	—	—	5·9	26·0
Melbourne	87·1	215	5 0	?	8 54	?	9·8	11·9
Pulkovo	85·6	348	i 12 56	+ 5	—	—	51·5	75·4
Edinburgh	88·3	10	18 30	? PR_1	—	—	—	—
De Bilt	93·1	12	e 17 36	? PR_1	—	—	70·5	E 87·6

Pulkovo gives PR_1 = +16m. 21s. (O−C = −11s). De Bilt records e = 46m.12s., mE = +46m.19s., mN = 46m.31s., eLN = +68·5m., MN = +81·4m. The Melbourne record seems to belong to another shock.

June 17d. Records also at 0h. (Zagreb and Helwan), 9h. (Edinburgh, Helwan, Eskdalemuir, Colombo, and Paris), 10h. (Rocca di Papa and Monte Cassino), 12h. (Zagreb), 13h. (La Paz), 18h. (Calcutta), 22h. (San Fernando, Monte Cassino, and Rocca di Papa).

June 18d. 16h. 29m. 20s. At 14°·5N. 145°·5E.

A = −·798, B = +·548, C = +·250 ; D = +·566, E = +·824 ;
G = −·206, H = +·142, K = −·968.

	△	Az.	P.	O−C.	S.	O−C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Osaka	22·1	338	5 8	+ 2	—	—	—	E 13·2
Manila	23·8	274	e 5 24	− 2	—	—	9·5	—
Mizusawa	24·9	352	5 39	+ 2	—	—	—	—
La Paz	32·4	98	18 32	?L	—	—	—	—
Pulkovo	89·5	333	—	—	e 23 40	−28	—	—
De Bilt	105·1	336	—	—	e 25 7	−96	54·7	E 58·9

Osaka gives MN = +13·6m. De Bilt MN = +58·7m. Epicentre 14°·0N., 144°·0E.

June 18d. 22h. 11m. 22s. At 4°·0N. 144°·0E.

A = −·807, B = +·586, C = +·070 ; D = +·588, E = +·809 ;
G = −·056, H = +·041, K = −·998.

		△	Az.	P.	O−C.	S.	O−C.	L.	M.
		°	°	m. s.	s.	m. s.	s.	m.	m.
Manila		25·0	297	e 5 34	− 4	—	—	—	—
Osaka		31·7	347	7 8	+24	—	—	—	E 16·0
Mizusawa	E.	35·2	358	6 56	−19	—	—	—	—
Batavia		38·5	255	e 6 38	−64	—	—	—	9·7
Sydney		38·5	171	5 20?	—	—	—	13·2	14·1
Melbourne		41·8	178	10 8	=PR_1	14 50	+18	18·2	18·9
Honolulu		58·8	67	—	—	—	—	24·1	28·6
Pulkovo		98·1	332	i 12 56	−65	i 25 40	+ 3	46·6	64·9
De Bilt	E.	114·0	334	e 26 0	?S	(26 0)	(−122)	57·6	61·3
Edinburgh		114·4	341	31 38	?	—	—	—	—
Kew		116·7	336	—	—	—	—	—	67·6

Osaka gives MN = +17·3m. Mizusawa gives PN = +6m. 49s., PE = +46m. 6s., PN = +46m.8s. Pulkovo gives iPR_1 = +17m.27s., SR_1 = +33m.38s., PS = +27m.9s. De Bilt has eLN = +58·6m., MN = +61·3m.

June 18d. Records also at 0h. (Manila, Rocca di Papa (2), and Monte Cassino), 1h. (Manila), 3h. (Monte Cassino), 4h. (Pulkovo), 10h. (Pulkovo and Helwan), 13h. (Manila), 15h. (Manila), 18h. (De Bilt), 21h. (San Fernando), 23h. (Lick).

June 19d. Records at 0h. (Lick), 6h. (Rocca di Papa), 13h. (Uccle), 14h. (Helwan, and Pulkovo), 15h. (Helwan), 17h. (Colombo), 20h. (San Fernando), 21h. (La Paz), 23h. (Manila, Melbourne, and Monte Cassino).

June 20d. Records at 1h. (Pulkovo and La Paz), 2h. (Monte Cassino), 4h. (Monte Cassino and Taihoku), 5h. (Rocca di Papa), 9h. (Rocca di Papa and Monte Cassino), 13h. (Athens), 16h. (Taihoku), 18h. (Lick and Paris), 21h. (San Fernando and Monte Cassino), 23h. (Paris, Uccle, and Zagreb).

June 21d. 8h. 36m. (20s.). Monte Cassino P = +8s. Rocca di Papa P = +27s., M = +34s. Probably from the epicentre noted as 41°·0N. 14°·0E. on April 26.

June 21d. 8h. 46m. (13s.). Pulkovo notes P = +7m.2s., PR_1 = +8m.12s., S = +12m.17s., and suggests 39°·6N. 68°·5E. Query same as April 21, with after correction for deep focus is given as 37°·2N. 70°·4E.

June 21d. 17h. 42m. 33s. Epicentre 1°·0N. 99°·0E.

A = −·156, B = +·988, C = +·017 ; D = +·988, E = +·156 ;
G = −·003, H = +·017, K = −1·000.

		Δ	Az.	P.	O−C.	S.	O−C.	L.	M.
		°	°	m. s.	s.	m. s.	s.	m.	m.
Batavia		10·6	132	2 29	− 9	4 49?	+ 5	—	6·4
Colombo	E.	20·0	288	9 27	?SR_1	—	—	—	11·4
Manila		25·7	57	e 5 47	+ 2	—	—	7·6	—
Helwan	E.	70·2	302	25 27	?SR_1	—	—	—	—
Pulkovo		78·6	331	12 13	+ 2	22 6	− 1	37·4	—
De Bilt		91·6	322	—	—	23 43	−48	54·4	E 59·6
Marseilles		92·0	313	22 12	—	—	—	—	—

De Bilt gives eN = +24m.11s., MN = +56·4m. The Manila L is perhaps PR_1?

June 21d. Records also at 10h. (Barcelona), 12h. (Osaka and Mizusawa), 13h. (Melbourne), 14h. (Harvard and Edinburgh), 21h. (San Fernando).

June 22d. 5h. 28m. 50s. At 55°·0N. 160°·0W. (as on 1916 Oct. 3d. 13h. See also 1917 June 16d. 22h.)

A = −·539, B = −·196, C = +·819 ; D = −·342, E = +·940 ;
G = −·770, H = −·280, K = −·574.

	Δ	Az.	P.	O−C.	S.	O−C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Victoria	23·4	90	10 53?	SR_1?	—	—	11·9	13·3
Toronto	50·7	67	—	—	—	—	30·2	31·6
Ottawa	51·4	63	9 4	−12	16 21	−15	24·5	—
Zi-ka-wei	58·6	281	e 10 2	− 1	—	—	—	—
Pulkovo	64·9	355	i 10 43	− 1	19 20	− 4	27·2	37·9
De Bilt	72·2	10	e 20 55	+ 3	—	—	37·2	E 40·2
La Paz	104·5	98	18 40	?PR_1	—	—	—	—

De Bilt gives MN = +45·7m. Eskdalemuir gives L = 6h.3m. to 6h.15m.0s.

June 22d. Records also at 0h. (Harvard), 1h. (La Paz), 3h. (San Fernando), 6h. (Helwan and Edinburgh), 9h. (Rocca di Papa), 10h. (Rocca di Papa and Paris), 11h. (Tortosa and Barcelona), 15h. (Paris), 23h. (Athens).

June 23d. Records at 0h. (San Fernando), 3h. (Athens), 7h. (Athens and Zagreb), 9h. (Pulkovo), 10h. (Helwan), 13h. (Helwan), 20h. (Athens), 23h. (San Fernando).

1917. June 24d. 19h. 48m. 30s. Epicentre 18°·0S. 173°·0W.

A = −·944, B = −·116, C = −·309 ; D = −·122, E = +·993
G = +·307, H = +·038, K = −·951.

Station and Component.		Machine.	Δ	Azimuth.	P.	O−C.	S.	O−C.	L.	M.
			°	°	M. S.	S.	M. S.	S.	M.	M.
Sydney		M.	35·7	236	6 30	−49	—	—	14·3	15·4
Melbourne		M.	41·6	233	7 48	−20	14 30	+ 1	21·1	23·0
Honolulu		—	42·0	21	9 6	+55	15 0	+25	18·6	19·5
Mizusawa	E.	O.	71·5	324	11 44	+17	20 47	+ 3	—	—
	N.	O.	71·5	324	11 43	+16	20 54	+10	—	—
Osaka		O.	71·9	317	11 41	+12	21 33	+44	29·8	E 41·7
Manila		—	72·8	292	e 11 42	+ 7	16 38	?	22·4	E 22·5
Berkeley		—	73·4	40	e 10 54	−44	—	—	—	—
Batavia		W.	78·8	274	i 12 7	− 5	—	—	—	21·5
Victoria		—	79·8	31	22 53	? S	(22 53)	+32	—	—
Zi-ka-wei		—	79·9	308	12 25	+ 7	—	—	—	—
La Paz		Bi.	98·4	69	e 14 55	+53	i 24 33	−67	43·5	49·2
Toronto		M.	104·8	48	18 48?	?PR_1	25 18	−82	28·2	29·7
Washington		—	105·7	54	e 19 17	?PR_1	25 12	−97	e 28·5	—
Ottawa		—	107·7	47	17 44?	—	27 2	− 5	e 51·3?	—
Colombo	E.	M.	108·4	270	—	—	18 24	?PR_1	27·3	37·1
Harvard		B.O.	110·6	51	e 18 40?	PR_1?	i 26 17	−76	E 59·9	—
Kodaikanal		M.	111·6	274	19 30	PR_1?	—	—	62·8	69·7
Simla		O.E.	115·9	297	e 19 24	PR_1?	—	—	—	—
Cape Town	E.	M.	126·9	192	34 30	?	37 48	?SR_1	—	41·5
Pulkovo		G.	135·0	344	i 16 44	− 5	i 30 17	−16	57·5	76·7
Edinburgh		M.	141·4	9	21 20	?	—	—	—	42·0
Eskdalemuir		G.	141·8	9	19 51	[+ 8]	29 49	?	—	41·8
Stonyhurst		M.	143·5	9	19 30	[−17]	—	—	—	42·3
De Bilt	N.	—	145·9	2	e 20 3	[+13]	e 30 10	−86	—	77·5
Kew		M.	146·0	8	—	—	—	—	—	54·0
Uccle		—	147·1	4	i 20 0	[+11]	e 30 18	−84	—	86·5
Paris		—	149·0	6	20 (5)	[+ 9]	—	—	—	55·2
Graz		W.	150·1	348	e 20 9	[+13]	—	—	—	—
Zagreb		W.	151·2	347	e 20 7	[+10]	i 31 51	−12	—	71·5
Moncalieri		S.	153·1	359	20 12	[+12]	32 45	+32	43·6	—
Coimbra		—	154·3	28	20 18?	[+17]	i 44 10	?SR_1	E 85·5	—
Helwan		M.	154·7	303	19 54	[− 8]	—	—	—	53·0
Athens		—	155·3	327	20 9	[+ 7]	—	—	—	—
Rocca di Papa		Ag.	155·7	350	i 20 17	[+14]	—	—	44·0	—
Monte Cassino	N.	—	155·8	347	20 10	[+ 7]	—	—	—	—
Barcelona		—	156·2	9	e 20 15	[+12]	32 32	+ 6	49·4	—
Tortosa		—	156·5	13	20 12	[+ 9]	35 33	?	65·6	—
Rio Tinto		M.	156·9	28	22 30	—	—	—	—	45·5
San Fernando		—	158·0	29	20 30	[+24]	46 0	?SR_1	90·7	E 107·0
Algiers		B.M.	160·9	9	20 19	[+10]	25 30	?PR_1	43·5	53·5

If T_0 is rightly determined from the epicentral stations, the hypocentric stations assign an error of about [+10s.] corresponding to a high focus (about ·013 above normal). But there may be a considerable error in T_0, and no correction for focus has been used. See 1916 Oct. 20.

Melbourne gives PR_1 = +9m.30s. (−12s.), PS = +13m.24s., SR_1 = +16m.54s. (−26s.), SR_2 = +18m.18s. Osaka MN = +31·2m. Manila MN = +22·6m. Toronto give an L = +60·7m. Ottawa gives L = +61·5m., L = +77·5m., L = +89·5m. Harvard gives eE = +20m.20s., iE = +25m.20s., ? = +42·9m. Kodaikanal gives an eL = +29·0m., M = +29·7m. Pulkovo gives PR_1 = +22m.17s. (+15s.), SR_1 = +39m.24s. (−26s.), ip = +19m.38s., PR_2 = +24m.17s., PS = +33m.44s., SR_2 = +45m.18s. Epicentre 17°·0S., 179°·0E. Eskdalemuir gives PR_1 = +23m.26s. (+42s.). De Bilt gives eN = +33m.47s., eE = +42m.28s?, SR_1, eE = +43m.41s., eE = +61m.39s., ME = +63·5m. Zagreb gives iP = +20m.17s. Coimbra LN = +86·5m. Athens gives e = +20m.40s., e = 21m.1s., iP = +22m.31s., eL = +22m.36s., e = +24m.0s. PR_1? San Fernando MN = +106·0m.

June 24d. Records also at 0h. (De Bilt, Zagreb, Athens, Pulkovo, and Rocca di Papa), 2h. (De Bilt, Melbourne, Osaka, Pulkovo, Manila, Batavia, and Helwan), 3h. (Helwan), 6h. (Zagreb and Athens), 13h. (Paris), 14h. (La Paz), 18h. (La Paz), 21h. (Rocca di Papa).

June 25d. 13h. 8m. 24s. At 40°·0N. 20°·0E. (see June 29d. 8h.).

A = +·720, B = +·262, C = +·643 ; D = +·342, E = −·940 ;
G = +·604, H = +·220, K = −·766.

		△	Az.	P.	O−C.	S.	O−C.	L.	M.
		°	°	m. s.	s.	m. s.	s.	m.	m.
Athens		3·6	122	0 51	− 5	1 22	−17	—	E 2·3
Monte Cassino	E.	4·9	289	2 35	?S	(2 35)	+21	—	3·9
Rocca di Papa		5·8	290	e 1 33	+ 4	—	—	—	4·5
Zagreb	W.	6·5	335	e 2 2	+23	i 2 54	− 4	—	5·8
Graz		7·8	336	e 2 29	+31	—	—	—	—
Moncalieri		10·3	303	e 4 36	?S	(4 36)	− 1	7·0	8·0
Helwan	E.	13·7	134	7 36	?L	—	—	—	—
Uccle		15·3	320	e 10 0	?L	—	—	—	—
De Bilt	E.	15·8	325	—	—	7 36	=SR_1	9·5	11·9
Pulkovo		20·8	15	5 1	+10	9 4	+24	11·6	—

Athens records i = +1m.38s., i = +1m.48s., MN = +1·9m., T_0 = 13h.8m.34s. Zagreb gives iME = −4·9m., iMW = +5·4m., MW = +5·8m. Moncalieri gives S? = +6m.0s. De Bilt gives MN = +12·0m.

June 25d. Records also at 0h. (San Fernando), 1h. (La Paz), 10h. (Batavia), 18h. (Helwan).

1917. June 26d. 5h. 49m. 30s. Epicentre 16°·0S. 171°·0W.

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

Station and Component.		Machine.	△	Azimuth.	P.	O−C.	S.	O−C.	L.	M.
			°	°	M. S.	S.	M. S.	S.	M.	M.
Apia		W.	2·3	340	i 0 39	—	—	—	—	—
Sydney		M.	38·3	235	7 24	−16	13 0	−42	—	21·6
Honolulu		—	39·5	19	7 39	−20	14 0	0	—	—
Melbourne		M.	44·4	232	i 7 36	−53	14 42	−25	21·8	27·5
Adelaide	E.	—	48·7	237	8 30	−28	—	—	—	—
Lick	E.	—	70·5	40	e 11 26	+ 6	e 20 50	+18	30·8	35·1
	N.	—	70·5	40	e 11 24	+ 4	e 20 46	+14	30·7	35·3
Berkeley	N.	—	70·6	39	i 11 32	+11	20 53	+20	e 32·4	34·7
	V.	—	70·6	39	i 11 34	+13	20 57	+24	e 32·1	34·9
Mizusawa	E.	O.	70·9	322	11 18	− 4	20 18	+19	—	—
	N.	O.	70·9	322	11 18	− 4	19 58	+39	—	—
Nagoya		—	71·1	317	10 59	−25	—	—	—	—
Osaka		O.	71·8	316	11 19	−10	20 42	− 6	28·8	E 35·0
Manila		—	73·8	291	e 11 33	− 8	21 4	− 8	35·7	E 36·8
Tucson	E.	B.O.	75·1	49	12 7	+17	21 56	+29	35·3	36·6
	N.	B.O.	75·1	49	12 3	+13	22 11	+44	35·4	43·4
Victoria		—	77·1	30	12 26	+24	21 21	−29	35·7	41·2
Taihoku		—	77·5	301	11 53	−11	—	—	21·3	39·1
Zi-ka-Wei	E.	—	80·1	307	11 9	−71	22 22	− 2	—	38·7
Batavia		W.	80·7	266	i 12 13	−10	22 20 ?	−11	e 32·5	L 37·5
La Paz		Bi.	97·3	109	i 14 1	+ 5	i 25 38	+ 9	38·5	42·8
Toronto		M.	102·1	48	14 48	+27	25 30	−46	42·9	61·6
Washington	E.	—	103·0	53	e 14 19	− 6	25 18	−66	—	55·6
Ottawa	E.	—	105·0	46	14 25	− 9	25 23	−79	e 42·5	57·5
Calcutta	N.	O.E.	105·6	289	14 18	−19	26 18	−30	33·7	67·6
Harvard	E.	B.O.	107·9	50	e 14 25	−23	i 28 16	+67	e 43·7	50·7
Colombo	E.	M.	110·2	271	15 18	+20	28 12	+42	—	64·0
Kodaikanal		M.	113·3	274	14 54	−18	—	—	19·2	67·2
Simla		O.E.	116·6	297	19 30	PR_1?	27 36	−47	35·7	61·6
Bombay	E.	—	119·4	283	20 2	PR_1?	—	—	—	76·0
Mauritius	E.	M.	120·0	235	15 12	−30	—	—	30·8	64·4
Cape Town	E.	M.	129·3	190	21 36	PR_1?	23 24	?	35·6	86·8

Continued on next page.

For the following stations near the hypocentre the observations are usually of the phase denoted [P] ; but for Eskdalemuir and De Bilt a true P has apparently been observed. The values of [P] range from +22s. to −17s. The mean and median are both +5s., with a mean numerical error of ±7s. It seems scarcely advisable at this stage to apply the suggested small correction for focal height.

Station and Component.		Machine.	△	Azimuth.	P.	O−C.	S.	O−C.	L.	M.
			°	°	M. S.	S.	M. S.	S.	M.	M.
Pulkovo		G.	133·6	345	i 19 23	[− 4]	—	—	—	68·9
Dyce	N.	Ma.	138·0	9	19 47	[+11]	22 42	PR_1	—	78·5
Edinburgh		M.	139·1	11	20 0	[+22]	—	—	—	78·0
Eskdalemuir		G.	139·6	11	17 4	[− 7]	—	—	—	—
West Bromwich		—	142·5	11	19 50	[+ 6]	30 15	—	—	—
Azores		M.	142·6	48	20 24	[+40]	—	—	—	94·1
De Bilt	N.	—	143·8	4	17 36	+10	—	—	67·5	74·3
Kew		M.	143·9	9	19 30	[−17]	—	—	—	82·5
Shide		—	144·3	11	19 45	[− 2]	32 12?	—	—	—
Uccle		—	145·0	5	i 19 43	[− 5]	33 30	—	67·5	E 76·8
Paris		—	146·8	8	i 19 51	[0]	e 33 36	—	65·5	—
Besancon		—	148·7	4	19 57	[+ 3]	30 27	—	—	—
Zagreb		W.	149·7	350	e 19 53	[− 2]	i 33 59	—	70·4	E 83·2
Moncalieri		S.	151·0	3	i 20 2	[+ 5]	42 51	?SR_1	64.0	E 89·2
Coimbra	E.	W.	151·5	28	20 4	[+ 6]	23 48	?PR_1	71·9	80·3
	N.	W.	151·5	28	—	—	23 46	?PR_1	71·2	76·5
Marseilles		Ma.	152·6	4	20 11	[+11]	29 21	—	75·5	86·0
Barcelona	E.	—	153·9	11	e 20 6	[+ 5]	—	—	66·2	76·7
Monte Cassino	E.	—	154·2	351	20 1?	[0]	—	—	—	89·2
Rocco di Papa		Ag.	154·1	353	20 1	[0]	29 18	—	e 44·6	86·8
Tortosa		—	154·2	14	20 2	[+ 1]	34 40 ?	—	69·4	89·0
Rio Tinto		M.	154·3	29	61 30	?	—	—	—	82·5
Athens		—	154·6	332	20 18	[+16]	32 39	—	—	E 90·7
Helwan	E.	M.	155·3	308	20 24	[+22]	—	—	—	119·4
San Fernando		—	155·5	30	20 21	[+18]	35 30	—	79·0	—
Granada		C.	156·1	25	20 16	[+13]	—	—	—	—
Algiers		B.M.	158·6	13	20 8	[+ 1]	28 30	?	—	45·5

Sydney records PR_1 = +9m.0s. Melbourne gives PR_1 = +9m.54s., PS = +13m.42s., SR_1 = +18m.6s., SR_2 = +19m.30s. Lick gives T_0 = 5h.49m.29s. Berkeley gives eLE = +32·3m., ME = +34·5m. Osaka MN = +35·0m. Manila MN = +39·2m. Victoria records a series of L waves from 7h.23m.46s. to 9h.52m.58s. Zi-ka-wei SN = +22m.24s. La Paz gives PR_1 = +20m.0s., SR_2 = +32m.30s. Toronto gives Pi = +18m.6s. and a series of L waves from 6h.32m.24s. to 8h.20m.36s. Washington MN = +56·5m. Ottawa eLN = +44·5m. Calcutta gives PE = +14m.30s. (−7s.). Harvard gives i = +19m.5s. =PR_1, i = +24m.57s., SE = +25m.13s. Colombo recorded S =PR_1, L =S. Kodaikanal L recorded =PR_1. Mauritius LN =30·7m., MN =64·4m. Pulkovo gives iP = +16m.22s., iPR_1 = +21m.54s. De Bilt gives e_1 = +19m.43s. =P, e_2 = +41m.50s. =SR_1, eLE = +71·5m., ME = +85·0m. Uccle gives PR_1 = +23m.3s., SR_1 = +41m.48s., SR_2 = +48m.18s., MZ = +71·0m., MN = +77·8m. Paris gives i = +23m.41s. =PR_1, e_1 = +25m.7s., e_2 = +26m.34s. Zagreb has iPW = +19m.57s., iP = +20m.4s., esE = +33m.30s., iSE = +33m.43s., MW = +86·8m. Moncalieri MN = +79·1m. Barcelona = +22m.18s.?, iN = +24m.11s., LN? = +48·0m., MN = +79·2m. Rocca di Papa L = +97·3m., L = +138·3m. Athens has eP = +19m.56s., m = +21m.18s., e = +24m.2s. =PR_1, e = +32m.22s., e = +38m.24s., e = +39m.10s., i = +43m.25s. =SR_1, MN = +92·7m. San Fernando gives MN =7h.15m.12s. to 7h.52m.18s., ME = +7h.13m.30s. to 7h.50m.0s. Algiers gives PR = +24m.30s.

June 26d. Records also at 8h. (La Paz and Victoria), 9h. (Zagreb), 11h. (Zagreb), 13h. (Zagreb, Edinburgh, Moncalieri, Mauritius, Melbourne, De Bilt, Rocca di Papa, and La Paz), 14h. (Zagreb, Helwan, Paris, Eskdalemuir, Pulkovo, and Honolulu), 15h. (De Bilt), 16h. (Zagreb and Pulkovo), 17h. (Pulkovo), 18h. (Zagreb, Pulkovo, Osaka, and Melbourne), 19h. (De Bilt), 20h. (Helwan), 23h. (Moncalieri).

1917. June 27d. 12h. 26m. 35s. Epicentre 8°·8N. 81°·5W.

A = +·146, B = −·977, C = +·153 ; D = −·989, E = −·148 ;
G = +·023, H = −·151, K = −·988.

Station and Component.	Machine.	△	Azimuth.	P.	O−C.	S.	O−C.	L.	M.
		°	°	M. S.	S.	M. S.	S.	M.	M.
La Paz	Bi.	28·5	152	4 41	−92	10 27	−41	14·4	17·8
Washington	—	30·3	6	e 5 46	−45	— .	—	E 16·7	—
Harvard	B.O.	34·8	14	e 8 5	+54	—	—	—	—
Toronto	M.	34·9	3	12 49	=S	12 49	− 5	19·8	21·8
Ottawa	—	36·9	7	i 7 25	− 4	13 25	+ 2	E 20·0	—
Victoria	—	52·9	326	29 51	?L	—	—	(29·8)	34·8
Coimbra	W.	71·4	50	—	—	e 20 58	+15	34·4	—
San Fernando N.	—	72·9	54	11 25	−10	—	—	—	—
Honolulu	—	74·3	290	—	—	—	—	34·4	39·8
Eskdalemuir	G.	76·1	35	11 56	0	21 46	+ 8	35·4	—
Kew	M.	77·7	39	—	...	—	—	—	54·4
Paris	—	79·4	42	e 22 22	=S	(22 22)	+ 6	34·4	—
Uccle	—	80·5	40	e 12 25	+ 3	e 22 37	+ 8	36·4	—
De Bilt E.	—	81·0	38	e 12 33	+ 8	22 48	+13	38·4	43·3
Moncalieri	S.	83·2	45	i 23 4	=S	(23 4)	+ 5	41·7	—
Rocca di Papa	Ag.	87·2	48	—	—	12 1?	?P	—	13·4
Pulkovo	G.	93·0	28	13 26	− 6	24 31	−14	40·4	50·0
Helwan	M.	104·8	60	5 24	?	—	—	—	—

The La Paz observations are discordant and suggest an epicentre nearer La Paz ; but there must be some error as the P and S residuals are not consistent ; or, to put it in another way, the T_c from La Paz differs sensibly from the accordant testimony of other observatories.

Washington LN = +18·3m. Toronto gives S as +16m.49s., M = +24·5m., Lc = +57·0m. Ottawa records iN = +9m.0s. =PR_1, iN = P, P =S, S =SR_1?, LN = +18·4m. Paris gives iS = +22m.29s. De Bilt eN = +12m.52s., SN = +22m.47s., MN = +37m.7s., T_c =12h.26m.52s. Rocca di Papa gives eP = +7m.39s. Pulkovo gives PR_1 = +17m.15s., epicentre 29°·0S. 57°·0E.

June 27d. Records also at 0h. (Rocca di Papa, Zagreb, La Paz, De Bilt, Pulkovo, Monte Cassino, and San Fernando), 1h. (Tortosa), 3h. (Rocca di Papa), 4h. (Helwan), 5h. (Pulkovo, De Bilt, Zagreb (2), Honolulu, Melbourne, and Manila), 6h. (Eskdalemuir and Edinburgh), 7h. (Pulkovo), 8h. (Bombay), 11h. (Pulkovo), 12h. (Toronto, Ottawa, Rocca di Papa, and Edinburgh), 15h. (Monte Cassino).

June 28d. 13h. 55m. 0s. Epicentre 16°·0S. 171°·0W.

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

	△	Az.	P.	O−C.	S.	O−C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Melbourne	44·4	232	—	—	—	—	19·2	27·9
Berkeley	70·6	39	—	—	—	—	e 38·8	—
Victoria	77·1	30	39 8	?L	—	—	(39·1)	42·1
La Paz	97·3	110	—	—	—	—	49·0	52·8
Toronto	102·1	48	—	—	—	—	53·3	—
Washington	103·0	53	—	—	—	—	57·0	—
Ottawa	105·0	46	—	—	—	—	e 52·0	—
Harvard	107·9	50	—	—	—	—	e 47·4	—
Pulkovo	133·6	345	i 21 41	PR_1?	e 31 34	?	65·0	—
Edinburgh	139·1	11	75 30	L?	—	—	(75·5)	82·8
De Bilt N.	143·8	4	e 21 12	PR_1?	—	—	72·0	84·2
Kew	143·9	10	—	—	—	—	—	93·0
Uccle	145·0	5	e 19 42	[−6]	—	—	—	—
Paris	146·8	8	—	—	—	—	e 77·0	—
Graz	148·5	352	e 19 53	[−1]	—	—	—	—
Zagreb	149·7	350	e 19 53	[−2]	—	—	85·0	94·0
Moncalieri	151·0	3	—	—	—	—	e 85·1	—
Rocca di Papa	154·1	353	20 6?	[+5]	36 36	?	—	38·6
Helwan E.	155·3	308	60 0	?L	—	—	(60·0)	—
San Fernando	155·5	30	—	—	—	—	84·5	E 89·0

Toronto gives LE = +71·9m. Ottawa gives L = +60·0m. Harvard gives L = +48·8m. Pulkovo has i_2 = +22m.45s. Eskdalemuir (△ =139°·6), L =15h.4m. to 15h.30m.0s. De Bilt has eLE = +78·0m., ME = +88·7m. Zagreb gives iP = +20m.11s.

June 28d. Records also at 1h. (San Fernando), 16h. (Paris and Osaka), 21h. (Uccle), 23h. (De Bilt and Lick).

June 29d. 8h. 45m. 20s. At 40°·0N. 20°·0E. (see June 25).

A = +·720, B = +·262, C = +·643 ; D = +·342, E = −·940 ;
G = +·604, H = +·220, K = −·766.

	△	Az.	P.	O−C.	S.	O−C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Athens	3·6	123	e 0 50	− 6	e 1 23	−16	1·7	E 2·2
Monte Cassino	4·9	289	2 31	?S	(2 31)	(+17)	—	4·4
Rocca di Papa	5·8	291	e 1 37	+ 8	2 20	−19	—	4·3
Graz	7·8	336	e 3 10	?S	(3 10)	(−22)	—	—
Moncalieri	10·3	303	e 3 55?	?S	(e 3 55?)	(−43)	6·7	—
Helwan	13·7	134	7 40	?L	—	—	(7·7)	—
Paris	15·2	311	10 40	?L	—	—	(10·7)	—
De Bilt E.	15·8	325	—	—	7 8	+18	9·7	12·0
Pulkovo	20·8	15	5 2	+11	9 2	+22	11·7	—
Zi-ka-wei	78·3	59	e 12 58	+49	—	—	—	—

Athens gives MN = +1·9m. Rocca di Papa e =P, P =S, S is recorded as 3m.54s. De Bilt gives eSN = +7m.6s., eE = +7m.36s., MN = +10·3m.

June 29d. 16h. 7m. 8s. At 21°·0N. 106°·5W.

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

	△	Az.	P.	O−C.	S.	O−C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Tucson	11·9	342	N 2 50	− 8	E 4 35	−42	E 8·7	E 9·2
Berkeley E.	21·7	324	e 4 43	−18	—	—	—	14·5
Victoria	30·6	338	16 22	?L	—	—	(16·4)	19·8
Washington	30·9	48	e 5 38	−59	12 24	+35	E 15·7	—
Toronto	31·9	39	—	—	12 16	+10	i 18·9	19·6
Ottawa	35·1	39	E 7 7	− 7	N 12 57	0	e 15·8	N 20·8
Harvard	36·5	46	e 8 40?	+74	12 40?	−37	17·9	—
La Paz	53·1	132	9 21	− 6	17 16	+19	27·9	31·8
Edinburgh	79·9	34	22 52	=S	(22 52)	+30	—	—
Kew	83·2	37	—	—	—	—	—	51·9
San Fernando	85·4	53	35 52	?	—	—	—	—
De Bilt	85·9	35	—	—	—	—	—	E 51·7
Melbourne	95·5	312	—	—	—	—	e 65·6	68·9

Tucson gives NL = +7·6m., NM = +8·8m. Berkeley ePN = +4m.47s., MN = +8·4m. Washington eLN = +15·8m., L = +21·8m. Ottawa eLE = +16·8m., L = +22·9m., L = +27·9m. Harvard L = +20·7m., T_c = 16h.5m.3s. De Bilt gives e = +38m.18s., mN = +39m.3s., mE = +39m.24s., MN = +51·6m. Eskdalemuir (△ =80°·0) gives 16h.40m. to 17h.14m.0s.

June 29d. Records also at 0h. (San Fernando), 9h. (Zi-ka-wei, Pulkovo, and Zagreb), 10h. (Zagreb), 12h. (Moncalieri), 15h. (Athens and Zagreb), 21h. (De Bilt, Helwan, San Fernando, Paris, Pulkovo, and La Paz), 22h. (Moncalieri), 23h. (San Fernando and Lick).

1917. June 30d. 16h. 19m. 55s. Epicentre 39°·5N. 27°·0W.

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

Station and Component.	Machine.	△	Azimuth.	P.	O−C.	S.	O−C.	L.	M.
		°	°	M. S.	S.	M. S.	S.	M.	M.
Azores	M.	2·1	148	0 41	+ 8	—	—	—	0·7
Coimbra E.	W.	14·2	83	3 46	+17	—	—	7·3	8·0
N.	W.	14·2	83	—	—	—	—	7·2	9·7
San Fernando	—	16·6	94	—	—	—	—	8·6	10·1
Kew	M.	22·0	48	—	—	—	—	—	13·1
Barcelona	—	22·1	75	e 5 1	− 5	—	—	—	13·1
Eskdalemuir	G.	22·3	37	5 20	+11	9 37	+26	11·5	—
Edinburgh	M.	22·7	36	11 53	? L	—	—	11·9	—
Paris	—	22·9	56	i 5 21	+ 5	i 9 36	+13	13·1	15·7
Algiers	B.M.	23·7	86	5 20	− 5	9 38	0	—	12·6
Uccle	—	24·6	52	e 5 36	+ 2	e 10 5	+10	—	—
De Bilt E.	—	25·4	49	5 (48)	+ 6	10 (37	+26	e 12·6	15·1
Moncalieri	S.	26·1	67	(6 13?)	(+24)	(10 26	(+ 2)	—	—
Rocca di Papa	Ag.	29·9	72	i 11 20	? S	(11 20)	(−12)	(e 16·2)	18·1
Graz	W.	31·4	62	e 6 59?	+17	--	—	—	—
Zagreb	W.	31·8	64	e 6 40	− 5	e 11 55	−10	18·1	—
Pulkovo	G.	40·5	41	i 8 0	+ 1	i 14 15	+ 1	20·1	25·9
La Paz	Bi.	67·9	223	11 15	+12	—	—	—	—

De Bilt gives eLN = +13·0m., MN = +14·6m., T_o = 16h.19m.39s. Moncalieri records P? = +1m.10s., S = P, L = S. Rocca di Papa iP = S, S = L? Pulkovo records PR_1 = +9m.39s., SR_1 = +17m.31s., epicentre 38°·0N. 25°·0W.

1917. June 30d. 17h. 50m. 8s. Epicentre 8°·0N. 84°·0W.

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

Station and Component.	Machine.	△	Azimuth.	P.	O−C.	S.	O−C.	L.	M.
		°	°	M. S.	S.	M. S.	S.	M.	M.
Port-au-Prince E.	B.O.	15·5	46	e − 2 21	?	0 9	?	—	0·0
La Paz	Bi.	29·1	147	i 5 57	−22	10 27	−52	14·7	15·9
Washington	—	31·5	10	6 53	+11	12 4	+ 4	18·9	—
Tucson	B.O.	34·8	318	10 32	? S	(10 32)	−140	—	—
Toronto	M.	35·9	6	—	—	11 28	−100	19·3	21·4
Harvard	B.O.	36·2	16	i 6 52	−32	13 6?	− 7	e 19·5	—
Ottawa	—	38·1	10	N 7 46	+ 7	E 13 42	+ 3	19·9	—
Berkeley	—	45·7	317	—	—	e 18 32	= SR_1	—	—
Chacareta	B.O.	49·0	152	e 12 10	= PR_1	—	—	—	—
Victoria	—	52·3	328	31 38	? L	—	—	—	40·6
Coimbra	W.	73·9	50	10 5	−98	20 32	−41	e 33·0	—
San Fernando	—	75·4	54	21 22	= S	(21 22)	− 8	41·1	E 44·9
Eskdalemuir	G.	78·1	35	12 13	+ 5	21 50	−11	35·9	—
Edinburgh	M.	78·3	34	20 22	? S	(20 22)	−102	—	45·4
Paris	—	81·7	42	i 12 28	− 1	i 22 20	−23	33·9	E 39·9
Barcelona	—	81·8	49	—	—	—	—	e 33·7	44·9
Uccle	—	82·8	40	e 12 34	− 1	e 22 35	−20	—	—
De Bilt E.	—	83·2	38	12 39	+ 2	22 42	−17	—	43·9
Moncalieri	S.	85·5	45	12 58	+ 8	23 13	−11	34·3	—
Rocca di Papa	Ag.	89·6	48	13 6	− 8	22 11	−119	—	—
Zagreb	W.	91·1	43	13 16	− 6	23 53	−32	—	24·0
Pulkovo	G.	94·9	27	i 13 36	− 6	24 45	−20	41·9	59·1
Helwan	M.	107·4	55	—	—	—	—	—	69·9
Melbourne	M.	126·3	228	—	—	—	—	e 70·0	74·4
Colombo	—	158·0	48	88 52	? L	—	—	(88·9)	101·3

Toronto records another S at = +11m.52s. Ottawa L = +24·9m., L = +44·9m. San Fernando gives MN = +48·9m. De Bilt gives SN = +22m.43s., MN = +43·2m., epicentre 8°·1N. 74°·6W., T_o = 17h.50m.42s. Zagreb gives another eP = +22m.19s., eSE = +32m.54s. Pulkovo gives iP_2 = +22m.44s., PS = +26m.0s., i = +24m.13s., epicentre 3°·0N. 70°·0W. Helwan records P = 16h.34m.0s.

June 30d. Records also at 0h. (Mizusawa), 3h. (Zagreb), 4h. (Pulkovo, 5h. (Zagreb), 7h. (La Paz), 8h. (La Paz), 11h. (Moncalieri and Helwan), 13h. (Edinburgh), 14h. (Edinburgh), 17h. (Port-au-Prince and Mizusawa), 18h. (Mauritius and Kew).

July 1d. 0h. 44m. 40s. At 24°·5N. 143°·5E. (as on 1913 July 12).

A = −·732, B = +·541, C = +·415 ; D = +·595, E = +·804 ;
G = −·333, H = +·247, K = −·910.

		△	Az.	P.	O−C.	S.	O−C.	L.	M.
		°	°	m. s.	s.	m. s.	s.	m.	m.
Osaka		12·3	327	4 38	?S	4 38	−49	—	N 12·8
Mizusawa	E.	14·9	355	3 32	− 6	—	—	6·8	—
	N.	14·9	355	3 50	+12	—	—	6·8	—
Zi-ka-wei		20·6	294	4 48	0	c 8 42	+ 6	—	—
Manila		23·4	349	c 5 20	− 1	—	—	—	—
Honolulu		53·6	80	—	—	—	—	25·8	33·3
Pulkovo		79·7	332	i 12 13	− 4	22 21	+ 1	44·3	48·7
Helwan	E.	95·1	306	31 20	=SR_1	—	—	—	—
De Bilt	E.	95·2	344	c 48 44	?L	—	—	(c 48·7)	60·0
	N.	95·2	344	e 49 44	?L	—	—	(e 49·7)	63·4
La Paz		149·3	100	20 5	[+11]	—	—	—	—

Pulkovo gives Epicentre as 22°·0N. 139°·0E. Eskdalemuir gives 1h.33m. to 2h.10m.0s.

July 1d. 13h. Monte Cassino records P = 13h.2m.28s. and 13h.5m.33s. La Paz gives P = 13h.22m.0s., L = 13h.23m.0s., M = 13h.23m.12s. None of these seem to be connected with one another or with the following.

July 1d. 13h. 20m. 50s. At 50°·0N. 128°·0W.?

A = −·396, B = −·507, C = +·767.

	△	Az.	P.	O−C.	S.	O−C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Victoria	3·4	114	0 46	−7	1 16	−18	—	2·3
Toronto	33·3	81	6 58	−1	13 52	SR_1?	18·0	18·3
Ottawa	34·8	77	—	—	i 16 9	?	27·2	—
Ithaca	35·7	82	—	—	16 16	SR_1?	18·8	—
Cheltenham, U.S.	37·4	88	—	—	18 24	?L	(18·4)	19·8

Ottawa gives another i = +16m.43s. Ithaca eN = +16m.13s., LN = +19·5m. Cheltenham PN = +18m.19s., MN = +19·9m.

July 1d. Records also at 0h. (San Fernando), 2h. (Rocca di Papa), 7h. (Bombay), 8h. (Pulkovo), 11h. (La Paz), 16h. (Zagreb), 18h. (Osaka).

July 2d. Records at 0h. (San Fernando), 1h. (Manila), 11h. (Rocca di Papa), 14h. (Rocca di Papa), 15h. (Helwan and Rocca di Papa), 16h. (Moncalieri), 17h. (La Paz), 19h. (Helwan), 21h. (Manila).

July 3d. 2h. (40m.). Zagreb and Pulkovo record a distant shock. Pulkovo gives △ >13000km. Pacific Ocean.

July 3d. 2h. (54m.). Osaka records P = 2h.55m.24s., L = 2h.56m.33s., MN = 2h.57m.19s., △ = 4°·9, which must refer to a shock close to Osaka, not connected with the preceding.

July 3d. Records also at 0h. (San Fernando), 3h. (Helwan, Mizusawa, and Osaka), 4h. (De Bilt and Graz), 5h. (Zagreb), 9h. (Rocca di Papa and Monte Cassino), 11h. (Rocca di Papa), 16h. (Helwan), 17h. (Rocca di Papa), 18h. (Edinburgh), 21h. (Edinburgh), 22h. (Helwan and Pulkovo).

1917. July 4d. 0h. 38m. 20s. (I)
4d. 5h. 36m. 30s. (II) } Epicentre **25°·0N. 123°·0E.**

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

		Machine.	△	Azimuth.	P.	O−C.	S.	O−C.	L.	M.
			°	°	m. s.	s.	m. s.	s.	m.	m.
Taihoku	I	O.	1·3	274	1 14	+54	—	—	2·9	3·8
	II	O.	1·3	274	1 12	+52	—	—	3·1	3·2
Manila	I	—	10·6	191	e 2 46	+ 8	5 44	+60	7·6	8·3
	II	—	10·6	191	e 2 48	+10	6 26	+102	8·1	9·3
Osaka	I	O.	14·5	45	3 2	−31	—	—	6·3	8·9
	II	O.	14·5	45	3 13	−20	—	—	8·0	8·8
Nagoya	I	—	15·7	46	3 11	−37	—	—	—	—
Mizusawa	I	O.	20·8	43	4 20	−31	7 45	−55	—	—
	II	O.	20·8	43	4 20	−31	7 49	−51	—	—
Calcutta	I	O.E.	31·8	273	7 4	+21	12 34	+29	20·6	22·8
	II	O.E.	31·8	273	7 6	+21	12 18	+13	19·6	23·8
Batavia	I	—	35·0	209	i 7 9	− 4	i 12 50	− 5	—	14·3
	II	—	35·0	209	7 8	− 5	12 38?	−17	—	13·5
Simla	I	O.E.	40·7	290	7 52	−10	14 10	− 7	20·9	23·5
	II	O.E.	40·7	290	—	—	14 18	+ 1	—	27·3
Colombo	I	M.	45·1	254	8 16	−18	10 22	=PR_1	15·4	34·2
	II	M.	45·1	254	—	—	16 0	+44	—	41·5
Kodaikanal	I	M.	45·7	259	8 28	−10	15 28	+ 4	—	35·1
	II	M.	45·7	259	—	—	15 42	+18	18·7	34·8
Bombay	I	M.	46·8	273	9 31	+45	—	—	—	32·7
	II	M.	46·8	273	—	—	—	—	—	35·7
Riverview	I	—	64·7	154	i 10 39	− 4	e 18 58	−23	e 30·1	38·6
	II	—	64·7	154	—	—	e 19 12	− 9	e 33·2	38·4
Sydney	I	M.	64·7	154	—	—	14 4	=PR_1	31·2	38·4
Melbourne	II	M.	66·1	161	i 19 42	=S	(i 19 42)	(+ 4)	—	44·0
Pulkovo	I	G.	69·9	328	i 11 28	−12	20 46	+21	31·7	48·1
	II	G.	69·9	328	i 11 26	+10	20 47	+22	31·5	45·0
Honolulu	I	—	71·7	75	11 58	+30	20 28	−18	33·6	44·0
	II	—	71·7	75	20 30	=S	(20 30)	(−16)	34·7	43·7
Mauritius	I	M.	77·7	241	21 58	? S	(21 56)	+ 1	—	37·5
Helwan	I	M.	79·2	298	12 4	−10	—	—	—	61·5
	II	M.	79·2	298	11 36	−38	—	—	—	—
Athens	I	Ma.	81·8	308	i 12 33	+ 4	e 23 0	+16	—	59·7
Graz	II	W.	82·9	319	e 12 39	+ 4	—	—	—	—
Zagreb	I	W.	83·2	318	i 12 57	−20	e 23 4	+ 5	—	58·8
	II	W.	83·2	318	i 12 50	+13	e 23 5	+ 6	49·5	N 55·6
De Bilt	I	—	85·8	327	12 45	− 7	23 19	− 9	—	56·3
	II	—	85·8	327	12 51	− 1	23 36	+ 8	—	56·1
Victoria	I	—	85·8	38	12 22	−30	22 40	−48	40·0	63·6
	II	—	85·8	38	—	—	—	—	52·6	73·9
Dyce	I	Ma.	85·9	334	12 57	+ 4	23 25	− 4	41·0	51·3
	II	Ma.	85·9	334	13 15	+22	23 15	−14	49·5	58·0
Paris	I	—	86·4	325	e 13 11	+16	i 23 38	+ 4	30·7	48·7
	II	—	86·4	325	13 30	+35	i 23 40	+ 6	45·5	59·5
Monte Cassino	I	—	86·7	315	13 8	+11	—	—	—	23·9
Uccle	I	—	87·0	326	e 12 55	− 4	e 23 25	−16	—	59·0
	II	—	87·0	326	e 12 48	−11	e 23 30	−11	—	59·0
Edinburgh	I	M.	87·2	333	11 50	—	—	—	—	55·9
Rocca di Papa	I	Ag.	87·3	316	e 12 53	− 8	23 28	−16	e 39·0	58·2
	II	Ag.	87·3	316	e 13 42	+41	e 23 42	+ 2	e 53·6	—
Eskdalemuir	I	G.	87·5	333	12 57	− 5	23 26	−20	41·3	50·2
	II	G.	87·5	333	12 58	− 4	23 27	−19	41·5?	51·4
Stonyhurst	I	M.	88·2	331	i 14 16	+70	i 23 51	− 2	i 51·7	60·2
	II	M.	88·2	331	—	—	i 24 0	+ 6	i 52·5	59·9
Moncalieri	I	S.	88·6	320	13 12	+ 4	23 33	−26	30·9	59·3
	II	S.	88·6	320	e 13 12	+ 4	23 34	−25	35·3	57·8
Kew	I	M.	88·8	329	23 10	=S	(23 10)	(−51)	—	54·7
	II	M.	88·8	329	22 30	? S	—	—	—	59·5
Shide	I	—	89·8	328	13 18	+ 3	23 38	−34	—	60·2
	II	—	89·8	328	13 8	− 7	23 30	−42	—	60·5

Continued on next page.

		Machine.	△	Azimuth.	P.	O−C.	S.	O−C.	L.	M.
			°	°	M. S.	S.	M. S.	S.	M.	M.
Berkeley	I	—	92·2	46	e 13 4?	−24	e 23 57?	−40	—	—
Lick	I	—	93·2	46	—	—	e 24 5	−42	—	—
Barcelona	I	—	94·0	320	e 13 4	−34	24 6?	−50	e 31·4	50·7
	II	—	94·0	320	—	—	e 26 30?	?	e 49·6	62·7
Tortosa	I	—	95·3	320	13 40	− 5	24 10	−59	36·7	—
	II	—	95·3	320	13 30	−15	24 12	−57	40·0	63·0
Algiers	I	B.M.	96·3	316	e 16 46	? PR_1	24 16	−63	32·7	—
	II	B.M.	96·3	316	e 24 15	?S	(24 15)	(−64)	49·5	68·0
Rio Tinto	I	M.	101·4	321	21 40	?	—	—	—	64·7
San Fernando	I	—	102·0	320	24 40	?	42 40	?	56·2	62·2
	II	—	102·0	320	—	—	57 30	?	67·0	69·5
Ottawa	I	—	107·5	14	i 18 51	= PR_1	i 25 22	?	e 33·7	—
	II	—	107·5	14	i 18 34	= PR_1	i 25 1	?	e 32·5	—
Toronto	I	M.	108·3	17	—	—	26 10	−63	46·9	60·0
	II	M.	108·3	17	52 54	? L	—	—	63·3	77·5
Ithaca	I	B.O.	110·2	15	—	—	33 20	SR_1?	49·0	—
Azores	I	M.	110·8	334	59 28	?	—	—	—	72·9
Washington	I	—	113·4	17	e 19 1	? PR_1	28 53	+56	53·2	—
La Paz	I	Bi.	166·5	53	20 14	[− 1]	34 38	[− 8]	71·7	81·7
	II	Bi.	166·5	53	20 8	[− 5]	—	—	87·5	91·9

Manila gives I MN = +7·8m., II MN = +8·6m. Osaka I MN = +8·6m., II MN = +8·7m. Calcutta gives N II P = +7m.18s., S = +12m.36s., L = +19·6m., M = +23·2m. Simla II MN = +24·9m. Colombo I S = PR_1, L = S, II P = S. Kodaikanal I L = S, II P = S. Riverview I gives PS = +19m.30s., MN = +37·4m., MZ = +37·5m. II MN = +37·1m. Pulkovo I gives eP = +11m.25s., PR_1 = +14m.9s., PR_2 = +15m.53s., PS = +21m.31s SR_1 = +26m.0s., SR_2 = +29m.3s.; II PR_1 = +14m.17s., PR_2 = +16m.5s., PS = +21m.29s., SR_1 = +25m.44s., SR_2 = +28m.56s. Epicentre 26°·2N. 128°·8E. Mauritius I ME = +43·4m. Athens I MN = +55·3m. Zagreb I eP = +13m.3s., iS = +23m.17s.; II eP = +12m.40s., iS = +23m.17s. De Bilt I PR_1 = +16m.21s., PSE = +23m.46s., PSN = +22m.48s., MN = +51·1m. Epicentre 24°·0N. 129°·0E.? T_c = 0h.38m.29s.; II PR_2 = +16m.15s., PS = 23m.20s., SN = +23m.40s., MN = +57·9m. Epicentre 25°·1N. 126·5E. T_c = 5h.36m.33s. Uccle I iS = +23m.47s., MN = +51·5m. MZ = +59·0m. II MN = +57·6m. Edinburgh gives I P = 0h.5m.10s. Eskdalemuir I PR_1 = +16m.32s., SR_1 = +29m.42s., II PR_1 = +16m.36s., SR_1 = +29m.30s. Moncalieri I MN = +59·5m., II MN = +58·2m. Shide I PR_1 = +16m.44s., II PR_1 = +17m.9s. Algiers II c_2 = +38m.33s. Ottawa I ePE = +18m.46s., iSE = +25m.18s., with a series of L's for each quake. Washington I eE = +18m.53s. Milan II e = +24m.34s. Ithaca eN = +33m.21s., eLN = +52·9m.

Discussion of the residuals suggests that the values for T_c adopted above might be increased by some 7s. or 8s. for both I and II. This would give (from La Paz) a focal depth slightly greater than normal. But the material is not good enough to warrant refinements.

July 4d. 20h. 46m. 50s. At 30°·0N. 90°·0W.?? A = ·000, B = −·866, C = +·500.

	△	P.	O−C.	S.	O−C.	L.	M.
	°	m. s.	s.	m. s.	s.	m.	m.
La Paz	51·0	9 33	+20	—	—	—	—
Edinburgh	63·9	30 30	?	—	—	—	—
Tortosa	71·3	9 57	−88	17 59	−163	27·8	33·3
Moncalieri	74·3	e 10 47	−57	20 48	− 30	29·9	—
Pulkovo	77·7	i 12 33	+28	22 47	+ 50	38·2	—
Zagreb	78·9	10 57	−75	—	—	—	—
Helwan	98·1	19 10	?PR_1	—	—	—	—

Eskdalemuir simply gives 21h.22m. to 21h.33m.

July 4d. 22h. 9m. 30s. At 13°N. 90°·0E.

A = ·000, B = +·974, C = +·225; D = +1·000, E = ·000; G = ·000, H = +·225, K = −·974.

		△	Az.	P.	O−C.	S.	O−C.	L.	M.
		°	°	m. s.	s.	m. s.	s.	m.	m.
Calcutta	E.	9·6	351	2 12	− 12	5 24	+ 65	8·6	—
	N.	9·6	351	2 18	− 6	5 24	+ 65	8·6	13·2
Colombo		11·7	240	3 12	+ 17	—	—	9·5	14·0
Kodaikanal		12·6	258	11 6	?	—	—	—	—
Bombay		17·5	292	7 20	= S	(7 20)	− 9	—	13·1
Simla		21·6	329	e 8 30	= S	(e 8 30)	− 27	—	—
Batavia		25·5	138	5 28	− 15	—	—	—	17·5
Manila		30·1	83	e 5 30	− 59	9 32	−124	13·9	14·7
Taihoku		32·0	63	13 28	?S	(13 28)	+ 80	14·7	16·0
Osaka		46·3	54	e 11 29	+167	17 38	+126	22·7	24·9
Pulkovo		63·7	331	i 10 31	− 5	19 2	− 7	29·5	42·6
Zagreb		69·6	314	11 21	+ 6	20 34	+ 13	—	—
Moncalieri		75·4	314	e 21 36	= S	(e 21 36)	+ 6	39·2	—
Paris		78·6	318	e 22 30	= S	(e 22 30)	+ 23	e 46·5	53·5
Edinburgh		81·0	320	24 50	?S	(24 50)	+135	—	51·8
Tortosa		81·1	310	12 27	+ 1	22 47	+ 11	—	54·1
Eskdalemuir		81·1	320	12 20	− 6	22 44	+ 8	—	—
Honolulu		104·9	63	—	—	—	—	48·2	62·5

Manila also gives MN = +15·1m. Osaka MN = +25·0m. Paris LN = +51·5m.

July 4d. Records also at 3h. (Rocca di Papa), 13h. (Pulkovo and Edinburgh), 14h. (Pulkovo and Helwan), 16h. (Pulkovo), 17h. (Pulkovo and Edinburgh), 18h. (Helwan), 19h. (Helwan and San Fernando), 21h. (Bombay, Moncalieri, Kew, and La Paz).

July 5d. 0h. 37m. 40s. At 27°·0N. 121°·0E.? A = −·459, B = +·764, C = +·454.

	△	P.	O−C.	S.	O−C.	L.	M.
	°	m. s.	s.	m. s.	s.	m.	m.
Taihoku	2·0	0 30	− 1	—	—	1·4	1·5
Manila	12·4	e 3 20	−15	—	—	—	—
Pulkovo	67·3	—	—	e 20 1	+ 7	39·3	46·5
De Bilt	83·2	—	—	22 32	−27	44·3	52·7
Edinburgh	84·6	48 40	?L	—	—	—	—

Eskdalemuir records simply 1h.25m. to 1h.42m. De Bilt gives MN = +49·3m.

July 5d. Records also at 0h. (Taihoku), 6h. (Colombo), 8h. (Colombo and Manila), 10h. (Edinburgh), 12h. (Moncalieri), 15h. (Pulkovo), 16h. (De Bilt and Helwan), 17h. (La Paz), 19h. (Rocca di Papa), 20h. (La Paz), 21h. (Rocca di Papa, Lick, and Monte Cassino), 22h. (Monte Cassino).

July 6d. Records at 0h. (Moncalieri and Rocca di Papa), 2h. (San Fernando), 5h. (Pulkovo), 6h. (Melbourne), 19h. (Pulkovo and La Paz), 20h. (Helwan), 22h. (Azores), 23h. (San Fernando and La Paz).

July 7d. Records at 1h. (Pulkovo), 2h. (Pulkovo), 4h. (Zagreb and Helwan), 6h. (Manila), 12h. (Batavia), 18h. (La Paz), 21h. (Moncalieri), 22h. (Moncalieri, Paris), 23h. (San Fernando).

July 8d. 1h. 59m. 32s. At 42°·4N. 11°·1E. A = +·725, B = +·142, C = +·674.

	△	P.	O−C.	S.	O−C.	L.	M.
	°	m. s.	s.	m. s.	s.	m.	m.
Rocca di Papa	1·3	i 0 19	− 1	0 31	− 5	—	0·6
Monte Cassino	2·3	0 29	− 7	—	—	—	0·8
Pola	3·2	e 0 56	+ 6	—	—	—	—
Moncalieri	3·5	e 1 33	?S	2 52	+75	3·7	5·7
Triest	3·8	1 6	+ 7	—	—	—	—
Zagreb	4·9	1 18	+ 2	i 2 18	+ 4	—	2·8
Graz	5·6	e 1 36	+10	—	—	—	—
Vienna	6·9	e 1 51	+ 6	—	—	—	—
De Bilt	10·5	—	—	e 5 46	+63	7·1	7·6
Lemberg	11·7	—	—	e 7 10	?L	(7·2)	—

Zagreb records iPE? = +1m.31s., i = +1m.54s., iE = +2m.0s., iME = +2·4m., ME = +2·4m., iMW = +2·6m., MW = +2·8m. De Bilt records MN = +8·1m.

July 8d. Records also at 0h. (Edinburgh), 3h. (Monte Cassino), 10h. (Edinburgh), 17h. (Pulkovo and Manila), 18h. (De Bilt, Graz, and Helwan).

1917. July 9d. 0h. 21m. 35s. Epicentre 64°·0N. 20°·0W.

A = +·412, B = −·150, C = +·899 ; D = −·342, E = −·940 ;
G = +·845, H = −·307, K = −·438.

Station and Component.	Machine.	△	Azimuth.	P.	O−C.	S.	O−C.	L.	M.
		°	°	M. S.	S.	M. S.	S.	M.	M.
Dyce	Ma.	11·0	119	—	—	4 55	+ 1	6·2	—
Eskdalemuir	G.	12·1	128	—	—	—	—	5·4	—
Kew	M.	16·2	131	—	—	—	—	—	8·9
De Bilt E.	G.	17·6	121	4 16	+ 4	7 32	+ 1	8·9	10·8
Uccle	G.	18·4	124	e 4 19	− 3	e 7 49	0	e 9·9	10·9
Paris	G.	19·4	131	e 4 34	0	e 8 12	+ 2	10·4	11·4
Pulkovo	G.	23·4	77	i 5 20	− 1	i 9 34	+ 1	12·4	15·5
Moncalieri	S.	24·5	127	e 5 31	− 2	9 56	+ 2	13·3	14·6
Barcelona	—	25·9	140	—	—	(11 38)	+78	11·6	16·4
Tortosa	—	26·1	143	10 16	=S	(10 16)	− 8	15·9	—
Triest	—	26·2	118	10 25	=S	(10 25)	− 1	..	..
Zagreb	W.	26·9	115	—	—	e 10 49	+10	15·4	16·4
Pola	W.	26·9	119	—	—	—	—	14·4	—
Lemberg	B.O.	27·1	99	e 11 13	? S	(11 13)	+30	—	—
San Fernando N.	—	28·8	157	11 55	=S	(11 55)	+42	—	—
Toronto	M.	38·6	267	—	—	—	—	33·9	—
Helwan E.	M.	46·8	112	15 25	=S	(15 25)	−13	—	—
Victoria	M.	52·8	306	26 25	?	—	—	28·9	29·9

De Bilt gives PN = +4m.13s., MN = +11·0m., T_o = 0h.21m.41s. Moncalieri gives MN = +14·7m. Tortosa gives S = +14m.6s. Toronto gives another L at 0h.17·8m., before T_o. Zagreb gives MW = +18·4m.

July 9d. Records also at 1h. (Taihoku and La Paz), 2h. (Bombay and Marseilles), 3h. (San Fernando), 4h. (Helwan and Pulkovo), 5h. (Colombo), 9h. (La Paz and Manila), 10h. (Pulkovo and Edinburgh), 13h. (Moncalieri), 16h. (Moncalieri), 18h. (Osaka and Mizusawa), 19h. (Batavia), 21h. (La Paz), 22h. (Lick).

July 10d. 15h. 17m. 57s. At 30°·6N. 141°·8E. (as on 1913 April 8).

A = −·677, B = +·532, C = +·509.

	△	Az.	P.	O−C.	S.	O−C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Osaka	6·7	308	1 47	+ 8	—	—	3·8	5·3
Mizusawa	8·5	355	1 57	−12	3 30	−20	—	—
Pulkovo	73·6	331	—	—	1 21 5	− 4	34·0	—
Moncalieri	93·6	329	—	—	e 23 31	−81	—	—
La Paz	149·3	80	e 19 23	[−31]	—	—	—	—

The residuals would be diminished by moving the Epicentre to 31°·5N. 144°·0E.

July 10d. Records also at 1h. (San Fernando), 8h. (Capetown and Pulkovo), 10h. (Rocca di Papa and Helwan), 15h. (Rocca di Papa), 16h. (Moncalieri and Rocca di Papa), 18h. (Helwan, Pulkovo, and Moncalieri), 20h. (Bombay), 21h. (Rocca di Papa), 22h. (Rocca di Papa), 23h. (Edinburgh).

July 11d. 3h. 23m. 55s. At 44°·0N. 25°·0E.? (as on 1913 June 14).

A = +·652, B = +·304, C = +·695 ; D = +·423, E = −·906 ;
G = +·630, H = +·294, K = −·719.

	△	Az.	P.	O−C.	S.	O−C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Athens	6·2	187	e 1 35	0	e 2 53	+ 4	3·7	5·3
Zagreb	6·9	290	2 39	?S	(2 39)	(−28)	E 7·5	—
Moncalieri	12·3	279	e 7 26	?PR_1	? 10 44	+317	12·8	—
Helwan	15·0	160	5 5	?	—	—	—	—
Uccle	15·5	303	e 4 29	−43	e 8 29	+105	—	—
Pulkovo	16·1	10	i 3 51	− 2	i 6 52	− 5	8·1	14·7
Paris	16·2	295	e 3 41	−14	e 8 46	+106	13·1	—

Zagreb actually records P 10 min. later, but this is probably a misprint, as P would follow L. Athens gives MN = +4·1m. Eskdalemuir gives 3h.38m. to 3h.55m.0s.

July 11d. 13h. 51m.57s. At 43°·0N. 32°·0E. A = +·620, B = +·388, C = +·682.

	△	P.	O−C.	S.	O−C.	L.	M.
	°	m. s.	s.	m. s.	s.	m.	m.
Zagreb	11·8	e 2 57	−1	—	—	7·7	—
Vienna	12·1	e 3 2	+2	—	—	—	—
Graz	12·3	e 3 2	−1	—	—	—	—
Helwan	13·2	6 3	=S	(6 3)	(+14)	—	—
Pulkovo	16·8	i 4 0	−2	7 9	− 4	9·0	15·0
Moncalieri	17·5	i 5 13	PR_1?	—	—	11·1	—
De Bilt	20·2	—	—	e 8 39	+ 12	e 12·6	14·6
Paris	21·2	e 5 3	+8	—	—	12·0	—

De Bilt gives MN = +13m.3s.

July 11d. 22h. 41m. 25s. At 14°·0S. 174°·0W. (as on 1916 Oct. 11).

A = −·965, B = −·101, C = −·242 ; D = −·105, E = +·995 ;
G = +·241, H = +·025, K = −·970.

	△	Az.	P.	O−C.	S.	O−C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Apia	2·2	86	i 0 40	+ 6	—	—	—	1·0
Riverview	37·2	232	e 8 41	=PR_3	13 23	−4	16·0	20·1
Sydney E.	37·2	232	9 23	PR_2?	—	—	17·6	19·8
Honolulu	38·7	24	—	—	—	—	17·6	23·9
Berkeley	70·9	41	e 31 8	?L	—	—	(31·1)	—
Victoria	76·9	32	33 29?	?	—	—	36·0	40·9
Toronto	102·9	47	—	—	—	—	53·2	61·6
Mauritius N.	118·6	237	53 47	?	—	—	—	—
E.	118·6	237	55 17	?	—	—	—	—
Pulkovo	130·9	344	19 24	[+ 3]	—	—	60·6	70·9
Eskdalemuir	138·1	10	e 19 47	[+11]	—	—	—	—
De Bilt	111·9	1	19 52	[+10]	—	—	56·6	83·8
Uccle	143·2	8	e 19 43	[− 2]	e 29 5	?	—	—
Vienna	144·7	350	i 19 50	[+ 2]	—	—	—	—
Paris	145·1	356	e 19 50	[+ 2]	—	—	71·6	82·6
Graz	146·0	350	19 59	[+ 9]	—	—	—	—
Zagreb	147·1	348	e 19 56	[+ 5]	e 30 11	?	e 79·1	82·7
Moncalieri	149·0	358	e 20 8	[+14]	33 11	—	e 68·8	88·9
Rocca di Papa	151·6	349	i 20 9	[+10]	—	—	—	20·6
Helwan	151·7	309	25 35	?	—	—	—	—
Barcelona	152·4	6	—	—	—	—	71·6	82·6

Riverview gives also P = +9m.5s., MN = +20·6m. Pulkovo also records P? = +16m.13s., PR_1 = +21m.39s., i = +22m.49s., PS = +31m.41s., SR_1 = +39m.22s. Epicentre 19°·0S. 184°·0E. De Bilt gives eN = +29m.43s., eE = +41m.41s., MN = +73·7m. Paris i = +20m.3s. Moncalieri MN = +88·1m.

July 11d. Records also at 0h. (San Fernando), 8h. (San Fernando), 13h. (Apia, nearly simultaneous with shock near Athens).

1917. July 12d. 11h. 41m. 30s. Epicentre 8°·0S. 160°·0E.

A = −·931, B = +·339, C = −·139 ; D = +·342, E = +·940 ;
G = +·131, H = −·048, K = −·990.

Station and Component.		Machine.	△	Azimuth.	P.	O−C.	S.	O−C.	L.	M.
			°	°	M. S.	S.	M. S.	S.	M.	M.
Sydney		M.	27·1	196	—	—	11 0	+17	13·5	15·0
Riverview		—	27·1	196	e 6 12	+13	10 44	+ 1	e 13·5	16·0
Manila		—	44·8	300	e 62 4	?	—	—	—	—
Honolulu		—	50·5	54	10 18	+68	—	—	28·0	31·7
Batavia		—	52·7	268	e 9 30	+ 6	—	—	—	—
Zi-ka-wei		—	53·8	319	e 9 31	− 1	—	—	—	—
Victoria		—	87·3	40	25 30	?	31 24	?SR$_1$	41·7	50·3
Mauritius	N.	M.	98·5	248	49 0	? L	—	—	(49·0)	—
	E.	M.	98·5	248	44 42	? L	—	—	(44·7)	50·3
Pulkovo		G.	116·1	335	15 24	− 1	29 26	+67	46·5	71·8
Toronto		M.	117·4	45	—	—	—	—	64·6	75·0
Ottawa		—	118·4	42	—	—	—	—	e 59·9	—
La Paz		Bi.	126·4	117	19 59	[−51]	—	—	64·5	69·2
Helwan		M.	127·2	302	21 30	PR$_1$?	—	—	63·5	68·5
Edinburgh		M.	130·3	348	32 30	PR$_1$?	—	—	—	—
Graz		W.	130·6	329	e 18 30	[−62]	—	—	—	—
Zagreb	E.	W.	131·1	327	e 19 45	[+24]	—	—	63·5	68·5
De Bilt	E.	—	131·3	340	e 21 52	=PR$_1$	—	—	58·5	61·5
	N.	—	131·3	340	—	—	—	—	63·5	69·5
Uccle		—	132·6	339	e 23 12	—	—	—	e 65·5	81·5
Kew		M.	133·6	343	—	—	—	—	—	63·5
Paris		—	135·0	339	e 23 19	PR$_1$?	—	—	66·5	82·5
Moncalieri		S.	135·9	332	e 59 40	—	—	—	85·2	—
San Fernando		—	148·9	338	54 0	—	75 30	—	87·5	98·5

The residuals suggest that T$_o$ might perhaps be increased by 10s. Riverview records PS = +11m.7s. =PR$_1$, MZ = +18·7m., MN = +19·1m. Pulkovo records PR$_1$ = +20m.7s., S? = +26m.58s., PS = +29m.26s. taken as S, SR$_1$ = +35m.48s. Epicentre 4°·0N. 143°·0E. Ottawa gives L = +66·5m., L = +78·5m. Zagreb gives eW = +19m.40s. Eskdalemuir (△ = 130°·8, Az. 347°) gives simply 12h.3m. to 14h.30m.0s.

July 12d. Records also at 0h. (Kew and San Fernando), 2h. (Zagreb), 5h. (Bombay), 8h. (La Paz), 9h. (San Fernando), 10h. (De Bilt and Monte Cassino), 11h. (Moncalieri and Rocca di Papa), 13h. (Victoria and Toronto), 17h. (La Paz), 19h. (De Bilt, Helwan, and Pulkovo), 23h. (San Fernando and Pulkovo).

July 13d. 5h. 13m. 56s. At 19°·0N. 70°·0W. (as on 1916 Nov. 30).

A = +·323, B = −·889, C = +·326 ; D = −·940, E = −·342 ;
G = +·111, H = −·306, K = −·946.

		△	Az.	P.	O−C.	S.	O−C.	L.	M.
		°	°	m. s.	s.	m. s.	s.	m.	m.
Port au Prince	E.	2·1	260	i 0 35	+ 2	0 48	−10	1·5	1·9
Vieques	N.	4·4	99	0 29	−39	0 52	?	1·4	1·8
Washington		20·8	344	e 5 9	+18	8 56	+16	9·2	—
Ithaca		24·0	348	e 5 24	− 4	9 16	−28	—	—
Toronto		25·9	344	13 34	?L	—	—	16·5	21·3
Ottawa	E.	26·8	351	e 10 38	?S	16 35	?L	20·3	—
Edinburgh		61·4	36	21 4	SR$_1$?	—	—	—	38·6
Kew		62·7	41	—	—	—	—	—	45·1
De Bilt	E.	66·1	41	—	—	e 19 39	+ 1	31·1	32·5
Pulkovo		78·7	30	i 12 9	− 2	i 22 8	0	34·1	49·5
Helwan		90·0	58	51 4	—	—	—	—	—

Vieques SE = +0m.59s., ME = 1·6m. Ithaca eE = +8m.15s., eN = +9m.26s. Ottawa's time 5min. wrong ? Ottawa also records iPR$_1$ = +11m.45s., iPR$_2$ = +12m.17s., eSN = +16m.31s., i = +16m.54s., L = +26·1m. T$_o$ = 5h.16m.47s. ? De Bilt gives eLN = +28·1m., MN = +29·3m. Eskdalemuir gives 5h.43m. to 6h.0m.0s.

July 13d. Records also at 2h. (Pulkovo and Helwan), 6h. (Helwan), 12h. (San Fernando), 14h. (Pulkovo), 16h. (Riverview and Mizusawa), 17h. (De Bilt), 22h. (Pulkovo).

July 14d. Records at 2h. (Monte Cassino), 8h. (San Fernando), 13h. (Taihoku), 20h. (Manila), 21h. (Washington), 23h. (Pulkovo, Zi-ka-wei, and San Fernando).

1917. July 15d. 10h. 25m. 0s. Epicentre 65°·0S. 0°·0.

A = +·423, B = ·000, C = −·906 ; D = ·000, E = −1·000 ;
G = −·906, H = ·000, K = −·423.

		△	Az.	P.	O−C.	S.	O−C.	L.	M.
		°	°	m. s.	s.	m. s.	s.	m.	m.
Cape Town	E.	33·0	29	12 42	=S	(12 42)	+18	15·5	18·5
Cipolletti		46·2	270	e 6 54	?	—	—	—	—
Rio de Janeiro		50·4	305	—	—	14 48	−96	—	—
Pilar		50·6	279	e 10 24	+73	—	—	—	—
Mauritius	N.	58·5	69	19 54	=S?	—	—	—	28·1
	E.	58·5	69	20 12	=S?	—	—	—	28·7
La Paz		65·9	283	i 10 56	+ 6	18 31	−65	28·0	29·3
Riverview		78·7	156	e 23 30	=S	(e 23 30)	(+82)	e 34·8	43·9
Batavia		91·3	108	e 13 0	−23	—	—	—	—
Kodaikanal		94·0	74	46 54	?	—	—	—	—
Helwan		97·9	27	25 42	=S	(25 42)	(+ 7)	—	55·7
San Fernando		101·5	355	25 15	=S	(25 15)	(−55)	45·5	46·0
Rio Tinto		102·8	354	28 0	?	—	—	—	46·0
Tortosa		105·8	0	18 23	=PR$_1$	24 58	?	27·8	66·7
Rocca di Papa		107·2	10	e 55 44	?	55 53	?	—	56·1
Pola		110·3	10	—	—	e 28 36	+65	—	—
Zagreb		111·5	12	e 19 32	=PR$_1$	e 28 54	+72	59·0	61·0
Graz		112·6	11	e 19 38	=PR$_1$	—	—	—	—
Paris		113·7	3	—	—	e 29 0	+68	48·0	50·0
Vienna		114·0	12	e 20 48	PR$_1$?	—	—	—	—
Uccle		115·8	4	e 19 48	=PR$_1$	—	—	49·0	62·5
Kew		116·5	0	—	—	—	—	—	65·0
De Bilt		117·1	3	—	—	—	—	—	51·1
Eskdalemuir		120·3	358	i 20 18	=PR$_1$	e 29 59	+68	—	—
Edinburgh		120·9	0	36 0	=SR$_1$	—	—	—	—
Ottawa		124·9	304	—	—	eN 29 32	+ 7	35·7	—
Pulkovo		126·8	19	16 25?	+12	—	—	52·0	70·5

Riverview (△ = 79°) records P = +23m.33s. e(S?) = +28m.42s. =SR$_1$?, MN = +43·3m. Zagreb gives iE = −35m.10s. =SR$_1$. De Bilt gives MN = +63·6m. Eskdalemuir gives iS = +36m.20s. =SR$_1$. Ottawa gives eN = +20m.0s. =PR$_1$, eN = +22m.24s., eN = +25m.48s. Pulkovo records i = +19m.26s., PR$_1$ = +21m.26s., PR$_2$ = +24m.0s., PS = +31m.5s., SR$_1$ = +38m.0s.

July 15d. 11h. 20m. (10s.). Zagreb P = +11s. Rocca di Papa P = +34s., S? = +43s., M = +0·9m. Victoria P = +17m.44s., L = +24·1m., M = +28·2m., but these are not necessarily associated.

1917. July 15d. 17h. 58m. 40s. (I) } Epicentre 33°·5N. 46°·5E.
21h. 22m. 10s. (II) }

A = +·574, B = +·605, C = +·552 ; D = +·725, E = −·688 ;
G = +·380, H = +·401, K = −·834.

		△	Az.	P.	O−C.	S.	O−C.	L.	M.
		°	°	m. s.	s.	m. s.	s.	m.	m.
Helwan	I	13·4	259	3 20	+ 2	7 8	+74	—	11·1
	II	13·4	—	6 44	=S	(6 44)	+50	—	13·2
Athens	I	19·0	290	i 4 45	+16	e 7 0	−62	—	14·4
	II	19·0	290	i 4 38	+ 9	e 8 22	+20	—	e 14·4
Lemberg	I	23·2	321	i 5 31	+12	—	—	—	—
	II	23·2	321	i 9 48	=S	(9 48)	+19	—	—
Zagreb	I	26·3	306	e 5 45	− 6	e 10 34	+ 6	16·3	E 20·2
	II	26·3	306	e 5 49	− 2	i 11 30	+62	18·8	22·8
Graz	II	27·0	309	5 56	− 2	—	—	—	—
Rocca di Papa	I	27·8	297	e 6 7	+ 1	e 11 5	+10	e 16·1	—
Pulkovo	I	28·3	343	6 12	+ 1	11 10	+ 6	14·3	19·4
	II	28·3	343	6 3	− 8	10 53	− 9	13·8	19·3
Moncalieri	I	31·8	304	i 6 49	+ 4	12 6	+ 1	16·0	21·8
	II	31·8	304	i 11 57	=S	(i 11 57)	− 8	(15·5)	—
De Bilt	I	34·9	315	7 14	+ 2	12 52	− 2	—	26·0
	II	34·9	315	—	—	12 45	− 9	—	25·8
Uccle	I	35·1	313	i 7 12	− 2	12 55	− 1	—	—
	II	35·1	313	e 7 14	0	e 12 50	− 6	—	—
Algiers	I	35·4	288	—	—	e 12 55	− 6	—	27·3
Barcelona	I	35·7	296	e 7 27	+ 8	—	—	—	26·6
Paris	I	35·9	309	i 7 19	− 2	13 1	− 7	18·3	26·3
Kodaikanal	I	36·7	125	18 8	?L	—	—	(18·1)	—
Tortosa	I	36·9	295	7 27	− 2	13 20	− 3	16·0	16·2
Kew	I	38·0	312	—	—	—	—	—	13·3
Eskdalemuir	I	40·5	318	e 7 58	− 1	14 12	− 2	—	—
Edinburgh	I	40·6	319	13 45	=S	(13 45)	−30	—	31·6
San Fernando	I	42·8	289	12 50	?	—	—	32·8	35·8
	II	42·8	289	33 20	?L	—	—	(33·3)	—
Mauritius	I	54·7	167	22 44	$=SR_1$	—	—	—	—
Zi-ka-wei	I	61·9	68	e 17 46	?S	(e 17 46)	−61	—	—
Cape Town	I	72·4	205	39 50	?L	—	—	(39·8)	42·9
La Paz	I	119·3	270	—	—	—	—	64·3	—

Helwan gives II S = +9m.14s. Athens I e = +4m.52s., MN = +7·5m. Zagreb I iP = +5m.53s., iSE = +10m.39s., M = +10·8m. MW = +19·9m.; II ePE = +5m.51s., iW = +9m.29s. Pulkovo gives epicentre as 34°·0N. 46°·0E. Moncalieri I MN = +24·9m., II gives S? = +15m.28s. taken as L. De Bilt I MN = +25·2m., II MN = +25·0. Eskdalemuir I PR_1 = +9m.29s., II gives only 21h.36m. to 22h.10m.0s.

July 15d. Records also at 3h. (Moncalieri), 4h. (Moncalieri), 14h. (La Paz), 19h. (Port-au-Prince and La Paz), 21h. (Moncalieri), 22h. (Moncalieri, 2).

July 16d. 18h. 16m. 6s. At 49°·0N. 144°·0E. (Pulkovo).

A = −·531, B = +·386, C = +·755 ; D = +·588, E = +·809 ;
G = −·611, H = +·444, K = −·656.

	△	Az.	P.	O−C.	S.	O−C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Pulkovo	58·7	327	10 0	− 3	18 5	− 2	30·9	35·0
Vienna	72·8	327	e 11 30	− 5	—	—	—	—
De Bilt	73·1	335	—	—	20 38	−25	39·9	45·2
Graz	74·1	326	e 10 54	−49	—	—	—	—
Zagreb	75·0	325	e 11 44	− 5	21 24	− 2	—	—
Kew	75·1	338	—	—	—	—	—	44·9
Paris	76·7	335	—	—	—	—	e 46·9	47·9
Helwan	81·0	306	46 54	?L	—	—	(46·9)	—
La Paz	138·4	50	46 46	?L	—	—	(46·8)	—

Eskdalemuir (△ = 72°·1) Records 18h.36m. to 19h.45m.0s. Pulkovo gives SR_1 = +22m.36s., SR_2 = +24m.30s. De Bilt MN = +50·6m. Zagreb gives ePE = +11m.44s. Mizusawa e = +57m.36s.

July 16d. Records also at 2h. (Helwan and Pulkovo), 5h. (Manila), 15h. (Rocca di Papa), 21h. (La Paz, but recorded as 11h. after 19h.), 23h. (San Fernando).

July 17d. Records at 0h. (Pulkovo), 3h. (Riverview), 4h. (Mizusawa, Helwan, and Pulkovo), 19h. (Manila), 20h. (Manila), 21h. (Zagreb).

July 18d. 7h. 50m. 50s. At 35°·0N. 143°·0E. (as on 1915 April 24).

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

		△	Az.	P.	O−C.	S.	O−C.	L.	M.
		°	°	m. s.	s.	m. s.	s.	m.	m.
Mizusawa	E.	4·4	340	1 19	+11	2 13	+12	—	—
	N.	4·4	340	1 20	+12	2 21	+20	—	—
Osaka		6·2	270	1 26	− 9	—	—	3·6	4·3
Zi-ka-wei		18·4	266	e 4 23	+ 1	—	—	—	—
Manila		28·5	230	e 8 10	?	—	—	—	N 16·5
Honolulu		53·0	88	17 58	?	—	—	26·1	33·4
Pulkovo		70·3	330	11 19	0	20 31	+ 1	36·2	40·6
Vienna		84·1	328	—	—	—	—	e 47·2	—
Graz		85·3	327	—	—	e 22 58	−24	—	—
De Bilt		85·4	336	—	—	23 20	− 3	45·6	54·2
Zagreb		86·1	326	—	—	e 23 10	−21	48·2	N 51·7
Kew		87·7	338	—	—	—	—	—	53·2
Pola		87·8	327	—	—	—	—	e 49·2	—
Helwan	E.	88·6	306	30 10	$=SR_1$	—	—	—	—
Paris		89·1	335	e 23 40	= S	(e 23 40)	−24	48·2	60·2
Rio Tinto		101·9	336	63 10	?	—	—	—	68·2
Cape Town		134·9	255	39 28	$=SR_1$	—	—	—	44·5

Eskdalemuir (△ = 85°·1) gives 8h.16m. to 9h.10m.0s. Pulkovo records SR_1 = +25m.22s., SR_2 = +28m.28s. Osaka gives MN = +5·4m. De Bilt MN = +52·5m. Moncalieri gives e = +18m.51s.

July 18d. Records also at 1h. (San Fernando and Pulkovo), 4h. (Taihoku), 5h. (Athens), 10h. (Osaka, Pulkovo, Mizusawa, and Nagoya), 11h. (De Bilt), 17h. (Mizusawa and Osaka).

July 19d. Records at 0h. (San Fernando and Rocca di Papa), 1h. (Rocca di Papa, 3), 2h. (Rocca di Papa and Zagreb), 4h. (Athens), 6h. (Rocca di Papa), 10h. (Rocca di Papa and Edinburgh), 11h. (Rocca di Papa, Manila), 12h. (Rocca di Papa, 2).

July 20d. Records at 1h. (Rocca di Papa), 3h. (San Fernando and Helwan), 5h. (La Paz), 6h. (Monte Cassino and Mizusawa (2)), 7h. (Osaka and Pulkovo), 8h. (Edinburgh), 13h. (Helwan, Pulkovo, Rocca), 15h. (Manila), 22h. (Athens), 23h. (Lick).

July 21d. Records at 0h. (San Fernando), 1h. (Zagreb), 3h. (Edinburgh), 4h. (La Paz), 7h. (Manila), 11h. (Mizusawa), 16h. (Berkeley), 19h. (Colombo), 21h. (Lick), 23h. (San Fernando).

July 22d. 4h. 34m. 40s. At 12°·5N. 145°·0E. (near 1917 May 9).

A = −·800, B = +·560, C = +·216 ; D = +·574, E = +·819 ;
G = −·177, H = +·124, K = −·976.

	△	Az.	P.	O−C.	S.	O−C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Manila	23·5	278	e 5 20	− 3	—	—	10·8	—
Osaka	23·8	340	5 38	+12	—	—	—	10·6
Pulkovo	91·1	333	i 13 22	0	24 44	+19	46·3	—
La Paz	147·7	101	20 20	[+29]	—	—	—	—

Pulkovo gives epicentre 11°·0N. 150°·0E. ; also PR_1 = +16m.59s., PR_2 = +18m.56s., i = +23m.42s. (is this what has been called Y ?). Osaka gives MN = +10·8m.

July 22d. Records also at 1h. (Colombo), 7h. (Batavia), 12h. (Rocca di Papa), 17h. (Taihoku), 23h. (San Fernando).

July 23d. Records at 3h. (Athens, Rocca di Papa), 6h. (Helwan, Moncalieri), 7h. (Rocca di Papa), 9h. (Mizusawa), 18h. (Bombay), 22h. (San Fernando).

July 24d. 16h. 12m. 40s. At 33°·5N. 46°·5E. (as on July 15).

A = +·574, B = +·605, C = +·552; D = +·725, E = −·688;
G = +·380, H = +·401, K = −·834.

	△	Az.	P.	O−C.	S.	O−C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Helwan	13·4	259	4 38	+80	—	—	—	9·0
Lemberg	23·2	321	e 9 32	?S	(e 9 32)	+ 3	—	—
Zagreb	26·3	306	e 5 50	− 1	10 20	− 8	17·4	—
Graz	27·0	309	e 6 12	+ 14	—	—	—	—
Pola	27·6	304	e 15 20	?L	—	—	(e 15·4)	—
Pulkovo	28·3	343	i 6 15	+ 4	10 51	−13	14·9	18·1
De Bilt	34·9	315	12 44	?S	(12 44)	−10	17·4	22·9
Edinburgh	40·6	319	17 35	?SR_1	—	—	—	25·4

Eskdalemuir (△ =40°·5) gives simply 16h.27m. to 17h.8m. De Bilt gives MN = +20·4m. The evidence for identity with July 15d. is not convincing. Moncalieri gives S = +11m.50s., L = +17·6m., M = +20·8m.

July 24d. Records also at 2h. (Tortosa and Barcelona), 9h. (Manila), 15h. (La Paz), 22h. (San Fernando).

1917. July 25d. 3h. 19m. 0s. (I) } Epicentre 53°·5N. 159°·0W.
22h. 32m. 43s. (II) }

(as on 1917 June 4).

A = −·555, B = −·213, C = +·804; D = −·358, E = +·934;
G = −·751, H = −·288, K = −·595.

		△	Az.	P.	O−C.	S.	O−C.	L.	M.
		°	°	m. s.	s.	m. s.	s.	m.	m.
Victoria	I	22·8	89	6 48	+93	9 48	+27	11·8	13·7
	II	22·8	89	9 53	?S	(9 53)	+33	12·3	14·3
Berkeley	I	29·5	106	e 11 26	?S	11 26	0	—	15·3
	II	29·5	106	8 47	?	—	—	—	—
Lick	I	30·5	107	e 6 (0)	—	—	—	—	—
Honolulu	I	32·2	177	—	—	(12 6)	− 5	12·1	18·0
	II	32·2	177	—	—	(13 17)	(+66)	13·1	22·1
Mizusawa	I	42·4	275	7 57	—	—	—	—	—
Osaka	I	48·7	275	8 58	0	16 3	+ 1	22·1	27·0
	II	48·7	275	8 57	− 1	—	—	—	N 13·4
Toronto	I	50·7	67	5 12	−239	16 42	+15	28·1	32·6
	II	50·7	67	9 59	+48	20 12	+225	29·0	31·7
Ottawa	I	51·6	63	i 9 22	− 5	i 16 40	+ 1	e 25·3	—
	II	51·6	63	i 9 24	+ 7	i 16 45	+ 6	e 25·4	—
Ithaca	I	53·1	66	—	—	e 16 28	−29	25·5	—
Washington	I	55·3	70	e 9 18	−23	17 37	+12	e 30·0	—
	II	55·3	70	e 10 0	+19	e 17 34	+ 9	e 30·6	—
Cheltenham, U.S.	I	55·5	70	24 29	?	—	—	30·4	34·5
Zi-ka-wei	I	59·4	282	10 8	0	18 18	+ 2	—	—
	II	59·4	282	e 10 13	+ 5	—	—	—	—
Pulkovo	I	66·5	355	i 10 53	− 1	19 39	− 5	26·0	38·0
	II	66·5	355	i 10 57	+ 3	i 19 35	− 9	30·3	38·2
Dyce	I	67·6	13	e 11 6	+ 4	20 6	+ 9	—	39·8
Edinburgh	I	66·8	14	16 45	?	—	—	—	41·8
	II	66·8	14	17 47	?	—	—	—	41·8
Eskdalemuir	I	69·3	14	11 14	+ 1	20 19	+ 1	34·0	36·1
	II	69·3	14	11 18	+ 5	20 20	+ 2	33·4	—
Stonyhurst	I	70·9	14	16 12	?	i 29 0	—	—	46·0
Kew	I	73·5	14	31 0	?L	—	—	(31·0)	46·0

Continued on next page.

		△	Az.	P.	O−C.	S.	O−C.	L.	M.
		°	°	m. s.	s.	m. s.	s.	m.	m.
De Bilt	I	73·6	10	11 41	+ 1	21 11	+ 2	—	43·5
	II	73·6	10	11 43	+ 3	21 9	0	—	43·4
Uccle	I	74·7	11	e 11 47	0	e 21 19	− 3	—	—
	II	74·7	11	i 11 50	+ 3	e 21 17	− 5	—	—
Paris	II	76·5	12	e 12 2	+ 4	e 21 42	− 1	42·3	49·3
Lemberg	I	76·6	359	e 22 0	?S	(e 22 0)	—	—	—
Graz	II	79·3	3	12 17	—	—	—	—	—
Zagreb	I	80·6	3	e 13 30	+67	22 30	?	—	—
	II	80·6	3	e 12 22	− 1	e 22 22	− 8	—	—
Moncalieri	I	80·8	9	e 12 25	+ 1	22 32	− 1	35·8	52·4
	II	80·8	9	e 12 20	− 4	22 39	+ 6	42·2	—
Barcelona	I	83·6	14	12 38	− 2	—	—	38·4	48·4
Tortosa	I	83·9	16	12 39	− 2	23 6	− 1	36·1	53·3
	II	83·9	16	12 42	+ 1	23 2	− 5	41·7	54·6
Rocca di Papa	I	84·4	6	12 39	− 5	23 5	− 7	53·2	—
	II	84·4	6	12 41	− 3	23 1	−11	—	—
Monte Cassino	I	84·7	5	11 43	—	—	—	—	—
	II	84·7	5	12 45	—	—	—	—	—
San Fernando	I	87·0	22	22 0	?S	—	—	45·5	68·0
	II	87·0	22	39 47	?L	—	—	(39·8)	—
Algiers	I	88·4	14	(13 4)	− 3	23 44	−12	43·0	51·0
	II	88·4	14	—	—	e 23 43	−13	—	50·3
Bombay	I	95·0	312	—	—	23 33	−93	—	61·2
Helwan	I	96·0	351	17 0	+191	—	—	—	—
	II	96·0	351	41 17	?	—	—	—	—
Colombo	I	102·1	300	57 0	?L	—	—	(57·0)	64·0
La Paz	I	103·7	99	47 0	?L	—	—	(47·0)	61·3

Cheltenham is taken an 1h. wrong. PN = +23m.38s., LN = +30·6m., MN = +35·7m. Mauritius (△ =136°·3). NSM =4h.29m., EWM =4h.29m. Honolulu records S as L for both quakes. Osaka gives I MN = +29·0m. Ottawa records a series of L's for both quakes and gives the T_o as 3h.19m.12s., 22h.32m.54s. Washington gives I eZ = +9m.57s., eLZ = +30·9m., LZ = +32·9m. Pulkovo gives I i = +19m.3s., II PR_1 = +13m.27s., PR_2 = +15m.16s. Eskdalemuir gives I SR_1 = +25m.15s. De Bilt I eSR_1 = +25m.56s., MN = −40·7m. Epicentre 53°·1N. 157°·4W., T_o =3h.19m.10s. II e(SR_1) = +26m.9s., MN = +43·2m. Epicentre 54°·0N. 159°·0W., T_o =22h.32m.59s. Uccle I SR_1 = +26m.0s. Paris gives II eSN = +21m.53s., MN = +47·3m. Zagreb II iPW = +12m.35s., iP = +12m.42s., iSW = +22m.39s., iSE = +22m.42s. Moncalieri I MN = +50·8m. Algiers I the P is given as +3m.4s.

July 25d. Records also at 0h. (Mauritius, Monte Cassino, 2), 3h. (San Fernando, 2), 7h. (Pulkovo, Mizusawa, Osaka, Zi-ka-wei, and De Bilt), 10h. (Brekeley and Lick), 14h. (La Paz and Manila), 16h. (La Paz), 22h. (Zagreb), 23h. (Helwan and Rocca di Papa).

July 26d. Records also at 1h. (Uccle), 2h. (Rio de Janciro), 3h. (Uccle), 8h. (Lick, Berkeley, and Barcelona), 10h. (Lick and Edinburgh), 14h. (Zagreb and La Paz), 18h. (De Bilt), 22h. (La Paz), 23h. (La Paz).

1917. July 27d. 1h. 1m. 9s. Epicentre 19°·0N. 68°·0W.

A = +·354, B = −·877, C = +·326 ; D = −·927, E = −·375 ;
G = +·122, H = −·302, K = −·946.

Station and Component.	Machine.	△	Azimuth.	P.	O−C.	S.	O−C.	L.	M.
		°	°	M. S.	S.	M. S.	S.	M.	M.
Vieques	B.O.	2·6	107	0 53	+12	—	—	1·2	—
Port-au-Prince	B.O.	4·1	268	i 0 0	−64	—	—	—	—
Cheltenham, U.S.	B.O.	21·2	341	5 3	+ 8	8 51	+ 3	11·0	18·0
Washington	—	21·4	340	i 5 2	=PR$_1$	i 8 53	0	e 10·6	12·7
Ithaca	B.O.	24·5	345	4 46	−47	9 12	− 42	11·1	18·9
Toronto	M.	26·4	341	5 45	− 7	10 27	− 3	12·2	20·0
Ottawa	—	27·2	348	i 5 55	− 5	i 10 30	−15	e 12·3	28·8
La Paz	Bi.	35·5	180	i 7 9	− 9	12 44	−19	18·7	23·2
Tucson N.	B.O.	40·5	298	8 19	+20	—	—	(8·3)	26·2
E.	—	—	—	7 17	−42	—	—	(7·3)	33·2
Azores	M.	41·2	54	6 39	?	—	—	—	41·7
Lick E.	—	49·9	303	9 20	+14	16 21	+ 3	...	35·3
N.	—	—	-	9 14	+ 8	16 19	+ 1	24·3	30·3
Berkeley	—	50·5	304	e 9 15	+ 5	e 16 29	+ 4	—	35·8
Pilar	M.	50·9	175	e 9 21	+ 9	—	—	—	—
Rio Tinto	M.	56·1	57	−0 9	?	—	—	—	18·8
San Fernando	...	56·4	58	11 51	?	—	—	18·3	31·8
Eskdalemuir	G.	60·2	36	10 21	+ 8	18 34	+ 8	28·8	31·3
Edinburgh	M.	60·3	36	10 11	− 3	—	—	...	30·8
Stonyhurst	M.	60·4	38	i 10 3	−12	i 17 51	−37	28·7	34·5
Shide	—	60·8	42	10 25	+ 7	18 43	+10	—	29·8
Dyce	Ma.	61·1	34	e 10 38	+ 18	18 48	+11	22·1	33·8
Kew	M.	61·4	41	9 51	−30	—	—	—	43·8
Barcelona	—	62·9	52	10 35	+ 4	18 55	− 5	26·0	45·2
Paris	—	63·1	44	i 10 41	+ 8	i 19 11	+ 8	28·8	30·8
Algiers	B.M.	63·9	58	e 10 40	+ 3	19 19	+ 7	26·8	35·8
De Bilt E.	—	64·8	40	10 54	+10	19 34	+11	29·8	34·5
Moncalieri	S.	66·7	48	11 7	+11	i 19 59	+13	28·1	42·5
Rocca di Papa	Ag.	70·7	51	11 26	+ 5	e 20 35	+ 1	e 29·0	—
Monte Cassino	—	71·6	51	11 37	+10	—	—	...	—
Zagreb	W.	72·4	47	e 11 39	+ 7	e 21 42	+47	35·8	—
Pulkovo	G.	77·7	31	i 12 8	+ 3	i 22 2	+ 5	33·8	41·6
Athens	—	79·8	55	12 25	+ 7	i 22 25	+ 4	e 36·5	...
Honolulu	—	83·2	290	12 45	+ 8	23 9	+10	40·1	48·5
Helwan	M.	88·4	59	13 51	+44	—	—	—	—
Cape Town E.	M.	97·7	123	24 27	=S	(24 27)	−66	—	—
Mizusawa E.	O.	115·8	335	19 21	=PR$_1$	—	—	—	—
Osaka	O.	121·8	337	21 20	PR$_1$?	—	—	...	67·8
Zi-ka-wei	...	129·0	350	e 22 50	PR$_1$?	—	—	...	...
Kodaikanal E.	M.	135·1	52	23 27	PR$_1$?	—	—	82·2	91·9
Colombo E.	M.	139·0	54	30 21	=S	30 21	−37	101·5	112·0
Sydney E.	M.	142·2	239	18 21	+61	34 33	?	70·3	74·3
Riverview	—	142·2	239	e 21 39	?	e 33 27	?	e 67·8	72·3
Manila	—	145·2	345	e 19 33	[−15]	26 36	?	34·3	35·8
Batavia	—	166·2	22	e 25 51	?	—	—	—	—

Vieques gives LN = +1·3m. Cheltenham MN = +17·7m. Ithaca gives MN = +12·7m., LN = 15·5m. Port-au-Prince records another quake 45m. later. Washington gives MN = +16m.43s., PZ = +5m.6s., SZ = +9m.7s., eLZ = +11·2m. Ottawa gives ePN = +5m.53s., LE = +14·8m., MN = +21·0m., T_o = 1h.1m.16s. La Paz PR$_1$ = +8m.44s., S recorded as iP, SR$_1$ = +15m.17s. Tucson PN and PE recorded as L. Lick gives T_o as 1h.1m.28s. Berkeley eSV = +16m.40s., MN = +30·7m., MV = +34·7m., T_o = 1h.1m.19s. Paris gives SR$_1$ = +20m.33s. De Bilt MN = +41·6m., T_o = 1h.1m.24s. Epicentre 19°·3N., 68°·4W. Moncalieri gives MN = +39·8m. Zagreb gives iP = +11m.45s., i = +11m.51s., eSW = +21m.55s., iS = +22m.2s., i = +22m.47s. Pulkovo PR$_1$ = +15m.19s., PR$_2$ = +16m.41s., PS = +22m.49s., SR$_1$ = +26m.57s., MN = +40·9m., MZ = +41·6m. Mizusawa gives PN = −20m.51s. Osaka gives MN = +71·8m. Riverview gives PR$_1$ = +24m.38s., eS = +33m.41s., SR$_2$ = +41m.33s., SR$_2$ = +42m.33s. Manila MN = +36·7m.

The single Manila record of [P] suggests a rather deep focus, and other residuals are compatible with this view ; but the evidence is scarcely sufficient to warrant the refinement.

1917. July 27d. 2h. 51m. 40s. Epicentre 31°·0S. 72°·0W.

A = +·265, B = −·815, C = −·515 ; D = −·951, E = −·309 ;
G = −·159, H = +·490, K = −·857.

	△	Az.	P.	O−C.	S.	O−C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Pilar	7·0	98	1 32	−14	—	—	—	—
La Paz	14·9	15	i 3 34	− 4	i 6 44	+14	9·0	9·20
Port au Prince	49·5	0	e 6 27	?	—	—	—	6·35
Cheltenham, U.S. N.	69·9	356	11 0	−16	20 14	−11	—	43·9
Washington	70·1	356	e 11 6	−12	i 20 21	− 6	25·3	—
Ithaca	73·5	356	e 10 47	−52	20 21	−47	36·5	—
Cape Town	73·6	120	—	—	19 50	?	46·9	51·4
Toronto	74·9	354	10 2	?	21 32	+ 7	33·8	56·3
Ottawa	76·4	356	i 11 43	−14	i 21 31	−11	e 38·3	—
Lick N.	82·4	322	e 12 37	+ 5	e 22 49	− 1	—	—
Berkeley E.	83·2	322	e 12 37	0	e 22 55	− 4	—	—
N.	83·2	322	e 12 41	+ 4	e 22 45?	−14	—	43·0
San Fernando	91·3	47	22 50	?	—	—	52·6	60·3
Algiers	97·6	51	e 13 21	−37	e 23 53	−99	40·3	57·3
Honolulu	97·6	290	—	—	—	—	45·7	50·4
Tortosa	98·2	47	13 25	−36	24 42	−56	44·6	63·0
Barcelona	99·5	47	e 10 54	?	—	—	43·4	57·5
Melbourne	103·1	209	—	—	—	—	—	53·8
Bidston	103·3	35	—	—	25 24	−63	—	—
West Bromwich	103·4	36	—	—	25 40	−48	—	—
Riverview	103·5	216	—	—	e 27 26	+58	e 50·7	53·3
Paris	103·6	41	—	—	25 49	−40	47·3	58·3
Eskdalemuir	104·3	33	25 58?	=S	(25 58)	(−38)	40·8	49·5
Moncalieri	104·8	46	17 32	?PR$_1$	25 50	−50	34·7	64·2
Dyce	105·8	32	e 18 20	=PR$_1$	26 17	−33	55·5	62·3
Rocca di Papa	106·5	51	17 30	?PR$_1$	—	—	e 51·0	61·6
De Bilt	106·8	39	—	—	25 57	−62	50·3	59·9
Monte Cassino	107·0	52	18 18	?PR$_1$	—	—	—	—
Mauritius E.	109·8	130	24 38	?	—	—	—	53·7
N.	109·8	130	25 8	?	—	—	—	54·7
Zagreb	110·4	48	—	—	e 26 19	−73	56·3	66·3
Athens	112·7	58	e 18 57	=PR$_1$	e 28 27	+35	—	64·3
Pulkovo	122·4	36	e 18 44	[−14]	—	—	50·3	69·4
Batavia	142·8	179	e 17 20	−2	—	—	68·3	72·4
Colombo	141·3	127	—	—	68 20	?	78·1	83·0
Kodaikanal	144·9	120	—	—	—	—	69·2	80·9
Bombay E.	146·0	103	—	—	—	—	—	78·9
Mizusawa E.	151·9	296	20 1	[+ 2]	—	—	—	—
Osaka	156·7	286	20 51	[+47]	—	—	—	80·0
Manila	159·7	219	e 20 20	[+12]	—	—	—	—
Zi-ka-wei	168·5	274	e 21 33	[+89]	—	—	—	—

Cheltenham gives PE = +10m.58s.(−18s.), SE = +20m.12s.(−13s.) Ottawa records a series of L's and gives T_o = 2h.51m.33s. Lick gives T_o = 2h.52m.4s. Berkeley gives ePV = +12m.30s., T_o = 2h.51m.43s. Algiers S? is recorded as e(P) S is given as +29m.44s. Riverview gives e = +33m.8s. = SR$_1$(−16s.). Paris gives MN = +54·3m. Eskdalemuir gives PR$_1$ = +27m.43s., S = +32m.52s. = SR$_1$, SR$_1$ = +36m.35s.? Moncalieri MN = +65·7m. Dyce give another e = +24m.45s. De Bilt gives e(PR$_1$) = +18m.32s.(−26s.), e(SR$_1$)E = +33m.15s.(−47s.), MN = +51·0m. Zagreb gives e = +17m.50s., i = +18m.50s. = PR$_1$(−30s.), eE = +28m.22s. Pulkovo gives i = +20m.5s., MN = +58·3m., MZ = +69·5m. Batavia gives another M at +22m.20s. Mizusawa gives PN = +19m.48s. Osaka MN = +79·1m.

1917. July 27d. 16h. 15m. 15s. Epicentre 16°·0N. 64°·0W. (as on 1914 Oct. 3).

A = +·421, B = −·864, C = +·276 ; D = −·899, E = −·438 ; G = +·121, H = −·248, K = −·961.

		△	Az.	P.	O−C.	S.	O−C.	L.	M.
		°	°	m. s.	s.	m. s.	s.	m.	m.
Vieques	E.	2·5	328	0 49	+10	1 23	+14	1·6	2·2
Port au Prince		8·3	288	e 3 27	+81	4 33	+48	4·2	5·8
Washington	E.	25·6	336	4 58	−46	8 58	−76	10·0	—
	N.	25·6	336	4 56	−48	8 54	−80	9·7	—
Ithaca		28·4	340	e 9 14	?	—	—	11·1	—
Toronto		30·5	338	5 9	−84	10 45	−58	13·2	13·6
Ottawa		31·0	344	5 9	−89	10 29	−82	e 12·8	—
La Paz		32·8	187	7 12	+17	12 38	+17	22·2	23·5
San Fernando		54·8	56	15 45	?S	(15 45)	−94	40·8	42·8
Berkeley		55·4	305	e 24 35	?L	—	—	(24·6)	—
Victoria		57·9	318	—	—	27 33	?	33·2	38·9
Tortosa		60·5	52	10 28	+12	—	—	26·2	42·2
Stonyhurst		60·5	37	—	—	i 18 3	−27	29·0	34·8
Edinburgh		60·6	34	18 30	=S	(18 30)	− 1	—	31·5
Kew		61·2	40	—	—	—	—	—	43·8
Barcelona		61·7	52	28 8	?L	—	—	(28·2)	—
Paris	E.	62·6	43	e 10 58	+29	e 19 9	+13	29·8	—
	N.	62·6	43	e 11 27	+58	e 19 16	+20	36·8	—
Uccle		64·1	41	e 10 45	+ 6	e 19 21	+ 7	30·7	—
De Bilt	E.	64·7	39	10 50	+ 7	19 28	+ 7	30·8	34·5
	N.	64·7	39	—	—	19 31	+10	—	43·4
Rocca di Papa		69·6	51	e 11 19	+ 4	—	—	—	11·6
Zagreb		71·7	46	11 37	+ 9	21 1	+15	35·8	—
Pulkovo		78·3	31	e 12 5	− 4	e 21 52	−12	34·7	41·2
Helwan		86·6	60	21 45	?	—	—	—	—

Vieques PN = +0m.47s., MN = +1·9m. Eskdalemuir give only 16h.34m. to 17h.30m.0s. Port au Prince gives P = +3m.29s., S = +4m.15s., L = +4·4m. Washington VP = +5m.2s., VS = +9m.4s., VeL = +11·1m., VL = +14·8m. Ottawa gives T_o = 16h.13m.40s. Edinburgh is assumed to be 1h. wrong. De Bilt gives MN = +43·4m. Epicentre 16°·0N. 63°·7W. T_o = 16h.15m.28s. Zagreb gives eSW = +20m.52s., T_o = 16h.15m.36s. Pulkovo iP = +12m.8s., iS = +21m.57s., SR_1 = +26m.45s., MN = +41·2m., MZ = +41·8m. Epicentre 16°·0N. 62°·0W.

July 27d. 23h. 36m. 10s. At 7°·0S. 140°·0E.

A = −·760, B = +·638, C = −·122 ; D = +·643, E = +·766 ; G = +·093, H = −·078, K = −·993.

	△	Az.	P.	O−C.	S.	O−C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Manila	28·7	319	e 6 50	+35	11 18	+ 6	14·5	19·2
Riverview	28·7	160	e 6 14	− 1	e 11 8	− 4	e 13·7	19·0
Sydney	28·8	161	—	—	—	—	16·7	18·9
Batavia	32·9	270	e 6 50	− 5	—	—	—	—
Taihoku	36·7	331	e 8 35	=PR_1	13 8	−14	17·5	20·9
Osaka	41·9	354	7 56	−14	—	—	—	21·8
Zi-ka-wei	42·1	336	e 7 47	−25	—	—	—	—
Mizusawa	46·1	2	7 44	−57	—	—	—	—
Honolulu	67·1	63	17 50	?	—	—	28·4	33·8
Pulkovo	105·9	331	13 53	−45	25 40	−71	47·8	63·6
De Bilt E.	121·7	329	e 15 36	−15	—	—	60·8	72·1
Tortosa	130·6	320	22 35	?PR_1	—	—	57·8	78·9
La Paz	143·6	130	19 53	[+ 7]	—	—	—	—

Manila gives MN = +19·1m. Riverview MN = +20·7m. Osaka MN = +30·1m. Pulkovo gives PR_1 = +18m.22s. (−30s.), PS = +27m.29s., SR_1 = +32m.32s. (−82s.), MN = +59·5m., MN = +63·7m. Epicentre 1°·0N. 143°·0E. De Bilt records eE = +36m.54s. =SR_1 (−16s.), eLN = +57·8m., MN = +71·1m.

July 27d. Records also at 0h. (Marseilles and Eskdalemuir), 1h. (Port au Prince), 2h. (Cipolletti, Marseilles, Melbourne, and Manila), 3h. (Algiers, Victoria, Stonyhurst, and Kew), 4h. (Helwan), 5h. (Port au Prince (2)), 6h. (Port au Prince and Mizusawa), 7h. (Port au Prince and Pulkovo), 8h. (De Bilt), 10h. (Port au Prince), 11h. (Port au Prince and La Paz), 12h. (Manila), 14h. (Helwan and Pulkovo), 15h. (Rocca di Papa), 20h. (Port au Prince), 21h. (La Paz, Eskdalemuir, and De Bilt (2)), 22h. (Rocca di Papa (2), Helwan, and Adelaide).

July 28d. Records at 1h. (Pulkovo, Berkeley, Ottawa, and Toronto), 4h. (Rocca di Papa), 5h. (Port au Prince), 6h. (Algiers), 7h. (Pulkovo), 17h. (Rocca di Papa), 20h. (Batavia), 22h. (San Fernando), 23h. (Zagreb).

1917. July 29d. 1h. 57m. 0s. (I) / 14h. 32m. 15s. (II) Epicentre 41°·0N. 144°·0E.

A = −·611, B = +·444, C = +·656 ; D = +·588, E = +·809 ; G = −·531, H = +·386, K = −·755.

Station and Component.		Machine.	△	Azimuth.	P.	O−C.	S.	O−C.	L.	M.
			°	°	M. S.	S.	M. S.	S.	M.	M.
Mizusawa	I	O.	2·9	230	0 51	+ 6	—	..	1·4	..
	II	O.	2·9	230	0 47	+ 2	—	—	1·3	—
Nagoya	I	—	8·0	226	2 19	+18	—	—	—	—
	II	—	8·0	226	1 54	− 7	—	—	—	—
Osaka	I	O.	9·2	230	2 56	+37	—	—	5·0	N 5·8
	II	O.	9·2	230	2 23	+ 4	—	—	4·9	5·6
Zi-ka-wei	I	—	20·6	249	e 4 55	+ 7	—	—	—	—
	II	—	20·6	249	4 41	− 7	8 36	0	9·7	12·5
Taihoku	II	—	24·6	236	5 36	+ 2	9 50	− 5	13·4	14·9
Manila	II	—	33·1	224	e 7 1	+ 4	13 45	?SR_1	19·9	21·2
Calcutta	II	O.E.	49·9	266	9 33	+27	16 33	+15	30·8	—
Honolulu	II	—	52·3	94	9 57	−35	17 27	+39	25·1	43·1
Batavia	II	—	58·2	225	10 2	+ 2	—	—	—	17·9
Victoria	II	—	62·2	49	19 15	?S	(19 15)	(−24)	33·5	38·7
Bombay	II	—	63·8	273	—	—	—	—	—	40·9
Pulkovo	I	G.	65·6	333	10 50	+ 1	19 32	0	35·0	37·6
	II	G.	65·6	330	e 10 47	− 2	i 19 33	+ 1	31·7	42·1
Kodaikanal	II	M.	65·7	262	20 3	?S	(20 3)	(+30)	41·0	42·9
Colombo	II	M.	66·1	258	21 15	?	28 45	?	40·7	44·8
Berkeley	II	—	68·7	58	—	—	e 29 20	?	—	—
Sydney	II	M.	75·1	174	21 15	=S	(21 15)	−12	—	—
Dyce	II E.	Ma.	77·8	342	12 56	+50	22 6	+ 8	—	46·3
	II N.	Ma.	77·8	342	e 12 16	+10	22 26	+28	31·6?	46·4
Melbourne	II	M.	78·7	180	22 15	?S	—	—	—	60·2
Edinburgh	II	M.	79·2	342	12 15	+ 1	—	—	—	—
Eskdalemuir	II	G.	79·8	342	12 19	+ 1	22 22	+ 1	38·7	47·6
De Bilt	I	—	80·3	336	—	—	22 40	+13	e 43·0	48·3
	II	—	80·3	336	12 24	+ 3	22 26	− 1	37·8	48·2
Stonyhurst	II	M.	80·9	341	i 13 9	+45	i 22 57	+23	—	50·3
Uccle	II	—	81·7	336	e 12 24	− 5	e 22 39	− 4	39·7	46·7
Zagreb	II	W.	82·1	326	e 12 25	− 6	i 22 37	−10	44·8	—
Kew	I	M.	82·5	339	—	—	—	—	—	52·0
	II	M.	82·5	339	22 45	?	—	—	—	52·2
Shide	II	—	83·4	339	22 58	=S	(22 58)	(− 3)	40·0	49·5
Paris	II	—	84·0	336	12 40	− 2	23 3	− 5	40·7	47·7
Athens	II	—	84·2	316	—	—	—	—	46·2	—
Moncalieri	II	S.	85·6	331	i 12 47	− 4	i 23 17	− 9	33·7	56·5
Helwan	I	M.	85·7	307	56 0	—	—	—	—	—
	II	M.	85·7	307	12 21	−31	—	—	—	55·5
Monte Cassino	II	—	86·0	325	12 52	− 1	—	—	—	50·7
Rocca di Papa	II	Ag.	86·3	326	e 12 45	−10	e 23 11	−22	e 37·5	50·1
Ottawa	II	—	86·6	27	e 23 21	=S	(e 23 21)	(−16)	e 39·2	—
Toronto	II	M.	86·8	30	23 39	=S	(23 39)	(0)	49·5	56·3
Barcelona	II	—	90·7	332	e 16 45	?PR_1	—	—	e 44·1	52·4
Tortosa	II	—	91·8	333	13 19	− 7	23 50	−43	43·6	55·6
Washington	II	—	91·8	31	e 12 34	?	..	..	B 52·5	—
Algiers	II	B.M.	94·5	330	e 16 57	?PR_1	—	—	43·8	59·8
Rio Tinto	II	M.	96·8	337	27 45	?	—	—	—	68·7
San Fernando	II	—	97·9	336	17 45	−PR_1	24 15	−80	53·7	58·7
Mauritius	II N.	M.	100·2	252	25 51	=S	(25 51)	(− 7)	—	—
	II E.	M.	100·2	252	26 21	?=S	(26 21)	(+23)	—	57·2
La Paz	II	Bi.	143·2	58	19 43	[− 2]	—	—	69·7	71·5

For Notes see next page.

NOTES TO JULY 29d. 1h. 57m. 0s. (I) and 14h. 32m. 15s. (II).

Osaka II gives MN = +5·4m. Manila II MN = +22·7m. Victoria II gives S = +26m.33s. Pulkovo II records iP = +10m.51s., PR_1 = +13m.11s. (−39s.), PR_2 = +15m.9s. (+1s.), PS = +20m.32s., SR_1 = +23m.45s. (−57s.), Epicentre 37°·0N. 135°·0E. Eskdalemuir II gives iPR_1 = +15m.21s. (−27s.), SR_1 = +27m.30s. (−40s.). De Bilt I MN = +52·8m. II PN = +12m.22s., PR_1 = +15m.24s. (−36s.), e(SR_1) = +27m.38s. (−42s.), MN = +52·5m. Uccle II MN = +53·0m., MZ = +52·9m. Zagreb II iPW = +12m.36s., iPE = +12m.39s. Moncalieri II MN = +54·9m. Rocca di Papa II gives iP = +12m.50s., MN = 55·9m. Ottawa II gives iPE = +23m.32s., S = +30m.18s., ?SR_1, and a series of L's. Toronto II gives another at +19m.39s., S = +36?21s. Washington II gives LN = +51·2m. San Fernando II MN = +64·7m. La Paz II gives another P = +14m.53s.

July 29d. 6h. 9m. 0s. At 22°·0N. 76°·0W.

A = +·224, B = −·900, C = +·375 ; D = −·970, E = −·242 ; G = +·091, H = −·363, K = −·927.

		△	Az.	P.	O−C.	S.	O−C.	L.	M.
		°	°	m. s.	s.	m. s.	s.	m.	m.
Port au Prince		4·9	134	e 1 17	− 1	2 4	−10	2·3	2·5
Vieques	E.	10·7	110	1 50	−50	—	—	2·1	2·4
La Paz		39·3	168	8 10	+21	16 7	=SR_1	23·3	28·5
De Bilt	E.	67·4	41	—	—	20 8	+13	32·0	33·4
	N.	67·4	41	—	—	—	—	29·0	33·5

Vieques gives PN = +1m.52s., LN = +2·0m., MN = +2·2m.

1917. July 29d. 21h. 52m. 6s. Epicentre 3°·0S. 143°·5E.

(See July 30 & 31).

A = −·803, B = +·594, C = −·052 ; D = +·595, E = +·804 ; G = +·042, H = −·031, K = −·999.

		△	Az.	P.	O−C.	S.	O−C.	L.	M.
		°	°	m. s.	s.	m. s.	s.	m.	m.
Manila		28·4	309	e 6 9	− 3	11 34	+28	13·0	14·0
Riverview		31·7	168	e 6 41	− 3	i 11 51	−12	e 13·8	15·7
Sydney		31·7	168	6 39	− 5	11 39	−24	15·1	—
Adelaide		32·3	188	6 36	−14	11 30	−43	—	17·2
Melbourne		34·8	178	7 24	+13	12 54	+ 2	16·3	20·9
Taihoku		35·2	324	7 15	0	12 40	−18	15·8	19·4
Batavia		36·7	264	i 7 9	−19	—	—	—	—
Osaka		38·4	350	7 47	÷ 6	13 38	− 6	16·6	17·2
Nagoya		38·6	351	6 47	−56	—	—	—	—
Zi-ka-wei		40·1	330	7 51	− 5	13 54	−14	e 16·8	18·8
Mizusawa	E.	42·2	357	8 15	+ 3	14 33	− 5	—	—
	N.	42·2	357	8 12	0	14 25	−13	—	—
Calcutta	N.	59·5	298	10 54	÷46	(18 54)	+37	(18·9)	19·5
Honolulu		62·2	64	11 48	+82	20 6	+75	30·4	36·9
Kodaikanal		67·1	282	10 36	−23	(19 18)	−33	19·3	53·5
Bombay		72·8	291	5 27	?	—	—	—	56·6
Mauritius	E.	84·8	250	12 54	+ 7	23 12	− 5	28·3	46·1
Victoria		94·4	42	14 36	+56	23 30	−80	43·1	58·9
Berkeley		95·1	52	e 13 57	+13	e 24 35	−32	—	52·7
Lick		95·7	53	24 33	?S	(24 33)	−40	—	56·0
Pulkovo		104·1	331	14 19	−11	i 26 6	−28	40·9	65·2
Helwan		110·7	301	14 30	−31	19 0	?	—	22·9
Lemberg		110·9	323	e 19 24	PR_1	—	—	—	—
Athens		115·2	311	e 19 19	PR_1	e 27 33	−39	—	—
Vienna		116·2	324	e 19 6	PR_1	—	—	—	—
Cape Town		116·5	229	21 0	PR_1?	28 6	−17	61·6	69·3
Graz		117·2	323	e 19 21	PR_1?	—	—	—	—
Zagreb		117·5	321	e 15 24	− 8	i 28 5	−25	61·9	65·9
Dyce		119·4	340	e 20 45	PR_1?	30 35	÷110	50·9	74·8
De Bilt		120·0	332	15 34	− 8	e 28 22	−27	50·2	62·5
Edinburgh		120·7	339	20 19	PR_1?	—	—	—	—
Monte Cassino		120·8	318	19 53	PR_1	—	—	—	—
Eskdalemuir		121·2	339	15 37	−11	27 36	−82	51·9	57·8

Continued on next page.

		△	Az.	P.	O−C.	S.	O−C.	L.	M.
		°	°	m. s.	s.	m. s.	s.	m.	m.
Uccle		121·2	331	e 19 15	—	28 42	−16	49·9	73·3
Rocca di Papa		121·4	319	e 19 9	—	e 28 51	− 9	42·7	72·4
Stonyhurst		122·0	337	i 20 54	PR_1	—	—	—	76·6
Kew		122·9	334	21 54	—	—	—	—	83·9
Moncalieri		122·9	324	15 49	− 7	28 52	−19	45·8	73·9
Paris		123·4	330	i 20 57	PR_1	i 28 59	−16	50·9	57·9
Shide		123·8	334	20 58	PR_1	30 56	+98	53·1	65·1
Toronto		124·4	37	19 36	—	31 30	+128	43·5	76·6
Marseilles		125·2	324	21 21	PR_1	—	—	37·9	79·9
Ottawa		125·5	33	20 40	—	i 32 56	+206	—	65·7
Ithaca		126·8	37	—	—	—	—	59·6	—
Barcelona		128·2	323	e 21 4	PR_1	i 29 39	− 9	e 52·8	67·9
Washington	E.	128·5	40	e 19 54	—	23 0	—	e 32·9	—
	N.	128·5	40	e 19 36	—	23 2	—	—	—
Cheltenham, U.S.	E.	128·8	40	21 48	PR_1	31 52	—	—	71·3
	N.	128·8	40	21 44	PR_1	31 29	—	—	73·5
Cipolletti		128·9	148	e 19 18	[0]	—	—	—	—
Tortosa		129·6	324	e 19 16	[− 2]	—	—	58·9	84·9
Algiers		130·4	318	e 19 17	[− 1]	28 0	—	—	69·9
Rio Tinto		135·8	326	23 54	—	—	—	—	98·9
San Fernando		136·4	324	22 48	PR_1	39 54	—	72·4	80·9
Pilar		136·7	145	e 23 0	—	—	—	—	—
La Paz		143·1	123	i 20 6	[+21]	30 7	−75	62·5	71·2
Rio de Janerio		153·3	166	e 20 42	[+42]	—	—	82·9	—

Manila records MN = +13·2m. Riverview gives iP = +6m.45s., PR_1 = +7m.55s., i = +8m.45s., iS = +11m.58s., T_o = 21h.52m.17s. Epicentre 4°·0S. 144°·5E. Batavia iS = +8m.37s. =PR_1. Epicentre 4°·5S. 140°·8E. T_o = 21h.52m.12s. Osaka gives MN = +18·8m. Zi-ka-wei gives LE = +17·1m., LN = +17·2m. Mauritius gives LN = +40·5m., MN = +46·7m. Lick gives MN = +60·7m. Pulkovo records iPR_1 = +18m.38s., PS = +27m.50s., SR_1 = +33m.18s., SR_2 = +37m.0s. Epicentre 0°·4S. 140°·5E. Athens gives i = +30m.31s., e = +33m.46s. Zagreb gives eW = +19m.10s., eE = +20m.17s. =PR_1, iE = +25m.46s., iW = −25m.58s. Dyce gives i = +37m.10s. De Bilt records PR_1 = +20m.36s., e = +26m.10s., e = +30m.23s., m = +37m.10s. =SR_1, MN = +62·9m. Epicentre 3°·0S, 143°·5E. Eskdalemuir gives PR_1 = +19m.56s., PR_2 = +22m.37s. Uccle gives MN = +63·2m., MZ = +73m.3s., eP_2 = +20m.42s. =PR_1, e_2 = +36m.48s. =SR_1. Moncalieri MN = +74·0m. Paris i_2 = +37m.39s. =SR_1. Toronto gives P_2 = +23m.18s., i = +58m.0s. Ottawa gives Epicentre as 1°·0S. 143°·15E, T_o = 21h.52m.5s. Barcelona gives S? = +38m.47s. =SR_1. Washington eL? = +24m.12s. Algiers gives i = +21m.32s. San Fernando MN = +86·9m. Tucson records EL = 22h.11m.15s., EM = 22h.57m.54s., MN = 23h.5m.28s.

The above solution to a casual inspection seems to satisfy the usual conditions, the residuals being fairly small. But on closer scrutiny the adopted value of T_o is not satisfactory. The following stations show the correction required :—

	S−P	P_c	P_o	P_c-P_o
Riverview	− 9	−11	− 3	− 8
Sydney	−19	−24	− 5	−19
Melbourne	−11	−14	+13	−27
Osaka	−12	−15	+ 6	−21
Zi-ka-wei	− 9	−11	− 5	− 6
Mizusawa	− 8	−10	+ 3	−13
Mauritius	−12	−15	+ 7	−22

The correction indicated is −17s., which means that T_o should be altered to 21h.52m.23s. If we make this alteration the hypocentric stations will show an error of [−13]s. instead of (+4)s., indicating a focal depth 0·017 below the normal. We can now proceed to correct the position of the epicentre on two hypotheses—

(A) That the focal depth is normal,
(B) That it is 0·017 below normal,

as shown by the hypocentric stations. Collecting the observations in different azimuths, and assuming a correction of 1 minute to the times at Honolulu and Nagoya we have—

Azimuth	No. Stations	Corrections to △ (A)	(B)	Residuals (A)	(B)
°		°	°	°	°
64	1	+0·3	+2·5	−2·8	+1·4
176	4	−1·9	−0·7	−1·3	−0·3
257	2	−2·7	−1·1	+0·4	0·0
337	6	−1·7	−0·2	−1·2	−0·3

In solving the equations for correction x sin Az. + y cos Az. to position of epicentre, the first was omitted, since it depends on the single station (Honolulu) and a correction of 1min. has been applied.

The solutions were—

	x	y	Revised position of Epicentre	
	°	°	°	°
(A)	+3·0	+0·8	3·8S	140·5
(B)	+1·0	+0·5	3·5S	142·5

The residuals are clearly smaller when we correct for focal depth: and as the correction is deduced independently from the hypocentric stations, it seems to be justified by this result.

July 29d. Records also at 0h. (De Bilt, Osaka, and Mizusawa), 1h. (Zagreb), 2h. (Eskdalemuir), 3h. (Mizusawa and Port au Prince), 4h. (Mizusawa), 7h. (Pulkovo), 8h. (Port au Prince), 10h. (La Paz), 12h. (Manila), 14h. (Mizusawa (2)), 15h. (Mizusawa (2)), 16h. (Athens and Mizusawa), 18h. (La Paz and Manila), 19h. (Mizusawa), 22h. (Berkeley and Taihoku), 23h. (Toronto and Tucson).

July 30d. 0h. (0m.) or earlier. Rio Tinto records P −0h. 19m. 0s., M −0h. 56m. 0s.

July 30d. 0h. 31m. (15s.). Near Osaka ? But it seems doubtful whether the following records can belong to the same shock :—

	P	L	M
	m. s.	m.	m.
Mizusawa	0 28	1·0	—
Osaka	1 17	2·5	E 3·1
Manila	e 4 45	—	—
Riverview	e 14 45	—	E 16·3
Adelaide	—	—	15·8
Melbourne	—	—	17·7
La Paz	17 29	—	—

Julu 30d. 2h. (5m.). Riverview gives P = +5m.12s., M = +10m.51s.

July 30d. 2h. 32m. (40s.). Calcutta gives NSP = +0m.56s. and EWP = +74s., NSS = +92s. and EWS = +134s. Pulkovo eL = +23m.20s.

July 30d. 3h. 0m. (0s.). Rocca di Papa gives P = +26s., M = +51s. Mizusawa PE = +53m.27s., LE = +55·1m. De Bilt eL = +14m., M = +14·8m. possibly refer to this or the previous shock.

We now have a series of possible repetitions from the epicentre of July 29d. 21h., as suggested by De Bilt. But some of them are very doubtful indeed.

July 30d. 4h. 21m. (0s.) ? ? At 3°·0S. 143°·5E. Riverview P = +7m.12s., L = +13·3m., M = +16.5m. La Paz P? = +15m.26s. Pulkovo SR_1? = +36·0m. De Bilt L = +57·0m.

July 30d. 8h. 46m. 50s. At 3°·0S., 143°·5E.? (as on July 29d. 21h.).

	△	Az.	P.	O −C.	S.	O −C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Manila	28·4	309	e 5 10	−62	—	—	—	—
Riverview	31·7	168	12 28	?S	(12 28)	+25	e 17·9	19·3
Sydney	31·7	168	9 46	?	—	—	18·0	19·7
Adelaide	32·3	188	14 4	?SR_1	—	—	—	20·6
Melbourne	36·8	178	10 40	?S	(10 40)	−161	20·2	22·2
Zi-ka-wei	40·1	330	8 13	+18	—	—	—	—
Pulkovo	104·1	331	14 34	+ 4	26 27	− 7	48·2	53·2
Helwan	110·0	301	50 10	?L	—	—	(50·2)	—
De Bilt	120·0	332	—	—	—	—	60·2	62·7
La Paz	143·1	123	20 27	[+42]	—	—	—	—

Riverview gives S? = +15m.58s., MZ = +23·1m., MN = +23·2m. Pulkovo records PR_1 = +18m.56s., i = +25m.21s., SR_1 = +33m.40s., SR_2 = +38m.28s. De Bilt MN = +63·0m. Edinburgh records P as + 62m.10s., M = +97·4m.

July 30d. 10h. 28m. 0s. At 3°·0S. 143°·5E.?

	△	Az.	P.	O −C.	S.	O −C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Sydney	31·7	168	6 24	−20	—	—	e 13·8	14·5
Riverview	31·7	168	e 7 12	+28	—	—	e 13·2	13·9
Melbourne	34·8	178	e 8 48	?PR_1	—	—	15·7	16·5
La Paz	143·1	123	16 11	?	—	—	—	—

Riverview gives MN = +18·2m.

July 30d. 10h. 36m. 10s. At 3°·0S. 143°·5E.?

	△	Az.	P.	O −C.	S.	O −C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Riverview	31·7	168	e 18 2	?	—	—	—	19·7
Pulkovo	104·1	331	14 53	+23	26 18	−16	36·8	—
De Bilt	120·0	332	—	—	—	—	47·8	63·0
La Paz	143·1	123	20 29	[+44]	—	—	—	—

Riverview gives MN = +21·4m. Pulkovo records PR_1 = +19m.10s., i = +25m.30s. De Bilt gives MN = +50·5m.

July 30d. 13h. 49m. 50s. At 3°·0S. 143°·5E.

It is assumed that this is a repetition from July 29d. 21h., but some of the residuals throw doubts on the exactness of the repetition.

		△	Az.	P.	O −C.	S.	O −C.	L.	M.
		°	°	m. s.	s.	m. s.	s.	m.	m.
Manila		28·4	309	6 10	− 2	—	—	—	—
Riverview		31·7	168	e 6 46	+ 2	e 11 28	−35	e 16·0	21·5
Sydney		31·7	168	(6 46)	+ 2	6 46	=P	18·1	21·2
Adelaide		32·3	188	10 52	—	—	—	17·0	18·3
Melbourne		34·8	179	e 11 16	—	16 10	—	19·2	20·2
Batavia		36·7	264	e 1 10	—	—	—	—	9·2
Zi-ka-wei		40·1	330	e 8 5	+ 9	—	—	—	—
Pulkovo		104·1	331	14 32	+ 2	26 17	−17	47·2	53·0
De Bilt	E.	120·0	332	e 22 4	?PR_2	—	—	60·2	62·8
Edinburgh		120·7	339	36 10	=SR_1	—	—	—	—
Kew		122·9	334	—	—	—	—	—	69·2
Paris		123·4	330	e 32 10	—	—	—	63·2	—
San Fernando		136·4	324	48 10	—	—	—	—	—
La Paz		143·1	123	18 0	+37	—	—	—	—

Riverview gives MN = +22·1m., MZ = +22·3m. Melbourne has PR_1 = +12m.10s. =S?, S =16m.10s. =L?. Pulkovo records PR_1 = +18m.48s., SR_1 = +33m.34s. Epicentre 3°·0S. 135°·0E. De Bilt gives eLN = +61·2m., MN = +64·2m.

July 30d. 16h. 22m. 30s. At 3°·0S. 143°·5E.?

		△	Az.	P.	O −C.	S.	O −C.	L.	M.
		°	°	m. s.	s.	m. s.	s.	m.	m.
Manila		28·4	309	6 40	+48	—	—	—	—
Riverview		31·7	168	e 6 46	+ 2	e 11 58	− 5	e 16·1	19·9
Sydney		31·7	168	8 28	?PR_1	13 52	?SR_1	17·5	18·3
Adelaide		32·3	188	12 46	?SR_1	—	—	17·3	17·9
Melbourne		34·8	180	12 40	?S	(12 40)	−12	19·2	20·1
Batavia		36·7	264	e 6 40	?	—	—	—	—
Zi-ka-wei		40·1	330	e 7 47	− 9	—	—	—	—
Honolulu		62·2	64	—	—	—	—	32·7	36·5
Pulkovo		104·1	331	14 10	−20	25 58	−36	46·7	52·7
De Bilt	E.	120·0	332	20 34	?PR_1	—	—	57·7	62·2
La Paz		143·1	123	i 19 57	[+12]	—	—	—	—

Riverview gives M = +18·8m., MN = +19·2m., MZ = +23·2m. Pulkovo gives PR_1 = +18m.29s., SR_1 = +32m.52s., SR_2 = +37m.28s.

July 30d. 16h. 55m. 50s. At 3°·0S. 143°·5E.?

		△	Az.	P.	O −C.	S.	O −C.	S.	M.
		°	°	m. s.	s.	m. s.	s.	m.	m.
Colombo		64·3	279	18 10	?S	(18 10)	(−67)	—	—
Victoria		94·4	42	—	—	—	—	—	25·7
De Bilt	E.	120·0	332	—	—	—	—	24·2	28·6
Edinburgh		120·7	339	15 10	−36	—	—	—	—
Kew		122·9	334	—	—	—	—	—	50·2
Paris		123·4	330	—	—	—	—	e 28·2	—
Toronto		124·4	37	—	—	—	—	35·2	—
La Paz		143·1	123	20 0	[+15]	—	—	49·2	50·7

De Bilt gives LN = +25·2m., MN = +37·3m. Toronto gives another L = +39·8m. Eskdalemuir records only 17h. 19?m. to 17h. 37?m.0s.

July 30d. 21h. 57m. (50s.) The following records may possibly refer to a shock about this time, but fuller interpretation is not easy.

	P.	S.	L.
	m. s.	m. s.	m.
Colombo	4 58	8 52	18·0
La Paz	26 16	—	44·2
Mizusawa	30 34	—	—
Riverview	64 10	—	69·1
Pulkovo	—	—	69·7
Edinburgh	—	—	113·7

1917. July 30d. 23h. 54m. 5s. Epicentre 29°·0N. 104°·0E.

A = −·212, B = +·849, C = +·485; D = +·970, E = +·242; G = −·117, H = +·470, K = −·875.

Station and Component.	Machine.	△	Azimuth.	P.	O—C.	S.	O—C.	L.	M.
		°	°	M. S.	S.	M. S.	S.	M.	M.
Calcutta	O.E.	15·5	249	3 58	+12	6 34	−10	9·2	—
Taihoku	—	16·1	100	6 22	=S	(6 22)	(−35)	9·4	15·4
Osaka	O.	27·2	70	6 7	+ 7	10 47	+ 2	14·9	16·7
Nagoya	—	28·4	69	4 29	?	—	—	—	—
Bombay E.	—	30·1	257	9 37	?	—	—	—	20·2
Kodaikanal E.	M.	31·2	238	11 25	?S	(11 25)	(−29)	19·3	25·2
Colombo E.	M.	31·8	231	11 37	?S	(11 37)	(−28)	—	26·3
Mizusawa N.	O.	32·1	62	7 20	+32	—	—	11·8	—
Batavia	—	35·3	175	6 50	−26	12 19?	−41	—	20·9
Pulkovo	G.	57·2	325	e 9 56	+ 3	i 17 56	+ 7	28·9	33·0
Lemberg	B.O.	62·1	314	e 12 37	?PR_1	—	—	—	—
Helwan E.	M.	62·2	291	10 13	−13	—	—	—	41·5
Athens	Ma.	65·6	301	e 10 50	+ 1	e 19 38	+ 6	—	46·4
Zagreb	W.	68·4	312	e 11 2	− 5	i 20 9	+ 2	—	—
Trieste	—	69·9	312	—	—	e 21 15	+50	—	—
Shide	—	76·8	321	12 9	+ 9	21 48	+ 1	—	47·9
Rocca di Papa	Ag.	72·1	309	e 11 31	0	—	—	e 38·1	54·8
De Bilt	—	72·6	320	—	—	21 6	+ 9	35·9	40·8
Uccle	—	73·6	320	e 11 40	0	e 21 13	+ 4	35·9	41·3
Dyce	Ma.	74·1	327	—	—	i 21 32	+17	37·5	47·9
Moncalieri	S.	74·1	313	11 59	+16	21 57	+42	31·4	46·1
Eskdalemuir	G.	75·5	326	e 12 33	+41	21 36	+ 4	34·9	42·9
Paris	—	75·5	318	e 11 (52)	0	i 21 36	+ 4	38·9	46·9
Stonyhurst	M.	75·8	324	i 21 19	=S	(i 21 19)	(−16)	—	48·7
Kew	M.	75·9	322	21 55	=S	(21 55)	(+19)	—	49·4
Melbourne	M.	77·0	148	—	—	—	—	—	50·9
Riverview	—	77·1	141	e 21 55	−S	(21 50)	(+ 5)	e 38·3	43·2
Barcelona	—	79·3	312	22 16	−S	(22 16)	(+ 1)	40·2	44·3
Tortosa	—	80·7	312	22 26	=S	(22 26)	(− 5)	40·5	44·2
Honolulu	—	86·4	68	22 13	?	—	—	36·5	59·1
San Fernando	—	87·4	311	19 25	?	—	—	47·9	54·9
Victoria	—	91·8	29	42? 7	?	51 1	?	55·9	64·8
Azores	M.	98·4	322	25 55	−S	(25 55)	+15	—	—
Berkeley	—	100·3	35	e 42 5	?	—	—	—	—
Cape Town E.	M.	102·4	238	56 19	?L	—	—	(56·3)	64·4
Ottawa	—	105·6	358	—	—	e 26 23	−25	e 51·9?	—
Toronto	M.	107·3	3	27 1	=S	(27 1)	(− 3)	47·1	64·1
Washington E.	—	112·0	0	19 19	−PR_1	e 26 39	−68	e 56·6	—
La Paz	Bi.	165·6	328	20 14	[+ 2]	34 21	—	73·9	80·2

Osaka gives MN = +15·2m. Mizusawa LE = +11·7m. Pulkovo gives iP = +9m.59s., PR_1 = +11m.28s., SR_1 = +21m.43s., SR_2 = +23m.37s. Epicentre 29°·3N. 105°·1E. Zagreb iP = +11m.9s., iNE = +11m.18s., iNE = +20m.20s. De Bilt MN = +40·8m. Dyce Ni = +31m.27s., ME = +45·9m. Moncalieri = + MN = +45·7m. Paris = MN = +40·9m. Stonyhurst gives Si = +30m.25s. Riverview gives eS? = +29m.1s., MN = +47·0m. San Fernando MN = +56·9m. Ottawa give a series of L's. Toronto gives S = +34m.55s. Washington eLN = +56·6m., LE = +62·0m., LN = +66·9m.

July 30d. Records also at 11h. (Mizusawa), 12h. (Washington), 13h. (Riverview, Port au Prince, and La Paz). 14h. (Eskdalemuir), 15h. (Stonyhurst), 16h. (Mizusawa), 18h. (Riverview), 22h. (Mizusawa).

1917. July 31d. 3h. 13m. 10s. Epicentre 3°·0S. 143°·5E.? (as on July 29 and July 30).

There is of course some liability to confusion with the following shock from another epicentre only 10min. later. Thus Pulkovo records 9 successive impulses from i_1 = 3h.27m.30s. to i_9 = 3h.41m.14s., followed by e_1 and e_2, and assumes i_1 and i_2 to be a P and S of the first shock, giving epicentre 8°·0S. 143°·1E.: but i_2 apparently belongs to the following shock, and if we take i_6 as S for the first there is close correspondence with the P and S of July 29d. 21h., with intervals of 29h.21m.5s. and 29h.21m.3s. Adopting then 29h.21m.4s. as a correction to T_o on July 29 we get above T_o and the case for the first shock being a repetition from that epicentre is as follows :—

Station and Component.	Machine.	△	Azimuth.	P.	O—C.	S.	O—C.	L.	M.
		°	°	M. S.	S.	M. S.	S.	M.	M.
Manila	—	28·4	309	6 2	−10	11 56	=SR_1?	19·4	20·0
Riverview	—	31·7	168	e 6 50	+ 6	e 11 56	− 7	e 13·8	19·2
Sydney	M.	31·7	168	—	—	10 44?	−79	17·5	18·5
Adelaide	—	32·3	188	11 32	?S	(11 32)	−41	16·8	18·0
Melbourne	M.	34·8	178	—	—	12 20	−32	19·2	20·1
Taihoku	—	35·2	324	12 30	?S	(12 30)	−28	17·1	17·5
Batavia	—	36·7	264	7 36	+ 8	—	—	—	26·8
Osaka	O.	38·4	350	12 8	?S	(12 8)	−36	13·7	14·4
Nagoya	—	38·6	351	7 17	−26	12 3	−103	—	—
Zi-ka-wei	—	40·1	330	e 7 50	− 6	—	—	—	—
Mizusawa	O.	42·2	357	8 12	0	—	—	—	—
Honolulu	—	62·2	64	19 56	?S	(19 56)	+65	33·7	37·2
Colombo	M.	64·3	279	18 26	?	19 26	+10	26·2	47·0
Bombay	—	72·8	291	19 5	?S	(19 5)	(−115)	—	30·9
Pulkovo	G.	104·1	331	14 20	−10	26 5	−29	—	—
Eskdalemuir	G.	121·2	339	e 20 26	=PR_1	29 50	+52	44·8	—
Toronto	M.	124·4	37	12 2	?	20 50	=PR_1	32·6	32·8
La Paz	Bi.	143·1	123	i 20 3	[+18]	—	—	—	—

Osaka gives MN = +14·2m. Bombay gives S = +29m.15s. Eskdalemuir records PR_1 = +23m.50s., SR_1 = +35m.19s. Riverview MN = +22·1m. Melbourne has SR_1 = +15m.26s., SR_2 = +16m.32s. Manila MN = +21·4m. The Pulkovo records are taken as i_1 = P, i_6 = S. We have also i_2 = +18m.37s. = PR_1: i_3, i_4, and i_7 belong to next shock: i_5 = +22m.13s. = PR_2?; i_8 = +26m.54s. (?) i_9 = +28m.4s.(?). The last two may belong to next shock. It is not clear whether the Bombay, Colombo, Eskdalemuir, and Honolulu, figures refer to this or the following shock.

The P residuals are fairly satisfactory, and though the S residuals are chiefly negative they compare closely with those of July 29. The case for repetition is indeed best exhibited by a direct comparison of the two sets. Whatever change in epicentre is needed seems applicable to both. It has already been suggested that the focus is at a depth of 0·017 radius below the normal, and that T_o requires correction by +17s., and this suggestion also fits the present shock fairly well.

1917. July 31d. 3h. 23m. 0s. Epicentre 45°·0N. 120°·0E.

A = −·354, B = +·612, C = +·707; D = +·866, E = +·500; G = −·354, H = +·612, K = −·707.

	△	Az.	P.	O−C.	S.	O−C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Zi-ka-wei	13·8	177	3 8	−15	5 19	−44	—	5·9
Mizusawa	16·7	103	2 13	?	—	—	3·9	—
Bombay	46·9	252	9 15	+29	19 25	=SR_1	—	21·0
Colombo	51·6	235	8 36	−41	11 36?	=PR_1	16·4	37·2
Pulkovo	52·2	320	i_1 9 26	+ 5	i_2 16 53	+ 7	—	24·5
Dyce	67·0	330	e 10 57	− 1	19 47	− 3	26·0	—
Zagreb	67·2	313	e 10 59	0	i 19 50	− 2	—	—
De Bilt	68·0	323	11 12	+ 8	i 19 56	− 6	—	47·6
Athens	68·1	303	e 11 9	+ 4	e_1 20 15	+12	—	25·6
Eskdalemuir	68·8	329	e 10 36	−34	20 0	−12	35·0	—
Uccle	69·2	323	e_1 10 54	−18	e 20 12	− 4	—	—
Honolulu	69·5	80	10 6	−68	—	—	23·9	27·3
Kew	70·7	325	20 0	?S	(20 0)	−34	—	20·5
Monte Cassino	71·3	311	11 25	0	—	—	—	—
Victoria	71·5	39	10 48	−38	—	—	17·2	59·5
Shide	71·6	325	11 14	−13	20 30	−15	—	—
Rocca di Papa	71·7	311	e 11 24	− 4	i 20 50	+ 4	35·9	—
Moncalieri	71·9	316	11 25	− 4	21 20	+31	31·3	34·9
Barcelona	77·3	317	12 16	+13	21 20	−32	—	34·7
Tortosa	78·6	318	12 4	− 7	21 29	−38	32·8	35·1
Berkeley E.	79·9	44	11 21	−57	20 14	?	—	—
Algiers	80·5	314	12 16	− 6	21 42	−47	—	36·0
Lick	80·9	45	e 11 18	−66	—	—	—	11·5
Rio Tinto	84·3	320	14 0	?	—	—	—	61·0
San Fernando	85·2	319	22 0	?	—	—	—	—
Ottawa	88·5	11	i 12 32	−36	i 23 30	−28	42·0	—
Washington E.	94·7	13	13 4	−38	22 38	?	e 28·3?	—
N.	94·7	13	13 7	−35	23 7	?	—	—
Cape Town	120·8	251	24 6	?	—	—	—	36·0
La Paz	150·7	16	i 19 7	[−50]	—	—	44·0	50·3

Zi-ka-wei gives MN = +6·0m. Pulkovo records also i_1 = +11m.30s. =PR_1, i_2 = +17m.4s.(?), and i_3 = +18m.14s.(?), e_1 = +20m.54s. =SR_1, e_2 = +22m.6s. Dyce gives i = +14m.12s. =PR_1, i = +18m.37s. Zagreb records iP = +11m.15s., i = +11m.20s., iSE = +19m.59s. De Bilt gives e(PR_1) = +14m.6s., iSW = +19m.59s., eN = +31m.5s., MN = +47·4m. T_0 =3h.23m.29s. Athens gives ePN = +11m.12s., i = +11m.21s., m = +11m.47s. Eskdalemuir gives PR_1 = +14m.0s., SR_1 = +26m.29s. Uccle records eP_2 = +11m.9s., i = +20m.23s., e = +23m.54s. Rocca di Papa records MN_2 = +12·7m., iP = +14m.36s. =PR_1, MN =$_3$ = +14·9m., SN = +20m.44s. Moncalieri MN = +33·8m. Berkeley iPN = +11m.14s., eSN = +20m.13s., eSN? = +20m.20s. Lick MN = +11·6m. Ottawa gives i = +16m.10s. =PR_1, i = +21m.53s., i = 25m.50s., eLE? = +31·7m., eLN? = +35·0m., L = +47·0m., L = +61·0m., L = +77·0m.

July 31d. 6h. 59m. 10s. At 46°·9N. 90°·0E.

A = ·000, B = +·683, C = +·730; D = +1·000, E = ·000; G = ·000, H = +·730, K = −·683.

	△	Az.	P.	O−C.	S.	O−C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Zi-ka-wei	28·7	112	e 6 21	+ 6	—	—	—	—
Pulkovo	36·4	313	i 7 28	+ 3	13 18	+ 2	18·8	19·7
Lemberg	42·4	299	e 19 8	?	—	—	—	—
Vienna	47·7	300	e 9 2	+10	e 16 8	+18	—	—
Graz	48·7	299	—	—	e 23 44	?L	(23·7)	—
Zagreb	49·1	298	e 9 2	+ 1	16 14	+ 7	26·8	28·8
Pola	50·8	297	—	—	—	—	e 25·8	—
De Bilt	52·1	309	—	—	—	—	e 26·8	34·6
Edinburgh	54·3	316	0 50	?	—	—	—	31·3
Stonyhurst	55·1	314	—	—	—	—	—	36·8
Rio Tinto	67·0	300	40 50	?	—	—	—	46·8
San Fernando	67·9	300	39 20	?	—	—	—	41·3
La Paz	144·6	322	19 53	[+ 5]	—	—	—	—

Bombay records 7h.14m. to 19m. Pulkovo gives SR_1 = +14m.50s., and the epicentre adopted. De Bilt gives MN = +31·6m.

July 31d. Records also at 4h. (Port au Prince), 8h. (Pulkovo, Zi-ka-wei, Sydney, and Manila), 9h. (Adelaide, La Paz, De Bilt, and Melbourne), 11h. (Mizusawa), 12h. (Batavia), 14h. (La Paz), 16h. (Mizusawa), 17h. (Monte Cassino, Rocca di Papa, and Zagreb), 22h. (Mizusawa), 23h. (La Paz).

TABLE.

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

I.W. County Press. 1192/7/22.

British Association for the Advancement of Science.—Seismological Committee.

Enquiries about instruments
to be addressed to
J. J. SHAW, Esq. (Secretary),
Sunnyside,
Birmingham Road,
WEST BROMWICH.

Other correspondence to
Prof. H. H. TURNER,
University Observatory,
OXFORD.

Bulletin for August and September, 1917.

The cases of apparent repetition from the same Epicentre continue to increase in number as more attention is paid to the possibility. The scrutiny of such cases in August, 1917, led to a rather startling conclusion, announced in the Report to the British Association (Hull, September, 1922). There were on August 8-10 some 20 shocks near Mizusawa and Osaka, the examination of which suggested a tendency to recur in a period of 21 minutes or multiples of it. Other cases of repetition showed the same periodicity, even when the intervals were considerable. Thus, on August 7, 9, 10 (2), 14 (2), and 30 there are shocks from 6°·0S. 136°·0E. or thereabouts, which show the periodicity : and on referring back to July, in which shocks from the same neighbourhood were recorded on July 27-31, the whole series could be associated with a recurrence in multiples of 21·0015min. Enquiring further, it was found that the recurrence was not limited to shocks from the same epicentre, but that earthquakes all over the earth could be brought under the law, with an empirical allowance for latitude, which represents a travel of the effect from equator symmetrically to both Poles in 21min. The period is 21·001548min. as at present determined. There are two large oscillations of the epoch of maximum (through about half a period or 10·5min.), one in 6 months with extremes at equinoxes and solstices, the other in 2 years with extremes at the March equinox. A full investigation will be published in due course, but these results are of sufficient interest to be mentioned at once. It seems scarcely possible to avoid the conclusion that the whole earth is in a state of regular vibration : for all the earthquakes from 1913-1917 for which epicentres have been assigned fall into the series.

As regards the details of the following bulletin, it will be seen that the practice of treating the larger earthquakes somewhat specially which in the bulletins from January-May threw them out of regular sequence, has been abandoned from June onwards. To avoid unnecessary printing when two records are given from N. and E. instruments, the E. records are always given in the text, any N. records which differ substantially from them being given in the notes.

1917, AUGUST & SEPTEMBER.

Aug. 1d. 1h. 2m. (30s.)? Close to the Lick Observatory, which records eP = 1h.2m.37s., iP,M = 1h.2m.40s. But this can scarcely account for records at Riverview e = 1h.12m.36s., eL = 1h.20m.0s., M = 1h.22m.54s. Melbourne eP = 1h.17m.24s., M = 1h.24m.18s. Pulkovo e = 1h.18m.54s., L = 1h.50m.0s. La Paz P = 1h.20m.42s. Nor can these apply to the epicentre of August 5d. 16h., which might be suspected.

Aug. 1d. Records also at 2h. (Eskdalemuir), 5h. (Pulkovo and Riverview), 9h. (Rocca di Papa), 10h. (La Paz), 13h. (Port au Prince), 21h. (Pulkovo) 23h. (Lick).

Aug. 2d. Records at 1h. and 7h. (San Fernando), 12h. (Zi-ka-wei and Pulkovo), 13h. (Edinburgh and De Bilt), 15h. (Zagreb), 21h. (Rocca di Papa).

Aug. 3d. 15h. 50m. 1s. Riverview records eP = +5m.10s., iP = +5m.14s., i = +5m.19s., PR_1 = +5m.53s., iS = +9m.10s., PS = +9m.36s., eL = +10·7m., MZ = +13·0m., ME = +18·4m., MN = +20·5m. These are probably from 40°·9s., 177°·1E. as on August 5, but there are no other corresponding records.

Aug. 3d. 18h. 34m. (0s.). Manila and Batavia assign a shock to N. Mindanao, say 9·5N. 126°·0E., as on 1913 April 26.

	△	Az.	P.	O−C.	S.	O−C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Manila	7·3	315	1 51	0	—	—	3·4	3·9
Batavia	25·0	232	6 0	+22	—	—	—	—
Pulkovo	84·9	330	i 12 59	+12	22 58	−20	47·0	—

Manila gives also MN = +4·5m.

Aug. 3d. Records also at 0h. (San Fernando), 4h. (Rocca di Papa), 5h. (Mizusawa), 7h. (Helwan), 10h. (Manila), 12h. (Pulkovo), 14h. (Port au Prince), 16h. (Rocca di Papa), 19h. (Manila), 21h. (Kodaikanal), 22h. (Ithaca), 23h. (San Fernando).

Aug. 4d. Records at 3h. (Melbourne and Pulkovo), 10h. (La Paz), 11h. (La Paz), 17h. (Uccle), 18h. (Moncalieri), 21h. (Athens), 23h. (San Fernando),

1917. August 5d. 15h. 50m. 13s. Epicentre 40°·9S. 177°·1E.

A = −·755, B = +·038, C = −·655; D = +·051, E = +·999;
G = +·654, H = −·033, K = −·756.

Station and Component.		Inst.	△	Az.	P.	O−C.	S.	O−C.	L.	M.
			°	°	M. S.	S.	M. S.	S.	M.	M.
Riverview		—	21·7	281	e 4 58	− 3	i 8 58	− 1	e 10·5	14·7
Sydney	E.	M.	21·7	281	4 47	−14	9 23	−24	11·0	12·6
Melbourne		M.	25·0	264	i 5 17	−21	10 11	− 8	13·0	14·8
Adelaide		—	30·8	268	6 11	−25	11 23	−25	—	19·0
Honolulu		—	66·5	25	11 5	+11	19 35	− 9	33·5	40·3
Batavia		—	71·1	278	11 32	+ 8	20 40	− 1	e 36·8	L 49·8
Manila		—	76·0	304	e 11 11	−44	21 33	− 4	39·6	41·3
Osaka		O.	84·8	327	12 50	+ 3	23 16	− 1	32·1	N 47·7
Pilar		M.	88·2	132	—	—	e 24 11	+17	—	—
Zi-ka-wei		—	88·6	315	e 12 1	−67	e 23 31	−28	—	—
Berkeley		—	96·2	44	—	—	—	—	e 43·3	—
La Paz		Bi.	96·8	119	14 6	+13	24 33	−51	45·8	56·2
Mauritius	E.	M.	97·0	236	24 35	?S	(24 35)	(−51)	—	49·3
	N.	M.	97·0	236	30 53	?	—	—	—	49·1
Colombo		M.	100·1	270	44 23	?	49 11	?	60·8	66·8
Cape Town		—	102·6	198	48 47	?	—	—	—	61·8
Victoria		—	103·6	36	26 47	=S	(26 47)	(+18)	51·0	71·2
Kodaikanal	E.	M.	104·0	271	46 23	?	—	—	56·9	64·6
Bombay	E.	—	112·9	275	39 1	?	—	—	—	71·4
Washington	E.	—	124·8	66	e 20 59	$=PR_1$	—	—	64·1	—
	N.	—	124·8	66	e 21 2	$=PR_1$	—	—	64·1	—
Toronto		M.	125·4	60	18 5	?	31 41	?	62·2	71·4
Ithaca		B.O.	126·8	62	—	—	—	—	63·6	—
Ottawa		—	128·5	59	e 19 39	?	i 31 37	?	69·8	—
Helwan		M.	150·2	260	19 53	[− 3]	—	—	—	115·9
Pulkovo		G.	152·2	324	18 45?	[+45]	32 13	+ 6	71·8	91·5
Dyce		Ma.	163·7	359	e 20 26	[−15]	34 16	?	85·8	97·9
Vienna		—	164·5	305	i 20 17	[+ 6]	—	—	—	98·8
Edinburgh		M.	165·0	2	27 27	? PR_1	—	—	—	108·5
Graz		W.	165·5	301	e 20 29	[+17]	—	—	—	—
Zagreb		W.	165·5	296	e 20 18	[+ 6]	31 43	—	e 87·8	98·8
Eskdalemuir		G.	165·6	2	20 17	[− 5]	32 21	−34	86·8	106·8
Triest		—	167·0	297	25 7	$=PR_1$	—	—	—	—
De Bilt		—	167·6	337	20 18	[+ 4]	35 37	—	93·8	100·0
Uccle		—	169·0	336	e_1 20 17	[+ 3]	31 47	—	—	—
Kew		M.	169·3	352	37 47	?	—	—	—	105·8
Shide		M.S.	170·1	353	20 31	[+16]	33 53?	+25	90·0	103·3
Moncalieri		S.	171·2	301	i 20 24	[+ 9]	31 40	?	46·9	42·2
Paris		—	171·2	336	e 21 41	[+86]	e 32 28	−64	51·8	97·3
Algiers		B.M.	173·8	230	20 18	[+ 2]	32 27	−57	46·8	93·8
San Fernando		—	174·8	149	22 17	?	—	—	98·5	99·8
Coimbra		—	175·7	98	e 20 57	[+40]	31 6	—	46·8	56·3
Rio Tinto		M.	175·7	137	24 47	?	—	—	—	53·8
Barcelona		—	176·2	275	—	—	—	—	—	99·8
Tortosa		—	177·8	270	20 25	[+ 8]	31 0	?	47·5	44·0

Riverview gives iP = +5m.2s., PR_1 = +5m.41s. (+15s.), PS = +9m.24s. Epicentre as adopted and T_0 as 15h.50m.1s. Melbourne gives SR_1 = +11m.5s. Adelaide records S as PR_1. Batavia gives another M at +21·4m. Manila gives MN = +41·5m. Ottawa gives iPR_1 = +21m.32s. (+12s.), eN = +38m.47s. = SR_1 (+13s.), eE = +39m.47s., also a series of L's and T_0 = 15h.50m.48s. Toronto gives a P = +21m.5s. = PR_1 (+5s.) Pulkovo records iP = +20m.59s., PR_1 = +24m.33s. (= +41s.), PR_2 = +27m.57s. (= −36s.), PS = +34m.54s. Epicentre 38°·0S. 174°·0E. Zagreb gives cSNW? = +31m.16s. Eskdalemuir gives eN = +25m.0s. ?PR_1. De Bilt gives eN = +25m.12s. = PR_1, cN = +32m.8s., eE = +32m.14s., MN = +94·6m. Uccle gives eP_2 = +21m.28s. Shide records S as +37m.26s. Moncalieri MN = +44·2m. San Fernando MN = +101·8m. Ithaca eLN = +64·4m.

Aug. 5d. 18h. 38m. 20s. At 24°·5N. 126°·5E. A = −·541, B = +·731, C = +·415.

	△	Az.	P.	O−C.	S.	O−C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Taihoku	4·6	280	1 18	+7	—	—	2·1	2·5
Zi-ka-wei	8·0	330	1 56	−5	—	—	—	5·3
Manila	11·3	205	e 2 45	−4	4 45	−17	?7·7	8·1
Osaka	12·7	35	3 15	−6	—	—	6·4	9·5
Mizusawa	19·1	35	4 21	−9	7 50	−14	—	—
Pulkovo	72·0	328	i 11 25	−5	20 43	− 7	36·7	45·8
De Bilt	87·9	328	—	—	23 23	−28	42·7	51·5
Edinburgh	89·0	334	46 40	?L	—	—	(46·7)	57·2
Uccle	89·1	320	—	—	23 40	−24	e 48·7	—
Moncalieri	91·0	320	23 22	?S	(23 22)	−62	49·9	—

The azimuths are only rough. Eskdalemuir gives only 19h.25m. to 19h.45m. Kew gives M = +59·7m. Moncalieri gives S as +32m.20s., probably SR_1.

Aug. 5d. 19h. 26m. (50s.). Near Apia which gives P = +9s. record for P. Other records are all from Europe, about 140° distant from Apia, and are probably of [P]. Approximate distances from Apia are as follows:

	△	[P.]	O−C.	L.	M.
	°	m. s.	s.	m.	m.
Pulkovo	125	18 53	−13	60·2	—
Vienna	139	19 18	−20	—	—
Graz	140	19 38	− 1	—	—
De Bilt	140	—	—	69·2	74·0
Zagreb	141	19 24	−17	—	—
Paris	143	19 32	−13	78·2	—

Eskdalemuir (△ = 138°) gives simply 20h.32m. to 20h.52m. Pulkovo gives also i = +22m.19s. De Bilt gives also LN = 67·2m., MN = 73·5m. Zagreb gives also i = +19m.38s.

Aug. 5d. Records also at 0h. (De Bilt), 1h. (Helwan), 2h. (Zi-ka-wei), 15h. (Colombo and Barcelona), 17h. (Coimbra, Mizusawa, and Rocca), 22h. (Port au Prince).

Aug. 6d. 16h. 8m. 8s. At 40°·9S. 177°·1E. as on Aug. 5d. 15h. 50m.

	△	Az.	P.	O−C.	S.	O−C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Riverview	21·7	281	5 0	− 1	9 1	+2	11·1	15·0
Sydney	21·7	281	6 22	?	—	—	9·4	10·3
Melbourne	25·0	264	(6 16)	(−38)	—	—	6·3	10·9
Pulkovo	152·2	324	19 44	[−15]	35 43	—	72·9	—
De Bilt	167·6	337	—	—	—	—	78·9	—
Edinburgh	165·0	2	91 52	?L	—	—	(91·9)?	—
Monte Cassino	168·0	270	100 4	?L	—	—	100·1?	—

Riverview gives also i = +5m.22s., i = +9m.19s. Pulkovo gives also PR_1 = +23m.38s., SR_1 = +42m.4s.

Aug. 6d. 23h. 51m. (6s.). Is this a repetition from the centre near Apia as on Aug. 5d. 19h. 26m. (50s.)?. Taking Apia as the epicentre (13°·8S. 171°·8W.) the approximate distances, etc., are:

	△	P.	O−C.	S.	O−C.	L.	M.
	°	m. s.	s.	m. s.	s.	m.	m.
Riverview	39	13 54	?S	(13 54)	+2	18·7	21·7
Sydney	39	10 54	?	—	—	19·3	20·3
Melbourne	45	—	—	—	—	20·0	21·0
Pulkovo	125	20 24	[+78]	—	—	36·0	—
Edinburgh	138	67 20	?L	—	—	(67·3)	—
De Bilt	140	—	—	—	—	60·0	64·8
San Fernando	157	38 0	?L	—	—	(38·0)	—

Without more definite information as to the precise epicentre we can scarcely say whether the hypothesis of repetition is justified. The L observations suggest that the distance from Australia is about right, but the Pulkovo records suggest that the distance from Pulkovo should be considerably increased, and the absence of Apia records tends in the same direction: 50°·0S. 160°·0W. would suit, but seems unlikely.

Aug. 6d. Records also at 4h. (Rocca di Papa), 10h. (Pulkovo, Edinburgh, Helwan, and De Bilt), 21h. (Zi-ka-wei).

Aug. 7d. 3h. 49m. 20s. At 40°·1N. 34°·5E. (according to Pulkovo).

	△	P.	O−C.	S.	O−C.	L.	M.
	°	m. s.	s.	m. s.	s.	m.	m.
Helwan	10·6	7 40	?L	—	—	—	—
Pulkovo	19·8	i 4 40	+1	8 21	+ 2	10·7	15·4
De Bilt	23·4	e 10 4	?S	(10 4)	+31	—	—
Edinburgh	29·2	19 0	?	—	—	—	—

The Pulkovo epicentre is thus not well supported.

Aug. 7d. 15h. 54m. 8s. At 6°·0S. 136°·0E., as on Aug. 9d. 23h., 10d. 0h. and 17h., 14d. 8h. and 17h., 21d. 4h., and 30d. 4h.? Pulkovo gives 9°·0N. 132°·0E., but this is only 8° from Manila, and will not suit the Manila records at all. On the hypothesis that the shock is an anticipation of that of Aug. 30 we get the following comparison :—

	△	Az.	P.	O−C.	S.	O−C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Manila	25·4	324	e 5 37	− 5	10 15	+ 4	13·5	15·0
Batavia	29·0	268	e 6 15	− 3	—	—	—	11·9
Riverview	31·2	155	e 13 22	?SR_1	—	—	—	—
Melbourne	32·8	167	—	—	—	—	16·4	32·3
Zi-ka-wei	39·7	340	e 8 30	+38	—	—	—	—
Pulkovo	103·1	330	15 8	+42	i 25 58	−27	45·9	62·0
Helwan	105·7	299	25 52	?	—	—	—	—
De Bilt	118·8	328	20 47	?PR_1	28 16	−24	56·9	71·3
Edinburgh	120·5	335	30 52	?	—	—	—	69·5

Riverview gives also e = +16m.58s., +20m.28s., and +20m.44s.; L = 27·1m. MN = 32·2m., ME = 32·8m. Pulkovo gives also PR_1 = +18m.48s. (C = 18m.34s.), PR_2 = 20m.14s. (C = 21m.24s.), PS 27m.4s. (C = 27m.41s.), SR_1 31m.40s. (C = 33m.18s.) Eskdalemuir gives simply 16m.25s. to 17m.30s. De Bilt gives also eE = +27m.2s., m = +31m.29s., MN = +63·0m.

Aug. 7d. Records also at 2h. (Melbourne), 4h. (Rocca di Papa), 7h. (Riverview), 11h. (Port au Prince, Edinburgh, Vieques, and De Bilt), 13h. (Port au Prince and De Bilt), 14h. (Port au Prince), 16h. and 22h. (Mizusawa), 23h. (San Fernando).

Aug. 8d. 2h. 48m. 50s. At 47°·5N. 15°·8E. A = +·650, B = +·184, C = +·737.

	△	P.	O−C.	S.	O−C.
	°	m. s.	s.	m. s.	s.
Graz	0·5	e 0 6	−2	—	—
Vienna	0·8	0 9	−3	—	—
Zagreb	1·7	e 0 33	+7	i 0 45	− 3
Pola	3·0	e 1 28	?S	(1 28)	+ 5
De Bilt	8·3	—	—	e 3 57	+12
Pulkovo	14·9	7 48	?S	(7 48)	+78

Zagreb has also e = +38s., MNE = +0·9m., MNW = +1·0m. De Bilt has also eN = +4m.12s. (another value for S probably).

Aug. 8d. 3h. 41m. 10s. At 39°·0N. 27°·0E.? A = +·692, B = +·353, C = +·629.

	△	P.	O−C.	S.	O−C.	L.	M.
	°	m. s.	s.	m. s.	s.	m.	m.
Athens	2·8	0 43	− 1	1 17	0	1·5	1·7
Zagreb	10·6	e 2 32	− 6	—	—	—	e 5·3
Graz	11·6	4 53	=S	(4 53)	−16	—	—
De Bilt	20·0	10 26	?L	—	—	—	—
Pulkovo	20·9	4 42	−10	8 45	+ 3	9·8	—

Aug. 8d.

I	5h.	25m.	0s.
II	6h.	10m.	55s.
III	8h.	15m.	34s.
IV	17h.	52m.	22s.
V	19h.	40m.	40s.

Possible repetitions from 35°·0N. 143°·0E., as on 1915 April 24, and 1917 July 18. The Nagoya records, however, are not in accord, nor is Pulkovo (overlooked), which gives for II iP = +15m.19s., S = +24m.7s., L = +39·1m. (△ = 70°·3, Az. 330°).

		△	Az.	P.	O−C.	S.	O−C.	L.
		°	°	m. s.	s.	m. s.	s.	m.
Mizusawa	I	4·4	340	2 24	?S	(2 24)	+23	—
	II	4·4	340	2 5	?S	(2 5)	+ 4	—
	III	4·4	340	1 38	+30	(2 32)	+31	—
	V	4·4	340	1 44	+36	—	—	—
Nagoya	II	5·0	283	0 0	−77	—	—	—
	III	5·0	283	0 0	−77	—	—	—
Osaka	I	6·2	270	1 28	− 7	—	—	2·8
	II	6·2	270	1 29	− 6	—	—	—
	III	6·2	270	1 41	+ 6	—	—	3·0
	IV	6·2	270	1 35	0	—	—	3·0
	V	6·2	270	1 34	− 1	—	—	2·8
Zi-ka-wei	III	18·4	266	4 26	+ 4	—	—	—
Edinburgh	V	84·7	337	15 20	?PR_1	—	—	—
De Bilt	II	85·4	336	48 5	?L	—	—	—
	III	85·4	336	51 26	?L	—	—	—

For II Mizusawa has also PE = +5m.59s., PN = +6m.17s., which may be further repetitions. For II PN is taken as S: There is also PE = +2m.24s. For III the Mizusawa PE is taken as P, and PN as S. Osaka gives for I MN = +3·9m., ME = +3·6m.: For II MN = +6·7m., ME = +7·5m.: For III MN = +3·3m., ME = +4·3m.: For IV MN = +4·9m., ME = +3·6m., for V, MN = +3·5m., ME = +4·8m.

Aug. 8d. 18h. 0m. 7s. Possibly a repetition from 40°·9S. 177°·1E., as on Aug. 5d. 15h. and Aug. 6d. 16h.

	△	P.	O−C.	S.	O−C.	L.
	°	m. s.	s.	m. s.	s.	m.
Riverview	21·7	5 5	+ 4	9 5	+ 6	10·7
Sydney	21·7	2 35	?	—	—	9·1
Melbourne	25·0	—	—	11 23	+80	—
Helwan	150·2	24 53	—	—	—	—
Pulkovo	152·2	19 36	[−23]	23 3	?PR_1	67·9
Edinburgh	165·0	80 23	?L	—	—	80·4
De Bilt	167·6	—	—	—	—	77·9

Pulkovo also records P = +17m.43s., which may indicate an earlier shock, supported by Sydney.

Aug. 8d. 19h. 12m. Records at Rocca, Edinburgh, and De Bilt.

Aug. 8d. 19h. 40m. See above, with 5h., 6h., and 8h.

Aug. 8d. Records also at 0h. (Colombo), 3h. (Rocca di Papa), 7h. (Monte Cassino), 10h. (Tucson and Cheltenham), 12h. (Zi-ka-wei), 20h. (Manila), 21h. (Riverview), 22h. (Pulkovo and Helwan), 23h. (Manila and De Bilt).

Aug. 9d.

VI	2h.	23m.	14s.
VII	2h.	40m.	30s.
VIII	3h.	39m.	13s.
IX	10h.	19m.	8s.
X	13h.	54m.	21s.
XI	18h.	24m.	31s.
XII	18h.	46m.	9s.

Possible repetitions from 35°·0N. 143°·0E., as on Aug. 8, and numbered accordingly, but recorded only at Osaka, and hence identification quite speculative. The values of T_o are obtained simply by subtracting 1m.35s. from the Osaka time for P. In support we have merely the Osaka M (and in one case L) as follows: For VI MN = +2·9m.; for VII MN = +2·7m.; for VIII MN = +3·3m.; for IX MN = +4·5m.; for X L = +2·7m., MN = +4·1m.; for XI MN = +3·1m.; for XII MN = +3·2m. No. XI is a possible exception. We have from Mizusawa P = +0m.41s., L = +1·3m., but this must almost certainly be from an origin near Mizusawa.

Aug. 9d. 16h. 14m. 26s. At 16°·0N. 64°·0W., as on 1917 July 27d. 16h.

		△	P.	O−C.	S.	O−C.	L.	M.
		°	m. s.	s.	m. s.	s.	m.	m.
Vieques	E.	2·5	1 5	=S	(1 5)	−4	2·1	2·2
	N.	2·5	1 0	=S	(1 0)	−9	2·0	2·4
Toronto		30·5	—	—	—	—	15·4	—
Ottawa		31·0	—	—	—	—	15·6	—
La Paz		32·8	7 27	+32	—	—	21·7	23·8
Edinburgh		60·6	29 49	?L	—	—	(29·8)	—
De Bilt		64·7	—	—	—	—	31·6	38·3
Pulkovo		78·3	12 11	+ 2	22 3	−1	37·6	43·0

Toronto gives also L = +17·9m. Ottawa also L = +25·6m. De Bilt gives LN = +28·6m., MN = +43·7m. But there is no record from Port au Prince at △ = 8°·3. Port au Prince does, however, record P = ? +25m.50s., S = +26m.55s., which are respectively 23m.42s. and 23m.10s. late of the theoretical P and S. It is possible that there is some curious error affecting these records, the correction of which would bring Port au Prince into line.

Aug. 9d. I 22h. 23m. 26s. } Taihoku records two shocks from epicentres
II 23h. 9m. 15s. } 0°·5 distant and probably identical, giving

for I P = +19s. L = +25s. M = +38s.
II P = +19s. L = +26s. M = +37s.

The Australian observatories record a shock near II, but it seems clear that if the origin is near Taihoku the effects could not have reached Australia so soon, and that the epicentre is probably much nearer Australia, possibly a repetition from the focus of Aug. 7d. 15h., as below ;—

Aug. 9d. 23h. 6m. (45s.). At 6°·0S. 136°·0E., as on Aug. 7 and 30?

	△	P.	O−C.	S.	O−C.	L.	M.
	°	m. s.	s.	m. s.	s.	m.	m.
Adelaide	29·0	11 9	?S	(11 9)	− 8	—	15·2
Sydney	31·2	6 51	+11	—	—	17·5	18·8
Riverview	31·2	9 33	?S	(9 33)	−14	15·6	18·0
Melbourne	32·8	—	—	—	—	16·3	21·8
Pulkovo	103·1	—	—	—	—	e 55·3	—
Edinburgh	120·5	70 15	?L	—	—	(70·3)	—
San Fernando	134·4	67 45	?L	—	—	(67·8)	—

Aug. 9d. Records also at 1h. (San Fernando), 11h.56m. (Manila, gives S.E. Luzon and N. Samar), 13h.55m. (Edinburgh), 15h.4m. (near La Paz), 21h.30m. (close to Mizusawa).

Aug. 10d. 0h. 50m. (10s.) Repetition from 6°·0S. 136°·0E., as on Aug. 9d. 23h? (Very doubtful).

	△	P.	O−C.	S.	O−C.	L.	M.
	°	m. s.	s.	m. s.	s.	m.	m.
Adelaide	29·0	11 50	?S	(11 50)	+33	—	15·5
Riverview	31·2	6 26	−14	—	—	15·6	16·6
Melbourne	32·8	—	—	—	—	16·2	17·4
Pulkovo	103·1	e 22 35	?	—	—	51·8	—
Helwan	105·7	40 50	?L	—	—	—	—
De Bilt	118·8	—	—	—	—	58·8	59·6
Edinburgh	120·5	59 50	?L	—	—	(59·8)	71·5
San Fernando	134·4	28 50	?	—	—	—	—

Riverview gives also MN = +15·8m. De Bilt MN = +59·2m.

Aug. 10 XIII 1h. 16m. 40s. } Repetitions from 35°·0N. 143°·0E., as on
XIV 11h. 17m. 40s. } Aug. 8? They have been numbered con-
XVI 11h. 58m. 40s. } secutively on this supposition, leaving
XVII 13h. 42m. 0s. } XV blank for a possible shock repre-
XVIII 18h. 23m. 36s. } sented only by an L at Mizusawa.
XIX 20h. 14m. 0s. }
XX 21h. 17m. 56s. }
XXI 21h. 32m. 1s. }

	Mizusawa.				Osaka.			
	PE.	PN.	LE.	LN.	(PS.)	L.	ME.	MN.
	m. s.	m. s.	m.	m.	m. s.	m.	m.	m.
XIII	1 14	1 2	2·3	2·1	—	—	—	—
XIV	1 32	1 14	2·7	—	0 14	1·4	4·4	4·8
XVI	—	—	—	—	0 27	1·5	3·3	3·8
XVII	1 7	—	—	—	—	—	—	—
XVIII	—	—	—	—	1 35	—	—	3·3
XIX	1 6	1 42	1·7	2·3	1 29	—	—	3·2
XX	—	—	—	—	1 35	—	—	3·1
XXI	—	—	—	—	1 35	—	—	3·3

For XIV we also have Zi-ka-wei (△ = 18°·4), e = +3m.41s. (=P?), and possibly Pulkovo (△ = 70°·3), eL = +37·3m.

Aug. 10d. 17h. 25m. (30s.)? Repetition from 6°·0S. 136°·0E., as at 0h. 50m.

	△	P.	O−C.	S.	O−C.	L.	M.
	°	m. s.	s.	m. s.	s.	m.	m.
Adelaide	29·0	12 6	?S	(12 6)	+49	—	15·5
Riverview	31·2	—	—	11 42	−12	e 16·7	18·5
Melbourne	32·8	—	—	—	—	e 16·4	18·0
Pulkovo	103·1	—	—	—	—	51·5	—
La Paz	147·2	18 15	+35	—	—	—	—

Riverview gives also e = +15m.6s., MN = +18·2m., MZ = +19·1m.

Aug. 10d. 22h. 5m. 50s. At 2°·0S. 122°·0E., as on 1913 Nov. 19 and 1917 June 3.

	△	Az.	P.	O−C.	S.	O−C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Batavia	15·7	255	e 4 38	+50	—	—	—	10·4
Manila	16·6	357	3 46	−14	—	—	6·7	—
Zi-ka-wei	33·2	359	e 6 54	− 4	—	—	—	—
Sydney	41·9	143	14 16	?S	14 16	−18	—	—
Riverview	41·9	143	14 16	?S	14 16	−18	27·1	32·0
Mizusawa	44·7	21	7 56	−35	14 4	−67	—	—
Helwan	91·5	300	—	—	25 10	+41	—	—
Pulkovo	91·6	330	13 10	−15	24 0	−31	44·2	—
De Bilt	107·8	325	—	—	24 48	−140	56·2	68·4
Edinburgh	110·6	331	—	—	—	—	65·7	—
San Fernando	121·2	312	—	—	—	—	65·7	—

The residuals, especially those for Mizusawa and Batavia, suggest an epicentre 1°·3N. 125°·3E., near that suggested by De Bilt (1°·2N. 121°·8E.). Pulkovo gives also PR_1 = +16m.45s., i = +23m.31s., PS = +29m.59s. Riverview gives also MN = +29·3m. De Bilt MN = +67·3m. Eskdalemuir gives simply 22h.51m. to 23h.24m.

Aug. 10d. Records also at 5h. (Batavia), 14h. (Helwan).

Aug. 11d. Records at 0h. (Pulkovo and Helwan), 2h. (Helwan), 4h. (Zi-ka-wei and Manila), 6h. (Mizusawa and Helwan), 14h. (Washington and Rocca di Papa), 18h. (De Bilt), 20h. (Port au Prince, close origin), 21h. (Pulkovo and De Bilt.)

Aug. 12d. Records at 1h. (Taihoku), 6h. (Rocca di Papa), 7h. (Manila), 11h. (Bombay), 15h. (Monte Cassino), 19h. (Rocca di Papa and Manila).

Aug. 13d. 6h. 26m. (0s.) Zi-ka-wei P = +1m.34s., M = +3·3m. Osaka PS = +5·1m., L = +6·1m., MN = +8·0m., ME = +7·6m. Pulkovo e = +24m.12s., L = +33·0m., M = +39·6m.

Aug. 13d. Records also at 0h. (San Fernando), 5h. (Mizusawa, close origin), 7h. (De Bilt), 8h. (Edinburgh), 9h. (Helwan, De Bilt, and Pulkovo), 16h. (Taihoku and Zi-ka-wei), 18h. (Lick and La Paz).

Aug. 14d. 8h. 9m. (0s.) Repetition from 6°·0S. 136°·0E., as on Aug. 7d. 15h., where other dates are given. Sydney P (=S?) = +11m.36s., M = +18·5m. Riverview e = +11m.48s. (=S?), eL = +16·4m., ME = +16·9m., MN = +18·7m. Melbourne L = +17·6m., M = +18·9m. Honolulu L = +30·9m., M = +33·8m. *Pulkovo records* i_1 = +1m.40s., i_2 = +12m.15s., which can scarcely belong to this shock, but also L = +49·0m., which may. De Bilt L = +59·0m., ME = +70·2m., MN = +71·4m. Edinburgh P (=L?) = +64·3m.

Aug. 14d. 17h. 1m. (0s.) *Possibly a further repetition from* 6°·0S. 136°·0E., as at 8h., on which supposition we should have Sydney P = +11m.48s., L = +18·5m. Riverview eP (=S?) = +12m.6s., eL = +18·7m., M = +20·2m. Melbourne S = +18·0m. (L), L = +21·8m., M = +24·2m. But Pulkovo iP = +26m.29s., PR_1 = 29m.56s., L = +77·0m., and the remark ">15000km. Az. 68°·0NE." suggest a different origin. We also have Helwan (L?) = +97m. De Bilt eLE = +89·0m., eLN = +87·0m., ME = +100·5m., MN = +111·0m. There seem to be two shocks concerned.

Aug. 14d. 23h. 7m. 0s. At 21°·0N. 120°·0E., as on 1917 Feb. 17d. 22h.

A = −·467, B = +·810, C = +·358.

	△	P.	O−C.	S.	O−C.	L.	M.
	°	m. s.	s.	m. s.	s.	m.	m.
Manila	6·4	e 1 7	−31	—	—	2·0	2·5
Zi-ka-wei	10·3	—	—	e 5 24	+46	—	—
Pulkovo	71·9	11 27	− 2	20 45	− 4	39·0	46·3
De Bilt	87·7	—	—	—	—	47·0	57·3
Edinburgh	89·5	49 35	?L	—	—	(49·6)	—

Eskdalemuir records simply 23h.55m. to 0h.15m.

Aug. 14d. Records also at 1h. (San Fernando), 7h. (Marseilles), 12h. (Azores), 19h. (Batavia), 22h. (Helwan).

Aug. 15d. Records at 0h. (San Fernando and Manila), 1h. (Lick, Monte Cassino, and Zi-ka-wei), 4h. (Bombay), 5h. (Mizusawa, close origin), 10h. (Mizusawa, close origin), 19h. (Zi-ka-wei), 20h. (Moncalieri), 23h. (La Paz, close origin).

Aug. 16d. 22h. 57m. 36s. At 16°·0S. 168°·0E., as on 1917 May 29d. 6h.

A = −·940, B = +·200, C = −·276; D = +·208, E = +·978; G = +·270, H = −·057, K = −·961.

	△	Az.	P.	O−C.	S.	O−C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Riverview	23·4	217	i 5 12	− 9	i 9 37	+ 4	11·3	12·6
Sydney	23·4	217	5 18	− 3	9 36	− 3	11·9	12·6
Melbourne	29·8	218	i 11 36	=S	(11 36)	+ 5	14·5	17·0
Adelaide	32·4	229	10 30	?	—	—	—	18·2
Honolulu	50·1	43	15 24	?S	(15 24)	−56	21·1	33·5
Toronto	117·2	49	—	—	—	—	62·8	70·8
Pulkovo	126·6	335	19 50	[+42]	—	—	54·4	67·4
Helwan	138·0	297	21 24	?PR_2	—	—	—	—
Edinburgh	139·6	352	17 24	+15	—	—	—	77·3
Eskdalemuir	140·2	352	21 39	?	—	—	54·4?	75·4
Vienna	140·3	330	19 0	[−40]	—	—	—	—
De Bilt	141·4	343	21 46	?	—	—	58·4	62·6
Graz	141·5	329	e 21 24	?	—	—	—	—
Zagreb	142·1	328	e 19 (24)	[−19]	—	—	—	—
Paris	145·2	343	—	—	—	—	64·4	75·4
Moncalieri	146·6	334	e 22 21?	?	30 19?	−81	67·8	—
Tortosa	152·9	339	19 24	[−36]	—	—	68·4	80·9

The conjecture as regards epicentre cannot be regarded as satisfactory. The situation is complicated by the fact that another shock was recorded by Victoria with T_o = 23h.31m.46s., P = +6m.44s., S = +12m.2s., L = +17·4m., M = +23·5m., which may originate some or all of the records at European stations. Riverview gives i (PS?) = +10m.24s., i = +10m.44s., MZ = +13·3m. Melbourne gives +14h.30s. as S (taken as L above), and L = +15·4m. Toronto gives also L = +67·0m. Eskdalemuir gives also i = +22m.49s. De Bilt gives also e = +22m.53s. (=PR_1), eLN = +59·4m., MN = +73·5m. Paris gives also L = +69·4m.

Aug. 16d. Records also at 0h. (Lick and San Fernando), 2h. (Rocca di Papa), 8h. (Mizusawa), 10h. (La Paz), 11h. (Mizusawa), 15h. (La Paz and Monte Cassino), 16h. (La Paz), 17h. (Osaka), 18h. (Osaka), 20h. (La Paz), 21h. (Rocca di Papa), 22h. (La Paz, Pulkovo, and Mauritius).

Aug. 17d. Records at 0h. (Manila, San Fernando, and Paris), 4h. (Manila), 5h. (Riverview and Melbourne), 6h. (San Fernando), 7h. (Edinburgh), 9h. (Manila), 13h. (Manila), 15h. (Rocca di Papa).

Aug. 18d. Records at 1h. (San Fernando), 6h. (Manila), 8h. (Edinburgh and Rocca di Papa), 13h. (Rocca di Papa), 19h. (Mizusawa and Manila (2)), 20h. (Manila), 23h. (Athens and San Fernando).

Aug. 19d. 4h. 32m. 13s. At 39°·3N. 21°·0E., as on 1917 May 23.

	△	Az.	P.	O−C.	S.	O−C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Athens	2·6	320	0 40	− 1	1 26	+14	1·6	1·7
Monte Cassino	5·9	294	1 37	+ 6	—	—	—	3·0
Rocca di Papa	6·8	294	e 0 59	−44	3 5	0	—	3·9
Zagreb	7·5	332	1 50	− 4	3 10	−14	—	4·0
Graz	8·7	333	e 2 17	+ 5	—	—	—	—
Moncalieri	11·3	305	3 41	−52	5 10	+ 8	6·5	—
Lemberg	10·7	5	e 1 29?	−71	—	—	—	—
Helwan	12·7	135	—	—	—	—	13·8	—
De Bilt	16·8	325	—	—	—	—	9·1	11·2
Pulkovo	21·3	13	4 36	−21	8 24	−26	10·8	—

Athens gives also i = +1m.39s. (taken as L), MN = +2·6m. Zagreb gives also i = +2m.19s. De Bilt gives also MN = +10·6m.

Aug. 19d. Records also at 0h. (La Paz), 1h. (Rocca di Papa), 16h. (Marseilles).

Aug. 20d. 23h. 2m. 0s. At 41°·0N. 24°·6E. (Pulkovo).

A = +·686, B = +·314, C = +·656.

But a better epicentre would be 40°·5N. 26°·0E. See note.

	△	P.	O−C.	S.	O−C.	L.	M.
	°	m. s.	s.	m. s.	s.	m.	m.
Athens	3·2	e 0 51	+ 1	1 22	− 6	1·6	1·8
Zagreb	7·9	2 13	+13	—	—	—	5·1
Monte Cassino	8·1	2 17	+14	—	—	—	8·0
Pola	8·7	i 2 25	+13	—	—	—	—
Lemberg	8·8	e 3 42	?S	(3 42)	−17	—	—
Graz	8·9	e 2 30	+15	—	—	—	—
Rocca di Papa	9·0	e 2 23	+ 7	—	—	—	7·0
Vienna	9·3	i 2 36	+16	—	—	—	—
Helwan	12·4	—	—	6 6	—	—	13·6
Moncalieri	12·9	3 43	+22	6 19	+37	8·0	9·5
Barcelona	16·8	4 10	+ 8	—	—	8·9	11·0
Uccle	17·1	e 4 18	+12	7 42	+22	9·5	10·8
Algiers	17·2	4 16	+ 9	8 15	+53	12·0	13·3
De Bilt	17·3	4 22	+13	7 54	+29	8·9	12·8
Paris	17·4	i 3 25	−45	7 53	+26	10·2	12·0
Tortosa	18·1	4 26	+ 8	8 4	+22	9·5	14·4
Pulkovo	19·0	i 4 35	+ 6	i 8 9	+ 7	10·0	11·4
Besançon	19·8	8 26	?S	(8 26)	+ 7	10·0	—
Kew	20·0	—	—	—	—	—	9·0
Eskdalemuir	23·2	5 19	0	9 34	+ 5	11·6	14·4
San Fernando	24·3	4 30	−61	8 30	−80	13·0	16·0
Coimbra	24·9	5 36	− 1	10 8	+ 7	16·0	—
Mizusawa	81·2	17 0	?PR_1	—	—	17·6	—
La Paz	102·8	21 24	?	—	—	—	—

Athens gives also P = +0m.58s., MN = +2·1m. Zagreb gives also i = +2m.19s. +2m.57s. +4m.36s. +4m.42s. +4m.56s. Rocca di Papa gives also eL = +12·4m. following M. Moncalieri gives also MN = +10·8m. De Bilt gives also MN = +10·8m. San Fernando gives also MN = +15·0m. Osaka gives also MN = +20·0m. The mean errors of P and S for the five stations Uccle, Algiers, De Bilt, Paris (assuming P 1min. in error), Tortosa is P = +11s., S = +31s., indicating that the epicentre should be moved rather more than 1° away from them. Having regard to Athens and Pulkovo it would appear that 40°·5N. 26°·0E. would suit the material better: A = +·683, B = +·332, C = −·649. △ for Athens = 3°·1, Zagreb = 9°·0, Algiers 18°·2, De Bilt 18°·3, Pulkovo 19°·5.

Aug. 20d. Records also at 0h. (La Paz, Osaka, San Fernando), 1h. (La Paz), 5h. (Helwan), 14h. (Mizusawa), 18h. (La Paz), 19h. (Rocca di Papa), 20h. (Helwan), 21h. (San Fernando).

Aug. 21d. 10h. 44m. 10s. At 72°·0N. 2°·8W. (as on 1917 May 14).

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

	△	Az.	P.	O−C.	S.	O−C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Dyce	14·7	179	i 3 44	+ 9	—	—	—	9·7
Eskdalemuir	16·7	184	3 56	− 5	7 1	−10	8·3	10·1
Pulkovo	17·8	118	i 4 17	+ 4	i 7 46	+10	9·3	10·3
De Bilt	20·2	166	4 42	− 1	8 22	− 5	9·3	12·6
Kew	20·6	180	6 50	?	—	—	—	10·8
Uccle	21·4	169	e 4 52	− 6	e 8 44	− 8	10·8	—
Paris	23·3	174	i 5 14	− 6	i 9 22	− 9	12·8	13·8
Lemberg	25·2	137	e 5 38	− 2	—	—	—	—
Vienna	25·3	149	5 37	− 4	—	—	—	—
Moncalieri	27·5	164	6 8	+ 5	10 41	− 9	13·6	17·9
Zagreb	27·6	151	e 5 56	− 8	e 10 40	−12	14·8	16·2
Pola	28·3	154	5 50	−21	—	—	—	—
Barcelona	30·6	173	—	—	—	—	15·6	19·8
Rocca di Papa	31·2	157	e 6 41	+ 1	—	—	—	22·6
Tortosa	31·2	175	6 23	−17	—	—	14·8	19·7
Coimbra	31·9	188	6 20	−26	—	—	14·8	17·3
Rio Tinto	34·3	185	68 50	?	—	—	—	83·8
Ottawa	42·2	272	e 8 12	0	14 24	−14	e 22·4	—
Toronto	44·9	274	—	—	—	—	23·3	27·9
Helwan	45·9	138	14 50	?S	(14 50)	−37	—	—
Victoria	52·7	314	—	—	—	—	31·4	31·9
Berkeley	62·4	309	34 50	?L	—	—	(34·8)	—

De Bilt gives also MN = +13·6m. Pulkovo gives for epicentre 71°·7N. 6°·0W. Moncalieri gives also MN = +18·0m. Rocca di Papa gives also eP = +6m.20s., M = +7m.14s., which probably refers to a previous shock, probably recorded at Pola and Tortosa and Coimbra also, instead of the above. Coimbra records also MN = +19·0m. Rio Tinto is perhaps an hour wrong. Ottawa gives also L = +24·8m., and Toronto L = +24·7m.

Aug. 21d. 15h. 22m. 30s. At 6°·0S. 136°·0E., as on Aug. 7, 9, 10, 14, and 30?

	△	Az.	P.	O−C.	S.	O−C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Manila	25·4	324	e 5 23	−19	7 30	?PR_1	9·4	9·4
Batavia	29·0	268	e 5 0	−78	—	—	—	11·5
Riverview	31·2	155	e 6 48	+ 8	11 54	0	e 16·7	19·0
Melbourne	32·8	167	e 11 30	?S	(11 30)	−51	—	20·4
Colombo	57·6	282	21 30	?SR_1	—	—	—	—
Pulkovo	103·1	330	13 57	−29	—	—	48·5	—
Helwan	105·7	299	29 30	?SR_1	—	—	—	—
De Bilt	118·8	328	—	—	—	—	e 59·5	—

Riverview gives also MN = +18·7m. The evidence is far from conclusive.

Aug. 21d. 21h. 38m. 50s. At 13°·0S. 10°·0W.

A = +·960, B = −·169, C = −·225 ; D = −·174, E = −·985 ;
G = −·222, H = +·039, K = −·974.

	△	Az.	P.	O−C.	S.	O−C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Rio de Janeiro	33·0	248	—	—	12 46	+22	—	—
Azores	52·8	345	21 28	?SR_1	—	—	—	—
Coimbra	53·3	1	e 11 10	?PR_1	16 20	−40	24·8	27·2
Tortosa	54·7	10	9 49	+12	17 17	0	26·3	31·7
Barcelona	55·6	11	—	—	—	—	e 21·3	28·8
Helwan	58·5	42	18 34	?S	(18 34)	+29	—	40·6
Rocca di Papa	58·6	20	e 9 58	− 5	18 1	− 5	30·0	32·1
Athens	60·0	30	—	—	—	—	—	35·8
Moncalieri	60·2	14	10 37	+24	18 43	+17	28·8	31·3
Paris	62·7	9	—	—	e 18 47	−10	28·2	30·2
Zagreb	63·5	20	e 10 35	+ 1	19 8	+ 3	—	—
Graz	64·2	19	10 10	−29	19 16	+ 1	—	—

Continued on next page.

	△	Az.	P.	O−C.	S.	O−C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Uccle	65·0	10	—	—	e 19 4	−21	e 32·2	38·2
Kew	65·1	7	27 10	?L	—	—	(27·2)	33·2
Vienna	65·6	19	e 10 46	− 3	e 19 28	− 4	—	—
De Bilt	66·4	10	—	—	19 34	− 8	29·2	33·2
Eskdalemuir	68·6	5	19 50	?S	(19 50)	−19	29·2	—
Edinburgh	69·1	4	20 2	?S	(20 2)	−13	—	35·2
Lemberg	69·6	23	—	—	e 20 16	− 5	—	—
Pulkovo	79·6	19	12 5	−12	i 22 10	− 9	35·2	41·2
Ottawa	83·1	320	—	—	—	—	38·2	—
Toronto	84·7	317	23 10	?S	(23 10)	− 6	42·5	44·5
Colombo	91·4	83	23 10	?S	(23 10)	−78	—	53·2
Victoria	115·2	318	—	—	—	—	65·8	68·8

Rocca di Papa gives also eL = +30·4m., M = +35·1m. Moncalieri = +MN 34·7m. Paris = MN 36·2m. De Bilt gives also e = +23m.51s., c = +26m.59s., MN = +40·5m. Eskdalemuir gives S at = +24m.39s. Edinburgh gives S = +27m.40s. Pulkovo gives also PR_1 = +14m.48s., PR_2 = +17m.18s., SR_1 = +27m.16s. Toronto gives S = +31m.52s. Rio de Janeiro gives eE = +11m.28s.

Aug. 21d. Records also at 6h. (Cape Town), 12h. (Pulkovo), 13h. (Lick), 17h. (Manila and La Paz), 18h. (Zagreb and Marseilles), 23h. (Honolulu (2)).

Aug. 22d. Records at 0h. (San Fernando), 5h. (Zi-ka-wei), 6h. (Helwan), 7h. (Rocca di Papa and Zagreb), 8h. (Port au Prince), 15h. (Melbourne and Riverview), 18h. (Mizusawa), 21h. (Mizusawa and San Fernando), 22h. (Zi-ka-wei).

Aug. 23d. 5h. 43m. (0s.) Shock near Mizusawa which gives P = +1m.7s., L = +2·1m. Pulkovo has iP = +10m.17s., PR_2 = +14m.9s., iS = +18m.48s., L = +33·0m., M = +41·2m. Is this a repetition from 35°·0N., 143°·0E., as on 1915 April 24, 1917 July 18, Aug. 8–10?

Aug. 23d. Records also at 2h. (Berkeley and Manila), 6h. (De Bilt), 8h. (Helwan), 14h. (La Paz), 16h. (Bombay and De Bilt), 18h. (Lick).

Aug. 24d. 13h. 27m. (15s.) Is this another repetition from 35°·0N. 143°·0E.? Mizusawa gives PE = +1m.7s., PN = +1m.13s., L = +2·9m. Osaka (PS) = +2m.54s., MN = +4·8m., Zi-ka-wei eP = +4m.17s. Pulkovo P = +10m.22s., S = +18m.49s., L = +30·7m., M = +34·9m.

Aug. 24d. Records also at 2h. (De Bilt), 3h. (Rocca di Papa), 5h. (San Fernando), 8h. (Edinburgh), 14h. (De Bilt, Moncalieri, Zagreb, and Edinburgh), 18h. (Algiers), 21h. (Athens).

Aug. 25d. Records at 1h. (San Fernando), 11h. (Azores), 18h. (La Paz), 20h. (Athens and Manila), 21h. (Bombay), 22h. (San Fernando).

Aug. 26d. 22h. 30m. 6s. A possible repetition from the same epicentre as Aug. 16d. 22h. Riverview gives P = +5m.18s., S = +9m.48s., L = +12·3m., M = +17·6m. Sydney gives P = +7m.54s(?), L = +12·7m., M = +14·2m. Melbourne gives P = +6m.24s., M = +19·4m. Helwan gives P = +37m.54s. [L]? There may be an earlier repetition at 3h.57m.(0s.) for which Riverview gives P = +5m.24s., S = +9m.12s., ME = +13·2m., MN = +15·4m. Helwan P = +44m. = [L]?

Aug. 26d. Records also at 0h. (Rio Tinto), 2h. (Mizusawa and Osaka), 3h. (Paris, Batavia, and La Paz), 4h. (Rocca di Papa, Helwan, and Riverview), 7h. (Rocca di Papa), 17h. (Paris), 18h. (De Bilt and Rio de Janeiro), 19h. (Helwan and Edinburgh), 20h. (Bombay), 22h. (San Fernando), 23h. (Helwan, Colombo, and Edinburgh).

Aug. 27d. 20h. 58m. 24s. Repetition from 37°·0N. 26°·0E., as on 1917 June 4?

	Δ	P.	O−C.	S.	O−C.	L.	M.
	°	m. s.	s.	m. s.	s.	m.	m.
Athens	2·0	e 1 45	+74	—	—	—	—
Helwan	8·3	8 36	—	—	—	—	—
Zagreb	11·5	—	—	—	—	—	8·2
Pulkovo	22·9	5 17	+ 1	9 25	+ 2	12·6	—

Athens gives also e = +2m.28s., e = +2m.44s., M = +3·7m. The conjecture as regards epicentre is not well supported.

Aug. 27d. Records also at 0h. (Manila), 3h. (Riverview and Helwan), 4h. (Colombo and Edinburgh), 10h. (Zi-ka-wei and Rocca di Papa), 11h. (two at Rocca di Papa, one La Paz), 12h. (Rocca di Papa), 13h. (Zi-ka-wei), 14h. (two at Rocca di Papa, one at Taihoku), 16h. (Bombay), 18h. (La Paz), 21h. (close to Athens), 23h. (Rocca di Papa and Zagreb).

Aug. 28d. Records at 0h. (Lick and San Fernando), 3h. (Pulkovo), 4h. (Riverview), 9h. (Helwan), 13h. (Taihoku), 18h. (Mizusawa and Osaka), 22h. (San Fernando and Taihoku), 23h. (La Paz).

Aug. 29d. Records at 1h. (Taihoku), 11h. (Monte Cassino), 13h. (La Paz), 15h. (Batavia), 16h. (Helwan, Pulkovo, and Monte Cassino), 19h. (Mizusawa).

1917. August 30d. 3h. 24m. 10s. Epicentre 5°·0N. 75°·0W.

A = +·258, B = −·962, C = +·087; D = −·966, E = −·259;
G = +·023, H = −·084, K = −·996.

Station and Component.	Machine.	Δ	Azimuth.	P.	O−C.	S.	O−C.	L.	M.
		°	°	m. s.	s.	m. s.	s.	m.	m.
Port au Prince	B.O.	13·8	11	2 40	−43	—	—	—	5·1
Vieques	B.O.	16·2	35	4 8	+13	—	—	9·4	10·2
La Paz	Bi.	22·5	163	i 4 52	−19	i 8 57	−18	13·0	13·5
La Quiaca	M.	28·6	161	e 8 50	?	—	—	—	—
Washington E.	W.	34·0	357	6 45	−20	12 36	− 2	15·2	—
N.	W.	34·0	357	6 58	− 7	12 29	−11	15·2	—
Ithaca	B.O.	37·4	357	6 2	−91	12 2	−88	20·0	—
Toronto	M.	38·8	354	9 32	=PR$_1$?	14 8	+19	17·2	38·5
Ottawa	—	40·4	359	i 7 56	− 2	i 14 12	− 1	e 17·1	—
Rio de Janeiro E.	—	41·8	133	13 50	?	19 26	?	20·7	21·6
N.	—	41·8	133	13 56	?	18 50	?	20·8	21·6
Coimbra	—	69·0	49	—	—	e 19 50	−24	37·8	—
Rio Tinto	M.	69·9	52	—	—	21 50	+85	—	—
Tortosa	—	75·4	49	11 54	+ 3	21 37	+ 7	34·9	39·5
Eskdalemuir	G.	75·6	34	11 59	+ 6	22 37	+64	37·8	—
Edinburgh	M.	75·7	33	22 35	=S	(22 35)	+61	—	—
Shide	—	75·9	39	21 28	=S	(21 28)	− 8	41·5	—
Kew	M.	76·6	38	23 50	?S	—	—	—	73·3
Paris	—	78·0	41	22 2	=S	(22 2)	+ 2	39·8	—
Uccle	—	79·4	39	e 12 14	− 1	e 22 14	− 2	—	—
De Bilt	—	80·0	38	—	—	22 24	+ 1	e 38·8	44·8
Honolulu	—	81·7	291	22 56	=S	22 56	+13	38·7	44·5
Lemberg	B.O.	91·9	40	20 44	?	—	—	—	—
Pulkovo	G.	93·3	29	i 13 26	− 8	24 29	−19	45·8	50·5
Helwan	M.	101·5	58	—	—	24 32	—	—	—

Vieques gives MN = +11·2m. Ithaca seems to be 1min. out, eN = +16m.10s. La Paz gives i = +11m.42s. Washington Mc gives ePE = +6m.28s., ePN = +6m.59s., eSE = +12m.36s., eSN = +12m.35s., eLE = +16·1m., eLN = +16·3m. Verte = +7m.3s. Toronto records a slight movement at 3h.25m.12s. Shide records S = +29m.34s. De Bilt gives eSR$_1$ = +27m.48s., m = +28m.33s., eN = +34m.42s., m = +35m.49s., LN = +40·8m. MN = +42·0m. Pulkovo gives PR$_1$ = +17m.16s., PS = +25m.54s.

1917. August 30d. 4h. 7m. 12s. Epicentre 6°·0S. 136°·0E.

(see August 7.)

A = −·715, B = +·691, C = −·105; D = +·695, E = +·719;
G = +·075, H = −·073, K = −·995.

Station and Component.	Inst.	Δ	Az.	P.	O−C.	S.	O−C.	L.	M.
		°	°	m. s.	s.	m. s.	s.	m.	m.
Manila	W.	25·4	324	e 5 3	−39	—	—	6·3	6·6
Adelaide	M.	29·0	175	5 42	−36	—	—	—	—
Batavia	W.	29·0	268	4 42	−96	8 23	−174	—	9·8
Riverview	W.	31·2	155	e 6 41	+ 1	i 11 59	+ 5	e 13·4	17·2
Sydney	M.	31·2	155	6 24	−16	12 0	+ 6	16·4	21·4
Melbourne	M.	32·8	167	i 6 54	0	12 18	− 3	15·6	19·7
Taihoku	O.	34·1	336	6 34	−32	(12 27)	−15	12·4	12·9
Zi-ka-wei	G.	39·7	340	7 23	−19	14 7	+ 5	e 16·3	16·8
Osaka	O.	40·7	0	8 0	− 1	14 9	− 8	17·4	19·0
Nagoya	O.	41·2	0	6 54	−71	—	—	—	—
Mizusawa	O.	45·4	5	8 34	− 2	15 30	+10	—	—
Calcutta	O.E.	54·6	303	8 42	−55	15 36	−100	21·5	24·6
Colombo	M.	57·5	282	8 48	−68	—	—	21·0	31·6
Kodaikanal	M.	60·5	285	(9 18)	−58	—	—	9·3	35·1
Bombay	O.E.	67·0	294	10 7	−51	18 12	−98	—	—
Honolulu	M.	70·2	65	11 54	+36	(21 36)	+68	21·6	44·0
Mauritius	M.	76·8	251	10 48	−72	(20 12)	−95	20·2	33·8
Victoria	M.	101·6	42	—	—	20 12	?	29·1	67·9
Pulkovo	G.	103·1	330	13 44	−42	24 54	−91	42·8	52·6
Lick	W.	103·5	53	e 18 27	=PR$_1$?	—	—	—	—
Lemberg	B.O.	108·6	321	e 14 0	−51	—	—	—	—
Cape Town	M.	108·8	231	10 42	?	16 42?	—	25·7	28·7
Tucson	B.O.	112·7	58	—	—	—	—	21·2	61·9
Vienna	W.	113·9	321	14 30	−46	—	—	—	—
Graz	W.	114·8	320	e 18 30	? PR$_1$	—	—	—	—
Zagreb	W.	115·0	313	18 40	? PR$_1$	28 36	+26	40·8	61·8
Monte Cassino	Ag.	117·8	314	19 27	? PR$_1$	—	—	—	30·0
Rocca di Papa	Ag.	118·5	315	i 18 31	? PR$_1$	e 28 57	+19	59·7	—
De Bilt	G.	118·8	328	19 41	? PR$_1$	e 29 7	+27	e 58·8	61·0
Dyce	Ma.	119·4	336	e 20 16	=PR$_1$	30 1	?	44·2	60·8
Uccle	G.	119·9	327	e 18 30	?	29 20	+32	46·8	69·6
Moncalieri	S.	120·7	320	e 19 21	[+28]	28 42	−13	37·7	63·3
Paris	G.	122·0	326	e 18 40	[−18]	29 35	+31	42·8	66·8
Shide	M.	122·9	329	20 6	[+15]	29 58	+47	—	—
Barcelona	Ma.	125·9	318	19 53	[+45]	30 12	+40	45·1	63·8
Algiers	B.	127·2	313	18 48	[−23]	30 3	+22	45·8	72·8
Tortosa	Ma.	127·6	319	18 50	[−22]	32 30	?	46·9	66·0
Toronto	M.	131·3	34	14 16	?	25 6	?	33·3	90·2
Ottawa	W.	132·0	30	19 26	[+ 3]	28 28	—	e 41·1	—
Coimbra	W.	133·3	323	21 21	=PR$_1$	—	—	67·5	69·5
Ithaca	B.O.	133·6	33	e 19 4	[−23]	i 21 28	—	54·3	—
Rio Tinto	M.	133·6	318	—	—	—	—	—	85·8
San Fernando	O.	134·4	317	17 48	+61	32 48	—	68·3	72·3
Washington	Ma.	135·6	37	e 19 16	[−15]	22 53	=PR$_1$	—	—
Cheltenham, U.S.	B.O.	135·9	37	19 32	[0]	23 14	—	—	29·3
Azores	M.	144·2	335	22 48	=PR$_1$	—	—	—	—
La Quiaca	M.	144·7	144	17 36	+ 6	—	—	—	—
La Paz	Bi.	147·2	134	i 19 48	[− 3]	30 2	−101	48·8	65·1

Adelaide gives also PR$_1$ = +10m.12s. (=S?) Riverview gives also iP = +6m.52s., PR$_1$ = +8m.13s., MZ = +15·9m., MN = +17·4m. Melbourne gives also SR$_1$ = +13m.48s. Taihoku L appears to be S; it gives also M(3) = 20·5m. Zi-ka-wei gives also SRE = +14m.57s., SRN = +15m.21s., MN = +18·3m. Osaka gives also MN = +18·3m. Kodaikanal L appears to be P? Honolulu and Mauritius L appears to be S? Mauritius gives also MN = +29·7m. Pulkovo gives also PR$_1$ = +17m.45s., PS = +26m.33s. Tucson gives also LN = +21·5m., MN = +37·9m. Vienna gives also iZ = +18·0m. Zagreb prints S 10min. earlier, but the sequence suggests a misprint. De Bilt gives several other records (as e chiefly), and MN = +61·3m. Dyce gives also PR$_1$ = +23m.31s. Uccle gives also e = +19m.42s., PR$_1$ = +22m.24s., i = +25m.22s., MN = +61·8m., MZ = +70·2m. Moncalieri gives also MN = +62·4m. Paris gives also PR$_1$ = +25m.28s., MN = +62·8m. Barcelona gives also PR$_1$ = +24m.55s., i = +25m.38s.,

Notes continued on next page.

eL = +49·6m. Algiers gives also i = +20m.23s., i = +25m.38s. Ottawa gives also iPR_1 = +22m.41s., and a series of Ls. Coimbra gives also ePN = +7m.21s., ePE = +7m.56s., which must belong to another (local?) shock: LN = +66·0m., MN = +68·8m. San Fernando gives also MN = +78·3m. Edinburgh gives for the previous earthquake three values of M, which probably belong to this one. Referred to this T_0 they are +34·3m., +63·6m., +70·6m. Helwan also gives +64·0m., but ascribes it to the former earthquake. Ithaca gives another LN = +38·8m. Cheltenham gives SN = +23m.8s.

Aug. 30d. Records also at 0h. (San Fernando and Lick), 1h. (Lick and Berkeley), 8h. (La Paz), 10h. (La Paz), 15h. (La Paz), 22h. (La Paz), 23h. (Taihoku).

1917. August 31d. 11h. 36m. 18s. Epicentre 5°·0N. 75°·0W.

A = +·258, B = −·962, C = +·087; D = −·966, E = −·259; G = +·023, H = −·084, K = −·996.

Station and Component.	Inst.	△	Az.	P.	O−C.	S.	O−C.	L.	M.
		°	°	M. S.	S.	M. S.	S.	M.	M.
Port au Prince	B.O.	13·8	11	e 1 45	−98	4 4	−119	6·5	7·9
Vieques	B.O.	16·2	35	3 59	+ 4	7 24	+24	9·1	11·9
La Paz	Bi.	22·5	163	4 50	−21	—	—	13·0	13·4
Cheltenham, U.S.	B.O.	33·8	358	7 0	− 3	12 35	− 2	17·1	21·7
Washington	W.	34·0	357	e 7 3	− 2	i 12 31	− 9	e 15·2	18·0
Ithaca	B.O.	37·4	357	6 57	−36	12 47	−43	—	23·9
Toronto	M.	38·8	354	7 48	+ 4	13 54	+ 5	23·0	29·2
Ottawa	W.	40·4	359	i 7 54	− 4	i 14 7	− 5	e 20·2	—
Rio de Janeiro	M.	41·8	133	e 8 6	− 3	14 6	−26	18·7	21·8
Tucson	B.O.	43·2	314	8 17	− 3	15 2	+11	E 22·7	23·4
Lick	W.	53·2	314	e 9 37	+10	e 17 21	+22	—	35·9
Azores	M.	55·5	47	18 0	?S	(18 0)	+32	—	—
Victoria	W.	59·7	325	9 24	−46	17 42	−37	31·8	42·8
Coimbra	W.	69·0	49	11 14	+ 3	20 14	0	35·8	38·4
Rio Tinto	M.	69·9	52	13 42	?	—	—	—	41·7
San Fernando	Ob.	70·0	53	11 42	+25	20 42	+16	—	41·2
Accra	M.	74·4	85	19 42	?	—	—	—	—
Tortosa	V.	75·4	49	11 53	+ 2	21 30	0	31·8	34·6
Eskdalemuir	G.	75·6	34	11 53	0	22 31	+57	37·7	39·2
Edinburgh	M.	75·7	33	12 57	−64	—	—	—	42·7
Shide	M.	75·9	39	11 59	+ 5	21 29	− 7	—	39·2
Dyce	Ma.	76·5	32	e 12 40?	+42	22 25	+42	32·3	42·3
Kew	M.	76·6	36	17 12	$?PR_2$	—	—	—	48·2
Barcelona	Ma.	77·1	49	12 1	− 1	21 43	− 7	e 30·6	43·0
Algiers	B.M.	77·5	54	11 59	− 5	21 42	−12	32·7	44·7
Paris	G.	78·0	41	i 12 5	− 2	i 21 54	− 6	34·7	39·7
Uccle	G.	79·4	39	i 12 13	− 2	i 22 10	− 6	e 33·7	43·4
Marseilles	Ma.	79·6	47	e 22 19	=S	(22 19)	0	40·7	45·7
De Bilt	G.	80·0	38	12 19	0	i 22 20	− 3	38·7	44·5
Moncalieri	S.	81·3	45	12 23	− 4	22 23	−15	30·9	49·6
Honolulu	M.	81·7	291	11 42	−47	22 24	−19	38·5	43·7
Rocca di Papa	Ag.	85·0	48	i 12 41	− 7	i 22 38	−41	e 39·8	45·0
Monte Cassino	Ag.	85·8	49	12 46	− 6	—	—	—	23·3
Zagreb	W.	87·1	44	e 12 53	− 7	i 23 17	−25	—	47·5
Pulkovo	G.	93·3	29	i 13 20	−14	24 27	−21	37·7	47·7
Cape Town	M.	95·6	124	23 30	?S	33 0	?	45·7	58·5
Helwan	M.	101·5	58	13 48	−30	17 54	?	—	65·7
Riverview	W.	128·4	230	—	—	e 31 24	?	e 61·0	67·7
Sydney	M.	128·4	230	—	—	62 12	? L	(62·2)	68·8
Melbourne	M.	131·1	318	21 36	$=PR_1$	—	—	—	72·1
Osaka	O.	131·1	327	21 44	$=PR_1$	—	—	—	88·3
Mauritius	M.	131·8	113	21 42	$=PR_1$	—	—	—	68·5
Bombay	B.O.	140·3	52	23 8	$=PR_1$	—	—	—	89·9
Zi-ka-wei	G.	140·6	338	22 26	$=PR_1$	—	—	—	88·2
Taihoku	O.	146·0	333	74 29	?	—	—	84·2	84·6
Kadaikanal	M.	148·6	61	20 24	[+31]	—	—	85·5	89·1
Colombo	M.	152·2	65	25 30	?	29 30	?	[36·7]	44·7
Manila	V.	154·8	321	20 11	[+ 9]	—	—	—	—
Batavia	W.	177·8	235	20 17	[0]	34 42	—	85·7	99·7

For Notes see next page.

NOTES TO AUGUST 31d. 11h. 36m. 18s.

Vieques gives PE = +4m.5s., LE = +7·9m., ME = +13·6m. La Paz gives also PS = +4m.54s., i = +11m.12s., i = +11m.52s. Cheltenham PN = +7m.1s., SN = +12m.34s., MN = +21·1m. Rio de Janeiro ePN = +8m.0s., SN = +14m.18s., LN = +19·2m., MN = +21·8m. Washington gives also MN = +18·4m. Tucson gives also LN = +21·7m., MN = +27·5m. Lick gives also eSN = +17m.25s., MN = +34·3m. San Fernando gives also MN = +40·9m. Eskdalemuir gives also M = +33·8m. Uccle gives also SR_1 = +26m.36s., MN = +42·3m. De Bilt gives also LN = +34·6m., MN = +35·7m., m = +36·3m; T_0 = 11h.36m.34s. Moncalieri gives also MN = +44·7m. Rocca di Papa gives also L = +61·6m. Zagreb gives also eP = +12m.34s., PR_1 = +16m.24s., PR_2 = +18m.37s., eS = +22m.39s. Pulkovo gives also PR_1 = +17m.9s., PS = +25m.42s., SR_1 = +30m.24s., SR_2 = +34m.12s., and epicentre 7°·0N. 76°·0W. Riverview gives also PR_1 = +21m.18s., iS = +31m.32s., MN = +68·3m. Mauritius gives also PN = +29m.54s. =S, MN = +69·1m. Colombo gives also L = +82·5m., M = +95·3m.

Aug. 31d. Records also at 2h. (San Fernando), 4h. (Athens), 5h. (Manila), 10h. (Manila and Pulkovo), 12h. (La Paz (3)), 13h. (La Paz (3)), 14h. (La Paz and Port au Prince), 15h. (La Paz), 16h. (La Paz (3)), 18h. (La Paz, Edinburgh, and De Bilt), 19h. (Edinburgh and Helwan), 20h. (La Paz and Edinburgh), 21h. (La Paz (2),), 23h. (La Paz).

Sept. 1d. 6h. The following records cannot be reconciled as a single shock: Rocca di Papa eP = +41m.50s., S = +42m.4s., M = +42·1m. Monte Cassino P = +45m.41s., M = +45·7m. Zagreb ePE = +46m.44s., i = +46m.50s., iW = +46m.55s., i = +46m.57s. S = +46m.58s., M = +47·0m.

Sept. 1d. Records also at 1h. (San Fernando and Athens), 2h. (La Paz and De Bilt), 12h. (Accra and La Paz), 16h. (La Paz and Lick (2)), 19h. (Colombo), 20h. (Edinburgh), 23h. (San Fernando).

Sept. 2d. Records at 3h. (Algiers and Tortosa), 4h. (La Paz), 7h. (La Paz and Rio Tinto), 14h. (La Paz and Batavia), 17h. (Osaka), 19h. (Mizusawa), 21h. (La Paz), 22h. (Manila).

Sept. 3d. (Records at 0h. (San Fernando), 7h. (La Paz), 8h. (Edinburgh (2)), 10h. (Manila), 13h. (Zi-ka-wei), 14h. (Edinburgh, Pulkovo, De Bilt, Paris, Moncalieri, and Helwan), 17h. (Helwan and Pulkovo), 20h. (San Fernando), 21h. (Taihoku), 22h. (Taihoku).

Sept. 4d. 16h. 42m. 16s. At 39°·0N. 95°·0E.

A = −·068, B = +·774, C = +·629; D = +·996, E = +·087,; G = −·055, H = +·627, K = −·777.

		△	Az.	P.	O−C.	S.	O−C.	L.	M.
		°	°	m. s.	s.	m. s.	s.	m.	m.
Calcutta	N.	17·4	201	4 2	− 8	7 38	+11	13·0	—
	E.	—	—	3 56	−14	7 38	+11	13·4	—
Zi-ka-wei		22·9	102	5 12	− 4	e 9 26	+ 3	—	—
Bombay	E.	27·8	230	6 13	+ 7	—	—	—	15·9
Nagoya	N.	33·3	83	18 16	?L	—	—	(18·3)	—
Manila		33·4	130	—	—	13 44	$?SR_1$	19·3	20·0
Colombo	E.	34·9	207	25 44	?	—	—	—	—
Pulkovo		44·7	319	i 8 15	−16	i 14 51	−20	22·7	24·5
Lemberg		49·9	307	e 15 26	?	—	—	—	—
Helwan	E.	52·2	280	18 44	?	—	—	—	—
Zagreb		56·4	305	9 48	0	e 17 33	− 6	—	32·0
Triest		57·8	305	—	—	—	—	20·7	—
De Bilt		60·2	315	—	—	18 31	+ 5	30·7	37·7
Rocca di Papa		60·2	302	i 10 13	0	18 30	+ 4	—	39·2
Uccle		61·2	314	—	—	e_1 18 38	0	—	38·0
Moncalieri		61·7	307	e 10 25	+ 2	i 18 50	+ 6	e 28·6	—
Edinburgh		62·7	321	—	—	18 44	−13	—	40·7
Eskdalemuir		63·0	321	19 3	=S?	(19 3)	+ 2	33·7	—
Paris		63·2	312	—	—	e_1 19 7	+ 4	e_2 34·7	—
Kew		63·4	316	—	—	—	—	—	40·2
Barcelona		67·2	306	—	—	—	—	e 36·4	42·5
Tortosa		68·6	306	11 3	− 5	—	—	34·1	40·9
Algiers		69·2	302	—	—	—	—	—	44·7
Coimbra		74·5	310	—	—	—	—	38·7	—
Rio Tinto		74·8	307	42 44	?	—	—	—	50·7
San Fernando		75·4	305	25 14	?	—	—	41·2	47·2
La Paz		153·1	322	20 20	[+20]	—	—	—	—

For Notes see next page.

NOTES TO SEPT. 4d. 16h. 42m. 16s.

Additional records and notes: Manila MN = +21·4m. Pulkovo iPR_1 = +9m.58s., SR_1 = +18m.20s. Zagreb eE = +9m.44s., iS = +17m.41s., eMW = +31·4m., T_2 = 16h.42m.14s. De Bilt MN = +33·8m. Epicentre 37°·4N., 94°·6E. Rocca di Papa eS = +18m.14s. (−12s.). Eskdalemuir records S as P and S = +26m.10s.

Sept. 4d. Records also at 2h. (Osaka, and Mizusawa), 11h. (Athens and Pulkovo, and Zi-ka-wei), 12h. (De Bilt and Pulkovo), 18h. (Stonyhurst), 19h. (Algiers).

Sept. 5d. 16h. 24m. 30s. At 16°·0S. 168°·0E. (as on 1917 May 29 and Aug. 16).

		△	P.	O−C.	S.	O−C.	L.	M.
		°	m. s.	s.	m. s.	s.	m.	m.
Riverview		23·4	e 5 12	− 9	e 6 18	?PR_1	e 12·9	14·7
Sydney	E.	23·4	5 30	+ 9	—	—	12·8	15·1
Melbourne		29·8	e 11 30	=S?	(e 11 30)	− 1	—	18·0
Honolulu		50·1	18 6	?	—	—	25·0	26·6
Pulkovo		126·0	i 19 21	?	—	—	80·5	—
Edinburgh		139·6	43 30	?SR_1	—	—	—	—

Additional records and notes: Riverview MN = +14·0m. Eskdalemuir 17h.50m. to 18h.40m. Pulkovo PR_1 = +23m.8s. The following records may belong to a separate shock, as indicated by San Fernando, or may refer to the one above: Colombo P = +67m.30s. Coimbra L = +86·5m. De Bilt LE = +89·5m., LN = +90·5m., MN = +94·5m., ME = +95·9m. Helwan P = +88·5m. San Fernando P = +86m.0s., S = +100m.45s., MN = +101·5m. ME = +110·5m.

Sept. 5d. Records also at 2h. (San Fernando), 12h. (Taihoku), 18h. (Paris), 20h. (De Bilt and Pulkovo), 22h. (San Fernando, Paris, and La Paz), 23h. (San Fernando and Mizusawa).

Sept. 6d. 14h. 21m. 50s. At 2°·7S. 83°·3W. (as on 1917 March 29).

		△	P.	O−C.	S.	O−C.	L.	M.
		°	m. s.	s.	m. s.	s.	m.	m.
La Paz		20·3	4 38	− 7	8 36	+ 7	12·8	13·2
Edinburgh		86·7	38 40	?	—	—	—	—
De Bilt	N.	91·2	e 35 4	?	—	—	e 41·2	43·0
Helwan	E.	112·6	65 10	?L	—	—	(65·2)	—

La Paz gives also i = +9m.18s. =SR_1, i = 11m.49s. De Bilt eLE = +42·2m.

Sept. 6d. 21h. 28m. 5s. At 47°·0N. 10°·0E.

A = +·672, B = +·118, C = +·731; D = +·174, E = −·985, ; G = +·720, H = +·127, K = −·682.

	△	Az.	P.	O−C.	S.	O−C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Moncalieri	2·5	218	e 0 41	+ 2	1 8	− 1	1·6	—
Graz	3·8	84	0 56	− 3	—	—	—	—
Zagreb	4·3	104	e 1 8	+ 1	i 1 50	− 8	—	2·4
Vienna	4·5	71	e 2 7	=S	(e 2 7)	+ 3	—	—
Paris	5·3	292	e 1 37	+15	i 2 10	−15	2·3	2·9
Uccle	5·3	318	e 1 49	+27	—	—	—	—
Rocca di Papa	5·6	158	e 2 9	=S?	(2 9)	−24	—	12·5
De Bilt	6·0	328	—	—	2 55	+11	—	—

Zagreb gives iME = +2·3m., eMW = +2·4m. Rocca di Papa e = +3m.56s. =L?

Sept. 6d. Records also at 1h. (Batavia), 4h. (Colombo and Taihoku).

Sept. 7d. 22h. 22m. 35s. At 13°·0N. 123°·0E. (as on 1917 May 28).

	△	P.	O−C.	S.	O−C.	L.	M.
	°	m. s.	s.	m. s.	s.	m.	m.
Manila	2·6	e 0 48	+ 7	—	—	1·3	—
Batavia	25·1	e 2 25	?	—	—	—	—
Pulkovo	80·2	12 14	− 6	22 19	− 6	39·4	43·8
De Bilt	95·9	—	—	e 24 55	−20	e 49·4	53·0
Edinburgh	97·8	44 55	?L	—	—	(44·9)	54·4

De Bilt gives MN = +51·5m. Epicentre 13°·7N. 123°·3E. Eskdalemuir gives only 23h.9m. to 23h.40m.0s. Batavia gives origin in S.E. Luzon.

Sept. 7d. Records also at 1h. (San Fernando), 5h. (Edinburgh, Moncalieri, and La Paz), 6h. (Helwan), 10h. (La Paz), 15h. (Edinburgh).

Sept. 8d. Records also at 1h. (San Fernando), 2h. (Manila, Taihoku, and Colombo) 5h. (Edinburgh), 7h. (Athens), 10h. (Athens), 15h. (Lick), 19h. (Rio Tinto and Manila), 21h. (Manila), 23h. (San Fernando).

Sept. 9d. 2h. 20m. (0s.). At 16°·0S. 168°·0E. (as on 1917 Sept. 5 and May 29).

	△	P.	O−C.	S.	O−C.	L.	M.
	°	m. s.	s.	m. s.	s.	m.	m.
Riverview	23·4	e 5 6	−15	e 9 42	+ 9	e 15·8	18·4
Melbourne	29·8	14 18	?L	—	—	19·8	22·1
Pulkovo	126·6	19 0	—	—	—	—	—

Sept. 9d. Records also at 0h. (Batavia), 1h. (Colombo, Helwan, Manila, and Pulkovo), 2h. (Pulkovo), 3h. (Pulkovo), 4h. (Batavia and Rio Tinto), 5h. (La Paz, but as the record follows that of 6h. it perhaps refers to Sept. 10), 6h. (La Paz), 9h. (Mizusawa).

Sept. 10d. Records at 5h. (La Paz? but see Sept. 9), 9h. (Rocca di Papa and Zagreb), 22h. (Batavia).

Sept. 11d. Records at 3h. (Zagreb), 9h. (Barcelona, Berkeley, Lick, and Tucson), 16h. (La Paz), 19h. (Lick and San Fernando), 20h. (Osaka).

Sept. 12d. 1h. 19m. 38s. Pulkovo records P = +6m.14s., PR_1 = +6m.55s., S = +11m.10s., L = +14·4m., M = +16·7m. Lemberg eP = +16m.34s. De Bilt eN = +23m.34s., eE = +24m.40s., MN = +25·4m., ME = +29·6m. Moncalieri e = +21m.16s., L = +21·9m. It is difficult to reconcile these records.

Sept. 12d. 4h. 44m. 34s. Close to Rocca di Papa, which gives iP = +0m.14s., S = +0m.25s., M = +0·9m. Monte Cassino P = +0m.13s., M = +0·4m. Zagreb e = +1m.45s., eNE = +2m.34s., eM = +2·7m. Moncalieri = e +3m.1s., L = +5·2m.

Sept. 12d. Records also at 4h. (Batavia), 6h., 8h. (Moncalieri), 9h. (Manila), 11h. (Lick (2) and Berkeley), 13h. (Mizusawa and Osaka), 16h. (Moncalieri and La Paz), 23h. (Manila).

Sept. 13d. Records at 0h. (San Fernando), 4h. (Manila), 11h. (Manila), 14h. (Lick), 17h. (Mizusawa).

Sept. 14d. Records at 0h. (Lick (3)), 1h. (San Fernando), 4h. (Taihoku), 5h. (Manila), 9h. (Shide), 14h. (La Paz), 15h. (Manila), 18h. (Helwan, Batavia, and Colombo), 21h. (La Paz).

Sept. 15d. 9h. 14m. 25s. At 1°·0S. 18°·0W. (as on 1917 March 16d).

A = +·951, B = −·309, C = −·018 ; D = −·309, E = −·951 ;
G = −·017, H = +·005, K = −1·000.

		△	Az.	P.	O−C.	S.	O−C.	L.	M.
		°	°	m. s.	s.	m. s.	s.	m.	m.
San Fernando		39·1	15	6 35	−72	15 35	?	21·1	26·1
Azores		39·4	351	15 59	=SR_1	—	—	—	—
Rio Tinto		40·2	14	10 35	?PR_1	—	—	—	31·6
Coimbra		42·2	11	7 59	−13	i 14 35	− 3	20·2	27·8
Algiers		42·5	25	e 8 11	− 4	14 48	+ 6	23·1	24·6
Tortosa		45·2	20	8 25	− 9	15 15	− 3	22·3	29·6
Barcelona		46·3	21	e 7 41	−61	15 34	+ 2	23·5	29·6
Cape Town	E.	47·4	138	15 59	=S?	(15 59)	+13	25·2	26·4
Marseilles		49·0	22	9 12	+12	—	—	28·6	—
Rocca di Papa		51·1	29	e 9 30	+16	16 44	+12	e 26·4	38·5
Moncalieri		51·4	23	9 29	+13	i 16 55	+19	23·2	31·3
La Paz		51·7	250	8 52	−26	16 15	−25	21·6	25·0
Pola		53·9	28	e 9 35	+ 3	—	—	—	—
Kew		54·6	14	17 35	=S?	(17 35)	+19	—	33·6
Uccle		55·2	17	e 9 35	− 5	e 17 29	+ 5	e 23·6	37·3
Zagreb		55·6	28	e 9 56	+13	e 17 31	+ 2	29·6	39·1
Helwan	E.	56·2	52	10 53	?	17 53	+17	—	34·3
De Bilt		56·6	17	9 59	+ 9	17 56	+15	24·3	25·5
Eskdalemuir		57·6	10	e 9 55?	− 1	18 7	+13	25·6?	—
Edinburgh		58·2	10	24 35	?	—	—	—	44·8
Cipolletti		59·4	224	—	—	e 17 17	?	—	—
Lemberg		62·3	29	e 17 35	=S?	(e 17 35)	−77	—	—
Pulkovo		71·4	23	11 41	+15	20 49	+ 6	29·6	32·8
Mauritius	N.	76·4	111	22 17	=S?	(22 17)	+35	—	—
Bombay	E.	91·1	71	30 25	=SR_1	—	—	—	54·1
Kodaikanal	E.	95·6	80	53 17	?	—	—	—	—
Colombo	E.	97·8	83	33 35	=SR_1	—	—	—	61·6
Zi-ka-wei		131·2	48	e 53 25	—	—	—	—	—
Taihoku		134·2	55	52 2	—	—	—	—	—
Riverview		143·7	165	e 60 11	—	—	—	—	—

Additional records and notes :—San Fernando MN = +24·6m. Coimbra MN = +28·6m. Barcelona SR_1 = +19m.3s. Rocca di Papa eP = +9m.21s., eL = +27·2m., M = +35·2m. Moncalieri MN = +31·0m. Uccle MN = +37·9m. Zagreb iP = +10m.3s., eSW = +17m.37s., iSW = +17m.42s., iSW = +17m.56s., MW = +41·1m., T_0 =9h.14m.53s. De Bilt ePR_1 = +13m.25s., SN = +17m.49s., iN = +18m.3s., iE = +18m.4s., e(SR)N = +21m.26s., MN = +25·7m., T_0 = 9h.14m.39s. Epicentre 3°·0S. 17°·3W. Pulkovo PR_1 = +14m.35s., SR_1 = +25m.5s. Mauritius eP = +19m.35s., EM = +23·7m., EM = +37·4m.

Sept. 15d. Records also at 1h. (La Paz), 9h. (Paris), 11h. (Mizusawa), 12h. (La Paz), 15h. (Lick, Monte Cassino, and Rocca di Papa), 17h. (Taihoku, Zi-ka-wei, and Azores), 23h. (San Fernando). Accra (△ =19°·0) gives P = +37m.35s. Possibly 30 minutes should be subtracted for local time ; and then the remainder +7m.35s. would not be far from S = 8m.2s.

Sept. 16d. Records at 1h. (Rocca di Papa), 12h. (Batavia), 17h. (Pulkovo and Honolulu), 18h. (Helwan and De Bilt), 23h. (San Fernando).

Sept. 17d. 5h. 47m. 36s. At 18°·5N. 120°·0E. (as on 1916 August 8).

		△	Az.	P.	O−C.	S.	O−C.	L.	M.
		°	°	m. s.	s.	m. s.	s.	m.	m.
Manila		4·0	166	e 1 3	+ 1	—	—	1·7	2·7
Zi-ka-wei		12·8	4	e 3 9	− 1	—	—	—	—
Pulkovo		73·9	328	—	—	—	—	e 43·4	—
De Bilt	E.	88·8	326	—	—	—	—	47·4	57·5
	N.	88·8	326	—	—	—	—	50·4	51·6
Kew		92·8	327	—	—	—	—	—	62·4

Manila gives MN = +2·4m. De Bilt gives an Epicentre 17°·7N. 121°·0E. Eskdalemuir gives only 6h.38m. to 6h.52m.0s.

Sept. 17d. Records also at 0h. (La Paz), 2h. (Pulkovo and De Bilt), 10h. (Batavia, Colombo, Helwan, and Pulkovo), 14h. (La Paz, Honolulu, and Pulkovo), 15h. (Helwan), 16h. (Lick), 17h. (Eskdalemuir), 18h. (Helwan, De Bilt, Kew, and Pulkovo), 20h. (Kodaikanal), 22h. (Helwan, Bombay, Batavia, Colombo, and Pulkovo), 23h. (San Fernando).

Sept. 18d. 21h. 54m. 40s. At 54·°5N. 160°·0W. (as on 1917 May 31, June 3, 5, & 7).

		△	Az.	P.	O−C.	S.	O−C.	L.	M.
		°	°	m. s.	s.	m. s.	s.	m.	m.
Victoria		23·4	90	—	—	16 50?	?	—	—
Honolulu		33·2	176	—	—	—	—	13·5	21·3
Toronto		50·9	67	9 50?	+38	—	—	26·1	39·1
Pulkovo		65·4	354	i 10 39?	− 8	19 39?	+ 9	28·3	42·8
Edinburgh		68·0	14	20 10	=S?	(20 10)	+ 8	—	51·3
De Bilt	E.	72·7	9	—	—	20 14	−44	—	50·9
	N.	72·7	9	—	—	21 14	+16	—	55·4
Kew		72·7	13	—	—	—	—	—	44·3
Rio Tinto		85·0	21	48 20	?	—	—	—	59·3
Athens		87·6	357	—	—	—	—	66·2	66·3
Helwan	E.	95·0	350	46 20	?L	—	—	(46·3)	—
La Paz		104·4	98	—	—	—	—	68·3	—

Toronto gives another L = +31·4m. Rio Tinto records the P as 23h., M as 22h. Eskdalemuir records 22h.11m. to 23h.30m.0s.

Sept. 18d. Records also at 7h. (Colombo), 13h. (Manila, Zagreb, Helwan, and Athens), 14h. (Athens (7) and Mizusawa), 15h. (Athens (2) and La Paz), 16h. (Rio Tinto, Helwan, Moncalieri, and Athens), 18h. (Athens (2)), 19h. (Athens (2) and Zagreb), 20h. (Athens and Manila), 21h. (San Fernando), 22h. (Paris), 23h. (Athens (2)).

Sept. 19d. Records at 1h. (Monte Cassino and Rocca di Papa), 4h. (Edinburgh), 7h. (Rocca di Papa), 9h. (Athens), 10h. (Athens), 12h. (Athens (2)), 14h. (Athens), 17h. (Kew), 19h. (Athens), 22h. (San Fernando and Athens), 23h. (Athens).

1917. Sept. 20d. 2h. 49m. 40s. Epicentre 16°·0S. 168°·0E.

(as on 1917 May 29d., Aug. 16d., Sept. 5d. and 8d.).

A = −·940, B = +·200, C = −·276 ; D = +·208, E = +·978 ;
G = +·270, H = −·057, K = −·961.

Station and Component.		Machine.	△	Azimuth.	P.	O−C.	S.	O−C.	L.	M.
			°	°	m. s.	s.	m. s.	s.	m.	m.
Sydney	E.	M.	23·4	217	5 2	−19	10 14	+41	13·3	14·3
Riverview		—	23·4	217	i 5 20	− 1	i 9 13	−20	e 11·2	13·7
Melbourne		M.	29·8	218	6 38	+12	11 20	−11	16·2	17·5
Honolulu		—	50·1	43	8 38	−30	16 26	+ 6	27·7	33·3
Manila		—	55·6	301	e 11 13	PR?	—	—	19·3	—
Osaka		O.	59·4	329	1 35	?	—	—	—	37·5
Batavia		—	60·8	271	e 11 20	+64	—	—	—	21·3
Berkeley		—	84·6	48	e 37 8	? L	—	—	(37·1)	—
Victoria		—	88·5	38	—	—	43 38	?	48·6	56·0
Colombo	E.	M.	90·2	277	48 20	? L	—	—	(48·3)	69·9
Kodaikanal	E.	M.	93·3	282	49 44	? L	—	—	(49·7)	—
La Paz		Bi.	115·8	118	—	—	34 35	? SR_1	62·3	64·9
Toronto		M.	117·2	49	—	—	—	—	65·2	70·7
Washington	E.	—	119·3	54	56 29	?	—	—	72·6	—
Pulkovo		G.	126·6	335	e 19 48	[+40]	—	—	75·3	81·1
Helwan	E.	M.	138·0	297	20 20	[+44]	—	—	—	—
Vienna		—	140·3	330	e 20 2	[+23]	—	—	—	—
De Bilt		—	141·4	343	e 20 49	[+68]	—	—	—	53·0
Graz		W.	141·5	329	e 20 14	[+32]	—	—	—	—
Zagreb		W.	142·1	328	e 20 2	[+19]	—	—	40·3	—
Kew		M.	143·4	348	—	—	—	—	—	96·3
Paris		—	145·2	343	e 24 20	? PR_1	—	—	94·3	96·3
Moncalieri		S.	146·6	334	e 20 34	[+43]	36 42?	—	37·3	—
Rocca di Papa		Ag.	146·7	325	e 20 41	[+50]	—	—	—	52·0
Tortosa		—	152·9	339	21 4	?	—	—	72·3	105·3
Coimbra		W.	155·6	354	e 86 20	?	—	—	100·3	—

For Notes see next page.

NOTES TO SEPT. 20d. 2h. 49m. 40s.

Additional records and notes: Riverview $PR_1 = +6$m.5s., MZ = +13·4m., MN = +14·4m. Melbourne P is recorded as PRe. Osaka MN = +32·3m. Toronto gives another L = +67·3m. Washington LN = +71·3m. E on the Mainka is given as 3h.47m.31s. Pulkovo $PR_2 = +23$m.24s. De Bilt records e = +30m.53s., eN = +43m.11s., eE = +43m.21s., MN = +35·7m. Zagreb ePW = +20m.25s., iPE = −20m.48s., iPW = +20m.52s. Rocca di Papa e = +20m.16s., M = +21m.26s., e = +27m.23s., $M_1 = +44·3$m., $M_2 = +41·6$m. Ottawa gives eL 3h.54m. to 4h.15m.0s. Eskdalemuir 4h.0m. to 5h.30m.0s.

Sept. 20d. 3h. 19m. 0s. At 40°·5N. 14°·0E. A = + 738, B = +·184, C = +·649.

	△	P.	O−C.	S.	O−C.	M.
	°	m. s.	s.	m. s.	s.	m.
Monte Cassino	1·0	0 9	− 7	—	—	—
Rocca di Papa	1·6	e 0 24	− 1	0 42	− 3	0·9
Zagreb	5·5	e 1 45	+20	—	—	e 2·1

Zagreb records e = +1m.55s., eM = +3·0m.

Sept. 20d. Records also at 4h. (Zagreb), 9h. (Athens), 14h. (Manila), 15h. (Athens) 20h. (Athens and Edinburgh), 21h. (San Fernando).

Sept. 21d. 1h. 6m. 40s. Pulkovo gives iP = +6m.40s., iS = +11m.54s., e = +12m.51s., L = +18·3m., M = +18·3m. Helwan P = +20m.20s. Rocca di Papa eP = +8m.10s., M = +8·6m., e = +8m.26s., M = +29·8m. De Bilt e = +25m.20s. Is the origin about 44°·0N. 14°·0W.?

Sept. 21d. Records also at 1h. (La Paz), 2h. (La Paz and Zagreb), 3h. (Helwan), 4h. (Taihoku), 5h. (Taihoku), 8h. (Tucson and Berkeley), 10h. (Riverview and Manila), 11h. (Manila and Osaka), 13h. (Athens), 17h. (Mizusawa), 18h. (Lick), 21h. (Tucson and Rocca di Papa), 23h. (Manila).

Sept. 22d. Records at 0h. (San Fernando), 3h. (Taihoku and La Paz), 6h. (Athens and Manila), 7h. (Athens), 12h. (Rio Tinto), 15h. (Taihoku), 18h. (Helwan and Lick), 22h. (San Fernando).

Sept. 23d. 19h. 45m. 20s. Close to Athens. Athens iP = +0m.9s., L = +0·2m., M = +0·3m. Rocca di Papa eP = +2m.4s., M = +4·0m. Pola eP = +4m.10s. Vienna ePZ = −5m.22s. Graz e = +5m.52s. De Bilt eE = +10m.46s., eN = +10m.52s.

Sept. 23d. Records also at 1h. (Helwan), 2h. (Taihoku, Zagreb, and Zi-ka-wei), 15h. (Manila, De Bilt, and Edinburgh), 16h. (Honolulu and Helwan), 17h. (La Paz), 18h. (Athens), 19h. (Athens (3)), 20h. (Sydney and Athens (2)), 21h. (Athens), 22h. (Athens, San Fernando, and Edinburgh), 23h. (Edinburgh).

1917. Sept. 24d. 20h. 7m. 40s. Epicentre **4°·5S. 152°·0E.**

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

Station.	Inst.	△	Az.	P.	O−C.	S.	O−C.	L.	M.
		°	°	m. s.	s.	m. s.	s.	m.	m.
Riverview	W.	29·2	182	e 5 54	−26	i 10 28	−52	e 14·0	16·6
Adelaide	M.	32·8	200	11 38	?S	(11 38)	−43	—	25·1
Manila	W.	36·2	302	e 7 34	+10	11 27	−106	13·4	13·5
Osaka	O.	42·2	340	8 12	0	—	—	18·2	21·6
Mizusawa	O.	44·8	348	8 27	− 5	—	—	9·0	—
Batavia	W.	44·9	266	i 8 41	+ 9	i 15 20	+ 6	—	17·3
Zi-ka-wei	G.	46·1	323	8 59	+18	—	—	—	—
Honolulu	M.	55·3	60	9 50	+ 9	17 14	−11	28·3	33·1
Bombay	O.E.	81·3	290	12 23	− 4	22 10	−28	—	23·4
Victoria	M.	89·9	41	22 26	?S	(22 26)	−109	43·2	54·6
Pulkovo	G.	109·4	333	i 14 36	−19	26 16	−67	53·3	—
Lemberg	B.O.	117·1	325	20 14	? PR_1	—	—	—	—
Helwan	M.	118·7	302	19 20	? PR_1	—	—	—	—
Toronto	M.	120·2	41	—	—	—	—	26·8	—
Vienna	W.	122·2	327	19 2	? PR_1	—	—	—	—
Graz	W.	123·4	326	20 58	? PR_1	—	—	—	—
Zagreb	W.	123·8	324	21 5	? PR_1	—	—	40·3	—
Edinburgh	M.	125·0	343	20 20	? PR_1	—	—	—	—
De Bilt	G.	125·1	336	e 21 12	? PR_1	40 50	—	—	67·3
Pola	W.	125·6	324	21 20	? PR_1	—	—	—	—
Uccle	G.	126·4	335	e 21 8	? PR_1	—	—	—	—
Rocca di Papa	Ag.	128·1	322	e 21 26	? PR_1	—	—	—	22·6
Paris	G.	128·7	335	i 22 38	? PR_1	—	—	66·3	—
Moncalieri	S.	128·9	329	i 21 25?	? PR_1	—	—	31·7	—
La Paz	Bi.	135·1	119	19 20	[−10]	—	—	39·3	48·0
Tortosa	Ma.	135·1	329	19 27	[− 3]	23 0	—	23·8	41·7
Rio Tinto	M.	141·5	332	26 20	?	—	—	—	83·3
San Fernando	—	142·4	331	19 20	[−24]	—	—	32·3	87·3

Additional records and notes: Riverview $PR_1 = +6$m.55s., $SR_1 = +12$m.4s. Manila MN = +13·6m. Osaka MN = +22·0m. Mizusawa PN = +8m.2s. Victoria S = +33m.20s. Pulkovo $iPR_1 = +19$m.20s., i = +25m.2s., i = +26m.3s., PS = +28m.35s., $SR_1 = +35$m.26s. Toronto L = +28·0m. Zagreb P = +19m.8s. Rocca di Papa e = +21m.32s., M = +38·6m. De Bilt MN = +66·8m.

Sept. 24d. Records also at 0h., 3h., 6h. (Athens), 10h. (Taihoku), 11h. (Manila and Athens (3)), 13h. (Athens), 14h. (Athens and La Paz), 15h. (La Paz), 16h. (Athens and La Paz), 17h. (Athens (2)), 19h. (Athens (2)), 21h. (Berkeley, Lick, and Athens), 22h. (San Fernando).

Sept. 25d. Records at 0h. (Athens), 1h. (Riverview and Pulkovo), 2h. (Edinburgh, Helwan, Rio Tinto, and De Bilt), 3h. (Riverview and Taihoku), 8h. (Athens), 9h. (Athens), 13h. (Athens), 18h. (Athens), 21h. (Athens), 22h. (Athens), 23h. (San Fernando).

Sept. 26d. Records at 9h. (Manila), 10h. (Athens), 16h. (Athens, Kew, and Edinburgh), 20h. (Athens), 21h. (San Fernando), 22h. (Kodaikanal).

Sept. 27d. Records at 0h. (Edinburgh), 3h. (Athens), 5h. (San Fernando), 7h. (Algiers (3)), 8h. (Algiers), 16h. (Rio Tinto), 20h. (Rocca di Papa), 22h. (San Fernando).

Sept. 28d. 15h. 42m. 40s. Barcelona gives P = +0m.18s., L = +0·6m. Tortosa P = +0m.42s., L = +1·3m., M = +1·5m. Marseilles P = +0m.36s., S = +0m.57s. Epicentre 42°·7N. 3°·5E.?

Sept. 28d. 19h. 53m. 20s. Repetition of 1917 July 4d. 0h. and 15h. 25°·0N. 123°·0E.

	Δ	Az.	P.	O−C.	S.	O−C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Taihoku	1·3	274	0 13	− 7	—	—	0·5	2·2
Zi-ka-wei	5·8	350	e 1 43	+13	—	—	e 3·6	—
Pulkovo	69·9	328	—	—	—	—	e 34·7	—
Helwan	79·2	298	50 40	?	—	—	—	—
Uccle	87·0	326	—	—	—	—	e 47·7	—
De Bilt	85·8	327	—	—	—	—	e 44·7	49·5
Edinburgh	87·2	333	46 40	—	—	—	—	—
San Fernando	102·0	320	56 40	—	—	—	—	—
Cape Town	115·2	230	—	—	—	—	—	51·1

Paris records long waves from 20h.42m. to 20h.44m.

Sept. 28d. Records also at 3h. (Monte Cassino), 11h. (La Paz), 15h. (La Paz and Moncalieri), 20h. (Moncalieri), 23h. (La Paz and Bombay).

Sept. 29d. Records at 3h. (Mizusawa), 4h. (La Paz), 9h. (Algiers), 10h. (Algiers, Rio Tinto, and Tortosa), 15h. (Mizusawa), 17h. (Algiers), 21h. (San Fernando), 23h. (La Paz).

Sept. 30d. Records at 1h. (Athens), 2h. (Athens), 5h. (Zagreb), 6h. (Mizusawa), 9h. (Lick), 15h. (La Paz), 18h. (Rocca di Papa (2)), 21h. (Rocca di Papa and San Fernando), 23h. (Helwan).

TABLE.

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

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British Association for the Advancement of Science.—Seismological Committee.

Enquiries about instruments
to be addressed to
J. J. SHAW, Esq. (Secretary),
Sunnyside,
Birmingham Road,
WEST BROMWICH.

Other correspondence to
Prof. H. H. TURNER,
University Observatory,
OXFORD.

Bulletin for Oct., Nov., and Dec., 1917.

The present Bulletin completes the year 1917, the series being (1) Jan. and Feb., (2) March April, (3) May, (4) June, July, (5) Aug., Sept., (6) Oct., Nov., Dec. In the preparation of these Bulletins the work has undergone some changes and developments. Firstly, more attention has been paid to the smaller earthquakes, which in (1) were omitted altogether, but which from (2) onwards have been mentioned in any case, and sometimes tentatively reduced. In (2) attention was called to the importance of records for P received at the Antipodes, and a formula was suggested for the relation between time and distance from the epicentre. In (3) it was remarked that different earthquakes shewed systematic variations from this formula which might be ascribed to variations in focal depth, and estimates were given for these variations. In (5) attention was called to a period of about 21 minutes in the recurrence of earthquakes; firstly, for those from the same focus, and secondly for those in any position, when allowance was made for latitude. All these matters have been mentioned tentatively, and are still under investigation.

In (4) brief mention was made of the Conference at Rome, and the suggestion of making the present Bulletin the official publication of the International Union for Jan., 1918. Assuming that this course will be adopted, the present number will thus mark the conclusion of the period during which the British Association has been immediately responsible for this work. It is the tradition of the British Association to foster new scientific enterprises until they can be handed over to other management; and the present case is perhaps not the least important of such activities.

H.H.T.

University Observatory, Oxford,
1922 October 6th.

1917, OCTOBER, NOVEMBER, & DECEMBER.

Oct. 1d. Records at 11h. (Mizusawa), 12h. (Pulkovo and Manila), 16h. (La Paz), 20h. (La Paz, Athens, and De Bilt), 21h. (Lick, San Fernando), 22h. (Athens), 23h. (Athens). Explosion in Kent on this day.

Oct. 2d. Records at 3h. (Lick), 9h. (Athens (2)), 10h. (Riverview and Athens), 11h. (Athens), 13h. (Athens), 14h. (Athens and Mizusawa), 16h. (Athens), 17h. (Manila), 21h. (San Fernando).

Oct. 3d. 7h. 17m. 20s. At 4°·0N. 115°·0E., as on 1914 Aug. 6?

A = −·422, B = +·904, C = +·070; D = +·906, E = +·423;
G = −·029, H = +·063, K = −·998.

	Δ	Az.	P.	O−C.	S.	O−C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Manila	12·1	29	e 2 55	− 5	—	—	5·1	5·7
Batavia	13·1	219	i 3 29	+15	—	—	—	7·7
Zi-ka-wei	27·9	12	e 5 40	−27	—	—	—	—
Pulkovo	83·9	330	e 24 10	?8	(24 10)	+63	—	—

Consideration of the residuals suggests that the epicentre should be moved to the N.E. about 1° or 2°.

Oct. 3d. 23h. 38m. (0s.). Close to Manila, which gives eP = +44s., L = +1m.18s., ME = +1m.26s., MN = +1m.37s. Manila also records a later shock with P = 23h.53m.47s.

Oct. 3d. 23h. 47m. (10s.). Close to Monte Cassino, which gives P = +3s., M = −2s. (Sic!), Rocca di Papa gives eP = +9s., M = +24s.

Oct. 3d. Records also at 0h. (Lick), 12h. (La Paz and Helwan), 13h. (San Fernando and Pulkovo), 16h. (Algiers, Lick), 19h. (Athens), 20h. (San Fernando), 22h. (Athens).

Oct. 4d. Records at 9h. (Moncalieri), 10h. (Mizusawa), 12h. (Simla), 15h. (Manila), 22h. (Manila), 23h. (Manila).

Oct. 5d. 23h. (32m.). A shock near Lick, which records e = 23h.32m.59s., F = 23h.33m.10s. This is followed by

Oct. 5d. 23h. 33m. (40s.). Possibly from some origin near 7°·5N. 79°·0W., as on 1913 Oct. 2d. 4h., though the De Bilt record cannot be reconciled. Adopting this epicentre for illustration (A = +·189, B = −·973, C = +·131) we have—

	Δ	Az.	P.	O−C.	S.	O−C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
La Paz	26·3	156	5 45	− 6	10 29	+1	16·3	17·6
Pilar	41·8	161	23 8	?L	—	—	—	—
De Bilt	80·5	38	32 50	i	—	—	—	—
Edinburgh	75·8	34	36 20	?L	—	—	—	—
Helwan	103·6	57	59 20	?L	—	—	—	—

La Paz gives also i = +14m.54s. and +15m.20s.

Oct. 5d. Records also at 0h. (Athens), 4h. (Manila), 6h. (Edinburgh, Pulkovo, Helwan, and La Paz), 8h. (Athens (2)), 9h. (Athens), 10h. (Athens and Mizusawa), 11h. (Athens and Manila (2)), 12h. (San Fernando and Manila (2)), 14h. (Athens and La Paz), 15h. (Manila and La Paz), 18h. (Taihoku), 20h. (Melbourne, Adelaide, Riverview), 21h. (Athens), 22h. (Manila), 23h. (Athens).

Oct. 6d. 4h. 1m. 0s. At 40°·0N. 20°·0E. (as on 1917 April 26d. 13h., June 25d. 13h., and 29d. 8h.).

A = +·720, B = +·262, C = +·643 ; D = +·342, E = −·940 ;
G = +·604, H = +·220, K = −·766.

	△	Az.	P.	O−C.	S.	O−C.	M.
	°	°	m. s.	s.	m. s.	s.	m.
Athens	3·6	123	e 0 58	+ 2	e 1 50	+11	3·0
Monte Cassino	4·9	290	2 11	?S	(2 11)	− 3	—
Rocca di Papa	5·8	291	e 1 48	+18	—	—	4·7
Zagreb	6·5	335	i 1 27	−12	2 48	− 9	3·0
Pola	6·6	319	e 1 0	−40	—	—	—
Triest	7·3	323	—	—	3 8	−10	—
Graz	7·8	336	e 1 23	−35	—	—	—
Vienna	8·6	343	e 2 0	−10	—	—	—
Helwan	13·7	134	15 0	—	—	—	—
De Bilt	15·8	325	e 8 6	?S	(8 6)	+76	9·5

Additional records : Athens MN = +2·9m. Zagreb eP = +1m.6s., iNE = +1m.36s., i = +2m.5s. Helwan P = +17m.0s. De Bilt MN = +9·4m.

Oct. 6d. 4h. 48m. 8s. At 40°·0N. 20°·0E. (as above).

	△	Az.	P.	O−C.	S.	O−C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Athens	3·6	123	e 0 56	0	1 48	+ 9	—	3·1
Monte Cassino	4·9	290	1 18	−13	—	—	—	3·3
Rocca di Papa	5·8	291	e 1 24	− 6	—	—	—	4·2
Zagreb	6·5	335	1 21	−18	2 35	−22	—	3·1
Pola	6·6	319	e 1 16	−24	—	—	—	—
Triest	7·3	323	2 31	+40	—	—	—	—
Graz	7·8	336	e 1 22	−36	—	—	—	—
Vienna	8·6	343	e 1 46	−24	—	—	—	—
Uccle	9·6	327	e 7 34	?	—	—	—	—
De Bilt	15·8	325	7 28	?S	(7 28)	+38	—	9·8
Pulkovo	20·8	15	e 2 4	−167	—	—	9·9	—

Additional records : Athens cE = +2m.10s., cN = +2m.14s. De Bilt MN = +8·3m. Zagreb iPE = +1m.36s., i = +2m.52s. The records from Uccle and Pulkovo seem to belong to a different shock or shocks ?

Oct. 6d. Records also at 0h. (Edinburgh), 1h. (Manila), 2h. (San Fernando), 3h. (Edinburgh), 5h. (Athens), 6h. (Athens), 7h. (Manila (2)), 8h. (Athens and Mizusawa), 9h. (Manila), 12h. (Riverview, Taihoku), 13h. (Sydney, Honolulu), 14h. (Paris, San Fernando, De Bilt, and Helwan), 15h. (Monte Cassino), 16h. (Athens), 17h. (Mizusawa), 18h. (Manila), 19h. (Athens and Manila), 20h. (Athens), 23h. (Athens).

1917. October 7d. 14h. 42m. 25s. Epicentre 0°·0. 27°·0W.

A = +·891, B = −·454, C = ·000 ; D = −·454, E = −·891 ;
G = ·000, H = ·000, K = −1·000.

Station and Component.	Inst.	△	Az.	P.	O−C.	S.	O−C.	L.	M.
		°	°	m. s.	s.	m. s.	s.	m.	m.
Rio de Janeiro N.	—	27·3	214	e 6 29	+23	—	—	14·6	17·4
San Fernando N.	M.	41·2	26	9 35	+90	—	—	23·1	25·1
E.	M.	41·2	26	17 35	SR_1	—	—	23·6	27·1
Rio Tinto	M.	42·1	24	11 35	?	—	—	—	24·6
Coimbra	W.	43·6	20	e 8 11	−12	14 39	−17	19·7	20·6
La Quiaca	M.	43·7	237	—	—	e 16 17	+79	—	—
La Paz	Bi.	43·8	246	i 8 29	+ 5	i 15 7	+ 8	22·7	24·8
Algiers	—	46·1	34	e 8 29	−12	15 14	−15	21·6	26·6
Tortosa	V.	47·8	28	8 42	−11	16 27	+36	22·6	30·5
Barcelona	Ma.	49·1	29	e 10 35	+94	—	—	e 22·8	—
Cape Town	M.	54·4	133	—	—	—	—	—	17·0
Moncalieri	S.	54·4	30	e? 8 37	−58	i 17 10	− 4	25·2	30·7
Paris	—	55·0	23	—	—	—	—	24·6	30·6
Rocca di Papa	Ag.	55·0	36	e 9 37	− 2	—	—	e 30·1	32·6
Kew	M.	56·2	20	23 35	?SR_1	—	—	—	33·6
Stonyhurst	M.	57·5	17	e 12 37	?PR_1	24 11	?SR_1	—	32·2
De Bilt	G.	58·6	23	—	—	18 8	+ 2	29·1	30·3
Eskdalemuir	G.	58·6	16	18 10	?S	(18 10)	+ 4	24·4	—
Edinburgh	M.	59·2	15	18 5	?S	(18 5)	− 8	—	34·6
Zagreb	W.	59·3	33	e 10 9	+ 2	18 15	0	30·6	53·1
Athens	—	61·5	45	e 10 12	−10	e 18 14	−23	—	—
Ottawa	—	62·4	323	13 56	?S	(13 56)	+ 3	26·0	—
Helwan	M.	62·9	56	14 17	?PR_1	—	—	—	40·8
Toronto	—	63·8	320	—	—	—	—	44·3	—
Pulkovo	G.	74·2	26	i 11 48	+ 5	i 21 18	+ 2	29·6	49·1
Mauritius	M.	85·2	110	34 23	?	—	—	—	44·8
Victoria	M.	94·2	316	39 9	?	43 13	?	48·2	53·2
Colombo	M.	106·6	80	55 35	?L	—	—	—	—
Honolulu	—	127·7	300	39 29	?	—	—	66·6	74·8
Riverview	—	146·1	177	e 70 41	?L	—	—	85·5	87·9

Coimbra gives also MN = +22·2m. La Paz gives also i = +18m.54s. =SR_1? Moncalieri gives also MN = +28·6m. Paris gives e = 14h.33m.0s., which precedes above shock : should it perhaps be 14h.53m.0s. which would be near P? De Bilt gives also SN = +18m.9s., e = +25m.11s., MN = +30·8m. Zagreb gives also iP = +10m.16s., SNW = +18m.21s. Athens gives also e = +14m.5s. Ottawa gives also S = +23m.20s. Pulkovo gives also PR_1 = +14m.36s., PR_2 = +16m.4s., SR_1 = +25m.11s., SR_2 = +28m.35s. Riverview gives also MN = +88·1m. Uccle record disturbed by wind.

Oct. 7d. Records also at 0h. (Mizusawa), 4h. (Monte Cassino), 10h. (La Paz), 12h. (Athens).

Oct. 8d. 6h. 21m. 21s. At 39°·3N. 21°·0E. (as on 1917 May 23d. 5h. and Aug. 19d.).

	△	Az.	P.	O−C.	S.	O−C.	M.
	°	°	m. s.	s.	m. s.	s.	m.
Athens	2·8	120	e 0 44	0	e 1 18	0	1·8
Rocca di Papa	6·6	294	e 1 35	−5	—	—	4·6
Barcelona	14·5	285	i 21 20	?	i 21 26	?	—

Athens also gives iN = +1m.36s. Rocca di Papa also gives MN = +3·7m. Zagreb's record fails from absence of minute marks.

Oct. 8d. 16h. 11m. 32s. Repetition from 39·3N. 21·0E. above ?

	△	Az.	P.	O−C.	S.	O−C.	L.
	°	°	m. s.	s.	m. s.	s.	m.
Athens	2·8	120	e 0 44	0	e 1 18	0	e 1·6
Helwan	12·7	135	10 28	—	—	—	—

Oct. 8d. Records also at 0h. (Besançon), 1h., 2h., 3h., 15h., and 16h.35m. at Athens, 7h. and 8h. (La Paz), 12h. (San Fernando), 18h. and 20h. (Zagreb), 22h. (San Fernando).

Oct. 9d. Records at 5h. (Athens), 9h. (Batavia), 15h. (La Paz).

Oct. 10d. Records at 2h. (Athens), 5h., 8h., and 9h. (Zi-ka-wei), 12h. (San Fernando), 19h. (Lick and San Fernando), 20h. (Algiers and La Paz), 21h. (Barcelona, and Tortosa), 22h. (Paris).

Oct. 11d. Records at 2h. (La Paz), 5h. (Colombo), 6h. (San Fernando), 10h. (Pulkovo and Riverview), 12h., 15h., and 19h. (La Paz), 21h. (Berkeley and Lick), 22h. and 23h. (Manila).

Oct. 12d. Records at 0h. (San Fernando), 1h. (Zi-ka-wei), 5h. (San Fernando), 11h. (La Paz), 17h., 18h., and 19h. (Athens).

Oct. 13d. 4h. 20m. 30s. At 18°·0N. 100°·0W. (as on 1916 Nov. 21d. 6h.).

	△	Az.	P.	O−C.	S.	O−C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Tucson	17·3	318	4 10	—	—	—	8·8	9·5
Toronto	31·0	30	—	—	—	—	39·8	—
Ottawa	34·0	31	—	—	—	—	e 19·5	—
Victoria	35·8	333	—	—	—	—	19·5	—
Pulkovo	92·5	23	e 25 30	?S	(25 30)	+50	46·5	—
Helwan	113·1	35	30 30	?S	(30 30)	+214	—	—

Additional records: Tucson MN = +9·9m. Victoria L = +22·9m.

Oct. 13d. 16h. 3m. 40s. At 38°·5N. 16°·0E. (as on 1917 June 12). It is assumed that there is some mistake in the Athens record, for there is no obvious way of reconciling it with the other two.

	△	Az.	P.	O−C.	S.	O−C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Rocca di Papa	4·1	323	e 0 58	− 6	1 56	+ 3	—	2·2
Athens	6·1	91	5 1	?	—	—	e 5·1	5·2
Zagreb	7·3	359	e 1 53	+ 3	3 16	− 2	—	—

Rocca gives also Pn = +1m.8s.: Zagreb i = +2m.32s., +2m.50s.

Oct. 13d. Records also at 3h. (La Paz), 3h., 19h., and 22h. (San Fernando), 21h. (Athens), 23h. (Taihoku).

Oct. 14d. Records at 0h. (La Paz), 2h. (Batavia), 3h. (Helwan and Honolulu), 5h. (Helwan), 6h. (Batavia, Rocca di Papa, and San Fernando), 11h. (Manila), 13h. (Rocca di Papa (2)), 14h. (Rocca di Papa and Manila), 17h. (Rocca di Papa, Monte Cassino, and Zagreb), 18h. (Rocca di Papa).

Oct. 15d. Records at 0h. (Athens), 1h. (Algiers), 4h. and 16h. (Manila), 17h. (Helwan).

Oct. 16d. Records at 0h. (San Fernando and Lick), 2h. (La Paz), 5h. (San Fernando), 11h. (Mizusawa), 13h. (La Paz), 14h. (Manila), 17h. (Bombay), 18h. (Mizusawa and Osaka), 21h. (Riverview), 23h. (Lick).

Oct. 17d. 1h. 24m. 50s. At 40°·5N. 90°·5E. (as on 1914 Aug. 4 ?)

A = −·007, B = +·760, C = +·649; D = +1·000, E = +·009; G = −·006, H = +·649, K = −·760.

	△	Az.	P.	O−C.	S.	O−C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Simla	14·3	333	e 3 28	− 2	—	—	—	6·1
Bombay	26·4	220	5 22	−30	—	—	—	9·1
Kodaikanal	32·4	204	12 22	?S	(12 22)	+8	—	—
Colombo	34·9	199	16 10	?L	—	—	—	—
Helwan	48·5	276	9 10	+13	—	—	—	—
De Bilt	59·2	310	—	—	—	—	e 29·7	32·4
Paris	59·6	310	—	—	—	—	e 30·2	35·2
Stonyhurst	59·9	317	—	—	—	—	—	37·7
Mauritius	67·7	213	22 58	?	—	—	—	—

De Bilt gives also eLN = +28·7m., MN = +29·4m. Mauritius gives also PN = +24m.10s. Kew gives max. at 1h.59m. "Very small." Stonyhurst max. 2h.2m.30s. Eskdale gives slight disturbance 1h.55m. to 2h.45m.

Oct. 17d. 13h. 54m. (0s.). Mizusawa P = +0m.28s., L = +0m.54s. Manila e = +43m.23s., F = +65m. is probably a different shock. We have also Riverview eP = 14h.51m.30s., L = 14h.59m.30s., ME = +8·7m., MN = +10·7m., and other records from Melbourne, Honolulu, Helwan, and Batavia eP = 15h.38m.0s.

Oct. 17d. Records also at 2h. (Manila), 7h. (Manila, local, and Riverview), 8h. (Batavia), 12h. (San Fernando), 21h. (Barcelona and Rocca di Papa), 22h. (San Fernando), 23h. (Athens).

Oct. 18d. 4h. 24m. 0s. At 40°·0N. 20°·0E. (as on Oct. 6d. 4h.).

A = +·720, B = +·262, C = +·613; D = +·342, E = −·940; G = +·604, H = +·220, K = −·766.

	△	Az.	P.	O−C.	S.	O−C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Athens	3·6	123	0 30	−26	—	—	1·2	2·0
Monte Cassino	4·9	290	1 25	− 9	—	—	—	3·5
Rocca di Papa	5·8	291	e 1 13	−17	3 28	+49	—	4·5
Zagreb	6·5	335	e 1 32	− 7	i 3 26	+29	—	4·2
Pola	6·6	318	e 2 30	?S	(2 30)	−30	—	—
Graz	7·8	344	e 2 13	+15	—	—	—	—
Vienna	8·6	347	e 2 6	− 4	—	—	—	—
Lemberg	10·2	15	e 4 42	?S	(4 42)	+ 7	—	—
Moncalieri	10·3	303	e 2 55	+21	—	—	6·0	9·1
Barcelona	13·6	282	—	—	—	—	e 3·0	11·0
Helwan	13·7	125	9 0	?	—	—	—	—
Paris	15·2	311	i 6 43	?S	(6 43)	+ 6	e 9·0	9·0
De Bilt	15·8	325	—	—	6 55	+ 5	8·5	11·0
Edinburgh	22·0	333	12 30	?L	—	—	(12·5)	15·0

Additional records: Athens MN = +2·3m. Zagreb i = +2m.1s., +2m.29s., +2m.41s., +2m.52s., +3m.9s., +3m.40s., SR = +3m.48s., +3m.56s., MNW = +4·4m. Moncalieri MN = +8·2m. De Bilt MN = +9·8m. Eskdalemuir 4h.36m. to 4h.47m. The residuals suggest that the epicentre might be moved a little nearer Athens.

Oct. 18d. 18h. 58m. 45s. At 40°·0N. 20°·0E., as above ?

	△	Az.	P.	O−C.	S.	O−C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Athens	3·6	123	1 6	+10	1 46	− 7	2·2	3·0
Monte Cassino	4·9	290	2 0	?S	(2 0)	−14	—	—
Rocca di Papa	5·8	291	e 2 28	?S	(2 28)	−11	—	4·9
Zagreb	6·5	335	e 1 36	− 3	3 18	+21	—	3·5
Graz	7·8	344	e 1 40	−18	—	—	—	—
Vienna	8·6	347	e 1 44	−26	—	—	—	—
Lemberg	10·2	15	e 3 27	+54	—	—	—	—
Helwan	13·7	135	11 15	?	—	—	—	—
Paris	15·2	311	—	—	—	—	e 9·3	9·8
De Bilt	15·8	325	e 7 33	?S	(7 33)	+43	8·3	9·4

Additional records: Athens e = +1m.57s. Zagreb iP = +1m.48s., i = +2m.20s., +2m.36s., +2m.45s., +2m.54s., +3m.50s., SR = +3·4m., +3·5m., MNW = +4·1m. De Bilt MN = +8·9m.

Oct. 18d. Records also at 5h. (Athens), 7h. (Athens), 9h. (Vienna), 11h. (Riverview), 16h. (Manila), 20h. (Osaka).

1917. Oct. 19d. 16h. 36m. 50s. Epicentre 18°·0N. 100°·0W. (as on 1916 Nov. 21 and 1917 Oct. 13).

Station.	Inst.	△	Az.	P.	O−C.	S.	O−C.	L.	M.
		°	°	m. s.	s.	m. s.	s.	m.	m.
Tucson	B.O.	17·3	328	...	...	...	...	9·7	15·9
Port au Prince	B.O.	26·2	85	11 24	?S	(11 34)	+63	—	—
Berkeley	—	27·8	320	16 10	?L	...	...	(16·2)	—
Washington	—	28·8	39	e 5 17	−59	11 17	+ 4	e 15·5	
Cheltenham	B.O.	28·9	40	7 10	+49	...	...	16·1	19·7
Toronto	M.	31·0	30	5 52	−46	12 28	− 37	14·8	20·2
Ithaca	B.O.	31·5	34	...	...	...	...	e 16·9	...
Vieques	B.O.	32·8	84	11 0	?S	(11 0)	−81	15·9	18·7
Ottawa	—	34·0	31	7 9	+ 4	12 33	− 7	e 16·7	—
Victoria	—	35·8	333	7 34	+14	14 30	+83	23·9	30·9
Pilar	M.	60·6	145	e 14 56	?PR_4	...	...	—	—
Edinburgh	M.	79·0	35	22 10	?S	(22 10)	− 2	—	48·7
Coimbra	—	79·7	50	...	...	(22 12)	− 8	e 22·2	—
Stonyhurst	M.	79·9	36	e 21 40	?S	(21 40)	−42	—	45·2
Rio Tinto	M.	81·7	53	24 10	?S	(24 10)	+87	...	49·2
San Fernando	—	82·3	54	23 10	?S	(23 10)	+21	45·4	50·2
Paris	—	84·5	40	e 23 10	?S	(23 10)	− 4	41·2	45·2
De Bilt	—	84·8	37	12 49	+ 2	23 16	− 1	e 39·2	48·3
Moncalieri	S.	89·2	42	36 36	?L	...	...	46·2	—
Graz	W.	93·0	38	—	—	—	—	e 34·2	—
Pola	W.	93·2	41	e 33 10	?SR_4	—	—	—	—
Helwan	M.	113·0	45	29 10	?S	...	...	—	...
Riverview	—	115·4	310	e 56 46	?L	...	...	e 63·8	64·8
Melbourne	M.	120·5	236	—	—	—	—	e 61·7	66·2
Cape Town	M.	123·3	119	60 16	?L	...	...	(60·3)	...
Batavia	—	151·3	291	e 43 20	—	—	—	—	47·2
Kodaikanal	M.	151·6	6	96 4	...	—	—	—	—
Mauritius	M.	159·0	99	74 4	?L	—	—	(74·1)	81·4

Additional records and notes: Tucson L = +10·7m., MN = +17·8m. Cheltenham PN = +6m.13s., MN = +16·1m. Washington eP = +5m.22s., S = −10m.59s. Toronto P at +2m.58s., S at +9m.52s. Vieques PN = +11m.46s., LN = +16·2m., MN = +19·7m. But also gives P at 16h.28m., S at 16h.39m., L at 16h.43m., M at 16h.55m. Probably, however, this should be dated Oct. 20 or Oct. 21, as otherwise these earlier records follow the later ones. Coimbra L is probably S as shown. San Fernando MN = +17·2m. Paris MN = +18·2m. De Bilt eSR_1 = +28m.53s., eSR_2 = +32m.31s., eLN = +45·2m., MN = +50·1m., T_o = 16h.37m.10s., Riverview MN = +67·0m. Mauritius PN = +75m.40s. Eskdalemuir 17h.0m. to 18h.0m. Bombay 18h.7m. to 18h.12m. Uccle M = +38m. Kew M = +40·6m.

Oct. 19d. Records also at 5h. (Riverview), 11h. (Mizusawa), 15h. (Moncalieri), 21h. (Lick).

Oct. 20d. 17h. 33m. 33s. At 16°·0S. 168°·0E.? (as on 1917 May 29d. 6h. and 1916 Aug. 16d. 22h., &c.).

A = −·940, B = +·200, C = −·276; D = +·208, E = +·978; G = +·270, H = −·057, K = −·961.

	△	Az.	P.	O−C.	S.	O−C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Riverview	23·4	217	e 5 21	0	e 9 33	0	13·6	15·4
Melbourne	29·8	218	—	...	—	—	e 14·0	17·5
Batavia	60·6	271	e 11 27	+71	...	—	—	—
Victoria	88·5	38	...	...	...	—	11·6	18·1
Mauritius	102·4	245	46 21	?L	...	—	(46·3)	—
Toronto	117·2	19	—	...	...	—	62·0	—
Helwan	138·0	297	86 27	?	—	—	—	...
De Bilt	141·4	343	—	...	...	—	e 70·1	73·9

Riverview also i = +11m.2Ss., MN = +15·7m. Toronto also L = +70·8m. De Bilt records also eLN = +68·4m., MN = +70·1m.

Oct. 20d. Record also at 4h. (Moncalieri), 15h. (Lick).

Oct. 21d. 6h. 54m. 15s. At 16°·0S. 168°·0E., as above?

	△	Az.	P.	O−C.	S.	O−C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Riverview	23·4	217	e 5 21	0	e 9 33	0	e 10·6	12·4
Melbourne	29·8	218	i 8 9	?	—	—	—	10·2
Mauritius	102·4	245	20 27	?	—	—	—	—

Riverview PS = +9m.49s., MN = +11·6m. Mauritius P = +21m.57s. Bombay records 7h. 14m. to 7h.47m.

Oct. 21d. Records also at 8h. (Helwan, Edinburgh, De Bilt, San Fernando: fragmentary), 9h. (Rocca di Papa), 22h. (Mizusawa).

Oct. 22d. 7h. 20m. 0s. At 13°·0N. 83°·0W.

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

	△	Az.	P.	O−C.	S.	O−C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Vieques	17·7	71	4 20	+ 7	4 15	?P	8·0	8·5
Washington	26·4	10	e 5 47	− 5	—	—	e 16·4	—
Ithaca	29·9	10	—	—	—	—	e 22·8	—
Toronto	30·8	5	—	—	13 12	+84	16·4	17·6
Ottawa	33·0	9	e 33 50	?	—	—	20·0	—
Andalgala	43·7	158	e 10 0	+96	—	—	—	—
Victoria	48·6	325	22 6	?L	—	—	31·1	36·5
Coimbra	69·9	51	e 11 22	+ 6	e 20 6	−19	36·6	—
Rio Tinto	71·4	54	83 0	?	—	—	—	113·0
Honolulu	71·6	288	22 6	?S	(22 6)	+81	39·0	41·2
Eskdalemuir	73·5	36	—	—	(22 0)	+52	22·0	—
Edinburgh	73·6	35	9 0	−160	—	—	—	—
Stonyhurst	74·0	37	—	—	—	—	—	49·2
Kew	75·3	40	—	—	—	—	—	54·0
Paris	77·3	42	e 22 6	?S	(22 6)	+14	41·0	46·0
Uccle	78·3	41	e 12 0	− 9	e 22 0	− 4	—	—
De Bilt	78·6	39	12 11	0	22 28	+21	e 39·0	46·7
Pola	85·6	45	—	—	e 23 0	−26	—	—
Helwan	103·7	54	17 0	—	—	—	—	—
Capetown	106·6	122	49 6	—	—	—	—	56·6
Bombay	140·2	37	89 0	?	—	—	—	—
Mauritius	141·9	106	68 12	?L	—	—	(68·2)	—
Kodaikanal	149·7	41	—	—	—	—	93·3	96·6
Colombo	153·8	41	89 0	?L	—	—	(89·0)	97·0

Additions and notes: Vieques PN = 0m.0s. Washington eN = +6m.21s., eLN = +17·0m., LE = +18·3m., LN = +22·6m. "No distinct max." Paris MN = +56·0m. Uccle MN = +48·1m. Mauritius P = +71m.42s. Moncalieri eL = +72·7m., M = +83·7m.

Oct. 22d. Records also at 4h. (Colombo), 5h. (San Fernando), 14h. (Osaka and Mizusawa), 23h. (San Fernando).

Oct. 23d. 1h. 8m. 30s. Repetition from 16°·0S. 168°·0E. (as on Oct. 20, 21?). But Honolulu does not accord.

	△	Az.	P.	O−C.	S.	O−C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Riverview	23·4	217	e 5 18	− 3	e 9 36	+ 3	e 12·9	14·7
Sydney	23·4	217	9 21	?S	(9 24)	− 9	13·8	15·0
Honolulu	50·1	43	12 36	?	—	—	15·5	16·0

Riverview gives also PS = +9m.55s., MN = +16·3m.

Oct. 23d. Records also at 2h. (Stonyhurst, De Bilt, and Helwan), 8h. (Toronto and Victoria), 15h. (Riverview), 16h. (Taihoku), 22h. (Barcelona and Tortosa).

Oct. 24d. 3h. 11m. 28s. At 3°·8 from Zagreb, which records P = +0m.59s., S = +1m.45s.

Oct. 24d. Records also at 3h. (not apparently related to above or to one another) at Zi-ka-wei, Honolulu, Rio Tinto, Helwan, at 12h. (San Fernando), 16h. (Tortosa), 21h. (Lick), 22h. (Osaka, Mizusawa, and San Fernando).

Oct. 25d. 15h. 11m. 15s. A possible repetition from 16°·0S. 168°·0E., as on Oct. 23d. &c., Riverview gives iP = +5m.31s., iS = +9m.25s., L = +11·1m., ME = +11·7m., MN = +13·6m. No other records.

Oct. 25d. Records also at 10h. (Helwan), 11h. (Manila), 15h. (Helwan and Algiers), 17h. and 18h. (Mizusawa), 19h. (Manila), 20h. (Honolulu, Riverview, and San Fernando), 23h. (Manila (2)).

Oct. 26d. Records at 6h. (Manila), 7h. (Taihoku, Zi-ka-wei, and Colombo), 9h. (Berkeley and Lick), 10h. (Helwan), 11h. (Capt Town and Colombo), 16h. (Lick), 19h. (Zi-ka-wei).

Oct. 27d. Records at 3h. (Berkeley), 4h. (Helwan), 6h. (Riverview, Melbourne, and Honolulu), 19h. (Taihoku and Athens).

1917. Oct. 28d. 16h. 52m. 35s. Epicentre 0°·0. 27°·0W. (as on October 7).

A = +·891, B = −·454, C = ·000.

Station.	Inst.	△	Az.	P.	O−C.	S.	O−C.	L.	M.
		°	°	m. s.	s.	m. s.	s.	m.	m.
Rio de Janeiro	—	27·8	214	i 7 25	+79	i 13 13	+138	15·5	18·6
San Fernando	M.	41·2	26	6 25	−100	—	—	19·7	23·4
Rio Tinto	M.	42·1	24	15 25	=S?	(15 25)	+49	—	24·4
Coimbra	W.	43·6	20	8 25	+ 2	14 50	− 6	20·8	23·6
Algiers	—	46·1	34	e 9 45	+64	—	—	21·4	22·4
Tortosa	V.	47·8	28	17 25	=S?	(17 25)	+104	21·5	24·5
Barcelona	Ma.	49·1	29	—	—	i 18 39	+152	—	—
Cape Town	M.	54·4	133	15 55	?	—	—	22·9	23·9
Moncalieri	S.	54·4	30	e 9 23	−12	16 35	−39	21·1	27·4
Paris	—	55·0	23	—	—	i 17 5	−16	26·4	28·4
Rocca di Papa	Ag.	55·0	36	i 2 51	?	i 15 29	−112	e 25·5	27·7
Kew	M.	56·2	20	25 25	?	—	—	—	29·9
Uccle	G.	57·4	22	e 9 55	0	e 17 31	−19	e 26·4	29·4
Stonyhurst	M.	57·5	17	18 7	?S	(18 7)	+14	—	32·1
De Bilt	G.	58·6	16	—	—	17 53	−17	e 24·4	29·7
Eskdalemuir	G.	58·6	16	i 18 13	?S	(18 13)	+ 7	29·7	—
Edinburgh	M.	59·2	15	17 15	?S	(17 15)	−58	—	35·9
Zagreb	W.	59·3	33	e 10 4	− 2	17 26	−49	28·4	31·4
Toronto	M.	63·8	320	—	—	—	—	59·7	—
Victoria	M.	94·2	316	—	—	—	—	58·2	—
Colombo	M.	106·6	80	56 25	?L	—	—	—	—

Stonyhurst gives also S = +23m.37s. Eskdalemuir gives also S = +25m.16s.

Additional records and notes: San Fernando MN = +22·4m. Coimbra SRE = +17m.34s., LN = +21·2m., MN = +24·9m. Moncalieri MN = +29·9m. Uccle MN = +33·4m. Zagreb MNW = +32·4m., T_o = 16h.53m.25s.

Oct. 28d. Records also at 0h. (San Fernando), 6h. (Moncalieri), 7h. (Zagreb), 8h. (Athens, Taihoku, and Zi-ka-wei), 11h. (Monte Cassino), 13h. (Edinburgh, Helwan, Honolulu, Toronto, and Victoria), 14h. (De Bilt), 21h. (San Fernando).

Oct. 29d. 20h. 36m. 20s. At 8°·5S. 149°·0E. (as on 1913 May 21d ?).

A = −·848, B = +·509, C = −·148; D = +·515, E = +·857,; G = +·127, H = −·076, K = −·989.

	△	Az.	P.	O−C.	S.	O−C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Riverview	25·4	176	i 5 46	+ 4	e 10 22	+11	e 14·0	16·3
Sydney	25·4	176	7 16	+94	11 28	+77	13·9	15·6
Melbourne	29·5	187	—	—	13 4	+98	16·1	18·7
Manila	36·2	310	e 7 16	− 8	9 53	−200	9·4	10·6
Batavia	41·9	270	e 8 17	− 7	—	—	—	16·3
Zi-ka-wei	47·7	328	e 8 47	− 5	e 15 25	+ 5	—	—
Colombo	70·7	280	9 40	−101	—	—	—	—
Kodaikanal	73·7	288	57 16	?	—	—	—	—
Victoria	94·8	42	23 0	?	—	—	41·4	54·3
Vienna	123·8	324	e 18 55	—	—	—	—	—
Graz	124·9	323	—	—	—	—	e 64·7	—
Toronto	125·2	42	—	—	—	—	65·2	75·4
De Bilt	127·4	333	e 58 46	?	—	—	e 71·7	75·0
Pilar	129·0	114	e 66 58	?	—	—	—	—
San Fernando	141·1	325	23 40	?PR_1	—	—	—	—

Additional records and notes: Riverview +6m.0s., iPS = +10m.51s., i = +12m.51s. Melbourne SR_1 = +14m.15s., SR_2 = +14m.40s. Manila M = +15·3m. Toronto L = +71·0m. De Bilt MN = +74·6m. San Fernando PN = +40m.10s.

Oct. 29d. Records also at 0h. (Helwan), 1h. (San Fernando), 4h. (Colombo), 12h. (Lick (2)), 19h. (Lick), 20h. (Helwan).

Oct. 30d. Records at 0h. (San Fernando and Lick), 1h. (Monte Cassino), 2h. (Helwan), 3h. (Manila), 17h. (Monte Cassino), 21h. (Helwan), 22h. (Manila).

Oct. 31d. 2h. 11m. 30s. At 16°·0S. 168°·0E. (as on Oct. 20, 21, and 23 ?).

	△	Az.	P.	O−C.	S.	O−C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Riverview	23·4	217	i 5 20	− 1	i 9 42	+ 9	e 12·4	14·0
Sydney	23·4	217	4 24	−57	—	—	12·8	14·5
Honolulu	50·1	43	15 30	?S	(15 30)	−50	23·5	28·2
Manila	55·6	301	e 9 21	−22	—	—	—	—

Riverview gives also MN = +14·2m.

Oct. 31d. Records also at 3h. (Helwan), 15h. (Manila and Mizusawa), 19h. (Manila).

Nov. 1d. Records at 1h. (Lick and Rocca di Papa), 2h. (Rocca di Papa), 3h. (Osaka), 12h. (Rocca di Papa), 18h. (La Paz), 20h. (Manila), 23h. (Lick (2)).

Nov. 2d. 16h. 6m. 22s. At 21°·0S. 67°·0W. (as on 1917 April 22d. 6h.).

	△	Az.	P.	O−C.	S.	O−C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
La Paz	4·6	345	i 1 11	0	—	—	2·0	2·2
Rio de Janeiro	22·2	101	10 8	?S	(10 8)	+59	15·4	17·6
Rio Tinto	81·6	44	45 38	?L	—	—	(45·6)	54·6
Coimbra	82·0	41	43 38	?L	—	—	(43·6)	—
Stonyhurst	93·1	30	23 8	?S	(23 8)	−98	—	53·6
Paris	93·2	38	—	—	—	—	48·6	—
Edinburgh	93·7	30	23 38	?S	(23 38)	−75	—	53·1
Moncalieri	94·3	43	—	—	e 24 57	− 2	49·8	57·0
De Bilt	96·1	36	—	—	—	—	e 49·6	54·3
Helwan	107·2	64	27 14	?S	(27 14)	+11	—	68·9

Additional records:—La Paz P = +34m.13s. (a second shock). Rio de Janeiro eN = +10m.2s., MN = +15·9m.

Nov. 2d. Records also at 5h. (Riverview and Monte Cassino), 6h. (Edinburgh), 11h. (La Quiaca), 16h. (Lick), 17h. (Colombo), 18h. (Manila and Moncalieri), 19h. (Colombo, Mizusawa, and Riverview), 22h. (Zagreb (5)), 23h. (Batavia).

Nov. 3d. Records at 0h. (Zagreb), 3h. (Manila), 6h. (Zi-ka-wei), 11h. (Athens), 12h. (Batavia and San Fernando), 20h. (Monte Cassino), 21h. (La Paz and Batavia), 23h. (San Fernando).

1917. Nov. 4d. 12h. 3m. 30s. Epicentre **4°·8N. 96°·8E.**
(See 1916 July 27d. 11h.).

A = −·118, B = +·989, C = +·084 ; D = +·993, E = +·118 ;
G = −·010, H = +·083, K = −·996.

Station.	Inst.	Δ	Az.	P.	O−C.	S.	O−C.	L.	M.
		°	°	M. S.	S.	M. S.	S.	M.	M.
Batavia	W.	14·9	138	e 3 17	−21	—	—	—	—
Colombo	M.	17·0	278	4 6	+ 1	—	—	6·9	10·9
Calcutta	O.E.	19·5	326	4 54	+19	8 54	+41	13·9	39·8
Kodaikanal	M.	19·9	287	6 0	+80	—	—	9·4	14·7
Manila	..	25·7	66	e 5 50	+ 5	11 46	+90	19·1	20·4
Bombay	—	27·3	303	5 56	− 5	10 32	− 14	—	17·4
Taihoku	..	30·9	49	e 17 4	?L	..	..	(17·1)	—
Zi-ka-wei	..	35·1	33	e 7 10	− 4	e 13 0	+ 3	e 18·4	22·4
Mauritius	M.	45·6	236	7 48	−49	..	..	—	22·4
Osaka	O.	46·5	45	8 37	− 7	17 18	+103	25·4	35·3
Mizusawa	O.	52·7	43	9 36	+12	17 13	+21	—	—
Adelaide	M.	61·5	139	17 12	?S	(17 12)	−90	—	32·7
Melbourne	M.	61·7	140	i 18 24	?S	(18 24)	−20	36·4	43·0
Riverview	—	64·2	131	e 18 42	?S	(18 42)	−33	30·2	36·2
Sydney	M.	64·2	131	18 54	?S	(18 54)	−21	35·8	41·5
Helwan	M.	66·4	301	10 30	−24	..	..	—	43·6
Lemberg	B.O.	75·2	40	—	—	—	—	e 48·1	—
Zagreb	W.	80·1	316	e 12 8	−12	e 22 18	− 6	46·5	55·0
Cape Town	M.	83·1	19	22 18	?S	(22 18)	−40	57·8	60·4
Moncalieri	S.	85·9	289	13 4	+11	23 28	− 1	38·1	63·4
De Bilt	—	87·2	322	—	—	23 41	− 2	48·5	62·5
Uccle	—	87·8	321	e 13 0	− 4	e 23 42	− 8	41·5	54·5
Paris	—	89·2	319	—	—	e 23 53	−12	37·5	52·5
Algiers	B.M.	90·1	280	e 13 13	− 4	e 24 1	−14	35·5	50·5
Barcelona	—	90·3	312	—	—	24 12	− 5	e 36·9	59·4
Kew	M.	90·6	322	41 30	?L	—	—	(41·5)	66·5
Dyce	Ma.	90·7	328	25 48	?S	(25 48)	+87	43·9	58·0
Edinburgh	M.	91·5	326	13 30	− 6	—	—	—	66·2
Eskdalemuir	G.	91·6	326	13 16	− 9	24 5	−26	43·2	52·8
Tortosa	..	91·6	311	13 21	− 4	23 58	−33	43·8	59·7
Granada	C.	94·7	308	24 53	?S	(24 53)	−10	—	—
San Fernando	..	97·5	308	21 30	?	—	—	55·5	63·5
Rio Tinto	M.	97·6	309	20 30	?	—	—	—	69·5
Coimbra	—	98·2	312	e 19 30	? PR_1	26 28	+50	57·5	65·9
Honolulu	—	102·2	67	—	—	—	—	18·5	58·1
Victoria	..	116·3	29	29 32	?S	(29 32)	+72	50·2	76·7
Toronto	M.	131·7	358	—	—	—	—	61·4	105·6
Washington	—	135·9	353	e 21 57	? PR_1	—	—	64·7	..
La Quiaca	M.	155·8	223	—	—	—	—	e 77·3	—
La Paz	Bl.	161·2	231	e 20 18	[+ 9]	34 55	—	73·5	109·4

Additional records :—Calcutta PN = +5m.0s., SN = +9m.0s., LN = +14·0m., MN = +19·1m. Manila MN = +19·6m. Taihoku L = +23·9m. Zi-ka-wei MN = +23·3m. Mauritius PN = +5m.54s., MN = +22·9m. Osaka MN = +32·5m. Melbourne S = +25m.36s., SR_1 = +30m.6s. = L?, SR_2 = +32m.12s. Riverview e = +19m.7s., S? = +22m.53s., MN = +36·0m. Zagreb iPNW = +12m.23s., eNE = +12m.34s., iNW = +12m.31s., iS = +22m.28s. T_0 = 12h.3m.57s. Capetown S = +38m.24s. = L? Moncalieri MN = +52·3m. De Bilt eE = +25m.4s., LN = +49·5m., Epicentre 2°·5N. 96·3W. Uccle M = +64·5m., M = +68·5m. Dyce eN = +24m.32s., +30m.44s., eE = +37m.48s. +51m.30s., MN = +54·0m. Eskdalemuir PR_1 = +17m.2s. Coimbra eN = +16m.30s., SN = +25m.28s., MN = +71·4m. Honolulu L is probably PR_1 due at +18m.28s. Victoria S = +43m.18s. Washington eN = +21m.38s. = PR_1? La Paz iP = +20m.32s. Toronto L = +76·3m. Ottawa gives 13h.7m. to 13h.40m.

Nov. 4d. Records also at 1h. (Zagreb and Monte Cassino), 2h. (Zagreb), 4h. (La Paz), 11h. (Manila), 14h. (La Paz and Manila), 16h. (De Bilt), 23h. (San Fernando).

Nov. 5d. 22h. 46m. 37s. Felt at Ancona, Italy : 43°·6N. 13°·5E. Adopting this as the epicentre we get A = −·704, B = +·169, C = +·690.

	Δ	Az.	P.	O−C.	S.	O−C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Pola	1·3	12	0 15	−5	—	—	—	—
Triest	2·0	4	0 29	−2	—	—	—	—
Rocca di Papa	2·0	198	e 0 32	+1	1 14	+19	—	1·5
Monte Cassino	2·2	174	0 32	−2	—	—	—	2·1
Zagreb	2·8	37	e 0 40	−1	1 25	+ 8	—	1·6
Graz	3·7	24	e 1 1	+3	—	—	—	—
Moncalieri	4·1	291	1 17	+9	2 8	+ 7	2·7	5·6
Vienna	5·0	22	e 1 16	−1	—	—	—	—
Paris	9·2	308	e 3 55	?S	(3 55)	−13	5·5	6·4
Uccle	9·5	322	e 3 47	?S	(3 47)	−29	e 5·4	—
Lemberg	9·5	46	e 5 23	?L	—	—	(5·4)	—
De Bilt	10·1	329	—	—	—	—	6·0	7·1

Paris gives S at +5m.24s. Zagreb iP = 0m.46s. and several other times.

Discussion of the residuals suggests putting the Epicentre about 0°·4 further north, to 44°·0N. 13°·5E.

Nov. 5d. 23h. 13m. 40s. As above : Rocca eP = +25s. Zagreb e = +50s.

Nov. 5d. 23h. 19m. 0s. As above : Rocca eP = +18s. Zagreb e = +66s.

Nov. 5d. 23h. 35m. 58s. As above ? Zagreb e = +44s.

Nov. 5d. 23h. 38m. 56s. As above : Rocca eP = +29s., S = +58s., M = +1·3m. Zagreb eP = +44s., S = +81s., M = +1·4m. Monte Cassino P = +31s., M = +4·1m.

Nov. 5d. Records also at 2h. (Mizusawa), 3h. (Rocca di Papa), 11h. (Manila), 12h. (Stonyhurst), 17h. (Mizusawa), 20h. (San Fernando), 23h. (San Fernando).

Nov. 6d. Records at 0h. (Zagreb), 2h. (Zagreb), 12h. (Bombay), 14h. (Edinburgh), 15h. (Colombo), 16h. (Helwan), 17h. (Lick).

Nov. 7d. 1h. 34m. (0s.). At 32°·0N. 119°·0W., as on 1915 Nov. 21? Berkeley Δ = 6°·5, e = +2m.5s. Tucson Δ = 6°·9, L = +2·5m., M = +4·0m. Toronto Δ = 33°·0, L = +15·8m., M = +17·0m. Ithaca Δ = 35°·0, e = +15·2m. = L? Washington Δ = 34°·5, SE = +15·2m. (= L?), SN = +15·3m., LE = +17·3m., LN = +16·2m. Ottawa Δ = 35°·8, e = +16·6m. (= L?), L = +17·2m. Honolulu Δ = 36°·2, L = +18·0m., M = +22·0m. Victoria Δ = 16°·7, M = +14·3m., but also a record of P at 0?h.49m.12s.

Nob. 7d. 2h. (6m.). Possibly a repetition from 64°·0N. 20°·0W., as on 1917 July 9. Edinburgh records P = 2h.12m.30s. : Eskdalemuir 2h.13m. to 2h.25m. De Bilt eL = 2h.15m., ME = 2h.22m.22s., MN = 2h.15m.36s. Rio Tinto P = 2h.21m.0s., M = 2h.25m.0s. Stonyhurst M = 2h.15m.12s.

Nov. 7d. Records also at 0h. (Victoria, as under 1h., and Helwan), 1h. (Monte Cassino (2)), 7h. (San Fernando), 15h. (Zagreb, Moncalieri, and La Paz), 16h. (Lick), 17h. (Helwan), 20h. (Manila), 22h. (Edinburgh).

Nov. 8d. Records at 2h. (San Fernando), 5h. (Tucson and Ottawa), 6h. (Toronto De Bilt, and Ithaca), 8h. (Manila), 10h. (Manila and Mizusawa), 13h. (Manila), 15h. (Taihoku and Zi-ka-wei), 16h. (Lick), 18h. (Honolulu and Riverview), 19h. (Helwan).

Nov. 9d. Records at 0h. (Lick and San Fernando), 4h. (San Fernando), 6h. (La Paz), 7h. (Rio Tinto (2), and Manila), 8h. (Taihoku), 13h. (Manila and Riverview), 14h. (Athens), 15h. (Algiers), 19h. (Stonyhurst), 21h. (Manila), 22h. (Mizusawa and Osaka), 23h. (Mizusawa and Taihoku).

Nov. 10d. Records at 0h. (Manila), 1h. (Rocca di Papa and Monte Cassino), 5h. (Helwan), 7h. (La Paz and Manila), 13h. (San Fernando), 17h. (Athens and Zagreb), 19h. (Manila), 23h. (Monte Cassino).

Nov. 11d. Records at 4h. (San Fernando), 8h. (Manila), 15h. (Monte Cassino), 18h. (Helwan, Athens, Moncalieri, Uccle, De Bilt, and Graz), 19h. (San Fernando), 20h. (La Paz and Athens), 21h. (Athens (2)), 22h. (San Fernando).

Nov. 12d. Records at 4h. (Colombo and Monte Cassino), 5h. (Taihoku), 16h. (Lick), 21h. (La Paz).

Nov. 13d. 2h. 15m. 42s. At 43°·6N. 13°·5E. (as on 1917 Nov. 5d. 22h.).

	△	Az.	P.	O −C.	S.	O −C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Pola	1·3	12	e 0 18	− 2	—	—	—	—
Rocca di Papa	2·0	198	0 25	− 6	0 53	− 2	—	1·3
Monte Cassino	2·2	174	0 33	− 1	—	—	—	1·8
Zagreb	2·8	37	e 0 47	+ 3	1 25	+ 8	—	1·5
Graz	3·7	21	e 0 54	− 4	—	—	—	—
Vienna	5·0	22	e 1 24	+ 7	—	—	—	—
De Bilt	10·1	329	e 6 6	?L	—	—	6·1	—

Zagreb also records LP = +51s., i =1m.36s.

Nov. 13d. 4h. 41m. 8s. at 43°·6N. 13°·5E. (as above).

	△	Az.	P.	O −C.	S.	O −C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Pola	1·3	12	e 0 20	0	—	—	—	—
Rocca di Papa	2·0	198	0 30	− 1	0 56	+ 1	—	1·4
Monte Cassino	2·2	174	0 36	+ 2	—	—	—	1·7
Zagreb	2·8	37	e 0 40	− 4	1 27	+10	—	1·5
Graz	3·7	21	e 0 53	− 5	—	—	—	—
Vienna	5·0	22	e 1 22	+ 5	—	—	—	—
De Bilt	10·1	329	e 6 4	?L	—	—	(6·1)	—
San Fernando	16·7	251	12 22	?L	—	—	(12·4)	—

Zagreb records iP at +48s., i = +52s. and +1m.20s.

Nov. 13d. 19h. 59m. 35s. At 11°·5N. 114°·0E. (as on 1917 March 2d. 2h.).

	△	Az.	P.	O −C.	S.	O −C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Manila	7·5	65	e 1 55	+ 1	—	—	4·7	4·7
Batavia	19·1	202	e 4 6	−24	—	—	—	9·4
Zi-ka-wei	20·9	18	e 5 1	+ 9	—	—	—	—
Riverview	57·5	143	e 16 55	?S	(16 55)	(−58)	e 26·1	27·6
Helwan	78·1	298	23 25	?S	(23 25)	(+84)	—	—
De Bilt	92·1	324	—	—	—	—	e 52·4	57·3
Edinburgh	95·0	330	54 25	?L	—	—	(54·4)	72·2

Riverview also records MN = +28·0m. De Bilt records eLN = +53·4m., MN = +56·9m.

Nov. 13d. Records also at 0h. (Lick and San Fernando), 12h. (Helwan).

Nov. 14d. 5h. 7m. 0s. At 0°·7S. 119°·7E. A = −·495, B = +·869, C = −·012.

	△	P.	O −C.	L.	M.
	°	m. s.	s.	m.	m.
Manila	15·3	e 3 29	−14	9·3	9·7
Kodaikanal	43·4	29 42	?L	(29·7)	—
Riverview	44·4	e 16 6	?S	e 27·1	32·1
Helwan	88·9	26 0	?S	—	—

Riverview also records MN = +30·0m.

Nov. 14d. 9h. 17m. 20s. Epicentre 52°·0N. 170°·0E.

A = −·606, B = +·107, C = +·788; D = +·174, E = +·985; G = −·776, H = +·137, K = −·616.

	△	Az.	P.	O −C.	S.	O −C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Honolulu	39·1	129	e 12 16	?S	(e 12 16)	(−101)	e 14·3	20·8
Zi-ka-wei	40·8	79	e 8 2	[illegible]	—	—	—	—
Victoria	41·3	68	13 6	?S	(13 6)	(−79)	22·0	29·0
Berkeley	48·1	79	—	—	e 13 3	?	—	—
Toronto	67·2	47	—	—	—	—	34·5	40·7
Ottawa	67·4	44	—	—	—	—	e 31·7	—
Edinburgh	72·0	356	230 40	?L	—	—	(30·7)	—
Washington	72·0	49	—	—	e 20 36	−14	41·2	—
De Bilt	75·1	351	—	—	e 21 22	− 5	e 38·7	48·3
Kew	76·2	354	—	—	—	—	—	58·7
Uccle	76·4	351	—	—	—	—	—	49·7
Paris	79·0	352	—	—	—	—	e 60·7	—
Riverview	87·4	255	—	—	e 29 28	=$8R_1$	—	53·9
Helwan	90·5	325	23 40	?S	(23 40)	(−39)	—	—
Algiers	90·5	350	—	—	—	—	—	67·7

Additional records: Toronto L = +40·0m. Ottawa iLN = +39·7m., L =44·7m. Washingto eN = +20m.38s. De Bilt gives eN = +26m.39s., m = +26m.58s., e = +31m.40s., and MN = +54·9m. Riverview MN = +51·8m. Eskdalemuir records only 9h.38m. to 10h.30m.0s.

Nov. 14d. Records also at 0h. (San Fernando), 1h. (La Paz), 5h. (Manila, Helwan, and Kodaikanal), 6h. (Edinburgh and De Bilt), 10h. (San Fernando, Melbourne, Rio Tinto, Riverview, and Zagreb), 14h. (Edinburgh), 15h. (Manila), 19h. (Mizusawa), 22h. (La Paz).

Nov. 15d. 1h. 16m. 20s. Epicentre 48°·5N. 178°·5E. (as on 1916 Feb. 6d.).

A = −·664, B = +·017, C = +·749; D = +·026, E = +1·000 G = −·749, H = +·019, K = −·664.

	△	Az.	P.	O −C.	S.	O −C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Honolulu	33·0	137	—	—	—	—	14·6	21·2
Toronto	65·5	51	—	—	—	—	41·9	42·2
Ottawa	66·0	48	—	—	—	—	e 34·7	—
Washington	70·1	53	—	—	—	—	e 35·8	—
Edinburgh	75·6	359	32 40	?L	—	—	(32·7)	—
De Bilt	80·0	356	e 22 34	?S	(e 22 34)	(+11)	e 39·7	47·1
Helwan	96·3	352	30 40	?$8R_1$	—	—	—	—

Additional records are De Bilt eN = +27m.29s., m = +27m.46s., MN = +54·9m. Eskdalemuir (△ =76°·2) says from 1h.36m. to 2h.17m. Zagreb eL = +53·7m.

Nov. 15d. 9h. 16m. 45s. Epicentre 49°·0N. 144°·0E. (as on 1917 July 16d.).

A = −·531, B = +·386, C = +·755; D = +·588, E = +·809; G = −·611, H = +·444, K = −·656.

	△	P.	O −C.	S.	O −C.	L.	M.
	°	m. s.	s.	m. s.	s.	m.	m.
Zi-ka-wei	24·5	e 5 41	+ 8	e 9 47	− 7	—	—
Edinburgh	71·6	35 45	?L	—	—	(35·8)	—
De Bilt	73·1	e 34 15	?L	—	—	(e 34·2)	39·3
Helwan	86·0	39 15	?L	—	—	39·3	—

De Bilt also records MN = +42·0m. Eskdalemuir gives 9h.53m. to 10h.5m.0s.

Nov. 15d. 15h. 0m. 30s. Epicentre at 41°·0N. 144°·0E. (as on 1917 July 29d. 1h. and 14h.).

A = −·611, B = +·144, C = +·656; D = +·588, E = +·809; G = −·531, H = +·386, K = −·755.

	△	Az.	P.	O−C.	S.	O−C.	L.	M.
	°		m. s.	s.	m. s.	s.	m.	m.
Mizusawa	2·9	230	0 36	− 9	—	—	1·0	—
Osaka	9·2	230	2 20	+ 1	—	—	—	—
Zi-ka-wei	20·6	249	e 5 0	+12	—	—	—	—
De Bilt	80·3	336	—	—	—	—	e 40·5	44·4
Ucele	81·7	336	—	—	—	—	—	46·5
Paris	81·0	336	—	—	—	—	e 42·5	—
La Paz	143·2	58	[19 53]	[+ 8]	—	—	20·5	20·9

Additional records: De Bilt gives eL = +39·5m., MN = +49·2m. Mizusawa gives PN = +0m.34s.

Nov. 15d. 17h. 5m. 10s. At 7°·0S. 116°·0E. (as on 1917 Jan. 20d.?) The objection is a record P = +4m.56s. at Riverview, which, however, is queried. If we neglect this and take the Riverview recorded S as P and L as S we get the following:—

	△	P.	O−C.	S.	O−C.	L.	M.
	°	m. s.	s.	m. s.	s.	m.	m.
Batavia	9·2	e 2 50	+31	—	—	—	—
Melbourne	40·5	7 50	− 9	—	—	12·1	14·3
Riverview	42·2	e (9 20)?	+68	e (14 26)	−12	e 14·4	16·4
Sydney	42·2	9 14	+62	—	—	15·6	17·1
Simla	53·2	—	—	—	—	e 36·2	—
Mauritius	57·5	10 2	+ 6	—	—	—	16·1
Helwan	88·8	45 50	?L	—	—	(45·8)	—
Honolulu	88·8	—	—	—	—	52·8	61·8

Other records Riverview MN = +17·6m. Mauritius PN = +9m.38s., MN = +16·5m.

The agreement is not good, and perhaps it would be better to neglect the Batavia record and recur to the original Riverview interpretations. But the material is poor.

Nov. 15d. Records also at 0h. (San Fernando), 2h. (Rio Tinto, Paris, and Mizusawa), 3h. (Colombo and Riverview), 5h. (Manila), 8h. (La Paz), 14h. (La Paz), 16h. (La Paz), 18h. (La Paz, Eskdalemuir, San Fernando, De Bilt, and Edinburgh), 21h. (San Fernando).

1917. Nov. 16d. 3h. 19m. 25s. Epicentre 29°·0S. 178°·0W.

A = −·874, B = −·030, C = −·485; D = −·035, E = +·999; G = +·485, H = +·017, K = −·875.

	△	Az.	P.	O−C.	S.	O−C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Apia	16·3	22	4 3	+ 7	—	—	—	—
Sydney	26·2	252	5 35	− 15	10 5	−21	12·7	15·2
Riverview	26·2	252	i 5 47	− 3	10 19	− 7	e 12·7	15·4
Melbourne	31·9	244	i 6 47	+ 1	11 59	− 3	16·0	20·8
Adelaide	37·0	250	7 11	−19	15 23	= PR_I	—	23·3
Honolulu	54·0	23	8 53	− 40	16 47	−22	e 30·1	32·4
Manila	73·3	298	e 11 47	+ 9	i 21 41	+ 35	e 36·6	37·1
Batavia	74·0	272	i 11 44	+ 2	—	—	e 30·6	42·6
Osaka	77·3	322	12 10	+ 7	21 53	+ 1	31·0	43·4
Mizusawa	78·1	329	12 7	− 1	21 41	−20	—	—
Zi-ka-wei	83·3	311	e 12 35	− 3	e 22 57	− 3	—	—
Lick	84·6	42	e 12 44	− 2	e 23 12	− 3	—	45·8
Berkeley	84·7	41	e 12 47	+ 1	e 23 22?	+ 6	e 35·0?	45·2
Tucson	88·4	51	12 55	12	—	—	36·6	61·6
Victoria	91·6	33	13 2	23	23 27	64	37·3	51·7
Andaigala	93·5	125	—	—	(26 53)	[122	—	—
Chacareta	94·6	134	(5 12)	?	23 53	?	—	—
La Paz	98·5	114	13 2	− 61	i 24 26	− 76	41·3	46·4
Colombo	104·0	270	17 29	? PR_I	27 53	+ 80	57·8	69·3
Mauritius	107·0	234	17 59	? PR_I	27 29	+28	51·1	53·2

Continued on next page.

	△	Az.	P.	O−C.	S.	O−C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Kodaikanal	107·6	271	18 47	? PR_I	—	—	28·5	66·3
Rio de Janeiro	112·3	135	e 28 47	?S	(28 47)	+59	52·6	59·1
Cape Town	115·2	195	27 29	?S	(27 29)	(−43)	64·0	88·7
Bombay	115·4	278	20 5	? PR_I	29 18	+65	—	68·3
Toronto	115·4	52	19 11	? PR_I	30 23	+130	50·2	66·2
Washington	115·8	58	e 19 36	? PR_I	e 29 38?	+52	e 51·4	59·0
Cheltenham	115·8	58	29 35	?S	(29 35)	+79	54·6	67·6
Simla	116·2	293	e 20 5	? PR_I	30 5	+105	37·1	81·3
Ithaca	117·1	53	—	—	e 29 30	+ 63	49·4	—
Vieques	118·1	84	28 35	?S	(28 35)	0	55·6	59·1
Ottawa	118·5	51	19 25	? PR_I	i 28 10	−28	e 49·6	—
Dyce	151·6	5	e 19 10	[−48]	33 16	—	43·6?	84·7
Edinburgh	152·9	5	20 35	[+35]	—	—	—	99·1
Lemberg	153·3	327	7 5	?	19 59	—	—	—
Eskdalemuir	153·4	6	19 58	[− 2]	30 42?	—	49·6?	77·4
Helwan	154·5	279	19 11	+66	—	—	—	123·0
De Bilt	156·8	355	20 3	[− 2]	e 32 57	+29	e 74·6	95·6
Kew	157·5	4	30 35	?S	(30 35)	(−117)	—	95·6
Vienna	157·8	334	20 4	[− 2]	34 35	—	—	—
Ucele	158·1	356	i 20 8	[+ 2]	34 35	—	—	77·6
Graz	159·1	334	20 11	[+ 4]	34 48	—	—	—
Athens	159·8	302	e 20 6	[− 2]	e 31 7	−97	—	99·8
Zagreb	159·9	331	e 20 11	[+ 3]	—	—	86·6	95·6
Paris	160·2	358	i 20 12	[− 4]	e 31 55	−49	58·6	78·6
Triest	161·0	334	20 14	[+ 5]	32 11	—	—	—
Besançon	161·5	352	21 2	[+53]	—	—	—	85·6
Pola	161·6	332	20 12	[+ 3]	31 53	—	—	—
Moncalieri	163·4	346	20 10?	[0]	34 6?	+66	55·8	103·4
Monte Cassino	164·2	325	19 35	+52	—	—	—	96·2
Rocca di Papa a	164·5	329	e 20 1	[−10]	—	—	e 84·0	95·8
c	164·5	329	e 18 31	−13	—	—	—	113·6
Marseilles	165·5	350	e 53 27	—	—	—	85·6	99·6
Coimbra	165·9	34	20 0	[−12]	31 26	−105	51·6	86·0
Barcelona	167·6	0	e 25 35	? PR_I	—	—	51·9	86·8
Tortosa	168·1	6	20 16	[+ 2]	31 44	−93	50·1	103·1
Rio Tinto	168·7	36	22 35	? PR_I	—	—	—	98·6
San Fernando E.	169·9	40	20 5	[−10]	—	—	36·1	103·6
N.	169·9	40	20 35	[+20]	47 5	? SR_I	49·1	97·1
Algiers	172·2	354	20 18	[+ 2]	30 52	−147	43·6	87·6

Additional records: Riverview gives iPR_I = +6m.47s., SR_I = +11m.53s., MN = +13·7m., MZ = +15·0m. Melbourne gives PR_2 = +7m.53s., SR_2 = +14m.23s. Manila MN = +37·8m. Batavia gives M = +20·6m., earlier than the L. Osaka gives MN = +39·0m. Lick gives ePV = +12m.45s., MV = +47·2m. Berkeley gives ePV = +12m.44s., ePN = +12m.53s., eSV = +23m.9s., eSN = +23m.10s., eLN = +34·9m., MN_2 = +51·0m., and MV = +46·0m. Victoria gives for vertical component P = +12m.35s., L = +42·6m., M = +45·6m. La Paz gives RS = +26m.41s. Mauritius SE = +23m.17s. (text gives SN), MN = +54·5m. Rio de Janeiro gives for North component eP = +29m.35s., L = +53·5m., M = +57·6m. Cape Town gives S = +34m.59s. Toronto gives also S = +31m.5s., L = +63·8m. Washington gives SN? = +29m.55s., eLN = +47·6m., MN = +67·2m. Vieques gives LN = +57·6m., MN = +60·1m. Ottawa gives SR_1 = +36m.25s., and several more Ls. Dyce gives three other Ms for the E.W. component. Eskdalemuir gives PR_1 = +23m.50s. De Bilt iN = +24m.16s. and +27m.55s., also six e's and two m's M = +96·0m. Ucele gives eP = +20m.3s. PR_1 = +24m.18s. and two more M's. The S in the table is given as (SR_1). Athens gives e = +40m.5s. and ME = +107·1m. Zagreb gives iP_{NW} = +20m.18s. and iP_{NE} = +20m.23s., and three i's at +20m.32s., +20m.55s., and +24m.25s. Paris gives PR = +24m.33s., Rocca di Papa gives two L's at +108·6m. and +114·6m. Coimbra gives LE = +54·0m., ME = +86·4m. Barcelona gives L_2 = +76·0m. and MN = +90·5m.

1917. Nov. 16d. 22h. 16m. 50s. Epicentre 6°·0N. 125°·0E.

(as on Jan. 31d. 3h.).

A = −·571, B = +·815, C = +·104; D = +·819, E = +·571;
G = −·060, H = +·085, K = −·995.

Station and Component.	Machine.	△	Azimuth.	P.	O−C.	S.	O−C.	L.	M.
		°	°	M. S.	S.	M. S.	S.	M.	M.
Manila	W.	9·5	335	e 2 42	+19	i 4 47	+31	i 5·4	5·5
Batavia	—	22·0	237	5 8	+ 3	? 9 15	+10	—	11·2
Zi-ka-wei	—	25·5	352	i 5 39	− 4	e 10 8	− 5	—	—
Osaka	O.	30·4	17	—	—	—	—	13·2	18·2
Mizusawa N.	O.	36·2	21	7 15	− 9	12 39	−34	—	—
E.	O.	36·2	21	7 24	0	12 42	−31	—	—
Colombo E.	M.	45·0	274	9 46	+73	15 22	+ 7	29·7	33·2
Riverview	W.	46·9	150	e 8 34	−12	15 4	−36	e 25·8	29·3
Sydney E.	M.	46·9	150	11 22	PR,?	18 40	SR,?	26·4	29·7
Kodaikanal E.	M.	47·2	278	10 22	=PR,	(18 16)	+32	16·3	30·6
Melbourne	M.	47·5	159	e 10 10	=PR,	14 28	−80	i 18·5	19·4
Simla	O.E.	51·3	306	e 9 58	+43	—	—	—	30·2
Bombay E.	O.E.	52·4	289	—	—	—	—	—	22·6
Mauritius N.	M.	70·9	246	21 52	?	—	—	—	27·4
E.	M.	70·9	246	12 28	−66	—	—	—	22·8
Honolulu	M.	75·8	70	21 16	?S	(21 16)	−19	e 34·8	42·1
Helwan	M.	90·2	300	14 10	+53	—	—	—	—
Vienna	W.	97·7	321	e 13 10	+48	—	—	—	—
Graz	W.	98·6	320	—	—	—	—	e 33·2	—
Zagreb	W.	98·7	318	—	—	e 24 28	−75	54·2	61·2
Victoria	—	99·6	39	—	—	—	—	62·2	—
Trieste	W.	100·3	319	23 10	?S	(23 10)	−169	—	—
Pola	W.	100·4	318	—	—	24 10	−110	—	—
De Bilt	—	102·9	327	—	—	—	—	e 53·2	57·5
Uccle	—	103·9	326	—	—	—	—	e 51·2	65·2
Moncalieri	S.	104·5	320	? 18 35	=PR,	? 27 45	+67	55·1	—
Edinburgh	M.	105·0	333	19 10	=PR,	—	—	—	64·2
Eskdalemuir	G.	105·4	332	16 49	+133	50 10	? L	(50·2)	58·9
Stonyhurst	M.	105·7	331	16 40	+122	i 55 46	—	61·4	64·4
Paris	—	105·9	325	—	—	25 4	−107	55·2	61·2
Kew	M.	106·1	328	—	—	—	—	—	71·2
Tortosa	—	111·1	313	21 34	—	29 11	+93	39·2	64·2
Coimbra	W.	117·2	322	—	—	29 2	+34	60·0	75·0
	M.	117·2	322	e 17 10	+100	29 25	+57	63·2	76·3
San Fernando	—	117·7	317	29 10	?S	(29 10)	+38	76·7	78·2
La Paz	Bi.	163·4	131	20 12	[+2]	34 13	—	76·8	111·2

Additional records: Manila MN = +5·9m. Osaka (PS) = +7m.42s., MN = +20·1m. Riverview (PS) = +15m.52s., iSR, = +18m.26s. and 20m.38s. Simla M = +39·9m. De Bilt e(PR,) = +18m.37s., e = +24m.46s., and +27m.46s., M = +62·3m. Epicentre 7°·7N. 125°·9E. Stonyhurst P = +41m.10s. Coimbra e? = +22m.10s., SR = +45m.10s. San Fernando S = +66m.10s., MN = +80·7m. Algiers M = +72·2m. Ottawa (△ = 125°·4) eLN = +65·2m. to +72·2m. Toronto (△ = 125°·7) L = +64·4m. and +84·5m. Graz L = SR,.

Nov. 16d. Records also at 0h. (Lick), 14h. (Mizusawa), 15h. (Osaka), 16h. (Helwan), 19h. (Batavia).

Nov. 17d. 8h. 6m. (0s.). Query repetition from 30°·0S. 178°·0W. (as on 1917 June 6d. 9h. and 13d.). If so Riverview (△ = 26°·6) S = +11m.0s., L = +18·4m., ME = +24·7m., MN = +21·7m. Melbourne (△ = 31°·7) e = +19m.0s. = L?. Honolulu (△ = 54°·9) e = +28·9m. = L?, and Helwan (△ = 153°·0) P = +45m.

Nov. 17d. Records also at 0h. (San Fernando), 1h. (Athens), 2h. (Riverview), 4h. (Helwan), 9h. (Edinburgh, De Bilt, and Rio Tinto), 10h. (La Paz and Riverview), 12h. (Manila), 14h. (Barcelona), 22h. (San Fernando), 23h. (Dyce).

1917. Nov. 18d. 2h. 57m. 30s. Epicentre 6°·0N. 125°·0E.

(as on Jan. 31d. 3h. and Nov. 16d. 22h.).

A = −·571, B = +·815, C = +·104; D = +·819, E = +·574;
G = −·060, H = +·085, K = −·995.

Station and Component.	Machine.	△	Azimuth.	P.	O−C.	S.	O−C.	L.	M.
		°	°	M. S.	S.	M. S.	S.	M.	M.
Manila	—	9·5	335	e 1 57	−26	—	—	i 2·9	—
Batavia	W.	22·0	237	i 5 1	− 4	—	—	—	10·5
Zi-ka-wei N.	—	25·5	352	e 5 27	−16	9 44	−29	—	14·3
E.	—	25·5	352	—	—	9 38	−35	—	14·6
Osaka	O.	30·4	17	6 34	+ 2	—	—	11·6	13·7
Mizusawa N.	O.	36·2	21	7 10	−14	12 55	−18	—	—
E.	O.	36·2	21	7 17	− 7	12 33	−40	—	—
Calcutta N.	O.E.	39·1	299	7 12	−35	13 6	−47	19·3	—
E.	O.E.	39·1	299	7 6	−41	13 6	−47	18·5	—
Adelaide	M.	42·9	163	8 24	+ 7	15 0	+13	—	23·4
Colombo E.	M.	45·0	274	(7 0)	(−93)	—	—	12·9	27·4
Riverview	—	46·9	150	e 9 12	+26	i 16 28	+48	e 21·2	26·6
Sydney E.	M.	46·9	150	9 18	+32	16 48	+68	25·3	35·4
Kodaikanal E.	M.	47·2	278	9 30	+42	(15 24)	−20	—	15·4
Melbourne	M.	47·5	159	i 17 0	?S	(i 17 0)	(+72)	33·3	34·0
Simla	O.E.	51·3	306	9 6	− 9	—	—	—	16·2
Bombay E.	—	52·4	289	9 17	− 5	16 19	−30	—	31·3
Mauritius	M.	70·9	244	10 54	−28	20 30	− 7	32·4	37·8
Honolulu E.	—	75·8	70	e 15 0	=PR,	23 30	+115	e 36·7	49·4
Helwan E.	M.	90·2	300	13 54	+37	—	—	—	63·9
Lemberg	B.O.	92·5	321	e 16 54	=PR,	—	—	—	—
Vienna	—	97·7	321	e 13 36	−22	—	—	—	—
Zagreb	W.	98·7	318	e 13 43	−21	e 25 6	−37	54·5	60·0
Victoria	—	99·6	39	—	—	(25 5)	(−47)	57·3	64·6
Pola	W.	100·4	318	e 17 30	=PR,	—	—	—	—
Rocca di Papa	Ag.	102·3	315	e 18 12	=PR,	—	—	e 40·2	66·4
De Bilt	—	102·9	327	—	—	24 37	−106	e 49·5	59·9
Berkeley	—	103·8	48	e 22 2	?	—	—	—	—
Dyce E.	Ma.	103·9	334	e 18 37	=PR,	27 37	+65	52·5	63·5
Uccle	—	103·9	326	e 18 6	=PR,	e 27 6	+34	e 47·5	—
Moncalieri	S.	104·5	320	16 19	+107	27 2	+24	49·6	63·6
Edinburgh	M.	105·0	333	22 0	—	—	—	—	64·3
Paris	—	105·9	325	i 18 32	=PR,	e 27 39	+48	40·5	55·5
Kew	M.	106·1	328	—	—	—	—	—	63·5
Cape Town E.	M.	107·1	236	32 0	SR,?	—	—	—	62·5
Barcelona	—	109·6	318	—	—	27 5	−19	e 43·5	60·5
Algiers	—	111·0	313	—	—	—	—	e 42·5	68·5
Tortosa	—	111·1	318	18 54	PR,	28 17	+39	37·9	80·3
Coimbra	W.	117·2	322	20 22	=PR,	29 6	+38	56·4	63·1
Rio Tinto	M.	117·3	318	22 30	PR,?	—	—	—	77·5
San Fernando N.	—	117·8	317	28 30	?S	(28 30)	− 2	62·5	76·0
E.	—	117·8	317	32 0	?	—	—	62·5	73·0
Ottawa	—	125·4	18	—	—	—	—	e 59·5	—
Toronto	M.	125·7	22	—	—	—	—	63·6?	84·1
Washington	—	130·7	23	—	—	—	—	e 58·7	—
La Paz	Bi.	163·4	131	i 20 30	[+20]	34 27	—	67·3	77·3

Osaka gives (PS) for P, MN = +13·6m. Colombo gives S = +7m.0s., which is too early for P, and L which may be S. Riverview records i = +9m.23s., PR, = +11m.15s., SR, = +19m.8s., SR, = +20m.46s., MN = +26·5m. Epicentre 11°·0N. 126°·0E. Kodaikanal gives S as M. Melbourne PR, = −19m.18s., which may be SR, S = +24m.12s., SR, = +28m.18s., which are probably L's, also PR, and SR,. Simla MN = +24·1m. Mauritius PN = +19m.54s. Zagreb gives i = +17m.51s., SNE = +26m.7s., MNE = +64·0m., T, = 2h.57m.44s. Victoria gives L = +25m.5s., which is probably S, also a P = +44·1m. and S = +48·9m., which are probably L's. Also M = +33m. Rocca di Papa gives e = +16m.25s. De Bilt records e(PR,) = +18m.3s., e(SR,) = +32m.28s., M = +54·0m., Epicentre 8°·5N., 121°·5E. Moncalieri M = +70·2m. Edinburgh also has M = +69·5m. Paris S is given as e, also gives e, = +25m.2s. Barcelona gives e = +20m.30s. Coimbra MN = +64·4m. Ottawa records eN = +20m.10s., L = +72·5m. to +77·5m., LN = +87·5m. Toronto also gives L = +73·3m. Washington L = +68·3m.

Nov. 18d. Records also at 3h. (Toronto and Uccle), 5h. (Riverview), 7h. (Mizusawa and Edinburgh), 9h. (Manila), 13h. and 15h. (Helwan), 19h. (La Paz, Melbourne, and Riverview), 20h. (Helwan).

Nov. 19d. Records at 0h. (San Fernando), 2h. (Rocca di Papa and Monte Cassino (2)), 3h. (La Paz), 4h. (Colombo), 5h. (Helwan), 21h. (San Fernando), 22h. (Taihoku).

Nov. 20d. Records at 0h. (Helwan), 3h. (Manila), 4h. (Helwan), 12h. (Helwan and Rocca di Papa), 15h. (Manila, Batavia, Riverview, Zi-ka-wei, and De Bilt), 19h. (Helwan), 21h. (Rocca di Papa, Zagreb, and Monte Cassino).

Nov. 21d. Records at 0h. (Riverview and Honolulu), 3h. (Taihoku), 5h. (San Fernando), 9h. (Mizusawa), 13h. (Batavia and Zagreb), 17h. and 21h. (Helwan), 23h. (San Fernando).

Nov. 22d. 6h. 13m. 30s. At 8°·0S. 160°·0E. (as on 1917 July 12d. 11h.).

A = −·931, B = +·339, C = −·139 ; D = +·342, E = +·940 ;
G = +·131, H = −·048, K = −·990.

	△	Az.	P.	O−C.	S.	O−C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Riverview	27·1	196	i 6 22	+23	i 10 23	−20	c 13·2	17·0
Melbourne	32·8	202	—	—	—	—	12·5	17·5
Honolulu	50·5	54	c 16 30	?S	(c 16 30)	(+ 5)	—	30·5
Batavia	52·7	268	c 9 30	+ 6	—	—	—	—

Riverview gives also iP at +6m.28s., iS at +10m.32s., and MN = +16·6m. Rocca di Papa gives P = +20m.58s., M = +21·0m.

Nov. 22d. Records also at 10h. (Monte Cassino), 12h. (Manila), 19h. (Monte Cassino), 21h. (La Paz), 22h. (Monte Cassino), 23h. (Mauritius, Helwan, Honolulu, and Melbourne).

Nov. 23d. 4h. 17m. 30s. Epicentre 33°·5N. 46°·5E. (as on 1917 July 15d. 17h. and 21h., and 24d. 16h.)

A = +·574, B = +·605, C = +·552 : D = +·725, E = −·688 ;
G = +·380, H = +·400, K = −·834.

	△	Az.	P.	O−C.	S.	O−C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Helwan	13·4	259	—	—	—	—	—	13·3
Zagreb	26·3	306	5 28	−23	i 10 43	+15	17·5	19·0
Graz	27·0	309	5 29	−29	—	—	—	—
Pola	27·6	304	—	—	—	—	e 18·0	—
Rocca di Papa	27·8	297	e 19 14	?L	—	—	(e 19·2)	19·9
Moncalieri	31·8	304	12 57	?S	(12 57)	+52	e 21·4	22·2
De Bilt	34·8	315	—	—	—	—	e 21·5	26·9
Paris	35·9	309	—	—	—	—	e 23·5	23·5
Tortosa	37·0	295	3 10	?	—	—	19·5	27·3
Stonyhurst	38·7	314	—	—	—	—	—	21·5
Eskdalemuir	40·5	318	—	—	—	—	22·5	—
Mauritius	54·7	167	23 42	?L	—	—	(23·7)	25·7
Cape Town	72·4	205	36 42	?L	—	—	(36·7)	37·3

Additional records : Helwan records commencement at 1h.10m., which, if correct, must belong to a previous shock, in the record of which the earlier phases of the present shock have been lost. De Bilt eLN = +19·5m., MN = +23·7m. Moncalieri S = +17m.21s., MN = +24·4m.

Nov. 23d. Records also at 0h. (San Fernando, Lick, Berkeley, and Monte Cassino), 3h. (La Paz), 5h. (Manila), 10h. (Stonyhurst), 11h. and 19h. (Riverview), 21h. (San Fernando).

Nov. 24d. 11h. 10m. 52s. Epicentre 13°·5N. 143°·0E.

A = −·777, B = +·585, C = +·233 ; D = +·602, E = +·799 ;
G = −·186, H = +·140, K = −·972.

	△	Az.	P.	O−C.	S.	O−C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Manila	21·4	276	e 5 1	+ 6	8 40	−13	10·2	11·3
Osaka	22·3	343	5 14	+ 5	—	—	9·1	10·0
Melbourne	22·5	353	16 14	?L	—	—	(16·2)	28·9
Mizusawa	25·7	355	5 38	− 7	9 45	−31	—	—
Zi-ka-wei	26·6	315	e 5 51	− 3	e 10 29	− 4	—	—
Batavia	41·0	244	e 7 51	−12	—	—	—	14·1
Riverview	47·9	171	i 8 28	−25	e 15 9	−44	e 22·7	26·8
Sydney	48·0	171	14 8	?S	(14 8)	(−106)	—	25·6
Honolulu	56·5	73	e 9 56	+ 7	17 50	+10	e 25·4	32·1
Colombo	62·4	272	20 8	?S	(20 8)	(+75)	—	—
Kodaikanal	64·1	275	36 20	?L	—	—	(36·3)	—
Lemberg	97·2	325	—	—	e 23 56	−92	—	—
Helwan	101·3	305	20 8	=PR_1	—	—	—	—
Graz	103·5	326	e 18 32	=PR_1	—	—	—	—
Zagreb	104·0	325	e 18 26	=PR_1	i 24 43	−110	54·1	65·1
De Bilt	105·0	335	—	—	e 24 44	−118	e 52·1	57·8
Edinburgh	105·1	341	—	—	32 38	=SR_1	—	67·9
Pola	105·7	325	—	—	e 24 50	−119	—	—
Uccle	106·3	334	—	—	—	—	—	56·1
Paris	108·6	334	—	—	—	—	e 57·1	59·1
Moncalieri	108·9	328	e 22 57	?	—	—	55·1	—
Coimbra	120·1	335	e? 25 8	?	—	—	63·4	—
Rio Tinto	121·4	332	33 8	?	—	—	—	70·1
San Fernando	122·2	331	20 38	=PR_1	—	—	—	—
La Paz	149·8	100	i 19 49	[− 7]	—	—	—	20·4

Additional records : Manila MN = +10·5m. Mizusawa SN = +9m.57s. Riverview PR_1 = +10m.38s., SR_2 = +19m.12s., MN = +25·1m., MZ = +26·8m. De Bilt MN = +59·4m. Epicentre 13·4N. 142°·0E. Toronto (△ = 111°·0) from 12h.11m.24s. to 12h.16m.36s. "A.C. going on." Ottawa (△ = 111·5) from 12h. 10m. to 12h.18m.

Nov. 24d. 19h. 57m. 40s. Repetition from 33°·5N. 46°·5E. (as on 1917 July 15, 24, Nov. 23).

A = +·574, B = +·605, C = +·552 ; D = +·725, E = −·689 ;
G = +·380, H = +·400, K = −·834.

	△	Az.	P.	O−C.	S.	O−C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Helwan	13·4	259	3 20	+ 2	—	—	—	—
De Bilt	34·9	315	—	—	—	—	e 20·3	21·1
Edinburgh	40·6	319	19 20	?L	—	—	(19·3)	29·1
Coimbra	43·8	296	e 22 24	?L	—	—	(e 22·1)	—
Taihoku	64·7	76	19 35	?S	(19 35)	(+14)	—	19·7

De Bilt gives MN = +21·4m.

Nov. 24d. Records also at 3h. (Helwan), 17h. (De Bilt), 18h. (Colombo), 19h. (Taihoku (3), Osaka, Zi-ka-wei (2), and Manila), 20h. (Honolulu), 23h. (Taihoku and Manila).

Nov. 25d. Records at 0h. (Taihoku), 1h. (Riverview, Melbourne, and Taihoku), 2h. (Helwan, San Fernando, Coimbra, and Rio Tinto), 3h. (Taihoku), 4h. (Taihoku and Zi-ka-wei), 8h. (Helwan), 13h. (Monte Cassino), 17h. and 18h. (Taihoku).

Nov. 26d. Records at 1h. (San Fernando), 2h. (Riverview, Rocca di Papa, and Monte Cassino), 3h. (Zagreb), 3h. (Helwan), 4h. (Colombo), 5h. (Riverview), 6h. and 8h. (Helwan), 21h. (San Fernando).

Nov. 27d. 5h. 7m. 30s. Repetition from 25°·0N. 123°·0E. (as on July 4, 0h. and 5h.).

	△	Az.	P.	O−C.	S.	O−C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Taihoku	1·3	274	1 8	?L	—	—	1·7	1·8
Zi-ka-wei	6·3	348	e 4 21	?L	—	—	(e 4·4)	—
Manila	10·6	191	e 2 39	+1	—	—	7·6	9·1

Nov. 27d. Records also at 0h. (San Fernando, Riverview, and Melbourne), 1h. (Helwan), 7h. (La Paz), 9h. (Helwan), 12h. (Riverview), 19h. (Monte Cassino), 22h. (Lick and Manila).

Nov. 28d. 10h. 21m. 10s. Epicentre 37°·5N. 19°·7E.

A = +·747, B = +·267, C = +·609; D = +·337, E = −·941; G = +·573, H = +·205, K = −·793.

	Δ	Az.	P.	O−C.	S.	O−C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Athens	3·2	81	0 49	− 1	1 28	0	1·6	2·2
Monte Cassino	6·0	315	1 49	+17	—	—	—	17·0
Rocca di Papa	6·8	311	1 59	+16	4 3	+58	—	5·3
Pola	8·5	321	e 2 12	+ 3	—	—	—	—
Zagreb	8·8	341	e 2 12	− 1	i 4 3	+ 4	—	5·7
Moncalieri	11·7	313	e 2 42	−13	5 38	+26	7·0	10·9
Helwan	12·3	128	6 50	?L	—	—	6·8	—
Lemberg	12·7	13	e 4 50	?S	(4 50)	(−47)	—	—
Algiers	13·4	266	e 3 15	− 3	10 17	?	12·8	15·8
Barcelona	14·1	292	—	—	—	—	e 5·7	13·8
Tortosa	15·2	289	3 42	0	6 39	+ 2	7·8	13·2
Paris	16·8	318	e 4 27	+25	e 7 16	+ 3	9·8	10·8
Uccle	17·2	325	e 4 10	+ 3	7 25	+ 3	10·2	—
De Bilt	17·8	329	4 20	+ 5	i 7 47	+11	10·0	10·5
San Fernando	20·6	275	4 50	+ 2	8 20	−16	13·8	16·8
Edinburgh	23·9	327	9 50	?S	(9 50)	(+ 8)	—	16·1

Additional records: Athens P = +1m.1s., ME = +2·3m. Moncalieri MN = +9·4m. Zagreb gives eight other i's and MNW = +6·0m. De Bilt gives T_0 = 10h.21m.(13s.), and Graz gives T_0 = 10h.21m.12s. Hamburg gives T_0 = 10h.21m.10s., as taken above.

Nov. 28d. 14h. 27m. 0s. At 3°·8S. 143°·5E. (as on 1917 July 29, 30, and 31).

A = −·803, B = +·594, C = −·052; D = +·595, E = +·804; G = −·042, H = −·031, K = −·999.

	Δ	Az.	P.	O−C.	S.	O−C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Riverview	31·7	168	e 5 48	−56	e 11 14	−49	e 15·2	16·5
Sydney	31·7	168	10 24	?S	(10 24)	−99	15·6	17·0
Melbourne	34·8	178	—	—	—	—	19·0	20·0
Zi-ka-wei	40·1	330	—	—	—	—	e 22·6	—
Uccle	121·2	331	—	—	—	—	e 41·0	47·0

Riverview also gives e = +10m.42s., MN = +17·0m.

Nov. 28d. 14h. 40m. 10s. At 46°·9N. 90°·0E. (as on 1917 July 31d. 6h. 59m. 10s.).

A = −·000, B = +·683, C = +·730; D = +1·000, E = ·000; G = ·000, H = +·730, K = −·683.

	Δ	Az.	P.	O−C.	S.	O−C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Simla	18·6	217	e 10 26	?L	—	—	(e 10·4)	12·2
Zi-ka-wei	28·7	112	—	—	—	—	e 28·4	—
Bombay	31·4	212	7 33	?PR_1	12 6	+ 8	—	—
Kodaikanal	38·2	200	21 38	?L	—	—	(21·6)	—
Colombo	41·0	196	21 50	?L	—	—	(21·8)	—
Vienna	47·7	300	e 8 38	−14	—	—	—	19·8
Helwan	47·8	278	14 20	?S	(14 20)	−91	—	—
Graz	48·7	299	e 8 56	− 2	16 12	+10	—	—
Pola	50·8	297	e 9 50	+38	—	—	—	—
De Bilt	52·1	309	—	—	e 18 51	+126	e 27·8	30·2
Rocca di Papa a	53·3	295	e 9 15	−13	—	—	—	11·2
c	53·3	295	e 11 0	+92	—	—	e 29·9	32·0
Edinburgh	54·3	316	17 20	?S	(17 20)	(+ 7)	—	35·2
Moncalieri	54·5	300	e 15 34	?S	(15 34)	(−101)	30·0	—
Eskdalemuir	54·6	316	29 50	?L	—	—	(29·8)	—
Kew	55·3	311	—	—	—	—	—	31·8
Barcelona	59·8	300	—	—	—	—	e 27·8	37·8
San Fernando	67·9	300	—	—	—	—	34·3	48·3
Victoria	80·4	22	41 21	?L	—	—	(41·4)	43·3
Cape Town	103·1	234	46 50	=?L	—	—	(46·8)	—

Additional records: Graz T_0 = 14h.39m.58s. De Bilt M = +36·3m. Moncalieri S?(=L) = +24·1m. Victoria adds that the observation may not be that of an earthquake.

Nov. 28d. Records also at 0h. (San Fernando), 2h. (Honolulu and Colombo), 7h. (Taihoku), 15h. (Zi-ka-wei and Taihoku), 18h. (Helwan and De Bilt).

Nov. 29d. 18h. 50m. 17s. At 41°·0N. 14°·0E.

A = +·732, B = +·183, C = +·656; D = +·242, E = −·970; G = +·636, H = +·159, K = −·755.

	Δ	Az.	P.	O−C.	S.	O−C.	L.	M.
	°	°	s.	s.	m. s.	s.	m.	m.
Monte Cassino	0·5	342	14	+ 7	(0 14)	0	—	0·7
Rocca di Papa	1·2	309	19	− 8	—	—	—	0·4
Zagreb	5·0	16	e 92	+15	2 24	+ 7	—	—

Zagreb also gives e/NW = +97s. and i = +127s.

Nov. 29d. 22h. 13m. 15s. At 16°·0S. 168°·0E. (as on 1917 May 29d. 6h., Aug. 16d., and Sept. 5d.).

A = −·940, B = +·200, C = −·276; D = +·208, E = +·978; G = +·270, H = −·057, K = −·961.

	Δ	Az.	P.	O−C.	S.	O−C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Riverview	23·4	210	e 5 15	− 6	e 9 39	+ 6	e 12·8	16·6
Adelaide	32·4	220	10 39	?S	(10 39)	−95	—	19·2
Honolulu	50·1	43	....	....	—	—	e 22·0	31·8
Victoria	88·5	38	....	....	....	....	46·9	50·9
Toronto	117·2	49	....	....	....	....	43·0?	—

Additional observations: Toronto L = +50·6m. Riverview eP = +5m.18s., PS = +9m.55s., ME = +15·7m.

Nov. 29d. Records also at 0h. (San Fernando), 1h. (Colombo), 3h. (Monte Cassino), 8h. (San Fernando), 14h. (Zagreb), 15h. (La Paz), 17h. (Mizusawa), 23h. (Riverview, Paris, and Helwan).

Nov. 30d. 17h. 3m. 29s. At 10°·5S. 161°·0E.

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

	Δ	Az.	P.	O−C.	S.	O−C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Sydney	25·0	199	4 10	−58	—	—	10·6	14·7
Riverview	25·0	199	e 5 40	+ 2	e 10 10	+ 7	e 13·1	16·1
Melbourne	30·9	204	11 40	?S	(11 10)	−10	16·7	18·2
Adelaide	31·9	216	10 52	?S	(10 52)	−15	—	20·1
Manila	47·0	302	e 8 50	+ 3	—	—	—	—
Honolulu	51·3	52	e 20 58	=SR_1	24 40	?	27·5	31·7
Batavia	53·7	270	e 10 40	+69	....	—	—	—
Zi-ka-wei	56·4	319	e 9 50	+ 2	e 17 28	−11	—	—
Victoria	88·6	40	—	—	41 23	?L	45·4	52·3
Mauritius	98·5	248	32 4	?SR_1	—	—	(51·6)	53·0
Toronto	118·5	46	—	—	....	....	61·8	—
Helwan	129·8	300	39 40	?SR_1	....	....	—	—
Edinburgh	132·9	348	85 40	?	....	....	—	—
De Bilt	134·0	339	....	—	....	....	e 63·7	67·8
San Fernando	151·6	338	61 40	?	86 40	?	92·7	115·7

Additional Records: Riverview PS = +10m.29s., MN = +17·3m., MZ = +17·8m. Mauritius PNS = +51m.34s. (probably L.) Toronto L = +65·2m. De Bilt MN = +75·0m. San Fernando MN = +105·2m., LN = 94·7m. Melbourne records S at +15m.34s.

Nov. 30d. Records also at 1h. (San Fernando), 5h. (Colombo), 14h. (Manila), 22h. (Athens), 23h. (Colombo).

Dec. 1d. 8h. 56m. 54s. At 40°·0N. 15°·0E. A = +·740, B = +·198, C = +·643.

	△	P.	O−C.	S.	O−C.	M.
	°	m. s.	s.	m. s.	s.	m.
Rocca di Papa	2·5	0 39	0	1 5	− 4	1·2
Zagreb	5·9	e 1 44	+13	2 29	−12	3·0

Zagreb records also iW = +1m.52s., iE = +2m.21s., ME = +2·6m., i = +2m.55s.

Dec. 1d. 9h. 4m. 22s. At 43°·0N. 15°·0E. A = +·706, B = +·189, C = +·682.

	△	P.	O−C.	S.	O−C.	M.
	°	m. s.	s.	m. s.	s.	m.
Rocca di Papa	2·1	0 34	− 1	1 3	+ 5	1·3
Zagreb	2·9	e 0 49	+ 4	1 30	+10	1·5

Zagreb gives also eW = +0m.53s., iW = +1m.9s., iE = +1m.14s., MW = +1·5m.

Dec. 1d. 9h. 47m. 15s. At 30°·0N. 71°·0E. A = +·282, B = +·819, C = +·500.

	△	P.	O−C.	S.	O−C.	L.	M.
	°	m. s.	s.	m. s.	s.	m.	m.
Bombay	11·2	5 7	=S	(5 7)	+ 8	—	11·0
Kodaikanal	20·7	10 33	=SR_1	—	—	14·0	15·4
Colombo	24·5	10 45	=SR_1?	—	—	—	16·9
Helwan	34·2	5 57	—	—	—	—	14·3
Vienna	45·0	i 8 48	+15	—	—	—	—
Zagreb	45·2	e 8 40	+ 6	—	—	—	—
Graz	45·6	i 8 35	− 2	15 21	− 2	—	—
Rocca di Papa	47·8	e 8 37	−16	—	—	—	11·0
Moncalieri	51·1	e 9 4	−10	16 22	−10	22·9	—
De Bilt	52·2	—	—	e 17 27	+41	26·7	N 30·2
Kew	55·7	—	—	—	—	—	42·7
Algiers	56·0	—	—	—	—	e 25·8	27·8
Edinburgh	56·9	35 45	?	—	—	—	—

Eskdalemuir gives 10h.25m. to 10h.40m.0s. Bombay gives S = +9m.0s.

Dec. 1d. Records also at 0h. (Zi-ka-wei and San Fernando), 4h. (Taihoku and Riverview), 5h. (La Paz), 18h. (Manila and Batavia), 19h. (Edinburgh).

Dec. 2d. 4h. 38m. 24s. At 4°·0N. 115°·0E. (as on 1914 Aug. 6d. and 1917 Oct. 3d?).

A = −·422, B = +·904, C = +·070; D = +·906, E = +·423, ;
G = −·029, H = +·063, K = −·998.

	△	Az.	P.	O−C.	S.	O−C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Manila	12·1	29	e 3 26	+25	—	—	6·3	—
Batavia	13·1	219	e 3 1	−13	—	—	—	9·6
Melbourne	50·2	149	—	—	—	—	24·6	26·6
Riverview	50·9	141	e 16 24	?S	(e 16 24)	− 6	23·4	28·1
Helwan	82·5	300	58 36	?L	—	—	(58·6)	—

The residuals suggest an epicentre nearer Batavia and further from Manila—say 2°·5N. 114°·0E., but the material is scanty.

Dec. 2d. 17h. 2m. 0s. Near La Paz, which records P = +0m.47s., L = +1·8m., M = +1·9m.

Dec. 2d. 17h. 39m. 0s. At 43°·0N. 15°·0E. (as on Dec. 1d. 9h.)

	△	P.	O−C.	S.	O−C.	L.	M.
	°	m. s.	s.	m. s.	s.	m.	m.
Monte Cassino	1·8	0 49	+21	—	—	—	2·6
Pola	2·0	e 0 30	− 1	—	—	—	—
Rocca di Papa	2·1	i 0 39	+ 6	1 15	+17	—	1·6
Triest	2·8	i 0 32	−12	—	—	—	—
Zagreb	2·9	e 1 1	+16	1 58	+38	—	2·2
Graz	4·1	1 7	+ 3	—	—	—	—
Vienna	5·3	e 1 20	− 2	—	—	—	—
Moncalieri	5·6	1 6	−20	1 47	−46	—	1·8
Lemberg	9·2	—	—	5 42	?L	(5·7)	—
Paris	10·4	e 3 28	?	e 3 52	−47	—	—
De Bilt	11·2	—	—	—	—	5·4	6·2
Helwan	18·5	19 0	?	—	—	—	—

Zagreb records also iP = +1m.7s., MW = +2·3m., iE = +2m.22s. Moncalieri MN = +2·0m. De Bilt MN = +6·5m. Uccle records 17h.42–48m.

Dec. 2d. Records also at 0h. (San Fernando), 12h. (La Paz, Edinburgh, Monte Cassino (2), and Rocca di Papa), 13h. (Monte Cassino), 14h. (Monte Cassino), 15h. (Monte Cassino (2) and Zi-ka-wei), 18h. (Monte Cassino and Zagreb), 19h. (Monte Cassino (2)), 21h. (Zagreb), 22h. (Monte Cassino and San Fernando).

Dec. 3d. Records at 0h. (Monte Cassino), 3h. (Monte Cassino), 4h. (Melbourne, Honolulu, and Riverview), 6h. (Taihoku), 7h. (Riverview), 11h. (Mizusawa), 13h. (Paris and La Paz), 14h. (Athens and Manila), 16h. (Barcelona, Lick, and Tortosa), 21h. (La Paz).

Dec. 4d. Records at 0h. (San Fernando), 1h. (La Paz), 6h. (La Paz), 9h. (Calcutta and Kew), 11h. (Lick).

Dec. 5d. 12h. 48m. 40s. At 14°·0N. 60°·0E. A = +·485, B = +·840, C = +·242.

		△	Az.	P.	O−C.	S.	O−C.	L.	M.
		°	°	m. s.	s.	m. s.	s.	m.	m.
Helwan		30·8	307	6 38	+ 2	11 50	+ 2	—	15·1
Mauritius	N.	34·1	188	7 2	− 4	—	—	—	9·8
	E.	34·1	188	6 14	−52	—	—	—	8·3
Moncalieri		53·8	320	e 11 28	?PR_1	17 10	+ 4	23·5	—
Algiers		55·3	305	e 19 52	?	—	—	23·5	26·3
Barcelona		56·8	315	—	—	—	—	23·5	29·6
De Bilt		57·7	325	—	—	e 17 24	−31	e 26·3	35·5
Capetown		62·1	220	10 32	+ 6	—	—	—	13·7
San Fernando		62·7	295	17 50	?S	(17 50)	−67	29·1	30·8
Coimbra		64·6	300	20 40	?S	(20 40)	+80	25·0	32·6

The solution is only rough; probably the epicentre is a few degrees further west, and T_0 should be reduced, but the material is too scanty to give accuracy. San Fernando gives S = +24m.30s. De Bilt gives also eLN = +27·3m., MN = +35·1m. Kodaikanal (△ = 17°·5) has the puzzling record P = +18m.26s., and Colombo (△ = 20°·7) has P = +16m.20s., M = +20·7m. Is this yet another shock?

Dec. 5d. 13h. 8m. 30s. At 46°·0N. 9°·0E. (as on 1917 Dec. 9?).

A = +·686, B = +·109, C = +·719.

The absence of records from Italian stations is puzzling, but this and the previous shock are not very easily separated.

	△	Az.	P.	O−C.	S.	O−C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Tortosa	8·0	233	1 44	−17	3 5	−32	3·3	9·0
Edinburgh	12·5	327	9 0	?	—	—	—	—
Granada	12·9	231	3 24	+12	6 5	+23	—	—
Rio Tinto	14·2	240	4 30	+21	—	—	—	13·2
San Fernando	14·9	235	4 40	+62	—	—	8·9	10·7

Eskdalemuir gives simply 13h.15m. to 13h.47m. San Fernando P is given as S for the previous shock, also MN = +11·7m.

Dec. 5d. Records also at 0h. (La Paz) and 22h. (Manila).

Dec. 6d. 11h. 37m. 30s. At 38°·0N. 145°·0E. (as on 1913 Oct. 12?).

A = −·646, B = +·452, C = +·616; D = +·574, E = +·819; G = −·504, H = +·353, K = −·788.

	△	Az.	P.	O−C.	L.	M.
	°	°	m. s.	s.	m.	m.
Mizusawa	3·1	289	0 20	−29	0·5	—
Osaka	8·5	250	1 59	−10	4·5	5·1
Zi-ka-wei	20·6	258	5 17	+29	—	—

Dec. 6d. Records also at 4h. (Helwan), 7h. (Riverview), 13h. (Mizusawa (2)), 19h. (Rocca di Papa, Manila, Mizusawa), 20h. (San Fernando), 21h. (Helwan).

Dec. 7d. Records at 3h. (Rio Tinto), 9h. (Taihoku), 10h. (Taihoku), 13h. and 17h. (Manila), 19h. (Helwan), 22h. (La Paz (2)), 23h. (Rocca di Papa and Monte Cassino).

Dec. 8d. Records at 6h. (La Paz), 9h. (Manila), 17h. (Mizusawa), 22h. (Manila).

Dec. 9d. 2h. 4m. 50s. Close to Algiers which gives iP = +10s., L = +0·3m.

Dec. 9d. 2h. 29m. 20s. At 30°·2S. 177°·7W. (as on June 6d. 3h. and 15h., 9d. 16h., and 13d. 6h.

	△	P.	O−C.	S.	O−C.	L.	M.
	°	m. s.	s.	m. s.	s.	m.	m.
Riverview	26·6	e 5 46	−8	10 35?	+2	e 13·1	13·5
Melbourne	31·7	—	—	—	—	18·1	23·1
Honolulu	54·9	—	—	—	—	e 14·7	15·7

Riverview gives e(PR,?) = +7m.10s., +7m.17s., MN = +15·5m., i = +16·0m. The Honolulu record is discordant, and cannot be reconciled with Riverview if it is really L. If we assume it to be S then we could satisfy the observations by an epicentre at 10°·0S. 177°·0E.

Dec. 9d. 5h. 34m. 0s. Close to Manila, which gives eP = +25s., L = +0·6m. Batavia gives e = +3m.0s.

Dec. 9d. 13h. 58m. 0s. Close to Athens, which gives P = +0m.24s., L = +0·8m., M = +1·0m. Zagreb eW = +1m.51s., eE = +2m.16s., eM = +4·5m., iW = +4·8m., ME = +4·8m., MW = +3·0m.

Dec. 9d. 15h. 51m. 10s. At 7°·0S. 155°·0E., (as on 1916 Sept. 3d.).

A = −·900, B = +·120, C = −·122.

	△	P.	O−C.	S.	O−C.	L.	M.
	°	m. s.	s.	m. s.	s.	m.	m.
Riverview	27·1	i 6 9	+10	e 10 26	−17	—	—
Melbourne	32·1	—	—	—	—	—	15·9
Batavia	47·9	—	—	e 16 50	+57	—	—
Honolulu	54·2	—	—	—	—	20·6	22·8
Rocca di Papa	131·7	e 20 21	[+59]	—	—	—	20·6

Riverview gives two more readings = +11m.30s., +11m.41s.

Dec. 9d. 21h. 40m. 30s. At 46°·0N. 9°·0E. (as on 1914 Oct. 27d. and 1917 Dec. 5).

A = +·686, B = +·109, C = +·719.

	△	P.	O−C.	S.	O−C.	L.	M.
	°	m. s.	s.	m. s.	s.	m.	m.
Moncalieri	1·4	0 33	+12	0 59	+20	1·5	—
Besancon	3·9	1 1	0	1 23	−24	—	—
Rocca di Papa	5·0	e 7 18	?	—	—	—	—
Paris	5·2	e 1 16	−4	e 2 35	+13	3·1	—
Uccle	5·7	e 1 48	+20	—	—	—	—
Zagreb	5·9	i 1 26	−7	2 16	−25	—	2·5

Zagreb gives also eW = +1m.13s., iE = +1m.27s., i = +1m.49s.

Dec. 9d. Records also at 9h. (La Paz), 21h. (Manila), 22h. (Helwan).

Dec. 10d. Records at 0h. (San Fernando), 5h. (Rio Tinto), 9h. (Melbourne), 12h. (Monte Cassino), 13h. (Taihoku), 14h. (Zi-ka-wei and Manila), 15h. (De Bilt), 17h. (Melbourne), 20h. (Monte Cassino), 21h. (La Paz).

Dec. 11d. 13h. 3m. 40s. At 7°·0S. 155°·0E. (as on Dec. 9d. 15h.).

	△	P.	O−C.	S.	O−C.	L.	M.
	°	m. s.	s.	m. s.	s.	m.	m.
Riverview	27·1	e 6 8	+ 9	e 10 32?	−11	e 14·8	20·7
Melbourne	32·1	—	—	—	—	16·6	17·8
Honolulu	54·2	—	—	—	—	28·5	33·1
La Paz	131·3	47 57	?	—	—	—	—

Riverview gives also MN = +16·8m.

Dec. 11d. Records also at 0h. (San Fernando), 2h. (Helwan), 3h. (Manila).

Dec. 12d. Records at 0h. (San Fernando), 2h. (Helwan), 4h. (Monte Cassino, Rocca di Papa, and Zagreb), 8h. (Batavia), 10h. (Berkeley), 11h. (Washington and Cheltenham), 13h. (Sydney).

Dec. 13d. Records at 3h. (Helwan and Honolulu), 4h. (San Fernando), 7h. (La Paz), 9h. (Helwan), 13h. (Taihoku), 23h. (La Paz).

Dec. 14d. Records at 1h. (Helwan), 2h. (Manila), 4h. (Helwan), 8h. (Helwan, Manila, Colombo, Melbourne, and Bombay), 10h. (Taihoku), 11h. (Zi-ka-wei), 20h. (San Fernando).

Dec. 15d. 15h. 35m. 15s. At 7°·0S. 155°·0E. (as on Dec. 9d. 15h. and 11d. 13h.).

	△	P.	O−C.	S.	O−C.	L.	M.
	°	m. s.	s.	m. s.	s.	m.	m.
Sydney	27·1	5 33	−26	—	—	13·4	15·1
Riverview	27·1	e 5 45	−14	e 11 15	+32	e 13·1	14·9
Melbourne	32·1	11 45	?8	16 3	?	17·3	19·1
Honolulu	54·2	—	—	—	—	e 28·4	32·7

Riverview gives MN = +15·2m.

Dec. 15d. Records also at 1h. (Monte Cassino), 2h. (Rocca di Papa), 6h. (Helwan), 7h. (Rio Tinto), 8h. (Helwan), 9h. (Helwan), 11h. (Helwan), 13h. (Monte Cassino and Mizusawa), 16h. (Monte Cassino), 17h. (Helwan), 18h. (Rocca di Papa).

Dec. 16d. Records at 3h. (Helwan), 5h. (La Paz), 8h. (Helwan), 13h. (Edinburgh), 22h. (Zi-ka-wei).

Dec. 17d. 22h. 18m. 0s. Close to Nagoya, which gives P = +0m.13s. Osaka PS = +6m.44s., L = +1·2m., MN = +1·7m., ME = +1·6m. Mizusawa PE = +3m.30s., PN = +3m.0s.

Dec. 17d. Records also at 4h. (Colombo), 6h. (San Fernando), 9h. (Mizusawa), 15h. (San Fernando), 19h. (Monte Cassino and Honolulu), 23h. (Helwan and De Bilt).

Dec. 18d. Records at 0h. (Lick), 1h. (La Paz), 12h. (Osaka), 17h. (Helwan), 20h. (San Fernando), 23h. (San Fernando and Batavia).

Dec. 19d. Records at 0h. (Lick (2)), 4h. (Colombo and De Bilt), 10h. (Kodaikanal), 14h. (La Paz), 15h. (Algiers), 17h. (Mizusawa), 22h. (Taihoku),

Dec. 20d. 1h. 52m. 0s. At 7°·0S. 155°·0E. (as on Dec. 9, 11, and 15 days).

A = −·900, B = +·420, C = +·122; D = +·423, E = +·906;
G = +·111, H = −·052, K = −·993.

	Δ	Az.	P.	O−C.	S.	O−C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Sydney	27·1	187	6 36	+37	—	—	13·5	15·0
Riverview	27·1	187	e 5 36	−23	e 10 48	+ 5	e 13·0	16·0
Adelaide	31·8	206	12 24	?S	(12 24)	+19	—	17·2
Colombo	76·3	279	60 30	?	—	—	—	67·0
Kodaikanal	79·1	283	—	—	—	—	61·0	68·6
Berkeley	80·0	51	e 58 30	?	—	—	—	—
Victoria	89·8	11	—	—	—	—	—	58·0
Toronto	120·1	13	—	—	—	—	64·0	65·6
Helwan	122·5	301	30 0	?S	(30 0)	+52	—	—
Edinburgh	128·1	318	25 0	?	—	—	—	—

Riverview gives MN = +15·7m.

Dec. 20d. Records also at 0h. (Lick), 1h. (Lick), 3h. (Eskdalemuir, San Fernando, De Bilt, and Taihoku), 4h. (Zi-ka-wei), 8h. (Manila), 15h. (La Paz).

1917. Dec. 21d. 17h. 54m. 16s. Epicentre 53°·5N. 152°·0W.

A = −·525, B = −·279, C = +·804; D = −·470, E = +·883;
G = −·710, H = −·377, K = −·595.

		Δ	Az.	P.	O−C.	S.	O−C.	L.	M.
		°	°	m. s.	s.	m. s.	s.	m.	m.
Victoria		18·6	94	4 5	−19	—	—	8·4	12·4
Berkeley		25·7	116	e 6 2	+17	e 10 48	+32	e 13·1	18·7
Lick		26·4	115	e 5 19	−33	—	—	—	17·8
Honolulu		32·5	191	e 9 2	?	—	—	—	—
Tucson		36·1	109	7 8	−15	13 18	+ 7	18·7	31·7
Mizusawa		46·5	280	8 38	− 6	15 24	−10	—	—
Toronto		46·9	71	—	—	16 3	+23	i 24·3	29·9
Ottawa		47·8	67	9 0	+ 7	15 44	− 7	22·7	27·7
Ithaca	N.	49·3	70	e 9 1	− 1	16 10	0	24·1	36·0
Washington		51·4	74	e 9 7	− 9	16 30	− 6	25·9	32·2
Cheltenham	E.	51·5	74	9 20	+ 3	16 42	+ 4	26·5	32·9
	N.	51·5	74	—	—	16 50	+12	26·2	33·7
Osaka		52·8	280	8 14	−71	17 56	+62	25·7	27·0
Zi-ka-wei		63·5	287	10 11	+ 6	e 19 6	− 1	—	—
Dyce		66·6	17	e 11 4	+ 9	19 52	+ 7	31·4	11·1
Edinburgh		67·6	18	13 14	?	—	—	—	41·7
Eskdalemuir		68·1	18	11 3	− 2	19 52	−11	32·6	37·1
Stonyhurst		69·8	18	e 12 8	+52	i 21 2	+38	—	44·0
Cork		70·2	23	20 44	=S	(20 44)	+16	—	44·2
Kew		72·4	18	8 44?	?	—	—	—	33·7?
De Bilt		72·7	14	i 11 35	+ 1	20 12	−16	e 34·7	43·9
Vicques		73·4	82	—	—	—	—	30·6	41·7
Uccle		73·8	15	i 11 39	− 2	20 57	−14	35·7	57·2
Paris		75·4	17	i 11 50	− 1	i 21 13	−17	35·7	37·7
Lemberg		76·6	3	—	—	e 21 14	−30	—	—
Manila		76·6	276	e 12 12	+13	18 24	?	21·6	22·1
Moncalieri		80·0	14	12 10	− 9	22 9	−14	31·1	50·6
Triest		80·1	10	—	—	22 3	−21	—	—
Zagreb	N.E.	80·1	8	e 12 12	− 8	i 22 10	−11	—	—
	N.W.	80·1	8	e 12 15	− 5	i 22 7	−17	—	53·3
Pola		80·9	10	—	—	22 12	−22	—	—
Coimbra	E.	81·1	27	12 20	− 6	i 22 18	−18	38·7	43·5
Marseilles		81·3	16	—	—	—	—	48·9	—
Barcelona		82·5	19	e 12 28	− 5	i 22 30	−22	e 30·7	43·3
Tortosa		82·6	21	12 26	− 8	22 36	−17	29·4	45·2
Rocca di Papa		83·8	11	12 35	− 6	e 22 13	−21	e 50·8	52·2
Rio Tinto		83·9	27	16 11	$-PR_1$	—	—	—	49·7
Granada		85·2	25	12 44	− 5	—	—	—	—
San Fernando		85·2	27	12 44	− 5	22 59	−22	44·5	50·7
Helwan		96·6	356	18 32	?	—	—	—	78·4

Continued on next page.

		Δ	Az.	P.	O−C.	S.	O−C.	L.	M.
		°	°	m. s.	s.	m. s.	s.	m.	m.
Algiers		87·2	20	—	—	e 23 19	−24	36·7	49·7
Bombay		98·0	318	21 47	?	—	—	—	58·5
La Paz		99·6	105	14 16	+ 7	i 24 49	−63	18·1	66·5
Sydney		100·2	225	24 50	?S	(24 50)	−68	53·2	55·7
Riverview		100·3	225	e 24 50	?S	(e 24 50)	−69	e 47·6	58·9
Kodaikanal		103·8	310	24 56	?	—	—	56·2	66·5
Colombo		105·6	306	25 44	?S	(25 44)	−64	53·0	73·2
Adelaide		106·9	233	26 2	?S	(26 2)	−58	—	56·6
Accra		116·3	32	27 14	?S	(27 14)	−66	—	65·7
Mauritius	E.	139·5	314	22 44	$?PR_1$	—	—	—	71·4
	N.	139·5	311	23 32	$?PR_1$	—	—	—	82·3
Cape Town		159·3	23	85 8	?	—	—	—	—

Victoria records on the vert. inst.: P = +1m.16s., S = +8m.40s., L = +9·5m., M = +13·7m. Lick MN = +19·1m. Berkeley MN = +22·3m. Mizusawa SN = +15m.6s. Toronto gives another Li = +27·3m. Ottawa SR_1 = +18m.44s., and gives T_0 = 17h.54m.45s. Washington MN = +30·7m., eZ = +9m.27s., LZ = +26·9m. Osaka MN = +26·8m. Dyce gives another ME = +39·4m., MN = +40·8m. Eskdalemuir PR_2 = +15m.24s., SR_1 = +25m.1s., SR_2 = +27m.27s. De Bilt records $e(PR_1)N$ = +14m.15s., $(SR_1)E$ = +25m.1s., SR_1N = +25m.16s., m = +25·7m., SR_2E = +28m.52s., SR_2N = +29m.5s., m = +29·6m., eLN = +36·7m., MN = +44·7m. Uccle eP = +11m.36s., SR_1 = +25m.32s., SR_2 = +29m.32s. Paris eP = +11m.43s. Moncalieri MN = +50·7m. Zagreb iP = +12m.20s., eS = +21m.59s., T_0 = 17h.54m.39s. Coimbra iSN = +22m.20s., LN = +38·8m., MN = +44·3m. Marseilles gives e_1 = +41m.38s., e_2 = +46m.38s. Barcelona MN = +53·1m. San Fernando MN = +55·2m. Algiers records another P = +47m.28s., L = +47·6m. Riverview i = +26m.0s., MN = +54·4m., MZ = +54·8m.

Dec. 21d. I = 20h. 45m. 50s. } At 55°·5N. 152°·0W.
II = 20h. 51m. 50s. }

A = −·500, B = −·266, C = +·824.

		Δ	P.	O−C.	S.	O−C.	L.	M.
		°	m. s.	s.	m. s.	s.	m.	m.
Victoria	I	18·9	5 28	+60	9 24	+84	14·3	19·2
Berkeley	II	26·6	—	—	10 45	+12	—	—
Lick	II	27·3	e 12 10	$=SR_1$	—	—	—	—
Honolulu	II	34·5	—	—	—	—	17·2	17·6
Toronto	I	46·3	—	—	—	—	23·2	36·7
Ottawa	II	47·0	—	—	e 15 54	+13	e 25·2?	—
Ithaca	II	48·6	—	—	e 16 15	+14	26·0	—
Washington	II	50·7	—	—	e 14 20?	?	e 26·4	—
De Bilt	II	70·8	—	—	e 20 58	+22	e 38·2	47·3
Uccle	II	71·9	e 11 28	− 1	e 21 10	+21	e 38·2	—
Paris	II	73·5	e 12 12	+33	i 21 27	+19	38·2	46·7
Moncalieri	II	78·0	—	—	e 22 23	+23	38·8	—
Barcelona	II	80·6	—	—	—	—	48·9	51·5
Rio Tinto	II	82·1	—	—	—	—	—	50·2
Bombay	II	96·5	54 17	—	—	—	—	55·5
La Paz	II	100·0	48 17	—	—	—	62·2	73·6
Kodaikanal	II	102·5	59 16	—	—	—	—	—
Colombo	II	104·4	57 10	—	—	—	—	—

Toronto gives other L's at +30·8m., +34·8m. Ottawa gives +21m.10s., eN = +21m.40s., L 21h.18m. to 21h.25m.0s., LN = +48·2m. Washington eN = +14m.6s. De Bilt gives $e(SR_1)N$ = +25m.34s., m = +25m.54s., $e(SR_2)N$ = +29m.16s., m = +29m.47s., MN = +45·1m.

Dec. 21d. Records also at 1h. (Taihoku), 4h. (La Paz), 16h. (Helwan), 20h. (Riverview and Moncalieri), 21h. (Zagreb).

Dec. 22d. Records at 6h. (Helwan), 8h. (Taihoku), 11h. (La Paz), 13h. (La Paz), 14h. (Victoria and Barcelona).

Dec. 23d. I = 5h. 39m. 40s. / II = 5h. 47m. 0s. / III = 14h. 46m. 40s. } At 40°·5N. 26°·0E.

A = +·683, B = +·333, C = +·649 ; D = +·438, E = −·899 ; G = +·584, H = +·285, K = −·760.

		△	Az.	P.	O−C.	S.	O−C.	L.	M.
		°	°	m. s.	s.	m. s.	s.	m.	m.
Athens	I	3·1	214	e 0 48	0	—	—	i 1·1	1·3
	II	3·1	214	e 0 48	0	—	—	1·1	—
	III	3·1	214	e 0 49	+ 1	—	—	1·2	1·4
Zagreb	I	9·0	309	e 3 20	+64	i 4 57	+54	—	5·8
	III	9·0	309	—	—	e 4 3	0	—	5·8
Pola	I	9·9	300	—	—	e 4 32	+ 6	—	—
	III	9·9	300	—	—	e 4 20	− 6	—	—
Graz	I	10·0	314	e 3 50	?	—	—	—	—
	III	10·0	314	e 3 50	?	—	—	—	—
Rocca di Papa	I	10·1	281	e 2 21	−10	—	—	—	5·8
	III	10·1	281	e 2 16	−15	—	—	—	5·0
Vienna	I	10·3	322	e 2 50	+16	—	—	—	—
	III	10·3	322	e 3 8	+34	—	—	—	—
Helwan	II	11·5	156	6 0	=S	(6 0)	+53	—	—
De Bilt	I	18·4	316	—	—	e 8 11	+22	—	—
	III	18·4	316	—	—	—	—	5·3	11·2
Edinburgh	III	24·5	319	1 10	?	—	—	—	—
Berkeley	III	96·4	335	e 61 9	?	—	—	—	—

Zagreb I also records i = +5m.6s., eM = +5·5m., eMW = +5·7m. De Bilt I gives eN = +8m.16s. Zagreb III gives also eE = +4m.27s., i = +5m.2s., iM = +5·6m. De Bilt record of eL = +5·3m. = PR_4?, MN = +8·9m.

Dec. 23d. 15h. 48m. 0s. At 50°·0N. 128°·0W. (as on 1917 July 1d.).

	△	P.	O−C.	S.	O−C.	L.	M.
	°	m. s.	s.	m. s.	s.	m.	m.
Victoria	3·4	0 54	+ 1	—	—	—	2·9
Toronto	33·4	—	—	—	—	18·6	—
Ottawa	34·8	—	—	e 17 0?	—	e 19·5	—
Ithaca	35·7	—	—	—	—	e 22·8	—
Washington	37·2	e 11 0?	—	—	—	18·0	—
Edinburgh	64·7	28 0	—	—	—	—	—
De Bilt	70·5	—	—	—	—	34·0	36·1

Dec. 23d. Records also at 3h. (Zagreb), 4h. (Helwan, De Bilt, and La Paz), 6h. (Manila), 7h. (Helwan), 10h. (Mizusawa), 14h. (Victoria, Ottawa, Berkeley, and Toronto), 18h. (Athens), 19h. (De Bilt, Zagreb, Pola, and Graz), 20h. (Algiers).

Dec. 24d. 9h. 13m. 45s. At 40°·5N. 26°·0E. (as on Dec. 23d. 5h. and 14h.).

A = +·683, B = +·333, C = +·649 ; D = +·438, E = −·899 ; G = +·584, H = +·285, K = −·760.

	△	Az.	P.	O−C.	S.	O−C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Athens	3·1	214	0 37	−11	—	—	0·9	1·3
Zagreb	9·0	309	e 2 14	− 2	i 3 32	−31	—	6·3
Monte Cassino	9·2	279	1 55	−24	—	—	—	4·6
Lemberg	9·4	352	e 3 3	+41	—	—	—	—
Graz	10·0	314	2 33	+ 3	—	—	—	—
Rocca di Papa	10·1	282	2 3	−28	4 47	+15	—	5·1
Vienna	10·3	322	e 2 45	+11	—	—	—	—
Helwan	11·5	156	7 9	?	13 15	?	—	14·9
Moncalieri	14·1	295	3 25	− 2	5 47	−23	7·4	10·7
Marseilles	15·6	286	e 8 2	?	—	—	—	—
Barcelona	18·0	281	3 47	−30	7 0	−40	8·2	11·2
Uccle	18·2	312	e 4 14	− 5	e 7 44	0	10·2	10·7
De Bilt	18·4	316	i 4 27	+ 5	7 56	+ 7	9·4	12·4
Paris	18·5	304	—	—	—	—	10·2	13·7
Tortosa	19·3	280	4 7	−26	7 14	−54	—	8·2
Kew	21·1	310	—	—	—	—	—	17·3
Granada	23·2	272	4 51	−28	—	—	—	—
Edinburgh	24·4	319	5 15	−17	—	—	—	17·5
Dyce E.	24·7	322	e 5 40	+ 5	10 5	+ 8	—	16·6
San Fernando	25·4	271	5 15	−27	—	—	—	20·2
Coimbra	26·1	281	5 17	−32	9 27	−57	14·7	17·6

For Notes see next page.

NOTES TO DEC. 24d. 9h. 13m. 45s.

Athens gives m = +0m.51s. = PR_3. Zagreb records iPW = +2m.13s., i = +2m.30s., iW = +2m.59s., iMW = +5·1m., iME = +5·2m., eME = +5·5m., MW = +5·9m. Moncalieri gives MN = +9·5m. De Bilt m = +8·0m., m = +8·2m., MN = +11·2m. Paris MN = +10·2m. Dyce SN = +10m.10s., MN = +16·7m. San Fernando MN = +14·7m. Coimbra PN? = +3m.39s., LN = +14·0m. Eskdalemuir 9h.23m. to 9h.47m.0s. Rocca di Papa gives eL = +8·2m.

Dec. 24d. Records also at 1h. (Barcelona and La Paz), 2h. (Mizusawa), 3h. (Helwan), 6h. (Colombo), 7h. (Rocca di Papa), 10h. (La Paz and Athens), 19h. (Athens), 21h. (San Fernando), 23h. (Athens).

Dec. 25d. Records at 4h. (Taihoku), 5h. (Athens), 6h. (Stonyhurst), 8h. (Helwan), 9h. (San Fernando), 13h. (San Fernando), 14h. (La Paz), 15h. (La Paz and Manila), 17h. (Zi-ka-wei and Mizusawa), 18h. (Athens), 19h. (Taihoku), 22h. (Taihoku).

Dec. 26d. I = 5h. 21m. 0s. / II = 6h. 18m. 10s. } At 10°·5N. 91°·0W., (as on 1916 Feb. 27d. 20h.).

A = −·018, B = −·983, C = + 182.

		△	P.	O−C.	S.	O−C.	L.	M.
		°	m. s.	s.	m. s.	s.	m.	m.
Tucson	I	28·4	—	—	—	—	10·1	16·1
Washington	I	31·0	e 9 1	?	13 11	$=SR_4$	e 14·4	—
Toronto	I	34·7	—	—	—	—	17·1	17·5
	II	34·7	—	—	—	—	18·3	18·6
La Paz	I	35·2	7 17	+ 2	13 9	+11	17·7	19·9
	II	35·2	7 18	+ 3	—	—	17·8	19·6
Berkeley	I	39·2	—	—	e 14 45	+50	—	—
	II	39·2	—	—	e 17 25	= L	(e 17·4)	—
Victoria	I	46·5	21 55	?	21 58?	?	27·9	30·9
	II	46·5	—	—	—	—	—	31·3
Edinburgh	I	80·1	—	—	—	—	—	48·2
De Bilt	I	84·9	—	—	—	—	48·0	50·1
Helwan	I	111·5	20 0	$=PR_1$	—	—	—	—

Eskdalemuir records 5h.0m. to 6h.30m.0s. Tucson LN = +10·2m., MN = +16·8m. Washington eN? = +9m.0s., SN? = +13m.29s. Toronto I gives LE = +16·1m.

Dec. 26d. 9h. 22m. (30s.). At 11°·0N. 20°·0W. (as on 1917 June 16d.12h.).

A = +·676, B = −·246, C = +·695 ; D = −·342, E = −·940 ; G = +·653, H = −·238, K = −·719.

	△	Az.	P.	O−C.	S.	O−C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Coimbra	9·2	108	—	—	—	—	1·2	3·3
San Fernando	13·0	121	—	—	—	—	3·0	5·0
Eskdalemuir	15·6	38	3 41	− 6	—	—	6·4	7·0
Edinburgh	16·0	36	—	—	—	—	—	9·5
Paris	16·2	65	—	—	—	—	6·5	7·0
Uccle	17·7	59	—	—	—	—	7·5	—
De Bilt	18·5	55	4 38	+13	—	—	7·5	8·6
Graz	24·8	70	e 13 0	?L	—	—	—	—
Helwan	12·6	91	10 30	?	—	—	—	—
La Paz	74·8	228	(12 45)	(+57)	(21 20)	+ 1	21·3	26·5

De Bilt also MN = 8·5. La Paz records P at 9h.25m.15s. If this is an error for 35m.15s., it would differ from P as shown ; and possibly the L may be S as shown. But the material is inconclusive. The position of the epicentre was adopted because it was active on June 16d., as mentioned, but the Coimbra and San Fernando records suggest a position much nearer them, say at 40°·0N. 11°·0W.

Dec. 26d. 13h. 30m. 40s. At 55°·5N. 152°·0W. (as on Dec. 21d. 20h.).

A = −·500, B = −·266, C = +·824.

	Δ	P.	O−C.	S.	O−C.	L.	M.
	°	m. s.	s.	m. s.	s.	m.	m.
Victoria	18·9	5 24	+56	9 22	+82	11·3	13·8
Toronto	46·3	—	—	25 2	?L	28·7	29·1
Ithaca	48·6	—	—	23 27	?L	(23·4)	—
Edinburgh	65·8	20 5	?S	(20 5)	+30	—	41·6
Kew	70·5	—	—	—	—	—	41·3
De Bilt	70·8	—	—	—	—	e 40·3	45·9
Paris	73·5	—	—	—	—	e 38·3	—
Coimbra	79·4	e 35 20	?L	—	—	44·3	—
San Fernando	83·5	24 20	?S	(24 20)	+77	49·1	51·8
Helwan	94·6	25 20	?S	(25 20)	+18	—	—

De Bilt gives eLN = +41·3m., MN = +45·0m. San Fernando MN = +51·3m. Ottawa gives eLN = 13h.57m. to 14h.15m.0s. Eskdalemuir L = 14h.5m. to 14h.15m.0s.

Dec. 26d. Records also at 1h. (La Paz, Edinburgh, Helwan and Colombo), 4h. (Athens, Berkley, La Paz, Toronto, and Victoria), 5h. (Edinburgh and Kew), 8h. (Manila), 9h. (Athens).

Dec. 27d. 7h. 42m. 20s. At 40°·5N. 26°·0E. (as on Dec. 23d. 5h. and 14h., Dec. 24d. 9h.).

	Δ	P.	O−C.	S.	O−C.	L.	M.
	°	m. s.	s.	m. s.	s.	m.	m.
Athens	3·1	e 0 38	−10	—	—	0·9	1·1
Zagreb	9·0	e 2 30	+14	i 4 25	+22	—	5·5
Pola	9·9	e 2 19	−10	—	—	—	—
Graz	10·0	e 2 44	+14	—	—	—	—
Rocca di Papa	10·1	e 2 1	−30	—	—	—	5·4
Vienna	10·3	e 2 46	+12	—	—	—	—
Moncalieri	14·1	e 2 1?	?	5 26?	−44	7·5	8·7
Uccle	18·2	e 4 10	− 9	e 9 40	?L	(9·7)	—
De Bilt	18·4	—	—	e 7 55	+ 6	10·0	12·5
Paris	18·5	—	—	e 7 40	−11	9·7	13·2
Edinburgh	24·4	9 40	=S	(9 40)	−12	—	—

Athens gives m = −0m.40s., MN = +1·3m. Zagreb iE = +2m.49s., iE = +3m.11s., iW = +4m.29s., iW = +4m.43s., i = +4m.50s., iM = −5·1m., iE = +5m.27s., MW = +5·6m. Rocca di Papa M_1 = +2·5m. De Bilt m = +7m.58s., MN = +11·1m. Eskdalemuir gives 7h.52m. to 8h.8m.0s.

Dec. 27d. 8h. 9m. 30s. About 11° from La Paz, which gives P = +2m.40s., S = +4m.49s., L = +5·9m., M = +6·5m.

Dec. 27d. Records also at 0h. (San Fernando), 4h. (Helwan), 5h. (La Paz), 10h. (Athens and Zagreb), 11h. (Athens (2)), 13h. (Athens), 14h. (Barcelona), 15h. (Mizusawa (2)), 16h. (Mizusawa (2)), 18h. (Athens), 21h. (San Fernando and Zi-ka-wei), 22h. (Manila), 23h. (Manila).

Dec. 28d. 16h. 4m. 40s. At 40°·0N. 12°·5E.

A = +·748, B = +·166, C = +·643 ; D = +·216, E = −·976 ;
G = +·628, H = +·139, K = −·766.

	Δ	Az.	P.	O−C.	S.	O−C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Rocca di Papa	1·7	3	0 54	+28	1 39	+52	—	1·8
Monte Cassino	1·8	34	0 54	+26	—	—	—	1·7
Pola	4·9	10	e 0 8	−67	—	—	—	—
Moncalieri	6·1	326	1 40	+ 7	—	—	3·1	3·4
Zagreb	6·3	22	i 1 35	− 1	2 46	− 6	—	2·8
Graz	7·4	16	e 2 20	+28	—	—	—	—
Algiers	8·0	249	i 2 13	+12	i 4 2	+25	—	—
Barcelona	8·0	284	e 2 8	+ 7	i 3 57	+20	—	—
Vienna	8·7	17	i 2 2	−10	—	—	—	—
Tortosa	9·2	280	2 31	+12	4 27	+19	—	—
Paris	11·3	325	i 2 45	− 4	e 4 56	− 6	6·3	—
Uccle	12·2	335	i 2 53	− 9	5 13	−11	—	—
Granada	12·9	262	3 2	−10	—	—	—	—
De Bilt	13·1	340	i 3 8	− 6	5 35	−11	6·8	—
Helwan	18·4	118	5 20	+58	—	—	—	—
Dyce E.	19·7	336	4 22	−15	7 46	−31	—	—

Rocca di Papa gives MN = +2·2m. Pola gives also L = +0m.15s. Zagreb i = +1m.41s., iE = +1m.53s., i = +2m.1s., i = +2m.11s., MW = +2·8m., iE = +2m.58s. De Bilt gives SN = +5m.38s. Dyce SN = +7m.44s.

1917. Dec. 28d. 21h. 14m. 30s. Epicentre **55°·5N. 152°·0W.** (as on Dec. 21d. 20h. & 26d. 13h.).

	Δ	Az.	P.	O−C.	S.	O−C.	L.	M.
	°	°	m. s.	s.	m. s.	s.	m.	m.
Victoria	18·9	100	4 50	+22	—	—	8·3	13·8
Berkeley	26·6	119	e 5 50	− 4	e 10 37	+ 4	—	18·3
Tucson	36·8	112	7 27	− 1	—	—	22·0	28·3
Toronto	46·3	73	—	—	15 36	+ 4	23·5	30·0
Ottawa	47·0	69	8 44	− 3	15 34	− 7	23·5	N 28·0
Ithaca	48·6	72	—	—	e 15 51	−10	e 25·7	—
Washington	50·7	76	e 8 58	−13	—	—	20·5	—
Cheltenham E.	51·0	76	9 28	+15	16 47	+16	27·1	32·2
N.	51·0	76	—	—	16 27	− 4	27·3	38·9
Dyce	64·7	18	e 10 54	+11	19 36	+15	39·1	—
Edinburgh	65·8	19	10 5	−45	—	—	—	40·5
Eskdalemuir	66·3	19	10 14	−39	19 34	− 7	34·5	43·1
Stonyhurst	67·9	19	i 22 0	?	—	—	—	43·0
De Bilt	70·8	15	—	—	20 40	+ 4	34·5	45·5
Uccle	71·9	16	e 11 26	− 3	e 20 48	− 1	—	46·5
Paris	73·5	17	e 11 39	0	i 21 4	− 4	35·5	37·5
Manila	76·4	276	—	—	20 30	−72	—	—
Triest	78·1	10	(11 50)	−18	11 50	=P?	—	—
Moncalieri	78·1	14	i 21 58	=S	(i 21 58)	+ 3	37·2	51·8
Zagreb	78·2	9	e 12 24	+16	e 21 53	− 9	47·5	50·5
Pola	78·9	10	—	—	20 55	—	—	—
Coimbra	79·4	27	e 14 24?	?	i 22 16	0	40·0	43·4
Barcelona	80·6	19	—	—	i 22 18	−12	35·4	47·5
Rio Tinto	82·1	27	22 30	=S	(22 30)	−17	—	48·5
San Fernando	83·5	27	—	—	22 30	−33	45·5	51·5
Simla	83·7	319	—	—	e 24 0	+53	—	47·7
Algiers	85·3	20	—	—	23 8	−14	45·5	50·5
Helwan	94·6	358	18 30	?PR_1	—	—	—	—
Bombay	96·5	318	—	—	—	—	—	55·1
La Paz	100·1	104	e 14 30	+19	i 24 28	−89	60·7	67·1
Riverview	101·6	225	e 24 36	?S	25 51	−21	e 47·3	55·9
Sydney	101·6	225	25 30	=S	(25 30)	−41	53·0	54·5
Kodaikanal	102·5	310	—	—	—	—	55·5	64·9
Colombo	104·4	306	54 30	?	60 18	?	69·2	74·1

Victoria Vert. P = +4m.35s., S = +8m.17s., L = +9·3m., M = +13·3m. Berkeley Vert. eP = +5m.53s., M = +15·3m., MN = +31·3m. Tucson LN = +20·0m., MN = +31·0m. Toronto gives L = +26·6m., LE = +49·9m. Ottawa SR_1 = +18m.32s., eLN? = +22·0m., T_o = 21h.14m.37s. Dyce SN = +20m.30s? LN = +38·8m. Stonyhurst gives another M = +47·7m. De Bilt $(SR_1)N$ = +25m.11s., mN = +25m.33s., $(SR_2)N$ = +28m.49s., mN = +29m.28s., eLN = +36·5m., MN = +45·0m. Paris MN = +45·5m. Zagreb iS = +21m.58s., MW = +54·5m. Coimbra eP? = +13m.48s? LN = +39·6m., MN = +44·5m. Coimbra records on the Milne machine iS = +22m.30s. (O−C +14s.), L = +41·1m., M = +44·5m. Barcelona i = +26m.25s. San Fernando MN = +50·0m. Simla MN = +55·5m. La Paz P = +18m.12s. = PR_1. Riverview eS = +32m.36s. = SR_1, MN = +54·1m. Granada gives T_o = 21h.16m.45s. Moncalieri MN = +51·3m.

Dec. 28d. Records also at 5h. (Athens), 6h. (Mizusawa), 11h. (Bombay), 13h. (Monte Cassino), 15h. (Marseilles).

Dec. 29d. 20h. 2m. 24s. At 65°·8 from La Paz., which records ie = +10m.50s., iS = +19m.35s., L = +29·8m., M = +35·2m.

Dec. 29d. 20h. 25m. near Toronto, which records L = +2·9m., LE = +4·8m., M = +5·1m., and we have also Victoria P = +14m.33s., L = +17·6m., M = +19·1m., Moncalieri records P? = 20h.32m.0s., S? = 20h.44m.21s., L = 20h.56m.16s., M = 21h.22m.30s., which may belong to one or other of the above. We have also Edinburgh P = 20h.57m.0s., and Marseilles e = 21h.2m.42s., M = 21h.5m.2s.

1917. Dec. 29d. 22h. 50m. 20s. Epicentre 15°·0N. 97°·0W.

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

		Δ	Az.	P.	O−C.	S.	O−C.	L.	M.
		°	°	m. s.	s.	m. s.	s.	m.	m.
Tucson	N.	21·4	326	5 2	+ 4	9 16	+24	11·8	—
	E.	21·4	326	4 58	0	9 10	+18	11·8	—
Port au Prince		23·9	77	e 5 37	+10	—	—	—	—
Washington		29·6	33	i 6 9	−15	10 57	−30	12·8	22·1
Cheltenham		29·7	33	6 12	−13	11 7	−22	14·1	20·1
Vieques	N.	30·4	80	7 0	+28	(11 40)	− 1	11·7	—
	E.	30·4	80	6 45	+13	(11 47)	+ 6	11·8	24·3
Lick		31·0	320	6 38	0	11 55	+ 4	—	21·4
Berkeley		31·9	320	e 6 49	+ 3	e 12 12	+ 5	—	22·0
Toronto		32·4	24	6 40	−12	12 16	+ 2	16·9	25·6
Ithaca		32·5	29	6 36	−17	11 58	−18	16·0	23·1
Ottawa		35·3	26	7 4	−12	12 33	−27	19·7	—
Victoria		39·8	333	7 49	− 4	13 10	−54	17·1	27·4
La Paz		42·5	137	i 8 6	− 9	i 14 34	− 8	20·2	22·4
Andalgala		52·0	145	e 10 58	?PR_1	—	—	—	—
Cipolletti		60·4	154	e 16 34	?	—	—	—	—
Cork		77·0	39	12 25	+24	—	—	—	54·2
Coimbra		79·4	51	i 12 24	+ 9	22 22	+ 6	36·3	44·1
Edinburgh		79·8	35	12 40	+22	—	—	—	51·2
Eskdalemuir		79·8	35	12 23	+ 5	22 19	− 2	—	47·2
Dyce		80·0	33	i 12 34	+15	22 44	+21	38·4	50·4
Stonyhurst		80·6	36	i 12 46	+23	i 22 46	+16	—	49·2
Rio Tinto		81·2	53	11 40	−46	—	—	—	54·7
West Bromwich		81·2	38	12 8	−18	22 38	+ 1	—	—
San Fernando		81·8	54	12 10	−19	23 10	+26	41·7	57·2
Shide		82·0	40	12 30	0	22 49	+ 3	—	—
Paris		84·9	41	i 12 49	+ 2	i 23 20	+ 2	39·7	40·2
Uccle		85·1	38	e 12 46	− 4	23 27	+ 1	38·7	51·1
De Bilt		85·5	37	12 55	+ 4	23 28	+ 3	39·7	41·7
Tortosa		85·8	49	12 48	− 4	23 25	− 3	36·2	64·9
Barcelona		86·9	48	e 12 50	− 8	23 29	−11	29·6	42·0
Algiera		88·9	52	e 13 10	0	23 46	−16	39·7	49·7
Moncalieri		89·5	43	i 13 10	− 3	23 45	−23	33·2	57·3
Rocca di Papa a		94·1	45	e 13 32	− 7	—	—	42·1	51·2
	c	94·1	45	e 13 28	−11	e 24 10	−47	—	72·6
Zagreb		94·5	40	e 13 38	− 3	i 24 30	−31	48·7	55·7
Athens		103·4	44	i 17 31	?PR_1	e 27 57	+89	—	—
Helwan		113·1	48	15 4	− 8	—	—	—	23·5
Sydney		116·2	239	16 49	+74	30 10	?	56·4	59·4
Riverview		116·4	239	e 17 22	?	e 30 4	?	e 49·3	58·3
Zi-ka-wei		120·9	322	e 20 40	=PR_1	—	—	—	—
Melbourne		121·2	234	—	—	—	—	—	67·6
Adelaide		126·5	237	47 10	?	—	—	—	65·3
Manila		132·1	306	e 19 7	[−16]	32 38	?	—	—
Simla		133·6	6	e 23 4	?	—	—	—	73·7
Kodaikanal		154·2	12	37 40	?	—	—	94·8	112·8
Batavia		155·0	288	e 17 55	−15	—	—	—	101·7
Colombo		157·9	8	19 40	[−26]	—	—	—	—

Washington MN = +19·9m., iPZ = +6m.11s., SZ = +11m.19s., LZ = +15·4m. Cheltenham PN = +6m.7s., LN = +14·5m., MN = +24·8m. Lick MN = +21·9m. Toronto Li = +14·1m., Li = +19·5m., Lc = +130·8m. Ottawa eLN = +16·2m., M = +25·7 to 33·7m. Victoria PV = +7m.59s., SV = +14m.41s., LV = +21·2m. MV = +26·9m. La Paz i = +12m.0s., i = +18m.21s. = SR_1. Coimbra LN = +32·7m., MN = +45·5m. Dyce = PR_1 = +15m.40s., SR_1 = +27m.54s., M = +45·5m. San Fernando MN = +51·2m. Uccle iP = +12m.51s., PR_1 = +16m.9s. De Bilt PR_1E = +16m.10s., SN = +23m.31s., $L(SR_1)E$ = +28m.52s., mE = +29m.4s., $e(SR_2)E$ = +32m.46s., m = +33m.7s., $e(SR_2)N$ = +33m.10s., eN = +36m.4s., MN = +48·8m. Barcelona PR_1 = +16m.23s. Moncalieri MN = +59·7m. Rocca di Papa M_1 = +63·1m., M_3 = 78·0m. Zagreb eP = +13m.29s., iPE = +13m.47s., iPW = +13m.50s., iW = +14m.8s., iE = +14m.13s., iSW = +24m.23s., eS = +24m.8s. Riverview e = +20m.10s., = PR_1, PS = +31m.16s., SR_1 = +36m.28s., also +37m.10s., MZ = +58·8m., MN = +63·9m. Adelaide PR_1 = +58m.22s. Simla MN = +71·2m.

Dec. 29d. Records also at 5h. (La Paz), 16h. (Mizusawa and Mauritius), 17h. (Batavia), 21h. (Helwan), 23h. (Rocca di Papa).

Dec. 30d. Records at 0h. (Colombo), 1h. (La Paz (2)), 2h. (Manila), 4h. (La Paz and Riverview), 6h. (Berkeley and Riverview), 7h. (Zagreb), 8h. (Riverview), 9h. (Riverview), 11h. (Mizusawa), 15h. (La Paz), 16h. (Eskdalemuir), 21h. (La Paz).

Dec. 31d. Records at 4h. (La Paz), 5h. (Zagreb), 7h. (San Fernando), 15h. (La Paz), 16h. (De Bilt, Toronto, Edinburgh, Victoria, Zi-ka-wei, and Eskdalemuir), 17h. (Helwan), 18h. (Helwan and Lick), 20h. (Edinburgh), 23h. (Moncalieri and Zurich).

ERRATA IN THE 1917 BULLETINS.

Jan. 11d. 11h. Melbourne. Instead of the figures given $\Delta = 29°{\cdot}3$, Az. $= 163°$, etc., read $\Delta = 31°{\cdot}2$, Az. $= 164°$: Residual -44s.

Feb. 15d. 0h. Shide: Insert L $= 52{\cdot}6$m. M $= 57{\cdot}6$m.

Feb. 18d. 1h. Melbourne: Read $\Delta = 53°{\cdot}3$, Az. $= 158°$. Residual -78s.

Feb. 20d. 19h. Washington $\Delta = 20°{\cdot}0$, Az. $= 10°$, P $= +4$m.43s. (O $-$ C $= +2$s.), S $= +8$m.16s. (O $-$ C $= -7$s.), L $= 9{\cdot}0$m., M $= 10{\cdot}8$m. Shide: Insert L $= 30{\cdot}7$m., M $= 52{\cdot}3$m.

May 1d. 18h. For B $= +{\cdot}046$ read $-{\cdot}046$. Cork $\Delta = 155°{\cdot}7$, Az. $= 17°$.

May 9d. In final note under 17h. include Cork.

May 31d. 8h. Cork $\Delta = 71°{\cdot}0$, Az. $= 18°$. Residuals for P, O $-$ C $= -39$s.; for S, O $-$ C $= -34$s.

June 6d. 15h. Epicentre for 30°·0S. read 30°·2S.

ERRATA

IN THE VOLUME OF

LARGE EARTHQUAKES OF 1916.

PAGE

3. Harvard: L for 13h.10m.10s. read 14h.10m.10s.

38. Zi-ka-wei: The P residual O $-$ C should be $+13$, not $+31$.

52. The recorded S is probably Y. From a copy of the records kindly supplied S was identified at 21h.55m.40s., well marked on the E.W. component; residual O $-$ C $= -15$s.

53. Batavia: For i21h.20m. read i51h.20m.

65. Coimbra: For $\Delta = 88°{\cdot}3$ read $82°{\cdot}9$. O $-$ C for P $+20$s., for S $+65$s.

86 and 87. The azimuths for Oct. 20d. 17h. are wrong from Pulkovo to the end. Instead of $180° + A$ read $360° - A$. Thus for:

	°		°		°		°
Pulkovo	196	read	344	Moncalieri	181	read	359
Edinburgh	171	,,	9	Coimbra	152	,,	28
Eskdalemuir	171	,,	9	Helwan	237	,,	303
Stonyhurst	171	,,	9	Rocca	190	,,	350
Bidston	170	,,	10	Barcelona	171	,,	9
De Bilt	178	,,	2	Rio Tinto	152	,,	28
Kew	172	,,	8	San Fernando	151	,,	29
Paris	174	,,	6				

93. Berkeley: The S residual O $-$ C should be $+74$s., not -78s.

111. Adelaide. Constant a: For $-{\cdot}763$ read $-{\cdot}615$.

111. Batavia. Constant b: For $-{\cdot}952$ read $+{\cdot}952$.

112. Melbourne. Latitude: For 35°50′S. read 37°50′S. New constants: a $= -{\cdot}647$, b $= +{\cdot}454$, c $= -{\cdot}613$.

112. Taihoku. Constant *b*: For $+{\cdot}781$ read $+{\cdot}772$.

112. Tokyo. Latitude: For 35°39′ read 35°41′. Constants not altered sensibly.

112. Tortosa. Longitude: For 0°1′E. read 0°30′E. Constant b: For ·000 read $+{\cdot}007$.

TABLE.

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

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