Note on the Kashgar (Turkestan) Earthquake of Aug. 22, 1902.

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1. ***Position of the Earthquake Origin.*** According to a map showing the isoseismal lines of the earthquake in question, given by Mr. A. Voznessensky in No. 4 of the "Bulletin Sismique de l'Observatoire Magnétique et Météorologique d'Irkoutsk," the earthquake origin seems to be situated at about *latitude* 39°42′ N, and *longitude* 76°E. This position has been assumed to be the source of disturbance in the calculation of the epicentral distances of different stations.

The times are, unless otherwise stated, always given in G.M.T.

2. ***Approximate Time*** $(=t_0)$ ***of Earthquake Occurrence at the Origin.***

(i) The epicentral distance of Taschkent, which was nearest the centre of disturbance is only 5°21′, the time of occurrence of the earthquake there being $3^h02^m12^s$. If we assume the mean transit velocity between the origin and Taschkent to be 6 km per sec.,* the time required by the vibrations of the 1st preliminary tremor in passing through that distance would be 91 sec., giving the following value for the time of occurrence at the origin:

$$t_0=3^h00^m41^s$$

* The "Publications," No. 13.

(ii) Taking the observation made in Tokyo, and using the formula

$$t_0 = t_1 - 1.165\ y_1{}^*,$$

we find:—

t_1 = Time of occurrence in Tokyo = $3^h09^m33^s$

y_1 = Duration of 1st Prel. Tremor = 6^m44^s

$t_0 = 3^h00^m43^s$

Taking the mean of the two above values of t_0, we obtain:—

Time of earthquake occurrence at the origin,

$t_0 = \mathbf{3^h00^m42^s}$ (G.M.T.)

3. *Time (t_1) of Eq. Occurrence at the different Stations.* The following table gives the latitude, longitude, and epicentral distance of, and the time of the earthquake occurrence at, each of the 36 different seismological stations, where the shaking was instrumentally observed.

Table I. Turkestan Earthquake: Epicentral Distance and Time of Occurrence.

Place.	Position.		Epicentral Distance $=x$.	Time of Eq ke Occurrence (G.M.T.) $=t_1$.
	Latitude.	Longitude.		
Origin	**39° 42′ N**	**76° E**	.....	**3^h 00^m 42^s**
(i) Taschkent	41° 19′ 31″ N	69° 17′ 42″ E	5° 21′	3^h 02^m 12^s
Colaba (Bombay) ...	18 53 45 N	72 48 56 E	20 59	05 24
Irkutsk	52 16 — N	104 18 33 E	23 07	05 24
Tiflis	41 43 08 N	44 47 51 E	23 36	05 14
(ii) *Mean*	....	.....	**22 34**	**3 05 21**
(iii) Kodaikanal	10 13 50 N	77 27 46 E	29 30	3 04 48
Nikolajev	46 58 18 N	31 58 27 E	32 24	07 00

* The "Bulletin," No. 1.

Table I. *Cont.*

Place.	Position.		Epicentral Distance $=x$.	Time of Eqke Occurrence (G.M.T.) $=t_1$.
	Latitude.	Longitude.		
Pavlovsk.....	59° 41′ —″ N	30° 29′ 15″ E	34° 35′	3^h 07^m 48
(iv) *Mean*.....	.....	.....	**33 30**	**3 07 24**
Budapest.....	47 22 29 N	19 03 55 E	41 02	3 09 20
Laibach	46 03 — N	14 31 — E	44 22	06 50
Leipzig	51 20 06 N	12 23 30 E	44 34	08 01
Triest	45 38 45 N	13 45 45 E	44 59	08 17
Hamburg	53 33 55 N	10 01 19 E	45 35	08 55
Ischia	40 40 — N	13 59 — E	46 22	10 05
Manila.....	14 34 41 N	120 58 33 E	46 34	09 04
Catania	37 29 — N	15 04 — E	46 44	08 59
Ōsaka	34 42 — N	135 31 — E	46 48	09 04
Rocca di papa.....	41 46 — N	12 42 — E	46 54	08 30
Quarto-Castells	43 49 11 N	11 13 11 E	47 15	08 53
Strassburg	48 35 — N	7 46 10 E	48 06	10 00
Pavia	45 11 N	9 09 E	48 13	08 52
Tokyo.....	35 42 29 N	139 45 53 E	49 32	09 33
Uccle	50 47 53 N	4 21 44 E	49 35	09 06
(v) *Mean*	.....	.....	**46 26**	**3 08 54**
Edinburgh	55 57 23 N	3 10 46 W	52 24	3 09 30
Shide	50 42 N	1 19 W	53 02	10 12
Paisley	55 51 N	4 25 W	53 05	10 10
Liverpool	53 24 04 N	3 04 18 W	53 09	.....
Batavia	6 08 S	106 50 E	53 56	09 54
(vi) *Mean*.....	.....	.....	**53 07**	**3 09 54**
(vii) San Fernando...	36 27 40 N	6 12 19 W	62 23	3 09 06

Table I. *Cont.*

Place.	Position.		Epicentral Distance $=x$.	Time of Eqke Occurrence (G.M.T.)$=t_1$.
	Latitude.	Longitude.		
Perth (W.A.)	31° 52′ —″ S	115° 50′ —″ E	80° 32′	3^h 13^m 36^s
Cape Town.....	33 56 03 S	18 28 41 E	90 47	14 48
Victoria, B.C.	48 27 — N	123 22 — W	90 12	16 00
Toronto*.....	43 39 36 N	79 23 24 W	93 43	25 48
Baltimore*	39 17 48 N	76 37 12 W	97 08	24 30
(viii) *Mean* ..... (*Excluded)	.....	.....	**87 10**	**3 14 48**
Christchurch	43 31 50 S	172 37 18 E	120 17	3 20 36
Wellington*	41 17 — S	174 47 — E	120 39	29 00
(ix) *Mean*..... (*Excepted)	.....	.....	**120 17**	**3 20 36**
(x) Cordova.....	31 26 — S	64 12 — W	146 52	3 19 30

Propagation Velocity v_1, calculated by "Difference Method." The mean group values of the epicentral distance (x) and the corresponding time (t_1) of earthquake occurrence are, according to the above table, as follows:—

(i)	$x=$ 5° 21′	$t_1=3^h02^m12^s$	(1 station)
(ii)	22 34	3 05 21	(3 stations)
(iii)	29 30	3 04 48 (?)	(1 „)
(iv)	33 30	3 07 24	(2 „)
(v)	**46 26**	**3 08 54**	(15 „)
(vi)	53 07	3 09 54	(5 „)
(vii)	62 23	3 09 06 (?)	(1 „)
(viii)	87 10	3 14 48	(5 „)
(ix)	120 17	3 20 36	(1 „)
(x)	146 52	3 19 30	(1 „)

The values of the velocity v_1 calculated by combining the group (v) with the others are given in the following table:—

Velocity v_1 Calculated by "Difference Method."

Combination of Groups.	δx	δt_1	v_1
(v)—(iv)	12° 55′	1^m30^s	15.9 *km/sec.*
,, —(ii)	23 52	3 33	12.4
,, —(i)	41 05	6 42	11.4
(vi)—(v)	6 41	1 00	12.4
(viii)— ,,	40 44	5 54	12.8
{(ix) (x)}— ,,	87 09	11 09	14.4

The average of the velocity, deduced from the 6 different values contained in the above table is

$$v_1 = \mathbf{13.2} \text{ km/sec.}$$

This is to be regarded only as a rough approximation.

4. ***Duration of the 1st Preliminary Tremor.*** Table II gives for a number of stations the epicentral distance and the duration (y_1) of the 1st preliminary tremor.

Table II. Turkestan Earthquake: Duration of the 1st Preliminary Tremor.

Place.	Epicentral Distance $=x$.	Duration of 1st Prel. Tremor $=y_1$.
Colaba (Bombay)	20° 59′	3^m54^s
Kodaikanal (Madras)	29 30	5 06
Pavlovsk	34 35	6 06
Mean	**28 21**	**5 02**
Leipzig	44 34	7 35
Ōsaka	46 48	7 12

Table II. *Cont.*

Place.	Epicentral Distance $=x$.	Duration of 1st Prel. Tremor $=y_1$.
Quarto-Castello	47° 15′	7^m39^s
Tokyo	49 32	6 44
Mean	**47 02**	**7 18**
Edinburgh	52 24	8 00
Batavia	53 56	8 00
Mean	**53 10**	**8 00**
San Fernando	62 23	10 12
Cape Town	90 47	9 30
Baltimore	97 08	8 48
Christchurch	120 17	20 36
Cordova	146 52	21 42
Mean	**133 35**	**21 09**

Taking provisionally only the 4 mean group values of the x and the corresponding y_1 contained in Table II, and calculating by the method of Least Squares the constants of a linear equation assumed between these two quantities, we obtain the following result:—

$$x^{km} = 11.8 y_1^{sec} - 60^{km}$$

(for x between 28° and 134°)

The above equation, which is to be regarded as being only roughly approximate, relates to the observation of the Turkestan earthquake at different places. (Compare with a similar equation for the San Francisco earthquake of April 18, 1906, given in the *Bulletin*, No. 1.)