

IMPROVED EPICENTRES OF EARTHQUAKES
IN TURKEY

Thesis by
KAZIM ERGIN

In Partial Fulfillment of the Requirement for
the Degree of Master of Science

California Institute of Technology
Pasadena , California

1943

C O N T E N T S

	Page
Introduction	1
Purpose and the Scope	2
Method of Investigation	2
Acknowledgment	4
Correlation	4
Bibliography	5
Additional Epicentres	6
Improved Epicentres	7-31

INTRODUCTION

The epicentres and origin times of the earthquakes from 1912 to 1939 in Turkey and Aegean Sea covering a region between 24-44 E. longitudes and 34-42 N. latitudes are improved and plotted on a map. Data for 55 shocks of 1927-1934 inclusive were revised by the writer. The origin times and locations given in the "International Seismological Summary", improved origin times and epicentres, as well as correction curves are listed on pages 7-31. In addition to these 55 shocks, 14 shocks (1912-1939) were taken from the "Seismicity of the Earth" (1) and 2 shocks from W. Salomon-Calvi (2). These 16 shocks are listed on page 6. The faults drawn on the map are according ^{to} A. Sieberg (3).

(1) Gutenberg, B., and Richter, C.F. (1941) Seismicity of the Earth, Geol. Soc. Am., Special Papers No. 34

(2) Salomon-Calvi, W., Türkiyedeki Zلزlelere Mütcellik Etüdler, M.T.A. Enstitüsü Yayınlarından Seri B, No. 5

(3) Sieberg, A., Erdbebengeographie, Handbuch der Geophysik, Band 4, Lief. 3, Herausg. von B. Gutenberg

PURPOSE AND THE SCOPE OF THE STUDY

An attempt is made to get a general picture about the correlation of the epicentres to existing fault structures .

METHOD OF INVESTIGATION

The method used by B.Gutenberg and C.F.Richter in 1937 (4) , was employed to improve the epicentres. The shocks considered are assumed to be normal . An example is given on the next page to illustrate the method . First four columns , namely the angular distance , azimuth , P and S were taken from I.S.S. for a number of selected stations . The column S-P is obtained by simply subtracting P from S . P-0 is constructed by using the table 45 for a focal depth of 25 km. in (Gutenberg,B.,Richter ,C.F.,1936) . Column O is simply P-(P-0) . The average of O's plus 6 seconds is subtracted from P to get the sixth column . Seventh column is obtained by using the table 1 in (Gutenberg, B.,Richter ,C.F.,1937) . The residuals ($\Delta - \Delta = \delta$) are plotted against azimuths , and a sinusoidal curve is drawn to represent them . The positive deviation of

(4) Gutenberg,B.,Richter C.F.,(1937)Mat.for the Study of Deep-focus Earthquakes(2ndPaper)Bul.Seis.Soc.Am.Vol.27

1929 April 5		23:38:15		41.5 N.		31.5 E.		Class		d
Stations		Az.	P	S	S-P	P-0	0	P-0	0 :08	
Sebastopol	3.5	25	1:08	1:50	:42	---	---	1:00	3.8	.3
Yalta	3.6	33	:45	1:32	:47	---	---	:37	2.2	-1.4
Simferopol	3.9	29	1:15	---	---	---	---	1:07	4.3	.4
Theodosia	4.5	38	1:20	2:20	1:00	1:18	:02	1:12	4.6	.1
Ksara	8.4	154	2:14	4:02	1:48	2:17	:-03	2:06	8.5	.1
Belgrade	8.7	296	2:12	---	---	---	---	2:04	8.3	-.4
Baku	14.0	89	3:40	6:18	2:38	3:20	:20	3:32	14:8	.8
Strasbourg	18.1	301	4:19	7:45	3:26	4:17	:02	4:11	17.9	-.2
Neuchatel	18.3	296	4:16	---	---	---	---	4:08	17.6	-.7
Pulkovo	18.3	358	4:19	7:49	3:30	4:22	:-03	4:11	17.9	-.4
Hamburg	18.7	318	4:25	---	---	---	---	4:17	18.4	-.3
De Bilt	20.7	310	4:56	8:44	3:48	4:45	:11	4:48	21.2	.5
Uccle	20.8	306	4:47	8:48	4:01	5:01	:-14	4:49	21:3	.5
Ekaterinb.	24.2	41	5:24	9:45	4:21	5:25	:-01	5:16	23.9	-.3
Tashkent	28.1	78	6:21	---	---	---	---	6:13	30.2	2.1

For the correction curve see p.23

Corrections : 9 seconds

.2 N.

.6 W.

these sinusoidal curves from the zero line at the azimuths 0 and 90 degrees give the necessary shift of the epicentre to the South and West respectively . To get the correction in the East-West direction , the deviation of the curve for the azimuth 90 degrees must be divided by the cosine of the latitude.

ACKNOWLEDGMENT

The problem was discussed with Dr. Beno Gutenberg, who supervised the work , and the writer owes him a debt of gratitude .

CORRELATION TO EXISTING FAULTS AND CONCLUSION

An exhaustive correlation to the faults is not attempted here , since the accuracy of the location of these structures is not high and references for detailed information are lacking .It also must be pointed out , that some locations of epicentres may be in error by several degrees . Nevertheless , the majority of the epicentres , especially those of larger shocks are near major faults . They lie along lines that are parallel to faults .

BIBLIOGRAPHY

1. Gutenberg , B. , Richter , C.F. , (1936)
Materials for the Study of Deep-focus Earthquakes ,
Bull . Seism . Soc . Am . Vol . 26 , p. 341-390
2. ----- - ----- (1937)
Materials for the study of Deep-focus Earthquakes ,
Second Paper , Bull . Seism . Soc . Am . Vol . 27
p. 157-183
3. ----- - -----(1941)
Seismicity of the Earth , Geol . Soc . Am . Special
Papers No. 34
4. International Seismological Summary for 1927-1934
5. Salomon-Calvi , W. , (1940) Türkiyedeki Zellelere
Müteallik Etüdler , M.T.A.Enstitüsü Yayınlarından ,
Seri B , No. 5
6. Sieberg , A. , Erdbebengeographie , Handbuch der Ge-
ophysik , Band 4 , Lief . 3 , Herausg . von Beno Gu-
tenberg .

ADDITIONAL EPICENTRES TAKEN FROM "SEISMICITY
OF THE EARTH"

1912 Aug. 9	01:29.0	40.5 N.	27.0 E.	a
1939 Dec. 26	23:57:4	39.5 N.	38.5 E.	a
1929 Aug. 4	09:03:53	36.0 N.	31.0 E.	d
1928 Aug. 23	06:15:55	36.5 N.	36.0 E.	d
1924 July 3	04:40:06	37.0 N.	32.0 E.	d
1925 Aug. 7	06:46:37	38.0 N.	30.5 E.	c
1930 Sept. 11	12:36:44	37.0 N.	31.0 E.	c
1928 March 31	00:29:47	38.0 N.	27.0 E.	c
1929 May 18	06:37:51	40.0 N.	38.0 E.	c
1923 April 29	09:34:35	40.0 N.	37.0 E.	c
1924 Sept. 13	14:34:05	40.0 N.	42.0 E.	c
1935 Jan. 4	14:41:25	40.5 N.	27.5 E.	c
1936 June 14	17:01:30	37.0 N.	35.5 E.	d
1936 Sept. 21	11:41:33	41.0 N.	33.0 E.	d

The following two shocks are from the paper

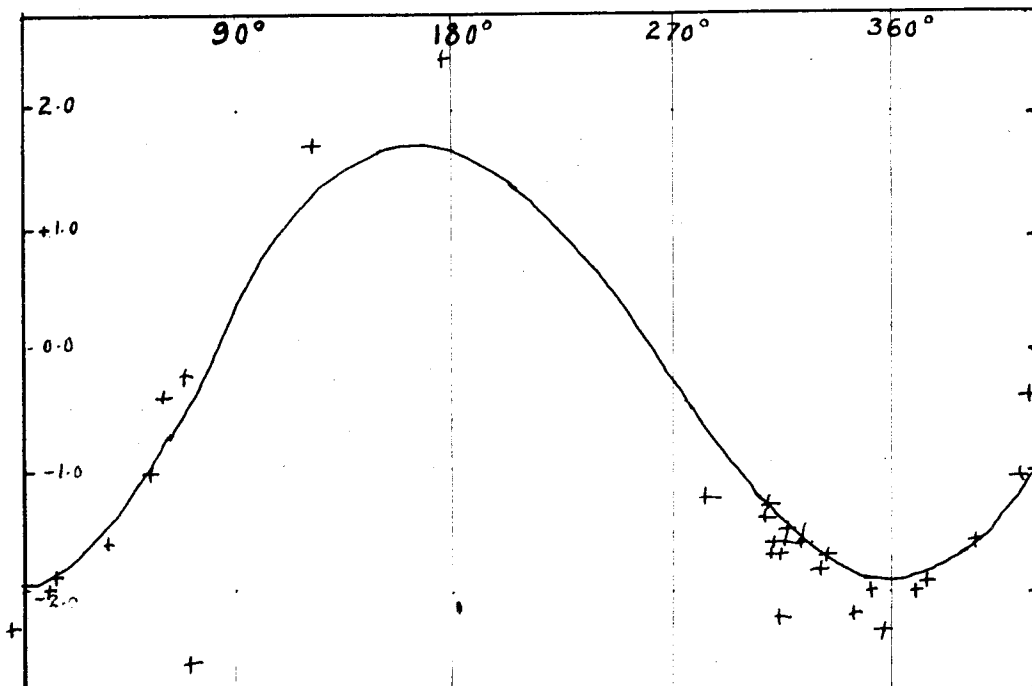
by W. Salomon-Calvi (see reference 5)

1938 April 19	11:02	40.6 N.	37.9 E.	c
1939 Sept. 21	00:37	39.1 N.	26.8 E.	d

1934 January 19

I.S.S. 18:43:05 Epicentre 36.5 N. 31.0 E. Class d

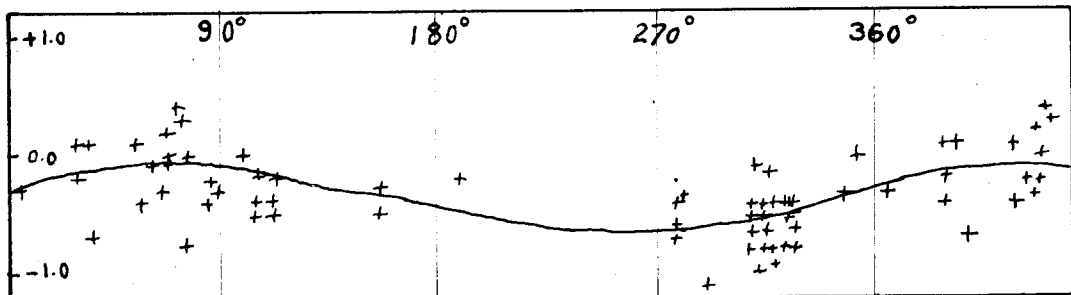
Improved 18:43:16 " 38.3 N. 30.6 E.



1933 April 23

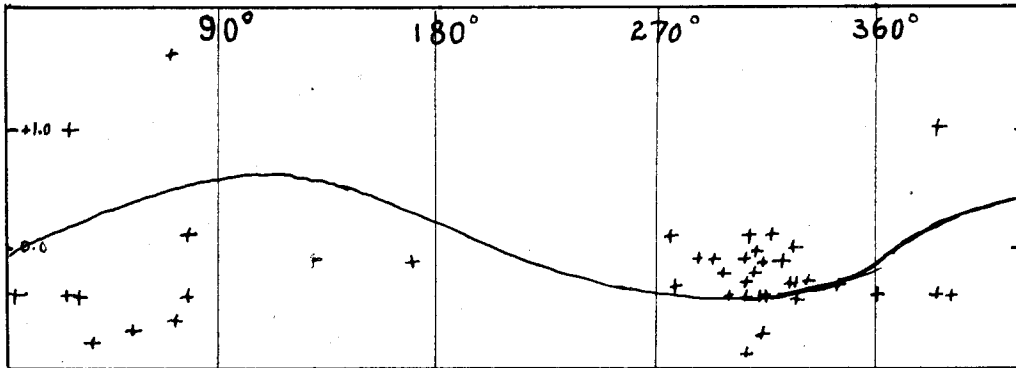
I.S.S. 05:57:38 Epicentre 36.8 N. 27.5 E. Class b

Improved 05:57:33 " 36.7 N. 27.1 E.



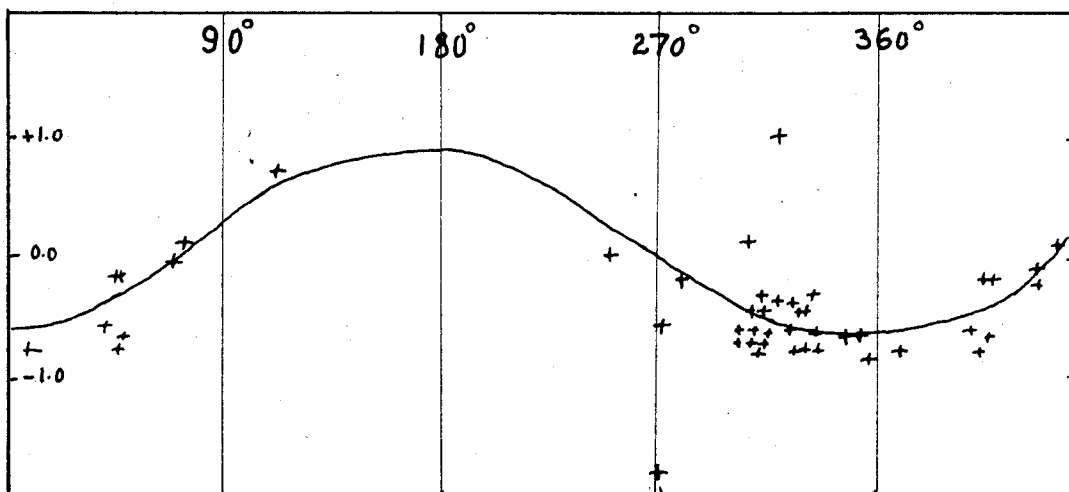
1933 July 19

I.S.S. 20:07:10 Epicentre 38.0 N. 29.5 E. Class c
Improved 20:07:07 " 38.2 N. 28.9 E.



1933 March 14

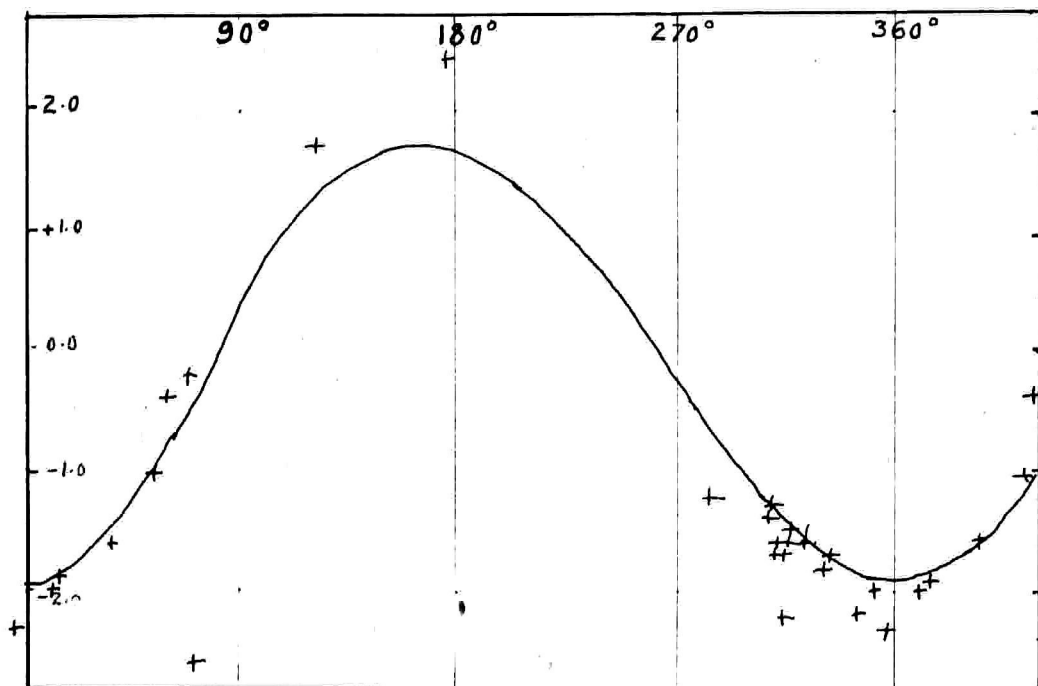
I.S.S. 01:19:39 Epicentre 38.4 N. 25.3 E. Class d
Improved 01:19:39 " 39.1 N. 25.0 E.



1934 January 19

I.S.S. 18:43:05 Epicentre 36.5 N. 31.0 E. Class d

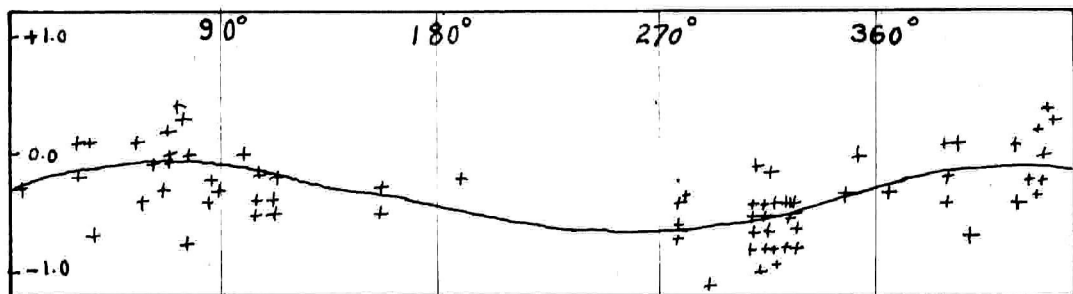
Improved 18:43:16 " 38.3 N. 30.6 E.



1933 April 23

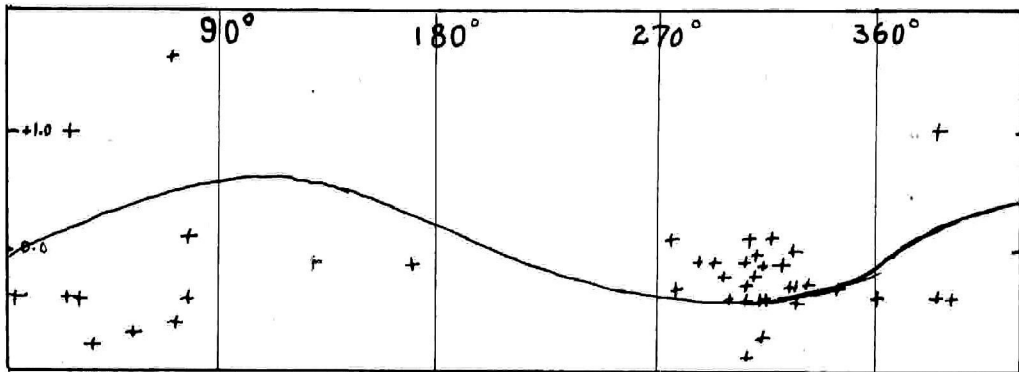
I.S.S. 05:57:38 Epicentre 36.8 N. 27.5 E. Class b

Improved 05:57:33 " 36.7 N. 27.1 E.



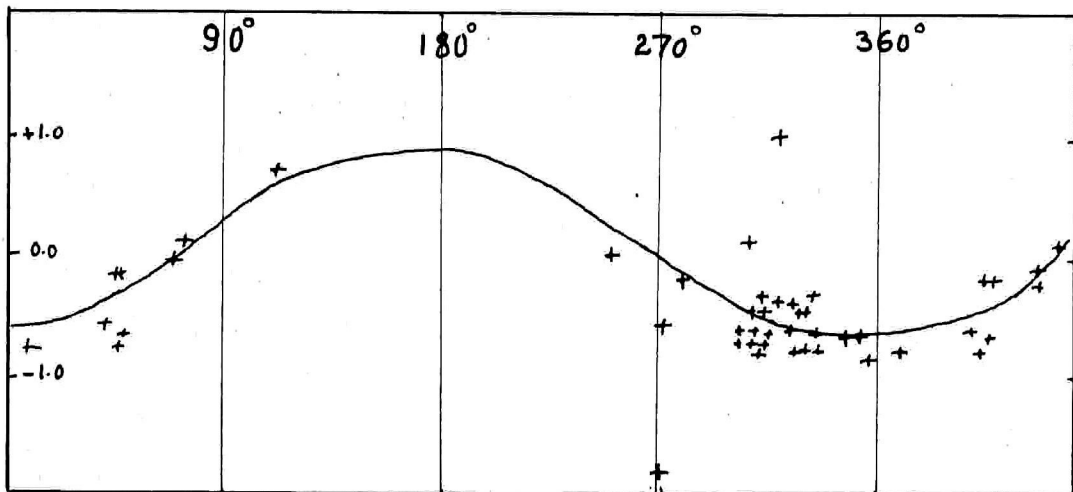
1933 July 19

I.S.S.	20:07:10	Epicentre	38.0 N. 29.5 E.	Class c
Improved	20:07:07	"	38.2 N. 28.9 E.	



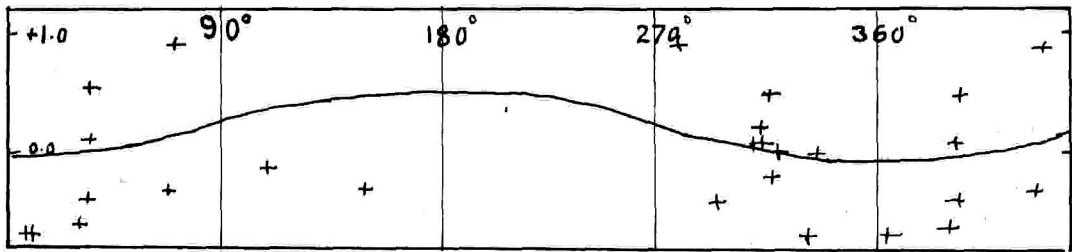
1933 March 14

I.S.S.	01:19:39	Epicentre	38.4 N. 25.3 E.	Class d
Improved	01:19:39	"	39.1 N. 25.0 E.	



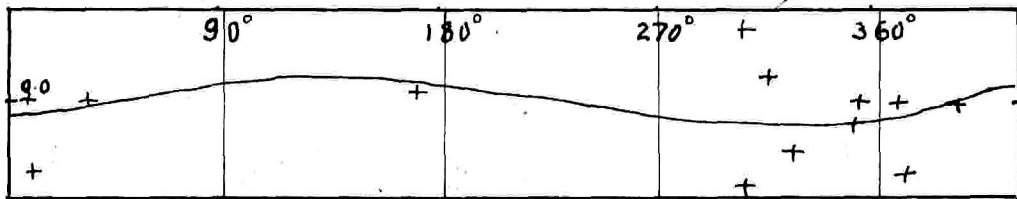
1933 May 15

I.S.S. 20:01:42 Epicentre 36.2 N. 26.6 E. Class d
Improved 20:01:39 " 36.5 N. 26.6 E.



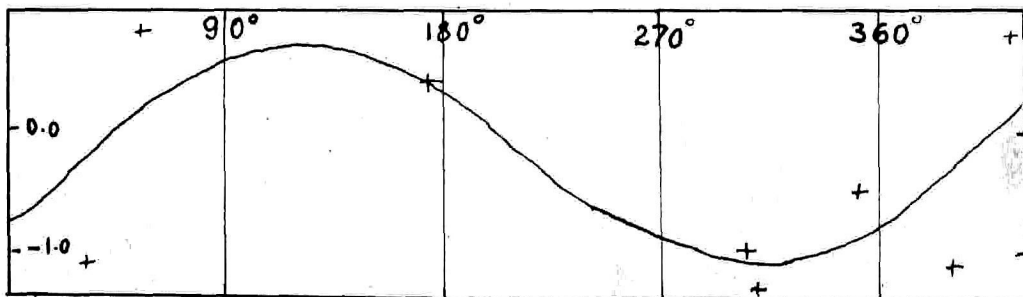
1933 July 12

I.S.S. 12:34:53 Epicentre 40.8 N. 34.2 E. Class d
Improved 12:34:47 " 40.9 N. 34.0 E.



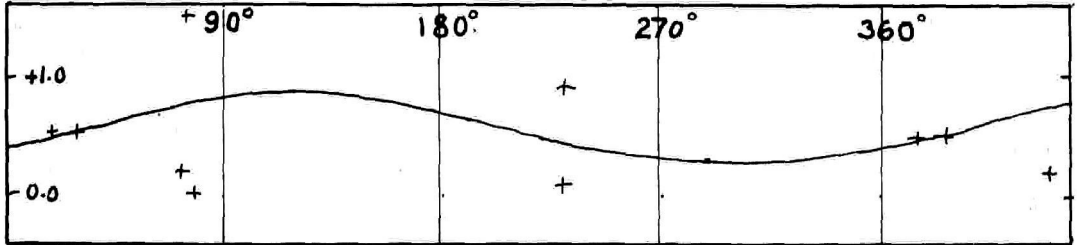
1933 September 25

I.S.S. 09:46:50 Epicentre 37.0 N. 35.5 E. Class d
Improved 09:46:48 " 37.6 N. 34.5 E.



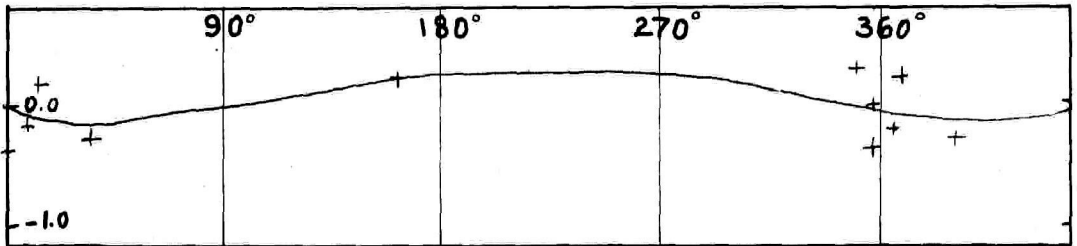
1933 November 6

I.S.S. 07:07:16 Epicentre 39.0 N. 43.5 E. Class d
Improved 07:07:11 " 39.2 N. 43.2 E.



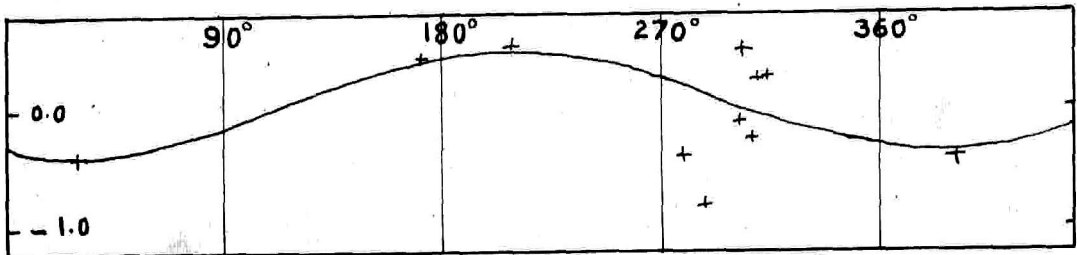
1933 May 26

I.S.S. 23:54:45 Epicentre 40.5 N. 33.5 E. Class d
Improved 23:54:50 " 40.5 N. 33.3 E.



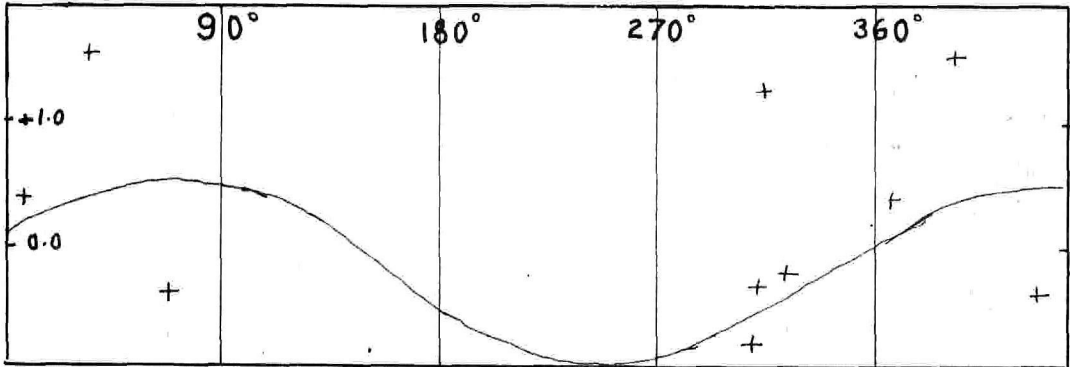
1933 December 26

I.S.S. 19:03:00 Epicentre 37.0 N. 35.5 E. Class d
Improved 19:03:08 " 37.4 N. 35.8 E.



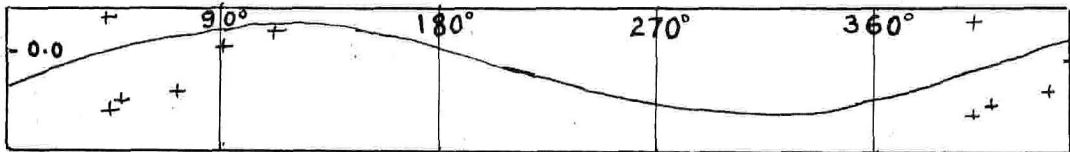
1932 July 8

I.S.S.	11:17:07	Epicentre	37.4 N. 26.1 E.	Class d
Improved	11:17:10	"	37.1 N. 25.3 E.	



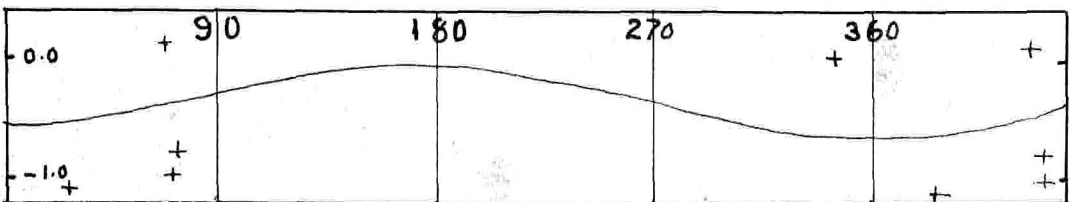
1932 November 30

I.S.S.	06:51:25	Epicentre	37.8 N. 25.0 E.	Class d
Improved	06:51:30	"	38.0 N. 24.6 E.	



1932 March 21

I.S.S.	19:53:35	Epicentre	38.0 N. 42.0 E.	Class d
Improved	19:53:40	"	38.2 N. 41.9 E.	

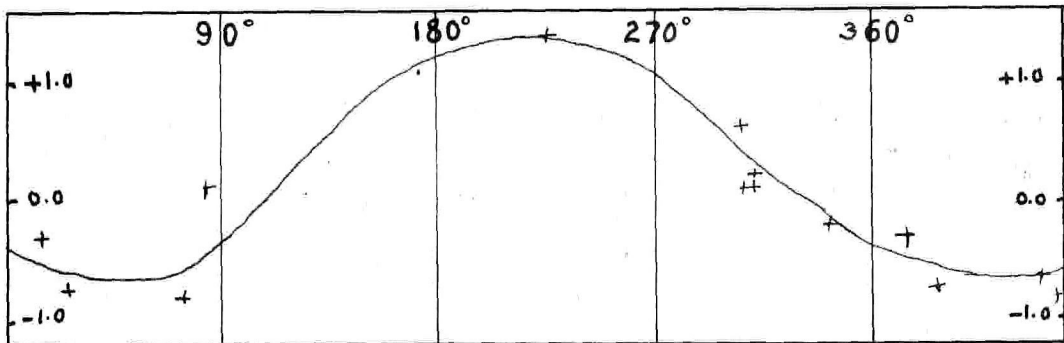


1932 March 15

Class d

I.S.S. 07:44:34 Epicentre 39.7 N. 44.0 E.

Improved 07:44:34 " 40.5 N. 43.0 E.

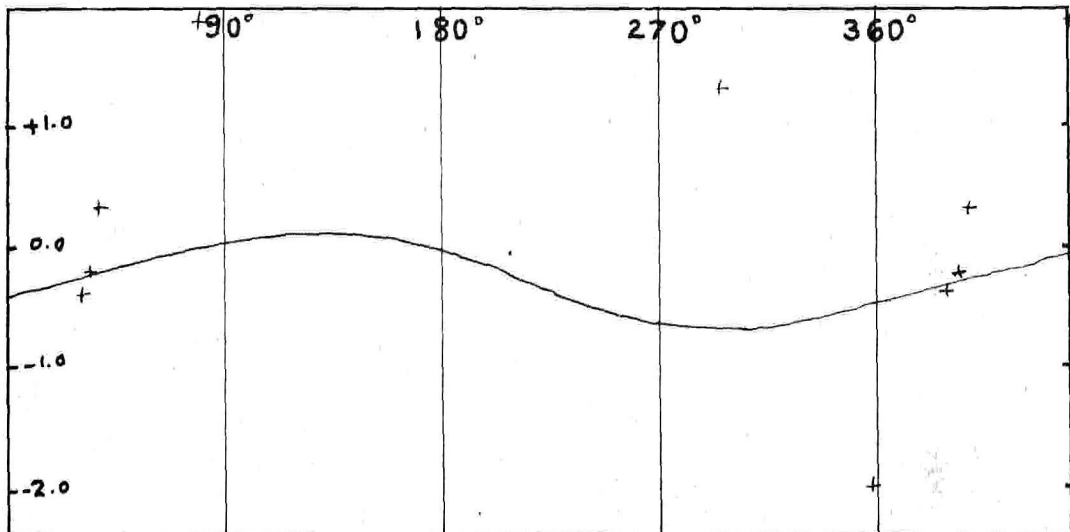


1932 October 15

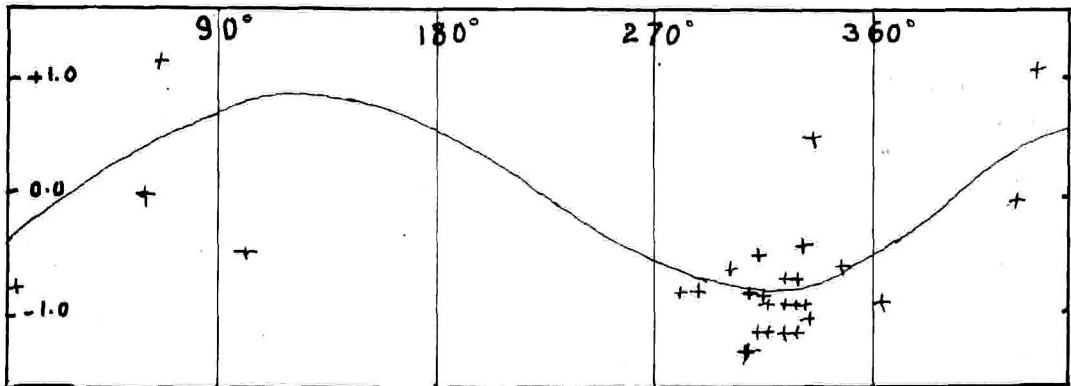
Class d

I.S.S. 22:19:54 Epicentre 40.9 N. 30.6 E.

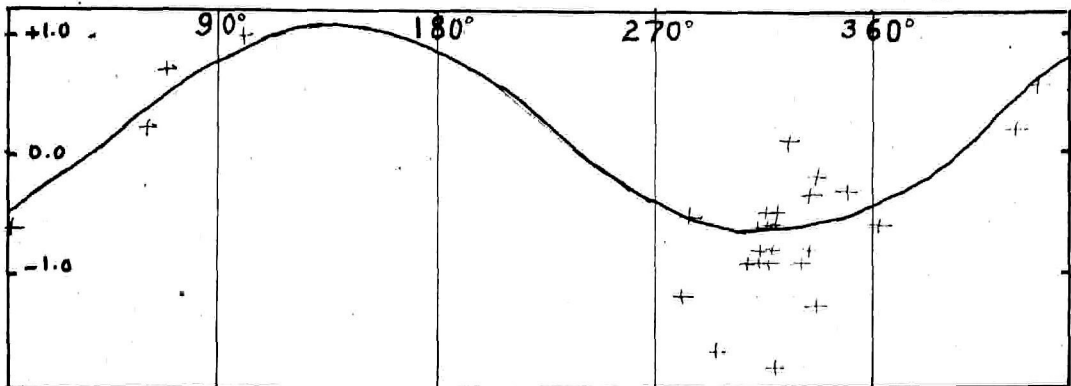
Improved 22:19:46 " 41.1 N. 30.2 E.



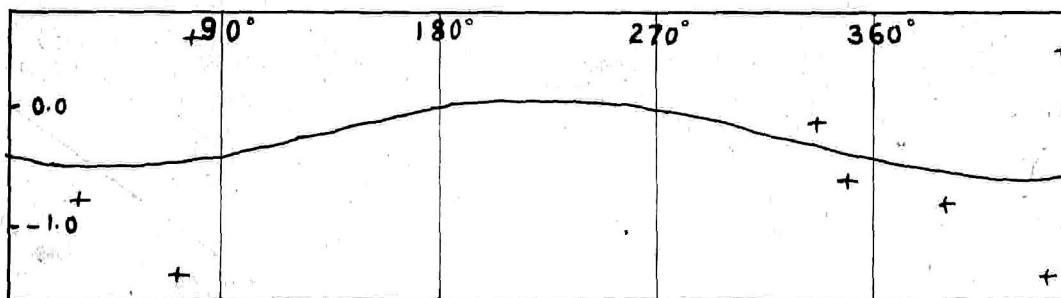
1932 June 29
 I.S.S. 02:30:06 Epicentre 35.5 N. 27.6 E. Class d
 Improved 02:30:08 " 36.1 N. 27.1 E.



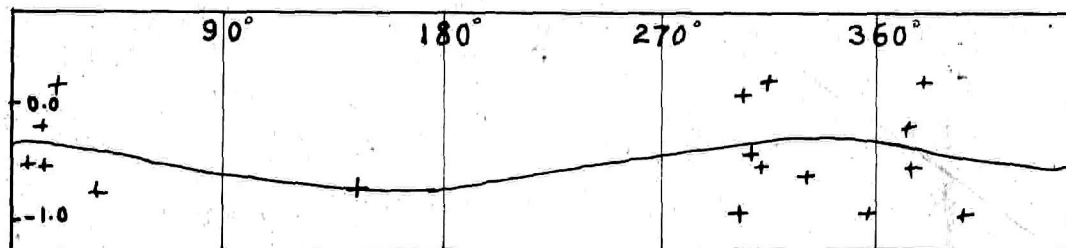
1932 June 29
 I.S.S. 18:33:31 Epicentre 35.5 N. 27.6 E. Class d
 Improved 18:33:33 " 36.2 N. 26.9 E.



1931 January 9 Class d
 I.S.S. 07:01:35 Epicentre 38.0 N. 38.5 E.
 Improved 07:01:34 " 38.2 N. 38.8 E.



1931 January 12 Class d
 I.S.S. 15:55:34 Epicentre 38.5 N. 31.9 E.
 Improved 15:55:27 " 38.3 N. 32.1 E.



1931 January 12

I.S.S.

15:06:15

Epicentre

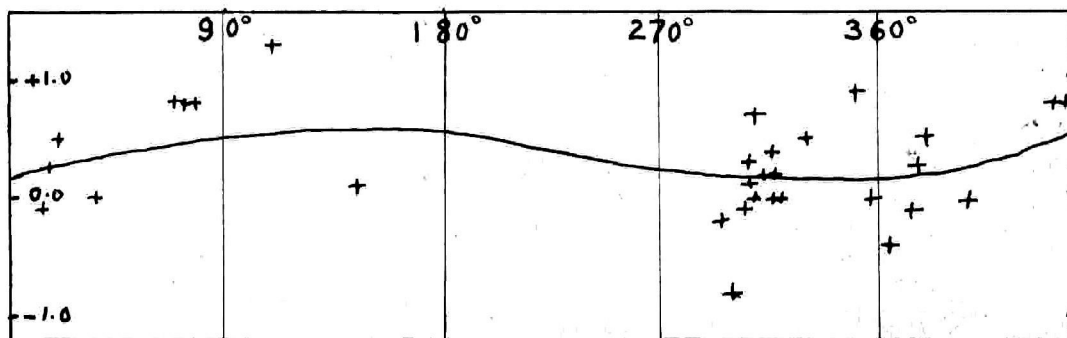
Class d
38.5 N. 31.9 E.

Improved

15:06:11

"

38.6 N. 31.6 E.



1931 May 6

I.S.S.

20:22:25

Epicentre

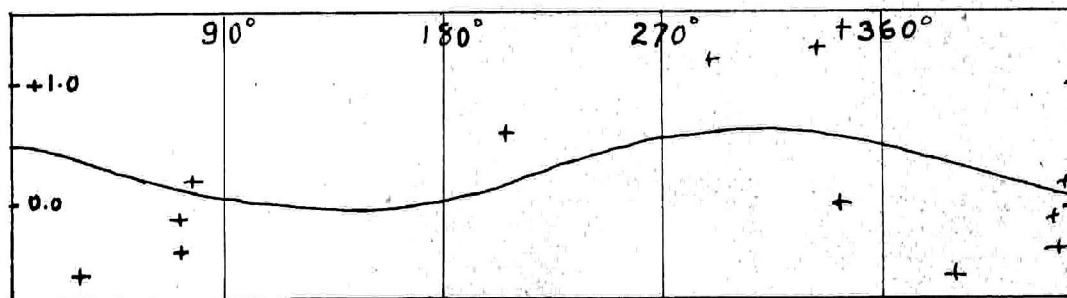
Class d
38.0 N. 38.5 E.

Improved

20:22:21

"

37.8 N. 38.8 E.



1931 July 12

I.S.S.

22:24:29

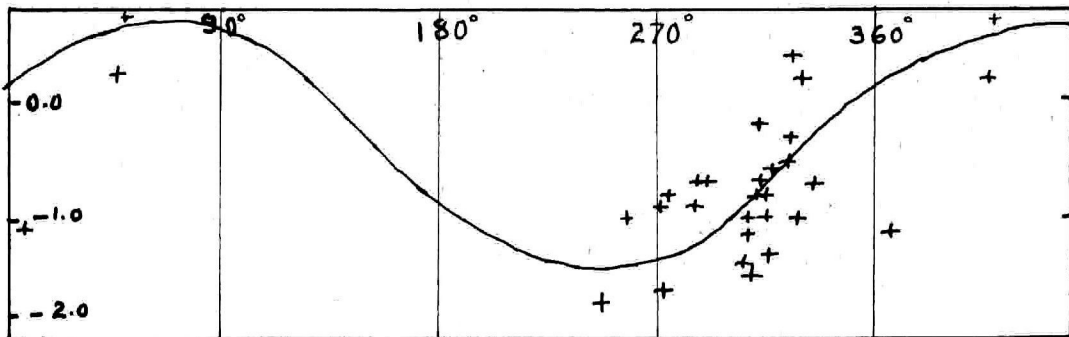
Epicentre 39.5 N. 26.0 E.

Class d

Improved

22:24:28

" 39.1 N. 24.9 E.



1931 July 31

I.S.S.

00:25:57

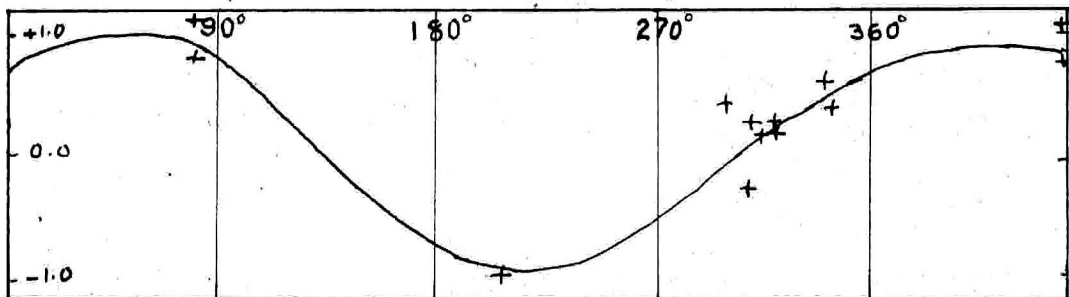
Epicentre 41.0 N. 40.2 E.

Class d

Improved

00:25:47

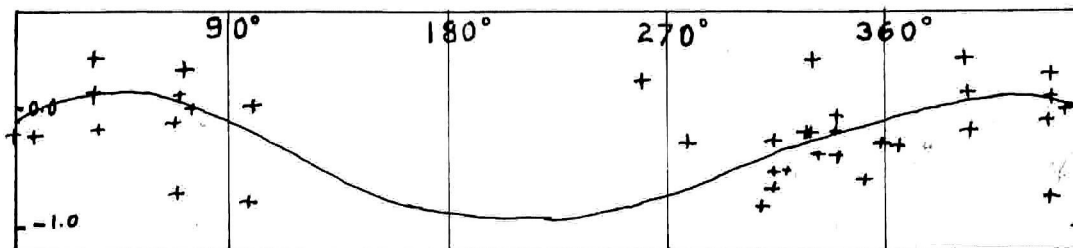
" 40.4 N. 38.9 E.



1930 February 14

I.S.S. 18:38:12 Epicentre 36.0 N. 25.0 E. Class b

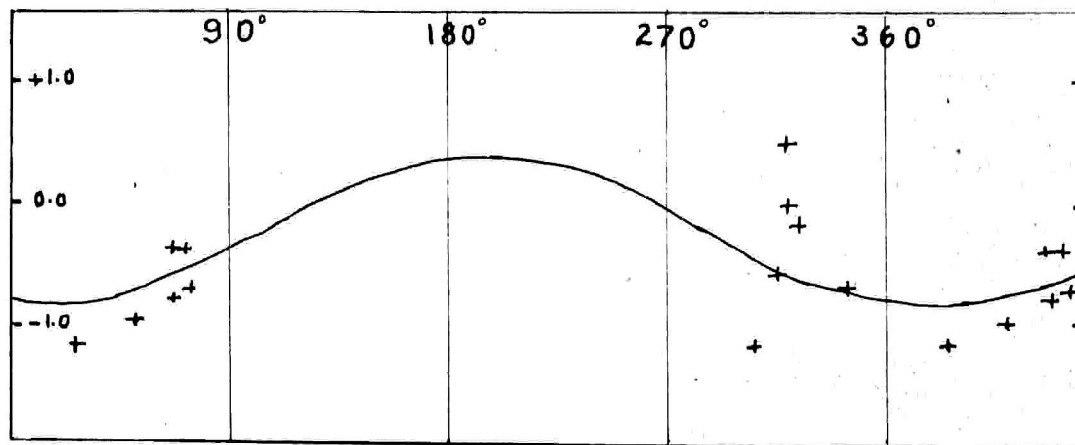
Improved 18:38:06 " 35.7 N. 24.6 E.



1930 May 10

I.S.S. 21:43:22 Epicentre 37.0 N. 44.0 E. Class d

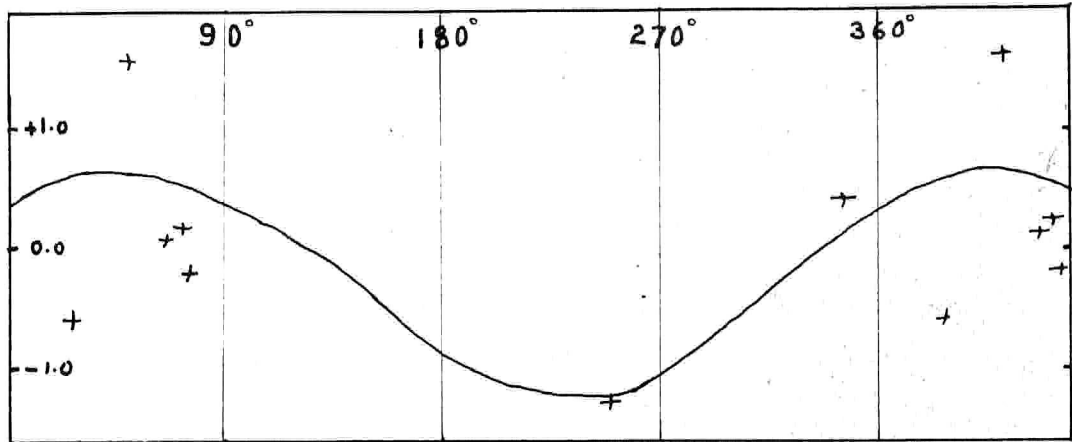
Improved 21:43:23 " 37.6 N. 44.3 E.



1930 May 21

I.S.S. 13:50:51 Epicentre 37.0 N. 44.0 E.
Improved 13:50:42 " 36.4 N. 43.2 E.

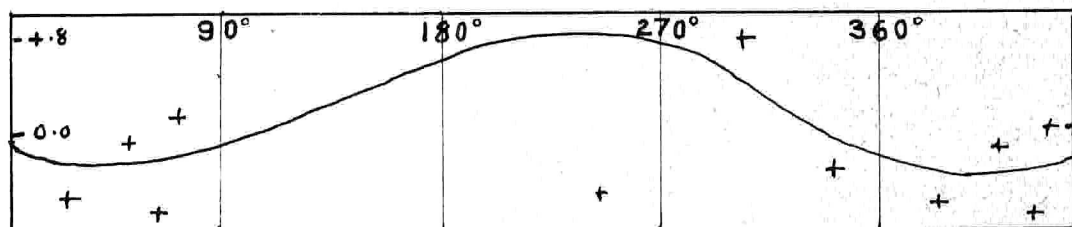
Class d



1930 July 9

I.S.S. 04:35:49 Epicentre 37.0 N. 44.0 E.
Improved 04:35:52 " 37.3 N. 44.5 E.

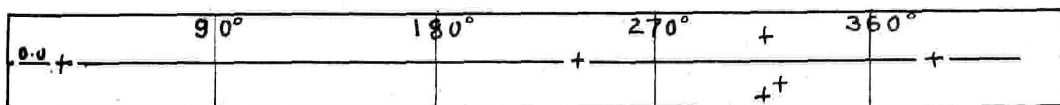
Class d



1930 April 16

I.S.S. 21:25:42 Epicentre 38.0 N. 43.8 E. Class d

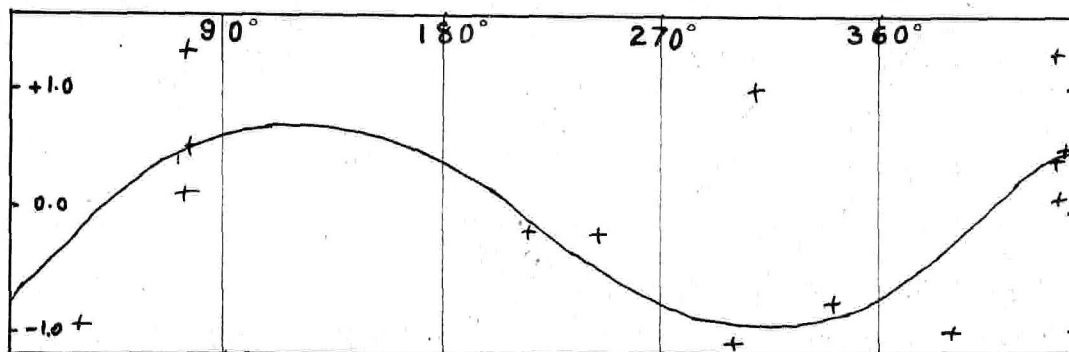
Improved 21:25:37 " 38.0 N. 43.8 E.



1930 February 8

I.S.S. 05:20:18 Epicentre 38.5 N. 40.0 E. Class d

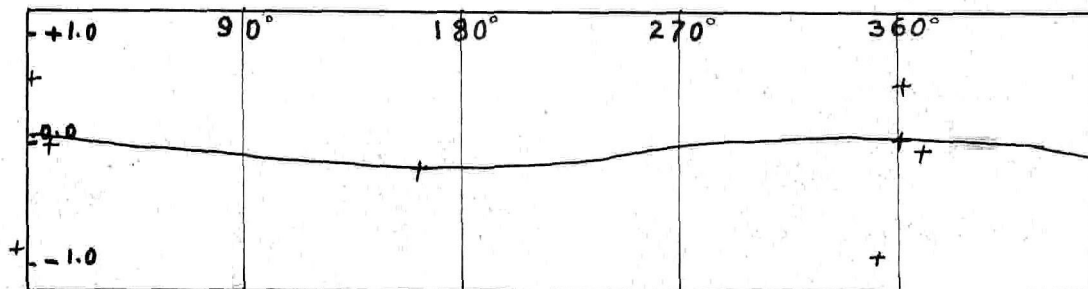
Improved 05:20:09 " 39.1 N. 39.0 E.



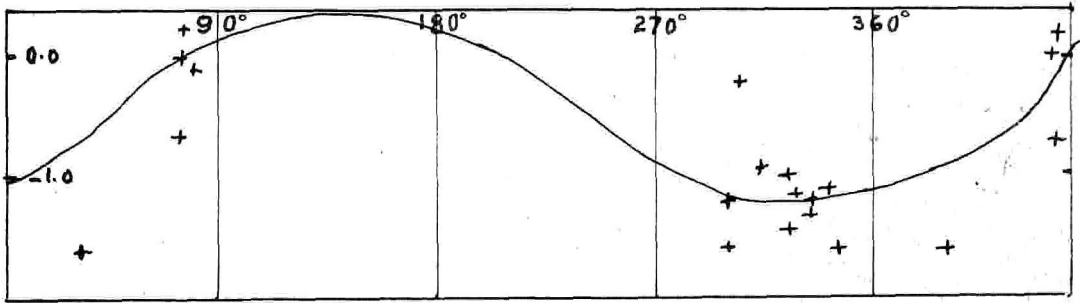
1930 April 9

I.S.S. 05:07:46 Epicentre 39.7 N. 34.0 E. Class d

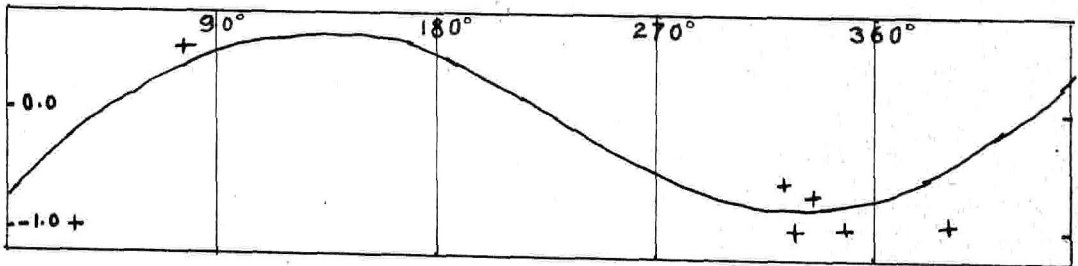
Improved 05:07:41 " 39.8 N. 34.0 E.



1930 April 9 Class d
 I.S.S. 05:27:49 Epicentre 39.0 N. 39.5 E.
 Improved 05:27:50 " 39.7 N. 38.7 E.



1930 April 20 Class d
 I.S.S. 10:20:38 Epicentre 39.0 N. 39.5 E.
 Improved 10:20:42 " 39.7 N. 38.8 E.



1930 December 10

I.S.S.

Improved

10:31:30

10:31:26

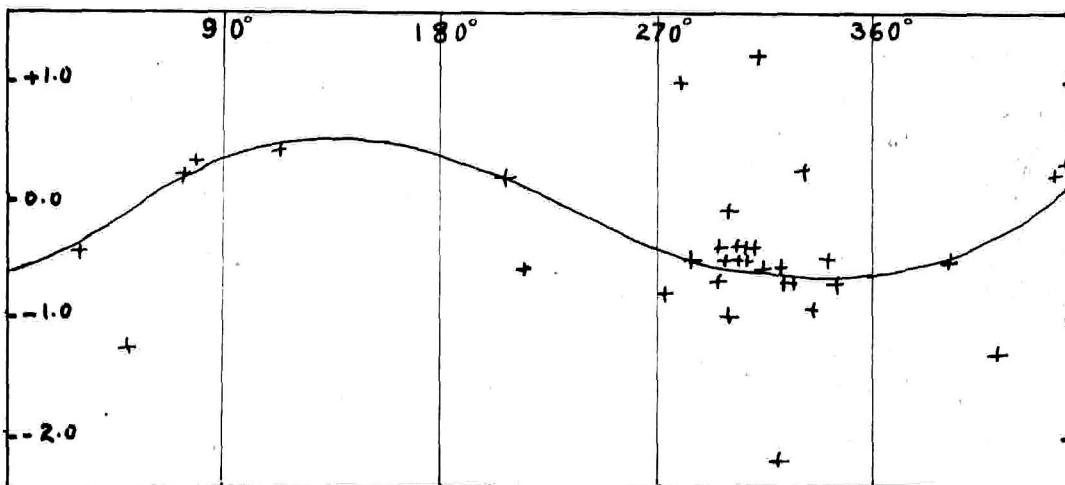
Epicentre

39.5 N. 39.4 E.

"

40.1 N. 38.9 E.

Class d



1930 August 4

I.S.S.

Improved

12:20:30

12:20:33

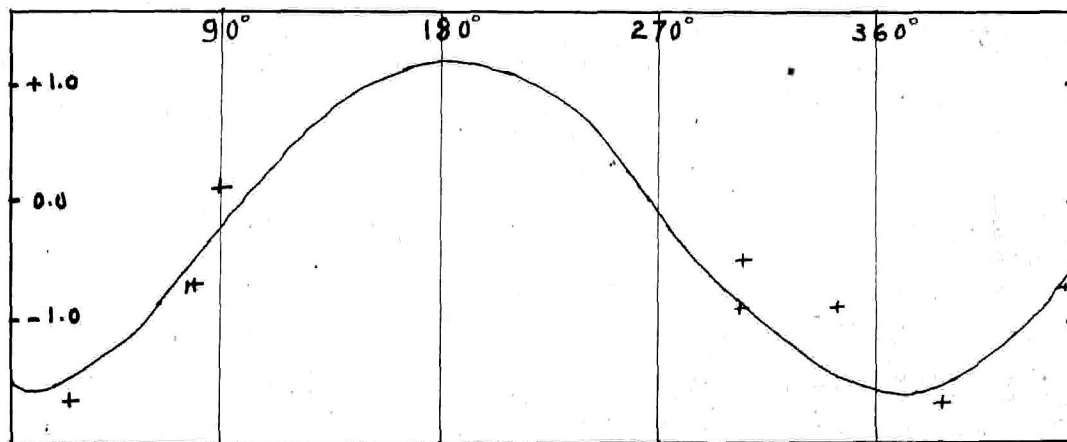
Epicentre

40.5 N. 43.8 E.

"

41.7 N. 43.8 E.

Class d



1930 November 7

I.S.S.

05:56:52

Epicentre

Class d

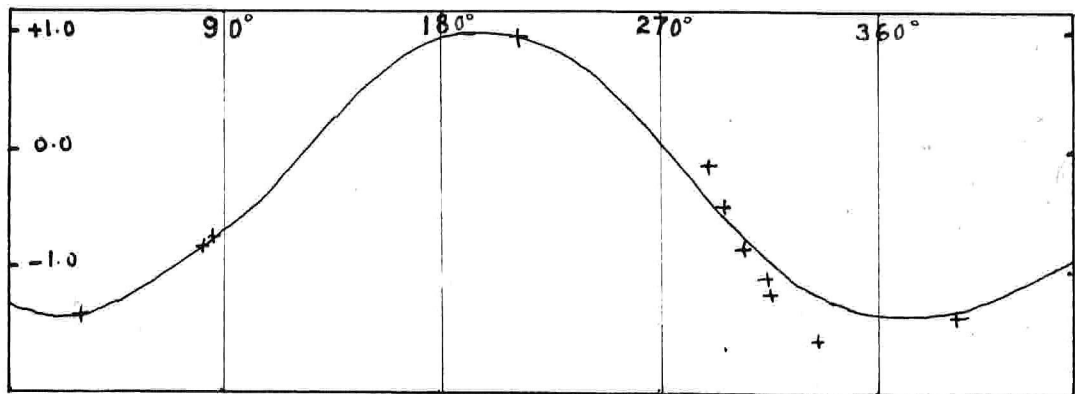
42.0 N. 42.0 E.

Improved

05:56:50

"

43.1 N. 42.6 E.



1929 March 27

I.S.S.

07:41:36

Epicentre

Class d

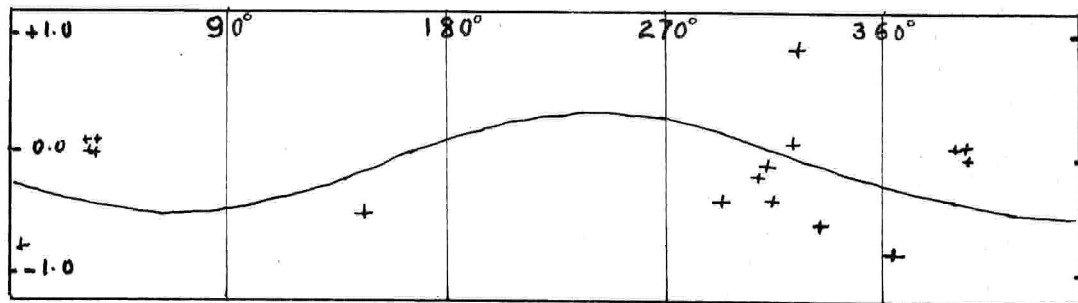
36.8 N. 26.5 E.

Improved

07:41:47

"

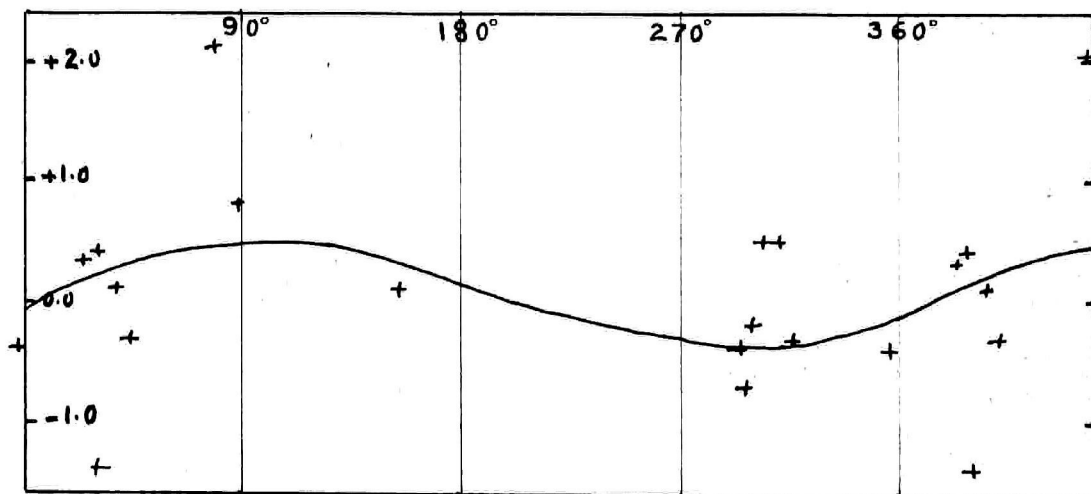
37.0 N. 27.0 E.



1929 April 5

I.S.S. 23:38:15
Improved 23:38:24

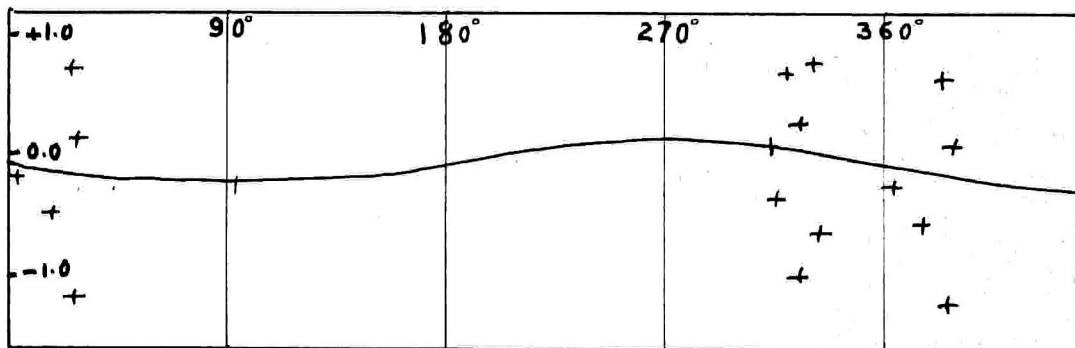
Class d
Epicentre 41.5 N. 31.5 E.
" 41.7 N. 30.9 E.



1929 April 17

I.S.S. 03:14:42
Improved 03:14:52

Class d
Epicentre 35.0 N. 27.5 E.
" 35.0 N. 27.8 E.



1929 April 17

I.S.S.

11:48:27

Epicentre

Class d

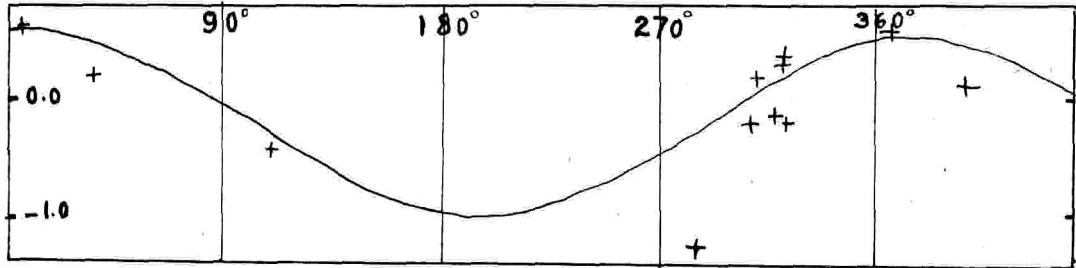
37.8 N. 25.0 E.

Improved

11:48:26

"

37.0 N. 24.7 E.



1929 April 27

I.S.S.

22:18:03

Epicentre

Class d

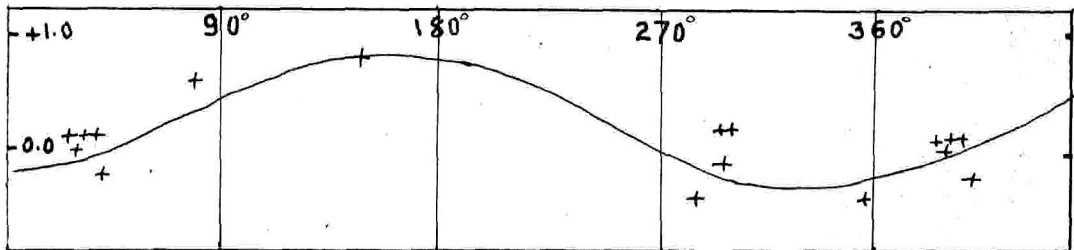
41.0 N. 31.0 E.

Improved

22:18:08

"

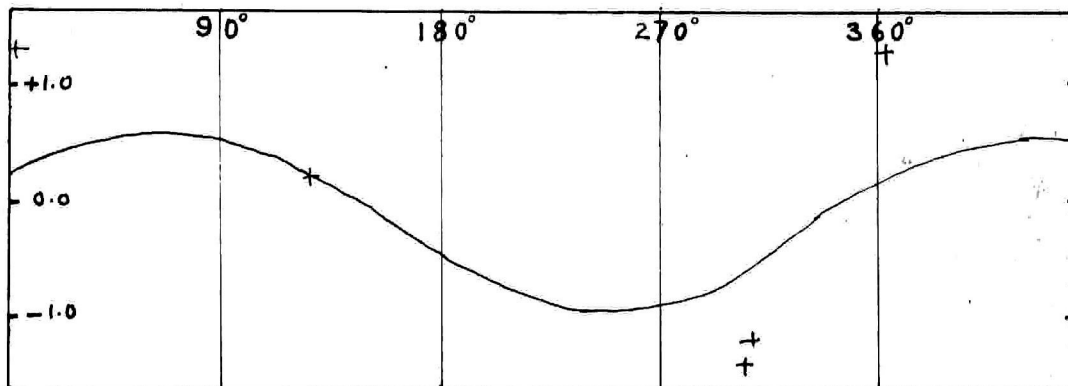
41.4 N. 30.6 E.



1929 May 8

I.S.S. 12:27:30
Improved 12:27:35

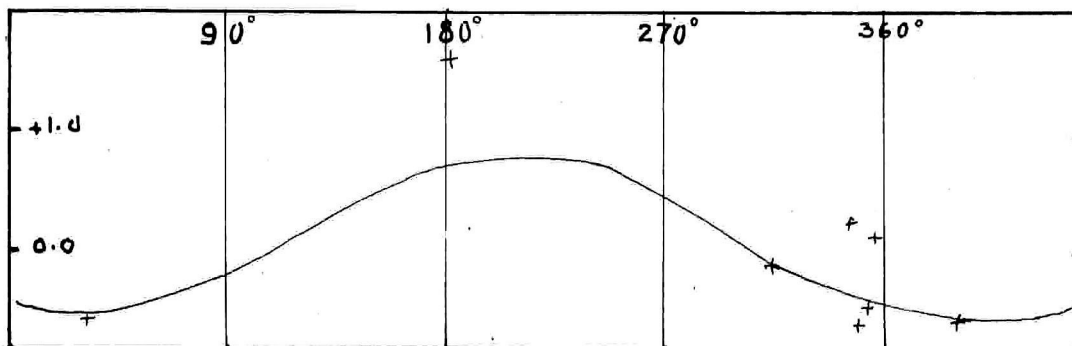
Class d
Epicentre 38.0 N. 29.5 E.
" 37.6 N. 28.5 E.



1929 May 16

I.S.S. 01:22:34
Improved 01:22:41

Class d
Epicentre 36.5 N. 36.0 E.
" 37.0 N. 36.4 E.

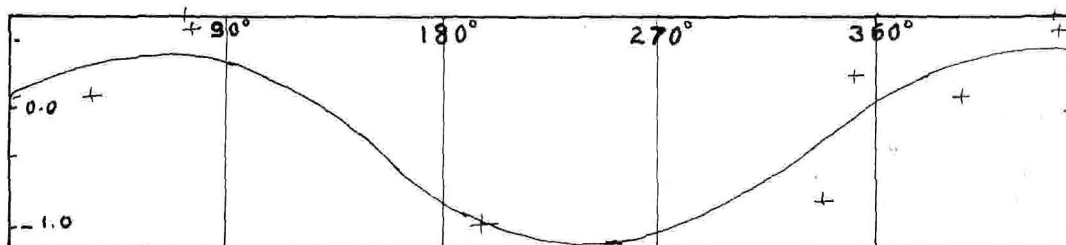


1929 June 28

Class d

I.S.S. 22:18:44 Epicentre 39.0 N. 37.5 E.

Improved 22:18:55 " 38.6 N. 36.5 E.

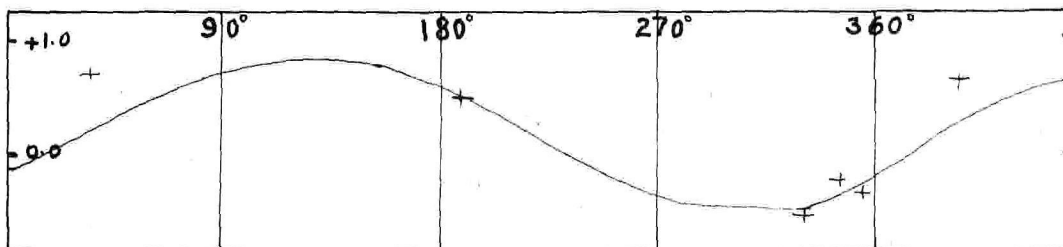


1929 August 21

Class d

I.S.S. 01:24:14 Epicentre 41.0 N. 37.0 E.

Improved 01:24:19 " 40.7 N. 36.3 E.

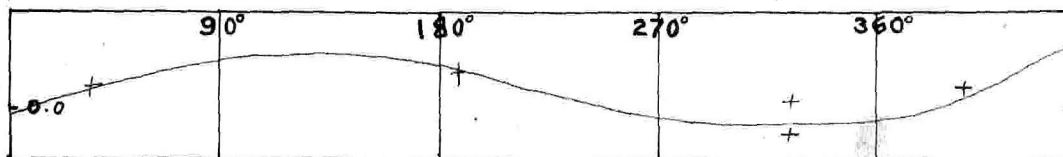


1929 September 8

Class d

I.S.S. 22:54:16 Epicentre 42.0 N. 36.9 E.

Improved 22:54:19 " 42.3 N. 36.6 E.



1929 September 15

I.S.S.

13:09:48

Epicentre

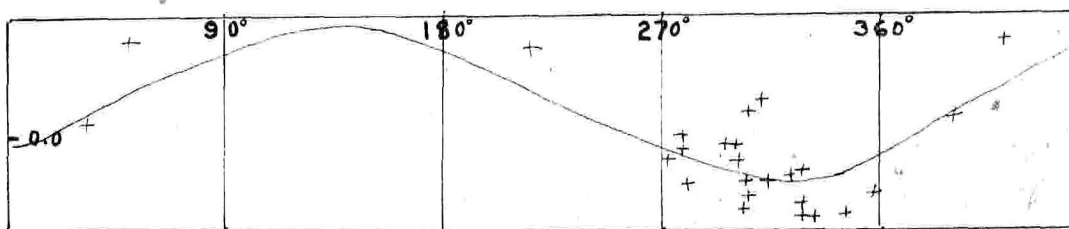
Class c
39.0 N. 39.5 E.

Improved

13:10:03

"

39.4 N. 39.0 E.



1929 November 11

I.S.S.

07:36:15

Epicentre

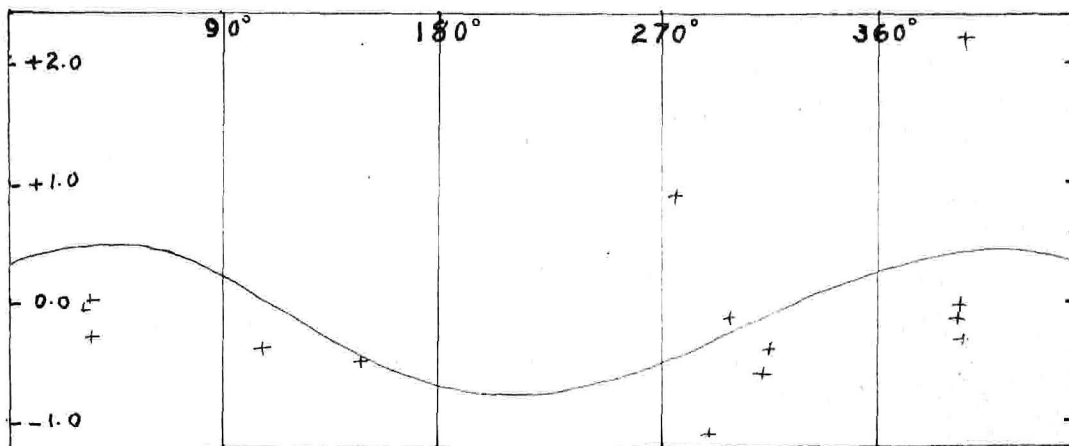
Class d
36.8 N. 26.5 E.

Improved

07:36:18

"

36.3 N. 25.9 E.



1928 January 24

I.S.S.

07:36:00

Epicentre

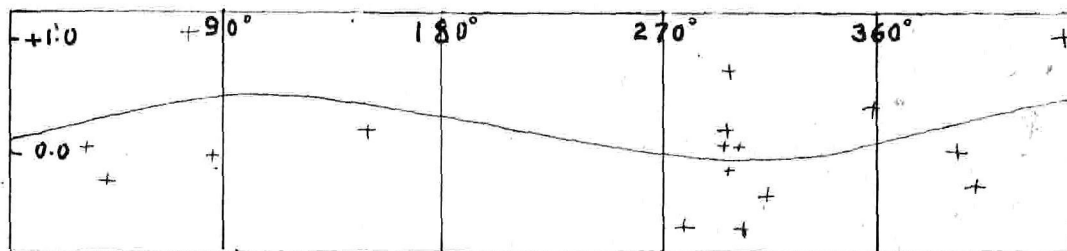
Class d
41.0 N. 31.0 E.

Improved

07:36:10

"

41.2 N. 30.6 E.



1928 February 24

I.S.S.

11:26:12

Epicentre

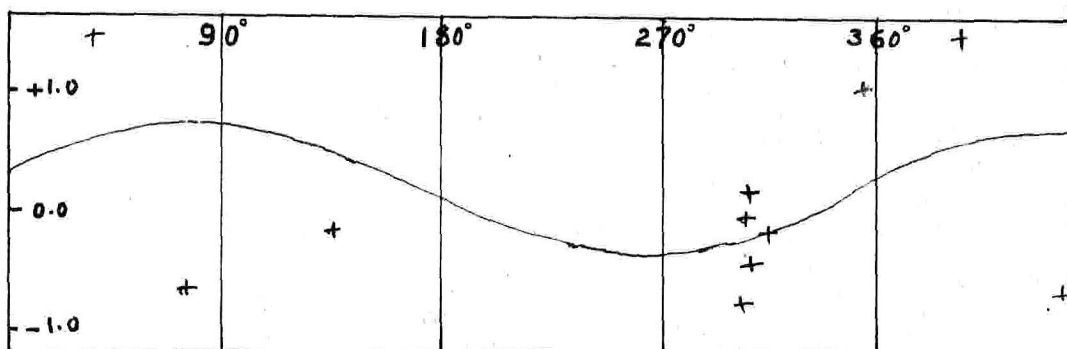
Class d
38.0 N. 33.5 E.

Improved

11:26:23

"

37.9 N. 32.7 E.



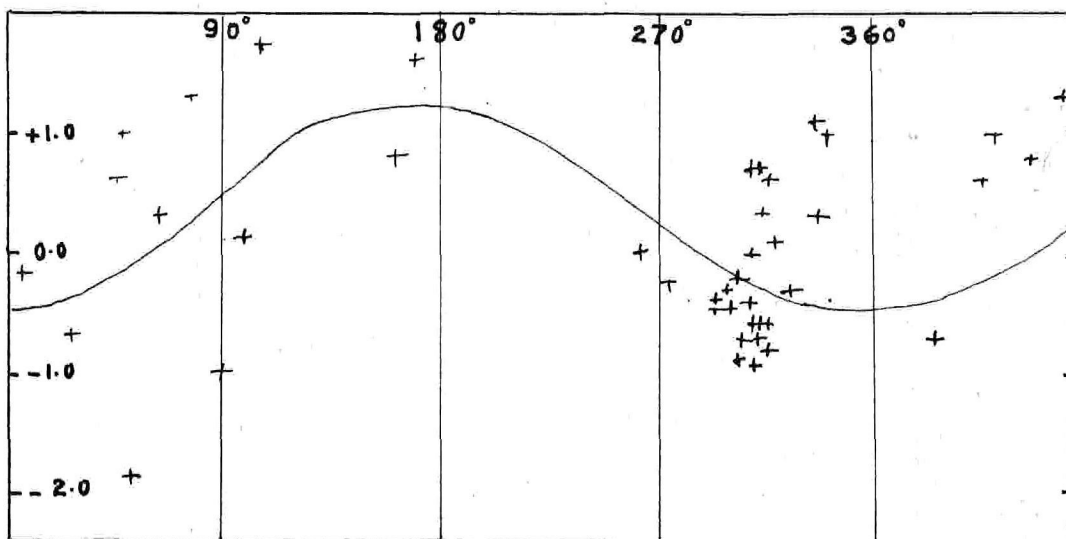
1928 April 14

I.S.S. 08:59:43

Improved 08:59:55

Class b
Epicentre 41.7 N. 26.3 E.

" 42.5 N. 26.0 E.



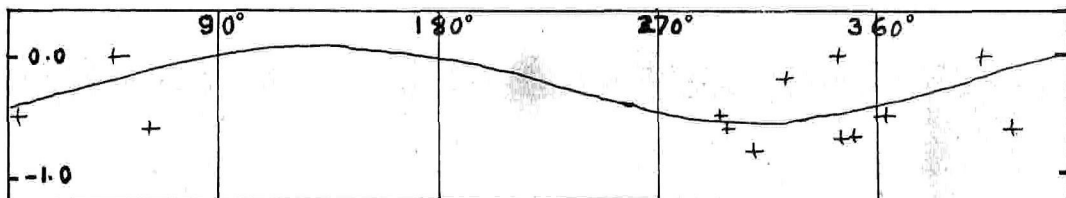
1928 April 14

I.S.S. 10:23:33

Improved 10:23:35

Class d
Epicentre 41.7 N. 26.3 E.

" 41.9 N. 25.9 E.



1928 April 18

I.S.S.

19:22:37

Epicentre 41.7 N. 26.3 E.

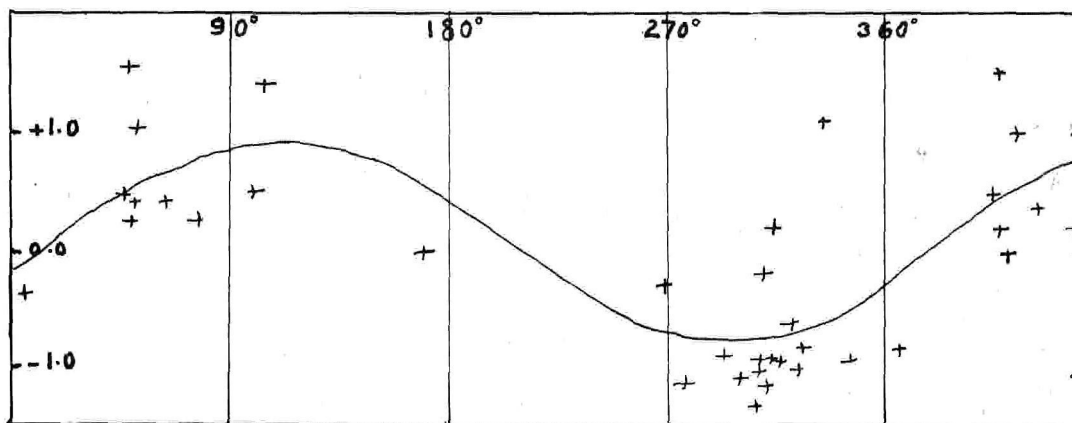
Class b

Improved

19:22:48

"

41.9 N. 25.3 E.



1928 May 2

I.S.S.

21:54:21

Epicentre 39.7 N. 29.3 E.

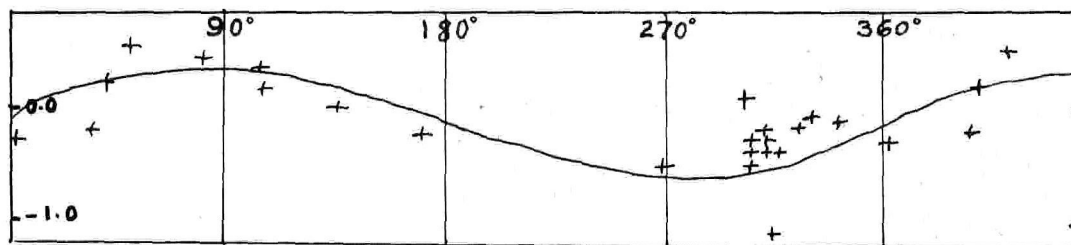
Class c

Improved

21:54:29

"

39.7 N. 28.7 E.

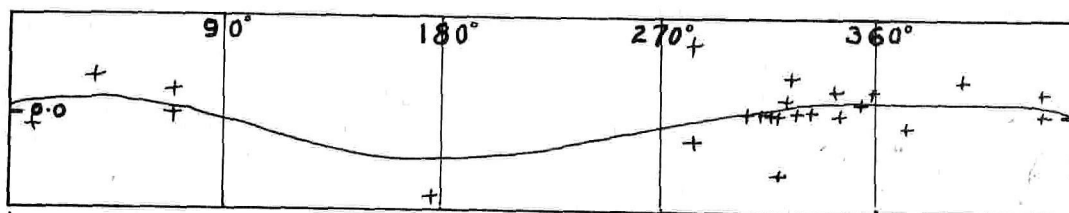


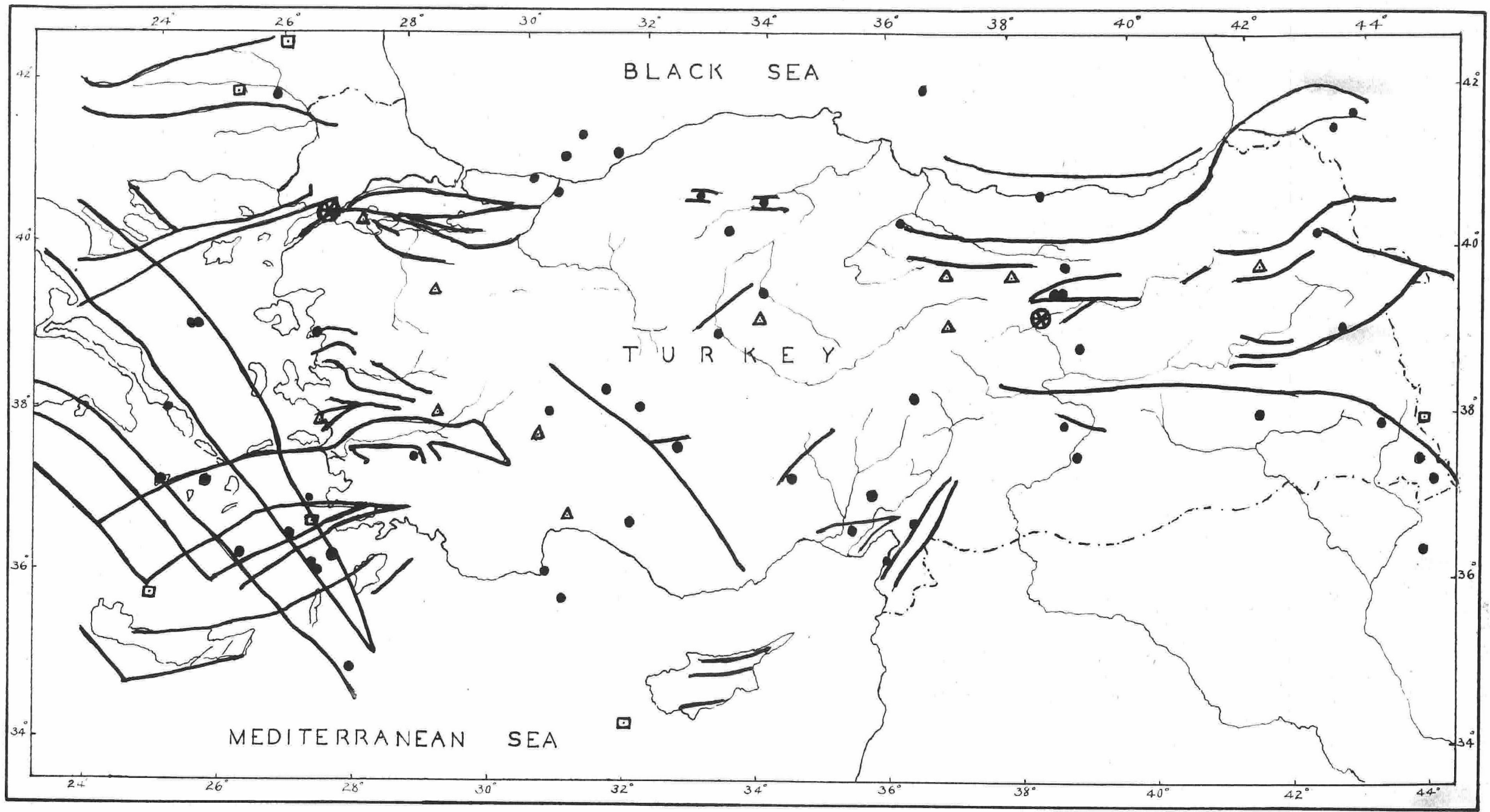
1927 June 5

Class d

I.S.S. 08:24:48 Epicentre 36.5 N. 31.0 E.





Improved 08:24:53 " 36.3 N. 30.8 E.





IMPROVED EPICENTRES OF THE EARTHQUAKES IN TURKEY

SCALE 1:6 360 000

- FAULTS 
- CLASS a SHOCKS 
- CLASS b SHOCKS 
- CLASS c SHOCKS 
- CLASS d SHOCKS 