

Kodaikanal Observatory

BULLETIN No. CXVII

SUMMARY OF PROMINENCE OBSERVATIONS FOR THE SECOND HALF OF THE YEAR 1938

For this half-yearly summary of prominence observations prepared under the scheme of co-operation inaugurated by the International Astronomical Union, the co-operating observatories supplied photographs as shown below for those days for which Kodaikanal records were imperfect or wanting.

	K prominence plates.	H α disc plates.
Meudon Observatory	29	23
Mount Wilson Observatory	22	22

Calcium Prominences at the limb.—With the additional photographs received and weightage given to those taken on days on which only incomplete observations were possible, there were data of prominences available for a total of 176 days during the half-year which were reduced to 144 effective days. The mean daily areas and numbers of prominences derived from the above records were:—

	Mean daily areas (Square minutes).	Mean daily numbers.
North	4.08	7.70
South	4.08	7.17
Total	<u>8.11</u>	<u>14.87</u>

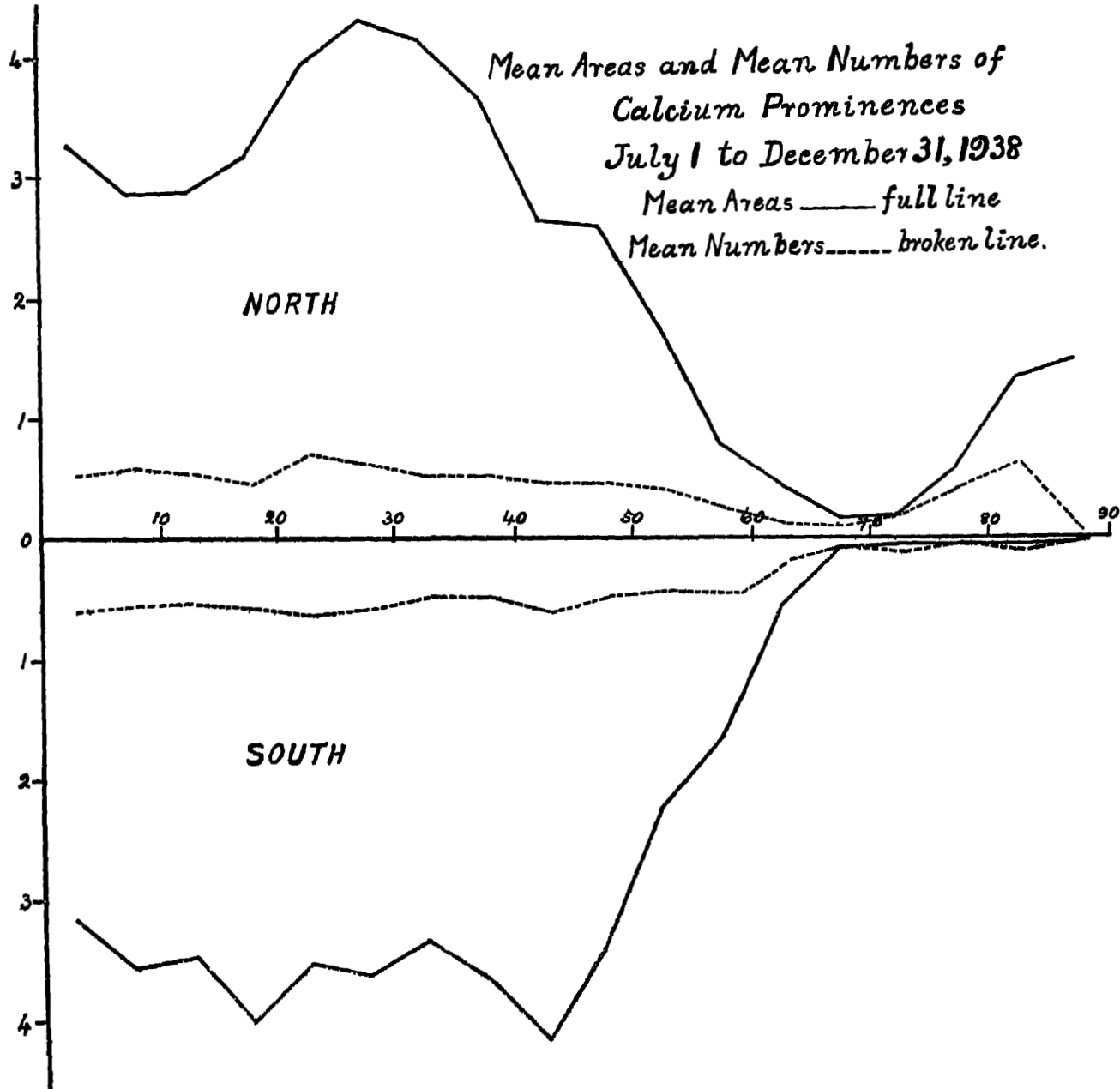
The areas show an increase of 6 per cent over the previous half-year, while numbers remain practically the same. The increase in areas, in spite of a fall in the northern hemisphere is due to a considerable increase in the southern hemisphere.

The corresponding figures derived from the Kodaikanal photographs alone are given below, 143 days of observation being taken as 122 effective days.

	Mean daily areas (Square minutes).	Mean daily numbers.
North	4.21	7.62
South	4.33	6.99
Total	<u>8.54</u>	<u>14.61</u>

The following diagram represents the distribution of prominences in latitude. The full line gives the mean daily areas and broken line the mean daily numbers for each zone of 5° of latitude, while the ordinates represent tenths of a square minute of arc for the full line and numbers for the broken line. Compared with the previous

half-year, the high activity near the north pole has dropped considerably, the distribution elsewhere remaining practically the same in character.



The monthly, quarterly and half-yearly areas and numbers and the mean height and the mean extent of prominences on photographs from all the co-operating observatories are given in Table I. The unit of area is one square minute of arc. The mean height and mean extent are derived in the same way as in all the previous half-years.

TABLE I.—ABSTRACT FOR THE SECOND-HALF OF 1938.

Months.	Number of days (effective).	Areas.	Numbers.	Daily means.		Mean height.	Mean extent.
				Areas.	Numbers.		
1938.							
July	22½	217.3	306	9.66	16.27	43.07	7.75
August	24½	246.6	390	10.07	15.92	44.35	8.41
September	23½	165.9	352	7.06	14.98	39.60	6.82
October	25	167.0	352	6.68	14.08	43.31	6.87
November	25½	150.3	366	5.89	14.35	42.96	6.22
December	23	221.5	314	9.54	13.65	54.04	8.11
Third quarter	70½	629.8	1108	8.93	15.72	42.42	7.69
Fourth quarter	73½	538.8	1032	7.33	14.04	40.45	7.11
Second half-year	144	1168.6	2140	8.12	14.86	44.36	7.41

Distribution east and west of the sun's axis.

July to December 1938.	East.	West.	Percentage East.
Total number observed	1058	1082	49.44
Total areas in square minutes	589.1	580.3	50.33

The above table shows that, while the areas show a slight eastern preponderance the numbers show an eastern defect.

Metallic Prominences.

The following table gives the details of the fifteen metallic prominences observed during the half-year.

TABLE II.—LIST OF METALLIC PROMINENCES—JULY TO DECEMBER 1938.

Date.	Time I. S. T.	Base.	Latitude.		Limb.	Height.	Lines.
			North.	South.			
1938.							
July	..	..	..	..	..	..	..
August	..	..	..	..	..	..	..
September	..	..	..	..	..	..	..
October	6 9 00	3	18.5		W	15	4 and 10.
	11 9 4		27		E	10	4 and 10.
	16 9 14	3		24.5	E	25	4 and 10.

TABLE II.—LIST OF METALLIC PROMINENCES—JULY TO DECEMBER 1938—*contd.*

Date.	Time I. S. T.	Base.	Latitude.		Limb.	Height.	Lines.	
			North.	South.				
1938.	H. M.	°	°	°		'		
November	8	9 4	3		19.5	W	10	4 and 10.
	20	9 8	2		9	W	10	4 and 10.
	22	8 32	6		23	W	15	1, 2, 4, 5, 8, 9, 10, 11 and 12.
	25	8 38	1	25.5		W	15	1, 2, 4, 5, 8, 9, 10, 11 and 12.
December	5	9 8	2		20	W	25	1, 2, 3, 4, 5, 6, 8, 9, 10, 11 and 12.
		8 55	3	14.5		W	20	1, 2, 3, 4, 5, 6, 8, 9, 10, 11 and 12.
	6	8 55	2	11		W	15	1, 2, 3, 4, 5, 6, 8, 9, 10, 11 and 12.
		8 55		16		W	10	1, 2, 3, 4, 5, 6, 8, 9, 10, 11 and 12.
	9	9 28	2	5		E	20	4 and 10.
	19	9 35	2	24		E	25	1, 2, 3, 4, 5, 6, 8, 9, 10, 11 and 12.
		9 35	2	14		E	20	1, 2, 3, 4, 5, 6, 8, 9, 10, 11 and 12.
	30	9 9	3		4.5	E	10	4 and 10.

NOTE.—The key to the wavelengths of the metallic lines observed is given below :—

No.	λ	Element.	No.	λ	Element.
1	4924.1	Fe+	7	5276.2	Fe +
2	5016.0	He	8	5316.8	Fe +
3	5018.6	Fe	9	5363.0	Fe +
4	b_4, b_3, b_2, b_1	Mg, Fe+	10	D_2, D_1	Na
5	5234.8	Fe	11	6677	He
6	5276.0	Cr	12	7065	He

The distribution of the metallic prominences was as follows :—

	1°—10°	11°—20°	21°—30°	31°—40°	Mean latitude.	Extreme latitudes.
North	1	5	3	..	16°.7	5° and 27°
South	2	2	2	..	16°.7	4°.5 & 24°.5

Six were on the east limb and nine on the west limb.

Displacements of the Hydrogen line.

Particulars of the displacements observed with the spectroscope in the chromosphere and prominences are given in the following table:—

TABLE III.—DISPLACEMENTS OF THE HYDROGEN LINE—JULY TO DECEMBER 1938.

Date.	Time I. S. T.	Latitude.		Limb.	Displacement.			Remarks.
		North.	South.		Red.	Violet.	Both ways.	
	H. M.	°	°		Å	Å	Å	
July 1938.	8	9 28	26.5		W	1		At top.
	9	9 30		20	W	2		At base.
		9 20	30		W		1	At top.
	13	10 45	32.5		E		2	At base.
		10 50	21.5		E	2	1	To red at top and to violet at base
	18	9 23	50		E	0.5		At base.
	21	9 30	21		W		0.5	Do.; 20° to 22°.
	22	10 15	22		W	1		At base.
	24	9 6	79.5		E		1.5	At top.
		9 1		74	W	Slight		In chromosphere.
	27	10 45	15		E		2	At base.
		10 45	13		E	1		At top.
	28	10 35	29.5		E	1		Do.
		10 35	15		E		0.5	
29	8 50	23		E	1		At base; 22° to 24°.	
	8 52	13		E	0.5		Do.	
August	4	9 7		12	E	1		At base; 10° to 14°.
		8 49		11	W	1		At top.
	8 47	1.5		W	1.5		Do. 0° to 3°.	
	9	11 20		28	E		2	Do. 27° to 29°.
		9 5	45.5		W	1		Do. 44°·5 to 46°·5.
	15	9 20	12		W		1	Do.
		9 20	18		W	1		Do.
	20	8 55		21	E	1		At base; 10° to 23°.
		8 38	52.5		W		0.5	
	25	10 22	69.5		W	1		At base.
27	10 15	11		E	1		Do. 10° to 12°.	
	10 7	13		W		0.5	Do.	
	10 00	30		W	1		At middle.	

TABLE III.—DISPLACEMENTS OF THE HYDROGEN LINE—JULY TO DECEMBER 1938—*contd.*

Date.	Time I. S. T.	Latitude.		Limb.	Displacement.			Remarks.
		North.	South.		Red.	Violet.	Both ways.	
1938.	H. M.	°	°		Å	Å	Å	
August 28	9 35	40.5		E	1			At base; 39°·5 to 41°·5.
	9 35	18		E	0.5			At top; 15° to 17°.
	9 45		27.5	E	1			At top.
	9 13	60.5		W	1.5			At top; 59°·5 to 62°·5.
29	9 11	10		E	1			Do.; 9° to 11°.
	9 14		31	E		1		At base.
	9 14		34	E	1			At top; 32°·5 to 35°·5.
30	9 42	11		E	1			At base.
September 1	9 50	22.5		W	1			At top.
2	9 00	10		E	1			At base.
15	10 15	30		E	1.5			Do.
	10 18	23		E			0.5	
October 3	9 54		11	W	1			At top.
5	10 40	9		E	1			At base; 8° to 10°.
6	9 7	22.5		W			1	Do.; 21° to 24°.
7	9 42		12	W		1		Do.
	9 16	20		W		1		Do.
	9 12	26		W	1			At top.
11	9 4	27		E		1.5		Do.
	8 40	57.5		W		1		At base.
	8 35	55.5		W	0.5			
12	10 10	17		W		1		At base.
14	8 40	53.5		E	0.5			At top.
	9 52	28		E	1			At base; 27° to 29°.
	10 00	28		E		2		At middle; 27° to 29°.
16	9 5	40.5		E	1			40° to 42°.
19	9 4	30.5		E	3	1.5		To violet at base and to red at top 28° to 33°.
	9 4	25		E		3.5		At base; 20° to 26°.
	9 20	20		E		8		At top; 19° to 21°.
	9 23	8.5		E		2		Do.; 7° to 10°.
	8 45	4.5		W	0.5			At base.

TABLE III.—DISPLACEMENTS OF THE HYDROGEN LINE—JULY TO DECEMBER 1938—*contd.*

Date.	Time I. S. T.	Latitude.		Limb.	Displacement.			Remarks.
		North.	South.		Red.	Violet.	Both ways.	
	H. M.	°	°		Å	Å	Å	
1938. October 19	8 45	6		W	1			At top.
	8 45	8		W		1		Do.
21	8 50		11	E		1.5		Do.
	8 37		56.5	W	1			Do.; 55°.5 to 57°.5.
November 8	9 4		19	W	1			At top; 18° to 20°.
10	8 44	12		W		0.5		At base.
11	8 38		5	W			1	
	8 36	10		W		0.5		At base.
12	0 20		9	E	2			Do.
14	8 48		16.5	W		1		At top.
16	9 15		6	W		1.5		At base.
20	9 8		4.5	W		1		At top; 3° to 6°.
	0 2	21.5		W		0.5		Do.; 20° to 23°.
21	8 53		4	W		1		Do.
	8 50	40		W	0.5			Do.; 38° to 42°.
22	8 40	28		E		1		At base.
	8 32		23	W	1			At top.
	8 32		25.5	W	1	2		To red at top and to violet at base.
	8 35		37.5	W	1			At top.
	9 15		21.5	W	4	3		To red at top and to violet at base.
24	9 4	45		E	0.5			At base.
	9 8	5		E	0.5			At middle.
	8 52	18		W		1		At base.
25	8 38	25.5		W			1	At top.
27	9 10	12		E	1			At base.
28	8 50	4		E		1		At top; 3° to 5°.
	8 51		26	E			0.5	Do.; 25° to 27°.
29	10 9	58		E	0.5			At top.
	10 40		6	E	0.5			At base.
	10 40		8.5	E		1		At middle.
	10 21		17	W	1			At top.

TABLE III.—DISPLACEMENTS OF THE HYDROGEN LINE—JULY TO DECEMBER 1938—*contd.*

Date	Time I. S. T.	Latitude.		Limb.	Displacement.			Remarks.
		North.	South.		Red.	Violet.	Both ways.	
1938.	H. M.	°	°		Å	Å	Å	
November 30	9 23	13		E	1			At base.
	9 28		4	E	1			Do.
December 1	9 3		11	E	0.5	1		At top; 8° to 12°.
	8 55		82	W		1		In chromosphere.
	8 50		25	W	1.5			At top; 23° to 27°.
	8 50		17.5	W	1			Do.
	8 44		1	W	1			Do.; 0° to 2°.
	8 40	33		W		1		Do.
2	9 22		17	E	1			At middle.
	9 8		31	W	0.5			Do.
3	9 00	24		E	1.5			At base.
5	9 20	21		E	1	2.5		Do.; 20° to 22°.
	9 25		10.5	E		1		At top.
	9 8		20	W			1	At base; 19° to 21°.
	9 30	13		W			3.5	Do.; 12° to 14°.
	8 55	14.5		W	2.5			At top.
	9 00	15		W		1.5		At base; 14° to 16°.
6	8 44	45.5		E		3.0		At middle.
	8 55	11		W		1		At base.
	8 55	16		W		1		Do.
9	9 28	4		E	0.5			Do.
10	8 43	4		W		1		Do.
11	9 25	Equator		W	0.5			At top; from +1° to -1°.
	9 22	19		W		1		Do.; 18° to 20°.
12	9 30		11	E	0.5			Do.; 10° to 12°.
	9 16		2	W			0.5	At base; 0° to 4°.
13	10 7	78		E		0.5		Do.
	10 25	11		E	0.5			Do.
19	9 12	71		E	Slight			In chromosphere.
	9 35	24		E	6			At top; 22° to 26°.
	9 35	14		E			1.5	At base; 13° to 15°.
	9 00		20	W	0.5			At top.

TABLE III.—DISPLACEMENTS OF THE HYDROGEN LINE—JULY TO DECEMBER 1938—*concl.*

Date.	Time I. S. T.	Latitude.		Limb.	Displacement.			Remarks.
		North.	South.		Red.	Violet.	Both ways.	
1938	H. M.	°	°		Å	Å	Å	
December 19	9 00		17	W	1			As top.
	8 50	4.5		W	0.5			Do.
20	10 45	13		E		1		Do.
23	9 20		1.5	E	0.5			At base; 1° to 3°.
	9 00	45		W	0.5			At top.
29	8 55	39		W	1			Do.; 38° to 40°.
30	9 7	14		E	0.5			At base.

There were 136 displacements as against 187 in the previous half-year and they were distributed as follows :—

	North.	South.
0°—30°	67	39
31°—60°	16	5
61°—90°	7	2
	Total .	90
East limb		67
West limb		69
	Total .	136

Of these, 76 were towards the red, 49 towards the violet and 11 both ways simultaneously.

Reversals and Displacements on the Sun's disc.

Three hundred and eighty bright reversals of the H_{α} line 297 dark reversals of the D_{β} line and 14 displacements of the H_{α} line were observed with the spectrocope during the second half of 1938. Their distribution is shown below :—

	North.	South.	East.	West.
Bright reversals of H_{α}	197	183	177	203
Dark reversals of D_{β}	145	152	144	153
Displacements of H_{α}	7	7	7	7

The displacements towards the red numbered 5, those towards the violet 3 and those both ways simultaneously 6.

The Hale spectrohelioscope was used daily (except on Sundays and holidays) for the observation in the $H\alpha$ line of changing phenomena and displacements on the sun's limb and disc. The observations were made normally at the hours allotted by the International Astronomical Union to this observatory for this purpose, namely 2^h-30^m to 3^h-00^m , 4^h-00^m to 4^h-30^m and 5^h-30^m to 6^h-00^m G. M. T. i. e., 8^h-00^m to 8^h-30^m , 9^h-30^m to 10^h-00 and 11^h-00 to 11^h-30 I. S. T., but observations were also made outside of routine hours, whenever there were occasions for watching the progress of interesting phenomena.

The observations * made during the second half of 1938 are summarised below :—

	East limb.		West limb.		Total.
	North.	South.	East.	West.	Total.
Displacements in prominences	50		35		85
Displacements in $H\alpha$ dark markings	24	27	31	20	51
Displacements in $H\alpha$ bright flocculi	4	1	4	1	5
	Displacements towards.				
			Red.	Violet.	Bothways.
Prominences			48	37	..
$H\alpha$ dark markings			29	22	..
$H\alpha$ bright flocculi			4	1	..

Prominences projected on the Disc as Absorption Markings.

Disc spectroheliograms in $H\alpha$ light were available from Kodaikanal and the Co-operating observatories for a total of 177 days which were reckoned as $164\frac{1}{2}$ effective days. The mean daily areas of ~~the~~ absorption markings (corrected for foreshortening) in millionths of the sun's visible hemisphere and their mean daily numbers are given below :—

	Mean daily areas.	Mean daily numbers.
North	5397	28.46
South	6027	27.17
Total	11424	55.63

Both areas and numbers have increased by 18 per cent and 6 per cent respectively over those of the previous half-year.

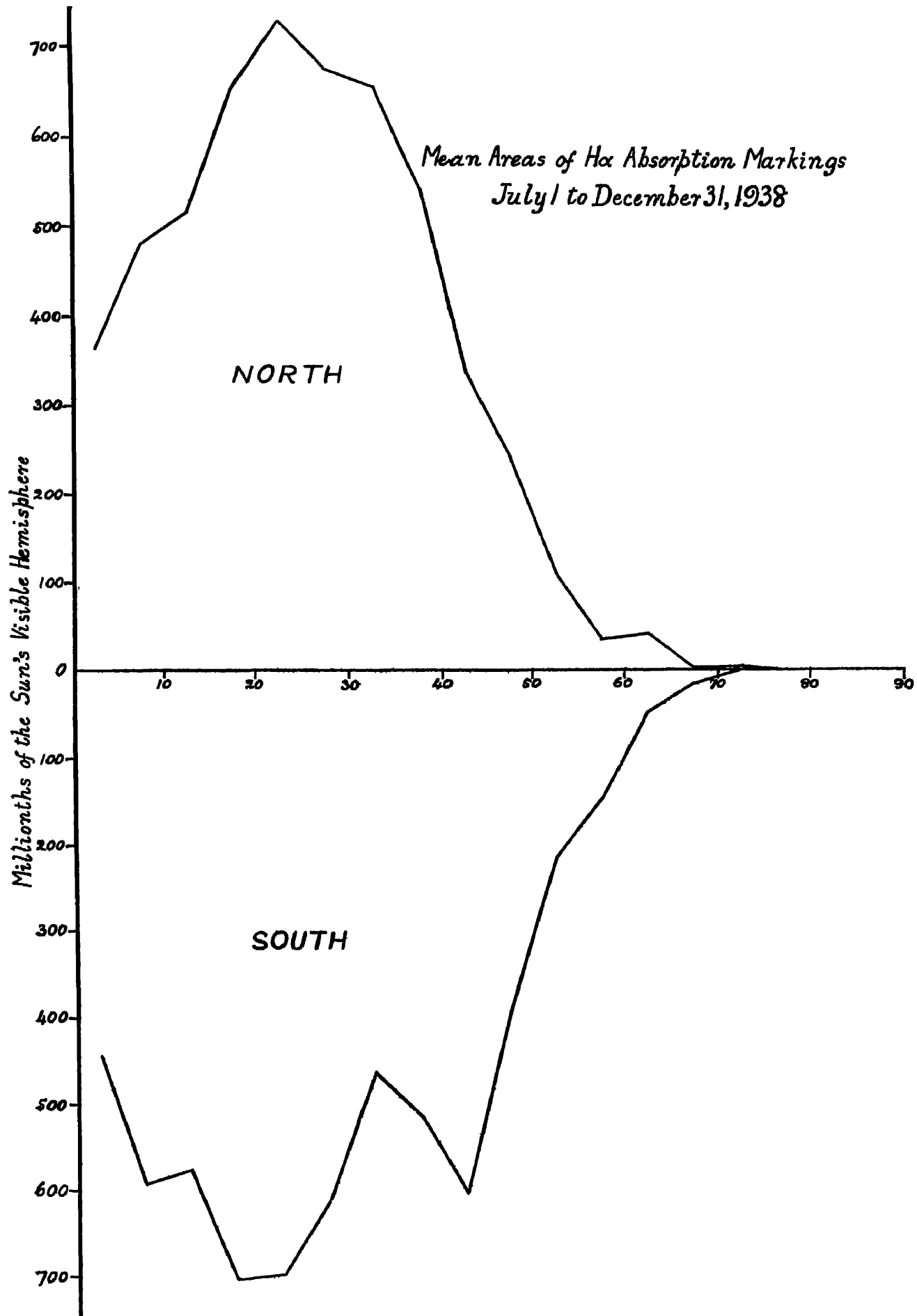
The corresponding figures for the absorption markings based on Kodaikanal records are as follows, 132 days of observation being counted as $124\frac{1}{2}$ effective days.

	Mean daily areas.	Mean daily numbers.
North (Kodaikanal Photographs only)	5047	26.44
South (do.)	5490	24.75
Total	10537	51.19

The distribution of the mean daily areas in latitude is shown in the following diagram. Compared with the previous half-year, the activity near 60° in the northern hemisphere has disappeared, while that between

* Observations of bright chromospheric eruptions are sent to the Director, Meudon Observatory, Paris, and the Director, Mount Wilson Observatory, California, and are published in the Bulletin for Character Figures of Solar Phenomena.

40° and 50° in the southern hemisphere has become more prominent, the major peaks in the curve in the low latitude region remaining stationary in both the hemispheres.



Both areas and numbers show an eastern defect, the percentage east being 48.75 for areas and 49.78 for numbers.

The mean daily areas of H α absorption markings uncorrected for foreshortening are :—

	Mean daily areas.
North	3223
South	3321
Total ..	<hr/> 6544 <hr/>

The uncorrected areas amount to 57 per cent of the corrected ones. The curve of distribution in latitude is similar to that of the corrected ones.

Thanks are due to the co-operating observatories for the photographs supplied by them.

KODAIKANAL,
The 29th December 1939.

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