

# Kodakanal Observatory

BULLETIN No. CXIX.

## SUMMARY OF PROMINENCE OBSERVATIONS FOR THE YEAR 1940.

Due to the international situation it has again been impossible to collect data from all the co-operating observatories. This bulletin therefore summarises the observations made during the year 1940 at this observatory alone. Parts I and II deal with the details of observations made during the first-half and the second-half of 1940 respectively.

### PART I.

#### SUMMARY OF PROMINENCE OBSERVATIONS FOR THE FIRST-HALF OF 1940.

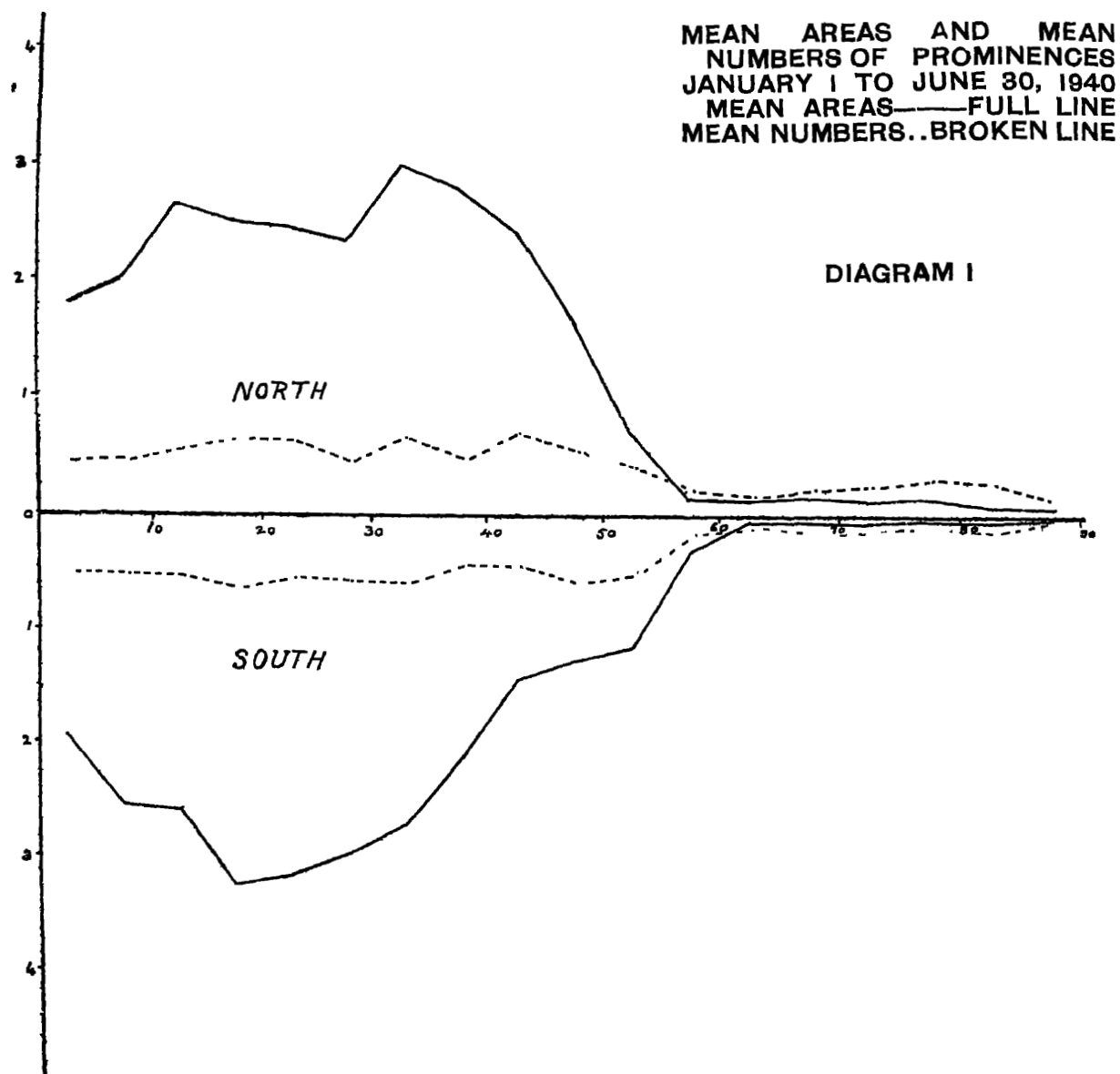
*Calcium prominences at the limb.*—Photographs of prominences were obtained during the half-year on 169 days which were reckoned as 160½ effective days after giving suitable weightage for days of incomplete observation. The mean daily areas and numbers of prominences are given below :—

	Mean daily areas (square minutes).	Mean daily numbers.
North . . . . .	2.48	7.43
South . . . . .	2.55	6.87
Total . . . . .	5.03	14.30

Compared with the previous half-year the areas and numbers show a decrease of 7 per cent. and 2 per cent. respectively.

The distribution of prominences in latitude is represented in the following diagram in which the full line gives the mean daily areas and the broken line the mean daily numbers for each zone of 5° of latitude. The ordinates represent tenths of a square minute of arc for the full line and numbers for the broken line. Two peaks of activity instead of the one observed in the last half-year, now appear in the northern hemisphere and the peak of activity

in the southern hemisphere now occurs  $10^\circ$  nearer the equator than in the previous half-year.



The monthly, quarterly and half-yearly areas and numbers and the mean height and the mean extent of the prominences are given in table I. The unit of area is one square minute of arc. The mean height and the mean extent are derived in the usual manner.

TABLE I.—ABSTRACT FOR THE FIRST-HALF OF 1940.

Months.	Number of days (effective).	Areas.	Numbers.	Daily means.		Mean height	Mean extent.
				Areas.	Numbers.		
1940							
January . . . . .	28½	194.9	461	4.73	16.18	34.11	5.04
February . . . . .	26½	129.8	384	4.90	14.49	36.24	5.95
March . . . . .	28½	123.7	378	4.30	13.16	36.48	6.16
April . . . . .	28½	161.9	391	5.73	13.84	38.47	6.50
May . . . . .	27	161.3	361	5.97	13.37	36.62	6.87
June . . . . .	21½	95.6	320	4.45	14.88	38.84	5.45
1st Quarter . . . . .	83½	388.4	1223	4.64	14.60	35.51	5.67
2nd Quarter . . . . .	76½	418.8	1072	5.46	13.97	37.96	6.31
1st Half year . . . . .	160½	807.2	2295	5.03	14.30	36.65	5.96

*Distribution east and west of the sun's axis.*

January to June 1940.	East.	West.	Percentage East.
Total number observed . . . . .	1131	1164	49.28
Total areas in square minutes . . . . .	391.0	416.1	48.44

The above table shows an eastern defect both in areas and numbers.

*Metallic Prominences.*

Twenty-four metallic prominences were observed during the half-year and their details are given below :—

TABLE II.—LIST OF METALLIC PROMINENCES—JANUARY TO JUNE 1940.

Date.	Time. I. S. T.	Base.	Latitude.		Limb.	Height.	Lines.
			North.	South.			
January	H. M.	°	°	°			
	4 10 33	1	7.5		E	10	4 and 10 only.
	11 9 2	2	33		W	30	4 and 10 only.
	12 9 27	6	14		W	10	4 and 10 only.
	25 9 42	1	15.5		E	10	4 and 10 only.
	9 42	5	5.5		E	20	1, 2, 3, 4, 5, 6, 8, 9 and 10.
30 9 30	4			5	E	10	4 and 10 only.

TABLE II.—LIST OF METALLIC PROMINENCES—JANUARY TO JUNE 1940—*contd.*

Date.	Time I. S. T.	Base.	Latitude.		Limb.	Height.	Lines.
			North.	South.			
	H. M.	°	°	°		'	
January	30 9 33	2		24	E	10	4 and 10 only.
February	12 9 50	1		10.5	W	10	4 and 10 only.
	19 9 23	4		16	W	20	1, 2, 3, 4, 5, 6, 8, 9, 10, 11 and 12.
	20 8 56	3		15.5	W	15	1, 2, 3, 4, 5, 6, 8, 9, 10, 11 and 12.
	22 8 52	4	15		E	10	4 and 10 only.
	24 9 43	2		7	E	20	4 and 10 only.
March	9 9 48	1		2.5	W	10	4 and 10 only.
	19 8 53	2		3	E	10	4 and 10 only.
	23 9 00	2		5	W	10	1, 2, 3, 4, 5, 6, 8, 9, 10, 11 and 12.
	31 9 35	1	14.5		W	40	1, 2, 3, 4, 5, 7, 8, 9, 10, 11 and 12.
April	2 8 57	..	7		W	10	4 and 10 only.
	8 57	..	12		W	10	4 and 10 only.
	5 8 43	2	..	13	E	10	4 and 10 only.
	8 43	3		18.5	E	15	4 and 10 only.
	6 10 8	3		3.5	E	25	4 and 10 only.
	13 9 53	1	6.5		W	15	4 and 10 only.
May	13 9 27	4	19		E	15	4 and 10 only.
June	12 9 48	6		21	W	25	4 and 10 only.

NOTE.—The key to the wave-lengths of the metallic lines is given below :—

No.	$\lambda$	Element.	No.	$\lambda$	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	$b_2, b_3, b_4, b_5$	Mg, Fe+	10	$D_2, D_1$	Ne
5	5234.8	Fe	11	6677	He
6	5276.0	Cr	12	7065	He

The distribution of metallic prominences was as follows :—

	1°—10°	11°—20°	21°—30°	31°—40°	Mean latitude.	Extreme latitudes.
North	4	6	..	1	13°.6	5°.5 & 33°
South	6	5	2	.	11°.1	2°.5 & 24°

They were equally divided between the east and west limbs.

*\*Displacements of the Hydrogen Line.*

There were 164 displacements as against 185 in the previous half-year and their distribution was as follows :—

	North.	South.
0°—30° . . . . .	53	70
31°—60° . . . . .	12	16
61°—90° . . . . .	10	3
	Total	89
East limb . . . . .		79
West limb . . . . .		85
	Total	164

Of these 88 were towards the red, 71 towards the violet and 5 both ways simultaneously.

*Reversals and displacements on the sun's disc.*

Four hundred and sixty-five bright reversals of the  $H_{\alpha}$  line, 435 dark reversals of the  $D_{\beta}$  line and 38 displacements of the  $H_{\alpha}$  line were observed with the spectroscope during the half-year under review.

Their distribution is shown below :—

	North.	South.	East.	West.
Bright reversals of $H_{\alpha}$ . . . . .	163	302	233	232
Dark reversals of $D_{\beta}$ . . . . .	153	282	217	218
Displacements of $H_{\alpha}$ . . . . .	24	14	19	19

Of the displacements 25 were towards the red, 9 towards the violet and those both ways simultaneously 4.

During the half-year eruptive prominences were photographed on February 24, 26, March 8 and May 29. The prominences of February 26 (N. E. limb Lat. 1°—42°) and March 8 (S. W. limb Lat.—22°—37°) rose to a height of 8' and 10' respectively. The prominences of February 24 and May 29, though small in height, showed large displacements of 9.0 A° to red and 6.4 A° to violet respectively.

The Hale spectroheliometer was used daily (except on Sundays and holidays) for observations in the  $H_{\alpha}$  line of changing phenomena and displacements on the sun's limb and disc. As in previous years these observations were made normally at the hours assigned by the International Astronomical Union to this observatory for this purpose but were also continued outside of these routine hours on occasions whenever interesting phenomena were in progress.

The displacements observed with the spectroheliometer in the prominences and in the  $H_{\alpha}$  dark and bright markings are summarised below :—

	East limb.	West limb.	Total.		
Displacements in prominences . . . . .	47	58	105		
	North.	South.	East.	West.	Total.
Displacements in $H_{\alpha}$ dark markings . . . . .	28	27	24	31	55
Displacements in $H_{\alpha}$ bright flocculi . . . . .	5	4	1	8	
	Displacements towards.				
	Red.	Violet.	Bothways.		
Prominences . . . . .	55	50	..		
$H_{\alpha}$ dark markings . . . . .	37	18	..		
$H_{\alpha}$ bright flocculi . . . . .	5	4	..		

\*The details of the displacements of the  $H_{\alpha}$  line observed with the spectroscope in the chromosphere and prominences usually given in Table III have been deleted as a measure of economy in printing paper due to the war.

The particulars of the bright chromospheric eruptions observed during the half-year are given in the following table.

TABLE III.—LIST OF BRIGHT CHROMOSPHERIC ERUPTIONS—JANUARY TO JUNE 1940.

Date.	Time I. S. T.			Mean Latitude.	Mean Longitude from C. M.	Intensity according to area.	Remarks.
	Beginning.	Maximum.	End.				
	H. M.	H. M.	H. M.	°	°		
6th January 1940 .	8 20	8 28	9 15	+10	10 W	2	
14th January 1940 .		8 36		-8	57 W	1	From Spectroheliogram.
19th January 1940 .		8 07		-11	30 W	1	At three different points in the same region; from Spectroheliogram.
20th January 1940 .		8 14		-11	21 E	1	From Spectroheliogram.
7th February 1940 .		8 18		-8	27 W	1	Do.
17th February 1940 .	11 00	11 06	11 30	-14	12 W	2	
23rd March 1940 .		8 02		+12	40 E	1	From Spectroheliogram.
24th March 1940 .		8 26		+12	28 E	1	Do.
25th March 1940 .		8 46		+12	15 E	1	At two different points in the same region from Spectroheliogram.
29th March 1940 .		10 01		+12	39 W	2	Do.
30th March 1940 .	8 04	8 16	9 40	+12	51 W	2	
30th March 1940 .	11 00	11 05	11 35	+12	51 W	2	
5th April 1940 .	8 15	8 20	8 55	-15	10 E	1	
26th April 1940 .	9 40	9 45 10 12	11 00	+12	50 W	2	At two points in the same region intensities 2 and 2; from Spectroheliogram.
14th May 1940 .		9 56		-8	28 W	1	From Spectroheliogram.
14th May 1940 .		12 10		-7	3 E	1	Do.
21st May 1940 .		8 06		-7	66 E	1	Do.
		8 08		+12	16 W	1	Do.
22nd May 1940 .		11 30		+12	34 W	1	Do.
30th May 1940 .		7 55		-12	35 W	1	Do.
11th June 1940 .		12 03		-13	85 W	1	Do.
16th June 1940 .		9 48		-8	52 W	1	Do.

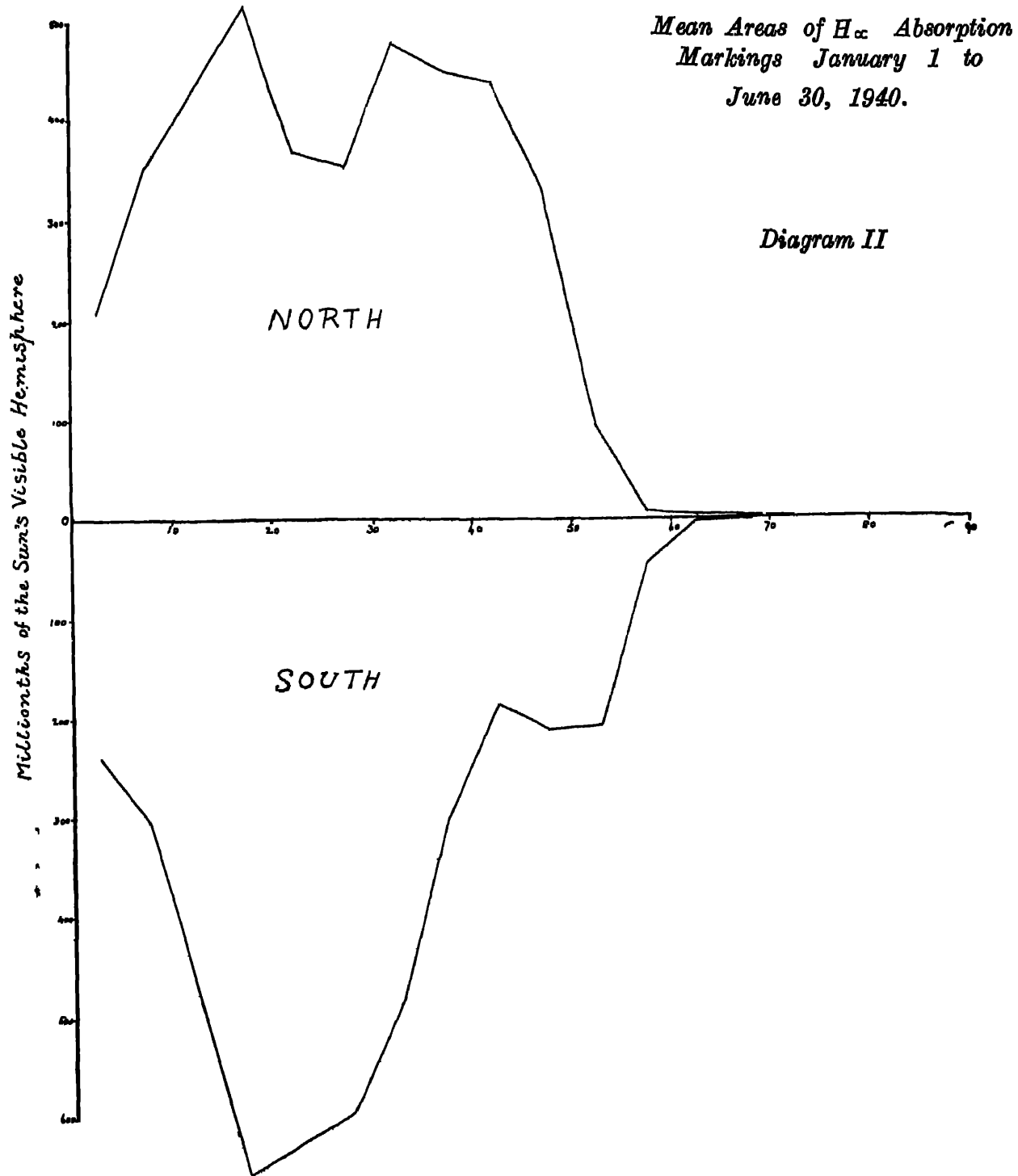
*Prominences projected on the Disc as Absorption Markings.*

Photographs of the sun's disc in the H $\alpha$  light were obtained during the half-year on 157 days which were counted as 154 effective days. The mean daily areas of H $\alpha$  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 . . . . .	4024	19.08
South . . . . .	4380	22.67
Total . . . . .	8404	41.75

The above figures show a decrease of 12 per cent. and 20 per cent. in areas and numbers respectively over those of the previous half-year.

The distribution of the mean daily areas in latitude is shown in the following diagram. When compared with the diagram for the previous half-year it is seen that there are two peaks of maximum activity instead of one in the northern hemisphere and in the southern hemisphere the peak of activity has advanced  $5^{\circ}$  towards the pole.



Both areas and numbers show an eastern defect the percentage east being 48.27 for areas and 49.69 for numbers.

The mean daily areas of H<sup>α</sup> absorption markings uncorrected for foreshortening are given below :—

North	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	Mean daily areas.
South	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	2185
															2496	
															Total	4681

The uncorrected areas amount to 56 per cent. of the corrected ones. The curve of distribution in latitude is as usual similar to that of the corrected ones.

PART II.

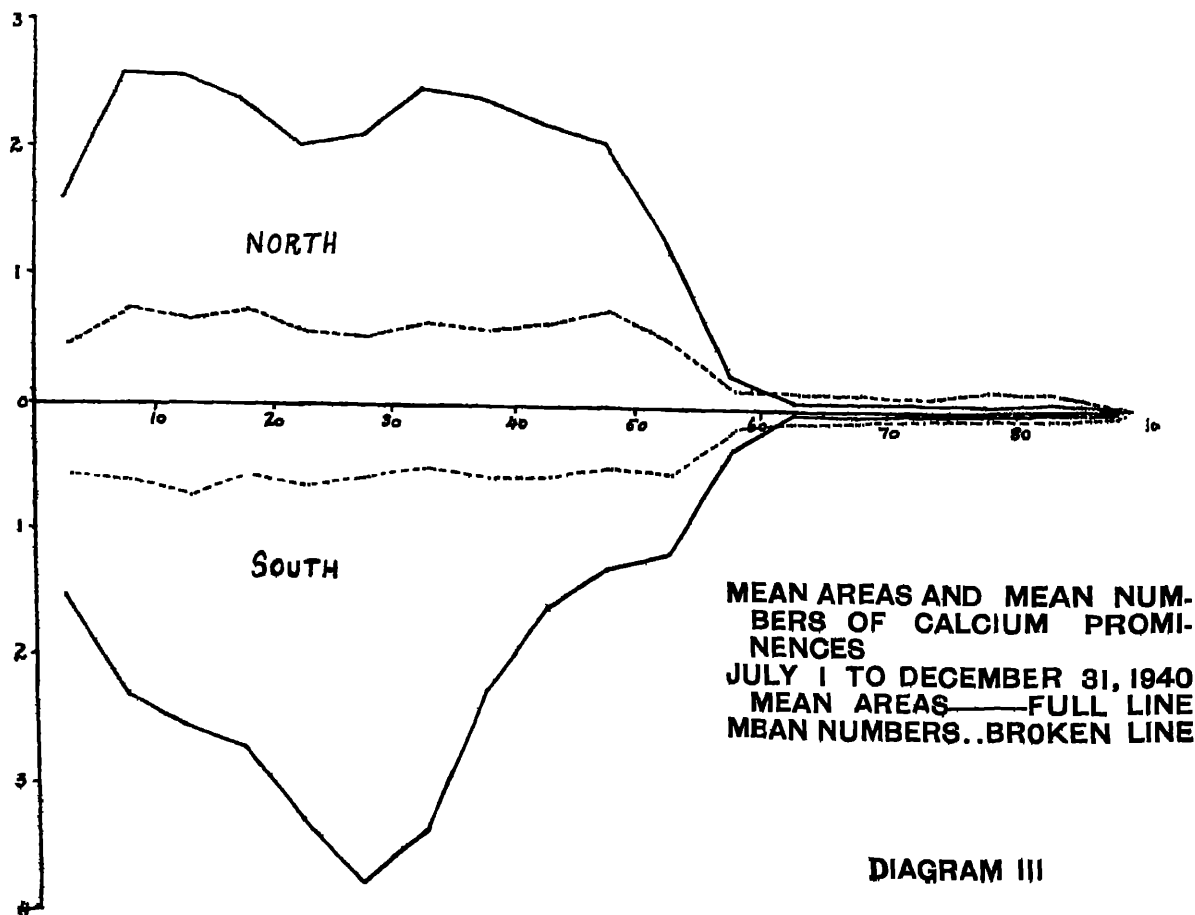
SUMMARY OF PROMINENCE OBSERVATIONS FOR THE SECOND-HALF OF THE YEAR 1940.

*Calcium prominences at the limb.*—Photographs of prominences were obtained on 133 days which were reduced to 110 effective days in the usual way. The mean daily areas and numbers of prominences are given below :—

North	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	Mean daily areas (square minutes).	Mean daily numbers.
South	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	2.40	7.47
															2.60	7.07	
															Total	5.00	14.54

The areas show a decrease of 1 per cent. and the numbers an increase of 2 per cent. over those of the previous half-year.

The distribution of prominences in latitude is represented in the following diagram. In the northern hemisphere the distribution is similar to that in the first-half of the year although the activity is less ; in the southern hemisphere the peak of activity has advanced 10° towards the pole as compared with the previous half-year.





The monthly, quarterly and half-yearly areas and numbers and the mean height and the mean extent of prominences are given in Table I.

TABLE I.—ABSTRACT FOR THE SECOND-HALF OF 1940.

Months.	Number of days (effective).	Areas.	Numbers.	Daily means.		Mean height.	Mean extent.
				Areas.	Numbers.		
1940							
July . . . . .	13	56.1	211	4.31	16.23	31.49	5.14
August . . . . .	21½	114.6	377	5.33	17.53	36.94	4.83
September . . . . .	23½	103.7	358	4.41	15.23	36.30	5.34
October . . . . .	19½	78.9	269	4.05	13.79	38.10	6.04
November . . . . .	8½	31.1	108	3.66	12.71	32.69	4.97
December . . . . .	24	165.3	277	6.89	11.54	42.64	6.80
3rd quarter . . . . .	58	274.4	946	4.73	16.31	35.43	5.09
4th quarter . . . . .	52	275.3	654	5.29	12.58	39.13	6.18
2nd half-year . . . . .	110	549.7	1600	5.00	14.54	36.97	5.54

*Distribution east and west of the sun's axis.*

July to December 1940.	East.	West.	Percentage east.
Total number observed . . . . .	818	782	51.13
Total areas in square minutes . . . . .	275.9	273.8	50.19

Both the areas and numbers show an eastern preponderance.

*Metallic prominences.*

Only nine metallic prominences were observed during the half-year and their details are given below.

TABLE II.—LIST OF METALLIC PROMINENCES—JULY TO DECEMBER 1940.

Date.	Time I. S. T.	Base.	Latitude.		Limb.	Height.	Remarks.
			North.	South.			
1940	H. M.	°	°	°			
August	6 9 7	3	7.5		E	10	4 and 10 only.
	17 9 11	5		11.5	W	15	4 and 10 only.
	29 8 45	2	23		E	20	4 and 10 only.
	" 8 39	3		29.5	W	10	4 and 10 only.
September	2 9 15	2	4		W	15	4 and 10 only.
	18 9 8	2		8	E	15	4 and 10 only.
	27 9 12	4	20		W	40	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11 and 12.
December	17 8 44	1		0.5	W	20	4 and 10 only.
	18 9 24	2		12	E	20	4 and 10 only.

N. B.—For key to the wave-lengths refer to Table II, Part I.

The distribution of metallic prominences was as follows :—

	1°—10°	11°—20°	21°—30°	Mean latitude.	Extreme latitudes.
North . . . . .	2	1	1	13°·6	4° and 23°
South . . . . .	2	2	1	12°·8	0°·5 and 29°·5

Of these four were on the east limb and 5 on the west limb.

*\*Displacements of the Hydrogen line.*

The total number of displacements observed was 40 as against 164 in the previous half-year and their distribution was as follows :—

	North	South.
0°—30° . . . . .	15	19
31°—60° . . . . .	5	..
61°—90° . . . . .	.	1
	Total	20
East limb . . . . .	.	13
West limb . . . . .	.	27
	Total	40

Twenty-four displacements were towards the red 14 towards the violet and 2 both ways simultaneously.

*Reversals and displacements on the sun's disc.*

Two hundred and seventy nine bright reversals of the H $\alpha$  line, 241 dark reversals of the D $\beta$  line and 6 displacements of H $\alpha$  line were observed during the half-year. Their distribution was as follows :—

	North.	South.	East.	West.
Bright reversals of H $\alpha$ . . . . .	120	159	128	151
Dark reversals of D $\beta$ . . . . .	101	140	112	129
Displacements of H $\alpha$ . . . . .	3	3	2	4

Four displacements were towards the red and 2 towards the violet.

No eruptive prominence was photographed during the half-year.

*Observations with the Hale Spectrohelioscope.*

The displacements observed with the spectrohelioscope during the second-half of the year are summarised below :—

	East.	West.	Total.		
Displacements in prominences . . . . .	10	9	19		
	North.	South.	East.	West.	Total.
Displacements in H $\alpha$ dark markings . . . . .	9	10	5	14	19
Displacements in H $\alpha$ bright focculi . . . . .	2	2	..	4	4

*Displacements towards.*

	R	V	Both ways.	Total.
Prominences . . . . .	12	7	..	19
H $\alpha$ dark markings . . . . .	12	7	..	19
H $\alpha$ bright focculi . . . . .	2	2	..	4

\* Vide Part I.

Particulars of the bright chromospheric eruptions observed during the half-year are given in the table below :—

TABLE III.—LIST OF BRIGHT CHROMOSPHERIC ERUPTIONS—JULY TO DECEMBER 1940.

Date.	Time I. S. T.			Mean Latitude.	Mean Longitude from C. M.	Intensity according to area.	Remarks.
	Beginning.	Maximum.	End.				
	H. M.	H. M.	H. M.				
9th July 1940 . . . . .	10 50	11 00	11 15	+19	20 W	1	
11th July 1940 . . . . .		8 00	8 30	+16	42 W	2	
17th August 1940 . . . . .		8 09		—4	67 W	1	From Spectroheliogram.
20th August 1940 . . . . .	8 30	8 35	8 50	+15	42 W	1	
28th August 1940 . . . . .		8 30		—15	67 W	1	From Spectroheliogram.
1st September 1940 . . . . .		8 40		—6	2 E	2	Do.
4th September 1940 . . . . .		8 49		—17	35 E	1	Do.
10th September 1940 . . . . .		9 21		+16	27 E	2	Do.
19th September 1940 . . . . .	8 20	8 25		+15	32 W	2	
22nd September 1940 . . . . .		8 45		—11	33 W	1	From Spectroheliogram.
10th October 1940 . . . . .	8 20	8 30		+18	42 E	2	
13th October 1940 . . . . .		8 23		+18	2 E	2	From Spectroheliogram.
21st November 1940 . . . . .		9 49		—15	68 W	1	Do.
27th November 1940 . . . . .		10 32		—12	53 W	1	Do.
1st December 1940 . . . . .		8 40		+9	68 W	1	Do.
18th December 1940 . . . . .		8 51		+9	59 W	1	Do.

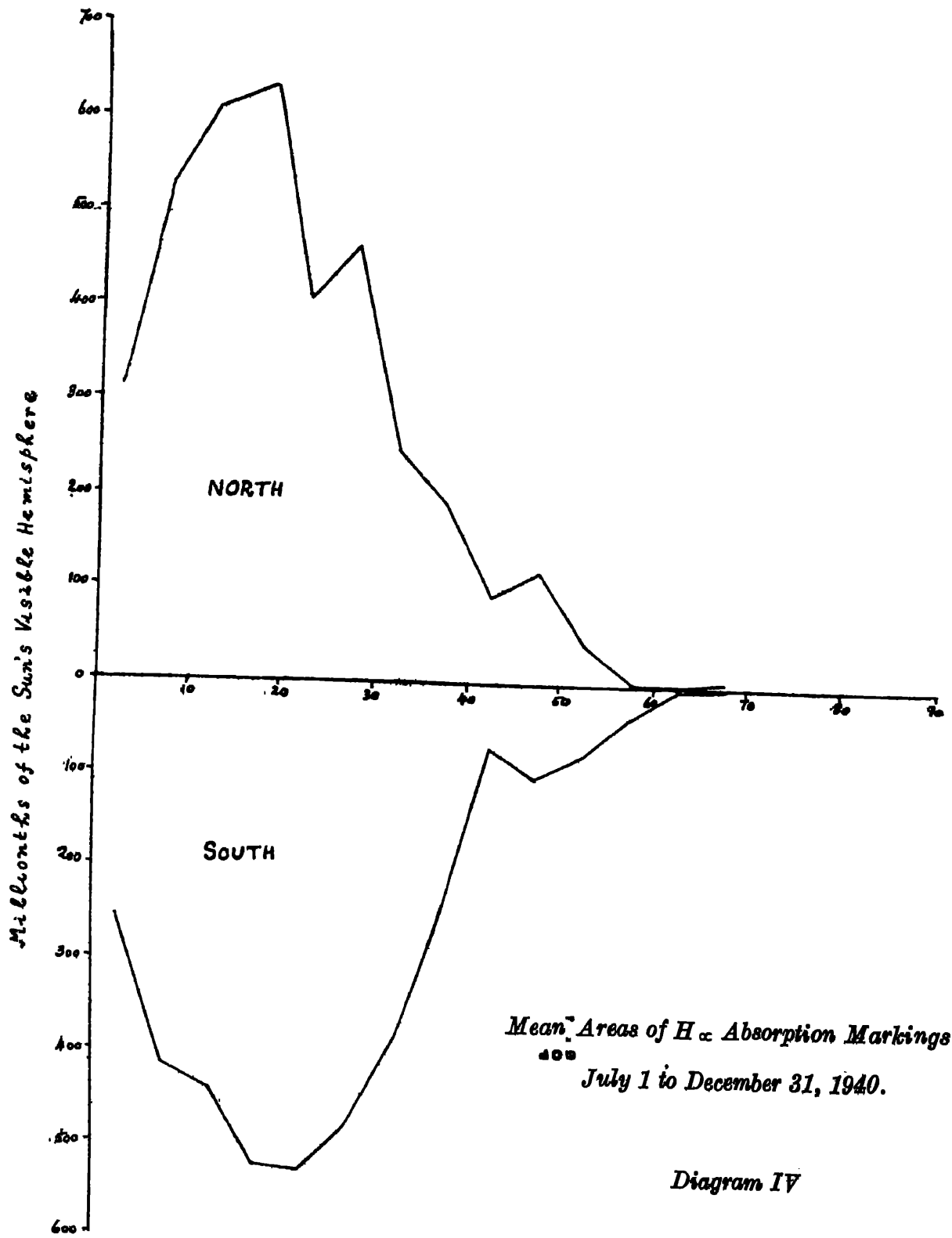
*Prominences projected on the Disc as Absorption Markings.*

Photographs of the sun's disc in H $\alpha$  light were taken on 116 days which were counted as 105 effective days. The mean daily areas of H $\alpha$  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 . . . . .	3659	21.30
South . . . . .	3527	20.30
Total . . . . .	7186	41.60

The above figures show that there has been a decrease of 14 per cent. in areas and a slight decrease in numbers compared with those of the previous half-year.

The distribution of mean daily areas in latitude is shown in the following diagram. When compared with the diagram for the first-half of the year it is seen that a well pronounced single peak has developed in the northern hemisphere in place of the two peaks. The peak in the southern hemisphere has weakened and advanced 5° towards the pole.



As in the previous half-year both areas and numbers show an eastern defect, the percentage east being 47.16 for areas and 49.79 for numbers. The mean daily areas of H $\alpha$  absorption markings uncorrected for foreshortening are given below:—

	Mean daily $\square$ areas.
North . . . . .	2189
South . . . . .	1995
	<hr/>
Total	4184

The uncorrected areas amount to 58 per cent. of the corrected ones. The curve of distribution in latitude is as usual, similar to that of the corrected areas.

KODAIKANAL OBSERVATORY ;  
6th September 1941.

A. K. DAS,  
Assistant Director, Kodaikanal Observatory.