Kodaikanal Observatory.

BULLETIN No. CXV.

SUMMARY OF PROMINENCE OBSERVATIONS FOR THE SECOND HALF OF THE YEAR 1937.

The material for the present review is the observations of prominences made at the Kodaikanal Observatory supplemented where necessary by the data available from other observatories, which under the auspices of the International Astronomical Union co-operate with this Observatory by supplying copies of their photographs on requisition, for the days on which Kodaikanal has imperfect or no photographs. We take this opportunity of thanking these observatories for their co-operation. The data from the co-operating observatories which have been incorporated in this summary, are calcium (K_{232}) prominence plates for 12 days and Hα disc plates for 38 days from the Meudon Observatory, calcium (K_{232}) prominence plates for 35 days and Hα disc plates for 8 days from the Mount Wilson Observatory and Hα disc plates for 8 days from Mr. Evershed's Observatory at Ewhurst. The available data are still not complete for all the days of the half-year under review ; in fact no calcium prominence photographs for 8 days and Hα disc photographs for 6 days are available from any of the observatories, while the photographs for a number of days are incomplete. The following procedure has, as usual, been adopted for estimating the solar activity for those days on which only incomplete photographs are available : the activity of a day of incomplete observation has been assumed to be represented by the best photograph of the day, after weighting it according to its quality, the remaining photographs being ignored.

Calcium Prominences at the limb.—The mean daily areas and numbers of prominences derived from all available photographs in the K line of calcium secured during the half year are given below. The means are corrected for incomplete or imperfect observations as indicated above, the total of 176 days for which plates were available being reduced to 161 effective days.

	Mean daily areas (square minutes).	Mean daily numbers.
North	3·31	8·22
South	2·76	7·29
Total .	6·07	15·51

The above figures show that compared to the previous half-year there has been a decrease of about 22 per cent in areas and an increase of about 2 per cent in numbers. The decrease in areas has occurred in both the hemispheres, being somewhat more pronounced in the southern ; but the increase in numbers is confined to the northern hemisphere, there being a slight decrease in the southern.

For comparison with bulletins issued prior to 1st January 1923, *i.e.*, before the co-operation of other observatories came into force, the means based on Kodaikanal photographs alone are also given, 142 days of observation being reckoned as 129 effective days.

	Mean daily areas (square minutes).	Mean daily numbers.
North (Kodaikanal photographs only)	3·65	8·79
South (Do. Do.)	3·03	7·67
Total .	6·68	16·46

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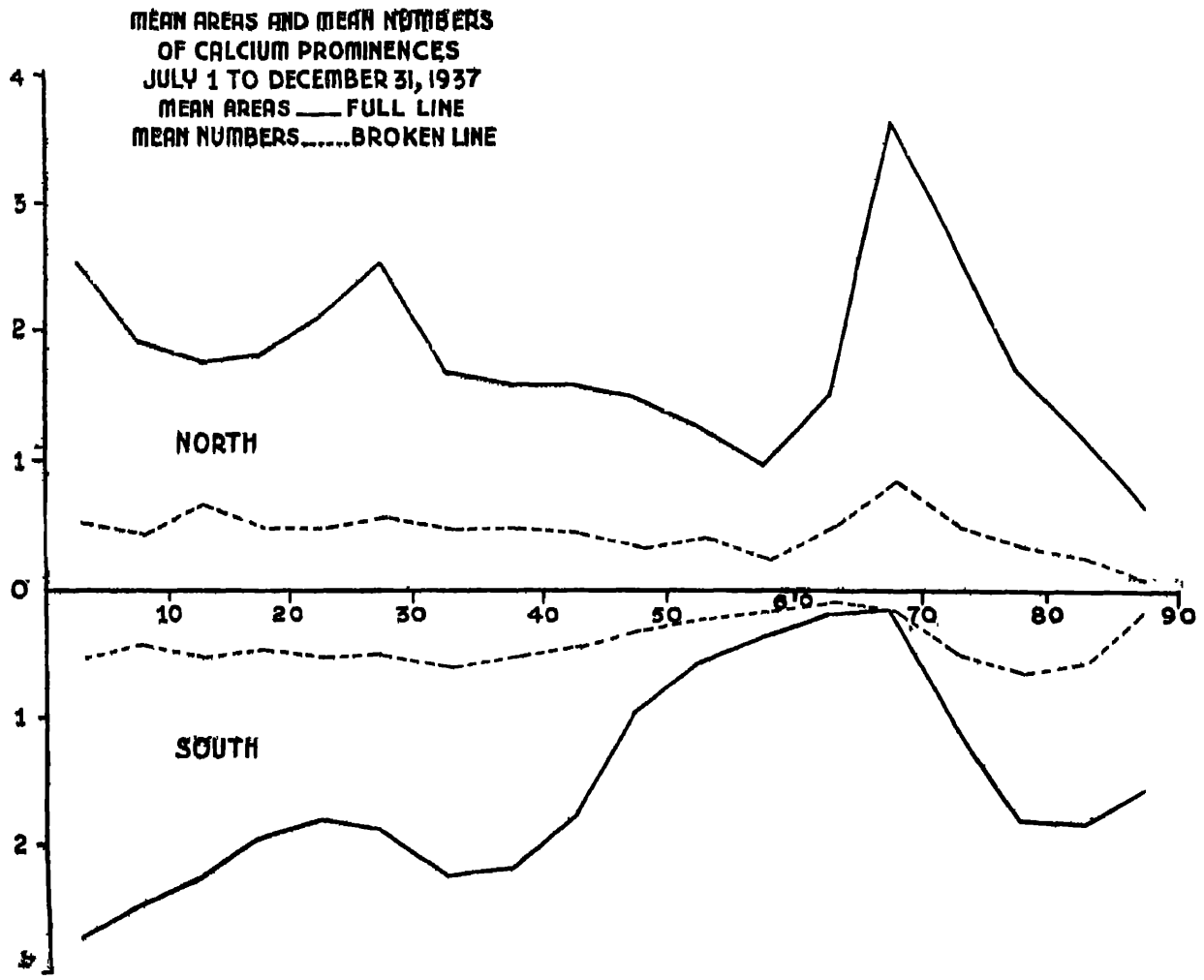
The distribution of prominences in latitude is represented in the following diagram, in which the full line gives the mean daily areas and the broken line the mean daily numbers for each zone of 5° of latitude. The ordinates represent tenths of a square minute of arc for the full line and numbers for the broken line. Compared with the previous half-year, the zones of maximum activity have advanced 5° towards the pole in the northern hemisphere and 10° in the southern hemisphere. The high latitude peak in the southern hemisphere has become less pronounced when compared to the low latitude activity.



The monthly, quarterly and half-yearly areas and numbers and the mean height and the mean extent of the prominences on photographs from all co-operating observatories are given in Table I. The unit of area is one square minute of arc. The mean height is derived by adding together the greatest heights reached by individual prominences and dividing by the total number of prominences observed and the mean extent is derived by adding together the lengths of the base on the chromosphere of individual prominences and dividing by the total number of prominences.

TABLE I.—ABSTRACT FOR THE SECOND HALF OF 1937.

Months.	Number of days (effective).	Areas.	Numbers.	Daily means.		Mean height.	Mean extent.
				Areas.	Numbers.		
1937.							°
July	24½	128·3	373	5·18	15·07	45·08	5·59
August	28	189·5	430	6·77	15·36	40·80	7·95
September . . .	28	177·0	426	6·32	15·21	45·50	7·89
October	27½	197·7	469	7·19	17·05	40·76	6·90
November . . .	23½	106·9	351	4·50	14·78	34·80	5·31
December . . .	29	176·7	447	6·09	15·41	37·30	6·94
Third quarter . . .	80½	494·8	1229	6·13	15·22	43·73	7·21
Fourth quarter . . .	80½	481·3	1267	6·00	15·79	37·89	6·48
Second half-year . .	161	976·1	2496	6·06	15·50	40·77	6·84

Distribution East and West of the Sun's Axis.

July to December 1937.	East.	West.	Percentage East.
Total number observed	1227	1269	49·16
Total areas in square minutes	4905	4855	50·26

The areas show a slight increase at the east limb and numbers a slight decrease as is clear from the above table.

Metallic Prominences.

Seventeen metallic prominences were observed during this half-year and their details are given below :—

TABLE II.—LIST OF METALLIC PROMINENCES.—JULY TO DECEMBER 1937.

Date.	Time I. S. T.	Base.	Latitude.		Limb.	Height.	Lines. (See note at end of Table).
			North.	South.			
1937.	H. M.	°	°	°		″	
July 26	9 25	7	20·5		W	30	1, 2, 3, 4, 8, 9, 10, 11 and 12.
30	9 30	7	15·5		E	20	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11 and 12.
	9 27	2	34		E	20	1, 2, 4, 5, 6, 8, 9, 10, 11 and 12.

TABLE II.—LIST OF METALLIC PROMINENCES—JULY TO DECEMBER 1937—*contd.*

Date.		Time I. S. T.	Base.	Latitude.		Limb.	Height.	Lines (See note at end of Table).
				North.	South.			
		H. M.	°	°	°		"	
1937.								
August	6	10 20	7	12·5		E	15	4 and 10.
	13	9 59	2	1		E	10	4 and 10.
		9 45	4		28	W	10	4 and 10.
		9 37	2	17		W	25	1, 2, 4, 5, 6, 8, 9, 10, 11 and 12.
		9 37	3	21·5		W	10	4 and 10.
September	5	8 49	2	26		W	20	1, 2, 3, 4, 5, 6, 8, 9, 10. 11 and 12.
October	5	9 50	3	14·5		W	10	1, 2, 3, 4, 5, 6, 8, 9, 10, 1 1 and 12.
	11	9 25	2	7		W	20	1, 2, 3, 4, 5, 6, 8, 9, 10, 11 and 12.
		9 25	1	10·5		W	25	1, 2, 3, 4, 5, 6, 8, 9, 10, 11 and 12.
	18	9 45	..		17	W	15	1, 2, 3, 4, 9, 10, 11 and 12.
December	11	10 15	2	12		W	25	1, 2, 3, 5, 6, 7, 8, 9, 10, 11 and 12.
	13	9 30	3	38·5		E	20	4 and 10
		9 34	..	25		E	25	4 and 10.
	14	9 15	2	39		E	10	1, 2, 3, 4, 5, 6, 8, 9, 10, 11 and 12.

NOTE:—The key to the wavelengths of the matallic lines 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 metallic prominences was as follows :—

	1°—10°.	11°—20°.	21°—30°.	31°—40°.	Mean latitude.	Extreme latitudes.
North	2	6	4	3	19°·6	1° and 39°
South	..	1	1	..	22°·5	17° and 28°

Seven were on the east limb and ten on the west limb.

Displacements of the Hydrogen line.

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

TABLE III.—DISPLACEMENTS OF THE HYDROGEN LINE.—JULY TO DECEMBER 1937.

Date.	Time I. S. T.	Latitude.		Limb.	Displacement.			Remarks.
		North.	South.		Red.	Violet.	Both ways.	
	H. M.	°	°		A	A	A	
1937.								
July 5	10 45		50	E		0·5		At top ; from —49° to —51°.
	10 20	27		W	0·5			Do. from +26° to +28°.
12	11 17	12·5		E			0·5	At base.
30	9 30	13		E	2			Do. from +12° to +14°.
	9 30	23		E	1			Do.
	9 20		11·5	W	0·5			At top ; from —10° to —13°.
August 5	9 27	24·5		W	4			At base.
	9 25	65		W		1		At base ; from +64° to +66°.
6	10 20	12·5		E			1	Do. from +9° to +16°.
	9 50		25	W	2			At top ; from —23° to —27°.
	9 10	26·5		W		0·5		At base.
9	9 22		2	W	0·5			At top ; from 0° to —4°.
13	9 27	20		W	0·5			At base.
14	10 00		34	W		Slight		Do.
	10 4		4	W	0·5			At top.
	10 10	26		W	1			Do. from +25° to +27°.
16	9 20	69		E	0·5			Do.
	9 5		14·5	W	3	1·5		At base.
17	9 10	70		E		0·5		Do.
	9 12	31		E		1		At top.
	9 12	25		E	1			At base.
	9 20		14·5	W		2		Do.
	9 20		15	W	1			Do.
20	9 11	40·5		E		1		At top.
	9 17		25	E		2		Do.
	9 11	38·5		W		3·5		At the middle of the prominence from +38° to +40°.
	11 00	38·5		W		2·5		Do. from +37° to +41°.
	11 00	37·5		W	1			At base.
	11 10	39		W	1·5			At the middle of the prominence.
21	10 5		26	W			0·5	
22	9 42	65		E	Slight			At base.
	9 35	30·5		E		1		At top ; from +30° to +32°.
23	9 3	12·5		W	0·5			At base ; from +11° to +14°.
26	9 22	27·5		E		1·5		Do. from +26° to +29°.
27	9 55	68		E	0·5			At top.
September 5	9 5		12	E		2		At top ; from —11° to —13°.
	8 55		59	W	0·5			Do.
	8 49	26		W		1		At base ; from +25° to +27°.
	8 45	67		W	1			At top.
8	10 8		21	W		Slight		At base ; from —20° to —22°.
10	8 35	47·5		W	0·5			At top.
	8 32	70		W		0·5		At base.
11	10 30		12	E	Slight			At top.
	10 35	28·5		W	3			Do.
	9 35	12·5		E		1		Do. from +11° to +14°.
15	10 5	40·5		E		1		Do.
	10 3	38		E		1		Do.
	9 28		18	E	1			At base.

TABLE—III.—DISPLACEMENTS OF THE HYDROGEN LINE—JULY TO DECEMBER 1937—*contd.*

Date.	Time. I. S. T.	Latitude.		Limb.	Displacement.			Remarks.
		North.	South.		Red.	Violet.	Both ways.	
	H. M.	°	°		A	A	A	
1937.								
September 17	8 57	27		E		1		At the middle of the prominence from +26° to +28°.
	8 42	6		W	1			At top.
	8 42	6·5		W		1		At base.
21	8 26	20		W	0·5			At top.
October 4	10 18	12·5		E		1		At the middle of the prominence.
5	9 50	14·5		W		1		At base.
	8 56	11		E			1	At top.
	8 57	11		E	3	3		To violet at top and to red at the middle of the prominence.
	9 35	30		W		1		At top.
11	9 55		9	E	2·5			At base.
	9 15		21	W	2			Do. from —20° to —22°.
	9 15		18·5	W		1·5		Do. from —17° to —20°.
	9 12	2·5		W	2	1·5		To red at top and to violet at base ; from +1° to +4°.
	9 12	7		W	2	3·5		Both at base.
	9 25	9		W	2			At top.
	9 25	10·5		W			3	
	9 26	22·5		W	1			
	9 5	22·5		W		Slight		At base.
14	10 5		21·5	W	2			At top.
	10 5		14·5	W		0·5		At base.
	10 2	14		W	2			At top.
	10 00	41		W	0·5			Do. from +39° to +43°
16	10 7	44·5		E		Slight		Do.
17	9 30		10	E	1			In chromosphere.
18	11 44		2·5	E	1·5			At top ; from —1° to —4°.
	11 30		39·5	W		2·5		At base.
	9 31		17	W			1	Do.
	9 42		8·5	W	1·5			At top.
	9 32	66		W	Slight			At base.
22	8 52		12	W			1	At the middle of the prominence.
	8 50	19		W		1		At base.
23	9 36	18		E		0·5		At top.
	10 20	16		W	1			Do.
November 10	9 17	6		E		4		At top ; from +4° to +8°.
18	8 25		2	W		Slight		In chromosphere.
19	8 37	15		E		1		At top.
22	8 45	24·5		W	1	1		To red at top and to violet at the middle of the prominence.
23	11 30	57		W	1			At top.
30	11 54	71		W	1			Do.
December 4	9 30	35		E	0·5			At top.
	9 43		17	W	1			Do.
	9 50	19		W	1			Do. from +17° to +21°.
5	9 15		73	E	1			Do.
	9 47		17	W	1			Do.
9	9 29	41		E		1		At base.
	9 20	37·5		E		1		At top.
	9 25	18·5		E		1		At base.
	8 54	59		W	Slight			At top.
11	10 00	17·5		W	5	2		
	10 40	11·5		W	6			Over the whole prominence.
13	9 30	38·5		E	0·5			At top.
	9 38	25		E		1·5		Do.
	9 15	43·5		W		0·5		In chromosphere.
14	9 15	39·5		E		1		At top ; from +36° to +40°.

TABLE III.—DISPLACEMENTS OF THE HYDROGEN LINE—JULY TO DECEMBER 1937—*concld.*

Date.	Time I. S. T.	Latitude.		Limb.	Displacement.			Remarks.
		North.	South.		Red.	Violet.	Both ways.	
	H. M.	°	°		A	A	A	
1937.								
December 16	9 24	64		E			0·5	At base.
	9 28	41·5		E	1			At top.
	9 38		41	E	1			Do. from —40° to —42°.
	9 00	74·5		W		0·5		Do.
22	10 55	74		E	0·5			Do. from +73° to +75°.
23	9 52		58	E	Slight			At base.
26	9 17	80		E	1·5			At top.
	9 31	12		E		0·5		Do. from +11° to +13°.
	9 25	Equator		W	1			Do.
27	9 14	30		W			0·5	At base.
	9 14	37·5		W	1			At top ; from +35° to +40°.
28	9 40	20		E		0·5		At top.
	9 28	26·5		W	2	0·5		To red at top and to violet at base ; from +25° to +28°.
	9 25	41·5		W		1		At base.
	9 23	56		W		0·5		In chromosphere.
29	11 8	74		E	1			At top.
	11 15	23		W	1			Do. from +22° to +24°.

The total number of displacements was 126 as against 245 in the previous half-year and their distribution was as follows :—

	North.	South.
0°—30°	54	27
31°—60°	23	6
61°—90°	15	1
Total	92	34
East limb	50	
West limb	76	
Total	126	

Of these 54 were towards the red, 53 towards the violet and 9 both ways simultaneously.

Reversals and Displacements on the Sun's Disc.

Three hundred and thirty one bright reversals of the Hα line, 321 dark reversals of the D_3 line and 21 displacements of the Hα line were observed with the spectroscope during the half-year. Their distribution is given below :—

	North.	South.	East.	West.
Bright reversals of Hα	188	143	159	172
Dark reversals of D_3	184	137	155	166
Displacements of Hα	13	8	10	11

Thirteen displacements were towards the red, 4 towards the violet and 4 both ways simultaneously.

The Hale spectroheliscope was used daily (except on Sundays and holidays) for observation in the Hα 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 2h. 30m. to 3h. 00m., 4h. 00m. to 4h. 30m., 5h. 30m. to 6h. 00m. G. M. T. *i.e.*, 8h. 00m. to 8h. 30m., 9h. 30m. to 10h. 00m., 11h. 00m. to 11h. 30m. 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 the year 1937 are summarised below :—

	East limb.	West limb.	Total.
Displacements in prominences	54	56	110

	North.	South.	East.	West.	Total.
Displacements in Hα dark markings	20	9	18	11	29
Displacements in Hα bright flocculi	4	..	1	3	4

	Displacements towards.			
	Red.	Violet.	Both ways.	Total.
Prominences	59	51	..	110
Hα dark markings	18	11	..	29
Hα bright flocculi	3	1	..	4

Prominences Projected on the Disc as Absorption Markings.

Photographs of the sun's disc in Hα light were available from Kodaikanal and co-operating observatories for 178 days which were reckoned as 171¼ effective days. The mean daily areas of Hα 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	5198	31·40
South	3223	22·69
Total	8421	54·09

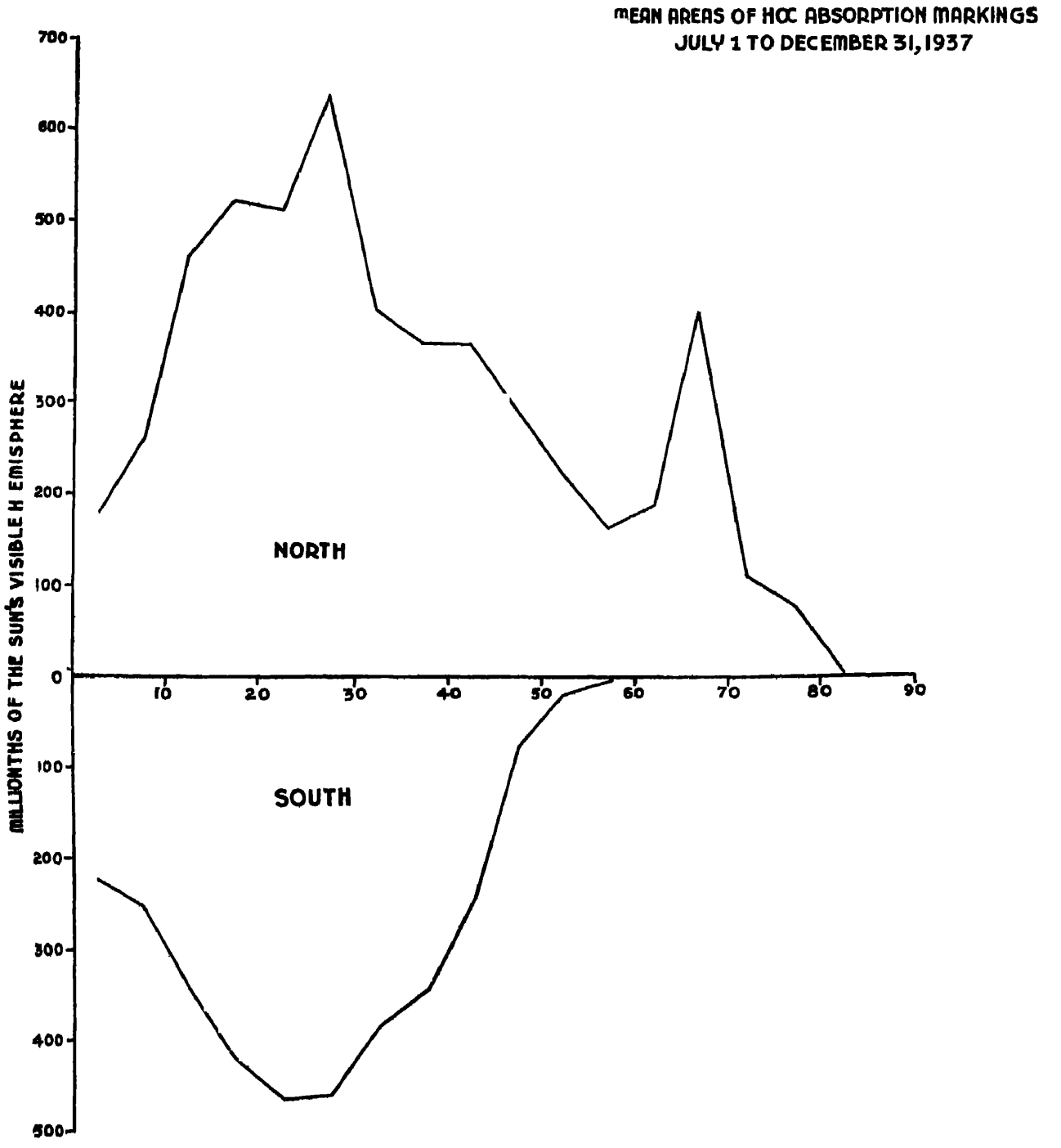
The above figures show that there has been a decrease of 19 per cent in areas and 5 per cent in numbers when compared with those of the previous half-year.

For comparison with bulletins issued prior to the co-operation of other observatories, the means based on Kodaikanal photographs only are also given, 127 days of observation being counted as 120 effective days.

	Mean daily areas.	Mean daily numbers.
North (Kodaikanal photographs only)	5088	30·79
South (do.)	3075	22·25
Total	8163	53·04

* 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.

The distribution of mean daily areas in latitude is shown in the following diagram. Compared with the previous half-year, the low latitude zone of maximum activity has advanced about 5° towards the pole in the northern hemisphere but there is no change in the southern. The high latitude peak in the northern hemisphere remains stationary but that of the southern hemisphere has disappeared, there being no activity at all beyond 60°.



Both areas and numbers show an eastern defect, the percentage east being 46·83 for areas and 48·82 for numbers.

The mean daily areas of Hα absorption markings uncorrected for foreshortening are given below :—

	Mean daily areas.
North	2860
South	1833
Total .	4693

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 areas.

KODAIKANAL,
The 23rd November 1938.

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