

# Kodaikanal Observatory.

BULLETIN No. LXXIV.

## SUMMARY OF PROMINENCE OBSERVATIONS FOR THE FIRST HALF OF THE YEAR 1923.

In accordance with a resolution of the International Astronomical Union meeting held in Rome in 1922, the Kodaikanal Observatory has undertaken the work of compilation and discussion of statistics derived from photographs of prominences and H $\alpha$  absorption markings of the Sun. All observatories taking prominence and H $\alpha$  spectroheliograms of the Sun have been asked to co-operate by supplying copies of their photographs on those days when the Kodaikanal record is imperfect or wanting. In response to our requirements, the Mount Wilson Observatory sent prominence plates in calcium K light for 34 days in the half-year and H $\alpha$  disc plates for 20 days; Mendon Observatory sent K $\beta$  disc plates for 24 days and H $\alpha$  disc plates for 14 days; no plates were asked for from the Yerkes Observatory where calcium H $\beta$  disc plates and prominence plates are occasionally taken.

When incomplete or imperfect photographs from more than one observatory are available for the same day, the best photograph is chosen as representing the solar activity of that day after weighting the plate according to its quality, and the remaining photographs are ignored.

The mean daily areas and numbers are given below. The means are corrected for incomplete or imperfect observations, the total of 176 days for which photographs are available being reduced to 160½ effective days.

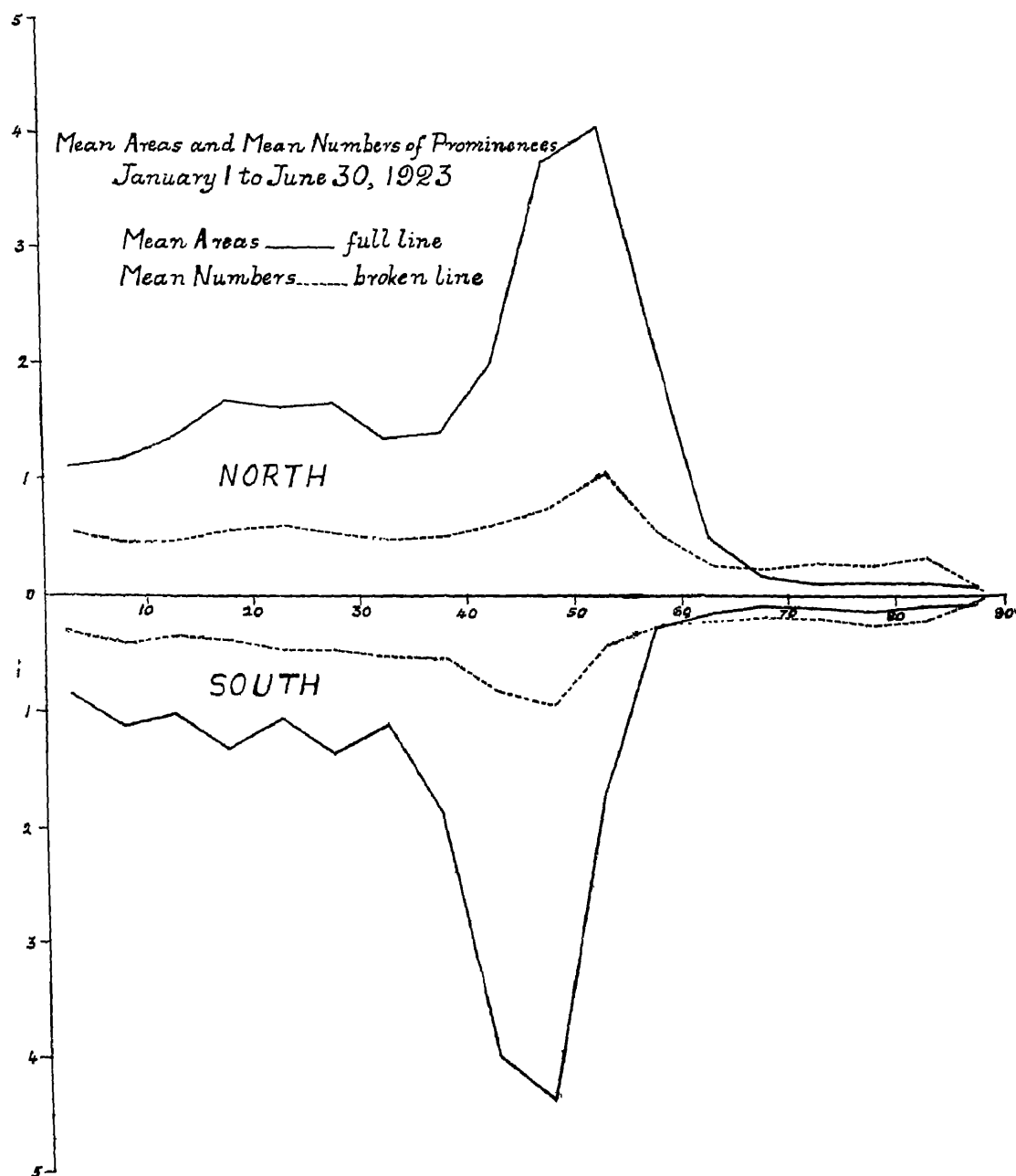
								Mean daily areas (square minutes).	Mean daily numbers.
North	...	...	...	...	...	...	...	2.43	8.37
South	...	...	...	...	...	...	...	2.06	7.13
								—	—
						Total	...	4.49	15.50
								—	—

For comparison with previous bulletins issued prior to the co-operation of other observatories, the means based on Kodaikanal photographs alone are also given. 164 days being counted as 152½ effective days.

							Mean daily areas (square minutes).	Mean daily numbers.	
North (Kodaikanal photographs only)	...	...	...	...	...	...	2.48	8.56	
South	do.	...	...	...	...	...	2.10	7.33	
							—	—	
						Total	...	4.58	15.89
							—	—	

Compared with the previous half-year areas show an increase of 57 per cent in the northern hemisphere and 24 per cent in the southern. In the case of numbers there is an increase of 70 per cent in the northern hemisphere and of 38 per cent in the southern.

The latitude distribution of prominences on photographs from all the co-operating observatories during the half-year ending 30th June 1923 is represented in the accompanying 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. The curve is similar to the distribution in the second half of 1922 except that there is greater activity in the higher latitudes and a slight advance towards the poles.



The monthly, quarterly and half-yearly areas and numbers, and the mean height and mean extent of the prominences on photographs from all the co-operating observatories are given in Table I. The unit of area is 1 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; 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 FIRST HALF OF 1923.

Months.	Number of days (effective).	Areas.	Numbers.	Daily Means.		Mean height.	Mean extent.
				Areas.	Numbers.		
January	26	124.0	449	4.8	17.3	31.9	3.45
February	28	140.0	471	5.0	16.8	33.5	3.86
March	27	122.8	435	4.6	16.1	33.2	3.38
April	27½	130.7	436	4.8	16.8	35.2	5.76
May	28½	116.7	411	4.1	14.3	33.2	3.32
June	23½	87.2	285	3.8	12.2	34.4	3.73
First quarter	81	386.8	1355	4.8	16.7	32.9	3.57
Second quarter	79½	334.6	1132	4.2	14.3	34.3	4.36
First half-year	160½	721.4	2487	4.5	15.5	33.6	3.93

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

Both areas and numbers show an excess in the western hemisphere as will be seen from the following table :—

1923 January to June.	East.	West.	Percentage East.
Total number observed ... ..	1229	1258	49.4
Total areas in square minutes ... ..	345.8	375.6	47.9

*Metallic prominences.*

Only six metallic prominences were recorded during the half-year.

All of them were on the west limb and their details are shown below :—

TABLE II.—LIST OF METALLIC PROMINENCES OBSERVED AT KODAIKANAL, JANUARY TO JUNE 1923.

Date.	Time S.T.	Base.	Latitude.		Limb.	Height.	Lines.
			North.	South.			
1923 January	5 8	11. 45 8 52	1 2	11.5 3	W W	15 10	b <sub>1</sub> , b <sub>2</sub> , b <sub>3</sub> , b <sub>4</sub> , 5316.8, 5535.06, D <sub>1</sub> , D <sub>2</sub> , 6677. 4924.1, 5016, 5018.6, b <sub>1</sub> , b <sub>2</sub> , b <sub>3</sub> , b <sub>4</sub> , 5208.7, 5276.2, 5316.8, D <sub>1</sub> , D <sub>2</sub> , 7065.
February	31 1	9 19 9 12	19 27	10.5 18.5	W W	65 65	b <sub>1</sub> , b <sub>2</sub> , b <sub>3</sub> , b <sub>4</sub> , D <sub>1</sub> , D <sub>2</sub> . 4924.1, 5016, 5018.6, b <sub>1</sub> , b <sub>2</sub> , b <sub>3</sub> , b <sub>4</sub> , 5316.8, 5363.0, D <sub>1</sub> , D <sub>2</sub> , 6677, 7065.
	2 14	8 54 9 23	15	18.5 0.5	W W	80 40	4924.1, 5018.6, b <sub>1</sub> , b <sub>2</sub> , b <sub>3</sub> , b <sub>4</sub> , 5234.8, 5316.8, D <sub>1</sub> , D <sub>2</sub> . 4922.0, 4924.1, 5018.6, b <sub>1</sub> , b <sub>2</sub> , b <sub>3</sub> , b <sub>4</sub> , 5197.8, 5234.8, 5276.2, 5316.8, 5363.0, 5535.06, D <sub>1</sub> , D <sub>2</sub> , 6677, 7065.

The distribution in latitude of the metallic prominences was as follows :—

—			1° - 10°.	11° - 20°.	Mean latitude.	Extreme latitudes.
North	...	...	...	4	14°·8	10°·5 and 18°·5
South	...	...	2	...	1°·8	0°·5 and 3°

*Displacements of the hydrogen lines.*

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

TABLE III.—DISPLACEMENTS OF HYDROGEN LINES.

Date.	Time I.S.T.	Latitude.		Limb.	Displacement.			Remarks.
		North.	South.		Red.	Violet.	Both ways.	
1923	H. M.	°	°		Λ.	Λ.	Λ.	
January	3	9 12		6	E	1		At base.
	4	11 34	2		W	2		At top.
	5	8 45	7		W	Slight		
	6	9 17	4		W		1	At base.
	6	9 19	8		W		1	Do.
	6	9 22	10		W		2	Do.
	6	9 20	12		W	1	0·5	To red at top ; to violet at base
	7	8 32	84		E		Slight	
	7	8 48		51	W		1·5	At top.
	8	9 4	50		E	1		At base.
	8	8 52		3	W		0·5	Do.
	8	8 44	37		W	1		At top.
	9	10 50	69·5		E	0·5		
	9	10 55	16		E		Slight	
	9	10 58		22	E	0·5		
	17	8 49		40	W	Slight		At top.
	18	8 54		35	E		1	Do.
	19	8 35	45		E	2		
	19	8 37	30		E	2		
	19	8 44	1		E		0·5	
	19	8 27		44·5	W		Slight	
	20	9 17	56		W		0·5	At top.
	20	8 46	75		E		Slight	At base.
	21	9 7	5		E	1		Do.
	21	8 58	56·5		W	1·5		At top.
	22	8 35	82		E	Slight		
	22	8 4	12·5		W	0·5		
	23	8 29	23·5		W		Slight	
	24	9 5	76		E	Slight		At base.
	24	8 54		58·5	E	1		Do.
	28	9 13	11·5		E		0·5	At top.
	29	8 42	49		E		1	Do.
	29	9 14	8		E	Slight		
	30	8 40	54		E	Do.		
	31	9 28		7·5	W	1		At base.
	31	9 12	5		W		1	Do.
February	1	8 47	66·5		E		Slight	
	1	8 44	55		E	1		At top.
	1	8 42	42		E		0·5	At base.
	1	8 50	9		W	1		
	2	8 46	45·5		E	Slight		
	2	8 35	19		W		2	
	3	9 2		37·5	W	1		At top.
	4	8 32	83		E		Slight	
	4	8 30	55		E	0·5		
	5	9 34		34	E	0·5		

Date.	Time I.S.T.	Latitude.		Limb.	Displacement.			Remarks
		North.	South.		Red.	Violet.	Both ways.	
1923.	H. M.	°	°		A.	A.	A.	
February	5	8 58	64	W	1			At top.
	6	8 28	35.5	W		Slight		
	7	9 19	52.5	W	0.5			At top.
	10	9 24	83.5	E	Slight			
	11	8 55	2	W		Slight		
	11	8 52	77	W	1			At base
	12	9 4	75.5	E	1			
	13	8 20	73	W			Slight	
	14	9 23	6	W	Slight	0.5		
	15	8 42	68	E		Slight		
	15	9 24	18	E		1		At base.
	16	8 27	63	E	Slight			
	17	8 44	46.5	E	Do.			
	18	9 4	30	E		Slight		At top.
	19	8 48	39.5	W		Do.		
	22	8 58	20	E	1.5	2.5		
	22	8 40	23	W	1			At top.
	23	8 30	35.5	E	0.5			Do.
	23	8 53	14	E	0.5			At base.
	23	9 4	83	W	0.5			
	23	8 44	21	W		0.5		
	25	8 42	69	E	1			
	25	8 46	81	W		1		
	26	8 43	65	E		Slight		
	26	9 2	29	E		0.5		At base.
	26	8 52	15	W		2		Do.
	27	8 39	36.5	E	Slight			
	28	8 47	79.5	E	3			
March	1	8 34	60	E	0.5			
	1	8 40	57	E		0.5		At base.
	1	8 37	49	E	Slight			At top.
	1	8 56	50	E	0.5			
	1	8 50	1.5	W		0.5		
	1	8 44	81.5	W	1			
	2	8 28	72	E		Slight		
	2	8 36	7.9	E		0.5		
	2	8 31	28	W	Slight			At top.
	4	9 4	16	E	2			Do.
	4	9 6	81	E	Slight			
	4	8 52	28	W		Slight		
	4	8 50	30	W	0.5			At top.
	5	8 45	82.5	E		Slight		
	5	8 44	71.5	E	Slight			
	5	8 40	50	E	0.5			At top.
	5	8 52	2	W	1			Do.
	6	8 39	17.5	W	1			Over whole height 30".
	6	8 45	63	W		Slight		
	7	8 40	57.5	E		Do.		
	7	8 46	53	W	0.5			
	9	8 50	14.5	E	1	1.5		To red at base ; to violet at top.
	9	8 27	82	W		1		At base.
	11	8 39	49	E		0.5		Do.
	12	8 30	50	E		1		At top.
	14	9 28	52	E	1			Do.
	14	9 24	2	W		Slight		
	14	9 14	82.5	W		Do.		
	16	9 7	50	E		2		At top.
	16	9 20	50.5	W		0.5		
	18	9 8	22	E		Slight		At base.
	19	8 32	82	E	Slight			At top.
	19	8 43	69	E	Do.			
	19	8 50	79.5	E	1	2		To red at top to violet at base.
	20	8 32	57.5	W		Slight		
	20	8 32	74.5	W		Do.		
	21	8 58	21.5	W	0.5			At top.
	23	8 30	80	E	Slight			

Date.	Time I.S.T.		Latitude.		Limb.	Displacement.			Remarks.
			North.	South.		Red.	Violet.	Both ways.	
1923	H.	M.	°	°		A.	A.	A.	
March	23	8 28	72.5		E	1			
	23	8 44	48		W	2			At top.
	23	8 40	58.5		W		Slight		
	23	8 34	65		W		0.5		
	24	8 37	34.5		E	Slight			
	24	8 47	59.5		W	Do.			
	25	9 8	39.5		E	Do.			
	25	8 58		8	W	Do.			
	26	8 46	85.5		E	1			At top.
	26	8 44	59		E		0.5		
	26	8 40	17.5		E	Slight			
	27	8 38	9		W	Do.	1		5 A to violet at 8h 50
	27	8 36	52		W	Do.			At top.
	27	8 34	53		W		Slight		
	28	8 47		23	E	Slight			At base.
	28	8 37	7		W		0.5		
	28	8 32	45		W	1			At base.
	29	8 40	70		E	0.5			At top.
	29	8 37	49		E		Slight		
	29	8 43	83		W	1			At top.
	30	9 9	81		E	Slight			
	30	9 15	56		E	0.5			At base.
	30	9 20		67	E	Slight			
	31	8 40	26		W	1			
April	1	8 44	55.5		W	Slight			
	3	8 2		68.5	E	Do.			
	4	8 26	79.5		E		Slight		
	4	8 41	19		E	Slight			
	5	8 34		75	E	0.5			
	5	8 25		37	W			Slight	
	6	8 43	52.5		W	0.5			At top.
	7	8 20	15		W	0.5			
	8	8 32	25		E		Slight		
	8	8 47		41	W	1			At base.
	9	8 50	69		E	1			At top.
	9	8 44	25		E		Slight		
	9	8 42	17		E		1		At base.
	9	8 55	54		W	1			At top.
	10	9 10	56		W		Slight		
	11	8 40	22		E		1		At base.
	11	9 8		0	E	Slight			
	14	8 26		Axis.	...	Do.			
	15	9 3	9		W	0.5			
	15	9 8	53		W		Slight		At base.
	16	10 36	54		W		Do.		At base.
	21	9 12	11		W		Do.		At base.
	22	8 40	34		E		Do.		At base.
	22	8 47	59		W		Do.		At base.
	26	8 18	57.5		E		Do.		
	26	8 20	53		E	1			At top.
	27	8 31	41		E		0.5		
	27	8 40	42		W		Slight		
	29	8 40	64.5		W		Do.		
	29	8 50		54.5	W		1.5		At top.
	29	8 44		42	W	Slight			
	30	8 54	45		E	Do.			
	30	9 15		59.5	W		0.5		
May	1	8 30	12		E		Slight		
	1	11 20	79		W			Slight	
	2	8 46	85		E				
	2	8 42	59		E	0.5			
	3	8 55		71	E	Slight			
	3	8 48	59.5		W	Do.			
	4	8 44	42		E		1		At top.
	4	8 48	71.5		W		Slight		

Date.	Time I.S.T.		Latitude.		Limb.	Displacement.			Remarks.
			North.	South.		Red.	Violet.	Both ways.	
						A.	A.	A	
1923	H.	M.	°	'					
May	6	8 44	57		E	Slight			
	6	8 53	51		E	Do.			At base
	6	8 56	22		E	0.5			
	7	8 31	67		E	1			
	8	8 45	Equator.		E		Slight		At top.
	8	8 40	84		W	Slight			
	8	8 25	41.5		W		Slight		
	8	8 35	68.5		W	Slight			
	9	8 44	80.5		E		Slight		
	9	8 52		85.5	E	1			
	10	8 32		29	W		2		
	10	8 40	78.5		W	2			
	11	9 0		30	W	1			At top.
	13	8 48	60		E		Slight		
	13	8 50	47		W	0.5			
	14	8 48	79.5		E		Slight		
	14	8 53		20	W	0.5			At top.
	16	8 48		15	W		Slight		
	17	8 24		4	W		Do.		
	19	8 30	84.5		W		2		
	20	8 30	52.5		E		0.5		
	20	8 35	67		W		Slight		
	21	8 32	69		E	Slight			
	21	8 35	41.5		E	Do.			
	21	8 46	31		W	0.5			At top.
	22	8 32		88	W	1			
	22	8 30		74	W	1			
	23	9 10	17		W		Slight		At base.
	24	8 38	55		E		0.5		Do.
	24	8 35	40		E	0.5			At top.
	24	8 50		9	E		0.5		
	25	8 51		1	W	0.5			
	28	8 48	76		E		1		At base.
	28	8 54	58		W		1		Do.
	29	8 30		68	W	1			
	30	9 8		42	W		Slight		
June	1	8 48	57		E		Slight		
	2	9 2	53		E		0.5		
	2	9 14		18.5	W	1			At top.
	4	11 26	14		W		Slight		
	5	9 28	22		E	1			At base.
	5	8 34		34	E		1		
	6	11 44	46		E		Slight		
	7	9 45		81.5	E		0.5		
	8	8 44	61		E		Slight		
	8	8 48	47.5		W	0.5			
	10	9 2	49		W		0.5		
	11	8 54	9		E		Slight		
	11	8 55		31	E	0.5			
	15	8 54	52		E	0.5			
	16	8 33		13	W		0.5		
	16	8 30	55		W	1			At top.
	18	10 10		25	W	0.5			Do.
	20	8 50	34		W		Slight		At base.
	20	8 36	84		W		0.5		
	27	11 15	4		W	1			
	29	9 53		6	E	0.5			
	29	9 34	84.5		W	Slight			To red at top; to violet at base.

The total number of displacements was 242, of which one was on the equator and the rest were distributed as follows :—

Latitude.	North.	South.
1°—30°	55	25
31°—60°	72	19
61°—90°	52	18
Total ...	179	62

East limb	...	...	...	...	...	127
West limb	...	...	...	...	...	114
Pole	...	...	...	...	...	1
Total	...	...	...	...	...	242

126 displacements were towards the red, 113 towards the violet and 3 both ways simultaneously.

*Reversals and displacements on the disc.*

Twenty-two bright reversals of the  $H\alpha$  line, 7 dark reversals of the  $D_3$  line and 8 displacements of the  $H\alpha$  line on the disc were observed during the half-year. Their distribution is shown below :—

	North.	South.	East.	West.
Bright reversals of $H\alpha$	12	10	9	13
Dark reversals of $D_3$	4	3	2	5
Displacements of $H\alpha$	3	5	4	4

Of the displacements, six were towards the red and the rest towards the violet.

*Prominences projected on the disc as absorption markings.*

Photographs of the Sun's disc in  $H\alpha$  light were available from the co-operating observatories for a total of 174 days counted as 166½ effective days. The mean daily areas of  $H\alpha$  absorption markings (corrected for foreshortening) in millionths of the Sun's visible hemisphere, and the mean daily numbers are given below :—

	Mean daily areas.	Mean daily numbers.
North	728	5.2
South	331	3.3
Total	1059	8.5

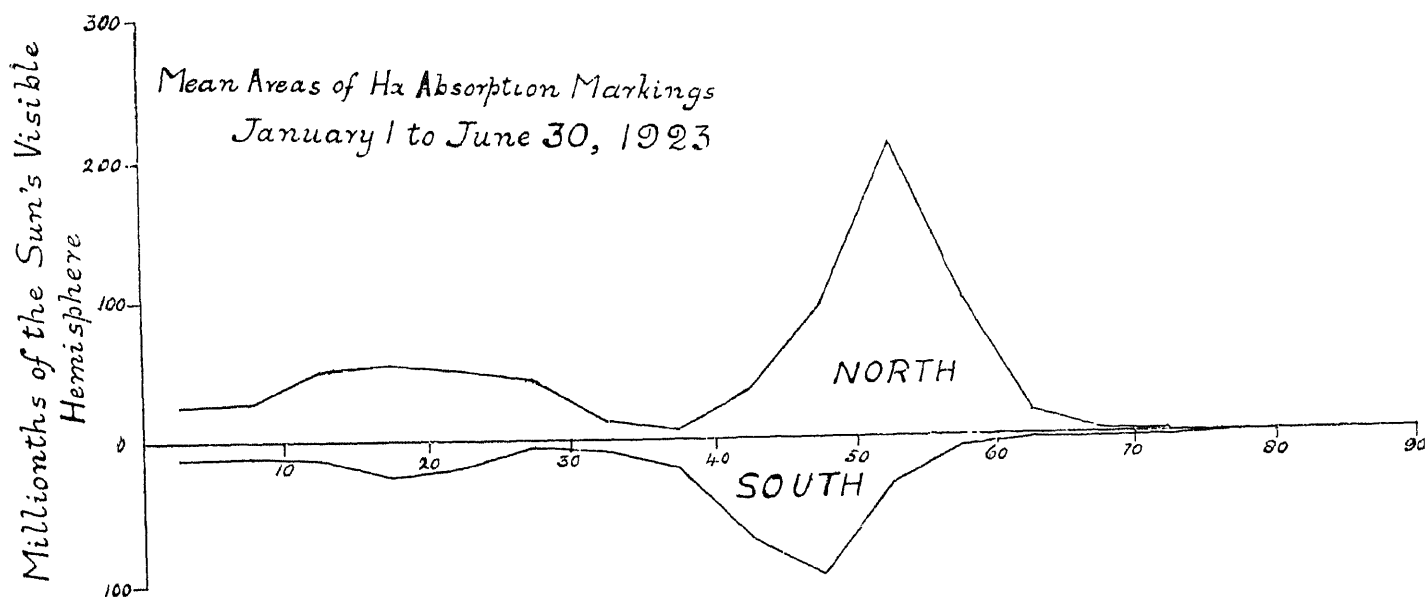
For comparison with previous bulletins issued prior to the co-operation of other observatories, the mean based on Kodaikanal photographs alone are also given, 162 days of observation being counted as 152½ effective days.

	Mean daily areas.	Mean daily numbers.
North (Kodaikanal photographs only)	688	4.8
South Do.	301	3.1
Total	989	7.9

These figures indicate an increase of 7 per cent in areas and a decrease of 11 per cent in numbers compared with the previous half-year.



The distribution of mean daily areas in latitude is shown in the following diagram. Compared with the second half-year of 1922 there is greater activity in the belt near  $50^\circ$  and in the southern hemisphere the maximum has advanced  $5^\circ$  towards the pole.



The absorption markings resemble prominences at the limb in their western preponderance, the percentage east being 48.08 for areas and 48.51 for numbers.

The thanks of the Director are due to the staffs of observatories at Mount Wilson, Meudon and Yerkes for the material they have forwarded to Kodaikanal and for the promptness with which they have responded to his requests.

THE OBSERVATORY, KODAIKANAL,  
17th March 1924.

T. ROYDS,  
Director, Kodaikanal and Madras Observatories.