

Kodaikanal Observatory.

BULLETIN No. XCIV.

SUMMARY OF PROMINENCE OBSERVATIONS FOR THE FIRST HALF OF THE YEAR 1931.

In pursuance of the programme of work adopted since 1st January 1923 under the auspices of the International Astronomical Union, all observatories taking spectroheliograms of the sun have been asked to co-operate with the Kodaikanal Observatory by supplying copies of their photographs on those days when the Kodaikanal records are imperfect or wanting. In response to our requirements for the first half of the year 1931, the Mount Wilson Observatory supplied calcium (K_{85}) prominence plates for 16 days and $H\alpha$ disc plates for 4 days, the Meudon Observatory supplied calcium (K_8) disc plates for 3 days and $H\alpha$ disc plates for 14 days.

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

Calcium Prominences at the Lamb.

The mean daily areas and numbers of prominences photographed during the half-year by means of the K line of calcium are given below. The means are corrected for incomplete or imperfect observations, the total of 180 days for which plates were available being reduced to 171 effective days.

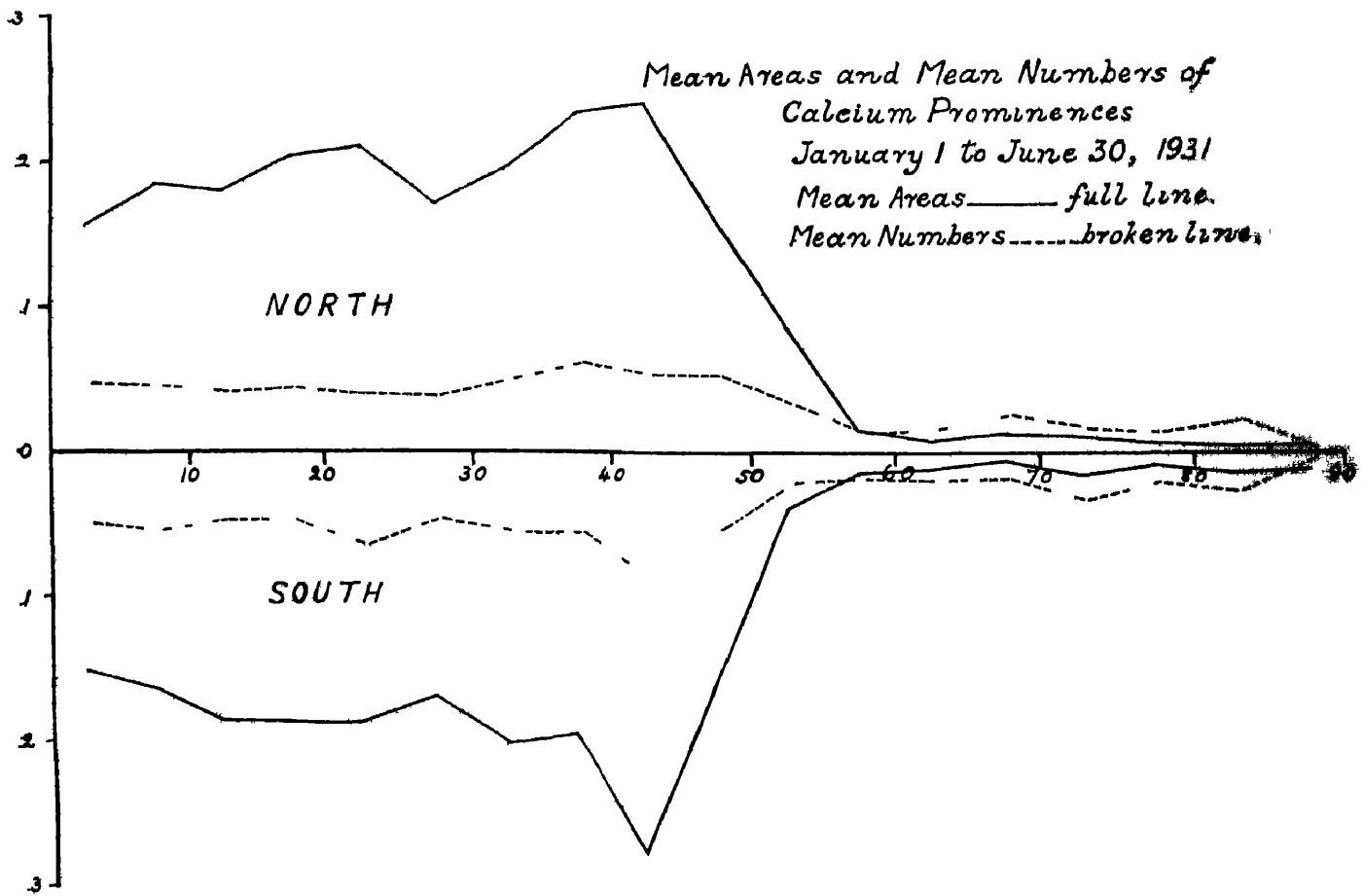
								Mean daily areas (square minutes)	Mean daily numbers.
North	...	...	...	.	...	...	...	2 11	6 60
South	...	...	...	...	...	...	..	1 98	7 09
								-----	-----
							Total	4 09	13 69
								-----	-----

Compared with the previous half-year, areas show an increase of 33 per cent, the increase being greater in the northern hemisphere than in the southern, whilst numbers show an increase of 16 per cent.

For comparison with bulletins issued prior to the co-operation of other observatories, the means based on Kodakanal photographs alone are also given, 166 days of observation being counted as 159½ effective days

	Mean daily areas (square minutes)	Mean daily numbers
North (Kodakanal photographs only)	2 18	6 78
South (do do)	2 06	7 24
Total	4 24	14 02

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. The distribution of activity is very similar in both the northern and southern hemispheres, and differs considerably from that in the previous half-year. The activity now increases from the equator up to latitude 45° and is very small beyond 55°



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 one square minute of arc. The mean height is derived by adding together the greatest heights measured 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.

It is seen that the increase in areas over the previous half-year is due to an increase in mean extent rather than to a change in the mean height of prominences.

TABLE I.—ABSTRACT FOR THE FIRST HALF OF 1931.

Months	Number of days (effective).	Areas	Numbers	Daily means		Mean height.	Mean extent
				Areas	Numbers.		
1931						"	°
January	27½	101.3	329	3.7	11.9	30.0	5.9
February	27½	131.2	410	4.8	14.9	31.0	5.9
March .. .	31	129.9	466	4.2	15.0	32.3	5.3
April .	27½	118.6	414	4.3	14.9	28.6	5.4
May ...	28½	122.1	370	4.3	13.1	32.8	5.6
June	28½	93.9	351	3.3	12.2	29.4	5.3
First quarter ..	86½	362.4	1,205	4.2	14.0	31.2	5.6
Second quarter	84½	334.6	1,135	3.9	13.4	30.2	5.4
First half-year .	171	697.0	2,340	4.1	13.7	30.7	5.5

Distribution east and west of the sun's axis.

Unlike the previous half-year, there is a defect of both the areas and numbers at the east limb, as will be seen from the following table.—

1931 January to June.	East.	West	Percentage East
Total number observed	1145	1195	48.93
Total areas in square minutes	329.0	368.1	47.20

Hydrogen Prominences at the Limb.

During the half-year photographs of the prominences in hydrogen light were taken in this observatory on 163 days which were counted as 148 effective days. The mean daily areas, in square minutes of arc, of hydrogen prominences are given below.—

	Mean daily areas (square minutes).
North	0.77
South	0.66
Total	1.43

Compared with the previous half-year, H α prominence areas show an increase of about 25 per cent. The percentage of H α areas to calcium areas is 34, as in the previous half-year. The curve of distribution of H α prominences in latitude is similar to that of calcium prominences. The northern preponderance of activity is more marked for H α prominences than for calcium ones, the ratio of the northern areas to the southern being 1.17 and 1.06 for H α and K prominences, respectively.

Metallic Prominences

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

TABLE II — LIST OF METALLIC PROMINENCES — JANUARY TO JUNE 1931

Date	Time LST	Base	Latitude		Limb	Height	Lines (See note at end of table)
			North	South			
1931	H M	°	°			"	
January	18	11 15	1	95	W	10	1, 2, 3, 4, 5, 7, 8, 9, 10
	19	10 0	4	5	W	10	1, 3, 4, 5, 7, 8, 9, 10, 11, 12
	20	8 50	4	4	W	10	3, 4, 7, 8, 10
	27	8 44		6	W	15	1, 2, 3, 4, 5, 7, 8, 9, 10, 11, 12
February	6	9 22		9	W	10	4, 10
	14	9 40	2		E	10	1, 2, 3, 4, 9, 10, 11, 12
	22	9 27	5	105	E	15	1, 2, 3, 4, 9, 10, 11, 12
	27	9 33	4	10	W	35	1, 2, 3, 4, 9, 10, 11, 12
		9 35	2		W	15	1, 2, 3, 4, 9, 10, 11, 12
	9 20	3	15	W	20	1, 2, 3, 4, 8, 9, 10, 11	
March	2	9 8	4	9	W	10	1, 3, 4, 7, 8, 9, 10, 11, 12
		9 5	3	175	W	15	1, 3, 4, 8, 10
	14	8 49	3		W	10	1, 2, 3, 4, 5, 7, 8, 9, 10, 11, 12
April	10	9 37	3	185	E	30	1, 2, 3, 4, 9, 10, 11
		9 18	5	05	W	30	1, 2, 3, 4, 8, 9, 10, 11, 12
	11	9 29		17	E	20	1, 3, 4, 5, 7, 8, 9, 10, 11, 12
	23	9 9	5	45	W	35	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12 Also λ 5371.8
	24	9 27	2	8	W	20	1, 2, 3, 4, 9, 10, 11, 12
May	19	8 51	4	6	W	15	1, 2, 3, 4, 5, 7, 8, 9, 10
	20	9 15	1	95	W	20	1, 2, 3, 4, 5, 7, 8, 9, 10, 11, 12
		9 15	2	13	W	20	1, 2, 3, 4, 5, 7, 8, 9, 10, 11, 12
June	12	9 0	1	35	W	15	1, 2, 4, 8, 9, 10, 11
	15	10 20	3		W	15	1, 2, 3, 4, 5, 7, 8, 9, 10, 11, 12
	25	9 10	1	35	E	10	4, 10 (Faintly reversed)

NOTE — The key to the wavelengths of metallic lines is as follows —

No	λ	Element	No	λ	Element
1	4924.1	Fe+	7	5276.2	Fe+ C ₁
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	C ₁	12	7065	He

The distribution of metallic prominences was as follows —

	1°—10°	11°—20°	Mean latitude	Extreme latitudes
North	16	4	5° 9	0° 5 and 18° 5
South	3	1	6° 2	1° 0 and 11° 5

Five were on the east limb and nineteen on the west limb.

TABLE III—Displacements of the hydrogen lines.

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

Date.	Hour I S T		Latitude		Lumb.	Displacement			Remarks
			North.	South.		Red.	Violet.	Both ways.	
1931.									
January	1	U M.	°	°		A	A.	A.	
		9 43		17.5	E	1			At top.
		9 45		74	E	0.5			No prominence
		9 32	11		W	1			At top.
		9 32	16		E	1.5			Do.
	2	9 16	83		E		0.5		No prominence
		9 18	53.5		W	1			At top
	3	9 25		32	E	0.5			Do
	8	10 40		56.5	W	1.5			Do
		10 34		1	W	2			At base
	10	9 4	33		E	0.5			Do.
		9 11		64.5	W	0.5			At top
		9 18	54		W		Slight		At base
	19	9 55	3.5		W	1.5			At top; extends over 3° from 2° to 5°.
		9 55	4		W		0.5		At base.
	22	9 20		11.5	W	0.5			Do
		9 16	50		W	1.5			At top
	23	9 33	16.5		E	0.5			Do
		9 38		34	E		0.5		Do
	26	9 4	29		W	0.5			Do
	27	8 51	6.5		E	0.5			Do.
		8 44	6		W	1			Do
	28	9 27		5	W	2			Do
		9 30	11.5		W	1			Do.
	29	9 6		3.5	E	Slight			No prominence
		9 7		11	E	1.5			At top
		9 10		41	W	Slight			Do.
		8 55	21.5		W	1			Do
	30	9 5		80	E		1		Do.
		8 55		76.5	W		Slight		No prominence.
		8 48	39.5		W	1.5			At base
	31	9 25		11	E	2.5			At top
		9 7	71		W	1.5			Do.
February	1	9 35	8		E	0.5			At top, extends over 4° from 6° to 10°.
		9 38		39.5	E		1		At top, extends over 4° from 38° to 42°
		9 17	3		W	1			At top, extends over 4° from 1° to 5°
		9 10	56		W		1.5		At top
	2	9 9	11		E	0.5			At base
		9 1		8	W	Slight			
	4	8 42	48.5		W	0.5			At top
	5	9 20		38	E			1	At base
		9 8		36	W		2.5		At top
	6	9 22	9		W			1	
	7	9 17		11	E		0.5		At top.
		9 1	30		W	Slight			Do
		9 0	60.5		W	1			
	9	9 14	8		E	0.5			At base.
	11	9 24		37.5	E	2			Do.
	12	9 36	17		E	1			No prominence.
		9 22	2		W	Slight			At top.
		9 16	22		W			1	At base.
		9 19	56.5		W		1.5		At top
	13	9 56	19		E	1			At base
		10 0		21	E	0.5			Do
	14	9 7	66		E	Slight			
		9 40		4	E	1.5			At top.
		9 12	45.5		W	1			Do.
	15	10 7		75.5	W		2		At base
		10 3	5		W		2.5		At top
	16	8 59	7		E	Slight			At base
	17	8 50		47.5	E	Do			Do

Date.	Hour L.S.T.		Latitude.		Limb.	Displacement.			Remarks.
			North	South		Red	Violet.	Both ways.	
1931.	II.	M	°	°		A	A	A	
April	7	8 47		18	W	1	0.5		To red at top, to violet at base
	8	10 31			E	2			At base
	9	10 45		32	E		1		At top
		9 15		34	W			Slight	
	10	9 2	24.5		W	2.5			At top
		9 5	43		E			light	Do
		8 55	26		E		0.5		Do
		9 40	6		E		0.5		Do
		9 28		42	W	1	1.5		To red at top, to violet at base
	11	9 55	49.5		E	1			At base
		9 51	47		E		6		At top; extends over 5° from 45° to 50°.
		9 46	26		E	2			
		9 21	8		E			Slight	At top
		9 17		9	E	1			No prominence.
		9 14		21	E	1			At base.
		9 14		22	E		2		At top
		10 2		2	W	1			
		10 12	39.5		W	1			At top
	15	9 17	59.5		E	0.5			At base
		9 15	45.5		E		2		At top
	18	8 40	70		E		Slight		
	21	8 52	78		W	0.5			At top
	23	9 10	4.5		W			1	At base
		9 9	14		W		1		At top
	24	9 37	60.5		E			1.5	
		9 27	8		W			1	
		9 21	20		W	1			At base.
		9 19	52.5		W		4		At top
	25	9 25	11.5		W	2			Do.
May	1	9 22	50		E	Slight			
	2	9 17		2	E	0.5			No prominence.
		9 0		9	W	1.5			At top
	6	9 20	10		E	1	1		To red at base, to violet at top
	7	9 13	12.5		E	Slight			No prominence.
		9 14	3		E		1.5		At top
		9 18		34.5	E		1		Do
	8	9 14		11	W	2			At base.
	15	8 50		26	W	Slight			Do.
	17	9 35	53		W	Slight			
	19	8 51	7		W		0.5		At base
	20	9 5		2	W	Slight			At top.
		9 20	67		W	0.5			Do
		9 20	70		W	Slight			Do.
	26	9 14		43	W		1		At base.
	27	9 35		31	E	0.5			No prominence.
		9 14		8	W	1	1		To red at top, to violet at base.
	29	9 56	.5		E		1.5		At top.
June	2	8 50	10		E	0.5			At base.
		8 45	6		W		1		Do.
	9	9 16		17	W	1			At top.
	11	9 32		46	E		0.5		At base.
		9 8	7		W		1		At top.
	12	9 0	3.5		W			0.5	
	13	9 2	33		E	Slight			At top.
	15	10 20		9	W	1.5	1		To red at top, to violet at base.
	16	8 58		9	W	1.5			At top
		8 58		7	W		0.5		At base.
	24	9 16		44	E	2			Do

The total number of displacements was 188 as against 79 in the second half of the previous year and their distribution was as follows —

Latitude	North	South
1°—30°	63	48
31°—60°	33	21
61°—90°	15	8
	<hr/>	<hr/>
Total	111	77
	<hr/>	<hr/>
East limb		83
West limb		105
		<hr/>
Total		188
		<hr/>

Reversals and displacements on the sun's disc

Two hundred and twenty one bright reversals of $H\alpha$ line, 208 dark reversals of the D_3 line and 28 displacements of the $H\alpha$ line were observed during the half-year Their distribution is given below —

	North	South	East	West
Bright reversals of $H\alpha$	148	73	104	117
Dark reversals of D_3	139	69	98	110
Displacements of $H\alpha$	22	6	12	16

Twenty displacements were towards the red, 6 towards the violet and 2 both ways simultaneously

Prominences projected on the disc as absorption markings

Photographs of the sun's disc in $H\alpha$ light were available from Kodaikanal and the co-operating observatories for a total of 180 days, which were counted as 178 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 —

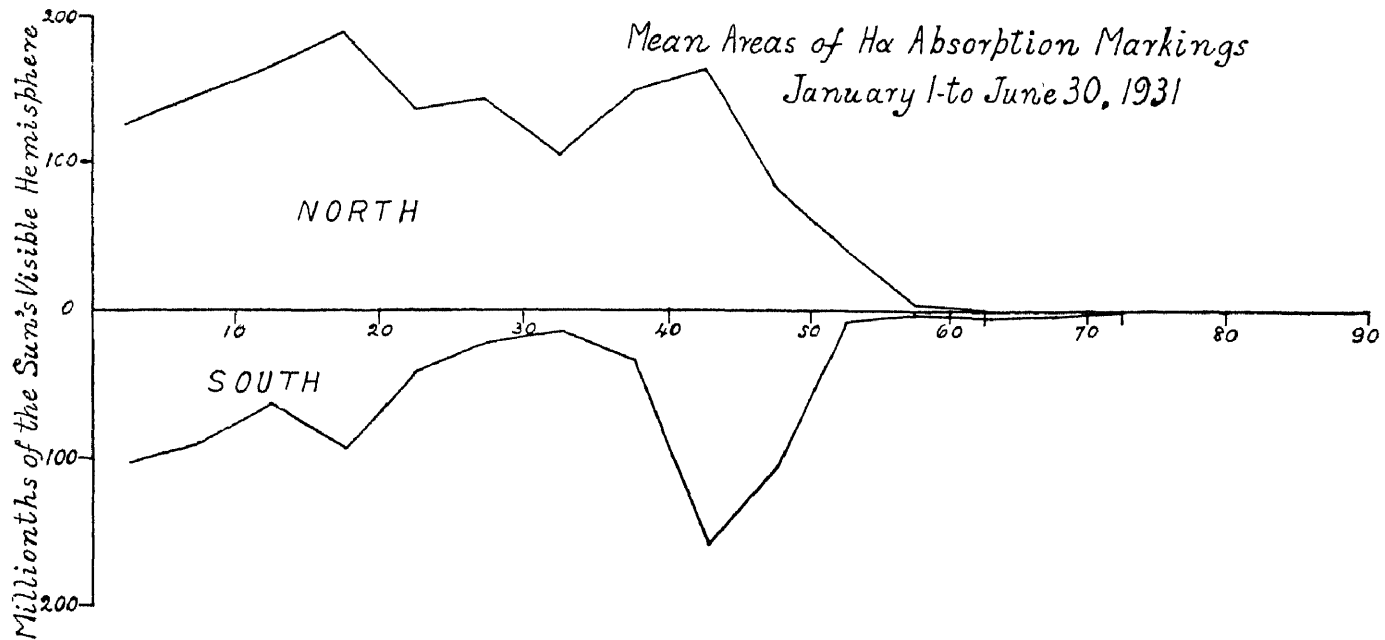
	Mean daily areas	Mean daily numbers
North	1,447	9 65
South	743	5 61
	<hr/>	<hr/>
Total	2,190	15 26
	<hr/>	<hr/>

The above show a decrease of about 12 per cent in areas and 15 per cent in numbers, compared with the previous half year The decrease has been confined to the southern hemisphere namely 38 per cent and 33 per cent for areas and numbers respectively

For comparison with bulletins issued prior to the co operation of other observatories, the means based on Kodaikanal photographs are also given, 165 days of observation being reckoned as 161½ effective days.

	Mean daily areas	Mean daily numbers
North (Kodaikanal photographs only)	1 430	9 64
South (do)	715	5 38
	<hr/>	<hr/>
Total	2,145	15 02
	<hr/>	<hr/>

The distribution of the mean daily areas in latitude is shown in the following diagram. In contrast to the distribution of prominences at the limb there is a minimum of activity near 30°, particularly marked in the southern hemisphere.



The numbers are almost equally divided between the eastern and western hemispheres, but the areas show a slight eastern excess, the percentage east being 51.7.

The areas of H α absorption markings uncorrected for foreshortening are given below.—

											Mean daily areas
North	...	...	...	...	...	...	...	...	...	...	804
South	...	...	...	...	...	...	...	...	...	...	424
											Total ... 1,228

The uncorrected areas amount to 56 per cent of the corrected ones, as against 60 per cent for the previous half-year. The curve of distribution in latitude is similar to that for the uncorrected areas as usual.

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

KODAIKANAL,
27th January 1932.

T. ROYDS,
Director, Kodaikanal and Madras Observatories.