Kodaikanal Observatory.

BULLETIN No. XC.

SUMMARY OF PROMINENCE OBSERVATIONS FOR THE FIRST HALF OF THE YEAR 1930.

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 1930, the Mount Wilson Observatory supplied calcium (K_{2s}) prominence plates for 28 days and Hα disc plates for 14 days, Meudon Observatory supplied calcium (K_3) disc plates for nine days and Hα disc plates for thirteen days; the Pitch Hill Observatory (Mr Evershed's) at Ewhurst, Surrey, England, supplied two Hα prominence plates and two Hα disc plates.

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 limb

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 179 days for which plates were available being reduced to 166½ effective days.

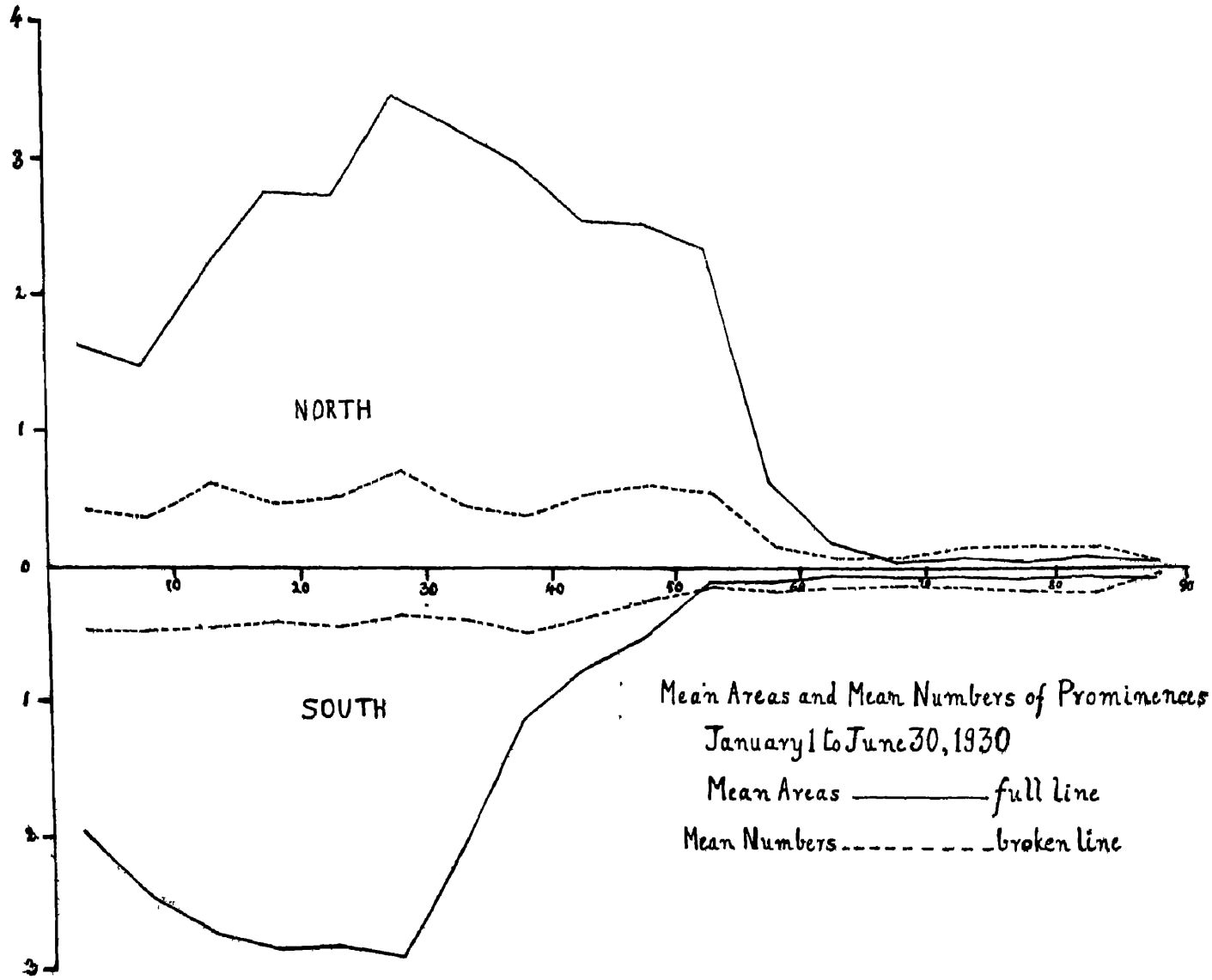
	Mean daily areas (square minutes).	Mean daily numbers
North	2 90	6·52
South	2 07	5 03
Total ...	4 97	11·55

Compared with the previous half-year prominence activity has increased in the northern hemisphere and decreased in the southern. So far as areas are concerned the decrease in the south is exactly compensated by the increase in the north, leaving the total unchanged from those for the first and second halves of 1929. As regards numbers the decrease in the southern hemisphere preponderates giving a nett decrease in the total of 10·3 per cent below that for the second half of 1929.

For comparison with bulletins issued prior to the co-operation of other observatories, the means based on Kodaikanal photographs alone are also given, 158 days of observation being counted as 145 effective days.

	Mean daily areas (square minutes).	Mean daily numbers
North (Kodaikanal photographs only)	3 13	6 96
South (do.)	2 16	5 33
Total ...	5·29	12 29

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. In the northern hemisphere the distribution is similar to that in the previous half year although the activity is greater ; in the southern hemisphere there is a notable decrease in activity in the region 35° to 70°



The monthly, quarterly and half-yearly areas and numbers, and the mean height and 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 ; 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 1930.

Months.	Number of days (effective).	Areas	Numbers	Daily means		Mean height.	Mean extent
				Areas	Numbers.		
1930						"	°
January .	28½	144 3	324	5·1	11·4	38 4	7 4
February ...	27¾	154·5	312	5·6	11 2	38 7	7 1
March . .	26½	125 5	362	4·7	13 7	33·7	5·9
April .	28½	147 1	322	5·2	11 3	34 3	7 1
May .	29	163·2	342	5 6	11·8	33 6	6 8
June .	26¼	91·8	262	3·5	10·0	30·8	6 1
First quarter .	82¾	424·3	998	5·1	12 1	36·8	6 8
Second quarter . .	83½	402 1	926	4 8	11 1	33 0	6 7
First half-year ..	166¼	826 4	1,924	5·0	11 6	35 0	6 7

Distribution east and west of the sun's axis.

Unlike the previous half-year, at the east limb there is an excess of areas but a defect of numbers as will be seen from the following table :—

1930 January to June.	East.	West.	Percentage East
Total number observed	905·0	1,018·0	47 06
Total areas in square minutes	421 6	404·8	51 02

Hydrogen prominences.

During the half-year, photographs of the prominences in hydrogen light were taken in this observatory on 146 days which were counted as 137½ effective days. The mean daily areas in square minutes of arc of hydrogen prominences are given below :—

	Mean daily areas (square minutes)
North (Kodaikanal photographs only)	1·22
South (do.)	1·00
Total ..	2·22

The H*α* areas are only 42 per cent of the calcium areas. Compared with the previous half-year H*α* areas show a decrease of 13·3 per cent. The curve of distribution of H*α* prominences in latitude is similar to that of calcium prominences. As in the case of calcium prominences the northern hemisphere now shows a greater activity than the southern, the ratio of the northern areas to the southern being 1·22 and 1 45 for H*α*

and K prominences, respectively. It is thus seen that the northern preponderance is more marked in K prominences than in Hα prominences, the opposite being the case in the previous half-year.

Metallic prominences.

Thirty-one metallic prominences were observed during the half-year. Their details are given below :—

TABLE II.—LIST OF METALLIC PROMINENCES OBSERVED AT KODAIKANAL, JANUARY TO JUNE 1930.

Date		Time. I.S.T.	Base.	Latitude.		Limb.	Height.	Lines.
				North	South.			
1930.		H. M.	°	°	°		"	
January	17	10 55	3	20 5		E	15	4924·1, 5016, 5018·6, b_4, b_3, b_2, b_1, 5316·8, 5363, D_2, D_1, 6677.
	20	8 43	7	10 5		W	10	4924·1, 5016, 5018 6, b_4, b_3, b_2, b_1, 5316·8, 5363, D_2, D_1, 6677, 7065
	28	9 9	2		19	E	15	4924·1, 5018 6, b_4, b_3, b_2, b_1, 5234·8, 5276·0, 5316·8, 5363, D_2, D_1, 7065
	30	10 0		24·5		E	15	4924·1, 5016, 5018·6, b_4, b_3, b_2, b_1, 5316·8, D_2, D_1, 6677.
	31	9 19		15·5		W	10	4924·1, 5016, 5018 6, b_4, b_3, b_2, b_1, 5316·8, D_2, D_1, 6677.
		9 18	2	20		W	20	4924·1, 5016, 5018 6, b_4, b_3, b_2, b_1, 5316·8, D_2, D_1, 6677.
February	2	9 20			9	E		b_4, b_3, b_2, b_1, D_2, D_1. Faint.
	14	9 23	3	19·5		E	25	b_4, b_3, b_2, b_1, D_2, D_1 Faint.
	16	9 5	3		18·5	W	15	4924·1, 5016. 5018 6, b_4, b_3, b_2, b_1, 5234·8, 5276·2, 5316·8, 5363, D_2, D_1, 6677, 7065.
	20	9 10	2		11	W	15	4924·1, 5016, 5018 6, b_4, b_3, b_2, b_1, 5198·9, 5208·8, 5284·8, 5268·8, 5270·6, 5276·0, 5276·2, 5284·2, 5316·8, 5328·1, 5363, 5371 7, D_2, D_1, 6677, 7065
	23	9 38			12 5	E	10	4924·1, 5016, 5018·6, b_4, b_3, b_2, b_1, 5234 8, 5276·0, 5316·8, 5363, D_2, D_1, 6677, 7065.
March	1	9 41			13	E	10	4924·1, 5016, 5018·6, b_4, b_3, b_2, b_1, 5234 8, 5276·2, 5316·8, 5363, D_2, D_1, 6677, 7065.
		9 41	1		16·5	E	10	4924·1, 5016, 5018·6, b_4, b_3, b_2, b_1, 5234·8, 5276·2, 5316·8, 5363, D_2, D_1, 6677, 7065.
	14	9 24	7		17·5	W	20	4924·1, 5018 6, b_4, b_3, b_2, b_1, 5316·8, D_2, D_1, 6677.
		9 16	5	0 5		W	30	b_4, b_3, b_2, b_1, D_2, D_1 Faint.
	15	10 10	1	30 5		E	10	4924·1, 5016, 5018 6, b_4, b_3, b_2, b_1, 5234 8, 5276·2, 5316·8, 5363, D_2, D_1.
		10 10	1	26·5		E	10	4924·1, 5016, 5018·6, b_4, b_3, b_2, b_1, 5234·8, 5276·2, 5316 8, 5363, D_2, D_1.
		10 25	1	13·5		W	5	4924·1, 5018·6, b_4, b_3, b_2, b_1, 5234 8, 5276·2, 5316·8, 5363, D_2, D_1.
	25	10 6	1		29·5	W	10	b_4, b_3, b_2, b_1, D_2, D_1.
	30	9 8	3	18·5		E	10	b_4, b_3, b_2, b_1, 5316·8, D_2, D_1.
		9 2	3		11 5	W	30	5018 6, b_4, b_3, b_2, b_1, 5276·2, 5316·8, D_2, D_1.
April	1	12 22	3	13·5		E	10	b_4, b_3, b_2, b_1, 5316 8, D_2, D_1, 6677.
	8	9 52	7		21·5	W	20	4924·1, 5018·6, b_4, b_3, b_2, b_1, 5234·8, 5276·2, 5316·8, 5363·0, D_2, D_1.
	14	8 40	4	12		W	20	4924·1, 5016, 5018·6, b_4, b_3, b_2, b_1, 5234·8, 5276·2, 5316 8, 5363·0, D_2, D_1.
	18	9 2	3	18·5		E	20	b_4, b_3, b_2, b_1, 5316 8, D_2, D_1.
	20	9 0	2	9		W	15	b_4, b_3, b_2, b_1, D_2, D_1.
May	5	8 43	3		17·5	W	20	5018·6, b_4, b_3, b_2, b_1, 5276·2, 5316·8, D_2, D_1, 7065.
	18	8 50	4		15	E	20	5018 6, b_4, b_3, b_2, b_1, 5234·8, 5276·2, 5316·8, D_2, D_1.
	22	10 26	2	15		E	10	4924·1, 5018 6, b_4, b_3, b_2, b_1, 5316·8, 5363, D_2, D_1, 6677.
	31	10 20	1	27·5		E		b_4, b_3, b_2, b_1, D_2, D_1.
June	5	8 55	3	10 5		W		4924·1, 5016, 5018·6, b_4, b_3, b_2, b_1, 5316·8, 5363, D_2, D_1, 6677.

The distribution of metallic prominences was as follows : —

——	1°–10°	11°–20°	21°–30°	31°–40°	Mean latitude.	Extreme latitudes
North . .	4	10	4	...	17° 0	0° 5 and 30° 5
South .	1	10	2	...	16° 3	9° 0 and 29°·5

Sixteen were on the east limb and 15 on the west limb.

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 THE HYDROGEN LINES, JANUARY TO JUNE 1930

Date	Hour I S.T	Latitude		Limb.	Displacement			Remarks.
		North	South.		Red.	Violet.	Both ways	
1930	H M.	°	°		A	A.	A.	
January 1	9 8	4		E	1			At base
	9 8	1		E		0 5		At top
	9 10		6.	E	0·5			At base
2	8 50	15		W	1			At top
	9 0	15		W	3·5			Do.
5	10 44	19		E		1		Do.
6	9 7	63		E		1		At base.
	9 14	12		E	1	0 5		To red at top, to violet at base.
11	8 52		4	E	0 5			At base.
	8 43	22		W	1·5			At top
12	9 31	28		E	1			At base.
	9 32	11		E		1		At top.
	9 12		77	E		Slight		Do.
13	8 52	59 5		E	0 5			Do
14	10 15	14		E	0 5			Do
17	11 0		1·5	E		0·5		At base
	9 20		6	W	3	1 5		Both at top.
18	12 10	81		W		1		In chromosphere
19	9 11		30	W	1			At top
	9 1		3	W	1			Do.
	9 0	3		W	0·5			Do
20	9 55	59·5		E			0 5	At base
	10 2	10		E	1·5			At top
	9 51		55 5	W		1		At base.
	9 51		48	W		0 5		Do.
	8 45	1		W	2			At top
21	10 30	15		E	0 5			At base
22	10 12	55·5		E		1		At top
	10 15	29		E	1			No prominence
	10 20	15·5		E		1		At top
	10 20	15		E	2			At top, extends over 6° from 12° to 18°.
	10 20	12		E		1		At top
	10 5		32 5	W			1	Do.
	9 56	20		W		1		At base.
23	9 9	14		E		0·5		Do.
	8 55	4		W		1		At top
	8 51	13		W	0·5			At top, extends over 4° from 11° to 15°.
24	9 17	11·5		E		2 5		At top, extends over 3° from 10° to 13°.
	9 4	9		W		0 5		At base.
25	9 29	25		E	1			At top
	9 25		3	E	3			No prominence.
	9 4	10		W	Slight			At top
26	10 28	36		E	1			At base

Date.		Hour I.S.T.		Latitude.		Limb.	Displacement.			Remarks.
				North.	South		Red.	Violet.	Both ways.	
1930.		H.	M.	°	°		A.	A.	A.	
January	26	10	29	25		E	Slight			At top.
	27	9	28	19		E	1			Do
		9	33	2 5		E		2		At top; extends over 7° from −1° to + 6°
		9	33	1 5		E	1			At base.
		9	10	26		W	2			At top.
		9	5	67		W		1		Do
	28	9	39	53 5		E		Slight		Do.
		9	30	8		E	Slight			Do.
		9	10		19	E		1		Do
	29	9	44	15		E		1		Do
		9	45	13		E	0·5			In a floating cloud.
		9	49	4		E	1 5			At base.
		9	29		19	W			2	On prominence.
		9	16	32		W		1		No prominence.
	30	9	45	24·5		E	1 5	1		To red at top; to violet at base.
		9	18	11		W	0·5			At base.
		9	9	76 5		W	1·5			At top.
	31	8	58	49 5		E		1·5		Do.
		9	43		8	E	1	1		To red at top; to violet at base.
		9	19	15 5		W	1			At base.
		8	18	20·5		W			Slight	Extends over 3° from 19° to 22°
February	1	9	34		5	E		1		At top.
		9	28		44 5	E	1			At base.
		10	1	12		W	1			At top.
	2	9	10	37		E	0·5			At base.
		9	20		9	E		0·5		Do.
		9	22		16	E	1			Do.
		9	27		8 2	W	1			At top.
	3	10	45		5 5	W	0·5			At top; extends over 3° from 4° to 7°.
	4	8	57		65	E		1		At top.
	5	10	30		36 5	E	1			Do.
		9	46	12		W	Slight			Do.
		9	47	28		W	1			Do.
	8	9	4	18		E		1		Do.
		9	10	15		E	3			Do.
		9	6		4	E	0 5			At base.
		9	8		14	E	1			Do.
	10	11	18		15	E		1·5		At top.
	11	9	0		13	W	0 5	1		To red at base; to violet at top
	13	11	15		11	W	0 5			At top; extends over 4° from 9° to 13°.
	14	9	23	19·5		E	1			At top; extends over 3° from 18° to 21°.
		9	6		9·5	W			0·5	
		9	3	16·5		W	0·5			At top.
	15	10	0	30·5		E	1			At base.
		10	13		17	W	2			
	16	9	5		18	W		1		At base
		8	48	15		W		1		
	17	8	44		2	E		2		At top.
	18	8	36		5	W		2		At base.
	19	9	23	19		E	1			Do.
	20	9	0		11	W	1 5	0 5		Do.
		8	48	4		W		2		At top.
		8	48	6		W		Slight		Do.
		8	47	16·5		W		1 5		
		8	40	54·5		W	1			At top.
	21	9	38		23	E	Slight			Do.
		9	13	61		W	0 5			Do.
		9	12	77		W		Slight		At base.
	22	11	53	32 5		W		Do		At top.
	23	9	15		79 5	E		1		Do.
		9	51		23	W		Slight		No prominence.
	25	8	50	10		W		1·5		At base.
	26	8	46		38·5	W		0·5		Do.
	27	9	22	45·5		E		0·5		At top.
	28	9	37		42·5	E		0·5		Do.
		9	4	57·5		W	Slight			At base.

Date		Hour I.S.T.	Latitude. North	Latitude. South	Limb.	Displacement. Red.	Displacement. Violet.	Displacement. Both ways.	Remarks.
1930.		H M	°	°		A	A	A.	
March	1	9 32		29	E		1		At top.
	3	9 1	10		E	1			At base.
		8 58		23	W	0 5			At top.
	8	10 4		10	W	0·5	1		To red at top
	9	10 1	2		E	1			At base
		9 54	6		W	1	0 5		To red at top, to violet at base
	13	9 19		7	W		1		At base
		9 11	14		W		1·5		At top, extends over 4° from 12° to 16°.
	14	9 33	26		E		1		At top.
		9 36		31 5	E	1			Do.
		9 24		20	W		2 5		At base
	15	10 33	70		E		1		Do
	16	8 37	82 5		E	2			At top.
	17	9 6	25		E	0 5			Do
		8 50	71 5		W	Slight			At base
	19	9 49		9	W		1		No prominence
	21	10 55	25		W	0 5			
	22	9 24	19		E		1		At top.
	23	9 32	11		E		1		Do.
	28	9 21	18		W		1 5		Do
	29	10 16		14	W		Slight		Do
April	1	12 22	14		E	1			At top.
	2	9 21	25		E		0 5		Do.
	4	9 6		31	E		1		Do
	5	10 33	11		E			1	Do.
		10 33	9		E		1		Do
		10 26		74·5	E	1			No prominence
	7	8 58		6	W		1		At base
	9	10 15		4 5	W	2			On prominence, extends from 3° to 6°
	10	10 15		77·5	W		1		At top
	11	8 49		16	W	0 5			Do
	12	9 32		30	W		1·5		At base
		8 32	49·5		E		0 5		Do
		8 14	12		W	1			At top.
	15	10 12		30	E		0 5		At base
	17	8 50	82 5		E	1			At top
	18	8 48	13		W	0·5			Do
	20	9 20		29 5	E	1			At top, extends over 9° from 25° to 34°
		9 5		10	W	1·5	1		To violet at base
		9 0	9		W		2		At top.
	24	9 28		24·5	E	1·5			At top, extends over 3° from 23° to 26°
		9 28		29 5	E	1			At top, extends over 3° from 28° to 31°
		9 8	26		W	Slight			At top.
		9 5	43 5		W		0 5		Do
	25	9 36		26	W		1·5		Do
	26	9 13		7	W	2			Do
		9 19		5	W			1	At base
May	1	9 35		14	E	1			At top.
	2	9 35	40 5		E			Slight	
		9 10	29		W		1		At top.
	4	9 8		35	W		1		At base
	5	8 46		40	W	1			At top.
	11	10 59		14	W	0·5			Do.
	12	8 58	26		W	0·5			Do.
	16	9 25		11	E			1·5	
	17	8 46	51		W			Slight	
	18	8 43	9		E		0 5		At base.
	20	8 49	47		E		0 5		Do
		8 52		2	W		1		
	22	9 44	77·5		E	0 5			At top
		10 25	15		E			0·5	
		10 45		31	E		1·5		At top.

Date		Hour I S T		Latitude		Limb	Displacement			Remarks
				North	South		Red	Violet	Both ways	
1930		H	M		°		A	A	A	
May	22	9	55	32		W	1	1 5		To red at top to violet at base
	25	8	50	11		E	0 5			At base
	29	9	48		11	W	Slight			At top
		9	16	26		W	0 5			Do
	30	9	24	8		W	1 5			Do
		9	7	45		W		1		Do
	31	9	12		69	E		1		Do
June	2	10	0	12		W	1 5			At top
		10	0	16		W	0 5			At base
	5	9	12	11 5		W	2 5			
	6	8	55	15		W		Slight		At base
	12	9	5	14 5		W	Slight			
	17	9	15		26	E	0 5			At base
		9	19		31	W		0 5		Do
	24	11	42	12		W	1 5			At top
		11	40	24 5		W		1 5		At base, extends over 3° from 23° to 26

The total number of displacements was 197 as against 250 in the previous half-year and their distribution was as follows —

Latitude		North	South
1°—30°		88	58
31°—60°		20	14
61°—90°		11	6
	Total	119	78
East limb		95	
West limb		102	
	Total	197	

Reversals and displacements on the sun's disc

Three hundred and sixteen bright reversals of the Hα line, 306 dark reversals of D_3 line and 30 displacements of the Hα line were observed during the half year Their distribution is given below —

	North	South	East	West
Bright reversals of Hα	196	120	168	148
Dark reversals of D_3	192	114	161	145
Displacements of Hα	19	11	15	15

Twenty one displacements were towards the red, 4 towards the violet and 5 both ways simultaneously

Prominences projected on the disc as absorption markings

Photographs of the sun's disc in Hα light were available from Kodaikanal and the co-operating observatories for a total of 177 days, which were counted as 174½ 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 —

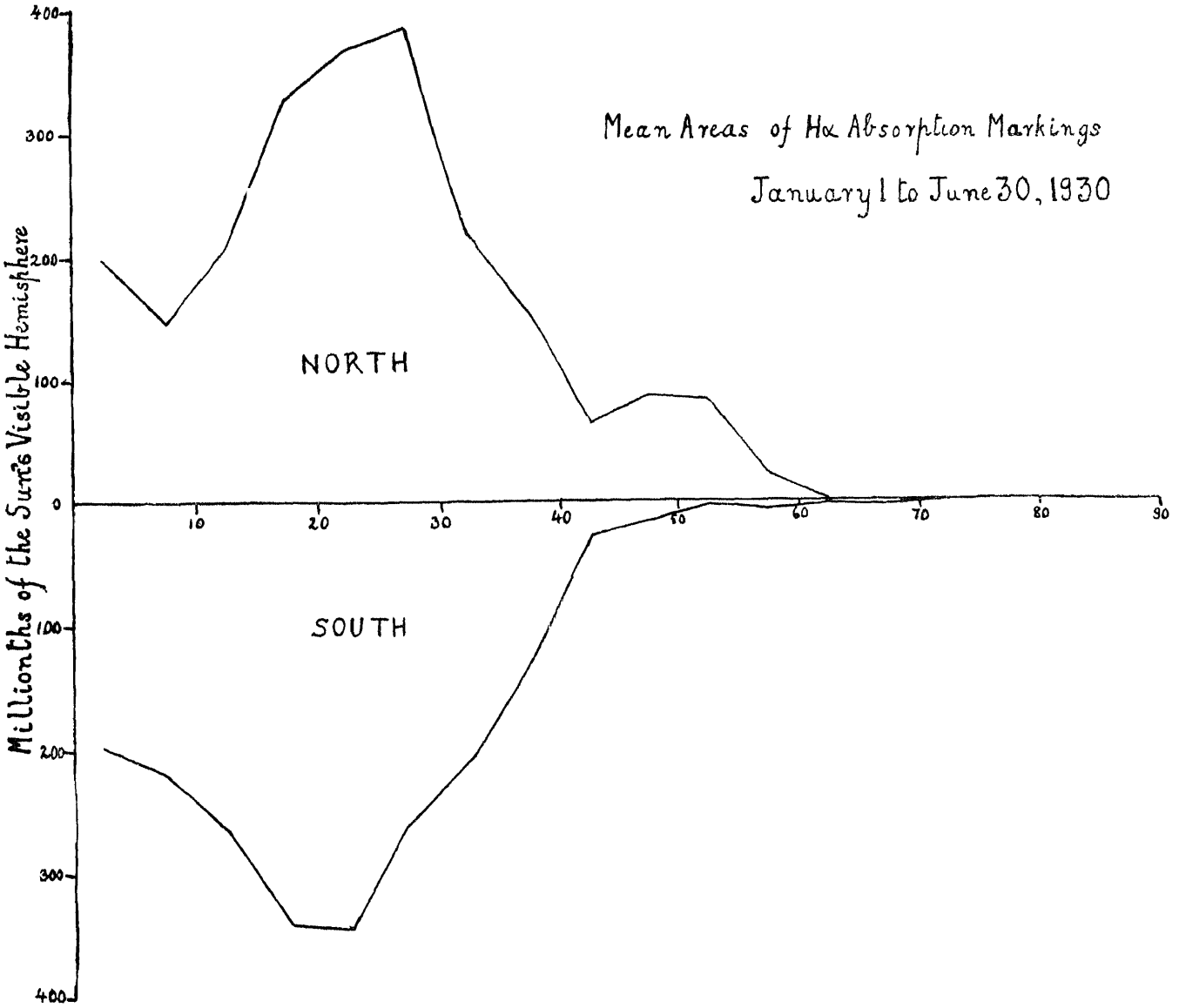
	Mean daily areas	Mean daily numbers
North	2,266	14 23
South	2,031	10 07
Total	4,297	24 30

The above show an increase of about 2 2 per cent in areas and a decrease of about 4 8 per cent in numbers compared with the previous half-year. The preponderance of activity has now shifted back again to the northern hemisphere.

For comparison with bulletins issued prior to the co-operation of other observatories, the means based on Kodaikanal photographs alone are also given, 156 days of observation being reckoned as 149¾ effective days.

	Mean daily areas	Mean daily numbers.
North (Kodaikanal photographs only) ..	2,180	14 06
South (do.)	1,963	9 96
Total ...	4,143	24·02

The distribution of the mean daily areas in latitude is shown in the following diagram. The distribution is similar to that of the previous half-year except that the secondary maximum near 50° has disappeared in the southern hemisphere.



The areas as well as numbers are almost equally divided between the eastern and western hemispheres, the percentage east being 50·1 for both.

When the data for the areas of absorption markings were begun in Kodaikanal Observatory Bulletin No. XXIX it was considered that the projected areas should be corrected for the curvature of the sun's surface by multiplying by the secant of the angular distance of the marking from the centre of the sun's disc. This practice has been continued up to the present although it has been known for a long time that the projected areas do not actually vary according to such a law. The correction hitherto applied must therefore, sooner or later, be dropped. Since the law of variation of the projected areas has not yet been established it seems preferable to give the projected areas themselves without applying any correction. Until the effect of this change becomes clear the areas corrected as hitherto will continue to be given in future bulletins along with the uncorrected areas. Below are given the uncorrected projected areas for the first and second halves of 1929 and the first half of 1930.

	Mean daily areas (uncorrected for foreshortening).		
	Jan.—June. 1929.	July—Dec. 1929	Jan.—June. 1930.
North	1,319	1,069	1,307
South	1,288	1,408	1,191
Total ..	2,607	2,477	2,498

Compared with the corrected areas the uncorrected areas amount to 58·3 per cent, 58·9 per cent and 58·1 per cent respectively of the corrected areas for these half-years. The curves of distribution in latitude are not much affected but it is not expected that this will hold when there is high latitude activity.

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

KODAIKANAL,
24th February 1931.

T. ROYDS,
Director, Kodaikanal and Madras Observatories.

PRICE, 8 *annas.*

MADRAS : PRINTED BY THE SUPERINTENDENT, GOVERNMENT PRESS—1931.