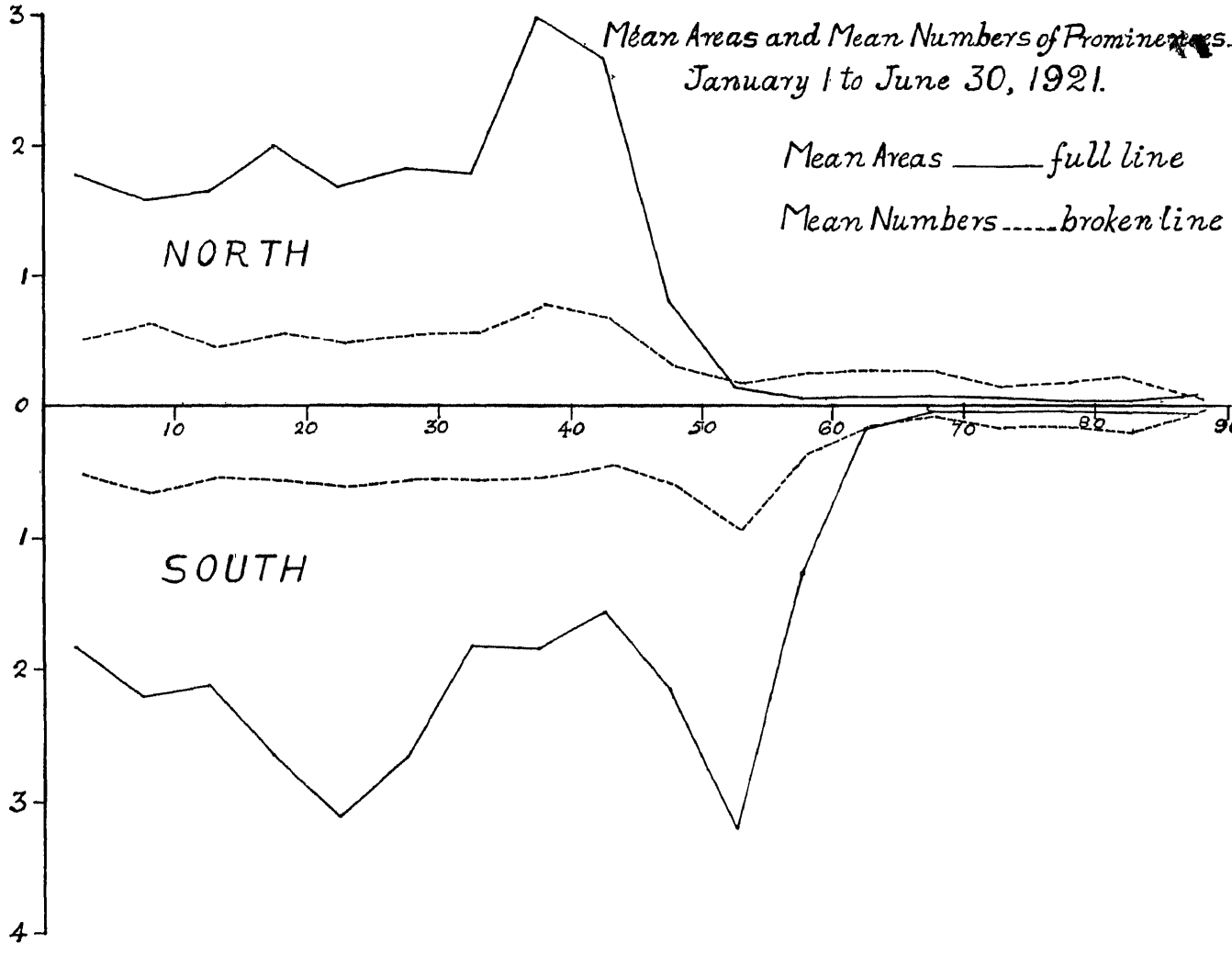
Kodaikanal Observatory.

BULLETIN No. LXVIII.

SUMMARY OF PROMINENCE OBSERVATIONS FOR THE FIRST HALF OF THE YEAR 1921.

The distribution of prominences observed and photographed during the half-year ending 30th June 1921 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 means are corrected for incomplete or imperfect records, the total of 171 days being reduced to 161 effective days.



Compared with the previous half-year the zones of greatest activity have advanced about 10° towards higher latitudes in both hemispheres. This is probably a temporary fluctuation as the regular advance towards the poles has not been observed previously until a few years before the epoch of maximum sunspots. There is still considerable activity in the equatorial region but this is likely to decrease during the next few years.

The mean daily areas and numbers corrected for imperfect observations are given below :—

	Mean daily areas (square minutes).	Mean daily numbers.
North	1·92	7·09
South	2·70	7·57
Total ...	4·62	14·66

Areas show a decrease of 9 per cent in the northern hemisphere and an increase of 24 per cent in the southern compared with the preceding half-year. In the case of numbers there is a general decrease amounting to 8 per cent. The activity is greater in the southern hemisphere in the case of both areas and numbers. The southern prominences are also on an average slightly brighter than the northern.

The monthly, quarterly and half-yearly areas and numbers, and the mean height and mean extent of the prominences are given in table I. The unit of area is 1 square minute of arc.

TABLE I.—ABSTRACT FOR THE FIRST HALF OF 1921.

Months.	Number of days (effective).	Areas.	Numbers.	Daily Means.		Mean height.	Mean extent.
				Areas.	Numbers.		
						"	"
January	22	104·2	321	4·74	14·6	31·3	3·77
February	26	139·8	390	5·37	15·0	32·5	3·82
March	31	142·8	465	4·61	15·0	32·9	3·79
April	29	142·0	406	4·90	14·0	34·3	4·58
May	30	138·9	460	4·63	15·3	32·0	3·67
June	23	76·3	319	3·32	13·9	30·8	3·14
First quarter	79	386·8	1176	4·90	14·9	32·3	3·79
Second quarter	82	357·2	1185	4·36	14·5	32·5	3·84
First half-year	161	744·0	2361	4·62	14·7	32·4	3·81

Distribution east and west of the Sun's axis.

Areas show a western excess in the first three months and an eastern excess in the last three, resulting in a slight western preponderance for the half-year. In the case of numbers, the activity was greater in the western hemisphere throughout the period.

1921 January to June.	East.	West.	Percentage east.
Total number observed	1154	1207	48·87
Total areas in square minutes	370·6	373·5	49·81

The average brightness of the western prominences was slightly greater than that of the eastern prominences.

Metallic prominences.

Thirty-five metallic prominences were recorded during the half-year of which as many as twenty-four were in southern latitudes. Details of these prominences are given in the table below :—

TABLE II.—LIST OF METALLIC PROMINENCES OBSERVED AT KODAIKANAL, JANUARY TO JUNE 1921.

Date.		Hour I.S.T.	Base.	Latitude.		Limb.	Height.	Lines.
				North.	South.			
1921.		H. M.	°	°	°		"	
January	6	9 15			15	W	80	5016, 5018·6, b_1, b_2, b_3, b_4, 5234·8, 5276·2, 5316·8, D_1, D_2, 6677, 7065.
	15	14 52			11·5	E	40	b_1, b_2, b_3, b_4, D_1, D_2.
	17	9 55		11·5		W	50	b_1, b_2, b_3, D_1, D_2.
	23	9 26			23	W	50	4924·1, b_1, b_2, b_3, b_4, 5316·8, D_1, D_2.
	24	9 12		20		E	10	b_1, b_2, b_3.
	24	9 2	7		27·5	W	50	b_1, b_2, b_3, D_1, D_2.
	25	8 22			19	W	40	b_1, b_2, b_3, b_4, D_1, D_2.
	29	9 15	3		20·5	E	75	4924·1, 6677.
February	1	8 41			10·5	W	10	b_1, b_2, b_3, b_4, 5316·8, D_1, D_2.
	5	9 4	3		29·5	E	55	4924·1, 5018·6, b_1, b_2, b_3, b_4, 5316·8, D_1, D_2, 6677, 7065.
	6	9 0			25·5	E	70	5018·6, b_1, b_2, b_3, b_4, 5316·8, D_1, D_2.
	10	9 5			25·5	E	40	b_1, b_2, b_3, b_4, D_1, D_2.
	21	9 5	6		30	W	60	b_1, b_2, b_3, b_4, 5316·8, D_1, D_2.
	25	8 45	2		7	W	65	4922·4, 4924·1, 5016, 5018·6, b_1, b_2, b_3, b_4, 5197·7, 5227·4, 5234·8, 5269·7, 5270·5, 5276·2, 5284·2, 5316·8, 5363·0, 5371·6, 5397·3, 5406·0, 5424·3, 5429·9, 5434·8, 5447·1, 5455·7, 5535·1, D_1, D_2, 6677, 7065.
	27	9 4			11	W	30	4924·1, b_1, b_2, b_3, b_4, 5316·8, D_1, D_2.
	28	9 16	13		23·5	W	30	4924·1, 5018·6, b_1, b_2, b_3, b_4, 5316·8, D_1, D_2.
March	3	9 10			24·5	E	85	b_1, b_2, b_3, b_4, D_1, D_2.
	5	9 35			22	E	135	b_1, b_2, b_3, b_4, D_1, D_2.
	6	9 32			10·5	E	40	b_1, b_2, b_3, b_4, D_1, D_2.
	13	9 15			22	E	55	b_1, b_2, b_3, b_4, D_1, D_2.
	20	9 38	3		28·5	W	30	b_1, b_2, b_3, b_4, D_1, D_2.
	21	8 55		18·5		W	20	5016, b_1, b_2, b_3, b_4, 5316·8, D_1, D_2, 7065.
	24	9 4		15		W	145	4924·1, b_1, b_2, b_3, b_4, 5316·8, D_1, D_2, 6677.
	25	9 20			19	W	40	5316·8.
April	4	9 22		18·5		E	50	4924·1, 5016, 5018·6, b_1, b_2, b_3, b_4, 5316·8, D_1, D_2, 6677, 7065.
	6	10 8	3		11·5	W	205	b_1, b_2, b_3, b_4, D_1, D_2, 6677, 7065 (metallic for 10″ height only).
	10	8 52		8		E	60	b_1, b_2, b_3, b_4, 5316·8, D_1, D_2.
	29	9 2	2		12	W	20	4924·1, 5018·6, b_1, b_2, b_3, b_4, 5316·8, 5363·0, D_1, D_2, 6677, 7065.
May	4	10 19		14		W	60	b_1, b_2, b_3, b_4, D_1, D_2.
	8	8 52	13	1·5		E	90	4924·1, 5016, 5018·6, b_1, b_2, b_3, b_4, 5316·8, 5363·0, D_1, D_2, 6677, 7065.
	18	9 25		11		W	25	b_1, b_2, b_3, b_4, D_1, D_2.
	21	8 35	21		2·5	W	75	4924·1, 5016, 5018·6, b_1, b_2, b_3, b_4, 5316·8, 5328·0, 5363·0, D_1, D_2, 6677, 7065.
	22	8 33		5		W	60	b_1, b_2, b_3, b_4, 5316·8, D_1, D_2, 7065.
	26	10 42	16		10	E	50	4924·1, 5016, b_1, b_2, b_3, b_4, 5316·8, D_1, D_2.
June	30	9 25	2	3		E	20	D_1, D_2, 6677, 7065.

The metallic prominences were distributed in latitude as follows :—

——	1° to 10°	11° to 20°	21° to 30°	Mean latitude.	Extreme latitudes.
				°	° °
North	4	7	...	11·5	1·5 and 20
South	3	9	12	18·4	2·5 and 30

Fifteen were on the east limb and 20 on the west.

Displacements of the hydrogen lines.

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

TABLE III.

Date.		Hour I.S.T.	Latitude.		Limb.	Displacement.			Remarks.
			North.	South.		Red.	Violet.	Both ways.	
1921.		H. M.	°	°		A.	A	A	
January	1	9 32		43	W	Slight			
	1	9 37		36	W	Do.			
	1	9 38		33	W		1		
	1	9 40		32	W	1			
	1	10 56	25		W	Slight			
	3	9 52	61·5		E	2			At top.
	4	8 38		6	E		Slight		
	4	8 43		15	W	Slight			
	5	9 42	85		E		1		
	5	9 38	33		E	Slight			
	5	9 7	4		E	Do.			
	5	10 2	29		W	1	Slight		
	7	9 13		25	W		4		At base.
	8	9 35		8	E		2		
	9	10 24		9	E	1			
	9	9 53	39		W	Slight			At top.
	9	9 48	47		W	1			
	15	15 8	77		E	1			
	15	15 3	47		E		Slight		
	15	14 58	29		E	2			
	15	14 56	21		E	2			
	16	9 5	30		W		0·5		At base.
	17	9 45	59·5		E	1			
	17	9 40		71	W	0·5			
	17	9 13	14		W	2	4		To red at base; to violet at top.
	22	10 35	10		W	1			At top.
	22	10 35	15·5		W	1·5			Do.
	23	9 22		17	W	1			At base.
	23	9 10	9		W	0·5			
	24	8 54	19		W	1·5			At top.
	25	8 27	17		E	Slight			
	25	8 20	4		W		0·5		At top.
	26	10 20		39	E	2			At base.
	27	8 24	42		W	1			
	29	9 15		20·5	E	6	3		At base. C was also displaced 2A to red and 1A to violet at top of prominence.
	29	9 0		45·5	E	Slight			At base.
	29	8 56		56·5	E	Do.			
	29	8 52		74	W		Slight		
	30	9 51		6	E		1		At base.
	30	9 51		8	E	1			Do.
	30	9 36		39	W		1		Do.
	31	8 30	69		E	0·5			
	31	8 34	70		E		Slight		
February	1	8 45	36		W	Slight			
	2	8 48	68		E	1			
	2	9 0		8	W		0·5		At base.
	3	9 25	14		E		2		At top.
	3	9 20	11		E		1		
	3	8 59		30	E	2			
	3	9 41		52	W		Slight		
	3	9 43		36	W	2			
	4	8 50		54·5	W		0·5		At top.
	4	8 40		5	W		Slight		
	4	8 40		8	W	Slight			
	5	9 4		24	E		1		
	5	10 10	83		W	Slight			
	6	10 27		15	E	1·5			At base.

Date.		Hour I.S.T.	Latitude.		Limb.	Displacement.			Remarks.
			North.	South.		Red.	Violet.	Both ways.	
1921.		H. M.	°	°		A	A	A	
February	7	8 52		18	E		1		At top.
	9	8 35	54·5		W	0 5			
	10	8 59		40·5	E	1			At base.
	10	9 45		19	W	Slight			
	11	8 30	79·5		E		0·5		
	12	9 40	34		E	1			
	12	9 32	15		E		1		At top.
	12	9 20		30	E	Slight			At base.
	12	9 9		73	W	Do.			
	12	10 2		15	W		2		
	13	9 33	Equator		E		1		
	13	9 14		23	W		1·5		
	13	9 14		24	W	1			
	13	8 55	39		W	1			
	14	9 24		10	E		1·5		At top.
	16	9 7		6	E	1	1		To red at base; to violet at top.
	16	9 10		15	E	1			At top.
	16	8 52	71		W		0·5		
	18	8 40	32		E	1·5			At top.
	21	9 5		30	W	2	1		To red at top; to violet at base.
	21	8 52		11	W		0·5		At base.
	22	9 57		25	E		1		
	22	10 5		62	E		1		
	22	9 35		61	W	Slight			
	22	9 30		27	W	1			
	22	9 3	51·5		W	Slight			
	22	9 0	56·5		W		Slight		
	22	8 36	72 5		W	1			
	24	8 47		9	E		1		
	24	8 40		30	E		0·5		
	24	8 33		65	E		1		At top.
	24	9 23	5		W	Slight			
	25	8 45		7	W			1	
	25	8 40		2	W		2		
	26	8 32	22		E	Slight			
	26	8 45	11·5		E	2			At top.
	27	8 50		4	W	2			Do.
	28	9 28	10·5		E		1		Do.
	28	9 6		11	W	1			
	28	9 6		7	W	2			
March	1	9 18	16		E	4			
	1	9 45		7	W		1		At top.
	2	8 28	74·5		E	Slight			
	2	8 40		3	W		0·5		
	2	8 36	13		W	1			At top.
	3	9 35	71·5		E		Slight		
	3	9 29	7		E		Do.		
	3	9 12		20	E	2			
	4	8 36		30	W		Slight		
	4	8 32	63		W		Do.		
	5	9 44	27·5		E	1			
	5	9 41	26		E		1		
	5	9 26		21	E		1		
	5	9 23		25	E	2			
	5	9 31	30		E	1			At base.
	6	9 1	68		E		Slight		
	7	8 11	81·5		E	Slight			
	7	8 7	59·5		E		Slight		
	7	8 37	33·5		E	0·5			
	7	8 13	81·5		W	1			
	8	9 16		19	E	Slight	Slight		To red at base; to violet at top.
	9	8 39	54·5		E	1			
	9	8 51	10		W	0·5			
	10	9 12		8	E	1	2		To red at base; to violet at top.
	10	8 58		73·5	W	1			
	11	8 26		13	E	Slight			

Date.		Hour I.S.T.		Latitude.		Limb.	Displacement.			Remarks.
				North.	South.		Red.	Violet.	Both ways.	
1921.		H.	M.	°	°		A	A	A	
March	12	8	11		8	E		1		
	12	9	52	28		W	Slight			
	12	9	57	77		W	Do.			
	13	8	50		52	W		Slight		
	13	8	51		56	W	Slight	1		At top.
	14	9	20		32·5	E	2			Do.
	14	9	4		58	W		0·5		At base.
	14	8	55		22·5	W	1			Do.
	16	8	51		25	W	1			
	16	8	44	24		W		Slight		
	17	9	24	55·5		E	Slight			
	17	9	34		30	W	1			
	17	9	40		28	W	1			
	18	8	34		34	E	Slight			
	18	8	38		70	E	Do.			
	19	8	44	34·5		E	1	0·5		To red at top; to violet at base.
	20	9	21	37·5		E		Slight		
	20	9	16	9		E			2	
	20	9	14		6	E		1		
	21	8	42	59·5		E	1			At top.
	21	9	18	.15		E	2			At base.
	21	9	6		27	W		1		Do.
	21	8	55	20		W		Slight		
	21	8	46	31		W	1·5			
	22	9	16	25		E		Slight		At top.
	22	9	18	15		E			1	At base.
	22	9	20	9·5		E		1		At top.
	22	9	0		69	E		Slight		
	23	8	32	60		E	Slight			
	23	9	2		52	E	Slight			At base.
	24	9	4	10		W	2	1		Do.
	25	9	8		33	E		0·5		
	26	9	55		11	W	0 5			
	27	8	50	57·5		E		Slight		
	29	9	14		13·5	W	1			
	30	9	0	83·5		W	1			
April	2	9	20	12·5		E		2		At top.
	2	9	10		30	E	1			At base.
	2	9	7		37 5	E		1		
	3	8	38	62		E		Slight		
	3	9	12	18·5		E	2			At top.
	4	9	22	17		E	2·5	2		To red at top; to violet at base.
	5	8	42	58·5		E	0·5			
	6	9	29	60·5		E	1			
	6	9	37		23	W	1			At top.
	6	10	8		11·5	W	8	2		To red at top; to violet at base. (Eruptive.)
	7	8	36	62·5		E	1			
	7	9	20		23	E	1·5			
	8	9	32	27		E	1			
	9	9	26	44		W		1		
	10	8	37	46·5		E		0·5		At base.
	10	8	42	53·5		W		Slight		
	11	8	40	64·5		E		0·5		
	11	8	51	7		E		Slight		
	13	8	56	56·5		E		0·5		
	15	8	32	50·5		E	1			
	15	8	37		6	W	1·5	1		
	16	9	42		53	W	Slight			
	16	9	8	12		W		1		At top.
	16	9	6	52·5		W	Slight			
	16	9	4	83·5		W	0·5			
	18	8	54	65·5		E	0·5			
	18	10	21	43·5		E		1		
	21	9	8		39	W	2	1		To red at base; to violet at top.

Date.		Hour I.S.T.		Latitude.		Limb.	Displacement.			Remarks.
				North.	South.		Red.	Violet.	Both ways.	
1921.		H.	M.	°	°		A	A	A	
April	22	8	44	67·5		E		0·5		At base.
	22	9	10		10	E	3	2		To red at base ; to violet at top.
	24	8	30	35·5		E	1			At base.
	24	9	1		47	E	0·5			
	24	9	4		84·5	E		0·5		
	24	8	35	61·5		W	0·5			
	26	8	57	77		E	0·5			At base.
	26	9	10	40		E	0 5			Do.
	27	9	7	31		E		1		
	27	8	52		25	E	5			
	27	8	48		52	E	Slight			At top.
	27	9	17	5		W		1		At base.
	28	8	30	78		E		Slight		
	28	8	28	63·5		E	0·5			At base.
	28	8	54		29	E	0·5			Do.
	28	8	42		2	W	Slight			
	28	8	36	15		W	1			At top.
	29	9	33	10		E	0·5			At base.
	29	9	2		12	W	2	3		To red at top ; to violet at base.
	29	8	47	36·5		W		1		At base.
	30	9	14		54·5	W	Slight			
	30	9	17		45	W	0·5			
	30	9	21	20·5		W	0·5			
May	1	8	35	26·5		E	1			At top.
	1	8	55		8	E		0·5		
	1	9	0		18	E	0·5			At base.
	1	8	44		11	W		Slight		Do.
	1	8	40	40		W	1			
	3	8	52	34·5		E	0·5			
	4	0	19	14		W	Slight			
	6	18	36	65		E	Do.			
	6	8	32	45		E		Slight		
	6	8	40	50		W	0·5			
	7	9	19	67 5		E		2		
	7	9	11	32		E		1		At base.
	7	9	5	24		E	1			Do.
	7	9	2	Equator		E	1			
	7	8	51		65	E		Slight		
	8	8	20	66		E		Do.		
	8	8	35	60·5		E	1·5	0·5		To red at base ; to violet at top.
	8	8	52	1·5		E	1	0·5		Do.
	8	8	30		16	W	0·5			
	9	9	30	2		E		1·5		
	9	9	30		8	E	1·5	1		To red at base ; to violet over middle of prominence.
	9	8	52	28		W	1·5	0·5		To red at top ; to violet at base.
	9	8	45	65		W		1		At base.
	10	9	40		39	E	1	2		To red at base ; to violet at top.
	10	8	58		14	W	0·5			
	10	8	49	24		W	0·5			At base.
	13	9	40	1		E	1			At top.
	15	10	0		21	E	1			At base.
	16	9	3		16	E	1·5			At top.
	18	10	29	22		E	1			
	19	8	50	66		E	0·5			
	19	10	22	43		E		0·5		At base.
	19	10	28	20		E	1	0·5		To red at base ; to violet at top.
	21	8	35	2		W	1	3·5		To red at top ; to violet at base.
	21	8	28	60		W	0·5			
	22	8	46		26	W		0·5		
	22	8	38		4	W	1			At top.
	23	9	0		42	E		1		Do.
	24	8	52	19		E	1			At base.
	24	9	12		27	E	0·5			Do.
	26	10	42		10	E	2	5		To red at base ; to violet at top.
	26	10	32	2		W	1			At base.
	27	9	22	75		W		0·5		

Date.		Hour I.S.T.		Latitude.		Limb.	Displacement.			Remarks.
				North.	South.		Red.	Violet.	Both ways.	
1921.		H.	M.	°	°		A	A	A	
June	1	9	13	20·5		E		0·5		
	1	9	4		83·5	W		Slight		
	3	8	36	68		E		Do.		At base.
	3	9	5	5		E	1			
	3	8	52		46	W		0·5		At base.
	3	8	50		20	W	1			At top.
	3	8	45	7		W	1			At base.
	5	8	38		15	W	1			At top.
	5	8	27	61		W		0·5		At base.
	6	9	28	68		W		0 5		Do.
	7	9	37	44		W	1			
	14	14	18	83		E	0·5			
	16	10	52	10		E		3		At top.
	17	9	24		33	E	0·5			
	17	9	14	Equator		W	Slight			
	21	9	5	52		E	Do.			
	23	9	16	11		E	Do.			
	24	8	40	76		E		Slight		
	25	9	3	12·5		E	2			
	27	9	24		28	W		0·5		
	29	9	28	18		W	1			
	30	9	16	13		E	3	2		To red at base; to violet at top.

The total number of displacements was 300, of which three were on the equator, and the rest were distributed as follows :—

Latitude	North	South
1°—30°	76	89
31°—60°	45	33
61°—90°	42	12
Total ...	163	134

East limb	168
West limb	132
Total ...	300

One hundred and seventy-four displacements were towards the red, 123 towards the violet and 3 both ways simultaneously. The greatest displacement observed was 8A to red over the upper portion of an eruptive prominence on April 6.

Reversals and displacements on the disc.

One hundred and fifty-one bright reversals of the Hα line, 86 dark reversals of the D_3 line and 120 displacements of the Hα line were recorded during the half-year. All these were in excess of the previous half-year, owing partly to more favourable observing conditions and partly to the appearance of very active spots on the Sun's disc. The large equatorial group of spots which crossed the central meridian on May 14-15 was the seat of very violent disturbances throughout the period it was visible. On one occasion (May 19) in addition to the hydrogen lines, the lines of sodium, magnesium and the enhanced lines of iron were observed to be brightly reversed over the umbra of the spot. Although reversals of the sodium and magnesium lines have been noticed on previous occasions, this is the first time that iron lines have been observed here to be so reversed. A photograph of the spot spectrum in the H and K region taken on May 14 at $8^h\ 15^m$ I.S.T., shows bright reversals of the stronger arc lines of iron, the aluminium lines and the silicon line at 3905·66, in an eruption between the principal spots of the group. The reversals and displacements were distributed as follows :—

	North	South	Equator	East	West
Bright reversals of Hα	72	67	12	69	82
Dark reversals of D_3	34	44	8	33	53
Displacements of Hα	51	54	15	49	71

Ninety-six displacements were towards the red, 25 towards the violet and 3 both ways simultaneously.

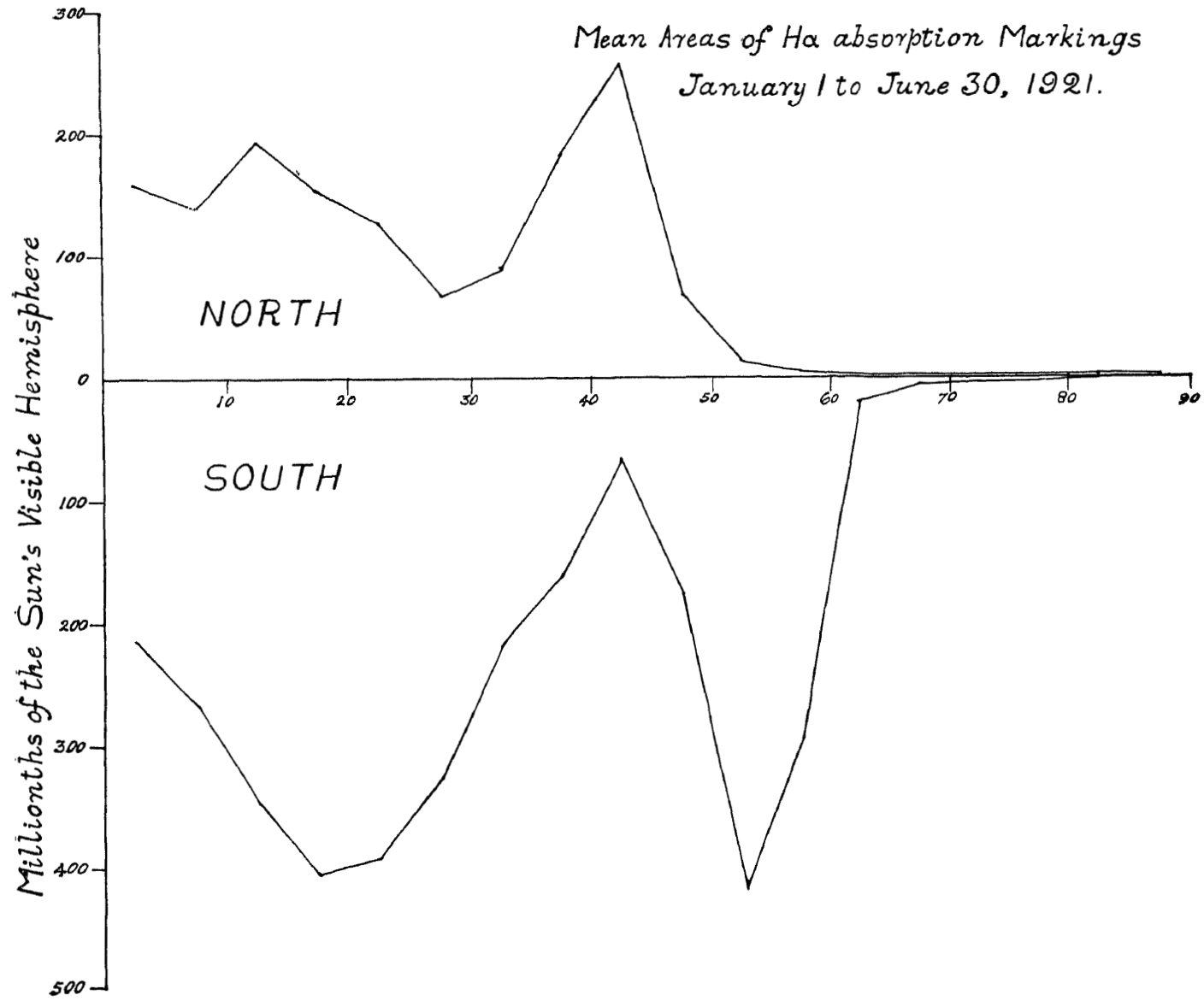
Prominences projected on the disc as absorption markings.

Photographs of the Sun's disc in Hα light were obtained on 157 days, counted as 150 effective days. The mean daily areas in millionths of the Sun's visible hemisphere, corrected for foreshortening, and the mean daily numbers are given below :—

	Areas	Numbers
North	1466	12·2
South	3332	22·1
Total ...	4798	34·3

Compared with the previous half-year both areas and numbers show a large decrease in the northern hemisphere and a large increase in the southern. In the case of areas the decrease in the north amounts to 44 per cent, and the increase in the south to 25 per cent. There results a large preponderance of activity in the south, as is also shown by the prominences at the limb.

The distribution of the mean daily areas in latitude is shown in the accompanying diagram :—



The distribution is practically the same as that of the prominence areas. Compared with the previous half-year the zones of maximum activity have moved towards the higher latitudes and as in the case of prominence areas, the curve is marked by a peak at about 40° in the northern hemisphere and between 50° and 55° in the southern hemisphere. In agreement also with the prominences at the limb areas show a western excess during the first quarter and an eastern excess during the second quarter. Numbers also show this distribution. For the whole period there was a slight eastern preponderance, the percentage east being 50·51 for areas and 50·76 for numbers.

THE OBSERVATORY, KODAIKANAL,
31*st August* 1921.

J. EVERSHED,
Director, Kodaikanal and Madras Observatories.

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