Kodaikanal Observatory.

BULLETIN No. XLV.

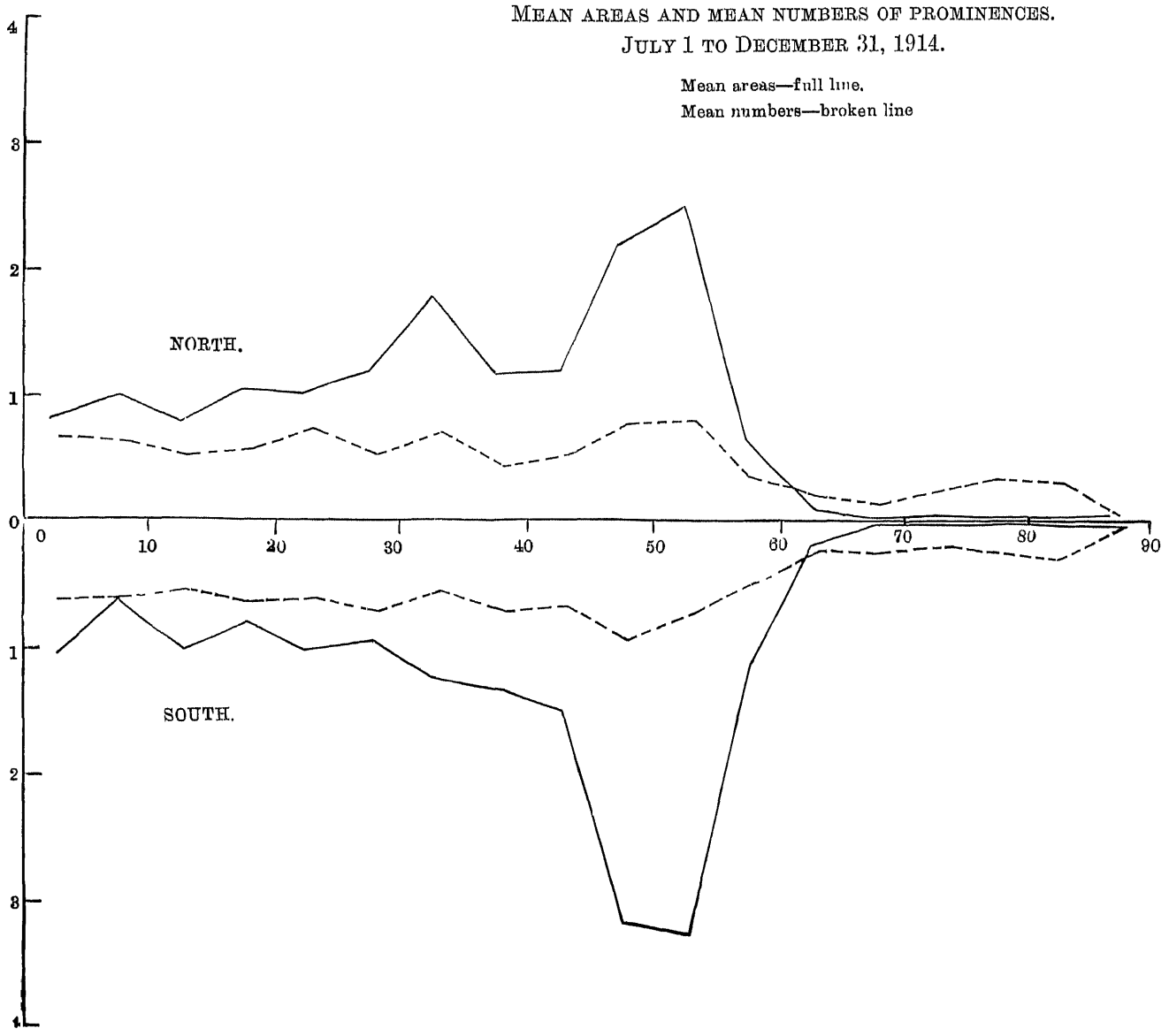
SUMMARY OF PROMINENCE OBSERVATIONS FOR THE SECOND HALF OF THE YEAR 1914.

From October 1, 1914, visual observations of prominences were practically confined to displacements of the hydrogen lines, and metallic prominences, as the position angles, heights and areas can now be much more satisfactorily determined from the photographs.

The distribution in latitude of the prominences observed and photographed during the six months ending December 31, 1914, is represented in the accompanying diagram. 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 square minutes of arc for the full line and numbers for the broken line. The means are corrected for partial or imperfect observations, the total of 140 days being reduced to 113 effective days.

MEAN AREAS AND MEAN NUMBERS OF PROMINENCES.
JULY 1 TO DECEMBER 31, 1914.

Mean areas—full line.
Mean numbers—broken line



The mean daily areas and daily numbers for each hemisphere corrected for partial observations are as follows :—

	Mean daily areas (square minutes).	Mean daily numbers
North	1·59	8·97
South	1·75	9·10
Total	3·34	18·07

Compared with the first six months of the year the mean areas have increased while the mean numbers have diminished, showing that larger prominences occurred during the latter half of the year. The distribution in latitude is much the same as during the earlier months but the zones of greatest activity have advanced in latitude about 5° and are symmetrically placed at 50° north and south. The zones between latitude 45° and 55° are, roughly speaking, about twice as active as the regions nearer the equator which show little variation even down to the equator itself.

The monthly, quarterly, and half-yearly frequencies and the mean height and extent are given in the following table. The frequencies are derived from the effective days.

Abstract for the second half of 1914.

Month.	Number of days of observations.		Number of prominences.	Mean daily frequency.	Mean height.	Mean. extent.
	Total.	Effective.				
1914.					"	°
July	16	11	147	13·4	34·4	1·61
August	27	20	431	21 6	30 7	1·50
September	29	22	413	18·8	28·2	1·33
October	19	16	211	13·2	36·1	2·09
November	27	24	459	19·1	31 3	2·23
December . ..	22	20	394	1.·7	30 5	2·42
Third quarter ...	72	53	991	18·7	30·2	1·45
Fourth quarter	68	80	1,064	17 7	31·9	2·27
Second half-year ...	140	113	2,055	18·2	31 1	1·87

The quarterly results, including those given in Bulletin No. XLI, show that a steady increase has occurred in the mean height and extent of the prominences during the whole year, while the mean frequencies diminished from 23·6 in the first three months of the year to 17·7 during the last three months. The increase in size of the prominences however more than compensates for the reduction in numbers.

Distribution east and west of the sun's axis.

Prominence numbers show a slight and areas a considerable eastern preponderance, which in the latter case was maintained in every month of the half year. The distribution was as follows :—

1914 July to December.	East.	West.	Percentage east
Numbers observed	1,037	1,018	50 46
Total areas in square minutes of arc	2,121	1,344	56·33

Metallic prominences.

The following metallic prominences were recorded in the half year :—

TABLE I.—LIST OF METALLIC PROMINENCES. JULY—DECEMBER, 1914.

Date.	Hour I S T.	Base.	Latitude.		Limb.	Height.	Lines reversed.
			North	South.			
1914.	H. M.	°	°	°		″	
July 31	8 48	5	20		W	30	6078·1, D_1, D_2, 5316·8, b_1, b_2, b_3, b_4, 5018·6, 5016·3, 4924·1. Eruptive.
August 8	9 18	—		31	E	20	D_1, D_2, b_1, b_2, b_3, b_4. Changing.
October 11	8 15	12		49·5	E	65	D_1, D_2, b_1, b_2, b_3, b_4, 5316·8, 4924·1.
November 4	11 55	1	21	..	W	30	D_1, D_2, b_1, b_2, b_3, b_4. Associated with a spot.
25	8 52	10	50	.	W	60	D_1, D_2 slightly bright near base.
December 12	9 0	1	25	.	E	20	D_1, D_2, b_1, b_2, b_3, b_4.
12	9 0	—	23	..	E	20	D_1, D_2, b_1, b_2, b_3, b_4.
21	8 50	1	42·5		E	15	D_1, D_2, b_1, b_2, b_3, b_4.
26	8 28	1	52	...	W	20	D_1, D_2, b_1, b_2, b_3, b_4.
31	8 42	1	22	.	E	15	D_1, D_2, b_1, b_2, b_3, b_4.
31	8 44	2	13	..	E	30	D_1, D_2, b_1, b_2, b_3, b_4. Associated with a spot.
31	9 5	3	18·5	...	W	20	D_1, D_2, 5316·8, 5269·7, 5234·8, b_1, b_2, b_3, b_4, 4924·1. Associated with a spot. Changing; height 20″ at $9^h\ 5^m$, 30″ at $9^h\ 9^m$ and 40″ at 9^h 11m, but only 10″ at 9^h 15m. In Ca photo at $8^h\ 18^m$ the height was 50″

Displacements of the hydrogen lines.

Particulars of these disturbances are given in the following table :—

TABLE II.—DISPLACEMENT OF THE C LINE IN PROMINENCES. JULY—DECEMBER, 1914.

Date.	Time. I.S.T.	Latitude.		Limb.	Amount of displacement.			Remarks.
		N.	S.		Red.	Violet.	Both ways.	
1914.	H. M.	°	°		A.	A.	A.	
July 31	8 48	20		W		1·5		Metallic prominence.
August 1	9 20	18		W		2		At top of prominence.
11	10 05		69	W		0·5		
12	9 53	58·5		E				C bulging to violet over 2°.
12	9 35	14		E		2		At top of prominence.
12	9 21		60·5	W	Slight			
12	10 2	11		W	1			Not seen at 10^h 7m.
12	8 25	56·5		W	1			
12	8 21	71		W	0·5			Not seen at 9^h 58m.
12	9 57	78		W	1			At top of prominence.
15	9 15		39·5	W	1			Over whole prominence.
17	9 30		44	W		Slight		At base of prominence.
17	9 35		46·5	E			Slight	No prominence.
20	9 20		82	E	Slight			
20	9 3		71	W	Slight at base	Slight at top		
22	8 38	68·5		E	0·5			At top of prominence.
22	8 18		69	E		1		
23	8 44		63	W		Slight		At top of prominence.
26	9 1	79·5		E	3			Very rapid changes in form and amount of displacement—5A at $9^h\ 5^m$ and $9^h\ 8^m$,; only about 1A at 9^h 9m.
26	8 28	73·5		W	Slight			No prominence.
30	8 33	81		E	Do.			
September 1	8 40		34·5	E		Slight		No prominence
2	9 9		83	W		0·5		At top of prominence.
4	11 48		80·5	W		Slight		
5	8 20		53	E		1		No prominence.
6	8 47	78		E	1			Do.
6	8 58		12	E		1		Do.

Date.	Time I.S.T.	Latitude.		Limb.	Amount of displacement.			Remarks.
		N.	S.		Red.	Violet.	Both ways	
1914.	H. M.	°	°		A	A	A	
September 6	8 32		75·5	E			Slight	
6	8 23		5	W		1		At top of prominence
6	8 13	67·5		W		1		No prominence.
6	8 9	72		W	0·5			At base of prominence. 45″ high, prominence 20″ high at 8h 44m and the displacement extended over the whole of it. Prominence gone at 9h 20m but C was slightly displaced to red.
8	12 0		50·5	E		Slight		
9	9 20		19·5	E	1			
9	9 16		25	E		0·5		At top of prominence.
9	9 26		59·5	E	1			No prominence.
11	8 40		29	E	2	1·5		At two different points.
20	10 47		19	W			Slight	No prominence
24	11 33		30	W	Slight			
27	8 20	70·5		E	Do			
27	8 40		36·5	E	0·5 at top	Slight at base		
27	9 59	55		W	Slight			At top.
27	8 18	83		W		Slight		
28	9 49	31·5		W	Do			No prominence
30	8 43		42 5	W	Do.			At base
30	8 34	33		W	0·5			
30	8 29	39 5		W	0 5			No prominence.
30	8 28	42 5		W	Slight			Do.
October 1	9 2		3 5	E	2			No prominence A small prominence visible at 9h 4m. The prominence was 40″ high in Ca at 9h 28m
1	9 15		50	E		Do.		
1	9 17		69	E		Do.		
1	9 24		36	W		Do.		
1	9 29	50		W		1		Not seen at 9h 30m.
2	8 40		65	E	2 at top	1·5 at base		
3	8 40	75·5		E	Slight at top	0·5 at base		No prominence at 9h 6m, but C was slightly displaced both ways.
4	10 26	48 5		E		Slight		At top of prominence.
5	8 26		34	E		1		
5	8 24		42	E		Slight		
5	8 49		82	E	2			Displaced portion detatched from C line. Not seen at 9h 5m.
5	9 13		50	W		Do		
5	8 27		23	W	Slight	Do.		At two different points.
11	8 15		49	E	0 5			
11	8 57		58 5	E	0·5			No prominence.
23	8 17	34		E		1		Do.
23	8 13	27·5		E		Slight		At top of prominence.
23	8 26		85	E	Slight at base	Slight at top		
31	9 14		23	W		1		Over whole prominence.
November 1	8 9	18·5		W		0·2		No prominence.
1	8 9	20		W		0 5		Do.
1	8 1	74·5		W		0·2		Do.
3	9 10		18	E		Slight		At base of prominence.
3	8 46	27		W			Slight	No prominence.
4	11 43		81 5	E		0·5		Do.
4	11 55	21		W	1	0·5	1 at 14h 15m.	
10	8 59	59		W		0 5		Do.
11	8 31	17 5		E		0·5		Do
11	8 38		38	E		Slight		Do
13	9 9	43·5	...	E	Slight			Do
13	8 42	53		W	Do.			Do.
13	8 40	67		W		0·5		Do. Chromosphere bright.
14	8 29		25·5	E		0·5		At base of prominence.
14	8 27		35	E		Slight		
14	8 50		79·5	W	1	0 5		No prominence.
14	8 28		57	W	2			Over whole prominence.

Date.	Time I. S. T.	Latitude.		Limb.	Amount of displacement.			Remarks.
		N.	S.		Red.	Violet.	Both ways.	
1914	H. M.	°	°		A	A.	A.	
November 15	8 40	29		W	1			Gone at 8h 44m
16	8 46		87	E	0·3			
16	8 55	10		W		0·2		Over whole prominence and over an extent of 3°.
18	8 48	46·5		E		Slight		No prominence
18	8 41	20		E		0·5		
18	8 57		80·5	E		0 5		
18	8 58		77·5	W		1		Do.
19	8 53	43		E	0·5			Over whole prominence.
19	8 41	20·5		E		Slight		
19	8 35		28·5	E	0·3	Do.		No prominence.
19	8 28		58	E		Do		Do.
19	9 7	59		W	0·2			
20	8 23	87		E		0·5		2A at 8h 23½m and 0·5 A at 8h 24m.
24	8 37		78	E	Slight at base	Slight at top		Gone at 9h 5m.
24	8 58	44		W	Slight			No prominence.
25	8 56		17·5	W	1·5			
25	8 45	80		E		1		
26	8 41		44	E	Slight			
27	9 52	12		W	0·5			
December 9	8 42	32·5		E		Slight		Do.
9	8 44	13		E			Slight	Do.
9	9 2		30	W		Do.		Do.
9	8 58		4	W		0·5		Do.
10	9 10	41		E	0·2			
10	9 14	15		E	Slight			
10	9 16	3		E		Slight		No prominence. Displacement at two points close to each other.
10	8 52	21		W		Slight		Over whole prominence in Hα. No prominence in Ca. Displacement gone at 8h 57m.
11	8 53		56	W		0·5		
11	8 58		25	W		Slight		
12	9 0	25		E		1 A at 8h 59m, 0·5		
12	9 14		20	E		Slight		
12	8 21		49	W	Slight			At top of prominence.
13	8 54	23·5		E	Slight			No prominence.
13	8 48	14 5		E	0 2			
13	8 45		5	E		1·5		No prominence.
13	9 4		26	W	Slight			Do.
15	9 20	28		E		Slight		
15	9 26		72	E	0·3			
15	8 43	52		W		Slight		
16	9 10	88 5		E	0·5			
16	9 6	23		E			Slight	
16	9 16		56	W	0 5 at top.			
16	9 18	18—23		W			Slight	At several points.
17	8 59		49	E	0·5	Slight		No prominence.
17	8 43		80·5	E			Slight	Do.
17	8 33	56		W		2		
17	9 5	80·5		W		1		Do.
18	9 40	74		W		2		Do.
20	8 31		76·5	E		0·5		Do.
20	8 58		22	W	2	1		Do. Displacement slight at 9h 18m.
21	8 42		71	W	Slight			Do.
21	8 25	77		W		Slight at top		
22	8 42	41		E		0 3		Do.
22	8 51		50	W	Do.			
24	8 58		27—29	E		Slight at base		0·5A to violet at—27° E.
25	8 54	88		E	Do.			No prominence.
25	8 35	68		E		Slight		Do.
25	8 35	63		E		Do.		Do.

Date.	Time. I.S T.	Latitude.		Limb.	Amount of displacement.			Remarks.
		N.	S		Red.	Violet.	Both ways.	
1914.	H. M.	°	°		A.	A.	A.	
December 25	8 25	18·5		E		Slight		
25	8 40		45	W		Do.		
25	8 46	16		W		0·5		
25	8 50	40-50		W		Slight		At about a dozen points.
25	8 54	82·5		W	Slight			No prominence.
25	8 54	83 5		W		0·5		Do.
26	8 55	21		E			Slight	Do.
26	8 50	16		E		2		Do Not seen at 8h 55 m.
26	9 3		49	E	0·2			
26	9 6		84·5	E		0 5		Do.
26	8 28	52		W		Slight at base		
26	8 25	77		W	0·3			Do
27	8 39	46		E	Slight			
27	8 52	82		W		Slight		
28	8 20	77		E	2			Not seen at 8h 22m when C was displaced to violet for 0·5A.
28	8 23	60		E		1		Changing rapidly 2A at 8h 25m. Nothing at 8h 27m
28	8 15		51·5	W	Slight			
29	8 34	41		E	0·5			
29	8 25		53	E		1		Over whole prominence.
29	8 25		50	E		1		At top only.
30	8 57		51	E		Slight		
31	9 5	18·5		W		0 2		Displacement 1A at 9h 11m.
31	9 5	50		W		1		At base.

Eighty-six of these displacements were in the northern hemisphere and seventy-eight in the southern; eighty-seven were in the eastern hemisphere and seventy-seven in the western. There was a decided increase in the displacements to the violet. Ninety-eight were towards the violet and seventy towards the red. A number of prominences showed displacements to the red in one part and to the violet in another part. Displacements both ways at the same point were recorded in ten prominences.

The displacements were recorded fairly uniformly over the whole limb, fifty-one were 0° to 30° of latitude, sixty from 31° to 60° and fifty-three from 61° to 90°.

Reversals and displacements of the C line on the disc.

Eighty-five reversals of the C line were observed in the neighbourhood of spots or occasionally near faculæ only. These as well as the darkenings of the D_3 line show a slight preponderance in the eastern hemisphere while the number of displacements of the C line in or near spots was slightly in excess on the western. The table following gives the distribution east and west of these phenomena :—

	East.	West.
Reversals of C near spots	44	41
Darkening of D_3	6	4
Displacements of C	20	22

There was a preponderance of the displacements towards red, twenty-five being towards red and eleven towards violet. The double spot group which crossed the central meridian on November 9 showed a prominence-like reversal on the 10th, and on the 11th there were displacements indicating violent changes in the direction and amount of the movement.

Prominences projected on the disc as absorption markings.

The grating spectroheliograph for photographing the absorption markings in hydrogen light was not in regular use but a few plates were obtained towards the end of the year. A considerable number of absorption markings are shown on the calcium spectroheliograms and there is no doubt that they have increased in

frequency since 1913 or the first half of 1914. Most of the markings are in the south-eastern quadrant of the sun's disc and correspond to the high latitude zone of prominence activity at about 50° south; from the middle of November however absorption markings appeared in the north-east quadrant in latitudes ranging from + 18° to + 70°. The great preponderance of these markings on the eastern side of the central meridian is very remarkable as it exceeds considerably the eastern preponderance of the prominences at the limb.

THE OBSERVATORY, KODAIKANAL,
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