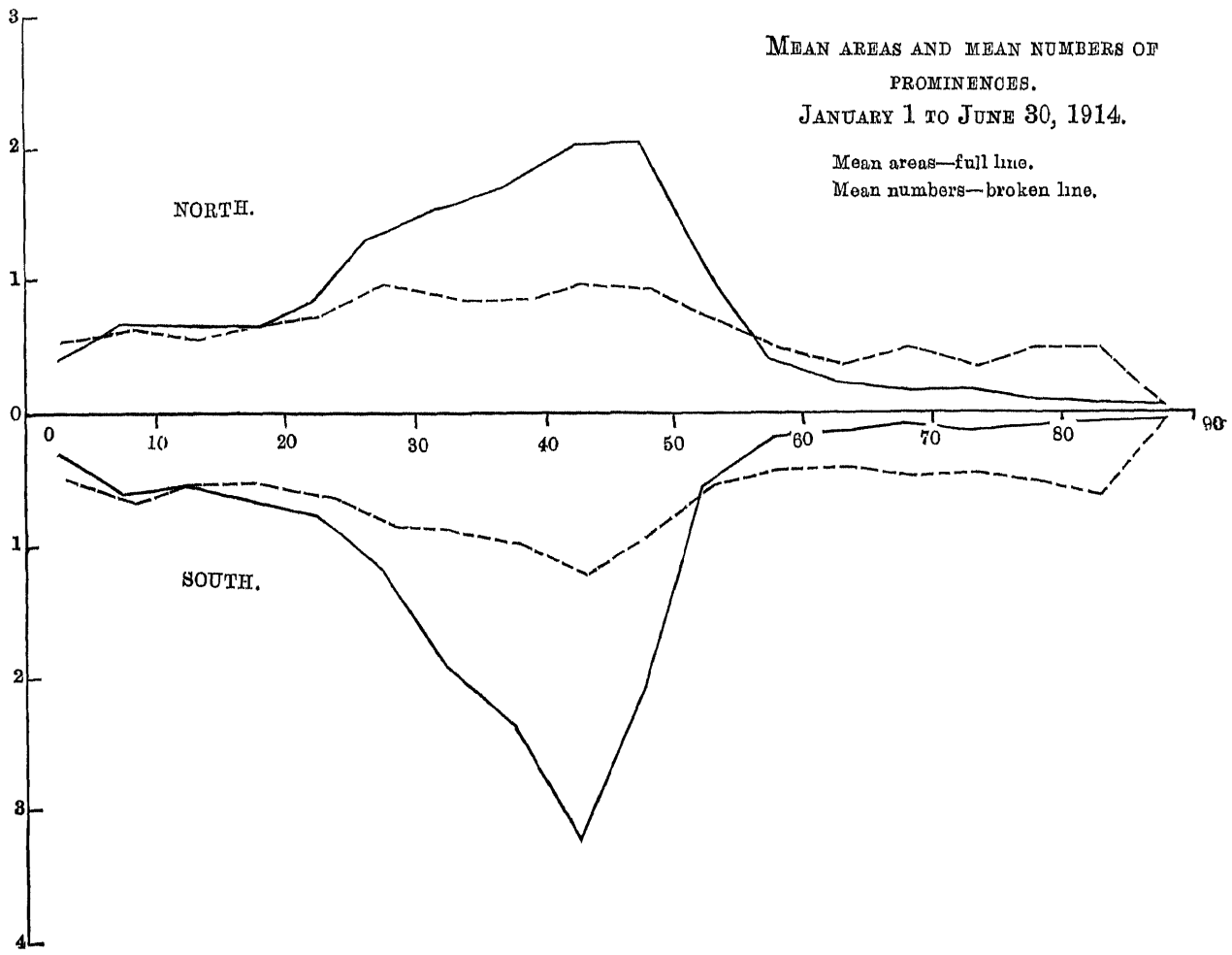
Kodaikanal Observatory.

BULLETIN No. XLI.

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

The distribution in latitude of the prominences observed during the six months ending June 30, 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 175 days being reduced to 158 effective days.



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

	Areas. Square minutes.	*Numbers.*
North	1·44	11·10
South	1·49	11·08
Total ...	2·93	22·18

There was a distinct recovery of prominence activity during the period. Both areas and numbers show an increase compared with the year 1913, the areas being about 20 *per cent.* and the numbers 15 *per cent.* greater than the corresponding figures for the first half of 1913. The increase affects practically all latitudes up to 60° north and 60° south and has even slightly affected the quiescent polar regions. The distribution in latitude was very much the same as in the previous six months but the northern maximum in the zone 40° to 50° was very much more pronounced in 1914.

The striking feature in the area curve in the southern hemisphere is the very conspicuous peak in the region 40° to 45° falling steeply on the pole side and somewhat more gently towards the equator.

The monthly, quarterly, and half-yearly frequencies and the mean height and extent are given in the following table. The frequencies given are corrected for partial observations

Abstract for the first half of 1914.

Months.	Number of days of observation.		Number of prominences.	Mean daily frequency.	Mean height.	Mean extent.
	Total.	Effective.				
					″	°
January	31	28	679	24 2	23 7	1·20
February	28	27	648	24·0	26 1	1·12
March	31	29	653	22 5	26·5	0 90
April	30	29	701	24 2	26 5	1 04
May	29	26	491	18·8	29·5	1·42
June	26	19	342	18·0	28 8	1·48
First quarter	90	84	1,980	23 6	25·4	1·07
Second quarter	85	74	1,534	20·7	28·0	1·26
First half-year	175	158	3,514	22 2	26·5	1·15

The increase of frequency and of area during the 6 months compared with 1913 is slightly discounted by a reduction in mean height, viz. from 29″·2 in the corresponding period of 1913 to 26″·5 in 1914. The mean extent is sensibly the same as in 1913.

The number of prominences 60″ or more in height was also smaller, being only 295 as against 334 in the first-half of 1913. The average was 1·9 *per diem*. The general reduction in height was also evident by the relatively small number of very tall prominences; only 3 prominences were recorded reaching a height of 180″ as against five exceeding 180″ in the first-half of 1913.

Distribution east and west of the sun's axis.

The period under consideration shows a preponderance on the western side, particularly in the case of the areas. The numbers show an eastern preponderance in the first three months and a western in the second three. The distribution was as follows:—

1914 January to June.	East.	West.	Percentage east.
Numbers observed	1,739	1,775	49·49
Total areas in square minutes of arc ..	220·0	243·4	47·47

Metallic prominences.

Five only were recorded during the 6 months, particulars of these are given in the following table:—

Date.	Time. I S T	Base.	Latitude.		Limb.	Height	Elements giving bright lines
			North	South.			
1914	H. M.	°	°	°		"	
January 10 ...	9 42	...	..	11	E	...	D_1, D_2, b_1, b_2, b_3 No prominence but chromosphere very bright over about 1°.
„ 17	8 56	2		68·5	W	15	D_1, D_2, b_1, b_2, b_3.
April 6 ..	8 38	1	..	45	W	65	b_1, b_2, b_4.
„ 12 ...	9 28	1	24·5		W	30	D_1, D_2, b_1, b_2, b_3, b_4.
„ 12 ...	8 58	1	30	..	W	15	D_1, D_2, b_1, b_2, b_3, b_4.

The last two were associated with the very active spot group in latitude 28° N., longitude 72°.

Displacements of the hydrogen lines.

The general increase of activity in 1914 is shown by the displacements of the C line of which 144 have been recorded as against 87 in the corresponding period of 1913.

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

DISPLACEMENTS OF C LINE IN PROMINENCES—JANUARY TO JUNE 1914.

Date.	Time. I S T.	Latitude.		Limb.	Amount of displacement.			Remarks.
		North.	South.		Red.	Violet.	Both ways.	
1914.	H. M.	°	°		A	A	A	
January 4 ...	8 43	...	86·5	E		Slight.		
„ 6 ...	9 54	...	12	E	Slight.			
„ 9 ...	9 22	...	80	W	Slight.			
„ 10 ..	9 49	...	67 5	W	1			
„ 11 ...	8 52	...	85	E		0·5		Not seen at 9h 58m.
„ 12 ...	9 53	...	84·5	E		Slight.		
„ „ ...	9 41	...	84·5	W	1			
„ „ ...	9 41	...	84	W	Slight.			Not seen at 9h 20m.
„ „ ...	9 20	.	84	W		Slight.		Not seen at 9h 41m.
„ 13 ...	10 10	62·5	...	E		Slight.		
„ „ ...	9 18	. .	22	W	1			
„ 5 ...	9 33	43	...	E	1			
„ „ ...	9 53	...	71 5	E	Slight.			
„ „ .	9 55	...	80	E	Slight.			
„ „	8 58	70·5	...	W			Slight.	
„ „ ...	8 57	78	...	W		Slight.		
„ 16 ...	8 45	...	83·5	E	2			
„ 17 ...	8 56	...	68·5	W	1			
„ „ ...	9 7	...	68·5	W		5		} The displacements were in two different places over the prominence.
„ „ ...	. .	...	68 5	W	1			
„ 18 ...	9 21	...	72·5	W	1			
„ „ ...	9 3	55·5	...	W		Slight		
„ 20 ...	9 21	...	28	W	1			
„ 21 ...	9 16	43	...	E		Slight.		
„ „	9 29	...	26·5	E		Slight.		
„ „ ...	8 38	83	.	W		Slight.		
„ „ ...	8 38	84		W		Slight.		
„ 23 ...	9 37	...	57·5	E		1		
„ 24 ...	10 5	.	68·5	E	Slight.			
„ „ . .	8 41	...	77·5	E	0·5			
„ „ ..	9 55	...	79·5	W		0·5		
„ „ . .	9 52	...	74	W			Slight.	
„ „ ...	9 33	57·5		W			Slight.	
„ 26 . .	9 0	67·5	...	E	0·5			
„ 27 ...	9 6	84	..	E		Slight.		
„ „ ...	8 31	...	43·5	E		Slight		
„ „ ..	8 30	...	49 5	E		Slight.		
„ „ ...	8 26	...	69·5	E		Slight.		
„ 28 ...	9 29	...	73 5	W	1			

DISPLACEMENTS OF C LINE IN PROMINENCES—JANUARY TO JUNE 1914—*cont.*

Date.	Time. I.S.T.	Latitude		Limb	Amount of displacement.			Remarks.
		North.	South		Red.	Violet.	Both ways	
1914.	H. M.	°	°		A	A	A	
January 28 ..	8 52	.	64·5	W		Slight		Shifts at different parts of the prominence
,, ,, ...	8 52	..	64·5	W	Slight.			
,, ,, ...	9 20	..	29	W		1		Not seen at 9h 16m.
,, ,, ...	9 20	...	29	W	1			
,, 30 ..	9 2	84	...	E		Slight.		
,, ,, ...	8 38	..	63·5	E	1			
,, ,, ...	9 12	...	82	W			Slight.	
,, ,, ...	9 16	.	64·5	W	Slight.			
,, ,, ..	9 22		30	W		Slight.		
,, 31 ...	8 52	64 5	..	E	Slight.			
,, ,, ...	9 38	...	47·5	E	0·5			
,, ,, ..	9 41	...	63 5	E		Slight.		
February 1 ...	8 28	..	28·5	E			Slight.	
,, ,, ...	8 13	...	83	W		Slight.		
,, ,, ...	8 12	...	78·5	W	Slight.			
,, 3 ...	10 10	..	12	E	Slight.			
,, ,, ...	10 18	...	78 5	E	Slight.			
,, ,, ...	10 22	...	82	E		0·5		
,, ,, ...	9 8	...	83 5	W		Slight.		
,, 4 .	8 40		84	W	Slight.			
,, 6	8 42	83	...	E	Slight.			
,, 8 ...	8 22	..	57	W		Slight.		
,, ,, ...	9 0	...	11·5	W		1		Not seen at 9h 8m.
,, ,, ...	9 0	...	11·5	W	3			
,, 11 ...	8 24	..	58·5	W	Slight.			
,, 13 ...	9 4	83		E	Slight.			
,, ,, ...	8 38	...	81·5	W		1		
,, 16 ...	9 33	Equator.		E			Slight.	Slightly bulged out both ways.
,, 20 ..	8 57	81	..	E		2		
,, ,, ..	8 31	...	78	W	1			
,, 21 ..	8 13	80	.	E			Slight.	
,, ,, ...	8 4	70	..	E		1		Disappeared in a few seconds.
,, ,, ...	8 5	61	..	E	Slight.			
,, ,, ...	8 19	45·5	.	W	Slight.			
,, 22 ...	8 40	62	...	E	Slight.			
,, ,, ...	9 26	.	41·5	W		Slight		
,, 23 ..	9 30	...	78·5	W		0·5		
,, ,, ..	10 0	...	70·5	W			Slight.	
,, 25 ...	8 39	78	..	E	0·5			
,, ,, ...	8 34	71·5	...	E	Slight.			
,, ,, ...	8 29	50	...	E			Slight.	C was symmetrically widened in the chromosphere to the north of this prominence.
,, ,, ...	8 52	...	77	E	0·2			Shift found over the whole prominence.
,, 26 ...	8 44	...	79·5	E		Slight.		
March 2 ...	9 16	49		E		Slight.		
,, ,, ...	8 58	...	81·5	W		Slight.		
,, ,, ...	8 58		32	W	2·5			
,, ,, ...	9 26	75·5	...	W		Slight		
,, 5 ...	9 41	79·5	.	E		2		Shift gradually increased, but disappeared at 9h 45m.
,, ,, ...	8 41	.	56	E		0·2		
,, ,,	8 33	...	77 5	W	0·2			
,, ,, ...	9 9	78	..	W			Slight.	Not seen at 9h 49m.
,, 8 ...	9 7	...	75·5	W	0 5			
,, ,, ...	8 36	70	...	W		Slight.		
,, 9 ...	9 2	...	75·5	W		0·5		
,, 12 ...	8 28	. .	67	W		Slight.		
,, 14 ...	8 34	...	74·5	E	1·0			Displacement at top of prominence
					0·5			Displacement at base of prominence.
,, ,, ...	8 33	...	75 5	E		1·5		Disappeared in a few seconds.
,, 15 ...	8 45	...	15	W	Slight.			
,, 17 ...	8 55	18	...	E		1·5		
,, ,, ..	8 57	18	...	E	0·5			
,, 19 ..	8 19	49 5	...	W	0·5			
,, 22 ...	8 53	81·5	...	E			Slight.	
,, ,, ...	8 39	68	...	W		1		At top of prominence.

DISPLACEMENTS OF C LINE IN PROMINENCES—JANUARY TO JUNE 1914—*cont.*

Date.	Time. I.S.T.	Latitude.		Limb.	Amount of displacement			Remarks.
		North.	South.		Red.	Violet.	Both ways.	
1914	H. M.	°	°		A	A	A	
March 22 ...	8 39	68	...	W	0·5			At base of prominence.
„ 27 .	8 44	. .	62	E	0 5			
„ „ .	8 48		73·5	W		Slight.		
„ „	9 9	. .	28	W	1			
„ „ ...	9 7	21	..	W			Slight.	
„ „	8 58	78		W	Slight.			
„ 28 ..	9 30	73	...	W		1		At top of prominence.
„ 30 ...	8 38	26		E		1		C displaced to red in many places near this position at 9h 52m.
„ „ ...	8 38	26	..	E	1·5			
April 1 ..	8 41	41·5	..	E		0 5		
„ „ ..	9 15	...	54 5	W	Slight.			
„ 6 ...	8 38	...	45	W		1		At base of prominence. Disappeared at 8h 55m.
„ 12 ...	9 28	24·5	...	W			0·5	
„ „ ...	9 2	30		W		3		Not seen at 9h 5m but was seen at 9h 44m when the amount of displacement was 1·0 Å.
„ 13 ...	8 22	57·5	..	E	Slight.			
„ 15 ..	9 14	71·5	...	E		Slight.		
„ „ ...	8 35	..	41	E			Slight.	
„ „ ...	8 54	. .	58·5	W	2·5			Not seen at 8h 57m.
„ 16 ...	8 54	31	..	E	0 5			There appeared to be a mass of dark hydrogen in front of the prominence obscuring the central part of it.
„ 17 ...	8 37	80·5	...	E	Slight.			
„ 19 ...	8 33	...	2	E	Slight.			
„ „ ..	8 26	..	83	E		Slight.		
„ 22 . .	8 48	30·5	...	E		0·5		At base of prominence.
„ „ ...	8 25	...	32	E		Slight.		
„ „ ...	9 2	..	28	W			Slight.	
„ 25 . .	8 21	...	74·5	E		0 5		
„ „ ...	8 14	.	41	W		0·5		
„ 26 ...	8 59	..	22	W		1		Over whole prominence.
„ 29 ...	9 20	26	...	E	Slight.			
„ „ ...	9 26	...	42	E	...	Slight.		
May 1 ...	8 36	...	54	E		0·5		
„ „ .	8 30	. .	79·5	W		1		
„ 10 ...	8 28	68	..	E	0·5			
„ „ ...	7 57	...	81·5	W		0·5		
„ 12 .	8 51	..	63	W		Slight.		
„ „ ...	8 26	..	45	W		1		
„ 25 ...	8 25	51·5	...	E	Slight.			
June 2 ...	9 24	17	...	E			Slight.	Bulged out slightly both ways.
„ 13 ...	9 33	75 5	..	E	Slight.			
„ 17 ..	8 35	29	.	W			Slight.	
„ „ ...	8 30	63	...	W		1		At top of prominence.
„ 28 ...	8 43	70	..	E		Slight.		

As is usually the case, at any rate at times of sunspot minima, the largest number was found in high latitudes between 60° and the poles where 85 were observed; 31 were recorded in mid-latitudes between 30° and 60°, and 28 in low latitudes between the equator and 30°. Sixty per cent. of these disturbances were in the southern hemisphere.

The distribution east and west of the sun's axis shows a slight preponderance on the west side, the figures being 71 east and 73 west, a proportion which is the same as that found for the prominences.

There is a preponderance of displacements towards violet in this series of observations, 66 being displacements towards violet, 61 towards red, and 17 in both directions simultaneously.

The greatest displacement recorded was 5 angstroms towards violet on January 17 in a prominence at latitude — 68° W. This prominence was not visible at 8h 52m I.S.T., but was very bright at 9h 02m showing

the sodium and magnesium lines bright, it rapidly increased in height from 35″ at $9^h\ 02^m$ to 140″ at $9^h\ 22^m$ at $9^h\ 50^m$ it had disappeared. The displaced portion of the line was entirely detached from the undisplaced line.

Reversals and displacements of the C line on the disk.

Forty-seven reversals of the C line were observed in the neighbourhood of sunspots. These also curiously enough show a preponderance west of the central meridian, 29 being west and 18 east. Thirty-eight displacements were recorded, of which 20 were east of the central meridian. Twenty-four displacements were towards the red and only 11 towards violet and 3 in both directions simultaneously.

The spots of March 31 to April 12, latitude + 28°, and April 27 to May 3, latitude + 18°, were especially active in producing reversals and displacements of the hydrogen lines.

Prominences projected on the disk as absorption markings.

Owing to the use of the large Michelson grating for other work no photographs of the sun's disk in Hα light were obtained. A new grating has been ordered and it is hoped to continue the records when this has been received.

A very conspicuous absorption marking was photographed in calcium light on five days from April 9 to April 13 inclusive. It was in latitude + 45° to + 54° and crossed the central meridian on April 13.

THE OBSERVATORY, KODAIKANAL,
15th August 1914.

J. EVERSHED,
Director, Kodaikanal and Madras Observatories.

MADRAS: PRINTED BY THE SUPERINTENDENT, GOVERNMENT PRESS—1914.