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Kodaikanal Observatory.

BULLETIN No. CX.

SUMMARY OF PROMINENCE OBSERVATIONS FOR THE SECOND HALF OF THE YEAR 1935.

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 for those days when the Kodaikanal records are imperfect or wanting In response to our requirements for the second-half of the year 1935, the Mount Wilson Observatory supplied calcium (K_{232}) prominence plates for 54 days and H α disc plates for 43 days, the Meudon Observatory supplied calcium (K_3) disc plates for 8 days and H α disc plates for 36 days and the Ewhurst Observatory (Mr J Evershed's) supplied H α prominence plates for 4 days and H α disc plates for 6 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 weighing 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 173 days for which plates were available being reduced to 145 effective days

	Mean daily areas (square minutes).	Mean daily numbers.
North	2·65	6·72
South	2·70	6·85
Total .	5·35	13·57

Compared with the previous half-year, areas show an increase of 19 per cent, numbers remaining almost the same. The increase in areas is considerably more in the northern hemisphere than in the southern

For comparison with bulletins issued prior to the co-operation of other observatories the means based on Kodaikanal photographs alone are also given, 125 days of observation being counted as 109½ effective days.

	Mean daily areas (square minutes).	Mean daily numbers
North (Kodaikanal photographs only)	2·54	6·65
South (do	2·61	6·58
Total	5·15	13·23

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. Compared with the previous half-year, the distribution remains unchanged in the northern hemisphere, whereas in the

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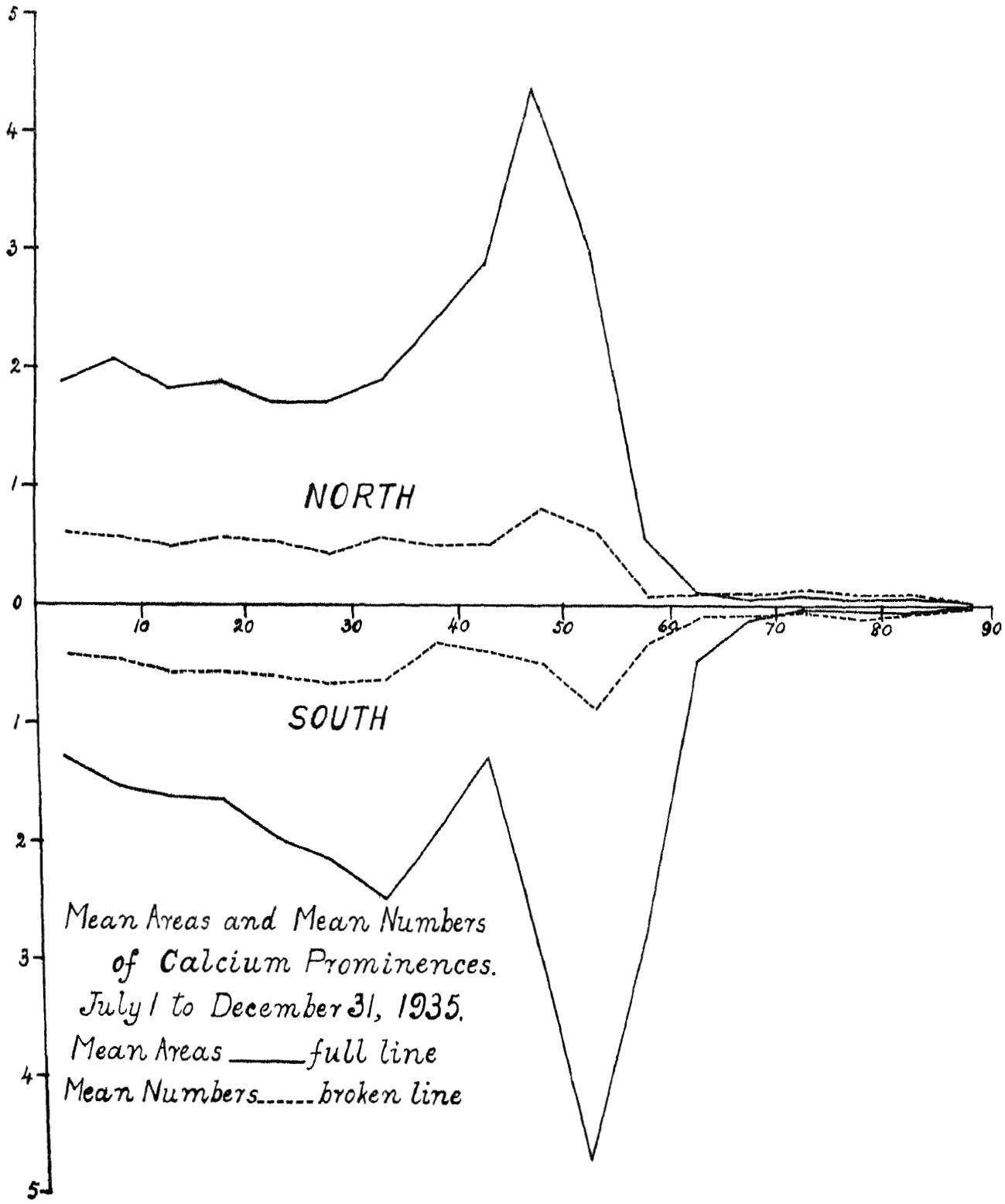
southern hemisphere the zone of maximum activity has advanced 5° towards the pole and there is reduced activity in the zones 10°-15° and 40°-45°



The monthly, quarterly and half-yearly areas and numbers and the mean height and the mean extent of the prominences on photographs from all co-operating observatories are given in Table I The unit of area is 1 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, and 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 SECOND HALF OF 1935.

Months	Number of days (effective).	Areas.	Numbers.	Daily means.		Mean height.	Mean extent
				Areas.	Numbers.		
1935.						"	°
July . .	23½	108 8	294	4 6	12 5	39 8	5·65
August .	24	117·5	321	4 9	13·4	38·3	5·79
September . .	27	166·5	353	6 2	13·1	40·3	6 08
October . .	24½	101·5	372	4·1	15·2	38 7	4·76
November .	22½	137·7	322	6 1	14·3	38·0	6·12
December . .	23½	142·8	301	6·1	12 8	41·7	7·39
Third quarter .	74½	392·8	968	5·3	13·0	39 5	5 85
Fourth quarter .	70½	382·0	995	5 4	14 1	39·4	6 00
Second half-year .	145	774 8	1,963	5 3	13·5	39 5	5 93

Distribution East and West of the Sun's Axis.

Both areas and numbers show a defect at the east limb, that in areas being more marked, as will be seen from the following table:—

1936 July to December.	East.	West.	Percentage East
Total number observed	970	993	49·41
Total areas in square minutes . .	352·1	422·6	45·45

Metallic Prominences.

Thirteen metallic prominences were observed during the half-year and their details are given below —

TABLE II.—LIST OF METALLIC PROMINENCES JULY TO DECEMBER 1935

Date.		Time I. S. T.		Base.	Latitude.		Limb	Height.	Lines (See note at end of table).
					North.	South.			
		H.	M.	°	°	°		"	
1935.									
July						*Nil*			
August	30	9	45	3	..	33	W	15	4 and 10.
September	27	9	17	3	25·5	.	W	20	4 and 10.
October	22	9	27	2		19	W	10	4 and 10
November	3	9	05	2		32	E	10	4 and 10.
	29	9	08	5	.	19 5	W	15	4 and 10.
December	4	10	53	1	..	24·5	E	15	1, 3, 4, 5, 7, 8, 10 and 12.
	8	10	22	5	..	27·5	W	20	1, 3, 4, 5, 9, 10, 11 and 12.
	9	9	35	4	.	28	W	25	1, 3, 4, 5, 9, 10, 11 and 12.
	10	8	38	..	.	27	W	20	1, 2, 3, 4, 5, 7, 9 and 10.
	11	10	43	.	..	28	W	15	1, 2, 3, 4, 5, 7, 8, 9, 10, 11 and 12.
		10	45	1	.	25·5	W	10	1, 2, 3, 4, 5, 7, 8, 9, 10, 11 and 12.
	23	10	18	3	..	22·5	E	20	1, 2, 4, 9, 10, 11 and 12
	30	10	40	3	..	30·5	E	10	4, 8, 10, 11 and 12.

NOTE —The key to the wave-lengths of metallic lines is as follows :—

No.	λ	Element.	No.	λ	Element.
1	4924·1	Fe+	7	5276·2	Fe+
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	Cr	12	7065	He

The distribution of metallic prominences was as follows :—

	1°—10°.	11°—20°	21°—30°.	31°—40°.	Mean latitude.	Extreme latitudes.
North	..	..	1	..	25°·5	25°·5
South . . .	..	2	8	2	26°·4	19°·0 and 33°·0

Four were on the east limb and nine on the west limb.

Displacements of the Hydrogen Line

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

TABLE III.—DISPLACEMENTS OF THE HYDROGEN LINE JULY TO DECEMBER 1935

Date.		Hour I.S.T		Latitude		Limb.	Displacement			Remarks.
				North	South		Red.	Violet	Both ways.	
		H.	M	°	°		A	A	A.	
1935.										
July	18	10	40		40	W	1 5			At top, extends over 4° from —38° to—42°.
	20	10	52		20	W	1			At top.
	23	9	23		39 5	E	Slight			At base; extends over 3° from —38° to —41°.
August	3	11	59		22	W		Slight		At top.
	23	8	35	2		W			Slight	In chromosphere.
	28	9	35	16		W		Slight		Do
	30	10	10		35	W	Slight			At base
		9	45		33	W	0·5	0 5		To red at top and to violet at base; extends over 3° from —31·5° to —34·5°.
September	13	9	15	28 5		E		0·5		At top; extends over 3° from +27° to +30°
		9	2		18	W		Slight		At base
		9	2		16	W	Slight			At top
	19	9	00	61		E	Slight			In chromosphere.
		9	5	27·5		E		1·5		At top, extends over 3° from +26° to +29°.
		9	24		57·5	E	1·5			At top; extends over 4° from —55 5° to —59·5°.
	20	9	32	36·5		W		Slight		In chromosphere.
	21	9	53	68		E		1		At top.
	22	9	15	34 5		E		0 5		At top; extends over 2° from +33 5° to +35·5°.
		9	4	12		W	2			At top; extends over 2° from +11° to +13°.
		9	2	31·5		W	1·5			At base.
	23	9	15	32·5		E		1		At top of floating prominence; extends over 2° from +31·5° to +33·5°.
		9	21		44·5	E	0 5			At base.
		9	3	26·5		W	1			At top; extends over 5° from +24° to +29°.
	24	9	27		7 5	E		Slight		At top.
		9	15	8		W	Slight			Do.
		9	8	22 5		W		1 5		At base.
	26	9	20	65		E	1			Do.
		9	05	21·5		W	0·5			At middle of prominence; extends over 3° from +20° to +23°.
		9	00	69		W	Slight			In chromosphere.
	28	8	58		33·5	E	Slight			At top.
		9	27	61		W		0·5		Do.

Date.		Hour I S.T.		Latitude North	Latitude South.	Limb.	Displacement Red.	Displacement Violet.	Displacement Both ways.	Remarks.
		H.	M.	°	°		A.	A.	A.	
1935.										
October	3	9	45		19 5	E	Slight			At base.
		9	33		55	W	2			At top; extends over 3° from —53·5° to 56—5°
	6	9	18	72		E	0·5			In chromosphere.
	21	9	25		15·5	W		1		At base.
	22	9	27		19	W	Slight			At top
	26	9	38		30	E		Slight		Do
		10	00	19		W	2			Over the whole detached prominence.
November	1	10	29		23	E	Slight			At base.
	3	8	58		30	E		1		At top
		8	58		31	E	1			At base.
		8	55		33	E	1			At top
	5	8	35	80		E	0 5			Do.
	6	10	34	31		E		Slight		Do
		10	32	23		E		Slight		Do
	8	9	00		16	W	Slight			At top, extends over 2° from —15° to —17°.
	9	9	42	21		E		1		At top.
		10	12	57		W	Slight			Do.
	19	9	40		27	E		Slight		At top; extends over 2° from —26° to —28°.
		9	30		51	W		0·5		At base, extends over 2° from —50° to —52°.
		9	23		30·5	W		2		At base; extends over 3° from —29° to —32°
	27	9	38		30	W	Slight			At top.
		9	41		17·5	W		1		Over the whole prominence.
		9	46		15	W		1		At base.
	28	9	11		16	W		0·5		At top.
		9	11		12	W			0 5	Do
	29	9	29		30·5	E	Slight			At base.
	30	11	03	68		W		1		In chromosphere
		11	05	83		W	1			At top.
December	2	9	22		12·5	W		2·5		At base.
		9	17	68·5		W		1		At top
	3	8	24	7		W	Slight			In the middle of prominence
	4	11	19		23	E		1		At top
	6	9	38	86		E		Slight		At base.
	8	10	39	23		E	1			Do.
		10	32		69	W		Slight		In chromosphere.
		10	23		38	W		0·5		At top.
		10	20		25	W	1			Do.
	9	11	05		83	E	1			Do.
		9	48		32	W	1·5			At top, extends over 2° from —31° to —33°.
		9	35		28	W		0·5		At base.
		8	38		27	W	4	2		To red at top and to violet at base.
		9	35		26	W	1			At top; extends over 2° from —25° to —27°
		9	35		20	W	1			At top; extends over 4° from —18° to —22°.
		8	30	85		W	Slight			In chromosphere.
	11	10	43		28	W	1			At top.
		11	9	50		W	1·5			Do.
	14	10	26	13		E			1	At base; extends over 2° from —12° to —14°
	23	10	12		12·5	E		1		At top; extends over 7° from —9° to —16°.
	30	10	21		30·5	E	2			At base; extends over 3° from —29° to —32°.
		10	40		30	E		2		At base.
		10	43		32 5	E		1·5		At top.

The total number of displacements was 83 as against 91 in the previous half-year and their distribution was as follows :—

	North.	South.
1°—30°	15	29
31°—60°	7	18
61°—90°	12	2
Total	34	49

East limb	34
West limb	49
Total	83

Of these displacements, 43 were towards the red, 37 towards the violet and 3 both ways simultaneously.

Reversals and displacements on the Sun's disc.

One hundred and ninety six bright reversals of the Hα line, 164 dark reversals of the D_3 line and 14 displacements of the Hα line were observed with the spectroscope during the half-year Their distribution is given below :—

	North.	South.	East	West
Bright reversals of Hα	87	109	91	105
Dark reversals of D_3	70	94	75	89
Displacements of Hα	3	11	8	6

Seven displacements were towards the red, two towards the violet and five both ways simultaneously.

The Hale spectrohelioscope has been used daily (except on Sundays and holidays) for the observation in the light of the Hα line of changing phenomena and of displacements which cannot readily be photographed. The hours allotted by the International Astronomical Union to this observatory for spectrohelioscope observations are 2-30 to 3-00, 4-00 to 4-30, 5-30 to 6-00 and 6-30 to 7-00 G M T or 8-00 to 8-30, 9-30 to 10-00, 11-00 to 11-30 and 12-00 to 12-30 I S. T but observations are continued at other times in cases where interesting developments are likely to occur A summary of the observations made during 1935 are given below

	East limb.	West limb.	Total.
Displacements in prominences	20	23	43

	North.	South	East.	West.	Total.
Displacements in Hα dark markings	42	89	59	72	131
Displacements in Hα bright flocculi	6	8	8	6	14

	Displacements towards			
	Red.	Violet.	Both ways.	Total.
Prominences	25	17	1	43
Hα dark markings	78	53	.	131
Hα bright flocculi	8	6	..	14

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 175 days which were counted as 160 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 :—

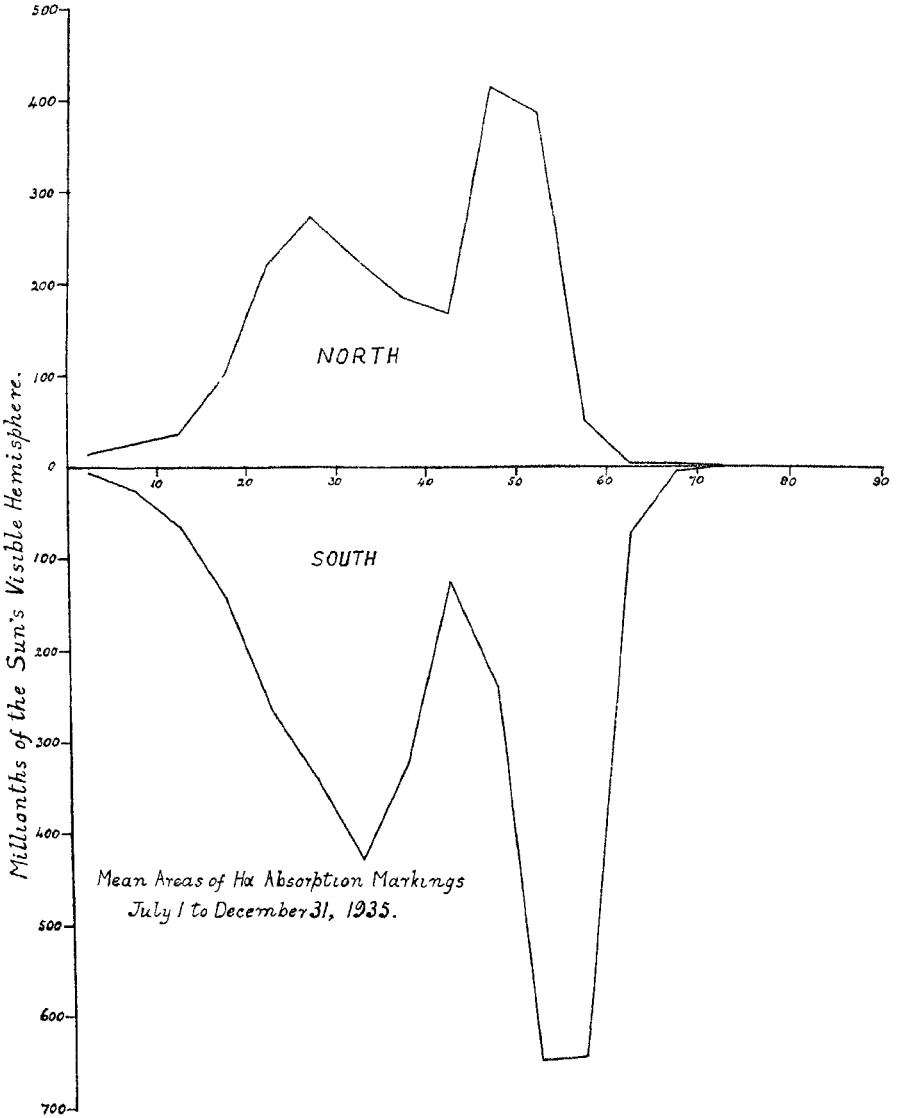
	Mean daily areas.	Mean daily numbers.
North	2079	12·76
South	3415	14 97
Total	5494	27 73

The above show an increase of 58 per cent in areas (the increase in the northern hemisphere being 117 per cent), and 43 per cent in numbers, compared with the previous half-year.

For comparison with bulletins issued prior to the co-operation of other observatories the means based on Kodaikanal photographs alone are also given, 102 days of observation being reduced to 94 effective days :—

	Mean daily areas.	Mean daily numbers.
North (Kodaikanal Photographs only)	2383	13·80
South (do.)	3551	15·83
Total	5934	29·63

The distribution of mean daily areas in latitude is shown in the following diagram Compared with the previous half-year the zone of maximum activity has advanced less than 5° towards the poles, and the secondary maxima near 30° remain unchanged in position



Compared with the previous half-year, both areas and numbers show a slight eastern preponderance, the percentage in areas being 50·97 and in numbers 50·73.

The mean daily areas of Hα absorption markings uncorrected for foreshortening are given below :—

	Mean daily areas
North	1137
South	1584
Total .	2721

The uncorrected areas amount to 50 per cent of the corrected ones. The curve of distribution in latitude is similar to that for the corrected areas as usual

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

T. ROYDS,
Director, Kodaikanal Observatory.

KODAIKANAL,
The 12th December, 1936.

ADDENDUM TO BULLETIN No. CVIII.

Page 372. Please insert the following before the last paragraph :—

The above figures show an increase of 36 per cent. in areas and 62 per cent. in numbers, compared with the previous half year

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 reduced to 153 effective days.

	Mean daily areas	Mean daily numbers.
North (Kodaikanal photographs only)	965	6 25
South (Do) .	2567	13 05
Total	3532	19 30

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