

# RESULTS OF MEASURES

MADE AT THE

## ROYAL OBSERVATORY, GREENWICH

UNDER THE DIRECTION OF

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ASTRONOMER ROYAL,

OF

# PHOTOGRAPHS OF THE SUN

TAKEN

AT GREENWICH, AT THE CAPE, AND IN INDIA

IN THE YEAR

1914.

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# GREENWICH PHOTO-HELIOGRAPHIC RESULTS, 1914.

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## INTRODUCTION.

§ I. *Measures of Positions and Areas of Sun Spots and Faculae on Photographs taken at the Royal Observatories of Greenwich, and of the Cape, and in India, at Kodaikánal and at Dehra Dún, in the year 1914; with the deduced Heliographic Longitudes and Latitudes.*

The photographs from which these measures were made were taken at the Royal Observatories of Greenwich or of the Cape; at the Kodaikánal Observatory, Southern India, or at Dehra Dún, North-West Provinces, India.

The photographs of the Sun, obtained at Greenwich, were taken with the Dallmeyer Photoheliograph, of 4 inches aperture, usually stopped down to 2.9 inches. The instrument was used in the Transit of Venus expedition to New Zealand in 1874, and, as now adapted, gives a solar image of about 10 centimetres radius on the photographic plate.

The photographs have been taken throughout the year on gelatine dry plates, "Fine grain, ordinary," "Process," or "Lantern," supplied by the Imperial Dry Plate Company, being used, with hydroquinone development.

The photographs from the Cape Observatory were taken under the superintendence of Mr S. S. Hough, His Majesty's Astronomer at the Cape; and those from Kodaikánal under the superintendence of Mr John Evershed, Director of that Observatory. The photographs from Dehra Dún, which have been forwarded by the Solar Physics Committee to fill the gaps in the combined series, were taken under the superintendence of the Deputy Surveyor-General, Trigonometrical Survey of India. At three of the observatories the instrument employed was a Dallmeyer Photoheliograph giving an image of the Sun about 10 centimetres in radius; at Kodaikánal a Cooke photo-visual object-glass of 6 inches aperture was used, the image of the Sun being on about the same 10 centimetre

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scale. The plates and development used have been much the same at each of the four collaborating observatories.

Photographs of the Sun were available for measurement upon each day in 1914, those finally selected for measurement being supplied by the different observatories as under :—

Greenwich . . . . .	236
Cape . . . . .	116
Kodaikáanal . . . . .	2
Dehra Dûn . . . . .	11
Total . . . . .	<hr/> 365

The measures were made in the manner described in the *Introduction to the Greenwich Photo-Heliographic Results* for 1909, and the results of the measures are printed upon the same general plan, the following being the signatures of those persons who measured the photographs for the year 1914 :—

D. J. R. Edney . . . . .	- . DE	A. W. Berry . . . . .	- . AB
H. W. Newton . . . . .	- . N	J. S. Smith . . . . .	- . JS
J. Van Dingenen . . . . .	- . VD		

At the principal focus of the photoheliographs one or two spider-lines are fixed by which the zero of position-angles on the photographs can be determined. There is only one such spider-line in the Kodaikáanal photoheliograph, and this is placed horizontally. In the other photoheliographs two spider-lines are used, crossing each other at right angles at the centre of the field. These lines are respectively perpendicular and parallel to the equator in the photoheliographs at the Cape and at Dehra Dûn, but are inclined to it at an angle of about 45° in that at Greenwich.

The method of determining the zero of position-angles for the Dallmeyer Photoheliograph at the Royal Observatory, Greenwich, was the same as that used for the Thompson Photograph, as described in 1909, except that, as in 1913, and as just noted, the two spider-lines were arranged nearly at an angle of 45° to the equator.

The determinations obtained were the following :—



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The method of taking transits of the Sun over the two wires, employed in 1913, as an alternative to that of photographs with double images of the Sun, was not used in 1914.

The double-image method, as described in 1909, was employed with the Dallmeyer Photoheliograph, at the Royal Observatory, Cape of Good Hope, and the following determinations were obtained:—

DALLMEYER PHOTOHELIOGRAPH, CAPE OF GOOD HOPE.

Date. Greenwich Civil Time.			Correction for Zero.	Date. Greenwich Civil Time.			Correction for Zero.
d	h		°	d	h		°
1913	December	27. 8	+0 3	1914	August	1. 0	R.A. wire broken.
1914	January	9. 8	+0 7			2. 0	New wire inserted.
	February	27. 9	+0 3			3. 10	+0 26
	March	23. 10	+0 8			8. 0	New wires inserted.
		17. 10	-0 1			8. 10	+0 4
	April	31. 9	+0 7		September	25. 8	+0 10
		17. 0	R.A. wire broken.			14. 8	-0 2
		20. 0	New wire inserted.		October	2. 9	+0 4
	May	20. 10	+0 14.5			19. 12	+0 10
		4. 12	+0 25		November	4. 10	-0 6
	June	16. 9	+0 24			18. 9	+0 2
		2. 10	+0 23		December	3. 8	+0 7
		16. 11	+0 20			17. 9	+0 4
	July	29. 12	+0 16	1915	January	4. 8	-0 4
		15. 11	+0 22			18. 9	+0 6

The zero-corrections used in the reduction of the photographs taken at the Cape Observatory with the Dallmeyer Photoheliograph were as follows:—

Date.	Correction for Zero.	Date.	Correction for Zero.
From 1914 January 1 to April 30	+0.1	From 1914 August 2 to August 7	+0.4
" " April 21 " April 30	+0.2	" " August 8 " October 31	+0.1
" " May 1 " June 30	+0.4	" " November 1 " November 30	+0.0
" " July 1 " July 31	+0.3	" " December 1 " December 31	+0.1

The zero-corrections for the photographs taken at the two Indian Observatories were determined in the same general manner, a correction of +0.4 for those taken at Kodaikānal, and of -0.5 for those from Dehra Dūn, being applied throughout the year 1914.

The method of reduction of the measures of the photographs is the same as that described in the *Introduction to the Greenwich Photo-Heliographic Results for 1909*. The inclination of the Sun's axis to the ecliptic is assumed to be  $82^{\circ} 45'$ , the longitude of the ascending node for 1914.0 to be  $74^{\circ} 33'.6$ , and the period of the Sun's sidereal rotation to be 25.38 days; the meridian which passed through the ascending node 1854 January 1, Greenwich Mean Noon, being taken as the zero meridian.

- § 2. *Ledgers of Areas and Heliographic Positions of Groups of Sun Spots deduced from the measurement of the Solar photographs for each day in the year 1914.*
- § 3. *Catalogue of Recurrent Groups of Sun Spots compiled from the Ledgers of Groups of Sun Spots for the year 1914.*
- § 4. *Total Areas of Sun Spots and Faculæ for each day, and Mean Areas and Mean Heliographic Latitude of Sun Spots and Faculæ for each Rotation of the Sun, and for the year 1914.*

These three sections are similar to the corresponding sections for 1911.

F. W. DYSON.

*Royal Observatory, Greenwich,  
1917 November.*

ROYAL OBSERVATORY, GREENWICH.

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MEASURES OF POSITIONS AND AREAS

OF

SUN SPOTS AND FACULÆ

ON

PHOTOGRAPHS

TAKEN WITH THE

PHOTOHELIOGRAPHS

AT GREENWICH, AT THE CAPE, AND IN INDIA,

WITH THE DEDUCED

HELIOGRAPHIC LONGITUDES AND LATITUDES.

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1914.

MEASURES of POSITIONS and AREAS of SUN SPOTS and FACULÆ on PHOTOGRAPHS taken at the ROYAL OBSERVATORIES of GREENWICH and of the CAPE, and in INDIA, at KODAIKÁNAL and at DEHRA DŪN, in the Year 1914.

NOTE.—The Greenwich Civil Time at which the Photograph was taken is expressed by the Day of the Year and decimals of a day, reckoning from Midnight, January 1<sup>st</sup>. For convenience of reference, the Month and Day of the Month (Civil Reckoning) are added. The letter G. signifies that the photograph was taken at Greenwich; the letter C. that it was taken at the Cape; the letter K. that it was taken at Kodaikánal; the letter D. that it was taken at Dehra Dūn; the time given is Greenwich Civil Time. The position-angles are reckoned from the North Pole of the Sun's Axis in the direction N., E., S., W., N. The Groups of Spots are numbered in the order of their appearance. When there is no number in the third column, it is to be understood that there is a Facula unaccompanied by a Spot. The positions of Faculæ relative to the Spots with which they are associated are indicated by the letters *n, s, p, f, c*, denoting respectively north, south, preceding, following, concentric. The Areas of Spots and Faculæ are expressed in millionths of the Sun's visible Hemisphere. In the line immediately below the results for each day are given in brackets:—1. The Position Angle of the Sun's Axis (from the North point); 2. The Heliographic Longitude and Latitude of the Centre of the Disc; 3. The total areas for each day of Spots and Faculæ.

Greenwich Civil Time.	Measurers.	No. of Group, and Letter for Spot.	Distance from Centre in terms of Sun's Radius.	Position Angle from Sun's Axis.	HELIOGRAPHIC		SPOTS.		FACULÆ.	Greenwich Civil Time.	Measurers.	No. of Group, and Letter for Spot.	Distance from Centre in terms of Sun's Radius.	Position Angle from Sun's Axis.	HELIOGRAPHIC		SPOTS.		FACULÆ.	
					Longitude.	Latitude.	Area of UMBRA for each Spot (and for Day).	Area of WHOLE for each Spot (and for Day).	Area for each Group (and for Day).						Longitude.	Latitude.	Area of UMBRA for each Spot (and for Day).	Area of WHOLE for each Spot (and for Day).	Area for each Group (and for Day).	
1914. 0.446	JS, AB	7022	0.456	340.6	238.8	+22.4	12	32		1914. Jan. 7			No	Spots	or	Faculæ				
		7022	0.446	342.3	237.8	+22.0	0	10												
C.		7022	0.449	355.0	231.8	+23.4	2	12												
		7023	0.912	113.4	164.7	-22.5	6	58	} 436e		7.342	JS, AB		0.915	240.7	203.3	-28.3			129
		7023	0.938	113.0	160.4	-22.6	24	84				C.		0.914	113.6	73.1	-23.1			128
Jan. 1				(+2.2)	(229.4)	(-3.1)	(44)	(196)	(436)		Jan. 8			(-1.2)	(138.5)	(-3.9)	(0)	(0)	(257)	
1.509	JS, AB	7022	0.573	318.4	239.6	+22.3	22	64			8.347	JS, AB		0.866	297.5	180.6	+21.3			156
		7022	0.545	325.2	235.1	+23.4	5	15			C.		7024†	0.607	92.9	88.0	-5.0	5	11	(156)
C.		7023	0.807	115.4	163.6	-22.3	7	25	} 304c		Jan. 9			(-1.7)	(125.3)	(-4.0)	(5)	(11)		
		7023	0.844	115.4	159.6	-23.1	0	14			(34)	(118)	(304)							
2.517	JS, AB	7022	0.704	306.4	239.6	+22.0	11	39	70c		9.341	JS, AB		0.920	294.2	175.6	+20.4			106
G.		7023*	0.450	81.1	175.8	+0.9	1	2			C.			0.790	242.2	155.1	-24.2			238
Jan. 3				(+1.1)	(202.1)	(-3.4)	(12)	(41)	(70)		Jan. 10				(-2.2)	(112.2)	(-4.1)	(0)	(0)	(344)
3.429	JS, AB	7022	0.823	300.1	240.1	+22.1	0	8	121nf				0.860	243.7	155.3	-24.7			357	
C.			0.573	125.5	159.9	-22.4	(0)	(8)	(185)	10.464	JS, AB		0.817	132.3	49.2	-36.1			118	
Jan. 4				(+0.7)	(190.1)	(-3.5)				Jan. 11				(-2.7)	(97.4)	(-4.2)	(0)	(0)	(475)	
4.309	JS, AB		0.925	271.3	245.9	-0.2			110				0.927	245.0	153.2	-24.7			388	
C.			0.892	298.7	236.9	+23.5			299	11.345	JS, AB									
Jan. 5		7024	0.531	331.1	194.8	+24.2	2	20	(409)	Jan. 12				(-3.1)	(85.8)	(-4.3)	(0)	(0)	(388)	
				(+0.3)	(178.5)	(-3.6)	(2)	(20)												
5.513	N, JS		0.973	294.7	236.2	+23.0			390				0.910	61.0	12.0	+24.0			126	
C.		7024*	0.835	115.8	107.7	-23.5	0	6	} 37c	12.365	JS, AB									
Jan. 6		7024*	0.850	115.9	106.1	-23.8	1	4		(427)	Jan. 13				(-3.6)	(72.4)	(-4.4)	(0)	(0)	(126)
				(-0.3)	(162.6)	(-3.7)	(1)	(10)												

Group 7022, 1913 December 30-1914 January 4. A pair of double spots varying their distance from each other, with occasional different companions.  
 Group 7023, 1914 January 1-2. A small unstable group.  
 Group 7023\*, January 3. A very small equatorial spot.  
 Group 7024, January 5. A small double spot.  
 Group 7024\*, January 6. Two very small spots.  
 Group 7024†, January 9. Two or three very small spots.