

GREENWICH

PHOTO-HELIOGRAPHIC

RESULTS.

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1915.

**HIGH ALTITUDE OBSERVATORY  
LABORATORY AND ADMINISTRATIVE  
OFFICE  
BOULDER, COLORADO**

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## ERRATA.

### GREENWICH PHOTO-HELIOGRAPHIC RESULTS, 1915.

#### MEASURES OF POSITIONS AND AREAS OF SUN SPOTS AND FACULÆ, 1915.

PAGE	COL.	LINE	
D 2	1	9	Day and Decimal, for $0^{\circ}551$ , read $1^{\circ}551$ .
D 11	7	35	Latitude, for $-14^{\circ}7$ , read $+14^{\circ}7$ .

Also in the footnotes:—

PAGE	
D 18	Group 7216, for April 2, read April 3.
D 92	Group 7586, for Jan. 8, read Jan. 7.

# GREENWICH PHOTO-HELIOGRAPHIC RESULTS, 1915.

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## INTRODUCTION.

§ 1. *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 Kodaikámal and at Dehra Dún, in the year 1915; 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 Kodaikámal 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-centimetre radius on the photographic plate.

The photographs have been taken throughout the year on gelatine dry plates; "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 Kodaikámal 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 Kodaikámal 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 1915, those finally selected for measurement being supplied by the different observatories as under :—

Greenwich . . . . .	201
Cape . . . . .	136
Kodaikánal . . . . .	11
Dehra Dûn . . . . .	17
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 1915 :—

E. W. Maunder	-	-	M	J. S. Smith	-	-	JS
H. W. Newton	-	-	N	Annie S. D. Maunder	-	-	AM
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 Kodaikánal 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 Photoheliograph, 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 :—

DALLMEYER PHOTOHELIOGRAPH, GREENWICH.

Date, Greenwich Civil Time.			Correction for Zero.	Date, Greenwich Civil Time.			Correction for Zero.
	d	h m			d	h m	
1914	December	14. 11 4	+2 38'	1915	June	16. 12 20	+2 28'
		14. 12 34	+2 42			17. 10 22	+2 32
1915	January	2. 12 44	+2 45			21. 7 20	+2 28
		18. 10 57	+2 38	July		9. 12 16	+2 31
		18. 13 2	+2 49			15. 8 4	+2 30
	February	5. 10 15	+2 39			26. 8 14	+2 31
		10. 12 6	+2 37	August		10. 16 9	+2 39
		23. 11 12	+2 42			19. 15 34	+2 26
		26. 9 35	+2 36			25. 9 43	+2 40
	March	8. 14 28	+2 42	September		6. 8 25	+2 20
		20. 11 44	+2 40			9. 11 18	+2 37
		30. 10 30	+2 30			18. 9 39	+2 41
		31. 9 48	+2 35			29. 14 44	+2 36
	April	15. 8 1	+2 29	October		12. 9 53	+2 36
		16. 9 29	+2 30			14. 12 28	+2 52
		19. 11 15	+2 41			20. 12 47	+2 44
		19. 15 45	+2 30			22. 9 57	+2 50
		21. 12 39	+2 43	November		10. 10 14	+2 48
						11. 11 48	+2 47
	May	6. 7 54	+2 32			26. 11 36	+2 46
		6. 12 50	+2 36	December		23. 10 11	+2 34
		25. 9 50	+2 27			23. 10 18	+2 41
		26. 16 2	+2 33			28. 11 14	+2 45
	June	7. 10 36	+2 30	1916	January	10. 11 43	+2 47

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

Date.	Correction for Zero.	Date.	Correction for Zero.
From 1915 January 1 to January 31	+2.7	From 1915 October 1 to 31	+2.7
„ „ February 1 „ May 3	+2.6	„ „ November 1 „ 30	+2.8
„ „ May 5 „ July 31	+2.5	„ „ December 1 „ 31	+2.7
„ „ August 1 „ September 30	+2.6		

Some slight adjustments were made to the declination axis of the photoheliograph on 1915 May 4.

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 :—

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DALLMEYER PHOTOHELIOGRAPH, CAPE OF GOOD HOPE.

Date. Greenwich Civil Time.			Correction for Zero.	Date. Greenwich Civil Time.			Correction for Zero.
d	h	m	o	d	h	m	o
1914	December	3. 8 10	+0 7	1915	June	29. 12 16	+0 18
		17. 9 2	+0 4		July	13. 10 40	+0 33
1915	January	4. 7 50	-0 4			27. 8 35	+0 15
	February	18. 8 49	+0 6		August	12. 10 44	+0 6
		3. 9 1	-0 1		September	10. 11 57	+0 7
	March	18. 9 15	+0 4			22. 10 59	+0 12
		5. 10 26	+0 11		October	5. 8 5	+0 4
	April	20. 10 39	o 0			20. 9 51	+0 2
		6. 8 56	+0 10		November	3. 8 23	+0 1
	May	20. 8 52	+0 17			19. 8 19	+0 6
		5. 9 0	+0 10		December	6. 8 27	+0 4
	June	23. 9 24	+0 10			21. 9 20	Definition bad.
		4. 10 43	+0 11	1916	January	7. 12 24	+0 6
		24. 9 26	+0 15			24. 10 22	+0 3

The wire frame was removed for cleaning on 1914 December 31 and 1915 November 5.

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 January 1 to February 28	o 0	From July 1 to July 31	+0 3
„ March 1 „ March 31	+0 1	„ August 1 „ August 31	+0 2
„ April 1 „ June 30	+0 2	„ September 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  $+0^{\circ}.4$  for those taken at Kodaikáanal, and of  $-0^{\circ}.8$  for those from Dehra Dûn, being applied throughout the year 1915.

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 1915.0 to be  $74^{\circ} 34'.4$ , 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 1915.*

§ 3. *Catalogue of Recurrent Groups of Sun Spots compiled from the Ledgers of Groups of Sun Spots for the year 1915.*

§ 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 1915.*

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

F. W. DYSON.

*Royal Observatory, Greenwich,  
1920 May.*



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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1915.

MEASURES OF POSITIONS AND AREAS OF SUN SPOTS AND FACULÆ ON PHOTOGRAPHS

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 KODAIKĀNAL and at DEHRA DŪN, in the Year 1915.

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> 0<sup>h</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 KodaiKANAL; 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).			
1915. 0.103	N, VD	7122a	0.404	210.6	109.2	-23.3	9	20		1915. 2.108	N, VD	7129	0.797	306.1	115.3	+25.7	5	10				
		7126	0.577	109.4	62.4	-13.6	4	12				7129	0.783	305.1	114.4	+24.3	1	5				
		7126	0.660	108.4	56.2	-14.4	8	15				7129	0.793	308.4	114.0	+27.1	5	12	137c			
		7127	0.952	73.4	25.9	+14.7	8	55				7129	0.775	308.5	112.3	+26.3	1	8				
		7127	0.964	72.5	23.6	+15.9	0	20	313c			7122a	0.676	238.8	108.7	-23.1	9	13				
		7127	0.976	74.4	20.3	+14.5	9	13				7127	0.728	67.1	26.4	+14.0	8	33				
		7127	0.923	65.7	32.2	+21.0			560			7127a	0.753	66.6	24.4	+15.0	46	309				
Jan. 1				(+2.4)	(96.3)	(-3.1)	(38)	(135)	(873)	K.		7127	0.783	67.1	21.6	+15.5	0	19				
												7127	0.797	68.6	20.0	+14.8	0	76	245c			
												7127	0.802	66.7	20.0	+16.3	5	11				
												7127b	0.819	67.7	18.1	+16.0	4	16				
												7127	0.829	67.3	17.1	+16.7	0	9				
0.551	JS, N	7122	0.902	250.1	141.0	-19.3			170	Jan. 3				(+1.5)	(69.9)	(-3.3)	(84)	(521)	(382)			
		7122a	0.606	234.1	109.4	-23.5	0	2														
		7126	0.595	234.1	108.7	-23.1	13	17														
		7126	0.379	124.2	58.3	-15.3	2	2														
		7126	0.383	122.7	57.8	-15.0	2	11														
		7126	0.390	120.2	56.9	-14.3	2	5														
		7128	0.779	60.8	31.0	+20.1	2	6	169c													
		7127	0.802	69.6	26.6	+14.1	10	26		3.321	N, VD	7129	0.922	299.3	116.5	+25.3	0	38				
		7127	0.814	68.9	25.5	+15.0	22	70				7129	0.913	299.9	114.9	+25.4	1	8	242c			
		7127	0.830	69.6	23.8	+14.9	6	35				7129	0.912	302.3	114.1	+27.5	16	71				
		7127	0.833	68.6	23.7	+15.8	10	46				7122a	0.831	244.4	108.2	-23.0	3	11	394s			
		7127	0.848	69.4	21.9	+15.5	0	10	599c			7130	0.226	200.9	66.0	-15.6	0	6				
		7127	0.858	70.6	20.6	+14.8	19	41				7127a	0.550	56.7	25.7	+14.5	47	393				
		7127	0.862	69.0	20.4	+16.3	3	7				7127	0.572	59.1	23.6	+14.1	4	10				
		7127	0.873	69.8	19.0	+15.9	7	28				7127	0.587	57.3	23.2	+15.5	0	7				
		7127	0.884	69.2	17.8	+16.7	0	5				7127c	0.627	58.3	20.3	+16.4	11	63				
			0.957	171.8	48.1	-73.7			52			7127	0.627	61.3	19.4	+14.7	1	7				
			0.786	52.6	33.3	+26.1			111			7127b	0.646	60.1	18.4	+15.9	15	93				
			0.893	55.7	20.4	+28.4			120			7127	0.670	60.1	16.7	+16.8	2	8				
Jan. 2				(+1.7)	(77.2)	(-3.2)	(98)	(311)	(1221)	Jan. 4			0.946	113.2	343.3	-23.0	(+0.9)	(53.9)	(-3.4)	(100)	(715)	112 (748)

Group 7122, 1914 December 25-1915 January 4. Return of Group 7102. A slowly contracting spot, *a* of Group 7102,—with a mass of faculæ to the South. The motion of the spot in longitude, since its maximum about December 3, appears to be consistently maintained.  
 Group 7126, 1914 December 30-1915 January 5. Probably a return of Group 7117. A few small spots in an intermittent group not seen on January 3 and 4.  
 Group 7127, 1914 December 31-1915 January 12. A fine cluster by January 3, developing into two large and active composite spots, *a* and *b*, with a few faint companions. The larger, *a*, has divided up by January 11, while *b* disappears quickly. Perhaps a return of Group 7110, but more probably a new disturbance in its neighbourhood.  
 Group 7128, 1915 January 2. A very small spot.  
 Group 7129, January 3-5. A few small spots in a short irregular stream forming near the West limb.  
 Group 7130, January 4. A pair of very small faint spots preceding the place of Group 7126, and in the same latitude.