GREENWICH

SPECTROSCOPIC AND PHOTOGRAPHIC RESULTS.

1889.

RESULTS

OF THE

SPECTROSCOPIC AND PHOTOGRAPHIC OBSERVATIONS

MADE AT THE

ROYAL OBSERVATORY, GREENWICH,

IN THE YEAR

1889:

UNDER THE DIRECTION OF

W. H. M. CHRISTIE, M.A., F.R.S.,
ASTRONOMER ROYAL.

(EXTRACTED FROM THE GREENWICH OBSERVATIONS 1889.)

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1890.

GREENWICH SPECTROSCOPIC AND PHOTOGRAPHIC RESULTS, 1889.

INTRODUCTION.

§ 1. *Spectroscopic Observations in the Year* 1889.

The spectroscope used for these observations was mounted on the South-east equatorial, the object-glass of which (made by Merz and Son of Munich) has a clear aperture of 12·8 inches, with a focal length of about $17^{ft.}\ 10^{in.}$

This section contains:—Measures of Displacement of Lines in the Spectra of Stars, Sun, Moon, and Planets; Collected Results for Motions of Stars in the line of Sight; and Observations of the Spectra of χ Cygni, Uranus, R Andromedæ, and of Comet *e* 1889.

The measures of displacement of lines in the spectra of stars were made with a micrometer in the viewing telescope of the "Half-prism" Spectroscope. The eye-piece used gives a magnifying power of 14. Estimations of the displacement, in terms of the apparent breadth of the bright comparison-line, were also made; the breadth corresponding to any given width of slit being determined by a careful observation under similar conditions. $1^{rev.}$ of the screw for opening the slit corresponds to 0·01 inch, or $10''$. It has not been thought necessary to give in detail all these particulars of the reductions. The values used in each case may be inferred from the observed motion, which is the algebraic sum of the concluded motion and of the Earth's motion. A displacement of one tenth-metre corresponds at D to a motion of 31·7 miles per second, at *b* to a motion of 36·1 miles, and at F to a motion of 38·4 miles. For comparison with the spectrum of hydrogen or other chemical element, an image of the vacuum tube or electrodes is formed on the slit, by means of a transparent plate of glass placed at an angle of 45° with the axis of the collimator, in connexion with a collimating lens, so that the cone of rays from the comparison-light fills the whole of the object-glass of the collimator.

Whenever the star-line was sufficiently distinct to allow of its being seen at the same time as the bright comparison-line, a direct comparison of the two was made; in other cases the bright line was compared with the pointer of the micrometer which had just previously been placed on the star-line, giving an indirect comparison.

The reading of the position-circle is given, as it is conceivable that the results might be affected by the position of the spectroscope. The slit lies north and south when the reading is 6°.

With regard to the observations of the spectra of χ Cygni, Uranus, and R Andromedæ, it is sufficient to remark that a curve has been laid down in the usual manner, connecting micrometer readings and wave-lengths for the Single-prism Spectroscope, and that a correction for index-error has been deduced from observations of comparison-lines, and applied to the observed readings to reduce them to the standard curve from which the corresponding wave-lengths have been read off. The tabular wave-lengths of comparison-lines have been taken from Ångström's *Spectre Normal du Soleil.*

§ 2. *Measures of Positions and Areas of Sun Spots and Faculæ on Photographs taken at the Royal Observatory, Greenwich, at Dehra Dûn in India, and at the Royal Alfred Observatory, Mauritius, in the year* 1889*; with the deduced Heliographic Longitudes and Latitudes.*

The photographs from which these measures were made were taken either at Greenwich; at Dehra Dûn, North-West Provinces, India; or at the Royal Alfred Observatory, Mauritius.

The photographs of the Greenwich series were taken with the Dallmeyer Photo-heliograph returned from the Transit of Venus expedition to New Zealand, which, as now adapted, gives a solar image of 8 inches diameter on the photographic plate.

Bromo-iodized gelatine dry plates with alkaline development have been regularly used throughout the year.

The Indian photographs, which have been forwarded by the Solar Physics Committee to fill the gaps in the Greenwich series, were taken under the superintendence of the Deputy Surveyor General, Trigonometrical Survey of India, with a Dallmeyer photoheliograph giving an image of the Sun nearly 8 inches in diameter. In the process adopted at Dehra Dûn bromo-iodized collodion has been used in connexion with iron development.

The Mauritius photographs were taken under the superintendence of Dr. C. Meldrum, Director of the Royal Alfred Observatory, Mauritius, with a Dallmeyer photoheliograph, giving an image of the Sun about 8 inches in diameter. At the Mauritius Observatory bromo-iodized gelatine dry plates have been used with alkaline development.

Photographs of the Sun were taken at Greenwich on 178 days, and Indian photographs on 166 days with Mauritius photographs on 16 days have been received from the Solar Physics Committee to complete the total of 360 days for which there are either Greenwich, Indian, or Mauritius photographs of the Sun available for measurement in 1889.

The *first* column on each page contains the Greenwich Civil Time at which each photograph was taken, expressed by the day of the year and decimals of a day, reckoning from Greenwich mean midnight January 1d. 0h., and also by the day of the month (civil reckoning), which latter is placed opposite the total area of Spots and Faculæ for the day. The photographs taken in India are distinguished by the letter I, and those taken in Mauritius by the letter M.

The *second* column contains the initials of the two persons measuring the photograph ; the initial on the left being that of the person who measured the photograph on the left of the centre of the measuring instrument, and that on the right being that of the person who measured on the right of the centre.

The following are the signatures of those persons who measured the photographs for the year 1889 :—

E. W. Maunder - - M S. J. Temple - - - ST

The *third* column gives the No. of the group, and the letter for the spot. The groups are numbered in the order of their appearance.

The *next two* columns give the Distance from the Centre of the Sun in terms of the Sun's Radius, and the Position-Angle from the Sun's Axis, reckoned from the Sun's North Pole in the direction *n*, *f*, *s*, *p*, both results being corrected for the effects of astronomical refraction.

The measures of the photographs were made with a large position-micrometer specially constructed by Messrs. Troughton and Simms for the measurement of photographs of the Sun up to 12 inches in diameter. In this micrometer the

photograph is held with its film side uppermost on three pillars fixed on a circular plate, which can be turned through a small angle, about a pivot in its circumference, by means of a screw and antagonistic spring acting at the opposite extremity of the diameter. The pivot of this plate is mounted on the circumference of another circular plate, which can be turned by screw-action about a pivot in its circumference, 90° distant from that of the upper plate, this pivot being mounted on a circular plate with position-circle which rotates about its centre. By this means small movements in two directions at right angles to each other can be readily given, and the photograph can be accurately centred with respect to the position-circle. When this has been done, a positive eye-piece, having at its focus a glass diaphragm ruled with cross-lines into squares, with sides of one-hundredth of an inch (for measurement of areas), is moved along a slide diametrically across the photograph, the diaphragm being nearly in contact with the photographic film, so that parallax is avoided. The distance of a spot or facula from the centre of the Sun is read off by means of a scale and vernier to 1-250th of an inch (corresponding to 0·001 of the Sun's radius for photographs having a solar diameter of 8 inches). The position-angle is read off on a large position-circle which rotates with the photographic plate. The photograph is illuminated by diffused light reflected from white paper placed at an angle of 45° between the photograph and the plate below.

The following is the process of measurement of a photograph :—By means of the screws attached to the plates carrying the pillars which hold the photograph, the image of the Sun is centred as accurately as possible by rotation. The position-circle is then set to the readings 0°, 90°, 180°, and 270° in succession, and the scale readings taken for the two limbs. The scale being so adjusted that its zero coincides with the centre of rotation of the position-circle, the mean of the eight readings for the limb gives the mean radius of the Sun directly.

At the principal focus of the photoheliograph are two cross-wires which serve to determine the zero of position-angles on the photograph.

The zero of position-angles for the Dallmeyer Photoheliograph, employed at Greenwich, has generally been determined throughout 1889 by the measurement of a plate which had been exposed to the Sun's rays twice, with an interval of about 100 seconds between the two exposures, the instrument being firmly clamped. Two images of the Sun, overlapping each other by a little more than the fifth part of the Sun's diameter, were

therefore produced upon the plate, and the exposures having been so given that the line joining the cusps passed through the centre of the plate, the inclination of the wires of the photoheliograph to this line was measured with the position-micrometer, and a small correction for the inclination of the Sun's path was then applied. The following table gives the correction for zero of position for the mean of the two wires as thus determined :—

Date, Greenwich Civil Time.		Correction for Zero.
	h	° ′
1888 December	7. 13	− 2. 3
1889 February	2 2	+ 0. 4
	26. 9	+ 0. 32
April	4. 12	+ 0. 33
June	6. 13	+ 0. 46
August	1. 12	+ 1. 47
	24. 13	− 0. 3
September	11. 11	+ 0. 52
	25. 12	+ 0. 14
October	25. 11	+ 0. 4
November	12. 12	+ 0. 3
December	3. 11	+ 0. 39
	23. 12	+ 0. 39
1890 January	29. 12	+ 0. 48
February	10. 12	+ 0. 48

The zero of position has also been determined on several occasions by allowing the diurnal motion to carry a spot or the Sun's limb along the equatorial wire, a correction for the inclination of the Sun's path being applied to the reading of the position-circle so obtained, and also by running the image along the wire by the use of the R. A. slow motion, the mean of the two determinations, further corrected for the error of the perpendicularity of the wires, being then taken.

The correction for error of perpendicularity of the wires in use up to 1889 February 25, was − 0°. 23′ ; for the new wires inserted 1889 February 20, it was + 0°. 6′· 5 ; for those inserted 1889 July 12, it was − 0°. 8′ ; and for those inserted 1889 November 27, − 0°. 25′. The following table gives the correction for zero of position of the mean of the two wires as obtained by this method :—

Date, Greenwich Civil Time.		h	Corrected Zero of Position-Circle from Transit.	Zero of Position-Circle obtained when using R.A. Slow Motion.
			° ′	° ′
1888	December	7. 13	− 2. 31	− 2. 32
1889	February	2. 10	+ 0. 3	− 0. 3
	March	14. 13	+ 0. 28	+ 0. 30
	June	6. 13	+ 0. 33	+ 0. 31
	August	24. 14	− 0. 26	.....
	September	25. 12	− 0. 2	− 0. 2
	October	25. 11	+ 0. 3	+ 0. 2
	November	12. 12	+ 0. 3	+ 0. 4
	December	3. 11	+ 0. 43	+ 0. 41
1890	February	10. 12	+ 0. 42	+ 0. 39

The mean of the values for the zero as determined by these two methods, the method of the photographs with double images of the sun, and that of running a spot or the sun's limb along the wires, has been adopted for the zero.

One or other of the wires was found to be broken on February 20, July 12, and November 27, and fresh pairs of wires were in consequence inserted on those days. The wires inserted on July 12 were re-fixed in their frame on August 14, September 2, and September 25.

In the use at Greenwich of the Dallmeyer Photoheliograph the position-circle has usually been set to some convenient reading near that for zero, so that the wires are respectively very nearly parallel and perpendicular to the circle of declination, and a correction for zero of position of the photoheliograph for the mean of the two wires

has been applied to the zero of the position-circle of the micrometer. The setting of the position-circle was altered on 1888 December 7, from 356°·0 to 353°·0, and it was retained at the latter reading throughout 1889.

The correction for zero of position adopted for any date has been the mean of the determinations of that zero made next before and next after that date. The zero of the position-circle of the micrometer has been determined from the readings of the position-circle for the four extremities of the two wires. The resulting combined correction is applied to all position-circle readings for spots and faculæ, so as to give true position-angles.

In the use of the Photoheliographs at Dehra Dûn and in Mauritius the position-circle has always been set to the zero as determined by allowing the diurnal motion to carry a spot or the Sun's limb along the horizontal wire, and the accuracy of the adjustment has been tested at short intervals. No correction for zero of position of the wires has therefore been applied for the reduction of the photographs taken in India or in Mauritius.

The uncorrected distance from the Sun's centre for spots and faculæ is read off directly to 1-250th of an inch by means of a scale and vernier, the zero of the scale of the new micrometer being adjusted to coincide with the centre of the instrument.

Two sets of measures of the Sun's limb and of spots and faculæ on each photograph have been taken and the mean of the two sets adopted.

No correction has been applied to the photographs on account of distortion.

The correction for the effect of refraction has been thus found, the Sun's image being assumed to be sensibly an ellipse. The refraction being sensibly $c \tan z$ where $c = \sin 57''{\cdot}5 = \frac{1}{3600}$ nearly, and z is the apparent zenith distance, we shall have—

$$\frac{\text{Vertical Diameter}}{\text{Horizontal Diameter}} = \frac{1 - c \sec^2 z}{1 - c} = 1 - c \tan^2 z \; ;$$

and thus the effect of refraction will be to diminish any vertical ordinate y by the quantity $c \tan^2 z$. Resolving this along and perpendicular to the radius vector r,

and putting v for the position-angle of the vertex, we have for δr and $\delta \theta$, the corrections to radius vector and position-angle for the effect of refraction—

$$\delta r = + c \,.\, \tan^2 z \times r \,.\, \cos^2 (\theta - v) = + c \,.\, \tan^2 z \times r \times \frac{1 + \cos 2 (\theta - v)}{2},$$

$$\delta \theta = - c \,.\, \tan^2 z \,.\, \sin (\theta - v) \,.\, \cos (\theta - v) = - c \,.\, \tan^2 z \, \frac{\sin 2 (\theta - v)}{2}.$$

The quantity δr thus found is the correction, on the supposition that a horizontal diameter of the Sun is taken as the scale. But, as the mean of two diameters at right angles has been used, the scale itself requires the correction $\delta \mathrm{R} = + c \,.\, \tan^2 z \times \mathrm{R} \times \frac{1}{2} \left\{ \frac{1 + \cos 2 (\theta_0 - v)}{2} + \frac{1 + \cos 2 (\theta_0 + 90^\circ - v)}{2} \right\} = + \frac{1}{2} c \,\mathrm{R} \,.\, \tan^2 z$, where R is the Sun's mean radius and θ_0 , $\theta_0 + 90^\circ$ the position-angles of the two diameters measured. Thus the final correction to r becomes—

$$\delta r = + c \,.\, \tan^2 z \times r \times \frac{\cos 2 (\theta - v)}{2}.$$

The quantities $c \tan^2 z$, $- \frac{\sin 2 (\theta - v)}{2}$, and $\frac{\cos 2 (\theta - v)}{2}$ have been tabulated for use as follows, $c \tan^2 z$ being expressed in circular measure and in arc for application to distances and position-angles respectively :—

$c \tan^2 z$.

z.	In Circular Measure.	In Arc.	z.	In Circular Measure.	In Arc.	z.	In Circular Measure.	In Arc.
°		′	°		′	°		′
80	·0089	31	70	·0021	7	60	·0008	3
79	·0073	25	69	·0019	6½	58	·0007	2
78	·0061	21	68	·0017	6	56	·0006	2
77	·0052	18	67	·0015	5½	54	·0005	2
76	·0045	15	66	·0014	5	52	·0005	2
75	·0039	13	65	·0013	4½	50	·0004	1
74	·0034	11½	64	·0012	4	45	·0003	1
73	·0030	10	63	·0011	4	40	·0002	1
72	·0026	9	62	·0010	3	30	·0001	0
71	·0023	8	61	·0009	3			

Factors for Refraction.

$\theta - v$	$\theta - v$	$-\frac{\sin 2(\theta-v)}{2}$	$\frac{\cos 2(\theta-v)}{2}$	$\theta - v$	$\theta - v$	$-\frac{\sin 2(\theta-v)}{2}$	$\frac{\cos 2(\theta-v)}{2}$
°	°			°	°		
0	180	·00	+ ·50	95	275	+ ·09	− ·49
5	185	− ·09	+ ·49	100	280	+ ·17	− ·47
10	190	− ·17	+ ·47	105	285	+ ·25	− ·43
15	195	− ·25	+ ·43	110	290	+ ·32	− ·38
20	200	− ·32	+ ·38	115	295	+ ·38	− ·32
25	205	− ·38	+ ·32	120	300	+ ·43	− ·25
30	210	− ·43	+ ·25	125	305	+ ·47	− ·17
35	215	− ·47	+ ·17	130	310	+ ·49	− ·09
40	220	− ·49	+ ·09	135	315	+ ·50	·00
45	225	− ·50	·00	140	320	+ ·49	+ ·09
50	230	− ·49	− ·09	145	325	+ ·47	+ ·17
55	235	− ·47	− ·17	150	330	+ ·43	+ ·25
60	240	− ·43	− ·25	155	335	+ ·38	+ ·32
65	245	− ·38	− ·32	160	340	+ ·32	+ ·38
70	250	− ·32	− ·38	165	345	+ ·25	+ ·43
75	255	− ·25	− ·43	170	350	+ ·17	+ ·47
80	260	− ·17	− ·47	175	355	+ ·09	+ ·49
85	265	− ·09	− ·49	180	360	·00	+ ·50
90	270	·00	− ·50				

The position-angle of the Vertex v is readily taken from a globe.

The distance from centre in terms of the Sun's radius given in the *fourth* column is then readily found by dividing the measured distance r_0, as corrected for refraction, by the measured mean radius of the Sun, R ; and the Position-Angle from the Sun's Axis given in the *fifth* column is obtained by applying to the Position-Angle (from the N. point) corrected for refraction the Position-Angle of the Sun's Axis derived from the "Auxiliary Tables for determining the Angle of Position of the Sun's Axis, and the Latitude and Longitude of the Earth referred to the Sun's Equator," by Warren De La Rue, F.R.S.

The *sixth* and *seventh* columns give the heliographic longitude and latitude of the spot, which are thus computed.* Let r be the measured distance of a spot from the centre of the Sun's apparent disc, R the measured radius of the Sun on the photograph, (R) the tabular semidiameter of the Sun in arc, and ρ, ρ' the angular distances of a

* Researches on Solar Physics: Heliographical Positions and Areas of Sun Spots observed with the Kew Photoheliograph during the years 1862 and 1863, by W. De La Rue, B. Stewart, and B. Loewy. Phil. Trans. 1869

spot from the centre of the apparent disk as viewed from the Sun's centre and from the Earth respectively. Then we have—

$$\rho' = \frac{r}{R}(R)\,;\ \text{and}\ \sin(\rho + \rho') = \frac{r}{R},$$

$$\text{whence}\ \rho = \sin^{-1}\frac{r}{R} - \rho'.$$

Log sin ρ and log cos ρ as computed from this formula are given in "Tables for the Reduction of Solar Observations No. 2," by Warren De La Rue, F.R.S. Then, if D, λ are the heliographic latitudes of the Earth and the Spot respectively, referred to the Sun's Equator, and L, l the heliographic longitudes reckoned from the ascending node of the Sun's Equator on the ecliptic, and χ the position-angle from the Sun's axis, we have by the ordinary equations of spherical trigonometry—

$$\sin\lambda = \cos\rho \sin D + \sin\rho \cos D \cos\chi$$
$$\sin(L - l) = \sin\chi \sin\rho \sec\lambda.$$

The quantities L and D are derived from Warren De La Rue's Auxiliary Tables before referred to, in the computation of which the following formulæ have been used—

$$\tan L = \cos I \tan(\odot - N)$$
$$\sin D = \sin I \sin(\odot - N)$$

where I is the inclination of the Sun's Equator to the ecliptic, N the longitude of the ascending node, and $\odot$ the longitude of the Sun.

The position-angle χ is given by the formula—

$$\chi = P + G + H$$

where P is the position-angle from the north point of the Sun, and G and H two auxiliary angles given by the formulæ—

$$\tan G = \tan\omega \cos\odot$$
$$\tan H = \tan I \cos(\odot - N)$$

where ω is the obliquity of the ecliptic.

It will be seen that G is the inclination of two planes through the line joining the centres of the Earth and Sun passing through the poles of the Earth and of the ecliptic respectively, and that H is the inclination of two planes through the same line and the poles of the Sun and of the ecliptic. The values assumed for I, N, ω in the computation of the Tables are 7° 15′, 74°, and 23° 27′·5 respectively.

The Heliographic Longitude of the Spot is found from l, the Heliographic Longitude from Node, by subtracting the Reduction to the Prime Meridian, which is the Longitude

of the Node at the epoch of the photograph, referred to the assumed Prime Meridian, the latter being the meridian which passed through the ascending node at mean noon, 1854, Jan. 1. The period of rotation assumed is 25·38 days.

The Heliographic Longitude and Latitude of the Centre of the Sun's Disk at the time of the exposure of each photograph are also given (in brackets) in the *sixth* and *seventh* columns respectively. The Longitude of the Centre of the Disk is found by subtracting the Reduction to the Prime Meridian from L, the Longitude of the Centre from the Node. The Latitude of the Centre is of course the same as D, the Heliographic Latitude of the Earth.

The measures of areas given in the *last three* columns were made with a glass diaphragm ruled into squares, with sides of one hundredth of an inch, and placed nearly in contact with the photographic film. The integral number of squares and parts of a square contained in the area of a spot or facula was estimated by the observer, two independent sets of measures being made by two observers. The mean of the two sets of measures has been taken for each photograph. The factor for converting the areas, as measured in ten-thousandths of a square inch, into millionths of the Sun's visible hemisphere, allowing for the effect of foreshortening, has been inferred by means of a table of double entry, giving the equivalent of one square for different values of the Sun's radius, and for different distances of the spot or facula from the Sun's centre, as measured by means of the position-micrometer.

The individual spots in a group have in some cases not been measured separately, but combined into a cluster of two or three small spots close together, the position of the centre of gravity and the aggregate area of the cluster being given. The actual number of individual spots is usually stated in the Notes.

§ 3. *Ledgers of Areas and Positions of Groups of Sun Spots deduced from the measurement of the Solar photographs for each day in the year* 1889.

In these Ledgers the daily results for each group are collected together from the measures of the individual spots and given in a condensed form. The first column gives for each day, on which the group was observed, the Greenwich civil time at which each photograph was taken, expressed by the day of the month (civil reckoning) and the decimals of a day reckoning from Greenwich mean midnight. The second and third columns give the sums, for each day, of the projected areas of all the umbræ and whole spots comprised in the group, the projected area being the area as it is measured upon the photograph, uncorrected for foreshortening, and expressed in

millionths of the Sun's apparent disk. The fourth and fifth columns give the sums for each day of the areas of all the umbræ and whole spots comprised in the group, corrected for foreshortening, and expressed in millionths of the Sun's visible hemisphere. The sixth and seventh columns give the mean longitude and latitude of the group, found by multiplying the longitude and latitude of each separately measured component of the group by its area, and dividing the sum of the products by the sum of the areas. The last column gives the mean longitude of the group from the central meridian, and is found by subtracting the longitude of the centre of the disk from the mean longitude of the group. At the foot of these daily results for each group are given the mean areas of umbræ and whole spots and the mean longitude and latitude for the period of observation.

§ 4. *Total Projected 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* 1889.

This section requires no further explanation.

1890 August 14. W. H. M. CHRISTIE.

ROYAL OBSERVATORY, GREENWICH.

SPECTROSCOPIC OBSERVATIONS

MADE AT THE

ROYAL OBSERVATORY, GREENWICH,

1889.

MEASURES of DISPLACEMENT of LINES in the SPECTRA of STARS, SUN, MOON, AND PLANETS as compared with those of TERRESTRIAL ELEMENTS, and CONCLUDED MOTIONS in the LINE of SIGHT, from OBSERVATIONS at the ROYAL OBSERVATORY, GREENWICH, in the Year 1889.

The day specified in the first column is the Civil Day, and the hours and minutes are those of Greenwich Civil Time, commencing at Greenwich Mean Midnight and counting from 0 to 24 hours.

Note.—The motion corresponding to the displacement actually observed may be inferred from the Concluded Motion by adding the Earth's Motion algebraically.

The "Half-prism" Spectroscope was used throughout. Each "Half-prism" is compound, and is composed of a flint "half-prism" (*i.e.*, the half of an isosceles prism, cut by a plane perpendicular to the base,) and a crown prism, cemented on the emergent face so as to form the half of a direct-vision prism. With one such half-prism a dispersion of about 18½° from A to H, equivalent to that produced by four flint prisms of 60°, is obtained; and with a train of two, a dispersion of about 80°, equivalent to that produced by sixteen flint prisms of 60°. One half-prism has been always employed. The dispersions have been inferred from measurements of the distance between b_1 and b_4 as compared with the wave-length measure.

1 rev. of the micrometer corresponds with one "half-prism" to 10·4 tenth-metres or 375 miles per second for the *b* lines, and to 7·91 tenth-metres or 304 miles per second for the F line.

1 rev. of the screw for opening the slit corresponds to 0·01 inch, or about 10″.

The slit lies north and south when the reading of the Position Circle is 6°.

The velocity of light has been taken as 186,660 miles per second, and the distance of the Sun as 92,250,000 miles.

The estimations of displacements have been made by *indirect* comparison with the comparison-line, except where the contrary is expressly stated. The displacement is estimated in terms of the breadth of the comparison-line.

The sign + denotes a displacement towards the red or a motion of recession, − a displacement towards the blue or a motion of approach.

Date, 1889. Greenwich Civil Time.	Observer.	Object.	Line.	Width of Slit.	Displacement.		Earth's Motion in Miles per Second.	Concluded Motion of Stars in Miles per Second.		REMARKS.
					Measured.	Estimated.		Measured.	Estimated.	
d h m				r	r					
Jan. 1. 20. 15	M	α Andromedæ.	F	0·198	−0·136	− 2/5	+ 17·1	− 58·4	− 71·8	Spectrum bright and steady. Star-line seen well.
20. 25	M	,,	F	0·198	−0·083	− 1/5	+ 17·1	− 42·3	− 47·5	
21. 0	M	β Arietis	F	0·198	−0·044	− 1/10	+ 17·6	− 31·0	− 35·8	Spectrum steady but faint. Definition good. Star-line broad and diffused.
21. 15	M	,,	F	0·198	+0·055	+ 1/10	+ 17·6	− 0·9	+ 0·6	
22. 15	M	Aldebaran.....	F	0·198	+0·142	+ 1/2	+ 10·4	+ 32·7	+ 35·2	Observation very rough. Interrupted by cloud. Position Circle 6°.
Jan. 29. 19. 35	M	β Persei.....	F	0·298	+0·018	+ 1/10	+ 16·9	− 11·4	− 9·0	Spectrum very faint and observations made with difficulty, but star-line seen well at moment of bisection. Position Circle 6°.
19. 55	M	,,	F	0·298	−0·015	− 1/10	+ 16·9	− 21·5	− 24·8	
Feb. 4. 19. 5	M	Venus	F	0·214	+0·084	+ 1/4		+ 25·5	+ 25·8	Calculated Motion − 7·8 miles per second.
19. 10	M	,,	F	0·214	+0·048	+ 1/10		+ 14·6	+ 10·3	
20. 0	M	Moon.....	F	0·214	−0·012			− 3·6		The coincidence of the two spectra appeared perfect.
20. 3	M	,,	F	0·214	−0·021			− 6·4		
20. 6	M	,,	F	0·214	+0·014			+ 4·3		
20. 9	M	,,	F	0·214	−0·004			− 1·2		
20. 12	M	,,	F	0·214	−0·011			− 3·3		
20. 15	M	Aldebaran.....	F	0·214	+0·044	+ 1/5	+ 17·4	− 4·0	+ 17·0	Spectrum faint and very unsteady.
20. 20	M	,,	F	0·214	+0·061	+ 1/5	+ 17·4	+ 1·1	+ 3·3	Star-line seen with difficulty. Observations rough.
20. 30	M	Rigel	F	0·214	+0·198	+ 2/5	+ 14·1	+ 46·0	+ 54·7	Spectrum bright but unsteady.
20. 40	M	,,	F	0·214	+0·118	+ 2/5	+ 14·1	+ 21·7	+ 27·2	Star-line rather faint. Definition fair.
20. 45	M	γ Orionis	F	0·214	−0·059	− 1/5	+ 15·1	− 33·0	− 35·8	Spectrum faint but fairly steady.
20. 50	M	,,	F	0·214	−0·031	+ 1/5	+ 15·1	− 5·7	+ 10·7	Star-line seen fairly well.
20. 53	M	,,	F	0·214	+0·059	+ 1/5	+ 15·1	+ 2·8	+ 10·7	
20. 55	M	,,	F	0·214	+0·034	+ 1/10	+ 15·1	− 4·8	− 4·8	
21. 5	M	β Tauri	F	0·214	+0·029	+ 1/4	+ 15·5	− 6·7	+ 10·3	Spectrum faint. Observations interrupted by cloud. Position Circle 6°.
21. 10	M	,,	F	0·214	−0·025	0	+ 15·5	− 23·1	− 15·5	

Date, 1889. Greenwich Civil Time.	Observer.	Object.	Line.	Width of Slit.	Displacement.		Earth's Motion in Miles per Second.	Concluded Motion of Stars in Miles per Second.		REMARKS.
					Measured.	Estimated.		Measured.	Estimated.	
d h m				r						
Feb. 8. 20. 40	M	Rigel	F	0·158	+0·059	+ 2/5	+ 14·6	+ 3·3	+ 14·0	Spectrum rather faint but steady. Star-line seen well.
20. 45	M	,,	F	0·158	+0·078	+ 1/3	+ 14·6	+ 9·1	+ 9·2	
21. 2	M	γ Orionis	F	0·158	+0·008	+ 1/20	+ 15·8	− 13·4	− 12·2	Spectrum faint. Star-line diffused.
21. 8	M	,,	F	0·158	+0·033	+ 1/4	+ 15·8	− 5·8	+ 2·1	
21. 22	M	β Tauri	F	0·158	−0·049	− 1/5	+ 16·1	− 31·0	− 30·4	Spectrum faint and unsteady. Measures made with difficulty.
21. 26	M	,,	F	0·158	−0·014	0	+ 16·1	− 20·4	− 16·1	
21. 50	M	Sirius.....	F	0·158	+0·044	+ 1/4	+ 8·9	+ 4·5	+ 9·0	Star-line very diffused, and bisection very difficult in consequence. Direct comparison seemed to show a slight displacement towards the blue.
21. 52	M	,,	F	0·158	−0·065	− 3/10	+ 8·9	− 28·6	− 30·3	
21. 54	M	,,	F	0·158	−0·055	− 3/10	+ 8·9	− 25·6	− 30·3	
21. 55	M	,,	F	0·158	−0·037	− 1/5	+ 8·9	− 20·2	− 23·2	
21. 56	M	,,	F	0·158	+0·045	+ 3/10	+ 8·9	+ 4·8	+ 12·5	
21. 57	M	,,	F	0·158	−0·016	− 1/10	+ 8·9	− 13·8	− 16·0	
22. 12	M	Procyon.....	F	0·158	−0·032	− 1/5	+ 8·0	− 17·7	− 22·3	Spectrum fairly steady, but star-line faint. Displacement practically *nil*.
22. 15	M	,,	F	0·158	+0·022	+ 1/10	+ 8·0	− 1·3	− 0·9	
22. 50	M	Pollux	F	0·158	−0·011	− 1/10	+ 9·0	− 12·3	− 16·1	Spectrum very unsteady. Wind high. Star-line very difficult to see.
23. 0	M	,,	F	0·158	−0·015	− 1/10	+ 9·0	− 13·6	− 16·1	Position Circle, 6°.
Feb. 9. 12. 0	M	Sky.....	F	0·158	+0·035			+ 10·6		The coincidence of the two spectra appeared perfect.
12. 3	M	,,	F	0·158	+0·007			+ 2·1		
12. 6	M	,,	F	0·158	−0·011			− 3·3		
12. 9	M	,,	F	0·158	−0·004			− 1·2		
12. 12	M	,,	F	0·158	−0·002			− 0·6		Position Circle, 6°.
Feb. 15. 19. 57	M	β Persei.....	F	0·162	+0·115	+ 2/5	+ 17·4	+ 17·5	+ 8·6	Spectrum very faint but steady. Bright moonlight and much thin haze. Measures made with difficulty.
20. 1	M	,,	F	0·162	+0·013	+ 1/10	+ 17·4	− 13·5	− 10·9	
20. 5	M	,,	F	0·162	−0·067	− 1/5	+ 17·4	− 37·8	− 30·4	
20. 9	M	,,	F	0·162	−0·035	− 1/10	+ 17·4	− 28·0	− 23·9	
20. 16	M	α Persei	F	0·162	−0·052	− 1/3	+ 16·2	− 32·0	− 37·9	Measures made with difficulty.
20. 20	M	,,	F	0·162	−0·078	− 1/2	+ 16·2	− 39·9	− 48·7	
20. 36	M	Venus	F	0·162	−0·051	− 1/10		− 15·5	− 6·5	Spectrum faint but steady. Planet-line very faint. Calculated Motion − 8·0 miles per sec.
20. 38	M	,,	F	0·162	−0·047	− 1/4		− 14·3	− 16·2	
20. 51	M	Capella	F	0·162	+0·061	+ 1/4	+ 16·0	+ 2·5	+ 0·2	Spectrum fairly bright and steady. Star-line seen fairly well.
20. 54	M	,,	F	0·162	+0·113	+ 1/2	+ 16·0	+ 18·3	+ 16·5	
20. 55	M	,,	F	0·162	+0·070	+ 1/3	+ 16·0	+ 5·3	+ 5·7	
20. 56	M	,,	F	0·162	+0·069	+ 1/3	+ 16·0	+ 5·0	+ 5·7	
21. 4	M	β Aurigæ	F	0·162	+0·016	+ 1/4	+ 15·0	− 10·1	+ 1·2	Spectrum fairly bright and steady. Star-line seen fairly well.
21. 7	M	,,	F	0·162	+0·060	+ 1/4	+ 15·0	+ 3·2	+ 1·2	
21. 16	M	Aldebaran.....	F	0·162	+0·217	+ 3/5	+ 18·4	+ 47·5	+ 20·7	Spectrum fairly bright and steady. Star-line seen very well.
21. 18	M	,,	F	0·162	+0·176	+ 3/5	+ 18·4	+ 35·0	+ 20·7	
21. 19	M	,,	F	0·162	+0·141	+ 1/2	+ 18·4	+ 24·5	+ 14·1	
21. 20	M	,,	F	0·162	+0·112	+ 1/2	+ 18·4	+ 15·6	+ 14·1	
21. 29	M	β Tauri	F	0·162	−0·013	0	+ 17·2	− 21·2	− 17·2	Spectrum fairly bright and steady. Star-line seen well.
21. 32	M	,,	F	0·162	+0·011	+ 1/10	+ 17·2	− 13·9	− 10·7	
21. 37	M	γ Orionis	F	0·162	−0·058	− 1/4	+ 16·7	− 34·3	− 32·9	Spectrum fairly bright and steady. Star-line seen fairly well.
21. 38	M	,,	F	0·162	−0·037	− 1/10	+ 16·7	− 28·0	− 23·2	
21. 54	M	Rigel	F	0·162	+0·040	+ 1/3	+ 15·3	− 3·2	+ 6·4	Spectrum bright but very unsteady. Star-line seen with difficulty.
21. 56	M	,,	F	0·162	+0·021	+ 1/10	+ 15·3	− 8·9	− 8·8	
22. 7	M	Sirius.....	F	0·162	−0·030	− 1/4	+ 10·2	− 19·3	− 26·4	Spectrum very bright and very unsteady. All the indirect comparisons gave a slight but unmistakeable displacement towards the blue. The direct comparisons suggested a very slight displacement towards the red.
22. 8	M	,,	F	0·162	−0·050	− 1/3	+ 10·2	− 25·4	− 31·9	
22. 10	M	,,	F	0·162	−0·014	0	+ 10·2	− 14·5	− 10·2	
22. 12	M	,,	F	0·162	−0·019	− 1/10	+ 10·2	− 16·0	− 16·7	
22. 14	M	,,	F	0·162	−0·169	− 1/2	+ 10·2	− 61·5	− 42·7	
22. 16	M	,,	F	0·162	−0·142	− 1/2	+ 10·2	− 53·3	− 42·7	
22. 35	M	γ Geminorum..	F	0·162	−0·016	− 1/2	+ 14·3	− 46·5	− 46·8	Spectrum faint but steady. Displacement evidently very large towards the blue.
22. 38	M	,,	F	0·162	−0·288	− 1	+ 14·3	−101·8	− 79·3	
22. 39	M	,,	F	0·162	−0·257	− 1	+ 14·3	− 92·4	− 79·3	
22. 40	M	,,	F	0·162	−0·148	− 1/2	+ 14·3	− 59·3	− 46·8	
22. 45	M	Procyon.....	F	0·162	−0·071	− 1/4	+ 9·9	− 31·5	− 26·1	Spectrum very unsteady. Star-line held with much difficulty. Measures rough.
22. 46	M	,,	F	0·162	−0·007	0	+ 9·9	− 12·0	− 9·9	
22. 47	M	,,	F	0·162	+0·029	+ 1/10	+ 9·9	− 1·1	− 3·4	
22. 49	M	,,	F	0·162	+0·076	+ 2/5	+ 9·9	+ 13·2	+ 16·1	

Date, 1889. Greenwich Civil Time.	Observer.	Object.	Line.	Width of Slit.	Displacement.		Earth's Motion in Miles per Second.	Concluded Motion of Stars in Miles per Second.		REMARKS.
					Measured.	Estimated.		Measured.	Estimated.	
d h m				r	r					
Feb. 15. 22. 54	M	Pollux	F	0·162	−0·169	− 3/5	+ 10·9	− 62·2	− 50·0	Spectrum bright and steady. Star-line faint.
22. 55	M	,,	F	0·162	−0·106	− 2/5	+ 10·9	− 43·1	− 36·9	Spectrum fairly bright and steady. Star-line seen very well.
23. 0	M	Castor	F	0·162	+0·190	+ 3/5	+ 11·6	+ 46·1	+ 31·7	Spectrum steady. Star-line seen fairly well, though moonlight bright.
23. 2	M	,,	F	0·162	+0·115	+ 2/5	+ 11·6	+ 23·3	+ 14·4	Measures made with the pointer.
23. 11	M	Regulus.....	F	0·162	+0·058	+ 1/4	− 0·3	+ 17·9	+ 16·5	
23. 12	M	,,	F	0·162	+0·106	+ 1/3	− 0·3	+ 32·5	+ 22·0	
23. 18	M	Moon	F	0·162	+0·023		+ 7·0			
23. 21	M	,,	F	0·162	+0·002		+ 0·6			
23. 24	M	,,	F	0·162	+0·026		+ 7·9			
23. 27	M	,,	F	0·162	−0·019		− 5·8			
23. 30	M	,,	F	0·162	+0·013		+ 4·0			
23. 33	M	Moon	F	0·162	+0·010		+ 3·0			Measures made with the spider line. Direct comparison suggested that the comparison line was very slightly inclined to the F line in the spectrum of the Moon, with which it coincided about the centre of the field.
23. 36	M	,,	F	0·162	+0·011		+ 3·3			
23. 39	M	,,	F	0·162	−0·017		− 5·1			
23. 42	M	,,	F	0·162	+0·021		+ 6·4			
23. 45	M	,,	F	0·162	+0·021		+ 6·4			Position Circle, 6°.
Mar. 5. 20. 37	M	Aldebaran	b_1	0·160	+0·187	+ 1/3	+ 18·4	+ 51·8	+ 40·5	Spectrum very unsteady. Star-line distinct, but the unsteadiness made measurement difficult.
20. 40	M	,,	b_1	0·160	+0·183	+ 2/5	+ 18·4	+ 50·3	+ 52·3	Spectrum bright but *very* unsteady. Measures made with great difficulty.
20. 51	M	Capella	b_1	0·160	+0·063	+ 1/10	+ 17·1	+ 6·5	− 5·3	Spectrum bright but very unsteady. Star-lines isolated with great difficulty from the shading of the band on which they stand.
20. 53	M	,,	b_1	0·160	+0·045	+ 1/4	+ 17·1	− 0·2	+ 12·4	Spectrum bright but *very* unsteady. Measures made with great difficulty.
21. 41	M	α Orionis	b_1	0·160	+0·076	+ 1/3	+ 17·5	+ 11·0	+ 21·8	Spectrum very bright but very unsteady. Star-line seen with difficulty. Measures rough.
21. 42	M	,,	b_4	0·160	−0·005	0	+ 17·5	− 19·4	− 17·5	Spectrum very bright but very unsteady. Star-line seen well at moment of bisection.
21. 45	M	,,	b_1	0·160	+0·048	+ 1/4	+ 17·5	+ 0·5	+ 12·0	Spectrum very bright but very unsteady. Star-line seen with difficulty. Measures rough.
21. 46	M	,,	b_1	0·160	+0·059	+ 1/5	+ 17·5	+ 4·7	+ 6·1	Spectrum very bright but very unsteady. Star-line seen with difficulty. Measures rough.
21. 58	M	Pollux	b_1	0·160	−0·095	− 1/3	+ 15·0	− 50·7	− 54·3	Spectrum very bright but very unsteady. Star-line seen well at moment of bisection.
22. 0	M	,,	b_1	0·160	−0·055	− 1/4	+ 15·0	− 35·6	− 44·5	Spectrum very bright but very unsteady. Star-line seen with difficulty. Measures rough.
22. 57	M	γ Leonis.....	b_1	0·160	−0·090	− 1/3	+ 5·5	− 39·3	− 44·8	Spectrum very bright but very unsteady. Star-line seen with difficulty. Measures rough.
22. 59	M	,,	b_1	0·160	−0·044	− 1/4	+ 5·5	− 22·0	− 35·0	Spectrum very bright but very unsteady. Star-line seen with difficulty. Measures rough.
23. 18	M	η Boötis	b_1	0·160	+0·113	+ 2/5	− 8·8	+ 51·3	+ 55·9	Spectrum very bright but very unsteady. Star-line seen with difficulty. Measures rough.
23. 20	M	,,	b_1	0·160	+0·074	+ 1/3	− 8·8	+ 36·6	+ 32·4	Spectrum very bright but very unsteady. Star-line seen with difficulty. Measures rough.
23. 30	M	Arcturus	b_1	0·160	−0·155	− 1/2	− 9·7	− 48·5	− 49·2	Spectrum very bright but very unsteady. Star-line seen well at moment of bisection.
23. 33	M	,,	b_1	0·160	−0·159	− 1/2	− 9·7	− 50·0	− 49·2	Spectrum very bright but very unsteady. Star-line seen well at moment of bisection.
23. 43	M	ε Boötis	b_1	0·160	−0·085	− 4/7	− 9·3	− 22·6	− 58·1	Spectrum very bright but unsteady. Star-line seen with difficulty. Measures rough.
23. 46	M	,,	b_1	0·160	−0·038	− 1/4	− 9·3	− 5·0	− 20·2	Position Circle, 6°.
Mar. 22. 0. 15	M	Arcturus	F	0·077	−0·126	− 2/3	− 5·5	− 32·7	− 24·7	Spectrum rather faint and unsteady, but star-line seen fairly well at times.
0. 30	M	,,	F	0·077	−0·101	− 1/2	− 5·5	− 25·2	− 17·1	Spectrum faint. Star-line seen with difficulty. Measures rough.
1. 15	M	α Coronæ Bor. .	F	0·077	−0·029	− 1/5	− 8·2	− 0·6	− 0·9	Position Circle, 6°.
1. 35	M	,,	F	0·077	+0·033	+ 1/5	− 8·2	+ 18·2	+ 17·3	
Mar. 27. 21. 25	M	Sirius.....	F	0·135	−0·051	− 1/3	+ 14·1	− 29·6	− 40·8	Spectrum *very* unsteady, and not quite so bright as usual. But this seemed to make measurement less difficult as the star-line did not appear to be so wide as usual.
21. 27	M	,,	F	0·135	−0·153	− 1/2	+ 14·1	− 60·5	− 54·2	
21. 30	M	,,	F	0·135	−0·069	− 1/3	+ 14·1	− 35·1	− 40·8	
21. 32	M	,,	F	0·135	−0·117	− 3/5	+ 14·1	− 49·6	− 62·3	
21. 47	M	Procyon.....	F	0·135	+0·048	+ 1/5	+ 16·9	− 2·3	− 0·8	Spectrum fairly steady.
21. 52	M	,,	F	0·135	+0·019	0	+ 16·9	− 11·1	− 16·9	
22. 0	M	Castor.....	F	0·135	−0·063	− 1/3	+ 17·8	− 36·9	− 44·5	Spectrum rather faint but steady. Star-line rather faint.
22. 1	M	,,	F	0·135	−0·064	− 1/3	+ 17·8	− 37·3	− 41·8	
22. 10	M	Pollux	F	0·135	−0·140	− 1/10	+ 17·7	− 60·3	− 71·1	Spectrum fairly bright and steady. Star-line seen fairly well.
22. 14	M	,,	F	0·135	−0·095	− 2/3	+ 17·7	− 46·5	− 49·8	
22. 20	M	Regulus.....	F	0·135	+0·081	+ 1/4	+ 11·6	+ 13·0	+ 8·4	Star-line broad, very diffused and faint. A difficult object.
22. 25	M	,,	F	0·135	+0·083	+ 1/3	+ 11·6	+ 13·6	+ 15·1	

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					Measured.	Estimated.		Measured.	Estimated.	
d h m				r	r					
Mar. 27. 22. 37	M	γ Leonis	F	0·135	−0·005	− 1/10	+ 11·5	− 13·0	− 19·5	Spectrum fairly bright and steady, but star-line seen with extreme difficulty.
22. 40	M	,,	F	0·135	−0·039	− 1/4	+ 11·5	− 23·3	− 31·5	
22. 46	M	β Leonis	F	0·135	+0·062	+ 1/3	+ 5·4	+ 13·4	+ 21·3	Spectrum fairly bright and steady. Star-line seen well.
22. 50	M	,,	F	0·135	+0·029	+ 1/5	+ 5·4	+ 3·4	+ 10·7	
22. 56	M	γ Virginis	F	0·135	+0·092	+ 1/2	− 0·4	+ 28·4	+ 40·5	Spectrum very faint but steady. Measures rough.
23. 0	M	,,	F	0·135	+0·054	+ 1/3	− 0·4	+ 16·8	+ 20·4	
23. 10	M	α Canum Ven...	F	0·135	−0·211	− 1/2	+ 3·5	− 67·6	− 56·9	Spectrum faint but steady.
23. 15	M	,,	F	0·135	−0·129	− 1/3	+ 3·5	− 42·6	− 51·7	
23. 22	M	Spica	F	0·135	+0·123	+ 1/2	− 4·7	+ 42·1	+ 44·8	Spectrum bright but very unsteady. Star-line faint.
23. 27	M	,,	F	0·135	+0·051	+ 1/5	− 4·7	+ 20·2	+ 20·8	
23. 37	M	ζ Ursæ Majoris	F	0·135	−0·089	− 1/3	+ 4·0	− 31·0	− 30·7	Spectrum bright and steady, but measures made with difficulty and somewhat uncertain owing to the awkward position.
23. 40	M	,,	F	0·135	−0·048	− 1/5	+ 4·0	− 18·6	− 44·1	
23. 44	M	,,	F	0·135	−0·041	− 1/5	+ 4·0	− 16·4	− 24·0	
23. 46	M	,,	F	0·135	−0·068	− 1/3	+ 4·0	− 24·7	− 30·7	
23. 53	M	η Ursæ Majoris	F	0·135	−0·235	− 1/2	+ 2·3	− 73·7	− 55·7	Spectrum bright and steady. Position awkward.
23. 56	M	,,	F	0·135	−0·162	−1	+ 2·3	− 51·5	− 82·5	
28. 0. 8	M	Arcturus	F	0·135	−0·108	− 1/3	− 4·1	− 28·7	− 36·0	Spectrum bright but very unsteady. Star-line faint.
0. 12	M	,,	F	0·135	−0·129	− 1/3	− 4·1	− 35·0	− 44·1	Position Circle, 6°.
Mar. 28. 12. 0	M	Sky.....	F	0·135	+0·021			+ 6·4		Both spectra seen well. The coincidence of the two spectra appeared perfect.
12. 3	M	,,	F	0·135	−0·007			− 2·1		
12. 6	M	,,	F	0·135	+0·025			+ 7·6		
12. 9	M	,,	F	0·135	−0·015			− 4·6		
12. 12	M	,,	F	0·135	−0·003			− 0·9		Position Circle, 6°.
Apr. 5. 20. 23	M	Rigel	F	0·146	+0·075	+ 1/4	+ 13·4	+ 9·4	+ 7·7	Spectrum rather faint and very unsteady. Star-line fairly dark and distinct.
20. 26	M	,,	F	0·146	+0·124	+ 1/3	+ 13·4	+ 24·3	+ 14·7	
20. 27	M	,,	F	0·146	+0·173	+ 1/2	+ 13·4	+ 39·1	+ 28·8	
20. 29	M	,,	F	0·146	+0·090	+ 1/4	+ 13·4	+ 13·9	+ 7·7	
20. 39	M	δ Orionis	F	0·146	+0·144	+ 1/2	+ 15·1	+ 28·6	+ 27·1	Spectrum faint and very unsteady. Measures very rough.
20. 42	M	,,	F	0·146	+0·029	+ 1/10	+ 15·1	− 6·3	− 6·7	
21. 0	M	Moon	F	0·146	+0·011			+ 3·3		Both spectra seen well. The coincidence of the two spectra appeared perfect.
21. 3	M	,,	F	0·146	+0·007			+ 2·1		
21. 6	M	,,	F	0·146	−0·006			− 1·8		
21. 9	M	,,	F	0·146	−0·003			− 0·9		
21. 12	M	,,	F	0·146	+0·040			+ 12·1		Position Circle, 6°.
Apr. 15. 20. 15	M	Sirius	F	0·129	−0·104	− 1/2	+ 13·7	− 45·3	− 47·2	Spectrum faint and *very* unsteady. Star very low down. Measures little better than guesses.
20. 17	M	,,	F	0·129	−0·073	− 1/2	+ 13·7	− 35·8	− 47·2	
20. 19	M	,,	F	0·129	−0·106	− 1/2	+ 13·7	− 45·8	− 47·2	
20. 23	M	,,	F	0·129	−0·117	− 1/2	+ 13·7	− 49·2	− 40·5	
20. 41	M	Procyon.....	F	0·129	−0·084	− 1/2	+ 17·5	− 43·0	− 51·0	Observations interrupted by cloud.
20. 57	M	Moon	F	0·129	−0·089			− 27·0		The coincidence of the two spectra appeared perfect. The first three observations were interrupted by cloud. The spectrum in the latter observations was seen fairly well.
20. 58	M	,,	F	0·129	+0·036			+ 10·9		
21. 3	M	,,	F	0·129	+0·023			+ 7·0		
21. 5	M	,,	F	0·129	−0·014			− 4·2		
21. 7	M	,,	F	0·129	+0·006			+ 1·8		
21. 8	M	,,	F	0·129	−0·006			− 1·8		
21. 9	M	,,	F	0·129	−0·016			− 4·8		
21. 10	M	,,	F	0·129	+0·019			+ 5·7		
22. 13	M	Arcturus	F	0·129	−0·075	− 1/3	+ 0·9	− 23·6	− 34·4	Spectrum bright but unsteady. Star-line faint.
22. 14	M	,,	F	0·129	−0·082	− 1/3	+ 0·9	− 25·8	− 27·7	
22. 30	M	Spica	F	0·129	+0·136	+ 1/2	+ 1·2	+ 40·1	+ 32·3	Spectrum bright but unsteady. Star-line faint.
22. 32	M	,,	F	0·129	+0·175	+ 1/2	+ 1·2	+ 51·9	+ 39·0	Position Circle, 6°.

Motions of Stars in the Line of Sight, inferred from Spectroscopic Observations

Date, 1889. Greenwich Civil Time.	Observer.	Object.	Line.	Width of Slit.	Displacement.		Earth's Motion in Miles per Second.	Concluded Motion of Stars in Miles per Second.		REMARKS.
					Measured.	Estimated.		Measured.	Estimated.	
d h m				r	r					
Apr. 25. 21. 31	M	Castor.....	F	0·190	+0·031	+ 1/3	+ 17·0	− 8·4	+ 2·9	Spectrum rather faint.
21. 33	M	,,	F	0·190	−0·005	0	+ 17·0	− 18·5	− 17·0	
21. 41	M	Regulus.....	F	0·190	+0·161	+ 1/2	+ 16·7	+ 32·2	+ 16·5	Spectrum fairly bright and steady. Star-line seen fairly well.
21. 44	M	,,	F	0·190	+0·199	+ 2/3	+ 16·7	+ 43·7	+ 49·7	
21. 47	M	,,	F	0·190	+0·074	+ 1/4	+ 16·7	+ 5·7	+ 8·2	
21. 50	M	,,	F	0·190	+0·055	+ 1/4	+ 16·7	00·0	+ 8·2	Position Circle, 6°.
Apr. 30. 21. 47	M	Regulus.....	F	0·190	−0·051	− 1/10	+ 17·2	− 32·7	− 27·1	Spectrum bright but unsteady. Star-line faint.
21. 49	M	,,	F	0·190	+0·005	0	+ 17·2	− 15·7	− 17·2	
21. 57	M	γ Leonis	F	0·190	+0·139	+ 2/3	+ 17·0	+ 25·2	+ 22·8	Spectrum bright and fairly steady. Star-line very faint.
21. 59	M	,,	F	0·190	+0·070	+ 3/10	+ 17·0	+ 4·2	+ 12·9	
22. 9	M	β Leonis	F	0·190	+0·033	+ 1/10	+ 13·6	− 3·6	− 3·7	Spectrum bright and steady. Star-line an exceedingly difficult object to bisect.
22. 11	M	,,	F	0·190	−0·128	− 1/3	+ 13·6	− 52·4	− 46·8	
22. 12	M	,, ...	F	0·190	−0·074	− 1/10	+ 13·6	− 36·0	− 23·5	
22. 14	M	,,	F	0·190	+0·019	0	+ 13·6	− 7·9	− 13·6	
22. 28	M	Spica	F	0·190	+0·037	+ 1/4	+ 5·7	+ 5·5	+ 19·2	Spectrum bright but rather unsteady. Star-line rather faint.
22. 29	M	,,	F	0·190	+0·121	+ 3/10	+ 5·7	+ 31·0	+ 24·2	
22. 32	M	,,	F	0·190	+0·016	0	+ 5·7	− 0·9	− 5·7	
22. 33	M	,,	F	0·190	+0·031	+ 1/10	+ 5·7	+ 3·7	+ 4·2	
22. 42	M	Arcturus	F	0·190	−0·080	− 1/3	+ 4·8	− 29·1	− 38·0	Spectrum very bright but unsteady. Star-line faint.
22. 43	M	,,	F	0·190	−0·054	− 1/3	+ 4·8	− 21·2	− 38·0	
22. 58	M	γ Boötis.....	F	0·190	−0·274	− 2/3	+ 4·9	− 88·1	− 71·3	Spectrum rather faint but steady.
23. 0	M	,,	F	0·190	−0·149	− 1/2	+ 4·9	− 50·1	− 54·7	
23. 15	M	β Libræ.....	F	0·190	−0·137	− 1/2	− 2·2	− 39·4	− 31·0	Spectrum fairly bright but unsteady.
23. 16	M	,,	F	0·190	−0·058	− 1/4	− 2·2	− 15·4	− 22·7	
23. 27	M	α Coronæ Bor.	F	0·190	+0·076	+ 1/10	0·0	+ 23·1	+ 9·9	Spectrum bright and fairly steady.
23. 30	M	,,	F	0·190	+0·106	+ 1/3	0·0	+ 32·2	+ 33·2	
23. 44	M	β Serpentis ...	F	0·190	−0·135	− 1/3	− 2·0	− 39·0	− 31·2	Spectrum faint and fairly steady. The star is about the limit of magnitude for this work.
23. 45	M	,,	F	0·190	−0·146	− 1/2	− 2·0	− 42·3	− 47·8	
23. 57	M	α Ophiuchi ...	F	0·190	+0·157	+ 1/2	− 9·4	+ 57·0	+ 59·2	Spectrum bright and fairly steady.
23. 59	M	,,	F	0·190	+0·151	+ 1/2	− 9·4	+ 55·2	+ 59·2	
May 1. 0. 9	M	Vega	F	0·190	−0·059	− 1/5	− 7·6	− 10·3	− 12·3	Spectrum very bright and steady.
0. 10	M	,,	F	0·190	−0·096	− 1/3	− 7·6	− 21·5	− 25·6	
0. 12	M	,,	F	0·190	−0·157	− 2/5	− 7·6	− 40·0	− 32·2	
0. 14	M	,,	F	0·190	−0·087	− 1/5	− 7·6	− 18·8	− 12·3	The evening throughout was a very good one for the work. Position Circle, 6°.
May 2. 21. 8	M	α Ursæ Majoris	F	0·182	+0·005	0	+ 11·7	− 10·2	− 11·7	Spectrum bright and steady. Star-line seen well occasionally.
21. 11	M	,,	F	0·182	−0·096	− 1/5	+ 11·7	− 40·8	− 32·0	
21. 15	M	,,	F	0·182	−0·122	− 1/3	+ 11·7	− 48·7	− 45·6	
21. 19	M	,,	F	0·182	−0·019	− 1/10	+ 11·7	− 17·4	− 21·9	
21. 29	M	β Ursæ Majoris	F	0·182	−0·024	0	+ 12·7	− 20·0	− 12·7	Spectrum bright and steady. Star-line seen very well.
21. 32	M	,,	F	0·182	−0·052	− 1/5	+ 12·7	− 28·5	− 33·0	
21. 34	M	,,	F	0·182	−0·086	− 1/4	+ 12·7	− 38·8	− 38·1	
21. 36	M	,,	F	0·182	−0·002	− 1/10	+ 12·7	− 13·3	− 22·9	
21. 49	M	γ Ursæ Majoris	F	0·182	+0·008	+ 1/10	+ 11·8	− 9·4	− 1·6	Spectrum bright and steady. Star-line seen well.
21. 56	M	,,	F	0·182	+0·119	+ 1/3	+ 11·8	+ 24·3	+ 22·1	
21. 58	M	,,	F	0·182	+0·052	+ 1/10	+ 11·8	+ 4·0	− 1·6	
22. 0	M	,,	F	0·182	+0·032	+ 1/10	+ 11·8	− 2·1	− 1·6	
22. 11	M	δ Ursæ Majoris	F	0·182	−0·031	− 1/5	+ 10·7	− 20·1	− 31·0	Spectrum bright and steady. Star-line seen well. Displacement evidently very small.
22. 14	M	,,	F	0·182	−0·077	− 1/5	+ 10·7	− 34·0	− 31·0	
22. 18	M	,,	F	0·182	+0·014	+ 1/10	+ 10·7	− 6·5	− 0·5	
22. 20	M	,,	F	0·182	+0·031	+ 1/10	+ 10·7	− 1·3	− 0·5	
22. 30	M	ε Ursæ Majoris	F	0·182	+0·005	0	+ 9·5	− 8·0	− 9·5	Spectrum bright and steady. Star-line seen well.
22. 33	M	,,	F	0·182	+0·046	+ 1/10	+ 9·5	+ 4·4	+ 0·7	
21. 35	M	,,	F	0·182	−0·029	− 1/10	+ 9·5	− 18·3	− 19·7	
22. 36	M	,,	F	0·182	+0·006	0	+ 9·5	− 7·7	− 9·5	
22. 56	M	Regulus.....	F	0·182	+0·161	+ 1/2	+ 17·4	+ 31·5	+ 33·4	Spectrum bright and fairly steady.
22. 57	M	,,	F	0·182	+0·061	+ 1/4	+ 17·4	+ 1·1	+ 8·0	

Date, 1889. Greenwich Civil Time.	Observer.	Object.	Line.	Width of Slit.	Displacement. Measured.	Displacement. Estimated.	Earth's Motion in Miles per Second.	Concluded Motion of Stars in Miles per Second. Measured.	Concluded Motion of Stars in Miles per Second. Estimated.	REMARKS.
d h m				r	r					
May 2. 23. 0	M	δ Leonis.....	F	0·182	−0·107	$-\frac{2}{5}$	+ 15·5	− 48·0	− 56·2	Spectrum rather faint but fairly steady.
23. 1	M	,,	F	0·182	−0·207	$-\frac{1}{3}$	+ 15·5	− 78·3	− 49·4	
23. 9	M	β Leonis	F	0·182	−0·151	$-\frac{1}{2}$	+ 14·0	− 59·8	− 64·8	Spectrum bright and fairly steady. Evidently a large displacement towards the blue.
23. 10	M	,,	F	0·182	−0·253	$-\frac{2}{3}$	+ 14·0	− 90·0	− 81·8	
23. 13	M	,,	F	0·182	−0·159	$-\frac{1}{2}$	+ 14·0	− 62·2	− 64·8	
23. 14	M	,,	F	0·182	−0·192	$-\frac{1}{2}$	+ 14·0	− 72·3	− 64·8	
23. 21	M	γ Virginis	F	0·182	−0·097	$-\frac{1}{4}$	+ 10·1	− 39·5	− 35·5	Spectrum faint but steady. Star-line faint.
23. 23	M	,,	F	0·182	−0·110	$-\frac{3}{10}$	+ 10·1	− 43·5	− 40·6	
23. 31	M	Spica	F	0·182	−0·008	0	+ 6·3	− 8·7	− 6·3	Spectrum bright but very unsteady.
23. 32	M	,,	F	0·182	−0·008	0	+ 6·3	− 8·7	− 6·3	
23. 42	M	ζ Ursæ Majoris	F	0·182	−0·019	$-\frac{1}{10}$	+ 8·5	− 14·2	− 18·7	Spectrum bright and steady. Star-line seen well.
23. 45	M	,,	F	0·182	+0·014	0	+ 8·5	− 4·3	− 8·5	
23. 47	M	,,	F	0·182	+0·069	$+\frac{1}{5}$	+ 8·5	+ 12·4	+ 11·8	
23. 51	M	,,	F	0·182	−0·040	$-\frac{1}{10}$	+ 8·5	− 20·6	− 18·7	
3. 0. 0	M	η Ursæ Majoris	F	0·182	−0·108	$-\frac{1}{3}$	+ 7·7	− 40·5	− 41·6	Spectrum bright and steady. Star-line faint.
0. 2	M	,,	F	0·182	−0·025	$-\frac{1}{10}$	+ 7·7	− 15·3	− 17·9	
0. 5	M	,,	F	0·182	−0·073	$-\frac{3}{10}$	+ 7·7	− 29·8	− 38·1	
0. 8	M	,,	F	0·182	+0·057	$+\frac{1}{10}$	+ 7·7	+ 9·6	+ 2·5	
0. 18	M	Arcturus	F	0·182	−0·143	$-\frac{2}{5}$	+ 5·3	− 48·7	− 46·0	Spectrum very bright but rather unsteady. Star-line faint.
0. 20	M	,,	F	0·182	−0·125	$-\frac{3}{7}$	+ 5·3	− 43·2	− 48·9	The evening throughout was a very good one for the work. Position Circle, 6°.
May 3. 12. 18	M	Sun	F	0·182	−0·059			− 17·9		
12. 21	M	,,	F	0·182	+0·039			+ 11·8		The coincidence of the two spectra appeared perfect.
12. 24	M	,,	F	0·182	−0·001			− 0·3		
12. 27	M	,,	F	0·182	0·000			0·0		
12. 30	M	,,	F	0·182	+0·012			+ 3·6		
12. 33	M	,,	F	0·182	−0·024			− 7·2		
12. 36	M	,,	F	0·182	−0·005			− 1·5		Position Circle, 6°.
June 26. 23. 30	M	Arcturus	F	0·161	−0·235	$-\frac{1}{2}$	+ 14·6	− 86·0	− 61·5	Spectrum bright but very unsteady.
23. 31	M	,,	F	0·161	−0·111	$-\frac{1}{2}$	+ 14·6	− 48·3	− 61·5	
23. 38	M	α Coronæ Bor.	F	0·161	+0·087	$+\frac{1}{2}$	+ 10·4	+ 16·0	+ 36·5	Spectrum very bright but very unsteady. Measures very rough.
23. 43	M	,,	F	0·161	−0·011	0	+ 10·4	− 13·7	− 10·4	
23. 45	M	,,	F	0·161	−0·092	$-\frac{1}{4}$	+ 10·4	− 38·4	− 33·9	
23. 46	M	,,	F	0·161	−0·019	$-\frac{1}{10}$	+ 10·4	− 16·2	− 19·8	
23. 55	M	α Ophiuchi ...	F	0·161	−0·145	$-\frac{1}{2}$	+ 3·6	− 47·6	− 50·5	Spectrum unsteady. Definition poor.
23. 57	M	,,	F	0·161	−0·051	$-\frac{1}{4}$	+ 3·6	− 19·1	− 27·1	
27. 0. 20	M	Altair.....	F	0·161	−0·261	$-\frac{2}{3}$	− 6·5	− 72·8	− 56·1	Spectrum occasionally bright and steady, but observations interrupted by cloud.
0. 31	M	,,	F	0·161	−0·077	$-\frac{1}{3}$	− 6·5	− 16·9	− 24·8	
0. 41	M	α Cygni	F	0·161	−0·178	$-\frac{1}{2}$	− 7·6	− 46·5	− 39·3	Spectrum bright and steady. Star-line seen well.
0. 44	M	,,	F	0·161	−0·159	$-\frac{2}{5}$	− 7·6	− 40·7	− 30·0	
0. 53	M	Vega	F	0·161	−0·022	$-\frac{1}{10}$	− 1·2	− 5·5	− 8·2	Spectrum bright but very unsteady.
0. 55	M	,,	F	0·161	−0·008	$-\frac{1}{10}$	− 1·2	− 1·2	− 8·2	Position Circle, 6°.
July 15. 22. 45	M	α Coronæ Bor.	F	0·168	+0·203	$+\frac{4}{7}$	+ 12·2	+ 49·5	+ 51·3	Spectrum bright but unsteady. Measures rough.
22. 47	M	,,	F	0·168	+0·110	$+\frac{1}{3}$	+ 12·2	+ 21·2	+ 24·9	
22. 48	M	,,	F	0·168	+0·049	$+\frac{1}{4}$	+ 12·2	+ 2·7	+ 15·6	
22. 50	M	,,	F	0·168	+0·126	$+\frac{1}{3}$	+ 12·2	+ 26·1	+ 24·9	
23. 0	M	α Ophiuchi ...	F	0·168	−0·067	$-\frac{1}{10}$	+ 7·8	− 28·2	− 18·9	Spectrum fairly bright but unsteady. Star-line seen fairly well.
23. 1	M	,,	F	0·168	−0·119	$-\frac{3}{10}$	+ 7·8	− 43·9	− 41·2	
23. 17	M	ζ Aquilæ	F	0·168	−0·039	$-\frac{1}{10}$	+ 1·3	− 13·1	− 12·4	Spectrum fairly bright and steady. Star-line seen fairly well.
23. 18	M	,,	F	0·168	−0·094	$-\frac{3}{10}$	+ 1·3	− 29·9	− 34·7	
23. 20	M	,,	F	0·168	−0·051	$-\frac{1}{10}$	+ 1·3	− 16·8	− 12·4	
23. 23	M	,,	F	0·168	−0·096	$-\frac{3}{10}$	+ 1·3	− 30·4	− 34·7	
23. 30	M	Vega	F	0·168	−0·046	$-\frac{1}{3}$	+ 1·4	− 15·4	− 38·5	Spectrum bright but unsteady. Definition poor.
23. 32	M	,,	F	0·168	−0·192	$-\frac{1}{2}$	+ 1·4	− 59·7	− 57·0	
23. 37	M	,,	F	0·168	−0·017	0	+ 1·4	− 6·5	− 1·4	
23. 39	M	,,	F	0·168	−0·016	0	+ 1·4	− 6·3	− 1·4	

Date, 1889. Greenwich Civil Time.	Observer.	Object.	Line.	Width of Slit.	Displacement.		Earth's Motion in Miles per Second.	Concluded Motion of Stars in Miles per Second.		REMARKS.
					Measured.	Estimated.		Measured.	Estimated.	
d h m				r	r					
July 15. 23. 45	M	β Lyræ								A very faint white line was just glimpsed near F, but it was too faint for measurement.
23. 54	M	Altair.....	F	0·168	−0·041	+ 1/10	− 1·8	+ 14·2	+ 12·9	Spectrum bright but unsteady. Definition
23. 55	M	,,	F	0·168	−0·034	− 1/10	− 1·8	+ 8·5	− 9·3	poor.
23. 56	M	,,	F	0·168	−0·201	− 1/2	− 1·8	− 59·3	− 53·8	
23. 57	M	,,	F	0·168	−0·172	− 2/3	− 1·8	− 50·5	− 45·9	
16. 0. 7	M	α Cygni	F	0·168	−0·233	− 3/5	− 5·8	− 65·0	− 60·9	Spectrum bright and fairly steady. Star-
0. 12	M	,,	F	0·168	−0·144	− 2/5	− 5·8	− 37·9	− 38·7	line seen fairly well.
0. 28	M	Moon	F	0·168	+0·023			+ 7·0		Moon Spectrum bright. Both spectra
0. 31	M	,,	F	0·168	+0·002			+ 0·6		seen well. The coincidence of the two
0. 33	M	,,	F	0·168	+0·016			− 4·9		spectra appeared perfect.
0. 35	M	,,	F	0·168	+0·012			+ 3·6		
0. 37	M	,,	F	0·168	−0·015			− 4·6		
										Position Circle, 6°.
July 19. 22. 45	M	α Ophiuchi ...	F	0·168	−0·028	− 1/10	+ 8·6	− 17·1	− 19·7	Spectrum fairly bright and steady. Star-
22. 46	M	,,	F	0·168	−0·205	− 2/3	+ 8·6	− 70·9	− 53·1	line very diffused and difficult to bisect.
22. 48	M	,,	F	0·168	−0·050	− 1/5	+ 8·6	− 23·8	− 30·8	
22. 50	M	,,	F	0·168	−0·062	− 3/10	+ 8·6	− 27·4	− 42·0	
23. 0	M	ζ Aquilæ	F	0·168	−0·109	− 3/10	+ 2·3	− 35·4	− 35·7	Spectrum rather faint but steady. Star-
23. 2	M	,,	F	0·168	−0·193	− 1/2	+ 2·3	− 60·9	− 57·9	line difficult to bisect.
23. 12	M	δ Aquilæ	F	0·168	−0·084	− 1/5	+ 1·5	− 27·0	− 23·7	Spectrum exceedingly faint. Measures
23. 14	M	,,	F	0·168	−0·132	− 3/10	+ 1·5	− 41·6	− 34·9	rough.
23. 22	M	Vega	F	0·168	−0·025	− 1/10	+ 2·0	− 9·6	− 13·1	Spectrum very bright.
23. 24	M	,,	F	0·168	−0·161	− 1/2	+ 2·0	− 50·9	− 57·6	
23. 26	M	,,	F	0·168	−0·062	− 1/5	+ 2·0	− 20·8	− 24·2	
23. 29	M	,,	F	0·168	−0·021	− 1/10	+ 2·0	− 8·4	− 13·1	
23. 40	M	Altair.....	F	0·168	−0·179	− 2/3	− 0·8	− 53·6	− 43·7	Spectrum bright and steady.
23. 41	M	,,	F	0·168	−0·155	− 1/2	− 0·8	− 46·3	− 54·8	
23. 52	M	α Cygni	F	0·168	−0·174	− 1/2	− 5·3	− 47·5	− 50·3	Spectrum fairly bright and steady. Position
23. 54	M	,,	F	0·168	−0·118	− 2/5	− 5·3	− 30·5	− 31·8	awkward.
20. 0. 5	M	α Cephei	F	0·168	−0·274	− 4/5	− 6·2	− 77·0	− 67·9	Spectrum fairly bright and steady. Position
0. 9	M	,,	F	0·168	−0·283	− 4/5	− 6·2	− 79·8	− 67·9	very awkward. A large displacement towards the blue evident.
										Position Circle, 6°.
July 31. 22. 0	M	α Cygni	F	0·122	−0·230	− 2/3	− 3·8	− 66·1	− 31·8	Spectrum faint and tremulous. Definition
22. 2	M	,,	F	0·122	−0·128	− 1/2	− 3·8	− 35·1	− 22·9	poor.
22. 15	M	α Cephei	F	0·122	−0·236	− 2/3	− 5·7	− 66·0	− 34·4	Spectrum very faint and unsteady. De-
22. 19	M	,,	F	0·122	−0·097	− 1/3	− 5·7	− 23·8	− 12·1	finition poor.
22. 26	M	β Cassiopeiæ...	F	0·122	−0·105	− 1/3	− 11·1	− 20·8	− 15·6	Spectrum very faint and unsteady. De-
22. 29	M	,,	F	0·122	−0·148	− 1/2	− 11·1	− 33·9	− 15·6	finition poor.
22. 37	M	γ Cassiopeiæ...	F	0·122	+0·097	+ 1/3	− 11·7	+ 41·2	+ 38·4	Spectrum faint and unsteady. The F line,
22. 39	M		F	0·122	−0·034	− 1/5	− 11·7	+ 1·4	+ 1·0	though very faint, was unmistakeably present as a bright line. Definition poor. Measures rough.
22. 58	M	α Andromedæ..	F	0·122	−0·150	− 2/3	− 14·4	− 31·2	− 17·7	Spectrum faint and unsteady. Definition
22. 59	M	,,	F	0·122	−0·173	− 2/3	− 14·4	− 38·1	− 28·4	poor.
										Position Circle, 6°.
Aug. 1. 11. 12	M	Sky.....	F	0·122	+0·005			+ 1·5		The coincidence of the two spectra appeared
11. 15	M	,,	F	0·122	+0·011			+ 3·3		perfect.
11. 18	M	,,	F	0·122	+0·003			+ 0·9		
11. 21	M	,,	F	0·122	−0·005			− 1·5		
11. 24	M	,,	F	0·122	+0·009			+ 2·7		
										Position Circle, 6°.
Sept. 6. 21. 20	M	Vega	F	0·120	−0·184	− 3/5	+ 7·5	− 63·4	− 58·6	Spectrum bright but not very steady.
21. 25	M	,,	F	0·120	−0·160	− 1/2	+ 7·5	− 56·1	− 50·1	Star-line seen fairly well.
21. 34	M	Altair	F	0·120	−0·068	− 3/10	+ 11·0	− 31·7	− 36·5	Spectrum bright but unsteady. Star-line
21. 38	M	,,	F	0·120	−0·129	− 2/5	+ 11·0	− 50·2	− 45·0	seen fairly well.

Date, 1889. Greenwich Civil Time.	Observer.	Object.	Line.	Width of Slit.	Displacement.		Earth's Motion in Miles per Second.	Concluded Motion of Stars in Miles per Second		REMARKS.
					Measured.	Estimated.		Measured.	Estimated.	
d h m				r	r					
Sept. 6. 21. 52	M	Moon	F	0·120	−0·033			− 10·0		The coincidence of the two spectra appeared perfect.
21. 55	M	,,	F	0·120	+0·014			+ 4·3		
21. 58	M	,,	F	0·120	+0·004			+ 1·2		
22. 2	M	,,	F	0·120	+0·008			+ 2·4		
22. 5	M	,,	F	0·120	−0·020			− 6·1		
22. 35	M	α Cygni	F	0·120	−0·125	− 1/2	+ 1·7	− 39·7	− 44·3	Spectrum fairly bright but unsteady.
22. 42	M	,,	F	0·120	−0·045	− 3/10	+ 1·7	− 15·4	− 27·2	Star-line faint and seen with much difficulty.
22. 56	M	α Andromedæ..	F	0·120	−0·117	− 1/3	− 7·7	− 27·8	− 20·6	Spectrum faint. Star-line observed with difficulty.
23. 6	M	,,	F	0·120	−0·025	− 1/5	− 7·7	+ 0·1	− 9·3	Position Circle, 6°.
Sept. 13. 20. 5	M	Vega	F	0·179	−0·114	− 1/4	+ 8·0	− 42·6	− 38·8	Spectrum rather faint and unsteady.
20. 55	M	,,	F	0·179	−0·143	− 2/5	+ 8·0	− 51·4	− 45·0	Definition poor.
21. 5	M	Altair.....	F	0·179	−0·034	− 1/10	+ 12·3	− 22·6	− 21·6	Spectrum unsteady. Definition poor.
21. 20	M	,,	F	0·179	−0·109	− 2/5	+ 12·3	− 45·4	− 49·3	
21. 35	M	α Cygni	F	0·179	−0·038	− 1/4	+ 2·7	− 14·3	− 25·9	Spectrum bright and fairly steady.
21. 42	M	,,	F	0·179	−0·116	− 2/5	+ 2·7	− 38·0	− 39·7	Star-line faint and observed with difficulty.
21. 55	M	α Pegasi.....	F	0·179	−0·186	− 1/2	− 0·2	(− 56·3)	(− 46·1)	Observation interrupted by clouds. Position Circle, 6°.
Sept. 16. 20. 10	M	Vega	F	0·124	−0·132	− 1/2	+ 8·1	− 48·2	− 53·8	Spectrum bright but unsteady. Star-line seen well.
20. 20	M	,,	F	0·124	−0·093	− 1/3	+ 8·1	− 36·4	− 38·6	
20. 35	M	Altair.....	F	0·124	−0·047	− 1/5	+ 12·8	− 27·1	− 31·1	Spectrum bright but unsteady. Star-line seen fairly well.
20. 40	M	,,	F	0·124	−0·058	− 1/4	+ 12·8	− 30·4	− 35·6	
20. 50	M	,,	F	0·124	−0·099	− 2/5	+ 12·8	− 42·9	− 49·4	
20. 55	M	,,	F	0·124	−0·083	− 1/3	+ 12·8	− 38·0	− 43·3	
21. 10	M	α Cygni	F	0·124	−0·209	− 2/3	+ 3·2	− 66·7	− 64·2	Spectrum bright but unsteady. Position
21. 30	M	,,	F	0·124	−0·192	− 3/5	+ 3·2	− 64·1	− 61·1	awkward. Measures made with difficulty.
21. 45	M	α Cephei	F	0·124	−0·049	− 1/5	− 1·9	− 13·0	− 16·4	Spectrum faint and unsteady. Position
22. 0	M	,,	F	0·124	−0·167	− 3/5	− 1·9	− 48·8	− 52·9	very awkward. Measures rough and made with great difficulty.
22. 10	M	α Pegasi.....	F	0·124	−0·096	− 1/3	+ 0·7	− 29·8	− 31·2	Spectrum fairly bright and steady.
22. 20	M	,,	F	0·124	−0·103	− 1/3	+ 0·7	− 32·0	− 31·2	Star-line seen fairly well.
22. 35	M	α Andromedæ.	F	0·124	−0·104	− 2/5	− 5·2	− 26·4	− 31·4	Spectrum rather faint and unsteady.
22. 45	M	,,	F	0·124	−0·078	− 1/4	− 5·2	− 18·5	− 17·6	Definition poor.
23. 0	M	γ Pegasi.....	F	0·124	−0·058	− 1/4	− 4·1	− 13·5	− 18·7	Spectrum rather faint and unsteady.
23. 25	M	,,	F	0·124	−0·095	− 1/3	− 4·1	− 24·7	− 26·4	Definition poor.
23. 35	M	β Persei.....	F	0·124	−0·145	− 1/2	− 14·6	− 29·4	− 31·1	Spectrum very faint, the star being at
23. 45	M	,,	F	0·124	−0·169	− 3/5	− 14·6	− 36·7	− 40·2	minimum. Measures made with difficulty.
23. 55	M	α Persei.....	F	0·124	−0·003	0	− 14·4	+ 13·5	+ 14·4	Spectrum fairly bright and steady.
23. 58	M	,,	F	0·124	−0·009	− 1/10	− 14·4	+ 11·7	+ 5·3	Star-line seen fairly well.
17. 0. 5	M	Capella	F	0·124	+0·049	+ 1/4	− 13·3	+ 28·2	+ 36·1	Spectrum bright but unsteady. Definition
0. 15	M	,,	F	0·124	+0·069	+ 3/10	− 13·3	+ 34·3	+ 40·7	poor.
0. 35	M	Moon	F	0·124	+0·008			+ 2·4		The coincidence of the two spectra appeared perfect.
0. 40	M	,,	F	0·124	+0·010			+ 3·0		
0. 45	M	,,	F	0·124	−0·004			− 1·2		
0. 50	M	,,	F	0·124	+0·003			+ 0·9		
0. 55	M	,,	F	0·124	+0·010			+ 3·0		Position Circle, 6°.
Sept. 18. 20. 40	M	Vega	F	0·166	−0·087	− 1/4	+ 8·2	− 34·6	− 33·8	Spectrum bright but rather unsteady.
20. 41	M	,,	F	0·166	−0·229	− 2/3	+ 8·2	− 77·7	− 65·8	Star-line seen fairly well.
20. 52	M	γ Lyræ	F	0·166	−0·260	− 3/4	+ 9·5	− 88·5	− 60·7	Spectrum very faint. Observations made
20. 53	M	,,	F	0·166	−0·218	− 3/4	+ 9·5	− 75·7	− 67·1	with great difficulty. Large displacement towards the blue. Measures rough.

Date, 1889. Greenwich Civil Time.	Observer.	Object.	Line.	Width of Slit.	Displacement.		Earth's Motion in Miles per Second.	Concluded Motion of Stars in Miles per Second.		REMARKS.
					Measured.	Estimated.		Measured.	Estimated.	
d h m				r	r					
Sept. 18. 21. 2	M	ζ Aquilæ	F	0·166	−0·070	− 1/4	+ 13·6	− 34·9	− 32·8	Spectrum very faint. Observations made with great difficulty. Measures rough.
21. 10	M	,,	F	0·166	−0·009	− 1/10	+ 13·6	− 16·3	− 21·3	Spectrum very faint. Measures rough.
21. 20	M	δ Cygni	F	0·166	+0·104	+ 1/3	+ 5·2	+ 26·4	+ 20·4	
21. 24	M	,,	F	0·166	−0·008	0	+ 5·2	− 7·6	− 5·2	
21. 40	M	Altair.....	F	0·166	−0·034	− 1/5	+ 13·2	− 23·5	− 28·6	Spectrum bright and fairly steady. Star-line seen fairly well.
21. 41	M	,,	F	0·166	−0·138	− 1/2	+ 13·2	− 55·1	− 51·6	
21. 42	M	,,	F	0·165	−0·056	− 1/4	+ 13·2	− 30·2	− 32·4	
21. 43	M	,,	F	0·166	−0·087	− 2/5	+ 13·2	− 39·6	− 43·9	
21. 52	M	α Cygni	F	0·166	−0·042	− 1/4	+ 3·5	− 16·2	− 22·7	Spectrum bright and fairly steady. Star-line faint but well defined.
21. 54	M	,,	F	0·166	−0·148	− 1/2	+ 3·5	− 48·5	− 41·9	
22. 20	M	α Pegasi	F	0·166	−0·190	− 2/3	+ 1·3	− 59·0	− 52·5	Spectrum faint. Measures made with difficulty and rough.
22. 21	M	,,	F	0·166	−0·150	− 1/2	+ 1·3	− 46·9	− 47·4	
22. 30	M	γ Pegasi.....	F	0·165	−0·113	− 1/2	− 3·5	− 30·8	− 34·9	Spectrum rather faint but fairly steady.
22. 31	M	,,	F	0·166	−0·148	− 2/5	− 3·5	− 41·5	− 27·2	
22. 40	M	α Andromedæ.	F	0·166	−0·119	− 1/3	− 4·7	− 31·4	− 20·9	Spectrum fairly bright and steady. Star-line seen fairly well.
22. 41	M	,,	F	0·166	−0·057	− 1/5	− 4·7	− 12·6	− 10·7	
22. 52	M	β Arietis	F	0·166	−0·137	− 3/10	− 10·7	− 30·9	− 12·3	Spectrum fairly bright and steady. Star-line seen fairly well.
22. 55	M	,,	F	0·166	−0·140	− 1/3	− 10·7	− 31·8	− 14·9	
23. 2	M	β Persei.....	F	0·166	+0·053	+ 1/4	− 14·3	+ 30·4	+ 33·5	Spectrum fairly bright and steady. Star-line seen well.
23. 3	M	,,	F	0·166	+0·102	+ 2/5	− 14·3	+ 45·3	+ 45·0	
23. 6	M	,,	F	0·166	+0·050	+ 1/3	− 14·3	+ 29·5	+ 39·9	
23. 8	M	,,	F	0·166	+0·008	0	− 14·3	+ 16·7	+ 14·3	
23. 17	M	α Persei	F	0·166	−0·050	− 1/4	− 14·2	− 1·0	− 5·0	Spectrum fairly bright and steady. Star-line seen fairly well.
23. 20	M	,,	F	0·166	+0·013	+ 1/10	− 14·2	+ 18·2	+ 21·9	
23. 35	M	β Cassiopeiæ...	F	0·166	−0·159	− 2/3	− 6·9	− 41·4	− 44·3	Spectrum fairly bright and steady. Star-line seen fairly well, but position very awkward, and measures made with difficulty.
23. 37	M	,,	F	0·166	−0·208	− 3/5	− 6·9	− 56·3	− 39·2	
23. 46	M	γ Cassiopeiæ...	F	0·166	−0·098	− 3/10	− 8·7	− 21·1	− 14·3	Spectrum bright and steady. The F line unmistakeably present as a bright line but faint and held with great difficulty.
23. 52	M	,,	F	0·166	−0·099	− 2/5	− 8·7	− 21·4	− 22·0	
19. 0. 0	M	Capella	F	0·166	+0·037	+ 1/5	− 16·7	+ 28·0	+ 32·1	Spectrum bright and steady. Star-line seen fairly well.
0. 2	M	,,	F	0·166	+0·038	+ 1/5	− 16·7	+ 28·3	+ 32·1	
0. 4	M	,,	F	0·166	+0·131	+ 1/2	− 16·7	+ 56·5	+ 55·1	
0. 5	M	,,	F	0·166	+0·080	+ 1/3	− 16·7	+ 41·0	+ 42·3	
0. 22	M	Aldebaran.....	F	0·166	+0·078	+ 1/3	− 17·2	+ 40·9	+ 42·8	Spectrum rather faint and unsteady.
0. 24	M	,,	F	0·166	+0·069	+ 1/4	− 17·2	+ 38·2	+ 36·4	Position Circle, 6°.
Sept. 25. 22. 0	M	Altair.....	F	0·182	−0·074	− 1/5	+ 14·2	− 36·7	− 38·5	Spectrum very faint and unsteady.
22. 15	M	,,	F	0·182	−0·090	− 2/5	+ 14·2	− 41·5	− 43·4	
22. 35	M	α Cygni	F	0·182	−0·229	− 1	+ 4·5	− 74·0	− 59·2	Spectrum fairly bright and steady. Star-line seen well.
22. 40	M	,,	F	0·182	−0·133	− 1/2	+ 4·5	− 44·9	− 40·9	
22. 50	M	α Cephei.....	F	0·182	−0·278	− 1	− 0·9	− 83·5	− 57·4	Spectrum faint. Star-line observed with great difficulty. Measures rough.
22. 30	M	,,	F	0·182	−0·081	− 2/5	− 0·9	− 23·7	− 28·3	
23. 20	M	α Andromedæ..	F	0·182	−0·007	0	− 2·8	+ 0·7	+ 2·8	Spectrum fairly bright. Definition bad.
23. 25	M	,,	F	0·182	−0·087	− 1/3	− 2·8	− 23·6	− 21·5	
23. 30	M	β Persei.....	F	0·182	−0·160	− 1/2	− 13·3	− 35·3	− 23·1	Spectrum bright and fairly steady. Definition poor.
23. 33	M	,,	F	0·182	−0·201	− 2/3	− 13·3	− 47·8	− 35·3	
23. 36	M	,,	F	0·182	−0·086	− 1/3	− 13·3	− 12·8	− 23·1	
23. 39	M	,,	F	0·182	−0·176	− 2/3	− 13·3	− 40·2	− 35·3	
23. 45	M	α Persei	F	0·182	+0·016	0	− 13·4	+ 18·3	+ 13·4	Spectrum bright and steady. Star-line seen fairly well.
23. 50	M	,,	F	0·182	−0·021	0	− 13·4	+ 7·0	+ 13·4	
23. 55	M	Capella	F	0·182	+0·065	+ 1/3	− 16·5	+ 36·2	+ 40·8	Spectrum bright but very unsteady. Definition bad.
23. 58	M	,,	*F	0·182	+0·098	+ 1/3	− 16·5	+ 46·3	+ 40·8	
26. 0. 6	M	β Aurigæ	M	0·182	−0·015	0	− 17·0	+ 12·4	+ 17·0	Spectrum fairly bright but unsteady. Definition poor.
0. 9	M	,,	M	0·182	−0·114	− 1/4	− 17·0	− 17·6	− 1·2	
0. 12	M	,,	M	0·182	−0·091	− 1/3	− 17·0	− 10·6	− 7·3	
0. 15	M	,,	M	0·182	−0·012	0	− 17·0	+ 13·4	+ 17·0	
0. 20	M	β Tauri	M	0·182	+0·014	0	− 17·8	+ 22·1	+ 17·8	Spectrum fairly bright and steady. Star-line seen fairly well.
0. 25	M	,,	M	0·182	−0·020	0	− 17·8	+ 11·7	+ 17·8	Position Circle, 6°.

Date, 1889. Greenwich Civil Time.	Observer.	Object.	Line.	Width of Slit.	Displacement. Measured.	Displacement. Estimated.	Earth's Motion in Miles per Second.	Concluded Motion of Stars in Miles per Second. Measured.	Concluded Motion of Stars in Miles per Second. Estimated.	REMARKS.
d h m				r	r					
Sept. 26. 12. 3	M	Sky	F	0·182	−0·001			− 0·3		The coincidence of the two spectra appeared perfect.
12. 6	M	,,	F	0·182	0·000			0·0		
12. 9	M	,,	F	0·182	0·000			0·0		
12. 12	M	,,	F	0·182	+0·004			+ 1·2		
12. 15	M	,,	F	0·182	−0·005			− 1·5		
										Position Circle, 6°.
Oct. 30. 20. 34	M	α Andromedæ..	F	0·232	−0·092	− ¼	+ 7·1	− 35·1	− 33·4	Spectrum fairly bright, but definition bad.
20. 36	M	,,	F	0·232	−0·071	− 3/10	+ 7·1	− 28·7	− 38·6	
										Position Circle, 6°.
Nov. 25. 20. 12	M	α Persei	F	0·174	+0·068	+ ⅕	+ 0·9	+ 19·8	+ 19·0	Spectrum faint but fairly steady. Star-line faint.
20. 14	M	,,	F	0·174	+0·068	+ ⅓	+ 0·9	+ 19·8	+ 32·2	
20. 32	M	β Persei.....	F	0·174	−0·174	− ⅖	+ 2·8	− 55·6	− 42·5	Spectrum and star-line faint. Definition poor.
20. 35	M	,,	F	0·174	−0·049	− ¼	+ 2·8	− 17·7	− 27·6	
20. 37	M	,,	F	0·174	−0·023	− 1/10	+ 2·8	− 9·8	− 12·7	
20. 40	M	,,	F	0·174	−0·011	0	+ 2·8	− 6·1	− 2·8	
21. 5	M	α Andromedæ..	F	0·174	−0·080	− ⅓	+ 13·3	− 37·6	− 46·4	Spectrum fairly bright but unsteady. Definition poor.
21. 8	M	,,	F	0·174	−0·155	− ⅓	+ 13·3	− 60·4	− 46·4	
21. 17	M	γ Pegasi	F	0·174	−0·016	− 1/10	+ 15·4	− 20·3	− 25·3	Spectrum faint and unsteady. Star-line seen with difficulty.
21. 20	M	,,	F	0·174	−0·116	− ⅓	+ 15·4	− 50·7	− 48·5	
21. 37	M	β Arietis	F	0·174	+0·077	+ ¼	+ 9·8	+ 13·6	+ 15·0	Spectrum fairly bright but unsteady. Definition poor.
21. 39	M	,,	F	0·174	+0·120	+ ⅓	+ 9·8	+ 26·6	+ 23·3	
21. 51	M	Aldebaran.....	F	0·174	+0·173	+ ⅔	− 1·4	+ 53·9	+ 67·6	Spectrum fairly bright. Star-line seen fairly well.
21. 53	M	,,	F	0·174	+0·199	+ ⅔	− 1·4	+ 61·8	+ 67·6	
22. 9	M	Capella	F	0·174	+0·060	+ ⅕	− 4·9	+ 23·1	+ 29·7	Spectrum bright and steady. Star-line seen fairly well.
22. 14	M	,,	F	0·174	+0·101	+ ⅓	− 4·9	+ 35·6	+ 38·0	
22. 20	M	β Aurigæ	F	0·174	+0·091	+ 3/10	− 7·3	+ 34·9	+ 37·1	Spectrum fairly bright and steady. Star-line faint and very diffused.
22. 25	M	,,	F	0·174	+0·038	+ 1/10	− 7·3	+ 28·9	+ 17·2	
22. 35	M	β Tauri	F	0·174	+0·116	+ 3/10	− 5·5	+ 40·8	+ 35·3	Spectrum fairly bright and steady. Star-line seen fairly well.
22. 37	M	,,	F	0·174	+0·108	+ ⅓	− 5·5	+ 38·3	+ 38·6	
22. 45	M	γ Orionis	F	0·174	−0·060	− ⅕	− 4·8	− 13·5	− 20·0	
22. 48	M	,,	F	0·174	−0·060	− ⅕	− 4·8	− 13·5	− 15·1	
23. 1	M	Rigel	F	0·174	+0·098	+ 3/10	− 3·2	+ 33·0	+ 33·0	Spectrum bright but unsteady. Star-line seen well.
23. 3	M	,,	F	0·174	+0·083	+ 3/10	− 3·2	+ 28·4	+ 33·0	
23. 14	M	δ Orionis	F	0·174	+0·038	+ 1/10	− 5·0	+ 16·6	+ 14·9	Spectrum faint. Star-line very faint and seen with great difficulty.
23. 15	M	,,	F	0·174	+0·001	0	− 5·0	+ 5·3	+ 5·0	
23. 24	M	ε Orionis	F	0·174	+0·051	+ ¼	− 5·3	+ 20·8	+ 30·1	Spectrum fairly bright and steady. Star-line seen fairly well.
23. 25	M	,,	F	0·174	+0·009	0	− 5·3	+ 8·0	+ 5·3	
23. 31	M	ζ Orionis	F	0·174	+0·039	+ ⅕	− 5·6	+ 17·4	+ 25·5	
23. 33	M	,,	F	0·174	−0·106	− ⅕	− 5·6	− 26·6	− 14·3	
23. 35	M	,,	F	0·174	−0·014	− 1/10	− 5·6	+ 1·3	− 4·3	
23. 36	M	,,	F	0·174	+0·050	+ 1/10	− 5·6	+ 20·8	+ 15·5	
23. 38	M	Sirius.....	F	0·174	−0·010	0	− 9·1	+ 6·1	+ 9·1	
23. 50	M	,,	F	0·174	+0·049	+ ¼	− 9·1	+ 24·0	+ 33·9	
23. 52	M	,,	F	0·174	−0·016	0	− 9·1	+ 4·2	+ 9·1	
23. 53	M	,,	F	0·174	−0·070	− ¼	− 9·1	− 12·2	− 15·7	
23. 55	M	,,	F	0·174	−0·019	0	− 9·1	+ 3·3	+ 9·1	
23. 56	M	,,	F	0·174	−0·039	− 1/10	− 9·1	− 2·7	− 0·8	
										Position Circle, 6°.
Dec. 3. 20. 30	M	Moon	F	0·174	+0·016			+ 4·9		Both Spectra very bright and seen well. The coincidence of the two spectra appeared perfect.
20. 33	M	,,	F	0·174	+0·020			+ 6·1		
20. 36	M	,,	F	0·174	−0·018			− 5·5		
20. 39	M	,,	F	0·174	+0·008			+ 2·4		
20. 42	M	,,	F	0·174	+0·012			+ 3·6		
										Position Circle, 6°.

Date, 1889. Greenwich Civil Time.	Observer.	Object.	Line.	Width of Slit.	Displacement. Measured.	Displacement. Estimated.	Earth's Motion in Miles per Second.	Concluded Motion of Stars in Miles per Second. Measured.	Concluded Motion of Stars in Miles per Second. Estimated.	REMARKS.
d h m				r	r					
Dec. 20. 21. 26	M	Aldebaran.....	F	0·304	+0·353	+ 8/8	+ 6·8	(+100·4)	(+ 59·4)	Spectrum very unsteady. Star-line seen with great difficulty. Measures rejected.
21. 28	M	,,	F	0·304	+0·217	+ 1/2	+ 6·8	(+ 59·1)	(+ 42·9)	
21. 45	M	Rigel	F	0·304	+0·202	+ 2/3	+ 3·9	+ 57·5	+ 45·8	Spectrum very unsteady. Definition bad.
21. 47	M	,,	F	0·304	+0·046	+ 1/4	+ 3·9	+ 10·1	+ 20·9	
21. 56	M	γ Orionis	F	0·304	+0·139	+ 3/10	+ 3·1	+ 39·1	+ 26·7	Star-line seen fairly well.
21. 57	M	,,	F	0·304	+0·005	0	+ 3·1	− 1·6	− 3·1	
21. 58	M	,,	F	0·304	−0·009	0	+ 3·1	− 5·8	− 3·1	
22. 1	M	,,	F	0·304	+0·034	+ 1/10	+ 3·1	+ 7·2	+ 6·8	
22. 16	M	β Tauri	F	0·304	+0·112	+ 1/4	+ 2·7	+ 31·3	+ 22·1	Spectrum fairly steady. Star-line seen fairly well.
22. 20	M	,,	F	0·304	+0·100	+ 1/5	+ 2·7	+ 27·7	+ 17·2	
22. 35	M	δ Orionis	F	0·304	+0·094	+ 1/5	+ 2·6	+ 26·0	+ 17·3	Spectrum fairly steady. Star-line seen fairly well.
22. 37	M	,,	F	0·304	−0·020	− 1/10	+ 2·6	− 8·7	− 12·5	
22. 48	M	ε Orionis	F	0·304	+0·142	+ 3/10	+ 2·2	+ 40·9	+ 27·6	
22. 49	M	,,	F	0·304	−0·029	0	+ 2·2	− 11·0	− 2·2	
22. 56	M	ζ Orionis	F	0·304	+0·137	+ 1/5	+ 1·9	+ 39·7	+ 18·0	
23. 2	M	,,	F	0·304	+0·054	+ 1/10	+ 1·9	+ 14·5	+ 8·0	
23. 25	M	γ Geminorum..	F	0·304	−0·184	− 2/5	− 2·7	− 53·2	− 37·0	Star-line seen very well.
23. 26	M	,,	F	0·304	−0·166	− 1/3	− 2·7	− 47·7	− 30·4	
23. 37	M	Sirius.....	F	0·304	−0·222	− 1/2	− 3·3	− 64·1	− 46·4	Spectrum very unsteady.
23. 39	M	,,	F	0·304	−0·192	− 1/2	− 3·3	− 55·0	− 46·4	
23. 40	M	,,	F	0·304	−0·149	− 1/3	− 3·3	− 42·0	− 29·8	
23. 41	M	,,	F	0·304	−0·163	− 1/3	− 3·3	− 46·1	− 29·8	
23. 50	M	Procyon.....	F	0·304	−0·071	− 1/10	− 7·7	− 13·9	− 2·2	Spectrum very bright and fairly steady. Star-line seen fairly well.
23. 51	M	,,	F	0·304	+0·078	+ 1/10	− 7·7	+ 31·4	+ 17·6	
23. 52	M	,,	F	0·304	−0·004	0	− 7·7	+ 6·5	+ 7·7	
23. 53	M	,,	F	0·304	−0·016	0	− 7·7	+ 2·8	+ 7·7	
21. 0. 7	M	Pollux	F	0·304	−0·057	− 1/10	− 7·2	− 10·1	− 2·7	Star-line very faint, and seen with extreme difficulty.
0. 10	M	,,	F	0·304	−0·073	− 1/5	− 7·2	− 15·0	− 12·7	
0. 17	M	Castor	F	0·304	+0·119	+ 1/4	− 6·2	+ 42·3	+ 31·0	
0. 20	M	,,	F	0·304	+0·061	+ 1/10	− 6·2	+ 24·7	+ 16·1	Position Circle, 6°.

ROTATION of SATURN'S RINGS deduced from the Relative Displacement of Lines in the Spectrum at the East and West Ansæ respectively.

Date, 1889. Greenwich Civil Time.	Observer.	W. Ansa.	E. Ansa.	Line.	Width of Slit.	Displacement, Measured.	Concluded Motion in Miles per Second. W.—E.	Position Circle.	REMARKS.
d h m		r	r		r			° ′	
Mar. 5. 22. 22	M	0·041	0·128	h_1	0·160	+0·087	+ 32·7	1. 30	Cylindrical lens. Slit parallel to minor axis of ring. The point observed in each case was, so far as could be ascertained, the ring B, immediately within the Cassinian division. The spectrum was very faint, and the lines were observed with great difficulty. The measures therefore were very rough. The readings of the micrometer increased towards the blue.
22. 30	M	0·040	0·172	h_1	0·160	+0·132	+ 49·6		
22. 35	M	0·871	1·001	h_1	0·160	+0·130	+ 48·8		
22. 45	M	0·520	0·598	h_1	0·160	+0·078	+ 29·3		
22. 47	M	0·499	0·564	h_1	0·160	+0·065	+ 24·4		
						Mean ...	+ 37·0		

Assuming that the particles of the Ring revolve as Satellites round Saturn, and taking the distance of the points of the Ansæ observed from the centre of Saturn, as 17″·2 at mean distance (9·5389), the mass of Saturn as $\frac{1}{3500}$, and the Sun's mean distance as 92,250,000 miles, the Calculated Relative Motion of the Ansæ in the line of sight (for the points observed) would be + 20·1 miles per second.

The "half-prism" spectroscope in the direct position with a dispersion of one "half-prism" was employed throughout.

COLLECTED RESULTS for MOTIONS of STARS in the line of Sight, from SPECTROSCOPIC OBSERVATIONS made at the ROYAL OBSERVATORY, GREENWICH, in the Year 1889.

(F for the Star or Moon is compared with Hβ of Hydrogen; and b_1, b_2, b_3 with Mg_1, Mg_2, Mg_3 of Magnesium.)

(+ denotes Recession; − Approach.)

Date, 1889.	Observer.	Number of Measures.	Number of Prisms.	Position Circle.	Width of Slit.	Line.	Earth's Motion in Miles per Second.	Concluded Motion of Star in Miles per Second.	
								Measured.	Estimated.
α ANDROMEDÆ. F line broad and nebulous. Estimated total breadth, 18 tenth-metres; central and more condensed portion, 8 tenth-metres.									
January 1	M	2	1	6	0·198	F	+ 17·1	− 50·4	− 59·7
July 31	M	2	1	6	0·122	F	− 14·4	− 34·7	− 23·1
September 6	M	2	1	6	0·120	F	− 7·7	− 13·9	− 15·0
16	M	2	1	6	0·124	F	− 5·2	− 22·5	− 24·5
18	M	2	1	6	0·166	F	− 4·7	− 22·0	− 15·8
25	M	2	1	6	0·182	F	− 2·8	− 11·5	− 9·4
October 30	M	2	1	6	0·232	F	+ 7·1	− 31·9	− 36·0
November 25	M	2	1	6	0·174	F	+ 13·3	− 49·0	− 46·4
β CASSIOPELÆ. F line broad, faint, and diffused at the edges.									
July 31	M	2	1	6	0·122	F	− 11·1	− 27·4	− 15·6
September 18	M	2	1	6	0·166	F	− 6·9	− 48·9	− 41·8
γ PEGASI. F line broad and diffused at the edges.									
September 16	M	2	1	6	0·124	F	− 4·1	− 19·1	− 22·6
18	M	2	1	6	0·166	F	− 3·5	− 36·2	− 31·1
November 25	M	2	1	6	0·174	F	+ 15·4	− 35·5	− 36·9
γ CASSIOPELÆ. F line narrow and feebly bright.									
July 31	M	2	1	6	0·122	F	− 11·7	+ 21·3	+ 19·7
September 18	M	2	1	6	0·166	F	− 8·7	− 21·3	− 18·2

Date, 1889.	Observer.	Number of Measures.	Number of Prisms.	Position Circle.	Width of Slit.	Line.	Earth's Motion in Miles per Second.	Concluded Motion of Star in Miles per Second.	
								Measured.	Estimated.
β ARIETIS. F line broad, dark, and diffused.									
January 1	M	2	1	6	0·198	F	+ 17·6	− 16·0	− 17·6
September 18	M	2	1	6	0·166	F	− 10·7	− 31·4	− 13·6
November 25	M	2	1	6	0·174	F	+ 9·8	+ 20·1	+ 19·2
β PERSEI. F line broad, dark, and diffused.									
January 29	M	2	1	6	0·298	F	+ 16·9	− 16·5	− 16·9
February 15	M	4	1	6	0·162	F	+ 17·4	− 15·5	− 14·2
September 16	M	2	1	6	0·124	F	− 14·6	− 33·1	− 35·7
18	M	4	1	6	0·166	F	− 14·3	+ 30·5	+ 33·2
25	M	4	1	6	0·182	F	− 13·3	− 34·0	− 29·2
November 25	M	4	1	6	0·174	F	+ 2·8	− 22·3	− 21·4
α PERSEI. F line apparently somewhat variable in character. Rather broad and diffused, but not very dark. Estimated breadth on November 25, 5 tenth-metres.									
February 15	M	2	1	6	0·162	F	+ 16·2	− 36·0	− 43·3
September 16	M	2	1	6	0·124	F	− 14·4	+ 12·6	+ 9·9
18	M	2	1	6	0·166	F	− 14·2	+ 8·6	+ 8·5
25	M	2	1	6	0·182	F	− 13·4	+ 12·7	+ 13·4
November 25	M	2	1	6	0·174	F	+ 0·9	+ 19·8	+ 25·6
α TAURI (*Aldebaran*). F line narrow and sharp. *b* lines narrow, sharp, and distinct.									
January 1	M	1	1	6	0·198	F	+ 10·4	+ 32·7	+ 35·2
February 4	M	2	1	6	0·214	F	+ 17·4	− 1·5	+ 10·2
15	M	4	1	6	0·162	F	+ 18·4	+ 30·7	+ 17·4
March 5	M	2	1	6	0·160	b_1	+ 18·4	+ 51·1	+ 46·4
September 19	M	2	1	6	0·166	F	− 17·2	+ 39·6	+ 39·6
November 25	M	2	1	6	0·174	F	− 1·4	+ 57·9	+ 67·6
December 20	M	2	1	6	0·304	F	+ 6·8	+ 79·8	+ 51·2

Date, 1889.	Observer.	Number of Measures.	Number of Prisms.	Position Circle.	Width of Slit.	Line.	Earth's Motion in Miles per Second.	Concluded Motion of Star in Miles per Second.	
								Measured.	Estimated.
α AURIGÆ (*Capella*). F line narrow and sharp, but not very dark.									
February 15	M	4	1	6	0·162	F	+ 16·0	+ 7·8	+ 7·0
March 5	M	2	1	6	0·160	b_1	+ 17·1	+ 3·2	+ 3·6
September 17	M	2	1	6	0·124	F	− 13·3	+ 31·3	+ 38·4
19	M	4	1	6	0·166	F	− 16·7	+ 38·5	+ 40·4
25	M	2	1	6	0·182	F	− 16·5	+ 41·3	+ 40·8
November 25	M	2	1	6	0·174	F	− 4·9	+ 29·4	+ 33·9
β ORIONIS (*Rigel*). F line narrow and sharp. Estimated breadth about 1 tenth-metre.									
February 4	M	2	1	6	0·214	F	+ 14·1	+ 33·9	+ 41·0
8	M	2	1	6	0·158	F	+ 14·6	+ 6·2	+ 11·6
15	M	2	1	6	0·162	F	+ 15·3	− 6·1	− 1·2
April 5	M	4	1	6	0·146	F	+ 13·4	+ 21·7	+ 14·7
November 25	M	2	1	6	0·174	F	− 3·2	+ 30·7	+ 33·0
December 20	M	2	1	6	0·304	F	+ 3·9	+ 33·8	+ 33·4
γ ORIONIS. F line somewhat diffused at the edges. Estimated breadth, 6 tenth-metres. No strongly marked central condensation.									
February 4	M	4	1	6	0·214	F	+ 15·1	− 10·2	− 4·8
8	M	2	1	6	0·158	F	+ 15·8	− 9·6	− 5·1
15	M	2	1	6	0·162	F	+ 16·7	− 31·2	− 28·1
November 25	M	2	1	6	0·174	F	− 4·8	− 13·5	− 17·6
December 20	M	4	1	6	0·304	F	+ 3·1	+ 9·7	+ 6·8
β TAURI. F line broad and fairly dark; darkest portion about 5 tenth-metres. Entire breadth, including a faint fringe on either side, about 10 tenth-metres.									
February 4	M	2	1	6	0·214	F	+ 15·5	− 14·9	− 2·6
8	M	2	1	6	0·158	F	+ 16·1	− 25·7	− 23·3
15	M	2	1	6	0·162	F	+ 17·2	− 17·6	− 14·0
September 26	M	2	1	6	0·182	F	− 17·8	+ 16·9	+ 17·8
November 25	M	2	1	6	0·174	F	− 5·5	+ 39·6	+ 37·0
December 20	M	2	1	6	0·304	F	+ 2·7	+ 29·5	+ 19·7

Date, 1889.	Observer.	Number of Measures.	Number of Prisms.	Position Circle.	Width of Slit.	Line.	Earth's Motion in Miles per Second.	Concluded Motion of Star in Miles per Second.	
								Measured.	Estimated.
δ ORIONIS. F line faint and ill-defined; breadth about 4 tenth-metres.									
April 5	M	2	1	6	0·146	F	+ 15·1	+ 11·2	+ 10·2
November 25	M	2	1	6	0·174	F	− 5·0	+ 11·0	+ 10·0
December 20	M	2	1	6	0·304	F	+ 2·6	+ 8·7	+ 2·4
ε ORIONIS. F line narrow and fairly dark; breadth about 1 tenth-metre.									
November 25	M	2	1	6	0·174	F	− 5·3	+ 14·4	+ 17·7
December 20	M	2	1	6	0·304	F	+ 2·2	+ 15·0	+ 12·7
ζ ORIONIS. F line narrow but faint; breadth about 1 tenth-metre.									
November 25	M	4	1	6	0·174	F	− 5·6	+ 3·2	+ 5·6
December 20	M	2	1	6	0·304	F	+ 1·9	+ 27·1	+ 13·0
α ORIONIS. Third type spectrum. The *b* lines stand out on the back ground of a shaded band from which it is often difficult to separate them.									
March 5	M	2	1	6	0·160	b_4	+ 17·5	− 4·2	+ 2·2
5	M	2	1	6	0·160	b_1	+ 17·5	+ 2·6	+ 9·1
β AURIGÆ. F line broad and diffused, but somewhat variable. On February 15 its breadth was estimated as 16 tenth-metres. On November 25 it was faint and very much diffused.									
February 15	M	2	1	6	0·162	F	+ 15·0	− 3·5	+ 1·2
September 26	M	4	1	6	0·182	F	− 17·0	− 0·6	+ 6·4
November 25	M	2	1	6	0·174	F	− 7·3	+ 31·9	+ 27·2

Date, 1889.	Observer.	Number of Measures.	Number of Prisms.	Position Circle.	Width of Slit.	Line.	Earth's Motion in Miles per Second.	Concluded Motion of Star in Miles per Second.	
								Measured.	Estimated.
γ GEMINORUM. F line dark, broad, and diffused at the edges. Estimated breadth, 13 tenth-metres.									
February 15	M	4	1	6	0·162	F	+ 14·3	− 75·0	− 63·1
December 20	M	2	1	6	0·304	F	− 2·7	− 50·5	− 33·7
α CANIS MAJORIS (*Sirius*). F line dark, but very broad and diffused at the edges. Estimated breadth, 20 tenth-metres; central condensation, 5 tenth-metres.									
February 8	M	6	1	6	0·158	F	+ 8·9	− 13·2	− 13·1
15	M	6	1	6	0·162	F	+ 10·2	− 31·7	− 28·4
March 27	M	4	1	6	0·135	F	+ 14·1	− 43·7	− 49·5
April 15	M	4	1	6	0·129	F	+ 13·7	− 44·0	− 45·5
November 25	M	6	1	6	0·174	F	− 9·1	+ 3·8	+ 7·5
December 20	M	4	1	6	0·304	F	− 3·3	− 51·8	− 38·1
α GEMINORUM (*Castor*). The two components of this double star have been observed together as one star. F line very broad and diffused. The estimations of its breadth vary considerably. On February 15, breadth estimated as 20 tenth-metres, central condensation 5 tenth-metres; dark. On March 27, breadth 13 tenth-metres, no central condensation; rather faint. On April 25, very broad and very diffused.									
February 15	M	2	1	6	0·162	F	+ 11·6	+ 34·7	+ 23·1
March 27	M	2	1	6	0·135	F	+ 17·8	− 37·1	− 43·2
April 25	M	2	1	6	0·190	F	+ 17·0	− 13·4	− 7·0
December 21	M	2	1	6	0·304	F	− 6·2	+ 33·5	+ 23·6
α CANIS MINORIS (*Procyon*). F line narrow, but rather faint and on a back ground of a faint diffused shading.									
February 8	M	2	1	6	0·158	F	+ 8·0	− 9·5	− 11·6
15	M	4	1	6	0·162	F	+ 9·9	− 7·9	− 5·8
March 27	M	2	1	6	0·135	F	+ 16·9	− 6·7	− 8·9
April 15	M	1	1	6	0·129	F	+ 17·5	− 43·0	− 51·0
December 20	M	4	1	6	0·304	F	− 7·7	+ 6·7	+ 7·7

Date, 1889.	Observer.	Number of Measures.	Number of Prisms.	Position Circle.	Width of Slit.	Line.	Earth's Motion in Miles per Second.	Concluded Motion of Star in Miles per Second.	
								Measured.	Estimated.
β GEMINORUM (*Pollux*). F line narrow but faint. *b* lines narrow and sharp but faint.									
February 8	M	2	1	6	0·158	F	+ 9·0	− 13·0	− 16·1
15	M	2	1	6	0·162	F	+ 10·9	− 52·7	− 43·5
March 5	M	2	1	6	0·160	b_1	+ 15·0	− 43·2	− 49·4
27	M	2	1	6	0·135	F	+ 17·7	− 53·4	− 60·5
December 21	M	2	1	6	0·304	F	− 7·2	− 12·6	− 7·7
α LEONIS (*Regulus*). F line rather faint. Estimations of its breadth vary, but it is always a difficult object to measure satisfactorily. February 15, line faint with diffused edges; breadth 8 tenth-metres. March 27, line faint, broad, and very diffused; breadth 16 tenth-metres. April 30, breadth 10 tenth-metres, a narrow central condensation suspected. May 2, line very diffused; breadth 13 tenth-metres; no central condensation seen.									
February 15	M	2	1	6	0·162	F	− 0·3	+ 25·2	+ 19·3
March 27	M	2	1	6	0·135	F	+ 11·6	+ 13·3	+ 11·8
April 25	M	4	1	6	0·190	F	+ 16·7	+ 20·4	+ 20·7
30	M	2	1	6	0·190	F	+ 17·2	− 24·2	− 22·1
May 2	M	2	1	6	0·182	F	+ 17·4	+ 16·3	+ 20·7
γ LEONIS. The two components of this double star have been observed together as one star. F line narrow but faint. *b* lines narrow and sharp.									
March 5	M	2	1	6	0·160	b_1	+ 5·5	− 30·7	− 39·9
27	M	2	1	6	0·135	F	+ 11·5	− 18·2	− 25·5
April 30	M	2	1	6	0·190	F	+ 17·0	+ 14·7	+ 17·8
β URSÆ MAJORIS. F line broad and diffused at the edges. Breadth about 16 tenth-metres. Some central condensation.									
May 2	M	4	1	6	0·182	F	+ 12·7	− 25·1	− 26·7
α URSÆ MAJORIS. F line narrow and faint.									
May 2	M	4	1	6	0·182	F	+ 11·7	− 29·3	− 27·8

Date, 1889.		Observer.	Number of Measures.	Number of Prisms.	Position Circle.	Width of Slit.	Line	Earth's Motion in Miles per Second.	Concluded Motion of Star in Miles per Second.	
									Measured.	Estimated.
δ LEONIS. F line very broad and dark, and somewhat ill-defined at the edges. Estimated breadth, 13 tenth-metres; some central condensation.										
May	2	M	2	1	6	0·182	F	+ 15·5	− 63·1	− 52·8
β LEONIS. F line dark and very broad and diffused. The total breadth estimated as about 31 tenth-metres on April 30, but only about 18 tenth-metres on March 27 and May 2. The darker central portion was estimated on April 30 as about 13 tenth-metres in breadth.										
March	27	M	2	1	6	0·135	F	+ 5·4	+ 8·4	+ 16·0
April	30	M	4	1	6	0·190	F	+ 13·6	− 25·0	− 21·9
May	2	M	4	1	6	0·182	F	+ 14·0	− 71·1	− 69·1
γ URSÆ MAJORIS. F line not very dark. Breadth estimated as about 8 tenth-metres.										
May	2	M	4	1	6	0·182	F	+ 11·8	+ 4·2	+ 4·3
δ URSÆ MAJORIS. F line rather faint and diffused. Breadth about 13 tenth-metres.										
May	2	M	4	1	6	0·182	F	+ 10·7	− 15·5	− 15·7
γ VIRGINIS. The two components of this double star have been observed together as one star. F line faint, diffused, but not very broad. Breadth about 9 tenth-metres.										
March	27	M	2	1	6	0·135	F	− 0·4	+ 22·6	+ 30·5
May	2	M	2	1	6	0·182	F	+ 10·1	− 41·5	− 38·0
ε URSÆ MAJORIS. F line fairly dark. Breadth about 7 tenth-metres.										
May	2	M	4	1	6	0·182	F	+ 9·5	− 7·4	− 9·5

Date, 1889.	Observer.	Number of Measures.	Number of Prisms.	Position Circle.	Width of Slit.	Line.	Earth's Motion in Miles per Second.	Concluded Motion of Star in Miles per Second.	
								Measured.	Estimated.
α CANUM VENATICORUM. F line broad, dark, and somewhat diffused. Breadth about 13 tenth-metres.									
March 27	M	2	1	6	0·135	F	+ 3·5	− 55·1	− 54·3
α VIRGINIS (*Spica*). F line faint and somewhat narrow. Breadth about 4 tenth-metres.									
March 27	M	2	1	6	0·135	F	− 4·7	+ 31·2	+ 32·8
April 15	M	2	1	6	0·129	F	+ 1·2	+ 46·0	+ 35·6
30	M	4	1	6	0·190	F	+ 5·7	− 9·8	− 10·5
May 2	M	2	1	6	0·182	F	+ 6·3	− 8·7	− 6·3
ζ URSÆ MAJORIS. F line faint and broad on March 27. Fairly dark, and somewhat broad and diffused; breadth about 10 tenth-metres on May 2.									
March 27	M	4	1	6	0·135	F	+ 4·0	− 22·7	− 32·4
May 2	M	4	1	6	0·182	F	+ 8·5	− 6·7	− 8·5
η URSÆ MAJORIS. F line faint and diffused, but not very broad. Breadth about 8 tenth-metres. A very difficult object to measure.									
March 27	M	2	1	6	0·135	F	+ 2·3	− 62·6	− 69·1
May 3	M	4	1	6	0·182	F	+ 7·7	− 19·0	− 23·8
η BOÖTIS. *b* lines narrow and sharp, but faint.									
March 5	M	2	1	6	0·160	b_1	− 8·8	+ 44·0	+ 44·2

Date. 1889.	Observer.	Number of Measures.	Number of Prisms.	Position Circle.	Width of Slit.	Line.	Earth's Motion in Miles per Second.	Concluded Motion of Star in Miles per Second.	
								Measured.	Estimated.
α BOÖTIS (*Arcturus*). F line narrow and sharp. *b* lines narrow, sharp, and dark.									
March 5	M	2	1	6	0·160	b_1	− 9·7	− 49·3	− 49·2
22	M	2	1	6	0·077	F	− 5·5	− 29·0	− 20·9
28	M	2	1	6	0·135	F	− 4·1	− 31·9	− 40·1
April 15	M	2	1	6	0·129	F	+ 0·9	− 24·7	− 31·0
30	M	2	1	6	0·190	F	+ 4·8	− 25·1	− 38·0
May 3	M	2	1	6	0·182	F	+ 5·3	− 45·9	− 47·4
June 26	M	2	1	6	0·161	F	+ 14·6	− 67·2	− 61·5
γ BOÖTIS. F line fairly dark, broad, and somewhat diffused at the edges. Breadth about 16 tenth-metres.									
April 30	M	2	1	6	0·190	F	+ 4·9	− 69·1	− 63·0
ε BOÖTIS. *b* lines narrow and sharp.									
March 5	M	2	1	6	0·160	b_1	− 9·3	− 13·8	− 39·2
β LIBRÆ. F line broad and diffused at the edges. Breadth about 16 tenth-metres.									
April 30	M	2	1	6	0·190	F	− 2·2	− 27·4	− 26·8
α CORONÆ BOREALIS. F line broad and diffused at the edges. Estimated breadth 16 tenth-metres.									
March 22	M	2	1	6	0·077	F	− 8·2	+ 8·8	+ 8·2
April 30	M	2	1	6	0·190	F	0·0	+ 27·6	+ 21·5
June 26	M	4	1	6	0·161	F	+ 10·4	− 13·1	− 6·9
July 15	M	4	1	6	0·168	F	+ 12·2	+ 24·9	+ 29·2
β SERPENTIS. F line broad and diffused at the edges. Estimated breadth 18 tenth-metres.									
April 30	M	2	1	6	0·190	F	− 2·0	− 40·6	− 39·5

Date, 1889.	Observer	Number of Measures.	Number of Prisms.	Position Circle.	Width of Slit.	Line.	Earth's Motion in Miles per Second.	Concluded Motion of Star in Miles per Second.	
								Measured.	Estimated.
α OPHIUCHI. F line very ill-defined and nebulous. Estimated breadth 20 tenth-metres.									
April 30	M	2	1	6	0·190	F	− 9·4	+ 56·1	+ 59·2
June 26	M	2	1	6	0·161	F	+ 3·6	− 33·3	− 38·8
July 15	M	2	1	6	0·168	F	+ 7·8	− 36·1	− 30·0
19	M	4	1	6	0·168	F	+ 8·6	− 34·8	− 36·4
α LYRÆ (*Vega*). F line broad and diffused. Breadth about 13 tenth-metres. Central condensation about 3 tenth-metres.									
May 1	M	4	1	6	0·190	F	− 7·6	− 22·6	− 20·6
June 27	M	2	1	6	0·161	F	− 1·2	− 3·3	− 8·2
July 15	M	4	1	6	0·168	F	+ 1·4	− 22·0	− 24·6
19	M	4	1	6	0·168	F	+ 2·0	− 22·4	− 27·0
September 6	M	2	1	6	0·120	F	+ 7·5	− 59·7	− 54·4
13	M	2	1	6	0·179	F	+ 8·0	− 47·0	− 41·9
16	M	2	1	6	0·124	F	+ 8·1	− 42·3	− 46·2
18	M	2	1	6	0·166	F	+ 8·2	− 56·2	− 49·8
γ LYRÆ. F line nebulous. No central condensation. Breadth about 13 tenth-metres.									
September 18	M	2	1	6	0·166	F	+ 9·5	− 82·1	− 63·9
ζ AQUILÆ. F line broad, nebulous, and faint.									
July 15	M	4	1	6	0·168	F	+ 1·3	− 22·6	− 23·6
19	M	2	1	6	0·168	F	+ 2·3	− 48·2	− 46·8
September 18	M	2	1	6	0·166	F	+ 13·6	− 25·6	− 27·1
δ AQUILÆ. F line broad and diffused at the edges.									
July 19	M	2	1	6	0·168	F	+ 1·5	− 34·3	− 29·3

Date, 1889.	Observer.	Number of Measures.	Number of Prisms.	Position Circle.	Width of Slit.	Line.	Earth's Motion in Miles per Second.	Concluded Motion of Star in Miles per Second.	
								Measured.	Estimated.
δ CYGNI. F line broad, diffused and faint.									
September 18	M	2	1	6	0·166	F	+ 5·2	+ 9·4	+ 7·6
α AQUILÆ (*Altair*). F line very broad and nebulous. Breadth about 18 tenth-metres.									
June 27	M	2	1	6	0·161	F	− 6·5	− 44·8	− 40·4
July 15	M	4	1	6	0·168	F	− 1·8	− 26·0	− 24·0
19	M	2	1	6	0·168	F	− 0·8	− 50·0	− 49·3
September 6	M	2	1	6	0·120	F	+ 11·0	− 41·0	− 40·8
13	M	2	1	6	0·179	F	+ 12·3	− 34·0	− 35·5
16	M	4	1	6	0·124	F	+ 12·8	− 34·6	− 39·9
18	M	4	1	6	0·166	F	+ 13·2	− 37·1	− 39·1
25	M	2	1	6	0·182	F	+ 14·2	− 39·1	− 41·0
α CYGNI. F line narrow and fairly dark.									
June 27	M	2	1	6	0·161	F	− 7·6	− 43·6	− 34·8
July 16	M	2	1	6	0·168	F	− 5·8	− 51·5	− 49·8
19	M	2	1	6	0·168	F	− 5·3	− 39·0	− 41·1
31	M	2	1	6	0·122	F	− 3·8	− 50·6	− 27·4
September 6	M	2	1	6	0·120	F	+ 1·7	− 27·6	− 35·8
13	M	2	1	6	0·179	F	+ 2·7	− 26·2	− 32·8
16	M	2	1	6	0·124	F	+ 3·2	− 64·1	− 61·1
18	M	2	1	6	0·166	F	+ 3·5	− 32·4	− 32·3
25	M	2	1	6	0·182	F	+ 4·5	− 59·5	− 50·1
α CEPHEI. F line broad, dark, and diffused at the edges.									
July 20	M	2	1	6	0·168	F	− 6·2	− 78·4	− 67·9
31	M	2	1	6	0·122	F	− 5·7	− 44·9	− 23·3
September 16	M	2	1	6	0·124	F	− 1·9	− 30·9	− 34·7
25	M	2	1	6	0·182	F	− 0·9	− 53·6	− 42·9
α PEGASI. F line broad and diffused at the edges.									
September 13	M	1	1	6	0·179	F	− 0·2	− 56·3	− 46·1
16	M	2	1	6	0·124	F	+ 0·7	− 30·9	− 31·2
18	M	2	1	6	0·166	F	+ 1·3	− 53·0	− 50·0

Date, 1889.	Observer.	Number of Measures.	Number of Prisms.	Position Circle.	Width of Slit.	Line.	Earth's Motion in Miles per Second.	Concluded Motion of Star in Miles per Second.	
								Measured.	Estimated.
VENUS.									
February 4	M	2	1	6	0·214	F	...	+ 20·1	+ 18·1
15	M	2	1	6	0·162	F	...	− 14·9	− 11·4
Calculated relative motion of Venus, Feb. 4, − 7·8 miles per second ; Feb. 15, −8·0.									
MOON.									
February 4	M	5	1	6	0·214	F	...	− 2·0	...
15	M	5	1	6	0·162	F	...	+ 2·7	...
15	M	5	1	6	0·162	F	...	+ 2·8	...
April 5	M	5	1	6	0·146	F	...	+ 3·0	...
15	M	8	1	6	0·129	F	...	− 1·5	...
July 16	M	5	1	6	0·168	F	...	+ 0·3	...
September 6	M	5	1	6	0·120	F	...	− 1·6	...
17	M	5	1	6	0·124	F	...	+ 1·6	...
December 3	M	5	1	6	0·174	F	...	+ 2·3	...
SUN.									
May 3	M	7	1	6	0·182	F	...	− 1·6	...
SKY.									
February 9	M	5	1	6	0·158	F	...	+ 1·5	...
March 28	M	5	1	6	0·135	F	...	+ 1·3	...
August 1	M	5	1	6	0·122	F	...	+ 1·4	...
September 26	M	5	1	6	0·182	F	...	− 0·1	...
ROTATION OF SATURN'S RING. Displacement between the W. and E. Ansæ.									
March 5	M	5	1	1° 30′	0·160	b_1	...	+ 37·0	...
Calculated relative motion, W.—E. Ansa, + 20·1 miles per second.									

OBSERVATIONS of the SPECTRA of χ CYGNI, URANUS, R ANDROMEDÆ, and of COMET *c* 1889.

χ CYGNI.

1889, June $3^{d.}$ $21^{h.}$ $30^{m.}$ to June $4^{d.}$ $2^{h.}$ $0^{m.}$

Single-prism Spectroscope.

Observer, M.

The spectrum of this star was examined with great care and compared with the spectrum of hydrogen as given by a vacuum tube, and that of carbon as given by a Bunsen flame.

No bright lines were distinctly made out. The spectrum was simply a very fine example of Secchi's Third Type; bands VII. and VIII. (of Dunér's numeration), and to a less degree band IX. also, being particularly dark, distinct, and broad. Bands I., II., and III. were also distinctly seen. The spectrum could be traced for a great distance in both directions, beginning considerably below Hα or C, and extending a good way above Hγ, the hydrogen line in the early violet. The red end of the spectrum was bright, the violet end rather faint.

C and F were *not* present as bright lines. There was some uncertainty about the third line of hydrogen, and a bright spot of light, at or near its place, was occasionally suspected, but the region of the violet was faint.

D_3 was not recognised as a bright line. There was a very distinct brightening of the spectrum above Band III., but the measures show that Band III. extended further towards the blue than the place of D_3; and since this brightening was above Band III. it was necessarily further still from D_3. It was moreover not a sharp narrow line,—the appearance D_3 always presents,—but a broad diffused band. It may therefore easily have been a mere effect of contrast, or a local brightening of the continuous spectrum.

The spectrum between bands III. and VII. was very bright and almost free from absorption bands. Those that were present were narrow and faint.

The close correspondence as to position of the green and blue bands of the hydrocarbon spectrum with two of the bright zones or interspaces of the stellar spectrum was very apparent. No such correspondence was evident in the case of the yellow band.

No cylindrical lens used.

The following two sets of measures of the more refrangible edges of the principal dark shaded bands as compared with the α, β, and γ lines of hydrogen were obtained:—

WAVE-LENGTH EXPRESSED IN TENTH-METRES.

Dunér's Numeration.	First Series.	Second Series.	Mean.
I.	6487	...	6487
II.	6156	...	6156
III.	5850	...	5850
A local brightening	5822	5824	5823
V.	5447	...	5447
VII.	5172	5167	5170
VIII.	4961	4957	4959
IX.	4776	4755	4766

URANUS.

1889, June 17.

Single-prism Spectroscope.

Observer, M.

The planet was low and in a good deal of mist and the spectrum therefore was very faint. A cylindrical lens was tried at first but was finally discarded as it made the spectrum too faint for work. Without it the spectrum was not too faint for some features to be made out, but only the most prominent could be detected. The spectrum was traced from about λ 6200 to about λ 4600. The spectrum was brightest between D and F, declining rapidly in brightness outside those limits. Between D and F it varied much in brightness. Two dark bands were measured, of these the less refrangible was much the more distinct. A little above this line was an ill-defined bright region which seemed to consist of two diffused bright bands; but these may easily have been due to an effect of contrast. An attempt was made to determine the places of these two supposed bright bands.

WAVE-LENGTH EXPRESSED IN TENTH-METRES.

Object Observed.	First Measure.	Second Measure.	Third Measure.	Fourth Measure.	Mean.
Darkest line	5410	5428	5419	5428	5419
Bright band	5319	5339	5350	...	5336
Bright band	5269	5282	5276	...	5276
Dark line ...	4867	4865	4865	...	4866

Other irregularities in the brightness of the continuous spectrum were suspected on either side of the principal dark line, but the spectrum, as the planet sank down lower in the sky, became too faint for further work.

R ANDROMEDÆ.

1889, September 30.

Single-prism Spectroscope.

Observer, M.

The spectrum was full of very marked contrasts, and consisted either of brilliant bright lines on a feebler continuous spectrum, or else of bright interspaces between dark absorption bands. But the spectrum was so faint, and was so frequently lost in cloud, that it was found impossible to hold it long enough for proper study.

1889, October 19.

Single-prism Spectroscope.

Observer, M.

The contrasts in the spectrum were much less strongly marked than on September 30. There was a bright line at or near F, and another at or near D_2. Nothing was seen at C; but a bright line was suspected in the green, supposed at first to be near E, but a measure proved it to be really situated above *b*. The spectrum appeared to be bright from about λ 5,700 to about F, with but little to mark it either in the way of bright or dark bands, and it faded away very rapidly beyond these limits.

The spectrum was very faint even when observed in a perfectly clear region of the sky, but the observations were further hindered by the constant passage of light clouds.

The following measures were obtained of the position of two of the bright lines in the stellar spectrum as compared with the spectrum of hydrogen. A cylindrical lens was used in front of the slit whilst the measures were being made.

	Wave length, tenth-metres.
Brightest line in the star, probably F	4872
A very feeble bright line	5136

COMET *e* 1889 (DAVIDSON).

1889, August 29.

Single-prism Spectroscope.

Observer, M.

The comet was fairly bright but its spectrum was found difficult of observation. It was almost purely continuous, not only from the nucleus, but also from the coma generally and the tail. Nevertheless one bright band in the green could be distinctly made out when the slit was opened very widely. It coincided nearly, if not exactly, with the green band of the hydrocarbon spectrum, but it was not found possible to obtain any measures of its position.

ROYAL OBSERVATORY, GREENWICH.

MEASURES OF POSITIONS AND AREAS

OF

SUN SPOTS AND FACULÆ

ON

PHOTOGRAPHS

TAKEN WITH THE

PHOTOHELIOGRAPHS

AT GREENWICH, IN INDIA, AND IN MAURITIUS,

WITH THE DEDUCED

HELIOGRAPHIC LONGITUDES AND LATITUDES.

1889.

MEASURES of POSITIONS and AREAS of SUN SPOTS and FACULÆ on PHOTOGRAPHS taken at the ROYAL OBSERVATORY, GREENWICH, at DEHRA DÚN in INDIA, and at the ROYAL ALFRED OBSERVATORY, MAURITIUS, in the Year 1889.

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 1d. 0h.

For convenience of reference the Month and Day of the Month (Civil Reckoning) are added.

The letter I. signifies that the photograph was taken in India; the letter M. that the photograph was taken in Mauritius; 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.

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).
1889.				°	°	°			
0d·271									
I.									
Jan. 1		Centre			(136·8)	(−3·3)	(0)	(0)	(0)
1·213									
I.									
Jan. 2		Centre			(124·5)	(−3·4)	(0)	(0)	(0)
2·217	ST,M		0·893	261·0	174·4	−9·6			26
I.									
Jan. 3		Centre			(111·2)	(−3·6)	(0)	(0)	(26)
3·248									
I.									
Jan. 4		Centre			(97·6)	(−3·7)	(0)	(0)	(0)
4·390	ST,M		0·932	92·9	14·3	−4·1			133
I.									
Jan. 5		Centre			(82·6)	(−3·8)	(0)	(0)	(133)
5·267	ST,M		0·768	93·3	20·9	−5·1			48
I.			0·960	94·1	357·3	−5·0			451
Jan. 6		Centre			(71·0)	(−3·9)	(0)	(0)	(499)
6·221	ST,M		0·857	94·2	359·6	−5·6			322
			0·901	88·1	354·5	0·0			30
I.			0·930	96·7	350·0	−7·7			261
Jan. 7		Centre			(58·5)	(−4·0)	(0)	(0)	(613)
7·317	ST,M		0·806	96·9	350·4	−8·0			207
I.			0·884	99·5	341·9	−10·3			39
Jan. 8		Centre			(44·1)	(−4·1)	(0)	(0)	(246)
1889.									
8d·217	ST,M		0·906	287·7	94·8	+14·0			44
I.			0·676	97·4	349·8	−8·1			302
Jan. 9		Centre			(32·2)	(−4·2)	(0)	(0)	(346)
9·194									
M.									
Jan. 10		Centre			(19·3)	(−4·3)	(0)	(0)	(0)
10·486									
Jan. 11		Centre			(2·4)	(−4·4)	(0)	(0)	(0)
11·348									
I.									
Jan. 12		Centre			(351·0)	(−4·5)	(0)	(0)	(0)
12·326									
I.									
Jan. 13		Centre			(338·1)	(−4·6)	(0)	(0)	(0)
13·349									
I.									
Jan. 14		Centre			(324·6)	(−4·7)	(0)	(0)	(0)
15·382	ST,M		0·918	266·5	4·5	−5·1			175
			0·902	261·2	2·4	−10·0			29
I.			0·829	262·9	353·9	−8·6			31
			0·822	267·2	353·1	−5·1			89
		2080	0·483	60·0	272·8	+9·5	2	21	
		2080	0·517	60·8	270·6	+10·2	2	20	
Jan. 16		Centre			(297·8)	(−4·9)	(4)	(41)	(324)
16·366	ST,M		0·986	265·7	365·4	−5·1			117
			0·918	262·2	351·7	−9·1			164
I.		2080	0·318	37·8	273·5	+9·6	7	18	

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 longitude and latitude of the centre of the disk are given in brackets.

The Areas of Spots and Faculæ are expressed in millionths of the Sun's visible Hemisphere.

Group 2080, 1889, Jan. 16–17. Four small spots, measured in two pairs on Jan. 16. Three small spots on Jan. 17.

Measures of Positions and Areas of Sun Spots and Faculæ on Photographs—*continued.*

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).
1889.				°	°	°				1889.				°	°	°			
16^{d}·366	ST,M	2080	0·357	40·1	271·4	+10·9	2	13		28^{d}·196									
I.		2080	0·383	42·4	269·7	+11·5	0	1		M.									
Jan. 17		Centre			(284·9)	(−5·0)	(9)	(32)	(281)	Jan. 29		Centre			(129·2)	(−6·0)	(0)	(0)	(0)
17·318	ST,M		0·979	260·5	351·1	−10·3			102										
I.										29·201									
Jan. 18		Centre			(272·4)	(−5·1)	(0)	(0)	(102)	M.									
18·515										Jan. 30		Centre			(115·9)	(−6·1)	(0)	(0)	(0)
Jan. 19		Centre			(256·6)	(−5·2)	(0)	(0)	(0)										
										30·535									
19·234										Jan. 31		Centre			(98·3)	(−6·1)	(0)	(0)	(0)
Jan. 20		Centre			(247·1)	(−5·3)	(0)	(0)	(0)	31·341	ST,M		0·938	256·7	158·2	−14·6			98
												2081	0·812	89·2	33·6	− 3·0	0	11	
20·189	ST,M		0·900	239·1	297·5	−30·0			17	I.		2081	0·841	88·2	30·8	− 1·9	7	22	138 *c*
I.			0·952	100·7	162·0	−11·8			41				0·973	92·2	11·1	− 3·6			154
			0·972	103·4	157·5	−14·3			171	Feb. 1		Centre			(87·8)	(−6·2)	(7)	(33)	(390)
Jan. 21		Centre			(234·6)	(−5·4)	(0)	(0)	(229)										
21·186	ST,M		0·813	281·9	274·4	+ 6·3			43	32·447	ST,M	2081	0·631	87·8	34·2	− 3·5	14	59	
I.			0·897	102·2	157·3	−13·4			164			2081	0·671	87·6	31·2	− 3·1	0	10	
Jan. 22		Centre			(221·4)	(−5·5)	(0)	(0)	(207)			2081	0·678	86·2	30·8	− 2·0	5	42	
													0·882	91·2	11·3	− 4·0			161
22·179													0·907	84·6	8·8	+ 2·2			24
M.													0·965	95·1	358·1	− 6·5			56
Jan. 23		Centre			(208·3)	(−5·5)	(0)	(0)	(0)	Feb. 2		Centre			(73·2)	(−6·3)	(19)	(111)	(241)
										33·542	ST,M	2081	0·427	87·1	33·6	− 4·5	10	57	
23·203												2081	0·471	84·5	30·9	− 3·0	5	24	
I.												2081*a*	0·475	86·9	30·5	− 4·1	0	32	
Jan. 24		Centre			(194·9)	(−5·6)	(0)	(0)	(0)	Feb. 3		Centre			(58·8)	(−6·3)	(15)	(113)	(0)
24·349																			
I.										34·204	ST,M	2081	0·308	82·8	32·3	− 3·9	5	38	
Jan. 25		Centre			(179·8)	(−5·7)	(0)	(0)	(0)			2081	0·331	79·6	31·2	− 2·6	1	9	
										I.		2081*a*	0·334	83·1	30·8	− 3·7	2	26	
25·425													0·844	98·3	352·2	−10·4			92
Jan. 26		Centre			(165·7)	(−5·8)	(0)	(0)	(0)				0·972	50·3	342·5	+36·1			71
										Feb. 4		Centre			(50·1)	(−6·4)	(8)	(73)	(163)
26·456																			
Jan. 27		Centre			(152·1)	(−5·9)	(0)	(0)	(0)	35·307	ST,M	2081	0·043	28·4	34·3	− 4·3	0	2	
												2081*a*	0·082	54·4	31·7	− 3·8	2	20	
27·461										I.			0·959	7·5	17·9	+65·5			43
Jan. 28		Centre			(138·8)	(−5·9)	(0)	(0)	(0)	Feb 5.		Centre			(35·5)	(−6·5)	(2)	(22)	(43)

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 longitude and latitude of the centre of the disk are given in brackets.
The Areas of Spots and Faculæ are expressed in millionths of the Sun's visible Hemisphere.

Group 2081, Feb. 1–6. Two small spots on Feb 1. A number of small spots measured in three clusters on Feb. 2. The group undergoes frequent changes on the succeeding days. The following cluster, *a*, remains however fairly persistent, on Feb. 3, 4, 5, and 6. On Feb. 6 its component spots are measured separately.

Measures of Positions and Areas of Sun Spots and Faculæ on Photographs—*continued.*

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).
1889.				°	°	°				1889.				°	°	°			
36^{d}·196	ST,M	2081	0·144	286·3	31·7	— 4·1	0	2		47^{d}·522									
I.		2081	0·143	290·7	31·5	— 3·5	0	3		Feb. 17		Centre			(234·7)	(−7·0)	(0)	(0)	(0)
		2081	0·138	282·3	31·5	— 4·7	0	1		48·461									
Feb. 6		Centre			(23·8)	(−6·5)	(0)	(6)	(0)	Feb. 18		Centre			(222·3)	(−7·0)	(0)	(0)	(0)
37·565										49·321									
Feb. 7		Centre			(5·7)	(−6·6)	(0)	(0)	(0)	I.									
38·318										Feb. 19		Centre			(210·9)	(−7·1)	(0)	(0)	(0)
I.										50·173									
Feb. 8		Centre			(355·9)	(−6·6)	(0)	(0)	(0)	I.									
39·516										Feb. 20		Centre			(199·8)	(−7·1)	(0)	(0)	(0)
Feb. 9		Centre			(340·1)	(−6·7)	(0)	(0)	(0)	51·427	ST,M		0·945	194·2	230·5	−71·6			58
40·179										I.			0·939	86·6	113·9	+ 0·7			40
M.										Feb. 21		Centre			(183·3)	(−7·1)	(0)	(0)	(98)
Feb. 10		Centre			(331·3)	(−6·7)	(0)	(0)	(0)	52·490	ST,M	2082	0·849	94·7	110·8	— 7·7	6	24	
41·219	ST,M		0·980	266·1	36·4	— 5·1			84			2082	0·884	93·7	106·8	— 6·6	0	8	
I.			0·909	263·5	23·4	— 8·7			23	Feb. 22		Centre			(169·2)	(−7·1)	(6)	(32)	(0)
			0·837	267·6	14·7	— 5·7			81										
Feb. 11		Centre			(317·7)	(−6·8)	(0)	(0)	(188)	53·415	ST,M	2082	0·700	92·9	112·5	— 7·2	10	36	
												2082	0·760	92·5	107·4	— 6·6	0	11	52c
42·260	ST,M		0·948	267·8	15·4	— 4·2			206	Feb. 23		Centre			(157·1)	(−7·2)	(10)	(47)	(52)
I																			
Feb. 12		Centre			303·9	(−6·8)	(0)	(0)	(206)	55·264	ST,M	2082	0·321	86·6	114·0	— 5·7	0	9	
												2082	0·331	87·6	113·4	— 6·0	2	13	
43·195	ST,M		0·897	265·8	355·6	— 6·8			86	I.		2082	0·376	92·7	110·6	— 5·6	0	3	
I.			0·855	140·5	240·6	−45·7			87			2082	0·413	90·9	108·2	— 6·9	0	8	
Feb. 13		Centre			(291·6)	(−6·9)	(0)	(0)	(173)	Feb. 25		Centre			(132·7)	(−7·2)	(2)	(33)	(0)
44·243										56·430	ST,M	2082	0·059	66·5	114·2	— 5·8	0	3	
I.												2082	0·076	92·0	112·9	— 7·3	0	2	
												2082	0·092	97·7	112·0	— 7·9	0	15	
Feb. 14		Centre			(277·9)	(−6·9)	(0)	(0)	(0)			2082	0·111	92·4	110·9	— 7·4	0	6	
												2082	0·129	86·1	109·9	— 7·6	0	11	
45·514												2082	0·152	92·2	108·5	— 7·4	0	4	
Feb. 15		Centre			(261·1)	(−7·0)	(0)	(0)	(0)	Feb. 26		Centre			(117·3)	(−7·2)	(0)	(41)	(0)
46·136										57·437	ST,M	2082	0·172	265·1	114·1	— 7·9	6	18	
M.										I.		2082	0·149	272·4	112·8	— 7·4	13	47	
Feb. 16		Centre			(252·9)	(−7·0)	(0)	(0)	(0)			2082	0·097	267·9	109·8	— 7·4	17	82	
										Feb. 27		Centre			(104·2)	(−7·2)	(36)	(147)	(0)

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The Areas of Spots and Faculæ are expressed in millionths of the Sun's visible Hemisphere.

Group 2082, Feb. 22–March 2. Two small spots on Feb. 22. Two clusters of small spots on Feb. 23, which have broken up by Feb. 25. The group undergoes frequent changes on the succeeding days. It has greatly increased both in total area and number of separate spots by Feb. 27, but diminishes rapidly after that day.

Measures of Positions and Areas of Sun Spots and Faculæ on Photographs—*continued*.

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).
1889.				°	°	°			
58d·581	ST, M	2082	0·430	268·3	114·5	− 7·2	5	26	
		2082	0·410	271·6	113·2	− 6·0	2	6	
		2082	0·353	267·1	109·7	− 7·7	12	62	
Feb. 28		Centre			(89·0)	(−7·2)	(19)	(94)	(0)
59·471	ST, M	2082	0·610	267·9	115·0	− 7·0	4	31	
		2082	0·538	267·2	110·0	− 7·6	6	30	
			0·868	93·8	16·8	− 6·9			26
			0·892	130·2	16·6	−38·8			31
Mar. 1		Centre			(77·3)	(−7·2)	(10)	(61)	(57)
60·239	ST, M	2082	0·733	266·6	114·4	− 7·4	2	15	
		2082	0·675	266·6	109·7	− 7·7	1	13	347 *c*
I.			0·913	133·3	3·6	−42·2			24
			0·945	96·1	355·7	− 8·1			88
Mar. 2		Centre			(67·1)	(−7·3)	(3)	(28)	(459)
61·506	ST, M		0·881	267·1	112·5	− 6·0			478
Mar. 3		Centre			(50·5)	(−7·3)	(0)	(0)	(478)
62·473	ST, M		0·961	265·4	112·1	− 6·4			166
Mar. 4		Centre			(37·8)	(−7·3)	(0)	(0)	(166)
63·498	ST, M	2083	0·945	95·5	312·8	− 7·6	0	9	84 *f*
Mar. 5		Centre			(24·2)	(−7·3)	(0)	(9)	(84)
64·493	ST, M	2083	0·839	93·5	313·8	− 6·9	2	24	25 *c*
			0·883	94·2	308·8	− 7·1			41
Mar. 6		Centre			(11·1)	(−7·3)	(2)	(24)	(66)
65·217	ST, M	2083	0·734	91·7	314·2	− 6·1	3	23	53 *f*
I.			0·801	93·4	308·2	− 7·0			72
Mar. 7		Centre			(1·6)	(−7·2)	(3)	(23)	(125)
66·164	ST, M	2083*a*	0·552	90·0	315·5	− 6·0	2	18	
		2083	0·570	91·1	314·2	− 6·6	0	4	
I.		2083	0·594	92·0	312·5	− 7·0	0	2	
Mar. 8		Centre			(349·1)	(−7·2)	(2)	(24)	(0)
67·462	ST, M	2083*a*	0·270	89·7	316·3	− 6·9	7	28	
Mar. 9		Centre			(332·0)	(−7·2)	(7)	(28)	(0)
1889.				°	°	°			
68d·393	ST, M		0·958	267·5	33·2	− 4·5			93
			0·865	264·4	19·9	− 8·4			77
I.		2083*a*	0·041	88·3	317·3	− 7·1	6	27	
			0·906	174·5	303·9	−71·4			38
Mar. 10		Centre			(319·7)	(−7·2)	(6)	(27)	(208)
69·487	ST, M	2083*a*	0·225	267·5	318·3	− 7·6	2	14	
		2083	0·170	272·3	315·1	− 6·7	0	4	
Mar. 11		Centre			(305·3)	(−7·2)	(2)	(18)	(0)
70·392	ST, M	2084	0·965	267·0	8·4	− 4·7	0	13	192 *p*
		2083*a*	0·437	266·1	319·4	− 8·1	6	15	
I.		2083	0·393	268·0	316·6	− 7·4	2	9	
		2083	0·354	269·3	314·2	− 6·9	0	2	
Mar. 12		Centre			(293·4)	(−7·2)	(8)	(39)	(192)
71·256	ST, M	2083*a*	0·622	265·3	320·6	− 8·5	3	11	
		2083	0·577	266·8	317·4	− 7·7	0	2	
I.		2085	0·484	294·6	308·1	+ 5·1	7	25	
		2085	0·462	296·0	306·5	+ 5·1	0	4	
		2085	0·456	300·8	305·1	+ 6·9	7	23	
		2085	0·436	298·9	304·5	+ 5·5	0	4	
Mar. 13		Centre			(282·0)	(−7·2)	(17)	(69)	(0)
72·517	ST, M	2083*a*	0·827	265·1	321·5	− 8·1	0	11	
		2085*a*	0·744	284·9	311·5	+ 6·1	3	48	55 *c*
		2085*b*	0·672	288·9	305·1	+ 7·1	4	62	
Mar. 14		Centre			(265·4)	(−7·1)	(7)	(121)	(55)
73·282	ST, M		0·867	264·1	315·8	− 8·6			68
		2083*a*	0·921	263·0	322·9	− 9·2	0	7	78 *n*
		2085*a*	0·860	281·1	313·1	+ 5·8	22	90	200 *c*
		2085*b*	0·784	284·1	305·0	+ 6·5	14	55	156 *s f*
Mar. 15		Centre			(255·3)	(−7·1)	(36)	(152)	(502)
74·555	ST, M	2085*a*	0·971	278·5	313·4	+ 6·5	23	155	336 *c*
		2085	0·964	278·6	311·7	+ 6·3	0	11	
		2085*b*	0·925	280·4	304·6	+ 6·7	4	37	
Mar. 16		Centre			(238·5)	(−7·1)	(27)	(203)	(336)
75·391	ST, M	2085*b*	0·980	277·6	304·9	+ 6·0	0	36	160 *p*
I.			0·899	78·1	165·2	− 7·4			74
Mar. 17		Centre			(227·5)	(−7·1)	(0)	(36)	(234)

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The Areas of Spots and Faculæ are expressed in millionths of the Sun's visible Hemisphere.

Group 2083, March 5–15. A small spot on March 5 and 6. A cluster of small spots on March 7. On March 8 a small spot, *a*, with two very small companions. *a* is seen alone on March 9, 10, 14 and 15, but one or two very small companions are seen near it on the intervening days.
Group 2084, March 12. A small spot.
Group 2085, March 13–17. Four spots on March 13, of which only two remain by March 14. Of these the preceding spot, *a*, increases in size rapidly, and moves forward in longitude. A small spot is seen between *a* and *b* on March 16. Only *b* is seen on March 17.

Measures of Positions and Areas of Sun Spots and Faculæ on Photographs—*continued*.

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).
1889.				°	°	°				1889.				°	°	°			
76d·198										88d·182	ST,M		0·922	262·6	126·4	− 9·3			28
I.													0·903	260·0	123·9	−11·9			58
Mar. 18		Centre			(216·9)	(−7·0)	(0)	(0)	(0)	I.			0·857	261·9	118·1	−10·3			110
													0·931	189·8	90·0	−72·2			52
77·181													0·910	183·5	68·8	−71·4			100
I.													0·769	97·9	8·3	−10·3			52
Mar. 19		Centre			(203·9)	(−7·0)	(0)	(0)	(0)	Mar. 30		Centre			(58·8)	(−6·5)	(0)	(0)	(400)
78·189	ST,M		0·950	263·4	262·9	− 8·4			122	89·200									
I.			0·933	97·2	121·2	− 9·2			126	I.									
Mar. 20		Centre			(190·6)	(−7·0)	(0)	(0)	(248)	Mar. 31		Centre			(45·3)	(−6·5)	(0)	(0)	(0)
79·449	ST,M		0·919	94·8	106·9	− 7·1			155	90·659	ST,M	2086	0·952	82·7	314·8	+ 4·9	18	89	185 *c*
Mar. 21		Centre			(174·0)	(−6·9)	(0)	(0)	(155)	Apr. 1		Centre			(26·0)	(−6·4)	(18)	(89)	(185)
80·579										91·465	ST,M	2086	0·879	80·8	315·1	+ 5·0	18	101	196 *c*
Mar. 22		Centre			(159·1)	(−6·9)	(0)	(0)	(0)	Apr. 2		Centre			(15·5)	(−6·3)	(18)	(101)	(196)
81·485										92·292	ST,M	2086	0·774	77·6	315·3	+ 5·5	21	114	212 *f*
Mar. 23		Centre			(147·2)	(−6·9)	(0)	(0)	(0)	I.			0·852	73·2	308·6	+10·7			54
										Apr. 3		Centre			(4·5)	(−6·3)	(21)	(114)	(266)
82·200																			
I.										93·416	ST,M	2086	0·594	72·9	315·1	+ 5·0	16	97	
Mar. 24		Centre			(137·7)	(−6·8)	(0)	(0)	(0)	Apr. 4		Centre			(349·7)	(−6·2)	(16)	(97)	(0)
83·314										94·518	ST,M	2086	0·391	61·1	315·2	+ 5·1	12	91	
I.										Apr. 5		Centre			(335·2)	(−6·2)	(12)	(91)	(0)
Mar. 25		Centre			(123·0)	(−6·8)	(0)	(0)	(0)										
										95·523	ST,M	2086	0·232	30·4	315·3	+ 5·5	9	83	
84·284	ST,M		0·923	176·0	97·3	−73·3			61	Apr. 6		Centre			(322·0)	(−6·1)	(9)	(83)	(0)
I.			0·948	98·4	28·2	−10·1			61										
Mar. 26		Centre			(110·2)	(−6·7)	(0)	(0)	(122)	96·532	ST,M	2086	0·230	330·5	315·2	+ 5·5	13	82	
										Apr. 7		Centre			(308·7)	(−6·0)	(13)	(82)	(0)
85·183	ST,M		0·945	32·8	47·8	+48·5			30										
			0·957	98·2	24·6	− 9·8			46										
I.			0·978	93·8	20·2	− 5·1			81	97·186	ST,M		0·960	261·9	14·2	− 9·4			54
													0·943	259·0	11·2	−12·4			16
Mar. 27		Centre			(98·3)	(−6·7)	(0)	(0)	(157)	I.			0·917	277·2	5·6	+ 4·2			47
												2086	0·324	306·2	315·2	+ 5·2	11	53	
86·577	ST,M		0·890	94·4	16·9	− 7·0			85	Apr. 8		Centre			(300·0)	(−6·0)	(11)	(53)	(117)
Mar. 28		Centre			(80·0)	(−6·6)	(0)	(0)	(85)										
87·201	ST,M		0·756	92·5	22·4	− 6·3			151	98·330	ST,M		0·899	264·8	349·1	− 7·3			42
I.			0·846	94·0	13·7	− 6·9			194	I.		2086	0·538	290·1	315·2	+ 5·5	9	39	
Mar. 29		Centre			(71·7)	(−6·6)	(0)	(0)	(345)	Apr. 9		Centre			(284·8)	(−5·9)	(9)	(39)	(42)

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Group 2086. April 1–11. A regular spot.

Measures of Positions and Areas of Sun Spots and Faculæ on Photographs—*continued*.

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 Longitude.	Heliographic Latitude.	Spots. Area of UMBRA for each Spot (and for Day).	Spots. Area of WHOLE for each Spot (and for Day).	Faculæ. Area for each Group (and for Day).
1889.				°	°	°			
99d·203	ST,M	2086	0·683	285·0	314·7	+ 5·8	2	22	
M.									
Apr. 10		Centre			(273·3)	(−5·8)	(2)	(22)	(0)
100·246	ST,M	2086	0·839	280·0	315·4	+ 5·2	0	7	255 *c*
		2087	0·818	87·7	204·9	− 1·4	0	8	
I.		2087	0·843	87·7	202·3	− 1·2	0	15	236 *c*
Apr. 11		Centre			(259·5)	(−5·7)	(0)	(30)	(491)
101·307	ST,M		0·938	277·8	314·2	+ 5·2			188
			0·899	284·5	307·5	+10·4			105
I.		2087	0·683	85·3	202·8	− 1·0	1	7	
			0·894	70·4	185·2	+14·7			78
Apr. 12		Centre			(245·5)	(−5·7)	(1)	(7)	(371)
102·207	ST,M		0·992	275·5	315·7	+ 4·7			152
I.			0·973	278·5	309·3	+ 6·9			47
Apr. 13		Centre			(233·7)	(−5·6)	(0)	(0)	(199)
103·223									
I.									
Apr. 14		Centre			(220·2)	(−5·5)	(0)	(0)	(0)
104·403									
I.									
Apr. 15		Centre			(204·7)	(−5·4)	(0)	(0)	(0)
105·205									
I.									
Apr. 16		Centre			(194·1)	(−5·3)	(0)	(0)	(0)
106·193									
I.									
Apr. 17		Centre			(181·1)	(−5·2)	(0)	(0)	(0)
107·314									
I.									
Apr. 18		Centre			(166·2)	(−5·2)	(0)	(0)	(0)
108·471									
Apr. 19		Centre			(151·0)	(−5·1)	(0)	(0)	(0)

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 Longitude.	Heliographic Latitude.	Spots. Area of UMBRA for each Spot (and for Day).	Spots. Area of WHOLE for each Spot (and for Day).	Faculæ. Area for each Group (and for Day).
1889.				°	°	°			
109d·226									
I.									
Apr. 20		Centre			(141·0)	(−5·0)	(0)	(0)	(0)
110·516									
Apr. 21		Centre			(124·0)	(−4·9)	(0)	(0)	(0)
111·431									
Apr. 22		Centre			(111·9)	(−4·8)	(0)	(0)	(0)
112·250	ST,M		0·933	96·7	31·9	− 8·1			46
I.									
Apr. 23		Centre			(101·1)	(−4·7)	(0)	(0)	(46)
113·229									
I.									
Apr. 24		Centre			(88·1)	(−4·6)	(0)	(0)	(0)
114·175									
I.									
Apr. 25		Centre			(75·6)	(−4·5)	(0)	(0)	(0)
115·529									
Apr. 26		Centre			(57·7)	(−4·4)	(0)	(0)	(0)
116·491									
Apr. 27		Centre			(45·0)	(−4·3)	(0)	(0)	(0)
117·679									
Apr. 28		Centre			(29·4)	(−4·2)	(0)	(0)	(0)
118·485									
Apr. 29		Centre			(18·7)	(−4·1)	(0)	(0)	(0)
119·334									
I.									
Apr. 30		Centre			(7·4)	(−4·0)	(0)	(0)	(0)
120·221									
I.									
May 1		Centre			(355·7)	(−3·9)	(0)	(0)	(0)

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Group 2087, April 11–12. Four very small spots measured in two pairs on April 11. Only one spot remains on April 12.

Measures of Positions and Areas of Sun Spots and Faculæ on Photographs—*continued.*

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).
1889.				°	°	°				1889.				°	°	°			
121d·232										133d·347									
I.										I.									
May 2		Centre			(342·3)	(−3·8)	(0)	(0)	(0)	May 14		Centre			(182·1)	(−2·5)	(0)	(0)	(0)
122·614										134·458									
May 3		Centre			(324·1)	(−3·7)	(0)	(0)	(0)	May 15		Centre			(167·5)	(−2·4)	(0)	(0)	(0)
123·528										135·435	ST,M		0·836	268·3	211·2	− 2·7			628
May 4		Centre			(312·0)	(−3·6)	(0)	(0)	(0)	May 16		Centre			(154·6)	(−2·3)	(0)	(0)	(628)
124·644	ST,M	2088	0·985	91·2	217·4	− 1·9	0	126	82 *f*	136·658	ST,M		0·949	266·5	209·8	− 4·0			551
May 5		Centre			(297·3)	(−3·5)	(0)	(126)	(82)	May 17		Centre			(138·3)	(−2·2)	(0)	(0)	(551)
125·461	ST,M	2088	0·934	90·3	217·6	− 1·5	20	121	160 *f*	137·552	ST,M		0·985	267·0	206·4	− 3·3			118
May 6		Centre			(286·4)	(−3·4)	(20)	(121)	(160)	May 18		Centre			(126·5)	(−2·0)	(0)	(0)	(118)
126·526	ST,M	2088	0·824	89·6	217·1	− 1·6	30	100	461 *f*	138·228									
May 7		Centre			(272·4)	(−3·3)	(30)	(100)	(461)	I.									
127·471	ST,M	2088	0·676	88·3	217·6	− 1·2	8	41		May 19		Centre			(117·6)	(−1·9)	(0)	(0)	(0)
		2088	0·719	90·9	214·1	− 2·9	0	12		139·510									
May 8		Centre			(259·9)	(−3·2)	(8)	(53)	(0)	May 20		Centre			(100·7)	(−1·8)	(0)	(0)	(0)
128·201	ST,M	2088	0·543	87·3	217·5	− 1·2	3	15											
M.		2088	0·564	88·6	216·0	− 1·8	0	3		140·422									
May 9		Centre			(250·2)	− 3·1	(3)	(18)	(0)	May 21		Centre			(88·5)	(−1·7)	(0)	(0)	(0)
129·495	ST,M	2088	0·244	79·8	219·3	− 0·5	0	5		141·441									
		2088	0·258	82·8	218·3	− 1·1	0	7		May 22		Centre			(75·1)	(−1·6)	(0)	(0)	(0)
May 10		Centre			(233·1)	(−3·0)	(0)	(12)	(0)										
										142·407									
130·137										May 23		Centre			(62·3)	(−1·5)	(0)	(0)	(0)
I.																			
May 11		Centre			(224·5)	(−2·8)	(0)	(0)	(0)	143·356									
										May 24		Centre			(49·7)	(−1·3)	(0)	(0)	(0)
131·192																			
M.																			
May 12		Centre			(210·6)	(−2·7)	(0)	(0)	(0)	144·427									
										May 25		Centre			(35·6)	(−1·2)	(0)	(0)	(0)
132·344		.	0·972	256·5	271·7	−13·7			63										
I.										145·259									
May 13		Centre			(195·4)	(−2·6)	(0)	(0)	(63)	May 26		Centre			(24·6)	(−1·1)	(0)	(0)	(0)

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 longitude and latitude of the centre of the disk are given in brackets.
The Areas of Spots and Faculæ are expressed in millionths of the Sun's visible Hemisphere.

Group 2088, May 5–10. A regular spot on May 5, 6, and 7. It has broken up into a stream of small spots by May 8.

Measures of Positions and Areas of Sun Spots and Faculæ on Photographs—*continued.*

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 Longitude.	Heliographic Latitude.	Spots. Area of UMBRA for each Spot (and for Day).	Spots. Area of WHOLE for each Spot (and for Day).	Faculæ. Area for each Group (and for Day).
1889.				°	°	°			
146d·218	ST,M	2089	0·211	242·8	22·6	− 6·5	4	9	
		2089	0·192	231·9	20·5	− 7·8	0	8	
I.			0·956	180·9	14·8	−73·5			85
			0·910	172·5	355·4	−65·1			26
May 27		Centre			(11·8)	(−1·0)	(4)	(17)	(111)
147·496									
May 28		Centre			(354·9)	(−0·9)	(0)	(0)	(0)
148·407									
May 29		Centre			(342·9)	(−0·7)	(0)	(0)	(0)
149·413									
May 30		Centre			(329·6)	(−0·6)	(0)	(0)	(0)
150·514									
May 31		Centre			(315·0)	(−0·5)	(0)	(0)	(0)
151·405									
June 1		Centre			(303·2)	(−0·4)	(0)	(0)	(0)
152·442	ST,M		0·946	184·2	301·7	−70·8			176
June 2		Centre			(289·6)	(−0·3)	(0)	(0)	(176)
153·436	ST,M		0·886	95·8	214·2	− 5·2			226
June 3		Centre			(276·3)	(−0·1)	(0)	(0)	(226)
154·490									
June 4		Centre			(262·4)	(0·0)	(0)	(0)	(0)
155·399									
June 5		Centre			(250·4)	(+0·1)	(0)	(0)	(0)
156·510									
June 6		Centre			(235·7)	(+0·3)	(0)	(0)	(0)
157·430									
June 7		Centre			(223·5)	(+0·4)	(0)	(0)	(0)
158·128									
I.									
June 8		Centre			(214·1)	(+0·5)	(0)	(0)	(0)
1889.									
159d·227									
I.									
June 9		Centre			(199·7)	(+0·6)	(0)	(0)	(0)
160·206									
M.									
June 10		Centre			(186·8)	(+0·7)	(0)	(0)	(0)
161·412									
I.									
June 11		Centre			(170·8)	(+0·8)	(0)	(0)	(0)
162·280	ST,M		0·916	270·4	225·4	+ 0·8			36
			0·905	261·4	223·5	− 7·4			21
I.			0·885	266·1	221·2	− 3·0			139
	*		0·816	260·4	213·3	− 7·3			66
			0·783	266·6	210·6	− 2·0			44
			0·829	51·8	109·7	+31·4			41
June 12		Centre			(159·3)	(+1·0)	(0)	(0)	(347)
163·373	ST,M		0·964	266·6	219·1	− 3·0			99
I.			0·928	260·9	212·4	− 8·0			120
			0·908	266·3	209·8	− 2·9			106
June 13		Centre			(144·9)	(+1·1)	(0)	(0)	(325)
164·191	ST,M		0·981	264·3	212·3	− 5·4			126
I.									
June 14		Centre			(133·9)	(+1·2)	(0)	(0)	(126)
165·251									
I.									
June 15		Centre			(120·0)	(+1·3)	(0)	(0)	(0)
166·471	ST,M	2090*a*	0·965	96·5	29·6	− 5·8	91	447	
June 16		Centre			(103·9)	(+1·4)	(91)	(447)	(0)
167·398	ST,M	2090*a*	0·888	97·2	29·4	− 5·6	89	444	302 *c*
		2090*b*	0·947	96·2	20·7	− 5·4	3	101	259 *c*
June 17		Centre			(91·5)	(+1·6)	(92)	(545)	(561)
168·625	ST,M	2090*a*	0·725	99·7	29·7	− 5·8	91	450	173 *c*
		2090*b*	0·821	98·5	20·9	− 6·0	5	88	341 *c*
June 18		Centre			(75·4)	(+1·7)	(96)	(538)	(514)

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The Areas of Spots and Faculæ are expressed in millionths of the Sun's visible Hemisphere.

Group 2089, May 27. Three very small spots, of which two are measured together.
Group 2090, June 16–28. A large spot *a*, followed on June 17 by a cluster of smaller spots, *b*, at a considerable distance. *b* breaks up, and diminishes in size after June 20, and has disappeared by June 23. Several small spots are seen near *a* on June 21 and the succeeding days, but *a* is seen alone on June 25, 27, and 28.

Measures of Positions and Areas of Sun Spots and Faculæ on Photographs—*continued.*

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).
1889.				°	°	°				1889.				°	°	°			
169d·407	ST,M	2090*a*	0·582	102·6	30·0	— 5·8	83	449		176d·386	ST,M		0·834	255·4	27·6	—10·6			72
		2090	0·675	99·3	22·9	— 5·0	0	13				2090*a*	0·872	263·0	32·7	— 4·8	92	496	} 274*c*
		2090*b*	0·698	100·3	21·2	— 5·8	8	77				2090	0·843	264·1	29·5	— 3·5	0	6	
June 19		Centre			(64·7)	(+1·8)	(91)	(539)	(0)	June 26		Centre			(332·6)	(+2·6)	(92)	(502)	(346)
170·397	ST,M	2090*a*	0·388	110·0	30·3	— 5·8	85	434		177·443	ST,M	2090*a*	0·965	264·2	32·8	— 4·8	81	400	699 *c*
		2090	0·481	104·1	23·9	— 5·1	0	10		June 27		Centre			(318·6)	(+2·7)	(81)	(400)	(699)
		2090*b*	0·515	105·1	21·8	— 6·1	8	75											
June 20		Centre			(51·7)	(+1·9)	(93)	(519)	(0)	178·388	ST,M	2090*a*	0·999	264·5	33·0	— 5·4	0	287	280*f*
										June 28		Centre			(306·1)	(+2·8)	(0)	(287)	(280)
171·525	ST,M	2090*a*	0·172	141·3	30·8	— 5·8	87	509											
		2090	0·166	119·6	28·7	— 2·8	0	5		179·506	ST,M	2091	0·846	143·0	249·6	—40·3	0	1	
		2090	0·255	120·6	24·3	— 5·5	0	12					0·839	144·5	251·4	—40·7			65
		2090*b*	0·277	118·6	22·9	— 5·6	5	26					0·927	93·6	223·7	— 2·3			64
June 21		Centre			(37·0)	(+2·0)	(92)	(552)	(0)	June 29		Centre			(291·3)	(+2·9)	(0)	(1)	(129)
172·458	ST,M	2090	0·199	233·4	33·7	— 4·7	0	8		180·360	ST,M	2091	0·769	152·8	252·5	—40·3	0	8	
		2090	0·225	216·8	32·3	— 8·7	0	27					0·759	85·4	230·6	+ 5·5			70
		2090	0·140	237·8	31·3	— 2·2	0	4					0·842	95·3	223·1	— 2·8			62
		2090*a*	0·174	219·8	30·9	— 5·6	123	571					0·920	101·4	214·1	— 9·2			53
		2090	0·135	191·6	26·1	— 5·5	2	14		June 30		Centre			279·9	(+3·0)	(0)	(8)	(185)
		2090*b*	0·138	182·8	24·9	— 5·8	0	9											
June 22		Centre			(24·5)	(+2·1)	(125)	(633)	(0)	181·399									
										July 1		Centre			(266·2)	(+3·2)	(0)	(0)	(0)
173·521	ST,M	2090	0·409	242·6	31·9	— 8·6	0	15		182·513									
		2090*a*	0·384	249·8	31·6	— 5·5	102	468		July 2		Centre			(251·5)	(+3·3)	(0)	(0)	(0)
		2090	0·348	254·0	30·0	— 3·3	0	8											
		2090	0·350	247·6	29·4	— 5·4	0	26		183·245									
		2090	0·363	238·8	28·7	— 8·6	0	8		M.									
		2090	0·323	252·9	28·4	— 3·2	1	8		July 3		Centre			(241·7)	(+3·4)	(0)	(0)	(0)
		2090	0·321	234·7	25·8	— 8·5	0	7											
		2090	0·322	229·7	24·9	— 9·8	0	7		184·598									
June 23		Centre			(10·5)	(+2·3)	(103)	(547)	(0)	July 4		Centre			(223·9)	(+3·5)	(0)	(0)	(0)
										185·393									
174·589	ST,M	2090*a*	0·598	257·9	32·1	— 5·2	100	457		July 5		Centre			(213·3)	(+3·6)	(0)	(0)	(0)
		2090	0·561	261·0	29·9	— 3·0	0	11											
		2090	0·554	255·5	28·8	— 5·9	0	42		186·436									
June 24		Centre			(356·3)	(+2·4)	(100)	(510)	(0)	July 6		Centre			(199·5)	(+3·7)	(0)	(0)	(0)
										187·183									
175·420	ST,M	2090*a*	0·738	261·0	32·1	— 4·9	102	487		M.									
June 25		Centre			(345·3)	(+2·5)	(102)	(487)	(0)	July 7		Centre			(189·7)	(+3·8)	(0)	(0)	(0)

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The Areas of Spots and Faculæ are expressed in millionths of the Sun's visible Hemisphere.

Group 2091, June 29, 30. A very small faint spot.

Measures of Positions and Areas of Sun Spots and Faculæ on Photographs—*continued.*

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 Longitude.	Heliographic Latitude.	Spots. Area of UMBRA for each Spot (and for Day).	Spots. Area of WHOLE for each Spot (and for Day).	Faculæ. Area for each Group (and for Day).
1889.				°	°	°			
189^{d}·537	ST,M		0·906	268·4	223·2	+ 0·3			90
July 9		Centre			(158·5)	(+4·0)	(0)	(0)	(90)
190·209	ST,M		0·964	267·8	223·8	— 1·1			136
I.									
July 10		Centre			(149·6)	(+4·1)	(0)	(0)	(136)
191·444									
July 11		Centre			(133·2)	(+4·2)	(0)	(0)	(0)
192·514	ST,M	2092*a*	0·993	98·0	36·8	— 7·4	45	280	258*c*
July 12		Centre			(119·1)	(+4·3)	(45)	(280)	(258)
193·447	ST,M	2092*a*	0·948	98·9	36·5	— 7·0	55	332	525*c*
July 13		Centre			(106·8)	(+4·4)	(55)	(332)	(525)
194·291	ST,M	2093	0·323	131·3	81·3	— 8·0	1	2	
		2093	0·306	125·3	80·9	— 5·8	1	3	
I.		2092*a*	0·870	101·0	36·2	— 7·3	66	317	650*f*
July 14		Centre			(95·4)	(+4·5)	(68)	(322)	(650)
195·428	ST,M	2093	0·204	191·6	82·9	— 6·9	4	24	
		2093	0·223	185·6	81·8	— 8·2	0	3	
		2093	0·171	183·8	81·1	— 5·2	1	7	
		2093	0·221	179·2	80·3	— 8·1	4	18	
		2092	0·684	102·5	38·6	— 5·1	0	4	} 254*f*
		2092*a*	0·720	104·3	36·0	— 7·0	47	305	
		2092	0·755	105·5	33·3	— 8·5	0	13	
July 15		Centre			(80·5)	(+4·6)	(56)	(374)	(254)
196·437	ST,M	2093	0·363	233·9	84·3	— 7·8	5	27	
		2093	0·346	230·3	82·7	— 8·2	2	14	
		2093	0·332	224·1	80·7	— 9·2	6	23	
		2092	0·527	111·4	37·7	— 7·0	0	1	} 147*c*
		2092*a*	0·553	110·6	35·9	— 7·2	50	308	
		2092	0·564	106·8	34·5	— 5·4	0	2	
		2092	0·581	112·6	34·5	— 8·9	0	9	
July 16		Centre			(67·2)	(+4·7)	(63)	(384)	(147)
197·242	ST,M	2093	0·533	247·5	86·2	— 7·5	8	17	
		2093	0·512	246·8	84·7	— 7·4	0	14	
I.		2093	0·464	247·5	81·9	— 5·9	3	7	
		2093	0·482	240·4	81·5	— 9·4	3	7	
1889.				°	°	°			
197^{d}·242	ST,M	2093	0·466	239·8	80·5	— 9·2	5	10	
I.		2092*a*	0·410	122·3	36·1	— 8·1	53	325	
July 17		Centre			(56·5)	(+4·8)	(72)	(380)	(0)
198·204	ST,M	2093	0·706	253·8	86·8	— 7·8	5	24	
		2093	0·666	252·7	83·6	— 7·7	0	2	
I.		2093	0·657	249·3	82·2	— 9·6	0	5	
		2093	0·635	251·2	81·0	— 7·9	0	10	
		2093	0·629	249·0	80·1	— 9·1	0	3	
		2092	0·218	145·0	36·6	— 5·4	0	5	
		2092*a*	0·264	149·6	36·1	— 8·3	51	311	
		2092	0·250	140·7	34·7	— 6·3	0	2	
		2092	0·298	145·1	33·9	— 9·3	0	6	
July 18		Centre			(43·8)	(+4·9)	(56)	(368)	(0)
199·471	ST,M	2093	0·891	259·1	88·8	— 7·4	0	6	
		2092	0·266	225·9	38·1	— 5·9	6	44	
		2092*a*	0·281	215·5	36·6	— 8·4	63	313	
		2092	0·236	215·1	34·9	— 6·2	11	59	
July 19		Centre			(27·1)	(+4·9)	(80)	(422)	(0)
200·242	ST,M	2093	0·957	259·7	88·6	— 8·3	2	7	571*f*
		2092	0·406	243·2	38·1	— 5·9	12	50	
I.		2092*a*	0·407	235·3	36·5	— 8·6	45	295	
		2092	0·423	230·0	36·0	—11·0	0	6	
		2092	0·365	236·8	34·6	— 6·7	5	30	
		2092	0·395	228·5	34·2	—10·4	2	19	
July 20		Centre			(16·8)	(+5·0)	(66)	(407)	(571)
201·282	ST,M		0·986	260·3	82·2	— 8·6			191
		2092	0·605	253·3	38·6	— 5·9	0	4	
I.		2092	0·574	251·6	36·2	— 6·2	0	5	
		2092*a*	0·584	247·4	36·0	— 8·7	61	272	
		2092	0·549	248·7	34·0	— 7·1	3	30	
		2092	0·557	242·1	33·0	—10·7	0	10	
July 21		Centre			(3·1)	(+5·1)	(64)	(321)	(191)
202·342	ST,M		0·979	261·3	66·3	— 7·4			81
I.		2092*a*	0·757	253·9	36·3	— 8·6	51	257	381 *c*
July 22		Centre			(349·1)	(+5·2)	(51)	(257)	(462)
203·210	ST,M		0·794	256·5	28·5	— 7·4			241
I.		2092*a*	0·874	256·7	36·8	— 8·9	44	283	621 *c*
July 23		Centre			(337·6)	(+5·3)	(44)	(283)	(862)

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 longitude and latitude of the centre of the disk are given in brackets.

The Areas of Spots and Faculæ are expressed in millionths of the Sun's visible Hemisphere.

Group 2092, July 12–24. A regular spot *a*. A few very small spots are seen near it on July 15 and 16. On July 18 a fresh series of spots is seen near *a*. These increase in number and size on the succeeding days, and on July 20 and 21 form a semicircle with the nucleus of *a* for its centre. *a* remains alone on July 22 and the succeeding days.

Group 2093, July 14–20. Three very small spots on July 14 of which two are measured together. The group has greatly increased in size by July 15, and undergoes rapid changes of form on the succeeding days. Only one very small spot remains by July 19.

Measures of Positions and Areas of Sun Spots and Faculæ on Photographs—*continued.*

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).
				°	°	°			
1889.									
204^{d}·367	ST,M		0·940	266·9	31·8	−1·1			122
			0·921	261·0	28·2	−6·1			50
I.			0·918	247·4	25·2	−18·3			74
			0·907	253·8	25·0	−12·2			61
		2092	0·969	259·3	36·5	−8·9	36	235	190*c*
July 24		Centre			(322·2)	(+5·4)	(36)	(235)	(497)
206·398	ST,M	2094*a*	0·818	236·0	342·9	−23·5	7	25	
		2094	0·807	234·6	341·3	−24·0	0	4	90*c*
I.		2094	0·799	233·4	340·1	−24·5	0	9	
		2094*b*	0·802	231·8	339·6	−25·7	6	25	
			0·911	91·3	230·0	+ 1·1			57
July 26		Centre			(295·4)	(+5·5)	(13)	(63)	(147)
207·354	ST,M		0·848	294·7	339·9	+23·8			38
		2094*a*	0·919	241·6	344·2	−23·3	19	54	80*c*
I.		2094*b*	0·893	237·6	339·3	−25·5	0	15	79*c*
July 27		Centre			(282·8)	(+5·6)	(19)	(69)	(197)
209·454	ST,M	2095	0·654	271·1	295·8	+ 5·0	11	44	
		2095	0·607	270·2	292·4	+ 4·7	5	18	
		2096	0·804	95·9	202·1	− 1·3	5	29	
		2096	0·866	94·1	195·5	− 0·7	0	7	216*c*
July 29		Centre			(255·0)	(+5·7)	(21)	(98)	(216)
210·397	ST,M	2095	0·811	271·8	296·7	+ 4·8	3	19	
		2095	0·765	269·5	292·3	+ 3·3	1	17	
		2096	0·651	97·8	202·5	− 0·7	9	26	
		2096	0·723	97·6	196·9	− 1·5	0	4	
July 30		Centre			(242·5)	(+5·8)	(13)	(66)	(0)
211·390	ST,M	2095	0·909	272·2	294·8	+ 4·5	0	6	307*c*
		2096	0·460	101·5	202·7	0·0	0	15	
		2096	0·484	103·2	201·4	− 1·2	0	17	
		2096	0·493	99·1	200·4	+ 0·8	0	6	
		2096	0·517	99·5	198·9	+ 0·2	13	42	
		2096	0·532	101·8	198·1	− 1·2	2	11	
July 31		Centre			(229·4)	(+5·9)	(15)	(97)	(307)
212·412	ST,M		0·975	275·1	293·3	+ 6·3			69
		2096	0·244	118·8	203·5	− 0·9	1	8	
		2096	0·272	118·2	202·0	− 1·5	0	30	

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).
				°	°	°			
1889.									
212^{d}·412	ST,M	2096	0·301	110·3	199·5	−0·2	10	45	
		2096	0·332	114·9	198·3	−2·3	8	57	
Aug. 1		Centre			(215·8)	(+6·0)	(19)	(140)	(69)
213·399	ST,M	2096	0·125	190·7	204·1	−1·1	1	29	
		2096	0·110	166·1	201·3	−0·1	1	13	
		2096	0·107	153·6	200·1	+0·5	2	28	
		2096	0·154	155·1	199·2	−2·0	6	24	
		2096	0·144	148·1	198·5	−1·1	1	4	
		2097	0·773	123·5	159·3	−20·9	2	6	
		2097	0·809	122·5	155·7	−21·7	0	6	
Aug. 2		Centre			(202·8)	(+6·0)	(13)	(110)	(0)
214·263	ST,M	2096	0·204	239·4	202·1	+0·1	0	4	
		2096	0·199	232·3	201·0	−0·9	0	3	
		2096	0·188	237·2	201·0	+0·2	2	6	
		2096	0·197	224·5	199·9	−2·0	3	24	
		2096	0·209	218·8	199·5	−3·3	1	6	
		2097	0·642	132·3	161·7	−20·3	7	14	
		2097	0·660	130·9	160·0	−20·4	1	9	
		2097	0·697	129·6	156·9	−21·4	5	11	
Aug. 3		Centre			(192·0)	(+6·1)	(19)	(77)	(0)
215·440	ST,M	2096	0·422	256·1	200·0	−0·2	0	10	
		2096	0·411	250·8	198·7	−2·0	0	3	
		2097*a*	0·494	154·5	162·8	−20·4	21	102	
		2097	0·511	150·3	160·3	−20·3	2	21	
		2097	0·538	149·5	158·9	−21·6	2	11	
		2097	0·529	146·5	157·8	−20·2	0	6	
		2097	0·561	146·6	156·5	−22·0	2	13	
		2097*b*	0·570	144·1	155·0	−21·7	18	114	
Aug. 4		Centre			(175·9)	(+6·2)	(45)	(280)	(0)
216·418	ST,M	2097*a*	0·451	185·1	165·4	−20·3	43	227	
		2097	0·478	174·4	160·1	−22·0	3	20	
		2097*b*	0·481	165·5	155·6	−21·4	26	147	
		2097	0·503	165·1	155·0	−22·7	6	20	
			0·939	102·3	94·9	−9·3			90
			0·973	100·1	87·8	−8·2			55
Aug. 5		Centre			(163·0)	(+6·3)	(78)	(414)	(145)

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The Areas of Spots and Faculæ are expressed in millionths of the Sun's visible Hemisphere.

Group 2094, July 26–27. A number of spots in a straight stream. Only *a* and *b*, the first and last spots, are seen on July 27.
Group 2095, July 29–31. A number of very small spots in an irregular stream. Only one very small spot remains by July 31.
Group 2096, July 29–Aug. 4. A number of small spots in an irregular group, which changes its form from day to day.
Group 2097, Aug. 2–11. Two very small spots on Aug. 2. The group has greatly increased by Aug. 3, and by Aug. 4 it has become a long straight stream of spots, of which the first and last, *a* and *b*, are the largest. The smaller spots tend either to coalesce with *a* and *b*, or to die out, on the succeedifig days. *b* has broken up by Aug. 6; but the separate components are usually measured together. Only *a* remains by Aug. 11.

Measures of Positions and Areas of Sun Spots and Faculæ on Photographs—*continued.*

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 Longitude.	Heliographic Latitude.	Spots. Area of UMBRA for each Spot (and for Day).	Spots. Area of WHOLE for each Spot (and for Day).	Faculæ. Area for each Group (and for Day).
1889.				°	°	°			
217d·398	ST,M		0·784	261·6	200·6	— 2·7			362
		2097*a*	0·516	210·0	165·8	—20·4	56	298	
I.		2097	0·496	205·5	163·0	—20·4	0	6	
		2097	0·514	202·9	162·3	—22·0	1	7	
		2097	0·477	200·4	160·1	—20·3	2	16	
		2097	0·500	197·3	159·1	—22·2	2	12	
		2097	0·485	197·2	158·7	—21·3	1	9	
		2097	0·470	195·0	157·2	—20·6	6	20	
		2097	0·493	190·8	155·6	—22·5	2	15	
		2097*b*	0·468	190·5	155·1	—21·1	20	92	
		2097	0·490	188·6	154·4	—22·6	1	13	
			0·857	105·7	93·2	—10·0			85
			0·918	102·9	85·1	— 9·2			70
Aug. 6		Centre			(149·9)	(+6·3)	(91)	(488)	(517)
218·230	ST,M		0·885	263·6	200·4	— 2·7			343
		2097*a*	0·611	224·2	165·8	—20·3	42	290	
I.		2097	0·569	218·1	160·8	—20·6	2	22	
		2097	0·575	214·4	159·4	—22·3	0	10	
		2097	0·549	213·4	157·7	—21·2	9	59	
		2097*b*	0·537	209·6	155·4	—21·6	10	92	
Aug. 7		Centre			(138·9)	(+6·4)	(63)	(473)	(343)
219·412	ST,M		0·974	265·9	199·7	— 2·5			203
		2097*a*	0·753	235·9	164·9	—20·1	58	326	
I.		2097	0·726	232·3	161·3	—21·3	0	4	
		2097	0·696	230·9	158·6	—20·8	6	22	
		2097	0·678	229·5	156·7	—20·8	18	56	
		2097*b*	0·673	228·0	155·7	—21·3	7	33	
			0·800	31·2	85·1	+48·2			42
Aug. 8		Centre			(123·4)	(+6·4)	(89)	(441)	(245)
220·184	ST,M		0·884	255·5	173·1	— 9·6			43
		2097*a*	0·842	240·9	164·6	—20·2	52	348	648 *c*
I.		2097	0·826	237·9	161·8	—21·8	0	5	
		2097*b*	0·775	235·9	156·4	—21·0	17	100	
		2098	0·620	110·8	77·5	— 7·4	2	6	
		2098	0·654	110·9	75·1	— 8·4	2	6	
		2099	0·974	99·7	37·6	— 7·9	13	116	126 *c*
			0·919	105·2	48·6	—11·2			37
			0·955	85·6	40·1	+ 6·2			32
			0·975	104·7	38·1	—12·7			37
			0·983	95·3	34·5	— 4·0			83
Aug. 9		Centre			(113·1)	(+6·5)	(86)	(581)	(1006)
1889.				°	°	°			
221d·360	ST,M		0·900	237·9	154·7	—25·1			74
		2097*a*	0·947	246·1	164·5	—20·1	62	375	382 *c*
I.		2097	0·905	240·0	156·1	—23·6	0	6	
		2097	0·901	241·4	156·0	—22·2	0	11	523 *c*
		2097*b*	0·896	242·8	155·8	—20·8	9	45	
		2098*a*	0·385	127·7	79·7	— 7·4	27	155	
		2098	0·435	121·4	75·6	— 7·0	0	8	
		2098	0·469	123·3	74·2	— 8·9	6	28	
		2098	0·470	118·5	73·0	— 7·0	0	18	
		2099	0·884	102·5	37·1	— 7·9	27	133	116 *f*
Aug. 10		Centre			(97·5)	(+6·5)	(131)	(779)	(1095)
222·189	ST,M	2097*a*	0·987	248·5	164·0	—19·9	0	342	768 *sf*
		2098*a*	0·265	155·9	80·4	— 7·4	31	222	
M.		2098	0·313	139·7	74·9	— 7·3	0	13	
		2098	0·345	141·1	74·0	— 9·1	0	26	
		2098	0·340	136·7	73·0	— 7·9	0	12	
		2099	0·785	106·0	37·1	— 8·2	23	115	
Aug. 11		Centre			(86·6)	(+6·6)	(54)	(730)	(768)
223·205	ST,M	2098*a*	0·279	209·0	81·0	— 7·5	30	180	
		2098	0·267	184·8	74·5	— 8·8	0	30	
M.		2099	0·638	111·8	36·6	— 8·4	22	82	
Aug. 12		Centre			(73·2)	(+6·6)	(52)	(292)	(0)
224·232	ST,M	2098*a*	0·439	237·3	81·4	— 7·5	34	163	
		2098	0·406	236·4	79·4	— 6·6	4	10	
I.		2098	0·411	233·9	79·1	— 7·7	0	4	
		2098	0·390	229·2	76·9	— 8·3	12	57	
		2098	0·370	227·5	75·5	— 8·0	1	11	
		2098	0·350	224·3	73·8	— 8·0	2	12	
		2099	0·440	125·6	38·5	— 8·5	0	2	
		2099	0·460	122·7	36·7	— 8·2	17	87	
Aug. 13		Centre			(59·6)	(+6·7)	(70)	(346)	
225·485	ST,M	2098*a*	0·655	251·6	81·7	— 6·7	45	336	
		2098*b*	0·607	250·9	78·2	— 6·0	11	39	
		2098*c*	0·593	248·0	76·6	— 7·3	12	98	
		2099	0·283	158·7	37·2	— 8·6	12	76	
			0·936	119·7	339·8	—24·7			60
			0·948	123·2	338·8	—28·5			71
Aug. 14		Centre			(43·1)	(+6·7)	(80)	(549)	(131)

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The Areas of Spots and Faculæ are expressed in millionths of the Sun's visible Hemisphere.

Group 2098, Aug. 9-17. Four very small faint spots, measured in two pairs on Aug 9. The group has greatly increased in size by Aug. 10, and consists of a large regular spot, *a*, followed by a number of smaller spots irregularly scattered over a considerable area. The group has become more condensed by Aug. 13, and by Aug. 14, consists of three large spots, *a*, *b* and *c*. *c* has disappeared by Aug. 17.

Group 2099, Aug. 9-20. A regular spot. Three very small spots which are measured together are seen near it on Aug. 13.

Measures of Positions and Areas of Sun Spots and Faculæ on Photographs—*continued.*

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 Longitude.	Heliographic Latitude.	Spots. Area of UMBRA for each Spot (and for Day).	Spots. Area of WHOLE for each Spot (and for Day).	Faculæ. Area for each Group (and for Day).
1889.				°	°	°			
226d·388	ST,M	2098*a*	0·795	256·5	82·0	— 6·5	60	404	
		2098*b*	0·756	255·8	78·4	— 6·1	13	120	
		2098*c*	0·736	253·9	76·3	— 7·0	12	115	
		2099	0·282	201·7	37·1	— 8·4	16	79	
Aug. 15		Centre			(31·1)	(+6·8)	(101)	(718)	(0)
227·404	S,M	2098*a*	0·912	259·8	82·0	— 6·4	69	459	} 641 *c*
		2098*b*	0·884	258·8	78·2	— 6·6	12	146	
		2098*c*	0·864	257·7	75·6	— 7·0	0	20	
		2099	0·417	232·3	37·0	— 8·3	14	66	
Aug. 16		Centre			(17·6)	(+6·8)	(95)	(691)	(641)
228·501	ST,M	2098*a*	0·983	262·0	81·5	— 6·6	41	232	} 722 *f*
		2098*b*	0·970	261·4	77·9	— 6·6	17	88	
		2099	0·598	246·5	36·7	— 8·1	14	31	
Aug. 17		Centre			(3·2)	(+6·8)	(72)	(351)	(722)
229·349	ST,M		0·998	262·0	77·2	— 7·5			214
		2099	0·735	252·3	36·8	— 8·0	12	40	
Aug. 18		Centre			(352·0)	(+6·9)	(12)	(40)	(214)
230·435	STM		0·889	254·7	38·1	—10·2			126
		2099	0·871	257·2	36·4	— 7·6	8	27	140 *c*
			0·914	98·5	272·8	— 4·9			69
Aug. 19		Centre			(337·7)	(+6·9)	(8)	(27)	(335)
231·382	ST,M		0·966	256·7	38·1	—10·9			118
			0·960	252·4	36·0	—14·7			39
I.			0·920	259·4	30·5	— 6·9			48
			0·913	252·6	28·2	—12·7			76
		2099	0·957	259·3	36·6	— 8·1	0	27	74 *c*
Aug. 20		Centre			(325·1)	(+7·0)	(0)	(27)	(355)
232·305	ST,M		0·975	255·5	27·9	—12·4			47
			0·964	261·7	26·3	— 6·0			68
I.			0·859	271·2	12·3	+ 4·7			52
Aug. 21		Centre			(313·0)	(+7·0)	(0)	(0)	(167)
233·429									
Aug. 22		Centre			(298·0)	(+7·0)	(0)	(0)	(0)
234·439									
Aug. 23		Centre			(284·7)	(+7·1)	(0)	(0)	(0)

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 Longitude.	Heliographic Latitude.	Spots. Area of UMBRA for each Spot (and for Day).	Spots. Area of WHOLE for each Spot (and for Day).	Faculæ. Area for each Group (and for Day).
1889.				°	°	°			
235d·451									
Aug. 24		Centre			(271·3)	(+7·1)	(0)	(0)	(0)
236·445									
Aug. 25		Centre			(258·2)	(+7·1)	(0)	(0)	(0)
237·408									
Aug. 26		Centre			(245·5)	(+7·1)	(0)	(0)	(0)
238·388	ST,M	2100	0·963	112·1	162·2	—19·0	44	250	315 *c*
			0·980	117·3	159·0	—24·9			117
Aug. 27		Centre			(232·6)	(+7·2)	(44)	(250)	(432)
239·392	ST,M	2100	0·891	115·7	161·4	—19·0	40	263	245 *c*
			0·927	120·2	157·8	—24·5			185
Aug. 28		Centre			(219·3)	(+7·2)	(40)	(263)	(430)
240·392	ST,M	2100	0·782	121·2	161·3	—18·8	50	266	125 *c*
			0·833	126·4	158·7	—24·8			80
Aug. 29		Centre			(206·1)	(+7·2)	(50)	(266)	(205)
241·410	ST,M	2100	0·657	130·5	160·9	—19·1	36	204	
Aug. 30		Centre			(192·7)	(+7·2)	(36)	(204)	(0)
242·405	ST,M	2100	0·537	145·0	160·5	—19·2	41	213	
Aug. 31		Centre			(179·5)	(+7·2)	(41)	(213)	(0)
243·506	ST,M	2100	0·457	170·4	160·3	—19·5	41	214	
Sept. 1		Centre			(164·9)	(+7·2)	(41)	(214)	(0)
244·440	ST,M	2100	0·467	195·1	160·0	—19·5	38	213	0
Sept. 2		Centre			(152·6)	(+7·2)	(38)	(213)	(0)
245·326	ST,M	2100	0·540	214·4	159·7	—19·5	33	168	
I.		2101	0·863	105·3	83·6	— 9·3	0	8	329 *c*
Sept. 3		Centre			(140·9)	(+7·2)	(33)	(176)	(329)
246·305	ST,M	2100	0·660	228·7	159·6	—19·6	31	172	
		2101	0·738	110·1	83·5	— 9·5	0	6	96 *c*
I.			0·775	105·4	79·3	— 7·3			105
Sept. 4		Centre			(128·0)	(+7·3)	(31)	(178)	(201)

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 longitude and latitude of the centre of the disk are given in brackets.
The Areas of Spots and Faculæ are expressed in millionths of the Sun's visible Hemisphere.

Group 2100. Aug. 27–Sept. 7. A regular spot.
Group 2101. Sept. 3–4. A very small faint spot.

Measures of Positions and Areas of Sun Spots and Faculæ on Photographs—*continued*.

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).
1889.				°	°	°			
247d·212	ST,M		0·814	229·8	159·9	−26·5			122
I.		2100	0·780	237·1	160·0	−19·8	44	163	184 *c*
			0·969	100·1	41·9	− 7·8			132
Sept. 5		Centre			(116·0)	(+7·3)	(44)	(163)	(438)
248·431	ST,M		0·907	236·4	157·2	−26·3			143
		2100	0·902	244·3	159·2	−19·4	20	137	203 *c*
Sept. 6		Centre			(99·9)	(+7·3)	(20)	(137)	(346)
249·163	ST,M		0·955	237·6	156·0	−28·0			166
		2100	0·959	246·7	159·4	−19·8	25	117	140 *c*
I.		2102	0·905	241·1	148·8	−22·2	0	6	163 *c*
		2102	0·889	240·2	146·4	−22·2	4	25	
Sept. 7		Centre			(90·2)	(+7·3)	(29)	(148)	(469)
250·182	ST,M	2102	0·986	245·7	152·4	−22·4	15	139	600 *c*
I.		2102	0·965	243·7	146·0	−23·0	0	56	
			0·930	117·2	13·3	−22·0			48
Sept. 8		Centre			(76·2)	(+7·3)	(15)	(195)	(648)
251·441									
Sept. 9		Centre			(60·2)	(+7·2)	(0)	(0)	(0)
252·392									
Sept. 10		Centre			(47·6)	(+7·2)	(0)	(0)	(0)
253·385									
Sept. 11		Centre			(34·5)	(+7·2)	(0)	(0)	(0)
254·440									
Sept. 12		Centre			(20·6)	(+7·2)	(0)	(0)	(0)
255·459	ST,M		0·956	258·1	78·2	− 9·1			83
			0·945	84·8	295·8	+ 7·3			68
Sept. 13		Centre			(7·1)	(+7·2)	(0)	(0)	(151)
256·474	ST,M		0·855	85·8	294·8	+ 7·3			59
Sept. 14		Centre			(353·8)	(+7·2)	(0)	(0)	(59)
257·357	ST,M		0·917	256·7	46·6	− 9·1			66
			0·889	250·5	41·5	−13·7			56
I.			0·949	101·1	272·2	− 8·1			31
Sept. 15		Centre			(342·1)	(+7·2)	(0)	(0)	(153)

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).
1889.				°	°	°			
258d·382									
Sept. 16		Centre			(328·5)	(+7·2)	(0)	(0)	(0)
259·384									
Sept. 17		Centre			(315·3)	(+7·1)	(0)	(0)	(0)
260·391									
Sept. 18		Centre			(302·0)	(+7·1)	(0)	(0)	(0)
261·289									
I.									
Sept. 19		Centre			(290·2)	(+7·1)	(0)	(0)	(0)
262·405									
Sept. 20		Centre			(275·4)	(+7·1)	(0)	(0)	(0)
263·395									
Sept. 21		Centre			(262·4)	(+7·0)	(0)	(0)	(0)
264·237									
Sept. 22		Centre			(251·3)	(+7·0)	(0)	(0)	(0)
265·403	ST,M		0·994	112·9	155·9	−21·7			287
Sept. 23		Centre			(235·9)	(+7·0)	(0)	(0)	(287)
266·215	ST,M	2103	0·950	115·2	158·0	−21·3	0	52	656 *c*
I.		2103*a*	0·974	112·5	152·0	−20·0	26	152	
Sept. 24		Centre			(225·1)	(+6·9)	(26)	(204)	(656)
267·395	ST,M	2103	0·845	121·9	159·0	−22·2	0	4	751 *c*
		2103*a*	0·891	117·2	152·1	−20·4	30	134	
		2103	0·900	120·5	152·0	−23·6	0	48	
			0·909	128·1	153·8	−30·3			92
Sept. 25		Centre			(209·6)	(+6·9)	(30)	(186)	(843)
268·413	ST,M	2103	0·738	129·3	158·0	−22·5	9	43	279 *c*
		2103	0·737	126·8	157·1	−20·9	8	31	
		2103	0·796	127·2	152·3	−23·9	0	37	359 *c*
		2103*a*	0·784	123·5	151·9	−20·8	28	122	
Sept. 26		Centre			(196·1)	(+6·8)	(45)	(233)	(638)
269·341	ST,M	2103	0·620	140·2	158·6	−22·2	4	20	
I.		2103	0·618	135·6	156·6	−20·1	2	8	

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The Areas of Spots and Faculæ are expressed in millionths of the Sun's visible Hemisphere.

Group 2102, Sept. 7–8. Two small spots on Sept. 7. Two spots on Sept. 8, of which the preceding appears to be a new formation.
Group 2103, Sept. 24–Oct. 4. A regular spot *a* accompanied by a number of smaller spots. The latter diminish in size after Sept. 26 and have all disappeared by Oct. 4. The apparent change in the position of the group on Sept. 24, 25, 26 appears to be due to the action of the surrounding faculæ, which conceal much of the preceding portion on Sept. 25.

Measures of Positions and Areas of Sun Spots and Faculæ on Photographs—*continued.*

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 Longitude.	Heliographic Latitude.	Spots. Area of UMBRA for each Spot (and for Day).	Spots. Area of WHOLE for each Spot (and for Day).	Faculæ. Area for each Group (and for Day).
1889.				°	°	°			
269d·341	ST,M	2103	0·636	136·8	156·1	−21·5	0	1	
I.		2103*a*	0·674	131·3	151·3	−20·6	27	128	
Sept. 27		Centre			(183·9)	(+6·8)	(33)	(157)	(0)
270·405	ST,M	2103	0·517	160·7	159·3	−22·5	6	23	
		2103	0·510	155·3	156·8	−20·9	0	9	
		2103	0·576	155·0	154·4	−24·9	0	2	
		2103	0·573	151·9	152·8	−23·8	0	4	
		2103*a*	0·549	147·4	151·5	−21·1	31	138	
Sept. 28		Centre			(169·9)	(+6·7)	(37)	(176)	(0)
271·388	ST,M	2103	0·489	185·1	159·6	−22·4	4	20	
		2103	0·473	175·5	154·6	−21·3	0	3	
		2103*a*	0·472	169·4	151·6	−20·9	37	146	
		2103	0·458	164·9	149·7	−19·5	0	6	
Sept. 29		Centre			(156·9)	(+6·7)	(41)	(175)	(0)
272·339	ST,M	2103	0·544	206·6	159·5	−22·5	0	5	
		2103	0·479	197·4	153·1	−20·4	0	1	
I.		2103	0·534	192·9	151·8	−24·6	0	4	
		2103*a*	0·475	193·8	151·2	−20·7	29	125	
		2103	0·499	191·3	150·3	−22·5	0	8	
Sept. 30		Centre			(144·3)	(+6·7)	(29)	(143)	(0)
273·486	ST,M	2103	0·610	215·4	157·4	−23·7	0	18	
		2103*a*	0·573	218·7	151·6	−20·4	23	118	
Oct. 1		Centre			(129·2)	(+6·6)	(23)	(136)	(0)
274·404	ST,M		0·763	233·4	158·3	−22·1			55
		2103*a*	0·694	231·1	152·1	−20·4	8	71	85*c*
		2103	0·711	226·1	151·1	−24·0	0	9	
			0·926	101·1	50·9	− 7·7			32
			0·958	106·7	46·4	−13·9			46
Oct. 2		Centre			(117·1)	(+6·6)	(8)	(80)	(218)
275·562	ST,M	2103*a*	0·837	240·3	152·5	−20·4	9	35	425*c*
		2103	0·810	237·2	148·7	−21·6	0	7	
Oct. 3		Centre			(101·8)	(+6·5)	(9)	(42)	(425)
276·495	ST,M		0·925	240·6	151·3	−24·1			138
		2103*a*	0·926	244·8	152·6	−20·4	0	19	160*p*
Oct. 4		Centre			(89·5)	(+6·4)	(0)	(19)	(298)
1889.									
277d·235	ST,M		0·976	277·3	157·7	+ 8·5			40
			0·972	244·7	151·7	−22·7			310
I.			0·945	237·2	143·8	−28·1			145
Oct. 5		Centre			(79·7)	(+6·4)	(0)	(0)	(495)
278·177									
I.									
Oct. 6		Centre			(67·2)	(+6·3)	(0)	(0)	(0)
279·384									
Oct. 7		Centre			(51·3)	(+6·3)	(0)	(0)	(0)
280·393	ST,M	2104	0·685	146·7	12·6	−29·2	0	8	
		2104	0·681	144·0	11·2	−27·9	0	4	
Oct. 8		Centre			(38·0)	(+6·2)	(0)	(12)	(0)
281·400	ST,M	2105	0·516	180·3	25·0	−24·9	0	9	
Oct. 9		Centre			(24·8)	(+6·1)	(0)	(9)	(0)
282·386	ST,M	2105	0·538	201·3	24·1	−24·0	0	5	
		2105	0·551	197·4	22·3	−25·6	0	5	
Oct. 10		Centre			(11·8)	+ 6·1	(0)	(10)	(0)
283·298	ST,M	2105	0·626	212·9	21·9	−26·1	0	6	73*np*
I.									
Oct. 11		Centre			(359·7)	(+6·0)	(0)	(6)	(73)
284·393									
Oct. 12		Centre			(345·3)	(+5·9)	(0)	(0)	(0)
285·487									
Oct. 13		Centre			(330·9)	(+5·8)	(0)	(0)	(0)
286·422									
Oct. 14		Centre			(318·5)	(+5·8)	(0)	(0)	(0)
287·384									
Oct. 15		Centre			(305·8)	(+5·7)	(0)	(0)	(0)
288·290	ST,M	2106	0·624	299·5	329·6	+22·4	1	7	
I.		2106	0·594	301·5	327·0	+22·8	2	9	
Oct. 16		Centre			(293·8)	(+5·6)	(3)	(16)	(0)

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The Areas of Spots and Faculæ are expressed in millionths of the Sun's visible Hemisphere.

Group 2104. Oct. 8. Two very small faint spots.
Group 2105. Oct. 9-11. A very small faint spot on Oct. 9. A second spot is seen near it on Oct. 10. The first spot has disappeared by Oct. 11.
Group 2106. Oct. 16–18. Three very small faint spots, of which two are measured together on Oct. 16. Two spots measured together on Oct. 17. Only one spot is seen on Oct. 18.

Measures of Positions and Areas of Sun Spots and Faculæ on Photographs—*continued.*

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).
1889.				°	°	°				1889.				°	°	°			
289d·399	ST,M	2106	0·757	296·0	326·7	+23·1	0	26		300d·307									
Oct. 17		Centre			(279·2)	(+5·5)	(0)	(26)	(0)	I.									
										Oct. 28		Centre			(135·4)	(+4·5)	(0)	(0)	(0)
290·149	ST,M	2106	0·886	291·2	331·5	+21·2	0	2	154 *sf*										
I.			0·994	88·8	185·7	+ 1·9			143	301·208									
Oct. 18		Centre			(269·3)	(+5·4)	(0)	(2)	(297)	I.									
										Oct. 29		Centre			(123·5)	(+4·4)	(0)	(0)	(0)
291·394	ST,M		0·966	291·7	328·9	+22·4			165										
I.			0·934	91·0	184·2	+ 1·1			335	302·397									
Oct. 19		Centre			(253·0)	(+5·4)	(0)	(0)	(500)	Oct. 30		Centre			(107·8)	(+4·3)	(0)	(0)	(0)
292·255	ST,M		0·837	92·2	185·0	+ 1·1			258	303·395									
I.										Oct. 31		Centre			(94·7)	(+4·2)	(0)	(0)	(0)
Oct. 20		Centre			(241·6)	(+5·3)	(0)	(0)	(258)										
										304·413	ST,M		0·966	243·3	152·4	−24·5			83
293·307	ST,M		0·976	203·2	279·4	−60·7			276				0·895	234·0	137·3	−29·5			83
I.			0·953	209·0	278·1	−53·2			35	Nov. 1		Centre			(81·2)	(+4·1)	(0)	(0)	(166)
Oct. 21		Centre			(227·7)	(+5·2)	(0)	(0)	(311)										
										305·395									
294·447	ST,M		0·899	117·7	153·7	−22·1			258	Nov. 2		Centre			(68·3)	(+4·0)	(0)	(0)	(0)
Oct. 22		Centre			(212·7)	(+5·1)	(0)	(0)	(258)										
										306·193									
295·314	ST,M		0·931	345·3	240·4	+68·1			76	I.									
			0·924	351·4	225·5	+70·4			45	Nov. 3		Centre			(57·8)	(+3·9)	(0)	(0)	(0)
I.		2107	0·807	122·8	154·1	−22·5	0	2	160 *sf*										
			0·930	19·5	154·7	+64·7			38	307·203	ST,M		0·924	66·2	337·6	+23·4			133
			0·928	124·6	140·1	−29·4			86	I.			0·948	75·3	333·0	+15·1			80
Oct. 23		Centre			(201·2)	(+5·0)	(0)	(2)	(405)				0·972	69·5	327·8	+20·8			60
										Nov. 4		Centre			(44·5)	(+3·8)	(0)	(0)	(273)
296·382										308·409									
I.										Nov. 5		Centre			(28·6)	(+3·7)	(0)	(0)	(0)
Oct. 24		Centre			(187·2)	(+4·9)	(0)	(0)	(0)										
										309·254									
297·399										I.									
Oct. 25		Centre			(173·7)	(+4·8)	(0)	(0)	(0)	Nov. 6		Centre			(17·4)	(+3·6)	(0)	(0)	(0)
										310·267									
298·400										I.									
Oct. 26		Centre			(160·5)	(+4·7)	(0)	(0)	(0)	Nov. 7		Centre			(4·0)	(+3·5)	(0)	(0)	(0)
299·229	ST,M		0·936	287·8	219·2	+18·3			64										
I										311·484									
Oct. 27		Centre			(149·6)	(+4·6)	(0)	(0)	(64)	Nov. 8		Centre			(348·0)	(+3·4)	(0)	(0)	(0)

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The Areas of Spots and Faculæ are expressed in millionths of the Sun's visible Hemisphere.

Group 2107. Oct. 23. A very small faint spot.

Measures of Positions and Areas of Sun Spots and Faculæ on Photographs.—*continued.*

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).
1889.				°	°	°				1889.				°	°	°			
312d·185										322d·220	ST,M		0·828	123·8	156·7	−26·0			65
I.													0·870	129·6	154·1	−32·4			34
Nov. 9		Centre			(338·7)	(+3·3)	(0)	(0)	(0)	I.			0·890	121·4	148·6	−26·5			123
										Nov. 19		Centre			(206·5)	(+2·1)	(0)	(0)	(222)
313·193																			
I.										323·225	ST,M		0·784	125·4	148·3	−25·5			82
Nov. 10		Centre			(325·5)	(+3·1)	(0)	(0)	(0)	I.			0·898	123·8	135·0	−28·8			48
										Nov. 20		Centre			(193·2)	(+2·0)	(0)	(0)	(130)
314·215																			
I.										324·248	ST,M		0·950	195·2	215·4	−64·8			57
Nov. 11		Centre			(312·0)	(+3·0)	(0)	(0)	(0)	I.			0·922	134·4	121·7	−39·2			52
										Nov. 21		Centre			(179·7)	(+1·8)	(0)	(0)	(109)
315·418																			
Nov. 12		Centre			(296·2)	(+2·9)	(0)	(0)	(0)	325·293									
										I.									
316·446										Nov. 22		Centre			(166·0)	(+1·7)	(0)	(0)	(0)
Nov. 13		Centre			(282·6)	(+2·8)	(0)	(0)	(0)										
										326·334									
										I.									
317·217	ST,M		0·919	292·2	338·2	+21·4			59	Nov. 23		Centre			(152·3)	(+1·6)	(0)	(0)	(0)
			0·836	296·4	326·8	+23·3			33										
I.			0·756	297·1	318·7	+22·0			22	327·225									
			0·963	133·5	206·0	−40·4			57	I.									
Nov. 14		Centre			(272·4)	(+2·7)	(0)	(0)	(171)	Nov. 24		Centre			(140·5)	(+1·5)	(0)	(0)	(0)
318·238	ST,M		0·952	293·0	330·4	+22·7			97	328·427									
I.			0·881	293·4	319·2	+21·8			58	Nov. 25		Centre			(124·7)	(+1·3)	(0)	(0)	(0)
			0·915	136·8	203·9	−40·3			45										
Nov. 15		Centre			(258·9)	(+2·6)	(0)	(0)	(200)	329·468									
										Nov. 26		Centre			(110·9)	(+1·2)	(0)	(0)	(0)
319·211																			
I.										330·236									
Nov. 16		Centre			(246·1)	(+2·4)	(0)	(0)	(0)	I.									
										Nov. 27		Centre			(100·9)	(+1·1)	(0)	(0)	(0)
320·245																			
I.										331·507									
Nov. 17		Centre			(232·5)	(+2·3)	(0)	(0)	(0)	Nov. 28		Centre			(84·1)	(+1·0)	(0)	(0)	(0)
321·185	ST,M		0·924	182·1	224·7	−65·0			50	332·337	ST,M		0·960	244·3	144·5	−24·3			94
			0·940	112·4	152·6	−20·1			68				0·918	308·2	134·6	+35·0			134
I.			0·965	118·0	148·6	−26·2			124				0·951	93·5	1·4	− 3·1			263
Nov. 18		Centre			(220·1)	(+2·2)	(0)	(0)	(242)	Nov. 29		Centre			(73·1)	(+0·8)	(0)	(0)	(491)

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 longitude and latitude of the centre of the disk are given in brackets.

The Areas of Spots and Faculæ are expressed in millionths of the Sun's visible Hemisphere.

Measures of Positions and Areas of Sun Spots and Faculæ on Photographs—*continued.*

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).
1889.				°	°	°				1889.				°	°	°			
333ᵈ·193										345ᵈ·458	ST,M	2108	0·964	262·9	334·5	− 7·1	7	73	282*p*
I.										Dec. 12		Centre			(260·2)	(−0·9)	(7)	(73)	(282)
Nov. 30		Centre			(61·8)	(+0·7)	(0)	(0)	(0)										
										346·293	ST,M		0·973	269·5	325·6	−0·7			54
334·469										I.		2108	0·997	262·2	334·5	− 7·8	0	71	
Dec. 1		Centre			(45·1)	(+0·6)	(0)	(0)	(0)	Dec. 13		Centre			(249·2)	(−1·0)	(0)	(71)	(54)
335·527										347·328									
Dec. 2		Centre			(31·1)	(+0·4)	(0)	(0)	(0)	M.									
										Dec. 14		Centre			(235·6)	(−1·1)	(0)	(0)	(0)
336·442																			
Dec. 3		Centre			(19·1)	(+0·3)	(0)	(0)	(0)	348·198									
										I.									
337·353										Dec. 15		Centre			(224·2)	(−1·2)	(0)	(0)	(0)
I.																			
Dec. 4		Centre			(7·0)	(+0·2)	(0)	(0)	(0)	349·314									
										I.									
338·306										Dec. 16		Centre			(209·4)	(−1·4)	(0)	(0)	(0)
I.																			
Dec. 5		Centre			(354·4)	(+0·1)	(0)	(0)	(0)	350·192									
										I.									
339·225										Dec. 17		Centre			(197·8)	(−1·5)	(0)	(0)	(0)
I.																			
Dec. 6		Centre			(342·4)	(−0·1)	(0)	(0)	(0)	351·236	ST,M	2109	0·488	27·5	170·0	+24·2	2	8	
												2109	0·513	31·4	167·2	+24·3	0	4	
340·272										I.		2110	0·992	116·7	101·7	−26·7	6	31	1128*f*
I.										Dec. 18		Centre			(184·2)	(−1·6)	(8)	(43)	(112)
Dec. 7		Centre			(328·6)	(−0·2)	(0)	(0)	(0)										
										352·495	ST,M	2109	0·431	352·9	170·9	+23·5	0	8	
341·303												2109	0·444	0·0	167·6	+24·5	1	20	
I.												2110	0·923	117·8	102·3	−26·2	4	18	173*f*
Dec. 8		Centre			(315·0)	(−0·3)	(0)	(0)	(0)	Dec. 19		Centre			(167·6)	(−1·7)	(5)	(46)	(173)
342·298																			
I.										353·247	ST,M	2109	0·482	334·8	170·5	+23·9	2	12	
Dec. 9		Centre			(301·8)	(−0·5)	(0)	(0)	(0)			2109	0·468	343·2	166·1	+24·7	5	33	
										I.		2110	0·857	120·0	101·9	−26·4	5	19	210*f*
343·226													0·917	119·1	93·5	−27·3			209
I.													0·970	97·5	81·8	− 7·7			368
Dec. 10		Centre			(289·7)	(−0·6)	(0)	(0)	(0)	Dec. 20		Centre			(157·6)	(−1·9)	(12)	(64)	(787)
										354·205	ST,M	2109	0·579	318·0	170·0	+23·5	2	21	
344·342												2109	0·547	324·0	165·7	−24·3	9	25	
I.																			
Dec. 11		Centre			(275·0)	(−0·7)	(0)	(0)	(0)	I.		2110	0·746	124·4	101·9	−26·3	1	3	878*f*

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 longitude and latitude of the centre of the disk are given in brackets.
The Areas of Spots and Faculæ are expressed in millionths of the Sun's visible Hemisphere.

Group 2108. Dec. 12–13. A regular spot. Group 2109. Dec. 18–22. Two clusters of small spots.
Group 2110. Dec. 18–30. A small spot which diminishes in size from day to day, and has disappeared by Dec. 23. A fresh spot is seen on that day, and others appear on the succeeding days, until by Dec. 26 the group consists of a straight stream of spots, of which the leader *a*, a regular spot, is the largest.

Measures of Positions and Areas of Sun Spots and Faculæ on Photographs—*concluded.*

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).
1889.				°	°	°			
354d·205	ST,M		0·939	176·7	135·4	−71·3			33
I.			0·897	96·9	81·5	− 7·1			360
Dec. 21		Centre			(145·1)	(−2·0)	(12)	(49)	(480)
355·216	ST,M		0·873	294·8	189·2	+20·3			85
		2109	0·717	306·5	170·5	+23·5	0	18	
I.		2109	0·666	310·8	165·1	+24·0	0	19	
		2110	0·613	132·7	101·7	−26·3	0	14	
			0·777	97·0	81·0	− 6·7			296
Dec. 22		Centre			(131·7)	(−2·1)	(0)	(51)	(381)
356·486	ST,M		0·970	291·5	188·9	+20·2			76
			0·870	301·1	170·4	+25·4			515
		2110	0·507	146·0	96·6	−26·8	0	7	
Dec. 23		Centre			(115·0)	(−2·2)	(0)	(7)	(591)
357·245	ST,M		0·916	298·4	167·2	+24·7			403
		2110	0·425	161·0	96·1	−26·0	2	15	
I.		2110	0·433	157·3	94·3	−25·8	0	5	
Dec. 24		Centre			(104·9)	(−2·4)	(2)	(20)	(403)
358·176	ST,M		0·975	296·0	167·2	+24·7			377
		2110	0·419	191·0	97·8	−26·7	12	29	
I.		2110	0·427	185·5	95·3	−27·6	1	7	
		2110	0·408	183·0	94·1	−26·4	1	12	
Dec. 25		Centre			(92·7)	(−2·5)	(14)	(48)	(377)
359·247	ST,M	2110*a*	0·520	218·6	99·7	−26·3	18	100	
I.		2110	0·480	211·6	94·9	−26·6	6	55	
Dec. 26		Centre			(78·6)	(−2·6)	(24)	(155)	(0)
1889.									
360d·266	ST,M		0·952	236·5	135·3	−32·6			41
			0·880	241·7	124·5	−26·1			47
I.		2110*a*	0·660	231·5	100·2	−26·4	32	154	
		2110	0·598	226·5	94·0	−26·6	15	73	
		2111	0·994	98·7	341·2	− 8·9	28	150	112*c*
Dec. 27		Centre			(65·1)	(−2·7)	(75)	(377)	(200)
361·213	ST,M	2110*a*	0·788	237·7	100·8	−26·7	22	173	
		2110	0·737	236·7	95·9	−25·9	0	12	
M.		2110	0·716	234·3	93·3	−26·8	7	42	
		2110	0·703	232·6	91·6	−27·4	0	2	
		2111	0·938	98·1	343·2	− 8·6	18	86	231*f*
Dec. 28		Centre			(52·8)	(−2·8)	(47)	(315)	(231)
362·187	ST,M	2110*a*	0·897	241·4	101·6	−26·8	35	156	
		2110	0·856	240·6	96·1	−26·5	6	30	663*c*
M.		2110	0·832	239·4	93·1	−26·8	3	35	
		2111	0·834	98·5	343·6	− 8·8	32	82	414*f*
Dec. 29		Centre			(39·9)	(−3·0)	(76)	(303)	(1077)
363·263	ST,M		0·912	98·5	320·0	− 9·0			57
			0·858	263·0	84·7	− 7·6			65
I.		2110*a*	0·978	243·6	103·7	−26·5	28	220	498*c*
		2110	0·950	243·3	96·7	−26·3	7	79	
		2111	0·676	100·3	343·5	− 9·2	14	71	
Dec. 30		Centre			(25·7)	(−3·1)	(49)	(370)	(620)
364·458	ST,M	2111	0·450	104·0	343·9	− 9·1	12	67	
I.									
Dec. 31					(10·0)	(−3·2)	(12)	(67)	(0)

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The Areas of Spots and Faculæ are expressed in millionths of the Sun's visible Hemisphere.

Group 2111. 1889 Dec. 27—1890 Jan. 7. A regular spot.

ROYAL OBSERVATORY, GREENWICH.

LEDGERS

OF

AREAS AND POSITIONS OF GROUPS OF SUN SPOTS

DEDUCED FROM THE MEASUREMENT

OF THE

SOLAR PHOTOGRAPHS,

FOR EACH DAY IN THE YEAR

1889.

AREAS and HELIOGRAPHIC POSITIONS of GROUPS of SUN SPOTS DEDUCED FOR EACH DAY from the MEASUREMENTS of the PHOTOGRAPHS taken at the ROYAL OBSERVATORY, GREENWICH, at DEHRA DÛN IN INDIA, and at the ROYAL ALFRED OBSERVATORY, MAURITIUS, in the YEAR 1889.

NOTE.—The Greenwich Civil Time at which the photograph was taken is expressed by the month, day of the month (civil reckoning), and decimal of a day, reckoned from Greenwich Mean Midnight.

The Projected Area of the Umbræ and Whole Spots is the area as it is measured on the photograph, uncorrected for the effect of foreshortening, and expressed in millionths of the Sun's apparent disk.

The Column "Longitude from Central Meridian" gives the Mean heliographic longitude of the group, reckoned from the meridian passing through the centre of the Sun's disk at the moment of observation; longitudes west of the centre being reckoned as positive.

Dates for which no numbers are given indicate days for which no photographic record is at present available.

Date. Greenwich Civil Time.	Projected Area of		Area for Group.		Mean Longitude of Group.	Mean Latitude of Group.	Longitude from Central Meridian.
	Umbra.	Whole Spot.	Umbra.	Whole Spot.			
Group 2080.							
1889. d					°	°	°
Jan. 16·382	7	68	4	41	271·7	+ 9·8	− 26·1
17·366	16	59	9	32	272·5	+10·2	− 12·4
Means ...	...	...	7	37	272·10	+10·00	...
Group 2081.							
Feb. 1·341	7	37	7	33	31·7	− 2·3	− 56·1
2·447	30	168	19	111	32·6	− 2·9	− 40·6
3·542	27	198	15	113	32·1	− 4·1	− 26·7
4·204	15	138	8	73	31·6	− 3·7	− 18·5
5·307	3	44	2	22	31·9	− 3·9	− 3·6
6·196	0	12	0	6	31·6	− 3·9	+ 7·8
Means ...	...	...	9	60	31·92	− 3·47	...
Group 2082.							
Feb. 22·490	7	32	6	32	109·8	− 7·4	− 59·4
23·415	14	66	10	47	111·3	− 7·1	− 45·8
24	No photograph.						
25·264	5	62	2	33	112·0	− 6·1	− 20·7
26·430	0	82	0	41	111·1	− 7·5	− 6·2
27·437	72	290	36	147	111·3	− 7·5	+ 7·1
28·581	35	172	19	94	111·3	− 7·5	+ 22·3
Mar. 1·471	16	99	10	61	112·5	− 7·3	+ 35·2
2·239	5	40	3	28	112·2	− 7·5	+ 45·1
Means ...	...	...	11	60	111·56	− 7·24	...

Date. Greenwich Civil Time.	Projected Area of		Area for Group.		Mean Longitude of Group.	Mean Latitude of Group.	Longitude from Central Meridian.
	Umbra.	Whole Spot.	Umbra.	Whole Spot.			
Group 2083.							
1889. d					°	°	°
Mar. 5·498	0	6	0	9	312·8	− 7·6	− 71·4
6·492	2	26	2	24	313·8	− 6·9	− 57·3
7·217	4	31	3	23	314·2	− 6·1	− 47·4
8·164	3	40	2	24	315·0	− 6·2	− 34·1
9·462	14	53	7	28	316·3	− 6·9	− 15·7
10·393	11	54	6	27	317·3	− 7·1	− 2·4
11·487	3	33	2	18	317·6	− 7·4	+ 12·3
12·392	13	46	8	26	318·0	− 7·8	+ 24·6
13·256	5	21	3	13	320·1	− 8·4	+ 38·1
14·517	0	12	0	11	321·5	− 8·1	+ 56·1
15·282	0	5	0	7	322·9	− 9·2	+ 67·6
Means ...	...	...	3	19	317·23	− 7·43	...
Group 2084.							
Mar. 12·392	0	7	0	13	8·4	− 4·7	+ 75·0
Means ...	...	...	0	13	8·4	− 4·7	...
Group 2085.							
Mar. 13·256	25	98	14	56	306·5	+ 5·9	+ 24·5
14·517	9	156	7	110	307·9	+ 6·7	+ 42·5
15·282	41	163	36	145	310·0	+ 6·1	+ 54·7
16·555	14	109	27	203	311·7	+ 6·5	+ 73·2
17·391	0	15	0	36	304·9	+ 6·0	+ 79·4
Means ...	...	...	17	110	308·20	+ 6·24	...

AREAS and HELIOGRAPHIC POSITIONS of GROUPS of SUN SPOTS—*continued.*

Date. Greenwich Civil Time.	Projected Area of		Area for Group.		Mean Longitude of Group.	Mean Latitude of Group.	Longitude from Central Meridian.
	Umbra.	Whole Spot.	Umbra.	Whole Spot.			
Group 2086.							
1889. d					°	°	°
Apr. 1·659	11	55	18	89	314·8	+ 4·9	− 71·2
2·465	17	97	18	101	315·1	+ 5·0	− 60·4
3·292	26	144	21	114	315·3	+ 5·5	− 49·2
4·416	25	154	16	97	315·1	+ 5·0	− 34·6
5·518	21	167	12	91	315·2	+ 5·1	− 20·0
6·523	17	161	9	83	315·3	+ 5·5	− 6·7
7·532	25	159	13	82	315·2	+ 5·5	+ 6·5
8·186	20	101	11	53	315·2	+ 5·2	+ 15·2
9·330	15	66	9	39	315·2	+ 5·5	+ 30·4
10·203	3	32	2	22	314·7	+ 5·8	+ 41·4
11·246	0	8	0	7	315·4	+ 5·2	+ 55·9
Means ...	...	...	12	71	315·14	+ 5·29	...
Group 2087.							
Apr. 11·246	0	25	0	23	203·2	− 1·3	− 56·3
12·307	1	10	1	7	202·8	− 1·0	− 42·7
Means ...	...	...	1	15	203·00	− 1·15	...
Group 2088.							
May 5·644	0	44	0	126	217·4	− 1·9	− 79·9
6·461	14	87	20	121	217·6	− 1·5	− 68·8
7·526	34	114	30	100	217·1	− 1·6	− 55·3
8·471	12	77	8	53	216·8	− 1·6	− 43·1
9·201	6	30	3	18	217·2	− 1·3	− 33·0
10·495	0	24	0	12	218·7	− 0·9	− 14·4
Means ...	...	...	10	72	217·47	− 1·47	...
Group 2089.							
May 27·218	8	34	4	17	21·6	− 7·1	+ 9·8
Means ...	...	...	4	17	21·6	− 7·1	...

Date. Greenwich Civil Time.	Projected Area of		Area for Group.		Mean Longitude of Group.	Mean Latitude of Group.	Longitude from Central Meridian.
	Umbra.	Whole Spot.	Umbra.	Whole Spot.			
Group 2090.							
1889. d					°	°	°
June 16·471	48	238	91	447	29·6	− 5·8	− 74·3
17·398	85	479	92	545	27·8	− 5·6	− 63·7
18·625	131	722	96	538	28·2	− 5·8	− 47·2
19·407	146	861	91	539	28·6	− 5·8	− 36·1
20·397	172	951	93	519	28·9	− 5·8	− 22·8
21·525	183	1090	92	552	30·3	− 5·8	− 6·7
22·458	247	1252	125	633	30·8	− 5·7	+ 6·3
23·521	191	1016	103	547	31·2	− 5·7	+ 20·7
24·589	161	823	100	510	31·8	− 5·2	+ 35·5
25·420	138	659	102	487	32·1	− 4·9	+ 46·8
26·386	90	496	92	502	32·7	− 4·8	+ 60·1
27·443	43	213	81	400	32·8	− 4·8	+ 74·2
28·388	0	28	0	287	33·0	− 5·4	+ 86·9
Means ...	...	...	89	500	30·60	− 5·47	...
Group 2091.							
June 29·506	0	1	0	1	249·6	− 40·3	− 41·7
30·360	0	11	0	8	252·5	− 40·3	− 27·4
Means ...	...	...	0	5	251·05	− 40·30	...
Group 2092.							
July 12·514	11	69	45	280	36·8	− 7·4	− 82·3
13·447	36	214	55	332	36·5	− 7·0	− 70·3
14·291	66	314	66	317	36·2	− 7·3	− 59·2
15·428	65	446	47	322	35·9	− 7·0	− 44·6
16·437	83	535	50	320	35·9	− 7·2	− 31·3
17·242	96	590	53	325	36·1	− 8·1	− 20·4
18·204	99	623	51	324	36·1	− 8·3	− 7·7
19·471	154	804	80	416	36·5	− 7·8	+ 9·4
20·241	115	729	64	400	36·5	− 8·2	+ 19·7
21·282	104	525	64	321	35·8	− 8·5	+ 32·7
22·342	68	338	51	257	36·3	− 8·6	+ 47·2
23·210	43	277	44	283	36·8	− 8·9	+ 59·2
24·367	18	118	36	235	36·5	− 8·9	+ 74·3
Means ...	...	...	54	318	36·30	− 7·94	...

AREAS and HELIOGRAPHIC POSITIONS of GROUPS of SUN SPOTS—*continued.*

Date. Greenwich Civil Time.	Projected Area of		Area for Group.		Mean Longitude of Group.	Mean Latitude of Group.	Longitude from Central Meridian.
	Umbra.	Whole Spot.	Umbra.	Whole Spot.			
Group 2093.							
1889. d					°	°	°
July 14·291	5	11	2	5	81·1	− 6·7	− 14·3
15·428	20	102	9	52	81·7	− 7·2	+ 1·2
16·437	22	121	13	64	82·7	− 8·4	+ 15·5
17·242	32	94	19	55	83·6	− 7·8	+ 27·1
18·204	7	64	5	44	84·4	− 8·1	+ 40·6
19·471	0	5	0	6	88·8	− 7·4	+ 61·7
20·241	1	5	2	7	88·6	− 8·3	+ 71·8
Means ...	...	...	7	33	84·41	− 7·70	...
Group 2094.							
July 26·398	15	75	13	63	341·1	− 24·5	+ 45·7
27·354	15	56	19	69	343·1	− 23·8	+ 60·3
Means ...	...	...	16	66	342·10	− 24·15	...
Group 2095.							
July 29·454	24	96	16	62	294·8	+ 4·9	+ 39·8
30·397	4	45	4	36	294·6	+ 4·1	+ 52·1
31·390	0	5	0	6	294·8	+ 4·5	+ 65·4
Means ...	...	...	7	35	294·73	+ 4·50	...
Group 2096.							
July 29·454	6	42	5	36	200·8	− 1·2	− 54·2
30·397	13	45	9	30	201·8	− 0·8	− 40·7
31·390	24	156	15	91	200·0	− 0·2	− 29·4
Aug. 1·412	37	267	19	140	199·8	− 1·4	− 16·0
2·399	19	141	11	98	201·2	− 0·7	− 1·6
3·263	14	85	6	43	200·3	− 1·6	+ 8·3
4·440	0	24	0	13	199·7	− 0·6	+ 23·8
Means ...	...	...	9	64	200·51	− 0·93	...

Date. Greenwich Civil Time.	Projected Area of		Area for Group.		Mean Longitude of Group.	Mean Latitude of Group.	Longitude from Central Meridian.
	Umbra.	Whole Spot.	Umbra.	Whole Spot.			
Group 2097.							
1889. d					°	°	°
Aug. 2·399	3	15	2	12	157·5	− 21·3	− 45·3
3·263	19	52	13	34	159·7	− 20·7	− 32·3
4·440	75	449	45	267	158·7	− 21·1	− 17·2
5·418	134	728	78	414	161·2	− 20·9	− 1·8
6·398	157	840	91	488	162·2	− 20·9	+ 12·3
7·230	102	766	63	473	162·4	− 20·7	+ 23·5
8·412	122	598	89	441	162·8	− 20·3	+ 39·4
9·184	77	508	69	453	162·8	− 20·4	+ 49·7
10·360	48	299	71	437	163·3	− 20·3	+ 65·8
11·189	0	113	0	342	164·0	− 19·9	+ 77·4
Means ...	...	...	52	336	161·46	− 20·65	...
Group 2098.							
Aug. 9·184	6	19	4	12	76·3	− 7·9	− 36·8
10·360	60	379	33	209	78·2	− 7·6	− 19·3
11·189	60	521	31	273	79·2	− 7·6	− 7·4
12·205	57	400	30	210	80·1	− 7·7	+ 6·9
13·232	95	467	53	257	79·7	− 7·7	+ 20·1
14·485	103	717	68	473	80·4	− 6·8	+ 37·3
15·388	106	809	85	639	80·3	− 6·5	+ 49·2
16·404	69	536	81	625	80·9	− 6·5	+ 63·3
17·501	24	131	58	320	80·5	− 6·6	+ 77·3
Means ...	...	...	49	335	79·51	− 7·21	...
Group 2099.							
Aug. 9·184	6	54	13	116	37·6	− 7·9	− 75·5
10·360	26	124	27	133	37·1	− 7·9	− 60·4
11·189	29	143	23	115	37·1	− 8·2	− 49·5
12·205	33	126	22	82	36·6	− 8·4	− 36·6
13·232	31	157	17	89	36·7	− 8·2	− 22·9
14·485	24	147	12	76	37·2	− 8·6	− 5·9
15·388	31	153	16	79	37·1	− 8·4	+ 6·0
16·404	25	120	14	66	37·0	− 8·3	+ 19·4
17·501	22	50	14	31	36·7	− 8·1	+ 33·5
18·349	17	56	12	40	36·8	− 8·0	+ 44·8
19·435	8	27	8	27	36·4	− 7·6	+ 58·7
20·382	0	16	0	27	36·6	− 8·1	+ 71·5
Means ...	...	...	15	73	36·91	− 8·14	...

AREAS and HELIOGRAPHIC POSITIONS of GROUPS of SUN SPOTS—*continued.*

Date. Greenwich Civil Time.	Projected Area of		Area for Group.		Mean Longitude of Group.	Mean Latitude of Group.	Longitude from Central Meridian.
	Umbra.	Whole Spot.	Umbra.	Whole Spot.			
Group 2100.							
1889. d					°	°	°
Aug. 27·388	24	137	44	250	162·2	− 19·0	− 70·4
28·392	36	241	40	263	161·4	− 19·0	− 57·9
29·392	62	331	50	266	161·3	− 18·8	− 44·8
30·410	55	308	36	204	160·9	− 19·1	− 31·8
31·405	68	359	41	213	160·5	− 19·2	− 19·0
Sept. 1·506	72	379	41	214	160·3	− 19·5	− 4·6
2·440	66	374	38	213	160·0	− 19·5	+ 7·4
3·326	56	283	33	168	159·7	− 19·5	+ 18·8
4·305	46	261	31	172	159·6	− 19·6	+ 31·6
5·212	55	203	44	163	160·0	− 19·8	+ 44·0
6·431	18	119	20	137	159·2	− 19·4	+ 59·3
7·163	14	67	25	117	159·4	− 19·8	+ 69·2
Means ...	...	...	37	198	160·38	− 19·35	...
Group 2101.							
Sept. 3·326	0	8	0	8	83·6	− 9·3	− 57·3
4·305	0	8	0	6	83·5	− 9·5	− 44·5
Means ...	...	...	0	7	83·55	− 9·4	...
Group 2102.							
Sept. 7·163	4	28	4	31	146·9	− 22·2	+ 56·7
8·182	5	77	15	195	150·6	− 22·6	+ 74·4
Means ...	...	...	10	113	148·75	− 22·40	...
Group 2103.							
Sept. 24·215	12	103	26	204	153·5	− 20·3	− 71·6
25·395	28	168	30	186	152·2	− 21·3	− 57·4
26·413	58	297	45	233	153·8	− 21·6	− 42·3
27·341	48	235	33	157	152·5	− 20·8	− 31·4
28·405	60	287	37	176	152·9	− 21·4	− 17·0
29·388	72	309	41	175	152·5	− 21·0	− 4·4
30·339	50	253	29	143	151·5	− 21·0	+ 7·2
Oct. 1·486	38	221	23	136	152·4	− 20·8	+ 23·2
2·404	12	115	8	80	152·0	− 20·8	+ 34·9
3·562	10	47	9	42	151·9	− 20·6	+ 50·1
4·495	0	14	0	19	152·6	− 20·4	+ 63·1
Means ...	...	...	26	141	152·53	− 20·91	...

Date. Greenwich Civil Time.	Projected Area of		Area for Group.		Mean Longitude of Group.	Mean Latitude of Group.	Longitude from Central Meridian.
	Umbra.	Whole Spot.	Umbra.	Whole Spot.			
Group 2104.							
1889. d					°	°	°
Oct. 8·393	0	18	0	12	12·1	− 28·8	− 25·9
Means ...	...	...	0	12	12·1	− 28·8	...
Group 2105.							
Oct. 9·400	0	15	0	9	25·0	−24·9	+ 0·2
10·386	0	16	0	10	23·2	−24·8	+ 11·4
11·298	0	9	0	6	21·9	−26·1	+ 22·2
Means ...	...	...	0	8	23·37	−25·27	...
Group 2106.							
Oct. 16·290	5	26	3	16	328·5	+22·6	+ 34·7
17·399	0	34	0	26	326·7	+23·1	+ 47·5
18·149	0	2	0	2	331·5	+21·2	+ 62·2
Means ...	...	...	1	15	328·90	+22·30	...
Group 2107.							
Oct. 23·314	0	3	0	2	154·1	−22·5	− 47·1
Means ...	...	...	0	2	154·1	−22·5	...
Group 2108.							
Dec. 12·458	4	39	7	73	334·5	− 7·1	+ 74·3
13·293	0	12	0	71	334·5	− 7·8	+ 85·3
Means ...	...	...	4	72	334·50	− 7·45	...
Group 2109.							
Dec. 18·236	4	21	2	12	169·1	+24·2	− 15·1
19·495	2	50	1	28	168·5	+24·2	+ 0·9
20·247	13	80	7	45	167·3	+24·5	+ 9·7
21·205	19	77	11	46	167·7	+23·9	+ 22·6
22·216	0	53	0	37	167·8	+23·8	+ 36·1
Means ...	...	...	4	34	168·08	+24·12	...

AREAS and HELIOGRAPHIC POSITIONS of GROUPS of SUN SPOTS—*concluded.*

Date. Greenwich Civil Time.	Projected Area of		Area for Group.		Mean Longitude of Group.	Mean Latitude of Group.	Longitude from Central Meridian.
	Umbra.	Whole Spot.	Umbra.	Whole Spot.			
Group 2110.							
1889. d					°	°	°
Dec. 18·236	2	8	6	31	101·7	−26·7	− 82·5
19·495	2	14	4	18	102·3	−26·2	− 65·3
20·247	5	20	5	19	101·9	−26·4	− 55·7
21·205	0	4	1	3	101·9	−26·3	− 43·2
22·216	0	22	0	14	101·7	−26·3	− 30·0
23·486	0	12	0	7	96·6	−26·8	− 18·4
24·245	4	37	2	20	95·6	−25·9	− 9·3
25·176	24	87	14	48	96·5	−26·8	+ 3·8
26·247	40	271	24	155	98·0	−26·4	+ 19·4
27·266	72	349	47	227	98·2	−26·5	+ 33·1
28·213	37	292	29	229	99·1	−26·7	+ 46·3
29·187	40	209	44	221	99·5	−26·8	+ 59·6
30·263	16	144	35	299	101·9	−26·4	+ 76·2
Means ...	...	...	16	99	99·61	−26·48	...

Date. Greenwich Civil Time.	Projected Area of		Area for Group.		Mean Longitude of Group.	Mean Latitude of Group.	Longitude from Central Meridian.
	Umbra.	Whole Spot.	Umbra.	Whole Spot.			
Group 2111.							
1889. d					°	°	°
Dec. 27·266	6	34	28	150	341·2	− 8·9	− 83·9
28·213	13	61	18	86	343·2	− 8·6	− 69·6
29·187	35	91	32	82	343·6	− 8·8	− 56·3
30·263	20	104	14	71	343·5	− 9·2	− 42·2
31·458	22	120	12	67	343·9	− 9·1	− 26·1
1890.							
Jan. 1·454	19	109	10	57	344·0	− 9·3	− 12·6
2·298	32	134	16	67	344·0	− 9·3	− 1·5
3·245	23	93	12	48	344·9	− 9·5	+ 11·9
4·213	17	74	9	41	344·4	− 9·5	+ 24·1
5·203	15	47	9	29	344·4	− 9·6	+ 37·2
6·212	8	33	7	26	345·0	− 9·6	+ 51·1
7·430	0	14	0	17	344·9	− 9·8	+ 67·0
Means ...	...	...	14	62	343·92	− 9·27	...

ROYAL OBSERVATORY, GREENWICH.

TOTAL PROJECTED 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

1889.

TOTAL PROJECTED AREAS OF SUN SPOTS AND FACULÆ FOR EACH DAY IN THE YEAR 1889.

The Projected Area is the area as it is measured on the photograph, uncorrected for the effect of foreshortening, and expressed in millionths of the Sun's apparent disk.

The Greenwich Civil Time is expressed by the month, day of the month (civil reckoning) and decimal of a day, reckoned from Greenwich Mean Midnight.

Greenwich Civil Time.	Projected Area.			Greenwich Civil Time.	Projected Area.			Greenwich Civil Time.	Projected Area.			Greenwich Civil Time.	Projected Area.		
	Umbræ.	Whole Spots.	Faculæ.		Umbræ.	Whole Spots.	Faculæ.		Umbræ.	Whole Spots.	Faculæ.		Umbræ.	Whole Spots.	Faculæ.
1889 d				1889 d				1889 d				1889 d			
Jan. 1·3	0	0	0	Feb. 22·5	7	32	0	April 14·2	0	0	0	June 4·5	0	0	0
2·2	0	0	0	23·4	14	66	73	15·4	0	0	0	5·4	0	0	0
3·2	0	0	23	24·	...	...	...	16·2	0	0	0	6·5	0	0	0
4·2	0	0	0	25·3	5	62	0	17·2	0	0	0	7·4	0	0	0
5·4	0	0	98	26·4	0	82	0	18·3	0	0	0	8·1	0	0	0
6·3	0	0	318	27·4	72	290	0	19·5	0	0	0	9·2	0	0	0
7·2	0	0	555	28·6	35	172	0	20·2	0	0	0	10·2	0	0	0
8·3	0	0	285					21·5	0	0	0	11·4	0	0	0
9·2	0	0	482	March 1·4	16	99	55	22·4	0	0	0	12·3	0	0	356
10·2	0	0	0	2·2	5	40	565	23·3	0	0	33	13·4	0	0	234
11·5	0	0	0	3·5	0	0	458	24·2	0	0	0	14·2	0	0	50
12·4	0	0	0	4·5	0	0	94	25·2	0	0	0	15·3	0	0	0
13·3	0	0	0	5·5	0	6	49	26·5	0	0	0	16·5	48	238	0
14·3	0	0	0	6·5	2	26	67	27·5	0	0	0	17·4	85	479	533
15·	...	...	...	7·2	4	31	158	28·7	0	0	0	18·6	131	722	633
16·4	7	68	302	8·2	3	40	0	29·5	0	0	0	19·4	146	861	0
17·4	16	59	172	9·5	14	53	0	30·3	0	0	0	20·4	172	951	0
18·3	0	0	42	10·4	11	54	164					21·5	183	1090	0
19·5	0	0	0	11·5	3	33	0	May 1·2	0	0	0	22·5	247	1252	0
20·2	0	0	0	12·4	13	53	91	2·2	0	0	0	23·5	191	1016	0
21·2	0	0	122	13·3	30	119	0	3·6	0	0	0	24·6	161	823	0
22·2	0	0	197	14·5	9	169	78	4·5	0	0	0	25·4	138	659	0
23·2	0	0	0	15·3	41	168	530	5·6	0	44	24	26·4	90	496	353
24·2	0	0	0	16·6	14	109	223	6·5	14	87	103	27·4	43	213	457
25·3	0	0	0	17·4	0	15	126	7·5	34	114	486	28·4	0	28	111
26·4	0	0	0	18·2	0	0	0	8·5	12	77	0	29·5	0	1	120
27·5	0	0	0	19·2	0	0	0	9·2	6	30	0	30·4	0	11	202
28·5	0	0	0	20·2	0	0	167	10·5	0	24	0				
29·2	0	0	0	21·4	0	0	123	11·1	0	0	0	July 1·4	0	0	0
30·2	0	0	0	22·6	0	0	0	12·2	0	0	0	2·5	0	0	0
31·5	0	0	0	23·5	0	0	0	13·3	0	0	30	3·2	0	0	0
				24·2	0	0	0	14·3	0	0	0	4·6	0	0	0
Feb. 1·3	7	37	291	25·3	0	0	0	15·5	0	0	0	5·4	0	0	0
2·4	30	168	203	26·3	0	0	88	16·4	0	0	692	6·4	0	0	0
3·5	27	198	0	27·2	0	0	82	17·7	0	0	352	7·2	0	0	0
4·2	15	138	133	28·6	0	0	78	18·6	0	0	42	8·	...	...	...
5·3	3	44	24	29·2	0	0	405	19·2	0	0	0	9·5	0	0	77
6·2	0	12	0	30·2	0	0	376	20·5	0	0	0	10·2	0	0	72
7·6	0	0	0	31·2	0	0	0	21·4	0	0	0	11·4	0	0	0
8·3	0	0	0					22·4	0	0	0	12·5	11	69	71
9·5	0	0	0	April 1·7	11	55	114	23·4	0	0	0	13·4	36	214	336
10·2	0	0	0	2·5	17	97	181	24·4	0	0	0	14·3	71	325	623
11·2	0	0	143	3·3	26	144	319	25·4	0	0	0	15·4	85	548	345
12·3	0	0	133	4·4	25	154	0	26·3	0	0	0	16·4	106	655	243
13·2	0	0	168	5·5	21	167	0	27·2	8	34	72	17·2	128	684	0
14·2	0	0	0	6·5	17	161	0	28·5	0	0	0	18·2	106	687	0
15·5	0	0	0	7·5	25	159	0	29·4	0	0	0	19·5	154	810	0
16·1	0	0	0	8·2	20	101	79	30·4	0	0	0	20·2	116	734	394
17·5	0	0	0	9·3	15	66	37	31·5	0	0	0	21·3	104	525	65
18·5	0	0	0	10·2	3	32	0					22·3	68	338	529
19·3	0	0	0	11·2	0	32	541	June 1·4	0	0	0	23·2	43	277	900
20·2	0	0	0	12·3	1	10	297	2·4	0	0	116	24·4	18	118	331
21·4	0	0	66	13·2	0	0	62	3·4	0	0	211	25·	...	...	...

TOTAL PROJECTED AREAS OF SUN SPOTS AND FACULÆ—*concluded.*

Greenwich Civil Time.		Projected Area.			Greenwich Civil Time.		Projected Area.			Greenwich Civil Time.		Projected Area.			Greenwich Civil Time.		Projected Area.		
		Umbræ.	Whole Spots.	Faculæ.			Umbræ.	Whole Spots.	Faculæ.			Umbræ.	Whole Spots.	Faculæ.			Umbræ.	Whole Spots.	Faculæ
1889	d				1889	d				1889	d				1889	d			
July	26·4	15	75	149	Sept.	3·3	56	291	326	Oct.	13·5	0	0	0	Nov.	22·3	0	0	0
	27·4	15	56	176		4·3	46	269	262		14·4	0	0	0		23·3	0	0	0
	28·	...	...	...		5·2	55	203	438		15·4	0	0	0		24·2	0	0	0
	29·5	30	138	239		6·4	18	119	299		16·3	5	26	0		25·4	0	0	0
	30·4	18	90	0		7·2	18	96	323		17·4	0	34	0		26·5	0	0	0
	31·4	24	162	251		8·2	5	77	307		18·1	0	2	186		27·2	0	0	0
						9·4	0	0	0		19·4	0	0	330		28·5	0	0	0
Aug.	1·4	37	267	31		10·4	0	0	0		20·3	0	0	284		29·3	0	0	325
	2·4	22	156	0		11·4	0	0	0		21·3	0	0	144		30·2	0	0	0
	3·2	33	136	0		12·4	0	0	0		22·4	0	0	227					
	4·4	75	473	0		13·5	0	0	94		23·3	0	3	369	Dec.	1·5	0	0	0
	5·4	134	728	88		14·5	0	0	62		24·4	0	0	0		2·5	0	0	0
	6·4	157	840	592		15·4	0	0	124		25·4	0	0	0		3·4	0	0	0
	7·2	102	766	323		16·4	0	0	0		26·4	0	0	0		4·4	0	0	0
	8·4	122	598	144		17·4	0	0	0		27·2	0	0	45		5·3	0	0	0
	9·2	90	582	948		18·4	0	0	0		28·3	0	0	0		6·2	0	0	0
	10·4	134	803	881		19·3	0	0	0		29·2	0	0	0		7·3	0	0	0
	11·2	89	777	411		20·4	0	0	0		30·4	0	0	0		8·3	0	0	0
	12·2	91	526	0		21·4	0	0	0		31·4	0	0	0		9·3	0	0	0
	13·2	126	624	0		22·2	0	0	0							10·2	0	0	0
	14·5	127	863	88		23·4	0	0	65	Nov.	1·4	0	0	118		11·3	0	0	0
	15·4	137	962	0		24·2	12	103	374		2·4	0	0	0		12·5	4	39	130
	16·4	94	656	572		25·4	28	168	771		3·2	0	0	0		13·3	0	12	26
	17·5	46	181	358		26·4	58	297	816		4·2	0	0	184		14·3	0	0	0
	18·3	17	56	29		27·3	48	235	0		5·4	0	0	0		15·2	0	0	0
	19·4	8	27	309		28·4	60	287	0		6·3	0	0	0		16·3	0	0	0
	20·4	0	16	227		29·4	72	309	0		7·3	0	0	0		17·2	0	0	0
	21·3	0	0	112		30·3	50	253	0		8·5	0	0	0		18·2	5	29	25
	22·4	0	0	0							9·2	0	0	0		19·5	5	64	110
	23·4	0	0	0	Oct.	1·5	38	221	0		10·2	0	0	0		20·2	18	100	452
	24·5	0	0	0		2·4	12	115	244		11·2	0	0	0		21·2	19	81	458
	25·4	0	0	0		3·6	10	47	447		12·4	0	0	0		22·2	0	75	456
	26·4	0	0	0		4·5	0	14	222		13·4	0	0	0		23·5	0	12	550
	27·4	24	137	213		5·2	0	0	262		14·2	0	0	143		24·2	4	37	323
	28·4	36	241	367		6·2	0	0	0		15·2	0	0	152		25·2	24	87	170
	29·4	62	331	244		7·4	0	0	0		16·2	0	0	0		26·2	40	271	0
	30·4	55	308	0		8·4	0	18	0		17·2	0	0	0		27·3	79	383	94
	31·4	68	359	0		9·4	0	15	0		18·2	0	0	152		28·2	49	352	142
						10·4	0	16	0		19·2	0	0	220		29·2	76	300	1108
Sept.	1·5	72	379	0		11·3	0	9	113		20·2	0	0	146		30·3	37	248	444
	2·4	66	374	0		12·4	0	0	0		21·2	0	0	77		31·3	22	120	0

MEAN AREAS of SUN SPOTS and FACULÆ, as measured on PHOTOGRAPHS taken at the ROYAL OBSERVATORY, GREENWICH, at DEHRA DÛN, INDIA, and in MAURITIUS, for each ROTATION of the SUN, from 1888 December 15 to 1890 January 1.

The Mean Areas have been formed by taking the Means of the Areas for each day of observation throughout each Rotation of the Sun, the Projected Areas being the areas as measured on the photographs and expressed in millionths of the Sun's apparent disk, and the Areas corrected for foreshortening being expressed (as in former years) in millionths of the Sun's visible hemisphere.

The rotations adopted in the following table (which is in continuation of those for the years 1873–1884, 1885, 1886, 1887, and 1888 printed in the Greenwich Observations for 1884, 1885, 1886, 1887, and 1888) correspond to the synodic rotation of the Sun, and the commencement of each is defined by the coincidence of the assumed prime meridian with the central meridian, the assumed prime meridian being that meridian which passed through the ascending node at mean noon on January 1, 1854, and the assumed period of the Sun's sidereal rotation being 25·38 days. The rotations adopted in the volumes of Greenwich Observations, 1877 to 1883, correspond on the other hand to the sidereal rotation of the Sun, the commencement of each being defined by the coincidence of the assumed prime meridian with the ascending node. The numeration of the rotations is in continuation of Carrington's series (*Observations of Solar Spots made at Redhill* by R. C. Carrington, F.R.S.), No. 1 being the rotation commencing 1853, November 9. The dates of commencement of the rotations are given in GREENWICH CIVIL TIME, reckoning from midnight.

No. of Rotation.	Date of Commencement of each Rotation.			No. of Days on which Photographs were taken.	Mean of Daily Areas.					
					Projected.			Corrected for Foreshortening.		
			d		Umbræ.	Whole Spots.	Faculæ.	Umbræ.	Whole Spots.	Faculæ.
471	1888	December	15·33	26	3·8	30·8	107	2·9	23·9	121
472	1889	January	11·66	26	4·0	27·8	57·2	2·5	16·6	76·2
473		February	8·00	27	5·9	33·6	75·1	3·4	20·0	79·6
474		March	7·34	27	7·1	41·1	116	6·3	37·8	137
475		April	3·64	27	4·7	32·7	38·9	2·7	18·7	46·9
476		April	30·90	27	2·7	15·2	66·7	2·4	16·6	80·5
477		May	28·12	27	44·5	245	79·0	29·0	160	84·3
478		June	24·31	27	50·0	277	128	37·4	214	165
479		July	21·52	25	73·9	448	280	54·8	345	343
480		August	17·74	27	22·4	122	131	17·9	101	175
481		September	14·00	27	14·4	77·7	125	10·4	58·6	151
482		October	11·28	28	0·2	2·6	72·1	0·1	1·9	93·0
483		November	7·58	27	0·0	0·0	45·0	0·0	0·0	58·0
484		December	4·89	27	14·1	81·9	166	12·7	76·3	214

MEAN AREAS of SUN SPOTS, and FACULÆ, as measured on PHOTOGRAPHS taken at the ROYAL OBSERVATORY, GREENWICH, at DEHRA DÛN, INDIA, and in MAURITIUS, for the YEAR 1889.

The Mean Projected Areas are expressed in millionths of the Sun's apparent disk.

The Mean Areas corrected for foreshortening are expressed in millionths of the Sun's visible hemisphere.

Year.	No. of Days on which Photographs were taken.	Mean of Daily Areas.					
		Projected.			Corrected for Foreshortening.		
		Umbræ.	Whole Spots.	Faculæ.	Umbræ.	Whole Spots.	Faculæ
1889	360	17·9	103	107	13·1	78·0	131

MEAN HELIOGRAPHIC LATITUDE of SUN SPOTS, as measured on PHOTOGRAPHS taken at the ROYAL OBSERVATORY, GREENWICH, at DEHRA DÛN, INDIA, and in MAURITIUS, for each ROTATION of the SUN, from 1888 December 15 to 1890 January 1.

The numbers given in the accompanying table have been formed as follows:—

The Heliographic Latitude of each Spot for each day has been multiplied by its Area (corrected for foreshortening), and the sum of the products for Spots North of the Sun's Equator has been divided by the sum of the corresponding Areas to form Mean Heliographic Latitude of Spotted Area North of Equator; similarly for Spots South of the Equator. In forming the Mean Heliographic Latitude of entire Spotted Area the algebraic sum of the products for Spots North and South of the Equator has been divided by the sum of the Areas; and for the Mean Distance from the Equator for all Spots, the numerical sum of the products, without regard to the sign of the latitude, has been similarly divided.

The Mean Areas have been formed by dividing the sum of the Daily Areas (corrected for foreshortening) by the number of days of observation for each Rotation of the Sun, and are expressed in millionths of the Sun's visible hemisphere.

No. of Rotation.	Date of Commencement of each Rotation.	No. of Days on which Photographs were taken.	Spots NORTH of the Equator.		Spots SOUTH of the Equator.		Mean Heliographic Latitude of entire Spotted Area.	Mean Distance from Equator of all Spots.
			Mean of Daily Areas.	Mean Heliographic Latitude.	Mean of Daily Areas.	Mean Heliographic Latitude.		
	d			°		°	°	°
471	1888 Dec. 15·33	26	0·0	...	23·9	6·63	− 6·63	6·63
472	1889 Jan. 11·66	26	2·8	10·16	13·8	3·60	− 1·28	4·71
473	Feb. 8·00	27	0·0	...	20·0	7·18	− 7·18	7·18
474	Mar. 7·34	27	31·6	6·08	6·2	7·16	+ 3·92	6·26
475	Apr. 3·64	27	17·6	3·32	1·1	0·95	+ 3·06	3·18
476	Apr. 30·94	27	0·0	...	16·6	2·03	− 2·03	2·03
477	May 28·12	27	0·0	...	160	5·94	− 5·94	5·94
478	June 24·31	27	0·0	...	214	6·64	− 6·64	6·64
479	July 21·52	25	7·6	2·69	338	13·78	− 13·42	13·54
480	Aug. 17·74	27	0·0	...	101	19·18	− 19·18	19·18
481	Sept. 14·00	27	0·0	...	586	21·08	− 21·08	21·08
482	Oct. 11·28	28	1·6	22·70	0·3	25·20	+ 15·34	23·08
483	Nov. 7·58	27	0·0	...	0·0	...	...	...
484	Dec. 4·89	27	6·2	24·27	70·0	20·90	− 17·21	21·17

MEAN HELIOGRAPHIC LATITUDE of SUN SPOTS, as measured on PHOTOGRAPHS taken at the ROYAL OBSERVATORY, GREENWICH, at DEHRA DÛN, INDIA, and in MAURITIUS, for the YEAR 1889.

YEAR.	No. of Days on which Photographs were taken.	Spots NORTH of the Equator.		Spots SOUTH of the Equator.		Mean Heliographic Latitude of entire Spotted Area.	Mean Distance from Equator of all Spots.
		Mean of Daily Areas.	Mean Heliographic Latitude.	Mean of Daily Areas.	Mean Heliographic Latitude.		
			°		°	°	°
1889	360	5·0	7·26	73·0	11·90	− 10·68	11·61

NOTE.—In the computations for forming the corresponding Tables given in the Volumes for 1884 and 1885 the latitudes of the Spots were only taken to the nearest whole degree, the next higher whole degree being adopted whenever the fractional part of the latitude amounted to or exceeded ·5. Thus, under 8°, for example, would be included all Spots from 7°·5 to 8°·4, both inclusive; and the corresponding mean latitude should have been taken as 7°·95 instead of 8°. The Mean Heliographic Latitudes, therefore, both for Spots North and Spots South of the Equator, and the Mean Distances from the Equator of all Spots, both for the rotations and for entire years, require a correction of − 0°·05. The Mean Latitude of the entire Spotted Area requires the following correction:—

$$-0°{\cdot}05 \times \frac{\text{Mean Area N.} - \text{Mean Area S.}}{\text{Mean Area N.} + \text{Mean Area S.}}$$

These corrections have been applied in computing the Mean Heliographic Latitudes and Mean Distance from the Equator given in the above Tables for 1889, and in the corresponding Tables for 1886, 1887 and 1888.