GREENWICH

SPECTROSCOPIC AND PHOTOGRAPHIC RESULTS.

1888.

RESULTS

OF THE

SPECTROSCOPIC AND PHOTOGRAPHIC OBSERVATIONS

MADE AT THE

ROYAL OBSERVATORY, GREENWICH,

IN THE YEAR

1888:

UNDER THE DIRECTION OF

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ASTRONOMER ROYAL.

(EXTRACTED FROM THE GREENWICH OBSERVATIONS, 1888.)

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GREENWICH SPECTROSCOPIC AND PHOTOGRAPHIC RESULTS, 1888.

INTRODUCTION.

§ 1. *Spectroscopic Observations in the Year* 1888.

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, of the planet Mars, and of the Moon and Sun; Collected Results for Motions of Stars in the line of Sight; and Observations of the Spectra of γ Cassiopeiæ, Mira Ceti, α Orionis, α Herculis, β Lyræ, R Cygni and P Cygni, and of Comets *a* and *e* 1888.

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 Mira Ceti and α Herculis, 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. In the case of the bright lines in the spectra of Mira Ceti, β Lyræ, R Cygni and P Cygni, the distance of the stellar line from some standard line in its immediate neighbourhood has been determined, and the value in wave-length of a revolution of the micrometer for that point of the spectrum taken out from the standard curve. The tabular wave-lengths of comparison-lines have been taken from Ångström's *Spectre Normal du Soleil.*

§ 2. *Measures of Positions and Areas of Spots and Faculæ upon the Sun's Disk on Photographs taken at the Royal Observatory, Greenwich, at Dehra Dûn in India, and at the Royal Alfred Observatory, Mauritius, in the year* 1888; *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 Colonel C. T. Haig, R.E., 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 171 days, and Indian photographs on 170 days with Mauritius photographs on 38 days have been received from the Solar Physics Committee to complete the total of 359 days for which there are either Greenwich, Indian, or Mauritius photographs of the Sun available for measurement in 1888. On 20 days both an Indian and a Mauritius photograph were measured.

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 1888:—

E. W. Maunder	M	W. Russell	WR
H. P. Hollis	H	S. J. Temple	ST
A. E. Pilkington	EP		

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 1888 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	° ′
1887, December	9. 12	+ 0. 27
1888, March	1. 12	+ 0. 34
	29. 11	+ 0. 30
May	25. 11	+ 0. 46
June	23. 13	+ 0. 31
August	3. 11	+ 1. 1
	15	+ 1. 12
September	11. 14	+ 0. 57
October	8. 12	+ 0. 51
November	10. 11	− 0. 18
December	7. 13	− 2. 3
1889, February	2. 12	+ 0. 4

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 1888, November 4, was − 0°. 7′; for the new wires inserted 1888, November 6, it was — 0°. 23′. 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.		Corrected Zero of Position-Circle from Transit.	Zero of Position-Circle obtained when using R.A. Slow Motion.
	h	° ′	° ′
1887, December	9. 12	+ 0. 36	.....
1888, February	1. 11	+ 0. 27	.....
March	29. 11	+ 0. 24	+ 0. 29
May	25. 11	+ 0. 49	.....
June	23. 11	+ 0. 47	+ 0. 44
July	30. 12	+ 0. 53	.....
August	7. 13	+ 0. 44	+ 0. 48
September	12. 12	+ 0. 50	+ 0. 51
October	8. 12	+ 0. 57	+ 0. 57
November	10. 11	− 1. 20	.....
December	7. 13	− 2. 31	− 2. 32
1889, February	2. 10	+ 0. 3	+ 0. 3

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.

The vertical wire was found to be broken on November 4, and a new pair of wires were accordingly inserted on November 6. The wire-frame was found to be loose on December 7. The position-circle reading was altered on December 7 after the double-image photographs and transits for the determination of the zero had been taken.

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 readings of the position-circle in 1888 have been as follows :—

From 1888, January 1	- - -	356°·0
December 7	- - -	353°·0

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 $c = \sin 57''\cdot5 = \frac{1}{3600}$ 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 $\delta\, r$ 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 $\delta\, r$ 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.

$\theta - v$	$\theta - v$	$-\frac{\text{Sin } 2(\theta - v)}{2}$	$\frac{\text{Cos } 2(\theta - v)}{2}$	$\theta - v$	$\theta - v$	$-\frac{\text{Sin } 2(\theta - v)}{2}$	$\frac{\text{Cos } 2(\theta - v)}{2}$
°	°			°	°		
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 Spot-groups upon the Sun's Disk deduced from the measurement of the Solar photographs for each day in the year* 1888.

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* 1888.

This section requires no further explanation.

§ 5. *Total Projected Areas of Sun Spots and Faculæ, for each day, and Mean Projected Areas for each Rotation of the Sun, and for each year from* 1882 *to* 1885.

This section also requires no further explanation.

W. H. M. CHRISTIE.

1889 *October* 23.

DISCUSSION OF PROBABLE ERROR AND PERSONALITY IN MEASUREMENTS OF SOLAR PHOTOGRAPHS.

I.—PROBABLE ERROR IN MEASUREMENTS ON FOUR-INCH PHOTOGRAPHS.

For the determination of probable error in measurements of distance, position-angle and area, six *four-inch* photographs, containing in all 50 spots, which had been already measured twice (on the right and left of the centre) in 1882, 1883, 1884, and 1886 for publication in the daily results, were remeasured on the right and left by each of four observers in 1888 November and December; so that in all ten independent measurements of each photograph were available for comparison. The mean of each set of measures of distance, position-angle, area of umbra, and area of whole spot was then formed; next the discordance of individual measures from the mean; and, finally, the mean discordance. The means and mean discordances are given in the subjoined tables.

The number and small letter in the *first* column of each table is the same as that given in the printed results, the letter I denoting that the spot was measured on an Indian photograph, and the letter M that it was measured on a photograph from Mauritius.

The spots are arranged in the first table in order of distance from the Sun's centre, the quantity $\frac{r}{R}$ in the *second* column giving this distance in parts of the radius of the apparent disk.

In the second table they are arranged according to area of whole spot as given in the *twelfth* column.

In the measures of distance a small correction for zero of scale has been applied. This correction has been derived from the difference between the mean of the readings obtained for the limb of the Sun when the magnifier was on the left of the centre of the measuring instrument, and the mean of those obtained when the magnifier was on the right.

In the measures of position angle it is obvious that the mean discordance depends on the distance of the spot from the Sun's centre. Accordingly in the *seventh* column is given the equivalent at the uniform distance of the Sun's radius (R), obtained by multiplying each term in this column by the corresponding factor in column 2.

The measures of areas are expressed in ten-thousandths of a square inch. It is again obvious that the mean discordance bears some relation to the mean area, the simplest supposition being that it varies directly as the mean area. The results of this supposition are given in columns 10 and 14 respectively, where the mean discordance is exhibited as a per-centage; but as these are not satisfactorily accordant, another hypothesis was tried, viz., that the mean discordance is proportional to the perimeter of the spot, which would be the case if we suppose it due to the existence of an ill-defined border of constant breadth. The results of this hypothesis are exhibited in columns 11 and 15 respectively, the square root of the area being considered roughly proportional to the perimeter.

TABLE I. (arranged according to distance from Sun's centre).

No. and Letter for Spot.	$\frac{r}{R}$	Distance.		Position-Angle.			Area of Umbra.				Area of Whole Spot.			
		Mean Reading.	Mean Discordance.	Mean Reading.	Mean Discordance.	Mean Discordance at distance R.	Mean Area.	Mean Discordance.	Mean Discordance per cent of Umbra.	Mean Discordance divided by Square Root of Umbra.	Mean Area.	Mean Discordance.	Mean Discordance per cent. of Whole Spot.	Mean Discordance divided by Square Root of Whole Spot.
		d	d	°	°	°								
I. 718	0·990	492·2	0·60	247·0	0·17	0·168	0·1	0·07	70·0	0·222	3·3	0·89	26·2	0·489
1271	0·969	478·5	0·65	266·9	0·10	0·097	2·0	0·54	27·0	0·383	10·1	1·49	14·8	0·469
M. 1578*a*	0·966	491·8	0·33	67·2	0·08	0·077	0·8	0·18	22·5	0·201	4·2	0·59	14·0	0·288
I. 729	0·966	480·2	0·76	90·7	0·20	0·193	10·5	2·28	21·7	0·704	90·2	10·28	11·4	1·082
M. 1573*a*	0·963	490·3	0·37	253·6	0·08	0·077	0·8	0·34	42·5	0·381	7·1	1·11	15·6	0·417
M. 1573*c*	0·956	486·7	0·36	256·8	0·14	0·134	3·3	0·50	15·2	0·275	22·1	1·57	7·1	0·334
I. 693	0·955	478·4	0·75	273·1	0·16	0·153	1·5	0·24	16·0	0·197	9·3	1·07	11·5	0·351
M. 1573*b*	0·928	472·1	0·56	259·1	0·11	0·102	11·2	1·78	15·9	0·531	48·0	2·00	4·2	0·289
I. 699	0·924	463·1	0·51	82·2	0·14	0·129	2·0	0·24	12·0	0·170	14·1	2·36	16·7	0·629
731	0·911	441·1	0·56	225·8	0·14	0·128	1·2	0·13	10·8	0·118	7·3	0·57	7·8	0·211
I. 726	0·816	405·2	1·04	83·3	0·17	0·139	0·9	0·62	68·9	0·653	10·5	1·64	15·6	0·506
1231*b*	0·814	403·6	1·14	252·9	0·09	0·073	2·4	0·82	34·2	0·529	12·7	1·87	14·7	0·525
726	0·771	373·8	0·67	220·3	0·07	0·054	1·3	0·22	16·9	0·193	7·7	0·92	11·9	0·332
I. 726	0·750	372·9	1·17	87·7	0·39	0·293	2·9	0·43	14·8	0·253	25·4	2·51	9·9	0·498
1284*a*	0·742	366·7	0·50	79·0	0·14	0·104	8·3	0·60	7·2	0·208	50·8	2·98	5·9	0·418

TABLE I.—*concluded.*

No. and Letter for Spot.	$\frac{r}{R}$	Distance.		Position-Angle.			Area of Umbra.				Area of Whole Spot.			
		Mean Reading.	Mean Discordance.	Mean Reading.	Mean Discordance.	Mean Discordance at Distance R	Mean Area.	Mean Discordance.	Mean Discordance per cent. of Umbra.	Mean Discordance divided by Square Root of Umbra.	Mean Area.	Mean Discordance.	Mean Discordance per cent. of Whole Spot.	Mean Discordance divided by Square Root of Whole Spot.
		d	d	°	°	°								
M. 1572*c*	0·706	359·3	0·45	238·5	0·10	0·071	3·2	0·25	7·8	0·140	13·4	0·62	4·6	0·169
M. 1572*d*	0·697	354·9	0·44	236·4	0·11	0·077	1·8	0·34	18·9	0·254	15·3	1·14	7·5	0·292
I. 697	0·683	342·3	0·70	231·6	0·18	0·123	5·4	0·57	10·6	0·246	44·2	2·58	5·8	0·389
726	0·655	317·9	0·80	75·2	0·09	0·059	4·8	0·34	7·1	0·155	28·9	1·31	4·5	0·244
726	0·654	317·2	0·75	222·0	0·14	0·092	16·8	1·15	6·8	0·280	79·4	4·52	5·7	0·507
I. 697	0·611	306·3	0·51	227·0	0·12	0·073	3·5	0·61	17·4	0·326	32·0	3·31	10·3	0·585
1246*b*	0·600	297·6	0·98	65·6	0·26	0·156	1·2	0·78	65·0	0·709	4·8	1·27	26·5	0·580
1235*a*	0·522	259·0	0·66	298·4	0·14	0·073	4·8	0·44	9·2	0·201	32·5	2·11	6·5	0·370
I. 722	0·522	259·2	0·53	302·0	0·24	0·125	5·0	0·67	13·4	0·299	28·9	2·16	7·5	0·402
734	0·499	242·2	0·38	32·2	0·24	0·120	6·2	0·57	9·2	0·229	37·7	1·76	4·7	0·287
I. 695	0·463	232·1	0·48	31·8	0·33	0·153	0·6	0·31	51·7	0·400	4·5	0·80	17·8	0·377
1235	0·455	225·5	0·54	310·9	0·21	0·096	3·2	0·73	22·8	0·408	16·0	1·40	8·8	0·350
1285*b*	0·454	224·3	0·89	238·9	0·29	0·132	4·0	0·38	9·5	0·190	25·6	3·38	13·2	0·668
729	0·432	209·4	0·53	172·4	0·35	0·151	2·5	0·81	32·4	0·513	12·7	1·32	10·4	0·371
I. 695	0·413	206·8	0·48	22·5	0·24	0·099	3·7	0·62	16·8	0·323	18·2	2·07	11·4	0·485
1235*b*	0·398	197·4	0·58	331·7	0·24	0·096	14·0	0·91	6·5	0·243	97·2	3·00	3·1	0·304
I. 725	0·353	175·6	0·57	64·6	0·32	0·113	0·0	0·00	0·0	0·000	2·4	0·47	19·6	0·303
1243*a*	0·321	159·4	0·56	25·3	0·29	0·093	2·1	0·32	15·2	0·221	8·6	0·94	10·9	0·321
I. 691	0·319	159·6	0·60	265·8	0·27	0·086	13·3	0·91	6·8	0·249	65·5	3·73	5·7	0·461
733	0·302	146·5	0·47	216·3	0·35	0·106	3·1	0·87	28·1	0·494	14·7	1·22	8·3	0·319
M. 1575	0·292	148·8	0·36	97·6	0·38	0·111	1·3	0·49	37·7	0·430	5·6	0·59	10·5	0·249
I. 694	0·285	143·0	0·47	92·6	0·27	0·077	2·9	0·53	18·3	0·312	13·9	0·80	5·8	0·215
M. 1575*b*	0·283	143·8	0·57	92·3	0·48	0·136	3·5	0·70	20·0	0·374	10·5	0·70	6·7	0·216
1281	0·279	137·7	0·59	87·9	0·30	0·084	2·2	0·46	20·9	0·311	6·8	1·12	16·5	0·429
1277*b*	0·274	135·3	0·96	10·0	0·94	0·258	7·9	1·24	15·7	0·441	58·2	2·72	4·7	0·356
1241	0·264	130·7	0·60	105·7	0·38	0·100	0·8	0·42	52·5	0·470	3·2	0·36	11·3	0·201
1277*a*	0·256	126·6	0·94	323·9	0·49	0·125	8·0	1·02	12·8	0·361	46·2	2·55	5·5	0·375
733	0·254	123·3	0·67	206·9	0·30	0·076	1·1	0·12	10·9	0·114	13·6	1·32	9·7	0·358
1277	0·248	122·7	0·72	360·3	0·38	0·094	1·5	0·54	36·0	0·443	5·9	0·67	11·4	0·276
1277	0·248	122·7	0·89	332·3	0·50	0·124	2·8	0·48	17·2	0·287	18·7	1·81	9·7	0·419
I. 728	0·235	116·7	1·69	170·7	1·34	0·315	6·1	0·96	15·7	0·389	33·9	4·51	13·3	0·775
I. 728	0·225	111·6	0·98	137·0	0·68	0·153	8·7	1·36	15·6	0·461	59·5	3·50	5·9	0·454
M. 1575*a*	0·189	96·2	0·48	89·0	0·73	0·138	2·6	0·54	20·8	0·335	7·0	0·71	10·1	0·268
1237	0·119	59·4	0·72	168·7	1·47	0·175	18·5	1·26	6·8	0·293	102·5	3·00	2·9	0·297
1286	0·104	51·1	0·55	101·4	0·99	0·103	1·4	0·30	21·4	0·254	4·8	0·59	12·3	0·270

MEANS OF EACH GROUP IN TABLE I.

	Distance.		Position-Angle.		Area of Umbra.				Area of Whole Spot.			
	Mean $\frac{r}{R}$	Mean Discordance.	Mean Discordance.	Mean Discordance at Distance R.	Mean Area.	Mean Discordance.	Mean Discordance per cent. of Umbra.	Mean Discordance divided by Square Root of Umbra.	Mean Area.	Mean Discordance.	Mean Discordance per cent. of Whole Spot.	Mean Discordance divided by Square Root of Whole Spot.
		d	°	°								
	0·971	0·54	0·13	0·122	2·8	0·68	36·7	0·378	23·0	2·87	16·4	0·549
	0·935	0·55	0·14	0·129	3·8	0·58	14·0	0·258	20·2	1·51	9·5	0·361
	0·779	0·90	0·17	0·133	3·2	0·54	28·4	0·3[illegible]7	21·4	1·98	11·6	0·456
	0·679	0·63	0·12	0·084	6·4	0·53	10·2	0·215	36·2	2·05	5·6	0·320
	0·551	0·61	0·20	0·109	4·1	0·61	22·8	0·353	27·2	2·12	11·1	0·445
	0·443	0·58	0·28	0·126	2·8	0·57	26·6	0·367	15·4	1·79	12·3	0·450
	0·339	0·56	0·29	0·099	6·5	0·60	11·3	0·241	37·7	1·87	9·5	0·342
	0·283	0·59	0·47	0·133	3·6	0·68	22·5	0·374	19·0	1·19	8·8	0·293
	0·254	0·76	0·41	0·104	2·8	0·52	25·9	0·335	17·5	1·34	9·5	0·326
	0·174	0·88	1·04	0·177	7·5	0·88	16·1	0·346	41·5	2·46	8·9	0·413
General Mean	0·5408	0·660	0·325	0·1216	4·35	0·619	21·45	0·3234	25·91	1·918	10·32	0·3955

1 division of scale in measure of distance = $\frac{1}{250}$ in., corresponding to 0·002012 × R.

The areas are expressed in ten-thousandths of a square inch, this unit corresponding to 4·02 millionths of the Sun's visible hemisphere for a spot at the centre of the disk.

TABLE II. (arranged according to area of Whole Spot).

No. and Letter for Spot.	$\frac{r}{R}$	Distance.		Position-Angle.			Area of Umbra.				Area of Whole Spot.			
		Mean Reading.	Mean Discordance.	Mean Reading.	Mean Discordance.	Mean Discordance at Distance R.	Mean Area.	Mean Discordance.	Mean Discordance per cent. of Umbra.	Mean Discordance divided by Square Root of Umbra.	Mean Area.	Mean Discordance.	Mean Discordance per cent. of Whole Spot.	Mean Discordance divided by Square Root of Whole Spot.
		d	d	°	°	°								
1237	0·119	59·4	0·72	168·7	1·47	0·175	18·5	1·26	6·8	0·293	102·5	3·00	2·9	0·297
1235*b*	0·398	197·4	0·58	331·7	0·24	0·096	14·0	0·91	6·5	0·243	97·2	3·00	3·1	0·304
I. 729	0·966	480·2	0·76	90·7	0·20	0·193	10·5	2·28	21·7	0·704	90·2	10·28	11·4	1·082
726	0·654	317·2	0·75	222·0	0·14	0·092	16·8	1·15	6·8	0·280	79·4	4·52	5·7	0·507
I. 691	0·319	159·6	0·60	265·8	0·27	0·086	13·3	0·91	6·8	0·249	65·5	3·73	5·7	0·461
I. 728	0·225	111·6	0·98	137·0	0·68	0·153	8·7	1·36	15·6	0·461	59·5	3·50	5·9	0·454
1277*b*	0·274	135·3	0·96	10·0	0·94	0·258	7·9	1·24	15·7	0·441	58·2	2·72	4·7	0·356
1284*a*	0·742	366·7	0·50	79·0	0·14	0·104	8·3	0·60	7·2	0·208	50·8	2·98	5·9	0·418
M. 1573*b*	0·928	472·1	0·56	259·1	0·11	0·102	11·2	1·78	15·9	0·531	48·0	2·00	4·2	0·289
1277*a*	0·256	126·6	0·94	323·9	0·49	0·125	8·0	1·02	12·8	0·361	46·2	2·55	5·5	0·375

TABLE II.—*concluded.*

No. and Letter for Spot.	$\frac{r}{R}$	Distance.		Position-Angle.			Area of Umbra.				Area of Whole Spot.			
		Mean Reading.	Mean Discordance.	Mean Reading.	Mean Discordance.	Mean Discordance at distance R.	Mean Area.	Mean Discordance.	Mean Discordance per cent. of Umbra.	Mean Discordance divided by Square Root of Umbra.	Mean Area.	Mean Discordance.	Mean Discordance per cent. of Whole Spot.	Mean Discordance divided by Square Root of Whole Spot.
		d	d	°	°	°								
I. 697	0·683	342·3	0·70	231·6	0·18	0·123	5·4	0·57	10·6	0·245	44·2	2·58	5·8	0·389
734	0·499	242·2	0·38	32·2	0·24	0·120	6·2	0·57	9·2	0·229	37·7	1·76	4·7	0·287
I. 728	0·235	116·7	1·69	170·7	1·34	0·315	6·1	0·96	15·7	0·389	33·9	4·51	13·3	0·775
1235*a*	0·522	259·0	0·66	298·4	0·14	0·073	4·8	0·44	9·2	0·201	32·5	2·11	6·5	0·370
I. 697	0·611	306·3	0·51	227·0	0·12	0·073	3·5	0·61	17·4	0·326	32·0	3·31	10·3	0·585
726	0·655	317·9	0·80	75·2	0·09	0·059	4·8	0·34	7·1	0·155	28·9	1·31	4·5	0·244
I. 722	0·522	259·2	0·53	302·0	0·24	0·125	5·0	0·67	13·4	0·299	28·9	2·16	7·5	0·402
1285*b*	0·454	224·3	0·89	238·9	0·29	0·132	4·0	0·38	9·5	0·190	25·6	3·38	13·2	0·668
I. 726	0·750	372·9	1·17	87·7	0·39	0·293	2·9	0·43	14·8	0·253	25·4	2·51	9·9	0·498
M. 1573*c*	0·956	486·7	0·36	256·8	0·14	0·134	3·3	0·50	15·2	0·275	22·1	1·57	7·1	0·334
1277	0·248	122·7	0·89	332·3	0·50	0·124	2·8	0·48	17·2	0·287	18·7	1·81	9·7	0·419
I. 695	0·413	206·8	0·48	22·5	0·24	0·099	3·7	0·62	16·8	0·323	18·2	2·07	11·4	0·485
1235	0·455	225·5	0·54	310·9	0·21	0·096	3·2	0·73	22·8	0·408	16·0	1·40	8·8	0·350
M. 1572*d*	0·697	354·9	0·44	236·4	0·11	0·077	1·8	0·34	18·9	0·254	15·3	1·14	7·5	0·292
733	0·302	146·5	0·47	216·3	0·35	0·106	3·1	0·87	28·1	0·494	14·7	1·22	8·3	0·319
I. 699	0·924	463·1	0·51	82·2	0·14	0·129	2·0	0·24	12·0	0·170	14·1	2·36	16·7	0·629
I. 694	0·285	143·0	0·47	92·6	0·27	0·077	2·9	0·53	18·3	0·312	13·9	0·80	5·8	0·215
733	0·254	123·3	0·67	206·9	0·30	0·076	1·1	0·12	10·9	0·114	13·6	1·32	9·7	0·358
M. 1572*c*	0·706	359·3	0·45	238·5	0·10	0·071	3·2	0·25	7·8	0·140	13·4	0·62	4·6	0·169
1231*b*	0·814	403·6	1·14	252·9	0·09	0·073	2·4	0·82	34·2	0·529	12·7	1·87	14·7	0·525
729	0·432	209·4	0·53	172·4	0·35	0·151	2·5	0·81	32·4	0·513	12·7	1·32	10·4	0·371
M. 1575*b*	0·283	143·8	0·57	92·3	0·48	0·136	3·5	0·70	20·0	0·374	10·5	0·70	6·7	0·216
I. 726	0·816	405·2	1·04	83·3	0·17	0·139	0·9	0·62	68·9	0·653	10·5	1·64	15·6	0·506
1271	0·969	478·5	0·65	266·9	0·10	0·097	2·0	0·54	27·0	0·383	10·1	1·49	14·8	0·469
I. 693	0·955	478·4	0·75	273·1	0·16	0·153	1·5	0·24	16·0	0·197	9·3	1·07	11·5	0·351
1243*a*	0·321	159·4	0·56	25·3	0·29	0·093	2·1	0·32	15·2	0·221	8·6	0·94	10·9	0·321
726	0·771	373·8	0·67	220·3	0·07	0·054	1·3	0·22	16·9	0·193	7·7	0·92	11·9	0·332
731	0·911	441·1	0·56	225·8	0·14	0·128	1·2	0·13	10·8	0·118	7·3	0·57	7·8	0·211
M. 1573*a*	0·963	490·3	0·37	253·6	0·08	0·077	0·8	0·34	42·5	0·381	7·1	1·11	15·6	0·417
M. 1575*a*	0·189	96·2	0·48	89·0	0·73	0·138	2·6	0·54	20·8	0·335	7·0	0·71	10·1	0·268
1281	0·279	137·7	0·59	87·9	0·30	0·084	2·2	0·46	20·9	0·311	6·8	1·12	16·5	0·429
1277	0·248	122·7	0·72	360·3	0·38	0·094	1·5	0·54	36·0	0·443	5·9	0·67	11·4	0·276
M. 1575	0·292	148·8	0·36	97·6	0·38	0·111	1·3	0·49	37·7	0·430	5·6	0·59	10·5	0·249
1286	0·104	51·1	0·55	101·4	0·99	0·103	1·4	0·30	21·4	0·254	4·8	0·59	12·3	0·270
1246*b*	0·600	297·6	0·98	65·6	0·26	0·156	1·2	0·78	65·0	0·709	4·8	1·27	26·5	0·580
I. 695	0·463	232·1	0·48	31·8	0·33	0·153	0·6	0·31	51·7	0·400	4·5	0·80	17·8	0·377
M. 1578*a*	0·966	491·8	0·33	67·2	0·08	0·077	0·8	0·18	22·5	0·201	4·2	0·59	14·0	0·288
I. 718	0·990	492·2	0·60	247·0	0·17	0·168	0·1	0·07	70·0	0·222	3·3	0·89	26·2	0·489
1241	0·264	130·7	0·60	105·7	0·38	0·100	0·8	0·42	52·5	0·470	3·2	0·36	11·3	0·201
I. 725	0·353	175·6	0·57	64·6	0·32	0·113	0·0	0·00	0·0	0·000	2·4	0·47	19·6	0·303

MEANS OF EACH GROUP IN TABLE II.

	Distance.		Position-Angle		Area of Umbra.				Area of Whole Spot.			
	Mean $\frac{r}{R}$	Mean Discordance.	Mean Discordance.	Mean Discordance at distance R.	Mean Area.	Mean Discordance.	Mean Discordance per cent. of Umbra.	Mean Discordance divided by Square Root of Umbra.	Mean Area.	Mean Discordance.	Mean Discordance per cent. of Whole Spot.	Mean Discordance divided by Square Root of Whole Spot.
		d	°	°								
	0·491	0·68	0·46	0·128	14·6	1·30	9·7	0·354	87·0	4·91	5·8	0·530
	0·485	0·79	0·47	0·148	8·8	1·20	13·4	0·400	52·5	2·75	5·2	0·378
	0·510	0·79	0·40	0·141	5·2	0·63	12·4	0·278	36·1	2·85	8·1	0·481
	0·667	0·75	0·23	0·149	4·0	0·46	12·0	0·234	26·2	2·19	8·4	0·429
	0·423	0·56	0·28	0·100	2·9	0·61	20·8	0·353	16·6	1·53	9·1	0·373
	0·597	0·65	0·18	0·085	2·3	0·39	16·6	0·253	13·5	1·39	10·3	0·379
	0·691	0·71	0·25	0·135	2·1	0·58	32·9	0·424	10·6	1·24	11·8	0·383
	0·631	0·53	0·26	0·098	1·6	0·31	21·2	0·250	7·5	0·85	11·3	0·310
	0·305	0·64	0·46	0·110	1·5	0·51	36·2	0·429	5·6	0·85	15·4	0·361
	0·607	0·52	0·26	0·122	0·5	0·20	39·3	0·259	3·5	0·62	17·8	0·332
General Mean	0·5407	0·662	0·325	0·1216	4·35	0·619	21·45	0·3234	25·91	1·918	10·32	0·3956

1 division of scale in measure of distance = $\frac{1}{250}$ in., corresponding to 0·002012 × R.

The areas are expressed in ten-thousandths of a square inch, this unit corresponding to 4·02 millionths of the Sun's visible hemisphere for a spot at the centre of the disk.

Expressing the Mean Discordance in distance in terms of $\frac{r}{R}$, and the areas and mean discordances in areas in millionths of the Sun's visible hemisphere for a spot at the centre of the disk, we have :—

Distance.		Position-Angle.		Area of Umbra.				Area of Whole Spot.			
Mean $\frac{r}{R}$	Mean Discordance in $\frac{r}{R}$	Mean Discordance.	Mean Discordance at distance R.	Mean Area.	Mean Discordance.	Mean Discordance per cent. of Umbra.	Mean Discordance divided by Square Root of Umbra.	Mean Area.	Mean Discordance.	Mean Discordance per cent. of Whole Spot.	Mean Discordance divided by Square Root of Whole Spot.
		°	°								
0·541	0·001330	0·325	0·1216	17·49	2·488	21·45	0·650	104·16	7·710	10·32	0·795

It appears from these tables that the means of two measures of distance and position-angle as printed may be taken as subject to an uncertainty of less than a unit in the last figure, the probable error in distance $\left(\frac{r}{R}\right)$ being 0·0008, and in position-angle (at distance R) 0°·077. As regards areas of umbræ and whole spots, Tables I. and II. indicate that the mean discordance may be taken to vary as the square root of the measured area, and that it does not sensibly depend on the distance from the Sun's centre. Assuming that the mean discordance varies as the square root of the measured area, the following table gives the values of the probable errors in measures of umbræ, and whole spots for spots of various sizes at the centre of the Sun's disk, the probable error being inferred from the mean discordance by the formula :—

$$\text{Probable Error} = 0{\cdot}845 \frac{\text{Sum of Discordances}}{\sqrt{10 \times 9}}$$
$$= 0{\cdot}891 \times \text{Mean Discordance.}$$

The similar results obtained in 1885 for the Probable Error of the measurement of positions of spots on *eight-inch* photographs compare as follows with those given above for *four-inch* photographs.

Diameter of Sun's Image.	Distance.			Position-Angle.	
	Mean $\frac{r}{R}$	Mean Discordance in measured Distance.	Mean Discordance in $\frac{r}{R}$	Mean Discordance.	Mean Discordance at Distance R.
		d		°	°
Eight inches	0·640	0·659	0·000676	0·12	0·053
Four inches	0·541	0·662	0·001330	0·325	0·1216

It appears, therefore, that the error in the measured distance is practically the same for the *four-inch* as for the *eight-inch* photographs, the error in $\frac{r}{R}$ consequently decreasing inversely as the diameter. But the position-angles are slightly more accordant proportionately as well as positively on the larger photographs, indicating that the precision of a reading of position-angle increases a little faster than the distance from the centre at which the pointing is made. Nevertheless, as the probable error of the means of two measures of distance and position-angle on the *four-inch* photographs, as printed in the Photographic Results, though about double that on the *eight-inch* photographs, is less than a unit in the last figure, it does not appear that the precision of measurement of positions has been practically increased by the adoption of the larger scale photographs.

The following results for the probable error in the measurement of the areas of umbræ and whole spots show that for the areas also, as expressed in millionths of the Sun's visible hemisphere, the measurements are sensibly as accurate for the smaller as for the larger photographs.

UMBRÆ.			WHOLE SPOTS.		
Area in Millionths.	Probable Error in Millionths.		Area in Millionths.	Probable Error in Millionths.	
	One Measure.	Mean of Two Measures.		One Measure.	Mean of Two Measures.
1	0·58	0·41	5	1·59	1·13
2	0·82	0·58	10	2·24	1·59
4	1·16	0·82	20	3·16	2·24
6	1·42	1·01	30	3·88	2·75
8	1·64	1·16	40	4·48	3·16
10	1·83	1·30	50	5·01	3·56
15	2·24	1·59	75	6·13	4·35
20	2·59	1·83	100	7·08	5·01
25	2·90	2·06	125	7·92	5·62
30	3·17	2·24	150	8·67	6·13
40	3·66	2·59	200	10·02	7·08
50	4·09	2·90	250	11·19	7·92
70	4·85	3·44	350	13·24	9·40
100	5·79	4·09	500	15·86	11·19
150	7·09	5·03	750	19·40	13·77
200	8·19	5·79	1000	22·37	15·86

The quantities given in the *third* and *sixth* columns represent the mean discordances of the measured areas as given in the Photographic Results for spots seen on *four-inch* photographs near the centre of the disk. For spots at a considerable distance from the centre these quantities should be multiplied by $\frac{1}{\sqrt[4]{1-\left(\frac{r}{R}\right)^2}}$, *i.e.*, by the square root of the factor for the effect of foreshortening, the argument being the area in millionths as given in the Photographic Results.

The following are the values of $\frac{r}{R}$ corresponding to different values of the factor $\frac{1}{\sqrt[4]{1-\left(\frac{r}{R}\right)^2}}$:—

$\frac{r}{R}$	0·000	0·722	0·862	0·922	0·954	0·969	0·988	0·994	0·997	0·998
Factor $\frac{1}{\sqrt[4]{1-\left(\frac{r}{R}\right)^2}}$	1·0	1·2	1·4	1·6	1·8	2·0	2·5	3·0	3·5	4·0

By the help of these tables the probable error may readily be inferred for the area of any spot on a *four-inch* photograph as printed in the Photographic Results.

The results for the Probable Error in measures of the areas of Umbræ and Whole Spots on *four-inch* and *eight-inch* photographs compare as follow :—

UMBRÆ.

Area in Millionths.	Probable Error in Millionths.			
	One Measure.		Mean of Two Measures.	
	Four-inch.	Eight-inch.	Four-inch.	Eight-inch.
1	0·6	0·5	0·4	0·4
2	0·8	0·8	0·6	0·5
4	1·2	1·1	0·8	0·8
6	1·4	1·3	1·0	0·9
8	1·6	1·5	1·2	1·1
10	1·8	1·7	1·3	1·2
20	2·6	2·4	1·8	1·7
30	3·2	3·0	2·2	2·1
40	3·7	3·4	2·6	2·4
50	4·1	3·8	2·9	2·7
70	4·9	4·6	3·4	3·2
100	5·8	5·4	4·1	3·8
150	7·1	6·7	5·0	4·7
200	8·2	7·7	5·8	5·4

WHOLE SPOTS.

Area in Millionths.	Probable Error in Millionths.			
	One Measure.		Mean of Two Measures.	
	Four-inch.	Eight-inch.	Four-inch.	Eight-inch.
5	1·6	1·3	1·1	0·9
10	2·2	1·9	1·6	1·3
20	3·2	2·7	2·2	1·9
30	3·9	3·3	2·8	2·3
40	4·5	3·8	3·2	2·7
50	5·0	4·2	3·6	3·0
100	7·1	6·0	5·0	4·2
150	8·7	7·3	6·1	5·2
200	10·0	8·5	7·1	6·0
250	11·2	9·5	7·9	6·7
350	13·2	11·2	9·4	7·9
500	15·9	13·4	11·2	9·5
750	19·4	16·4	13·8	11·6
1000	22·4	18·9	15·9	13·4

The larger photographs, therefore, show only a very slight advantage in precision over the smaller; and this is probably due to the fact that spots are more frequently measured in groups and clusters on the smaller photographs, and that when so measured it is not always easy to secure that different observers, or the same observer at different times, shall always adopt precisely the same arrangement in measuring.

II.—PERSONALITY IN MEASUREMENT OF AREAS ON EIGHT-INCH PHOTOGRAPHS.

In the preceding investigation the measures of area by the different observers have been considered as comparable, without the application of any correction for systematic differences in habit. Sensible differences of this kind have been suspected, and an investigation of their character and amount as shown in the measurement of *four-inch* photographs was given in the Volume of the Results for 1885. It was then found that these differences were not large as compared with the probable error of observation, and indeed that in the case of Whole Spots they were quite insignificant, whilst their determination was subject to considerable uncertainty.

The following series of comparisons between the different observers in the measurements of areas on *eight-inch* photographs has been made in a precisely similar manner to that for the *four-inch* photographs published in the Volume for 1885. The photographs used for the comparison extend from 1881 November to the end of 1888. The fifth and sixth columns under each heading are referred to below; for the other columns no explanation is required.

For M and H.

UMBRÆ.	No. of Obs.	Total Area as measured by M	Total Area as measured by H	$\frac{H}{M}$	$\sqrt{H}-\sqrt{M}$
Under 5 squares	106	293·9	246·1	0·837	− 0·141
Above 5 & under 10..	70	552·4	443·3	0·803	− 0·293
Above 10 & under 20	50	771·8	632·8	0·820	− 0·371
Above 20 & under 40	15	575·8	493·5	0·857	− 0·410
Above 40 & under 80	12	745·5	648·5	0·870	− 0·543
Above 80 squares ..	7	1231·0	1125·5	0·914	− 0·582
Total & Means..	264	15·80	13·60	0·830	− 0·274

WHOLE SPOTS.	No. of Obs.	Total Area as measured by M	Total Area as measured by H	$\frac{H}{M}$	$\sqrt{H}-\sqrt{M}$
Under 10 squares	161	796·7	784·2	0·984	− 0·018
Above 10 & under 20..	76	1084·5	1051·7	0·970	− 0·057
Above 20 & under 40..	54	1648·5	1570·3	0·953	− 0·134
Above 40 & under 100	82	5488·2	5160·3	0·940	− 0·248
Above 100 & under 200	30	3850·0	3677·5	0·955	− 0·256
Above 200 & under 400	14	3937·0	3828·0	0·972	− 0·233
Above 400 squares....	13	9882·0	9907·0	1·003	+ 0·035
Total & Means....	530	62·06	60·42	0·967	− 0·105

FACULÆ.	No. of Obs.	Total Area as measured by M	Total Area as measured by H	$\frac{H}{M}$	$\sqrt{H}-\sqrt{M}$
Under 50 squares.....	140	3665·0	4233·0	1·155	+ 0·382
Above 50 & under 100..	93	6231·0	6475·0	1·039	+ 0·159
Above 100 & under 200	62	8762·0	8743·0	0·998	− 0·013
Above 200 & under 400	24	6867·0	6348·0	0·924	− 0·651
Above 400 squares	11	6320·0	5492·0	0·869	− 1·624
Total & Means....	330	96·50	94·82	1·066	+ 0·103

For M and J P.

UMBRÆ.

	No. of Obs.	Total Area as measured by M	Total Area as measured by J P	$\frac{JP}{M}$	$\sqrt{JP}-\sqrt{M}$
Under 5 squares	10	22·3	28·7	1·287	+ 0·201
Above 5 & under 10..	3	18·8	18·8	1·000	0·000
Above 10 & under 20	2	35·6	29·0	0·815	− 0·351
Above 20 & under 40	3	69·0	61·4	0·890	− 0·271
Above 40 & under 80	1	42·0	37·5	0·893	− 0·257
Above 80 squares....					
Total & Means..	19	9·88	9·23	1·109	+ 0·013

WHOLE SPOTS.

	No. of Obs.	Total Area as measured by M	Total Area as measured by J P	$\frac{JP}{M}$	$\sqrt{JP}-\sqrt{M}$
Under 10 squares ..	10	42·5	44·4	1·044	+ 0·045
Above 10 & under 20	8	103·6	101·1	0·976	− 0·043
Above 20 & under 40	4	104·5	109·5	1·048	+ 0·121
Above 40 & under 100	2	131·0	133·0	1·015	+ 0·062
Above 100 & under 200	5	784·5	738·0	0·941	− 0·377
Above 200 & under 400					
Above 400 squares..					
Total & Means..	29	40·21	38·83	1·006	− 0·040

FACULÆ.

	No. of Obs.	Total Area as measured by M	Total Area as measured by J P	$\frac{JP}{M}$	$\sqrt{JP}-\sqrt{M}$
Under 50 squares....	19	440·0	493·0	1·120	+ 0·282
Above 50 & under 100	7	490·0	454·0	0·927	− 0·314
Above 100 & under 200	1	114·0	120·0	1·053	+ 0·277
Above 200 & under 400	2	500·0	595·0	1·190	+ 1·437
Above 400 squares..	1	500·0	440·0	0·880	− 1·385
Total & Means..	30	68·13	70·07	1·069	+ 0·164

For M and F.

UMBRÆ.

		M	F	$\frac{F}{M}$	$\sqrt{F}-\sqrt{M}$
Under 5 squares	8	17·7	17·9	1·011	+ 0·010
Above 5 & under 10..	5	36·0	34·5	0·958	− 0·056
Above 10 & under 20	6	87·7	88·5	1·009	+ 0·017
Above 20 & under 40	3	84·0	83·0	0·988	− 0·031
Above 40 & under 80	2	122·0	115·0	0·943	− 0·227
Above 80 squares....	1	318·0	310·0	0·975	− 0·226
Total & Means..	25	26·62	25·96	0·990	− 0·034

WHOLE SPOTS.

		M	F	$\frac{F}{M}$	$\sqrt{F}-\sqrt{M}$
Under 10 squares....	14	72·8	72·4	0·995	− 0·006
Above 10 & under 20	3	39·6	40·0	1·010	+ 0·018
Above 20 & under 40	5	112·5	115·0	1·022	+ 0·053
Above 40 & under 100	7	448·0	456·0	1·018	+ 0·070
Above 100 & under 200	6	701·4	705·0	1·005	+ 0·028
Above 200 & under 400	2	554·0	543·0	0·980	− 0·166
Above 400 squares..	2	1663·4	1640·0	0·986	− 0·203
Total & Means..	39	92·10	91·57	1·004	+ 0·040

FACULÆ.

		M	F	$\frac{F}{M}$	$\sqrt{F}-\sqrt{M}$
Under 50 squares....	24	557·0	565·7	1·016	+ 0·037
Above 50 & under 100	12	863·0	863·0	1·000	0·000
Above 100 & under 200	13	1687·0	1604·8	0·951	− 0·281
Above 200 & under 400					
Above 400 squares..	3	1480·0	1395·0	0·943	− 0·647
Total & Means..	52	88·21	85·16	0·992	− 0·091

For M and J H.

UMBRÆ.

		M	J H	$\frac{JH}{M}$	$\sqrt{JH}-\sqrt{M}$
Under 5 squares....	25	65·9	61·8	0·938	− 0·053
Above 5 & under 10	12	84·1	71·0	0·844	− 0·215
Above 10 & under 20	16	217·8	195·0	0·895	− 0·197
Above 20 & under 40	9	260·7	250·5	0·961	− 0·107
Above 40 & under 80	3	139·0	135·0	0·971	− 0·099
Above 80 squares....	2	180·0	165·5	0·919	− 0·390
Total & Means..	67	14·14	13·12	0·915	− 0·135

WHOLE SPOTS.

		M	J H	$\frac{JH}{M}$	$\sqrt{JH}-\sqrt{M}$
Under 10 squares....	40	177·2	187·5	1·058	+ 0·061
Above 10 & under 20	17	228·9	229·5	1·003	+ 0·005
Above 20 & under 40	18	492·6	522·5	1·061	+ 0·156
Above 40 & under 100	22	1378·2	1325·0	0·961	− 0·154
Above 100 & under 200	13	1835·0	1751·0	0·954	− 0·275
Above 200 & under 400	7	1925·6	1751·0	0·909	− 0·770
Above 400 squares..					
Total & Means..	117	51·60	49·29	1·012	− 0·060

FACULÆ.

		M	J H	$\frac{JH}{M}$	$\sqrt{JH}-\sqrt{M}$
Under 50 squares....	25	586·0	576·0	0·983	− 0·041
Above 50 & under 100	9	591·0	693·0	1·170	+ 0·673
Above 100 & under 200	9	1249·0	1279·0	1·024	+ 0·141
Above 200 & under 400	4	1035·0	1230·0	1·188	+ 1·450
Above 400 squares..	4	2460·0	2240·0	0·911	− 1·135
Total & Means..	51	116·10	118·00	1·034	+ 0·148

For M and S P.

UMBRÆ.	No. of Obs.	Total Area as measured by M	Total Area as measured by S P	$\frac{SP}{M}$	$\sqrt{SP}-\sqrt{M}$
Under 5 squares	35	95·5	81·8	0·857	− 0·122
Above 5 & under 10	18	125·2	121·5	0·970	− 0·040
Above 10 & under 20	15	234·3	209·0	0·892	− 0·220
Above 20 & under 40	13	374·1	351·0	0·938	− 0·169
Above 40 & under 80	5	286·5	260·0	0·907	− 0·359
Above 80 squares....	1	87·0	85·0	0·978	− 0·107
Total & Means..	87	13·82	12·74	0·903	− 0·142

WHOLE SPOTS.	No. of Obs.	Total Area as measured by M	Total Area as measured by S P	$\frac{SP}{M}$	$\sqrt{SP}-\sqrt{M}$
Under 10 squares....	57	327·7	349·7	1·067	+ 0·080
Above 10 & under 20	23	322·3	308·0	0·955	− 0·084
Above 20 & under 40	28	828·0	798·0	0·964	− 0·099
Above 40 & under 100	28	1746·6	1635·0	0·936	− 0·257
Above 100 & under 200	20	2897·0	2596·0	0·896	− 0·642
Above 200 & under 400	4	1067·0	1007·0	0·944	− 0·465
Above 400 squares..	2	953·0	920·0	0·965	− 0·381
Total & Means..	162	50·26	47·00	0·985	− 0·141

FACULÆ.	No. of Obs.	Total Area as measured by M	Total Area as measured by S P	$\frac{SP}{M}$	$\sqrt{SP}-\sqrt{M}$
Under 50 squares....	28	809·0	902·0	1·115	+ 0·301
Above 50 & under 100	34	2343·0	2603·0	1·111	+ 0·449
Above 100 & under 200	18	2469·0	2660·0	1·077	+ 0·444
Above 200 & under 400	9	2560·0	2310·0	0·902	− 0·844
Above 400 squares..	1	1500·0	1380·0	0·920	− 1·582
Total & Means..	90	107·57	109·50	1·082	+ 0·250

For M and W.

		M	W	$\frac{W}{M}$	$\sqrt{W}-\sqrt{M}$
Under 5 squares....	6	18·5	14·0	0·757	− 0·229
Above 5 & under 10..	11	83·6	78·0	0·933	− 0·094
Above 10 & under 20	9	145·5	131·5	0·904	− 0·199
Above 20 & under 40	12	360·2	321·0	0·891	− 0·307
Above 40 & under 80	2	170·0	127·0	0·747	− 1·251
Above 80 squares....					
Total & Means..	40	19·45	16·79	0·878	− 0·260

		M	W	$\frac{W}{M}$	$\sqrt{W}-\sqrt{M}$
Under 10 squares....	25	131·8	107·6	0·817	− 0·222
Above 10 & under 20	5	71·5	72·0	1·007	+ 0·013
Above 20 & under 40	11	285·1	300·0	1·052	+ 0·131
Above 40 & under 100	15	963·4	900·0	0·934	− 0·268
Above 100 & under 200	11	1472·0	1437·0	0·976	− 0·138
Above 200 & under 400	5	1257·0	1248·0	0·993	− 0·056
Above 400 squares..	1	457·0	441·0	0·965	− 0·378
Total & Means..	73	63·53	61·72	0·928	− 0·140

		M	W	$\frac{W}{M}$	$\sqrt{W}-\sqrt{M}$
Under 50 squares....	11	412·0	404·0	0·981	− 0·059
Above 50 & under 100	8	518·0	677·0	1·307	+ 1·152
Above 100 & under 200	10	1244·0	1492·0	1·199	+ 0·062
Above 200 & under 400	3	729·0	686·0	0·941	− 0·466
Above 400 squares..					
Total & Means..	32	90·72	101·84	1·127	+ 0·243

For M and E P.

		M	E P	$\frac{EP}{M}$	$\sqrt{EP}-\sqrt{M}$
Under 5 squares....	135	376·5	394·7	1·048	+ 0·039
Above 5 & under 10	48	366·8	346·4	0·944	− 0·077
Above 10 & under 20	46	691·1	674·5	0·976	− 0·047
Above 20 & under 40	46	1383·1	1279·8	0·925	− 0·209
Above 40 & under 80	11	591·0	574·0	0·972	− 0·106
Above 80 squares....					
Total & Means..	286	11·92	11·43	0·996	− 0·040

		M	E P	$\frac{EP}{M}$	$\sqrt{EP}-\sqrt{M}$
Under 10 squares....	186	875·4	899·7	1·028	+ 0·030
Above 10 & under 20	44	679·0	661·6	0·974	− 0·050
Above 20 & under 40	45	1239·4	1173·2	0·947	− 0·142
Above 40 & under 100	57	3738·5	3532·5	0·945	− 0·226
Above 100 & under 200	28	4095·0	3863·4	0·943	− 0·247
Above 200 & under 400	12	3345·0	3202·0	0·957	− 0·361
Above 400 squares..					
Total & Means..	372	37·56	35·84	0·990	− 0·073

		M	E P	$\frac{EP}{M}$	$\sqrt{EP}-\sqrt{M}$
Under 50 squares....	162	3924·0	4302·5	1·096	+ 0·233
Above 50 & under 100	61	4549·0	4602·0	1·012	+ 0·051
Above 100 & under 200	43	6054·0	6111·0	1·009	+ 0·055
Above 200 & under 400	13	3233·0	3455·0	1·069	+ 0·532
Above 400 squares..					
Total & Means..	279	63·66	66·20	1·063	+ 0·180

For M and W R.

UMBRÆ.

	No. of Obs.	Total Area as measured by M	Total Area as measured by W R	$\frac{WR}{M}$	$\sqrt{WR}-\sqrt{M}$
Under 5 squares....	14	42·0	39·1	0·931	− 0·062
Above 5 & under 10	4	22·7	23·6	1·040	+ 0·046
Above 10 & under 20	1	11·6	14·0	1·207	+ 0·336
Above 20 & under 40					
Above 40 & under 80					
Above 80 squares....					
Total & Means..	19	4·02	4·04	0·968	− 0·018

WHOLE SPOTS.

	No. of Obs.	Total Area as measured by M	Total Area as measured by W R	$\frac{WR}{M}$	$\sqrt{WR}-\sqrt{M}$
Under 10 squares....	28	130·7	144·0	1·102	+ 0·106
Above 10 & under 20	17	253·9	206·5	0·813	− 0·379
Above 20 & under 40	7	217·5	197·0	0·906	− 0·269
Above 40 & under 100	1	66·0	65·0	0·985	− 0·062
Above 100 & under 200					
Above 200 & under 400					
Above 400 squares..					
Total & Means..	53	12·61	11·56	0·981	− 0·102

FACULÆ.

	No. of Obs.	Total Area as measured by M	Total Area as measured by W R	$\frac{WR}{M}$	$\sqrt{WR}-\sqrt{M}$
Under 50 squares....	22	507·0	571·0	1·126	+ 0·293
Above 50 & under 100	12	781·0	836·0	1·070	+ 0·279
Above 100 & under 200	14	1879·0	1968·0	1·048	+ 0·271
Above 200 & under 400	2	450·0	400·0	0·889	− 0·858
Above 400 squares..	1	566·0	620·0	1·095	+ 1·109
Total & Means..	51	82·02	86·18	1·082	+ 0·255

For H and J P.

UMBRÆ.

		H	J P	$\frac{JP}{H}$	$\sqrt{JP}-\sqrt{H}$
Under 5 squares....	60	147·5	170·1	1·153	+ 0·114
Above 5 & under 10	33	225·8	230·6	1·021	+ 0·029
Above 10 & under 20	19	259·9	275·1	1·058	+ 0·106
Above 20 & under 40	8	212·6	232·0	1·091	+ 0·230
Above 40 & under 80	9	485·0	482·5	0·995	− 0·019
Above 80 squares....	2	239·4	240·6	1·005	+ 0·028
Total & Means..	131	11·99	12·45	1·089	+ 0·088

WHOLE SPOTS.

		H	J P	$\frac{JP}{H}$	$\sqrt{JP}-\sqrt{H}$
Under 10 squares....	61	285·6	309·4	1·083	+ 0·089
Above 10 & under 20	17	195·7	216·5	1·106	+ 0·176
Above 20 & under 40	31	866·3	908·9	1·049	+ 0·128
Above 40 & under 100	33	2070·0	1991·7	0·962	− 0·151
Above 100 & under 200	21	2948·6	2904·4	0·985	− 0·090
Above 200 & under 400	11	3460·0	3362·5	0·972	− 0·253
Above 400 squares..	6	3621·0	3434·0	0·948	− 0·643
Total & Means..	180	74·71	72·93	1·034	− 0·006

FACULÆ.

		H	J P	$\frac{JP}{H}$	$\sqrt{JP}-\sqrt{H}$
Under 50 squares....	39	1223·0	1185·0	0·969	− 0·088
Above 50 & under 100	30	2173·0	2078·0	0·956	− 0·188
Above 100 & under 200	33	4838·0	4546·0	0·939	− 0·371
Above 200 & under 400	15	4508·0	4132·0	0·917	− 0·739
Above 400 squares..	2	970·0	850·0	0·876	− 1·407
Total & Means..	119	115·23	107·49	0·949	− 0·296

For H and F.

UMBRÆ.

		H	F	$\frac{F}{H}$	$\sqrt{F}-\sqrt{H}$
Under 5 squares....	25	78·0	76·9	0·986	− 0·011
Above 5 & under 10	11	64·9	74·6	1·149	+ 0·175
Above 10 & under 20	12	162·0	195·6	1·207	+ 0·363
Above 20 & under 40	12	328·0	381·0	1·162	+ 0·407
Above 40 & under 80	3	164·0	172·6	1·052	+ 0·191
Above 80 squares....	2	323·5	318·0	0·983	− 0·109
Total & Means..	65	17·24	18·75	1·090	+ 0·173

WHOLE SPOTS.

		H	F	$\frac{F}{H}$	$\sqrt{F}-\sqrt{H}$
Under 10 squares....	31	165·8	167·8	1·012	+ 0·013
Above 10 & under 20	10	143·8	141·0	0·981	− 0·038
Above 20 & under 40	10	255·3	263·0	1·030	+ 0·075
Above 40 & under 100	20	1219·7	1200·0	0·986	− 0·063
Above 100 & under 200	12	1811·5	1817·0	1·003	+ 0·017
Above 200 & under 400	9	2439·5	2333·0	0·956	− 0·364
Above 400 squares..	2	1220·0	1226·0	1·005	+ 0·061
Total & Means..	94	77·19	76·04	0·998	− 0·037

FACULÆ.

		H	F	$\frac{F}{H}$	$\sqrt{F}-\sqrt{H}$
Under 50 squares....	25	722·0	701·0	0·971	− 0·079
Above 50 & under 100	21	1535·0	1417·0	0·923	− 0·335
Above 100 & under 200	12	1609·0	1482·0	0·921	− 0·467
Above 200 & under 400	5	1640·0	1640·0	1·000	0·000
Above 400 squares..	1	800·0	750·0	0·938	− 0·898
Total & Means..	64	98·53	93·60	0·948	− 0·242

For H and J H.

UMBRÆ.

	No. of Obs.	Total Area as measured by H	Total Area as measured by J H	$\frac{JH}{H}$	$\sqrt{JH}-\sqrt{H}$
Under 5 squares....	48	125·5	126·0	1·004	+ 0·006
Above 5 & under 10	19	146·7	138·0	0·941	− 0·082
Above 10 & under 20	20	293·0	288·0	0·983	− 0·033
Above 20 & under 40	8	236·0	251·0	1·064	+ 0·171
Above 40 & under 80	8	504·0	507·0	1·006	+ 0·024
Above 80 squares....	2	186·0	188·0	1·011	+ 0·051
Total & Means..	105	14·20	14·27	0·993	+ 0·003

WHOLE SPOTS.

	No. of Obs.	Total Area as measured by H	Total Area as measured by J H	$\frac{JH}{H}$	$\sqrt{JH}-\sqrt{H}$
Under 10 squares....	78	412·4	411·0	0·997	− 0·004
Above 10 & under 20	39	540·5	540·0	0·999	− 0·003
Above 20 & under 40	35	955·0	979·5	1·026	+ 0·067
Above 40 & under 100	40	2378·0	2374·5	0·999	− 0·005
Above 100 & under 200	21	3044·0	2990·0	0·982	− 0·100
Above 200 & under 100	13	3940·0	3922·0	0·995	− 0·040
Above 400 squares..	5	2377·0	2259·0	0·950	− 0·548
Total & Means..	231	59·08	58·34	1·000	− 0·016

FACULÆ.

	No. of Obs.	Total Area as measured by H	Total Area as measured by J H	$\frac{JH}{H}$	$\sqrt{JH}-\sqrt{H}$
Under 50 squares....	34	1115·0	1115·0	1·000	0·000
Above 50 & under 100	32	2222·0	2624·0	1·181	+ 0·722
Above 100 & under 200	32	4524·0	4605·0	1·018	+ 0·107
Above 200 & under 400	14	3290·0	3716·0	1·129	+ 0·963
Above 400 squares..					
Total & Means..	112	99·56	107·68	1·073	+ 0·357

For H and S P.

UMBRÆ.

		H	S P	$\frac{SP}{H}$	$\sqrt{SP}-\sqrt{H}$
Under 5 squares....	131	349·7	331·0	0·947	− 0·043
Above 5 & under 10	65	481·1	510·0	1·060	+ 0·080
Above 10 & under 20	45	619·5	655·5	1·058	+ 0·106
Above 20 & under 40	39	1077·0	1148·0	1·066	+ 0·171
Above 40 & under 80	21	1292·0	1275·0	0·987	− 0·051
Above 80 squares....	1	90·0	80·0	0·889	− 0·543
Total & Means..	302	12·99	13·24	1·006	+ 0·031

WHOLE SPOTS.

		H	S P	$\frac{SP}{H}$	$\sqrt{SP}-\sqrt{H}$
Under 10 squares....	210	1038·1	1004·9	0·968	− 0·036
Above 10 & under 20	95	1284·5	1235·5	0·962	− 0·070
Above 20 & under 40	85	2431·5	2511·5	1·033	+ 0·086
Above 40 & under 100	90	5795·0	5772·0	0·996	− 0·016
Above 100 & under 200	51	7368·0	7149·0	0·970	− 0·180
Above 200 & under 400	30	8872·0	8673·0	0·978	− 0·193
Above 400 squares..	5	2424·0	2340·0	0·965	− 0·385
Total & Means..	566	51·61	50·68	0·982	− 0·045

FACULÆ.

		H	S P	$\frac{SP}{H}$	$\sqrt{SP}-\sqrt{H}$
Under 50 squares....	97	2993·0	3005·0	1·004	+ 0·012
Above 50 & under 100	114	7704·0	7374·0	0·957	− 0·179
Above 100 & under 200	55	7561·0	7386·0	0·977	− 0·137
Above 200 & under 400	25	6270·0	6150·0	0·981	− 0·153
Above 400 squares..					
Total & Means..	291	84·29	82·18	0·979	− 0·105

For H and W.

UMBRÆ.

		H	W	$\frac{W}{H}$	$\sqrt{W}-\sqrt{H}$
Under 5 squares	65	162·1	187·8	1·159	+ 0·119
Above 5 & under 10	33	210·6	244·2	1·160	+ 0·194
Above 10 & under 20	30	399·0	431·4	1·081	+ 0·145
Above 20 & under 40	17	428·5	433·0	1·011	+ 0·026
Above 40 & under 80	5	260·0	274·3	1·055	+ 0·196
Above 80 squares....	2	160·5	179·0	1·115	+ 0·502
Total & Means..	152	10·66	11·51	1·123	+ 0·138

WHOLE SPOTS.

		H	W	$\frac{W}{H}$	$\sqrt{W}-\sqrt{H}$
Under 10 squares....	86	376·1	391·6	1·041	+ 0·043
Above 10 & under 20	39	538·5	558·0	1·036	+ 0·067
Above 20 & under 40	32	864·2	938·1	1·085	+ 0·218
Above 40 & under 100	49	3161·0	3383·6	1·070	+ 0·279
Above 100 & under 200	28	4153·5	4102·5	0·988	− 0·075
Above 200 & under 400	8	2076·0	2070·0	0·997	− 0·023
Above 400 squares ..	2	876·0	819·0	0·935	− 0·692
Total & Means..	244	49·37	50·26	1·043	+ 0·095

FACULÆ.

		H	W	$\frac{W}{H}$	$\sqrt{W}-\sqrt{H}$
Under 50 squares....	35	1175·0	1120·0	0·953	− 0·137
Above 50 & under 100	27	1890·0	1944·0	1·029	+ 0·118
Above 100 & under 200	28	3918·0	4030·0	1·029	+ 0·164
Above 200 & under 400	31	8233·0	8491·0	1·031	+ 0·253
Above 400 squares ..	7	3840·0	3645·0	0·949	− 0·604
Total & Means..	128	148·87	150·23	1·004	+ 0·052

For H and E P.

UMBRÆ.

	No. of Obs.	Total Area as measured by H	Total Area as measured by E P	$\frac{EP}{H}$	$\sqrt{EP} - \sqrt{H}$
Under 5 squares	272	672·9	723·8	1·076	+ 0·059
Above 5 & under 10	116	799·2	840·5	1·052	+ 0·068
Above 10 & under 20	81	1152·3	1174·1	1·019	+ 0·036
Above 20 & under 40	41	1054·5	1100·0	1·043	+ 0·108
Above 40 & under 80	25	1364·0	1398·0	1·025	+ 0·092
Above 80 squares....	3	255·0	274·0	1·075	+ 0·337
Total & Means..	538	9·85	10·24	1·057	+ 0·064

WHOLE SPOTS.

	No. of Obs.	Total Area as measured by H	Total Area as measured by E P	$\frac{EP}{H}$	$\sqrt{EP} - \sqrt{H}$
Under 10 squares....	266	1349·2	1356·2	1·005	+ 0·006
Above 10 & under 20	112	1578·2	1574·5	0·998	− 0·004
Above 20 & under 40	77	2204·5	2139·0	0·970	− 0·080
Above 40 & under 100	82	5384·0	5291·0	0·983	− 0·071
Above 100 & under 200	34	4547·0	4508·0	0·991	− 0·050
Above 200 & under 400	11	2708·0	2593·0	0·958	− 0·337
Above 400 squares ..					
Total & Means..	582	30·53	30·00	0·994	− 0·026

FACULÆ.

	No. of Obs.	Total Area as measured by H	Total Area as measured by E P	$\frac{EP}{H}$	$\sqrt{EP} - \sqrt{H}$
Under 50 squares....	294	9147·4	8663·2	0·947	− 0·149
Above 50 & under 100	171	12013·0	12315·0	1·025	+ 0·104
Above 100 & under 200	115	14684·0	16542·0	1·126	+ 0·693
Above 200 & under 400	20	4630·0	5344·0	1·154	+ 1·131
Above 400 squares ..					
Total & Means..	600	67·46	71·44	1·010	+ 0·127

For J P and F.

		J P	F	$\frac{F}{JP}$	$\sqrt{F} - \sqrt{JP}$
Under 5 squares....	5	9·4	9·0	0·957	− 0·029
Above 5 & under 10	7	44·8	48·8	1·089	+ 0·110
Above 10 & under 20					
Above 20 & under 40	1	21·0	26·2	1·248	+ 0·536
Above 40 & under 80	1	45·6	47·5	1·042	+ 0·139
Above 80 squares....					
Total & Means..	14	8·63	9·39	1·050	+ 0·093

		J P	F	$\frac{F}{JP}$	$\sqrt{F} - \sqrt{JP}$
Under 10 squares....	7	28·8	31·5	1·094	+ 0·094
Above 10 & under 20	5	64·6	68·4	1·059	+ 0·110
Above 20 & under 40	4	122·6	117·0	0·954	− 0·128
Above 40 & under 100	1	51·0	54·0	1·059	+ 0·207
Above 100 & under 200	1	138·0	146·0	1·058	+ 0·336
Above 200 & under 400	1	239·0	251·0	1·050	+ 0·383
Above 400 squares..					
Total & Means..	19	33·90	35·15	1·049	+ 0·085

		J P	F	$\frac{F}{JP}$	$\sqrt{F} - \sqrt{JP}$
Under 50 squares....	8	206·5	206·0	0·998	− 0·006
Above 50 & under 100	3	258·0	217·0	0·841	− 0·769
Above 100 & under 200	1	154·0	165·0	1·071	+ 0·435
Above 200 & under 400	2	402·0	440·0	1·095	+ 0·655
Above 400 squares .					
Total & Means..	14	72·89	73·43	0·983	− 0·044

For J H and S P.

		J H	S P	$\frac{SP}{JH}$	$\sqrt{SP} - \sqrt{JH}$
Under 5 squares....	200	460·4	455·0	0·988	− 0·010
Above 5 & under 10	86	587·1	630·5	1·074	+ 0·094
Above 10 & under 20	80	1086·5	1071·0	0·986	− 0·026
Above 20 & under 40	49	1431·0	1401·0	0·979	− 0·057
Above 40 & under 80	23	1186·0	1173·0	0·989	− 0·040
Above 80 squares....					
Total & Means..	438	10·85	10·80	1·004	− 0·001

		J H	S P	$\frac{SP}{JH}$	$\sqrt{SP} - \sqrt{JH}$
Under 10 squares....	325	1794·2	1737·0	0·968	− 0·036
Above 10 & under 20	133	1854·5	1800·0	0·971	− 0·055
Above 20 & under 40	131	3725·5	3604·0	0·968	− 0·088
Above 40 & under 100	131	8517·0	8570·0	1·006	+ 0·025
Above 100 & under 200	85	12007·0	11965·0	0·997	− 0·020
Above 200 & under 40	27	7807·0	7944·0	1·018	+ 0·149
Above 400 squares..	2	920·0	930·0	1·011	+ 0·116
Total & Means..	834	43·92	43·83	0·979	− 0·030

		J H	S P	$\frac{SP}{JH}$	$\sqrt{SP} - \sqrt{JH}$
Under 50 squares....	49	1587·0	1590·0	1·002	+ 0·005
Above 50 & under 100	101	7616·0	7200·0	0·945	− 0·241
Above 100 & under 200	118	17588·0	16909·0	0·961	− 0·245
Above 200 & under 400	58	15335·0	14880·0	0·970	− 0·243
Above 400 squares..	10	4830·0	4860·0	1·006	+ 0·068
Total & Means..	336	139·75	135·24	0·965	− 0·198

For J H and W.

UMBRÆ.	No. of Obs.	Total Area as measured by J H	Total Area as measured by W	W/JH	√W—√JH	WHOLE SPOTS.	No. of Obs.	Total Area as measured by J H	Total Area as measured by W	W/JH	√W—√JH	FACULÆ.	No. of Obs.	Total Area as measured by J H	Total Area as measured by W	W/JH	√W—√JH
Under 5 squares	60	131·4	127·3	0·969	− 0·024	Under 10 squares....	95	461·3	447·1	0·969	− 0·035	Under 50 squares....	47	1676·0	1534·0	0·915	− 0·259
Above 5 & under 10	27	223·4	207·0	0·927	− 0·107	Above 10 & under 20	33	475·0	490·0	1·032	+ 0·061	Above 50 & under 100	42	3137·0	2905·0	0·926	− 0·325
Above 10 & under 20	25	371·3	336·4	0·906	− 0·185	Above 20 & under 40	17	492·5	496·6	1·083	+ 0·023	Above 100 & under 200	32	5034·0	4437·0	0·881	− 0·767
Above 20 & under 40	22	620·0	591·0	0·953	− 0·125	Above 40 & under 100	45	2809·5	2910·0	1·036	+ 0·140	Above 200 & under 400	21	6016·0	5664·0	0·942	− 0·503
Above 40 & under 80	7	404·5	385·0	0·952	− 0·185	Above 100 & under 200	22	3048·0	3099·0	1·017	+ 0·098	Above 400 squares ..	3	1400·0	1390·0	0·993	− 0·077
Above 80 squares....	2	214·0	208·0	0·972	− 0·146	Above 200 & under 400	10	2639·5	2765·0	1·048	+ 0·381						
						Above 400 squares ..	3	1488·0	1494·0	1·004	+ 0·045						
Total & Means..	143	13·74	12·97	0·947	− 0·093	Total & Means..	225	50·73	52·01	1·009	+ 0·051	Total & Means..	145	119·06	109·86	0·916	− 0·422

For S P and W.

		SP	W	W/SP	√W—√SP			SP	W	W/SP	√W—√SP			SP	W	W/SP	√W—√SP
Under 5 squares	69	174·5	175·2	1·004	+ 0·003	Under 10 squares....	106	510·0	452·8	0·888	− 0·127	Under 50 squares....	58	1920·0	1705·0	0·888	− 0·331
Above 5 & under 10	31	241·4	230·4	0·954	− 0·065	Above 10 & under 20	33	463·0	477·0	1·030	+ 0·056	Above 50 & under 100	49	3791·0	3317·0	0·875	− 0·569
Above 10 & under 20	22	328·0	310·0	0·945	− 0·108	Above 20 & under 40	35	970·5	916·0	0·944	− 0·112	Above 100 & under 200	30	4109·0	4034·0	0·982	− 0·108
Above 20 & under 40	15	406·0	403·0	0·993	− 0·019	Above 40 & under 100	33	2147·0	2137·0	0·995	− 0·019	Above 200 & under 400	13	3333·0	3213·0	0·964	− 0·291
Above 40 & under 80	5	261·0	246·0	0·943	− 0·211	Above 100 & under 200	30	4067·0	4155·0	1·022	+ 0·125	Above 400 squares ..	2	850·0	879·0	1·034	+ 0·348
Above 80 squares....	2	189·0	208·0	1·101	+ 0·477	Above 200 & under 400	5	1299·0	1342·0	1·033	+ 0·264						
						Above 400 squares ..	3	1421·0	1532·0	1·078	+ 0·834						
Total & Means..	144	11·11	10·92	0·982	− 0·032	Total & Means..	245	44·40	44·95	0·951	− 0·035	Total & Means..	152	92·13	86·50	0·911	− 0·351

For S P and E P.

		SP	EP	EP/SP	√EP—√SP			SP	EP	EP/SP	√EP—√SP			SP	EP	EP/SP	√EP—√SP
Under 5 squares....	32	101·2	94·2	0·931	− 0·063	Under 10 squares....	67	345·5	326·9	0·946	− 0·063	Under 50 squares....	28	917·0	944·0	1·029	+ 0·083
Above 5 & under 10	18	143·5	135·5	0·944	− 0·079	Above 10 & under 20	24	366·0	370·5	1·012	+ 0·024	Above 50 & under 100	25	1730·0	1820·0	1·052	+ 0·190
Above 10 & under 20	17	238·5	226·5	0·950	− 0·096	Above 20 & under 40	18	526·0	512·5	0·974	− 0·070	Above 100 & under 200	18	2496·0	2410·0	0·966	− 0·205
Above 20 & under 40	7	186·0	176·0	0·946	− 0·141	Above 40 & under 100	25	1583·0	1601·0	1·011	+ 0·045	Above 200 & under 400	4	1085·0	1110·0	1·023	+ 0·188
Above 40 & under 80	8	438·0	421·0	0·961	− 0·145	Above 100 & under 200	17	2427·0	2394·0	0·986	− 0·082	Above 400 squares..	1	450·0	400·0	0·889	− 1·213
Above 80 squares....	1	98·0	88·0	0·898	− 0·518	Above 200 & under 400	8	2165·0	2136·0	0·987	− 0·111						
						Above 400 squares..											
Total & Means..	83	14·52	13·75	0·941	− 0·093	Total & Means..	159	46·62	46·16	0·976	− 0·032	Total & Means..	76	87·87	87·95	1·019	+ 0·038

For E P and W R.

UMBRÆ.	No. of Obs.	Total Area as measured by		$\frac{WR}{EP}$	$\sqrt{WR}-\sqrt{EP}$	WHOLE SPOTS.	No. of Obs.	Total Area as measured by		$\frac{WR}{EP}$	$\sqrt{WR}-\sqrt{EP}$	FACULÆ.	No. of Obs.	Total Area as measured by		$\frac{WR}{EP}$	$\sqrt{WR}-\sqrt{EP}$
		E P	W R					E P	W R					E P	W R		
Under 5 squares....	13	34·7	34·5	0·994	− 0·006	Under 10 squares....	20	92·9	106·0	1·141	+ 0·146	Under 50 squares....	12	365·0	362·0	0·992	− 0·022
Above 5 & under 10	3	21·0	20·0	0·952	− 0·063	Above 10 & under 20	13	187·0	194·0	1·037	+ 0·071	Above 50 & under 100	8	638·0	610·0	0·956	− 0·198
Above 10 & under 20						Above 20 & under 40	3	77·0	69·0	0·896	− 0·271	Above 100 & under 200	5	565·0	586·0	1·041	+ 0·196
Above 20 & under 40						Above 40 & under 100	1	48·0	44·0	0·917	− 0·295	Above 200 & under 400	2	460·0	394·0	0·856	− 1·130
Above 40 & under 80						Above 100 & under 200						Above 400 squares..					
Above 80 squares....						Above 200 & under 400											
						Above 400 squares..											
Total & Means..	16	3·48	3·41	0·986	− 0·017	Total & Means..	37	10·94	11·16	1·079	+ 0·074	Total & Means..	27	75·48	72·30	0·980	− 0·116

As in the discussion of personality in the measurement of areas on four-inch photographs, and as in the preceding section in connexion with the probable error of such measurement, two suppositions have been made :—

(1.) That the measures of each observer are to be multiplied by a constant factor to reduce them to a uniform standard, in which case (*a*) the ratio of the areas (as given in each of the third columns) should be constant for the same pair of observers measuring spots of varying area ; and (*b*) the ratios for the various pairs of observers should be accordant, *i.e.*, for any three observers the product of the ratios for each pair taken in order should be unity.

With regard to (*a*) an inspection of the deduced factors shows that there is not always a satisfactory agreement between them, and it is possible that the variation of personality with area may be better represented by some other hypothesis. But the assortment of spots measured in the majority of cases being roughly the same, the mean factor deduced by any uniform method ought still to be subject to the condition (*b*). As in the measurement of the four-inch photographs, however, it has been found that many of the measures bear traces of being not altogether independent, so that the personal factor does not remain constant when the companion observer varies. This is doubtless due to the fact that in order to secure the same grouping of complicated spot-groups by the two measurers, the measures of the first are necessarily referred to by the second, and a certain amount of bias is thus introduced. The effect of this bias is somewhat less marked in the measurement of the eight-inch photographs than in that of the four-inch ; the greater proportion of

the eight-inch photographs having been taken since the time of maximum spot activity, and therefore at a time when extensive and complicated spot-groups were less frequent, and a close attention on the part of the second measurer to the observations of the first was not so frequently demanded.

The accordance of the personal factor in different combinations was actually tested as follows :—The ratios were reduced to algebraical differences by taking logarithms in each case, and these differences were then treated in the same manner as the personal equations in clock-error, as described in the various Introductions to the Greenwich Observations, *i.e.*, the various equations in which the same observer occurs are added together, so that in the resulting equation that observer is affected by a large co-efficient. Then writing for convenience m, h, etc., for log. M, log. H, etc., so that :—

$$h - m = \log. \frac{\mathrm{H}}{\mathrm{M}} = \left.\begin{matrix}\log. 0{\cdot}830\\ \log. 0{\cdot}967\\ \log. 1{\cdot}066\end{matrix}\right\} = \left\{\begin{matrix}9{\cdot}91908\\ 9{\cdot}98543\\ 0{\cdot}02776\end{matrix}\right\} \text{ for } \left\{\begin{matrix}\text{Umbræ,}\\ \text{Whole Spots,}\\ \text{Faculæ,}\end{matrix}\right.$$

and making M the standard observer, *i.e.*, putting M = 1, or m = O, we obtain the following systems of equations :—

		Umbræ.	Whole Spots.	Faculæ.
$7h - jp - f - jh - sp - w - ep$	=	9·77062	9·96400	0·04625
$3jp - h - f$	=	0·06077	9·99634	0·01370
$3f - h - jp$	=	0·05426	0·02164	9·96587
$4jh - h - sp - w$	=	9·98029	0·01051	0·09869
$5sp - h - jh - w - ep$	=	9·99432	0·00870	0·04185
$4w - h - jh - sp$	=	9·96233	9·96790	9·97507
$4ep - h - sp - wr$	=	0·00204	9·94946	0·04779
$2wr - ep$	=	9·97976	0·02469	0·02546

The solution of these equations gives the following values for m, h, jp, &c.

	Umbræ.	Whole Spots.	Faculæ.
m	0·00000	0·00000	0·00000
h	9·94974	9·98791	0·02881
jp	0·00444	9·99529	0·01528
f	0·00281	0·00161	0·00332
jh	9·96517	9·99391	0·04579
sp	9·96906	9·99184	0·03458
w	9·96158	9·98539	0·02106
ep	9·97449	9·98330	0·03540
wr	9·97713	0·00400	0·03043

and hence the following values of the ratios $\frac{H}{M}$, $\frac{J\,P}{M}$, &c., M being taken as 1 :—

	Umbræ.	Whole Spots.	Faculæ.
$\frac{H}{M}$	0·891	0·973	1·069
$\frac{J\,P}{M}$	1·010	0·989	1·036
$\frac{F}{M}$	1·006	1·004	1·008
$\frac{J\,H}{M}$	0·923	0·986	1·111
$\frac{S\,P}{M}$	0·931	0·981	1·083
$\frac{W}{M}$	0·915	0·967	1·050
$\frac{S\,P}{M}$	0·943	0·962	1·085
$\frac{W\,R}{M}$	0·949	1·009	1·073

The following table exhibits the differences between the values of the ratios for the several pairs of observers found by direct comparison, and those deduced from the solution of the equations :—

Ratio.	Umbræ.			Whole Spots.			Faculæ.		
	Value deduced from		Difference.	Value deduced from		Difference.	Value deduced from		Difference.
	Direct Comparison.	Equations.		Direct Comparison.	Equations.		Direct Comparison.	Equations.	
H ÷ M	0·830	0·891	+ ·061	0·967	0·973	+ ·006	1·066	1·069	+ ·003
J P ÷ M	1·109	1·010	− ·099	1·006	0·989	+ ·017	1·069	1·036	− ·033
F ÷ M	0·990	1·006	+ ·016	1·004	1·004	·000	0·992	1·008	+ ·016
J H ÷ M	0·915	0·923	+ ·008	1·012	0·986	− ·026	1·034	1·111	+ ·077
S P ÷ M	0·903	0·931	+ ·028	0·985	0·981	− ·004	1·082	1·083	+ ·001
W ÷ M	0·878	0·915	+ ·037	0·928	0·967	+ ·039	1·127	1·050	− ·077
E P ÷ M	0·996	0·943	− ·053	0·990	0·962	− ·028	1·063	1·085	+ ·022
W R ÷ M	0·968	0·949	− ·019	0·981	1·009	+ ·028	1·082	1·073	− ·009
J P ÷ H	1·089	1·134	+ ·045	1·034	1·017	− ·017	0·949	0·969	+ ·020
F ÷ H	1·090	1·130	+ ·040	0·998	1·032	+ ·034	0·948	0·943	− ·005
J H ÷ H	0·993	1·036	+ ·043	1·000	1·014	+ ·014	1·073	1·040	+ ·033
S P ÷ H	1·006	1·045	+ ·039	0·982	1·009	+ ·027	0·979	1·013	+ ·034
W ÷ H	1·123	1·028	− ·095	1·043	0·994	− ·049	1·004	0·982	− ·022
E P ÷ H	1·057	1·059	+ ·002	0·994	0·989	− ·005	1·010	1·015	+ ·005
F ÷ J P	1·050	0·996	− ·054	1·049	1·015	− ·034	0·983	0·973	− ·010
S P ÷ J H	1·004	1·009	+ ·005	0·979	0·995	+ ·016	0·965	0·975	+ ·010
W ÷ J H	0·947	0·992	+ ·045	1·009	0·981	− ·028	0·916	0·945	+ ·029
W ÷ S P	0·982	0·983	+ ·001	0·951	0·985	+ ·034	0·911	0·969	+ ·058
E P ÷ S P	0·941	1·013	+ ·072	0·976	0·981	+ ·005	1·019	1·002	− ·017
W R ÷ E P	0·986	1·006	+ ·020	1·079	1·049	− ·030	0·980	0·989	+ ·009

The following table gives the factors for the various pairs of observers, who have measured eight-inch photographs :—

FACTORS BY WHICH THE AREAS (ON EIGHT-INCH PHOTOGRAPHS), AS MEASURED BY THE VARIOUS PAIRS OF OBSERVERS, ARE TO BE MULTIPLIED TO REDUCE TO THE STANDARD OBSERVER, M.

Observers.	Umbræ.	Whole Spots.	Faculæ.
M, H	1·058	1·013	0·966
M, J P	0·995	1·006	0·982
M, F	0·997	0·998	0·996
M, J H	1·040	1·007	0·947
M, S P	1·035	1·010	0·960
M, W	1·044	1·017	0·976
M, E P	1·029	1·019	0·959
M, W R	1·026	0·995	0·964
H, J P	1·047	1·019	0·950
H, F	1·054	1·011	0·963
H, J H	1·103	1·020	0·917
H, S P	1·098	1·024	0·929
H, W	1·107	1·031	0·943
H, E P	1·091	1·033	0·928
J P, F	0·992	1·004	0·978
J H, S P	1·079	1·017	0·911
J H, W	1·088	1·025	0·925
S P, W	1·083	1·027	0·937
S P, E P	1·067	1·029	0·922
E P, W R	1·057	1·015	0·927

(2.) The second hypothesis tried is that each observer has a tendency to add to or subtract from the area of each spot, a ring of constant breadth, owing to the indefinite nature of the border. He is thus characterised by the algebraical excess of the square root of his measure of a spot over the square root of the measure of the standard observer. The sixth column in the tables of comparisons shows the value of this difference, as deduced from the various measures ; so that to reduce the measure of

any observer to that of another we subtract algebraically the mean value of the corresponding sixth column from the square root of his measure, and square the result. These quantities, to be in satisfactory accordance, should fulfil two conditions similar to (*a*) and (*b*) above.

The accordance between the results obtained from spots of different area does not appear to be more satisfactory on the second hypothesis than on the first, but the second hypothesis is to be preferred as corresponding to that which is indicated by the results for probable error.

The following are the equations deduced from the above sets of measures by a method similar to that used in the case of factors :—

		Umbræ.	Whole Spots.	Faculæ.
$7\sqrt{H} - \sqrt{JP} - \sqrt{F} - \sqrt{JH} - \sqrt{SP} - \sqrt{W} - \sqrt{EP}$	=	−0·771	−0·070	+0·210
$3\sqrt{JP} - \sqrt{H} - \sqrt{F}$	=	+0·008	−0·131	−0·088
$3\sqrt{F} - \sqrt{H} - \sqrt{JP}$	=	+0·232	+0·088	−0·377
$4\sqrt{JH} - \sqrt{H} - \sqrt{SP} - \sqrt{W}$	=	−0·040	−0·097	+1·125
$5\sqrt{SP} - \sqrt{H} - \sqrt{JH} - \sqrt{W} - \sqrt{EP}$	=	+0·015	−0·149	+0·260
$4\sqrt{W} - \sqrt{H} - \sqrt{JH} - \sqrt{SP}$	=	−0·247	−0·029	−0·478
$4\sqrt{EP} - \sqrt{H} - \sqrt{SP} - \sqrt{WR}$	=	−0·052	−0·205	+0·461
$2\sqrt{WR} - \sqrt{EP}$	=	−0·035	−0·028	+0·139

Solving these equations we get the following values for $\sqrt{H} - \sqrt{M}$, &c. :—

	Umbræ.	Whole Spots.	Faculæ.
$\sqrt{H} - \sqrt{M}$	−0·199	−0·077	+0·158
$\sqrt{JP} - \sqrt{M}$	−0·068	−0·077	−0·001
$\sqrt{F} - \sqrt{M}$	−0·012	−0·022	−0·073
$\sqrt{JH} - \sqrt{M}$	−0·134	−0·087	+0·398
$\sqrt{SP} - \sqrt{M}$	−0·120	−0·100	+0·232
$\sqrt{W} - \sqrt{M}$	−0·175	−0·073	+0·078
$\sqrt{EP} - \sqrt{M}$	−0·111	−0·113	+0·263
$\sqrt{WR} - \sqrt{M}$	−0·073	−0·070	+0·201

The following table exhibits the differences between the values for the several pairs of observers found by direct comparison, and those deduced from the solution of the equations :—

	UMBRÆ.			WHOLE SPOTS.			FACULÆ.		
	Values deduced from		Difference.	Values deduced from		Difference.	Values deduced from		Difference.
	Direct Comparison.	Equations.		Direct Comparison.	Equations.		Direct Comparison.	Equations.	
$\sqrt{H} - \sqrt{M}$	− 0·278	− 0·199	+ ·079	− 0·112	− 0·077	+ ·035	− 0·043	+ 0·158	+ ·201
$\sqrt{JP} - \sqrt{M}$	+ 0·013	− 0·068	− ·081	− 0·040	− 0·077	− ·037	+ 0·164	− 0·001	− ·165
$\sqrt{F} - \sqrt{M}$	− 0·034	− 0·012	+ ·022	+ 0·040	− 0·022	− ·062	− 0·091	− 0·073	+ ·018
$\sqrt{JH} - \sqrt{M}$	− 0·135	− 0·134	+ ·001	− 0·060	− 0·087	− ·027	+ 0·148	+ 0·398	+ ·250
$\sqrt{SP} - \sqrt{M}$	− 0·142	− 0·120	+ ·022	− 0·141	− 0·100	+ ·041	+ 0·250	+ 0·232	− ·018
$\sqrt{W} - \sqrt{M}$	− 0·260	− 0·175	+ ·085	− 0·140	− 0·073	+ ·067	+ 0·243	+ 0·078	− ·165
$\sqrt{EP} - \sqrt{M}$	− 0·040	− 0·111	− ·071	− 0·073	− 0·113	− ·040	+ 0·180	+ 0·263	+ ·083
$\sqrt{WR} - \sqrt{M}$	− 0·018	− 0·073	− ·055	− 0·102	− 0·070	+ ·032	+ 0·255	+ 0·201	− ·054
$\sqrt{JP} - \sqrt{H}$	+ 0·088	+ 0·131	+ ·043	− 0·006	0·000	+ ·006	− 0·296	− 0·159	+ ·137
$\sqrt{F} - \sqrt{H}$	+ 0·173	+ 0·187	+ ·014	− 0·037	+ 0·055	+ ·092	− 0·242	− 0·231	+ ·011
$\sqrt{JH} - \sqrt{H}$	+ 0·003	+ 0·065	+ ·062	− 0·016	− 0·010	+ ·006	+ 0·357	+ 0·240	− ·117
$\sqrt{SP} - \sqrt{H}$	+ 0·031	+ 0·079	+ ·048	− 0·045	− 0·023	+ ·022	− 0·105	+ 0·074	+ ·179
$\sqrt{W} - \sqrt{H}$	+ 0·138	+ 0·024	− ·114	+ 0·095	+ 0·004	− ·091	+ 0·052	− 0·080	− ·132
$\sqrt{EP} - \sqrt{H}$	+ 0·064	+ 0·088	+ ·024	− 0·026	− 0·036	− ·010	+ 0·127	+ 0·107	− ·020
$\sqrt{F} - \sqrt{JP}$	+ 0·093	+ 0·056	− ·037	+ 0·085	+ 0·055	− ·030	− 0·044	− 0·072	− ·028
$\sqrt{SP} - \sqrt{JH}$	+ 0·001	+ 0·014	+ ·013	− 0·030	− 0·013	+ ·017	− 0·198	− 0·166	+ ·032
$\sqrt{W} - \sqrt{JH}$	− 0·093	− 0·041	+ ·052	+ 0·051	+ 0·014	− ·037	− 0·422	− 0·320	+ ·102
$\sqrt{W} - \sqrt{SP}$	− 0·032	− 0·055	− ·023	− 0·035	+ 0·027	+ ·062	− 0·351	− 0·154	+ ·197
$\sqrt{EP} - \sqrt{SP}$	− 0·093	+ 0·009	+ ·102	− 0·032	− 0·013	+ ·019	+ 0·038	+ 0·031	− ·007
$\sqrt{WR} - \sqrt{EP}$	− 0·017	+ 0·038	+ ·055	+ 0·074	+ 0·043	− ·031	− 0·116	− 0·062	+ ·054

For the application of these corrections the following tables have been constructed for the various pairs of observers who have measured photographs; the corrections are applicable algebraically to the areas as printed in the daily results, to obtain the area as measured by the standard observer, M :—

UMBRÆ.

Corrections to be applied to measured area on hypothesis of error varying as perimeter.

Pairs of Observers.

Area.	M, H	M, J P	M, F	M, J H	M, S P	M, W	M, E P	M, W R	H, J P	H, F
1	+ 0·2	+ 0·1	0·0	+ 0·1	+ 0·1	+ 0·2	+ 0·1	+ 0·1	+ 0·3	+ 0·2
2	+ 0·3	+ 0·1	0·0	+ 0·2	+ 0·2	+ 0·3	+ 0·2	+ 0·1	+ 0·4	+ 0·3
4	+ 0·4	+ 0·1	0·0	+ 0·3	+ 0·2	+ 0·4	+ 0·2	+ 0·2	+ 0·6	+ 0·4
6	+ 0·5	+ 0·2	0·0	+ 0·3	+ 0·3	+ 0·4	+ 0·3	+ 0·2	+ 0·7	+ 0·5
8	+ 0·6	+ 0·2	0·0	+ 0·4	+ 0·3	+ 0·5	+ 0·3	+ 0·2	+ 0·8	+ 0·6
10	+ 0·6	+ 0·2	0·0	+ 0·4	+ 0·4	+ 0·6	+ 0·4	+ 0·2	+ 0·9	+ 0·7
20	+ 0·9	+ 0·3	+ 0·1	+ 0·6	+ 0·5	+ 0·8	+ 0·5	+ 0·3	+ 1·2	+ 1·0
30	+ 1·1	+ 0·4	+ 0·1	+ 0·7	+ 0·7	+ 1·0	+ 0·6	+ 0·4	+ 1·5	+ 1·2
40	+ 1·3	+ 0·4	+ 0·1	+ 0·9	+ 0·8	+ 1·1	+ 0·7	+ 0·5	+ 1·7	+ 1·4
50	+ 1·4	+ 0·5	+ 0·1	+ 1·0	+ 0·9	+ 1·3	+ 0·8	+ 0·5	+ 1·9	+ 1·5
70	+ 1·7	+ 0·6	+ 0·1	+ 1·1	+ 1·0	+ 1·5	+ 1·0	+ 0·6	+ 2·3	+ 1·8
100	+ 2·0	+ 0·7	+ 0·1	+ 1·4	+ 1·2	+ 1·8	+ 1·1	+ 0·7	+ 2·7	+ 2·1
150	+ 3·4	+ 0·8	+ 0·1	+ 1·6	+ 1·5	+ 2·3	+ 1·3	+ 0·9	+ 3·3	+ 2·6
200	+ 2·8	+ 1·0	+ 0·2	+ 1·9	+ 1·6	+ 2·5	+ 1·6	+ 1·0	+ 3·7	+ 3·0
250	+ 3·1	+ 1·1	+ 0·2	+ 2·1	+ 1·9	+ 2·8	+ 1·8	+ 1·1	+ 4·2	+ 3·4
300	+ 3·5	+ 1·2	+ 0·2	+ 2·3	+ 2·3	+ 3·1	+ 2·0	+ 1·3	+ 4·7	+ 3·7
350	+ 3·7	+ 1·3	+ 0·2	+ 2·5	+ 2·2	+ 3·3	+ 2·1	+ 1·4	+ 5·0	+ 4·0

Area.	H, J H	H, S P	H, W	H, E P	J P, F	J H, S P	J H, W	S P, W	S P, E P	E P, W R
1	+ 0·4	+ 0·3	+ 0·4	+ 0·3	+ 0·1	+ 0·3	+ 0·3	+ 0·3	+ 0·2	+ 0·2
2	+ 0·5	+ 0·5	+ 0·6	+ 0·5	+ 0·1	+ 0·4	+ 0·5	+ 0·4	+ 0·3	+ 0·3
4	+ 0·7	+ 0·7	+ 0·8	+ 0·6	+ 0·2	+ 0·5	+ 0·6	+ 0·6	+ 0·5	+ 0·4
6	+ 0·8	+ 0·8	+ 0·9	+ 0·8	+ 0·2	+ 0·6	+ 0·8	+ 0·7	+ 0·6	+ 0·5
8	+ 1·0	+ 0·9	+ 1·1	+ 0·9	+ 0·2	+ 0·7	+ 0·9	+ 0·9	+ 0·7	+ 0·5
10	+ 1·1	+ 1·0	+ 1·2	+ 1·0	+ 0·3	+ 0·8	+ 1·0	+ 1·0	+ 0·7	+ 0·6
20	+ 1·5	+ 1·5	+ 1·7	+ 1·4	+ 0·4	+ 1·2	+ 1·4	+ 1·3	+ 1·0	+ 0·8
30	+ 1·9	+ 1·8	+ 2·1	+ 1·7	+ 0·4	+ 1·4	+ 1·7	+ 1·6	+ 1·3	+ 1·0
40	+ 2·2	+ 2·1	+ 2·4	+ 2·0	+ 0·5	+ 1·6	+ 2·0	+ 1·9	+ 1·5	+ 1·2
50	+ 2·4	+ 2·3	+ 2·7	+ 2·2	+ 0·6	+ 1·8	+ 2·2	+ 2·1	+ 1·7	+ 1·3
70	+ 2·8	+ 2·7	+ 3·2	+ 2·6	+ 0·7	+ 2·2	+ 2·6	+ 2·5	+ 2·0	+ 1·6
100	+ 3·4	+ 3·2	+ 3·4	+ 3·1	+ 0·8	+ 2·6	+ 3·1	+ 3·0	+ 2·3	+ 1·9
150	+ 4·1	+ 3·9	+ 4·6	+ 3·8	+ 1·0	+ 3·1	+ 3·8	+ 3·6	+ 2·8	+ 2·3
200	+ 4·7	+ 4·6	+ 5·3	+ 4·4	+ 1·1	+ 3·6	+ 4·4	+ 4·2	+ 3·3	+ 2·6
250	+ 5·3	+ 5·1	+ 6·0	+ 4·9	+ 1·3	+ 4·0	+ 4·9	+ 4·7	+ 3·7	+ 2·9
300	+ 5·9	+ 5·6	+ 6·3	+ 5·4	+ 1·4	+ 4·4	+ 5·4	+ 5·2	+ 4·1	+ 3·2
350	+ 6·3	+ 6·0	+ 7·0	+ 5·8	+ 1·5	+ 4·8	+ 5·8	+ 5·5	+ 4·3	+ 3·4

WHOLE SPOTS.

Corrections to be applied to measured area on hypothesis of error varying as perimeter.

Pairs of Observers.

Area.	M, H	M, J P	M, F	M, J H	M, S P	M, W	M, E P	M, W R	H, J P	H, F
5	+ 0·2	+ 0·2	0·0	+ 0·2	+ 0·2	+ 0·2	+ 0·3	+ 0·2	+ 0·4	+ 0·2
10	+ 0·2	+ 0·2	+ 0·1	+ 0·3	+ 0·3	+ 0·2	+ 0·4	+ 0·2	+ 0·5	+ 0·3
20	+ 0·4	+ 0·4	+ 0·1	+ 0·4	+ 0·4	+ 0·3	+ 0·5	+ 0·3	+ 0·7	+ 0·4
30	+ 0·4	+ 0·4	+ 0·1	+ 0·5	+ 0·5	+ 0·4	+ 0·6	+ 0·4	+ 0·8	+ 0·5
40	+ 0·5	+ 0·5	+ 0·1	+ 0·6	+ 0·6	+ 0·5	+ 0·7	+ 0·5	+ 1·0	+ 0·6
50	+ 0·6	+ 0·6	+ 0·2	+ 0·6	+ 0·7	+ 0·5	+ 0·8	+ 0·5	+ 1·1	+ 0·7
100	+ 0·8	+ 0·8	+ 0·2	+ 0·9	+ 1·0	+ 0·7	+ 1·2	+ 0·7	+ 1·5	+ 1·0
150	+ 0·9	+ 0·9	+ 0·3	+ 1·1	+ 1·2	+ 0·9	+ 1·4	+ 0·8	+ 1·9	+ 1·2
200	+ 1·1	+ 1·1	+ 0·3	+ 1·2	+ 1·4	+ 1·1	+ 1·6	+ 1·0	+ 2·2	+ 1·4
250	+ 1·2	+ 1·2	+ 0·3	+ 1·4	+ 1·6	+ 1·2	+ 1·8	+ 1·1	+ 2·4	+ 1·6
350	+ 1·4	+ 1·4	+ 0·4	+ 1·6	+ 1·8	+ 1·4	+ 2·1	+ 1·3	+ 2·8	+ 1·8
500	+ 1·8	+ 1·8	+ 0·5	+ 2·1	+ 2·3	+ 1·7	+ 2·6	+ 1·6	+ 3·5	+ 2·3
750	+ 2·2	+ 2·2	+ 0·6	+ 2·4	+ 2·7	+ 2·0	+ 3·2	+ 2·0	+ 4·2	+ 2·7
1000	+ 2·5	+ 2·5	+ 0·7	+ 2·8	+ 3·2	+ 2·4	+ 3·6	+ 2·2	+ 5·0	+ 3·2
1250	+ 2·7	+ 2·7	+ 0·8	+ 3·0	+ 3·5	+ 2·6	+ 4·0	+ 2·5	+ 5·4	+ 3·5
1500	+ 3·0	+ 3·0	+ 1·1	+ 3·5	+ 3·9	+ 2·8	+ 4·4	+ 2·7	+ 5·8	+ 3·9
2000	+ 3·5	+ 3·5	+ 1·2	+ 3·9	+ 4·4	+ 3·3	+ 5·0	+ 3·1	+ 6·8	+ 4·4

Area.	H, J H	H, S P	H, W	H, E P	J P, F	J H, S P	J H, W	S P, W	S P, E P	E P, W R
5	+ 0·4	+ 0·4	+ 0·4	+ 0·4	+ 0·2	+ 0·4	+ 0·4	+ 0·4	+ 0·5	+ 0·4
10	+ 0·5	+ 0·6	+ 0·5	+ 0·6	+ 0·3	+ 0·6	+ 0·5	+ 0·5	+ 0·7	+ 0·6
20	+ 0·7	+ 0·8	+ 0·7	+ 0·9	+ 0·4	+ 0·8	+ 0·7	+ 0·8	+ 1·0	+ 0·8
30	+ 0·9	+ 1·0	+ 0·8	+ 1·0	+ 0·5	+ 1·0	+ 0·9	+ 0·9	+ 1·2	+ 1·0
40	+ 1·1	+ 1·1	+ 1·0	+ 1·2	+ 0·6	+ 1·2	+ 1·0	+ 1·1	+ 1·4	+ 1·2
50	+ 1·2	+ 1·3	+ 1·1	+ 1·4	+ 0·7	+ 1·3	+ 1·1	+ 1·2	+ 1·5	+ 1·3
100	+ 1·7	+ 1·8	+ 1·5	+ 1·9	+ 1·0	+ 1·9	+ 1·6	+ 1·7	+ 2·2	+ 1·8
150	+ 2·0	+ 2·2	+ 1·8	+ 2·3	+ 1·2	+ 2·3	+ 1·9	+ 2·1	+ 2·6	+ 2·3
200	+ 2·3	+ 2·5	+ 2·1	+ 2·7	+ 1·4	+ 2·7	+ 2·3	+ 2·4	+ 3·0	+ 2·6
250	+ 2·6	+ 2·8	+ 2·3	+ 3·0	+ 1·6	+ 3·0	+ 2·5	+ 2·7	+ 3·4	+ 2·9
350	+ 3·0	+ 3·3	+ 2·8	+ 3·6	+ 1·8	+ 3·5	+ 2·9	+ 3·2	+ 4·0	+ 3·4
500	+ 3·7	+ 4·0	+ 3·4	+ 4·3	+ 2·3	+ 4·3	+ 3·6	+ 3·9	+ 4·8	+ 4·1
750	+ 4·5	+ 4·9	+ 4·1	+ 5·2	+ 2·7	+ 5·2	+ 4·4	+ 4·7	+ 5·9	+ 5·1
1000	+ 5·2	+ 5·7	+ 4·8	+ 6·0	+ 3·2	+ 6·0	+ 5·0	+ 5·4	+ 6·8	+ 5·8
1250	+ 5·8	+ 6·3	+ 5·3	+ 6·7	+ 3·5	+ 6·7	+ 5·6	+ 6·1	+ 7·6	+ 6·5
1500	+ 6·3	+ 7·0	+ 5·8	+ 7·4	+ 3·9	+ 7·3	+ 6·2	+ 6·6	+ 8·2	+ 7·2
2000	+ 7·3	+ 8·0	+ 6·6	+ 8·5	+ 4·4	+ 8·5	+ 7·1	+ 7·7	+ 9·6	+ 8·2

FACULÆ.

Corrections to be applied to measured area on hypothesis of error varying as perimeter.

Pairs of Observers.

Area.	M, H	M, J P	M, F	M, J H	M, S P	M, W	M, E P	M, W R	H, J P	H, F
10	− 1·0	0·0	+ 0·5	− 2·4	− 1·4	− 0·5	− 1·6	− 1·2	− 0·5	− 0·3
20	− 1·4	0·0	+ 0·7	− 3·4	− 2·0	− 0·7	− 2·3	− 1·8	− 0·7	− 0·4
30	− 1·7	0·0	+ 0·8	− 4·2	− 2·5	− 0·8	− 2·8	− 2·2	− 0·9	− 0·5
50	− 2·2	0·0	+ 1·0	− 5·5	− 3·2	− 1·1	− 3·6	− 2·8	− 1·1	− 0·6
70	− 2·6	0·0	+ 1·2	− 6·5	− 3·8	− 1·3	− 4·3	− 3·3	− 1·3	− 0·7
100	− 3·1	0·0	+ 1·5	− 7·8	− 4·6	− 1·5	− 5·2	− 4·0	− 1·6	− 0·9
150	− 3·9	0·0	+ 1·8	− 8·6	− 5·6	− 1·9	− 6·4	− 4·9	− 2·0	− 1·1
200	− 4·4	0·0	+ 2·1	−11·1	− 6·5	− 2·2	− 7·4	− 5·7	− 2·2	− 1·2
250	− 5·0	0·0	+ 2·3	−12·4	− 7·3	− 2·5	− 8·3	− 6·3	− 2·5	− 1·4
300	− 5·4	+ 0·1	+ 2·5	−13·6	− 8·0	− 2·7	− 9·0	− 6·9	− 2·7	− 1·5
350	− 5·9	+ 0·1	+ 2·7	−14·7	− 8·6	− 2·9	− 9·8	− 7·5	− 3·0	− 1·6
400	− 6·3	+ 0·1	+ 2·9	−15·8	− 9·2	− 3·1	−10·5	− 8·0	− 3·2	− 1·7
500	− 7·0	+ 0·1	+ 3·3	−17·6	−10·3	− 3·5	−11·7	− 8·9	− 3·5	− 1·9
1000	−10·0	+ 0·1	+ 4·6	−25·0	−14·6	− 4·9	−16·5	−12·7	− 5·0	− 2·7

Area.	H, J H	H, S P	H, W	H, E P	J, P F	J H, S P	J H, W	S P, W	S P, E P	E P, W R
10	− 1·7	− 1·2	− 0·7	− 1·3	+ 0·2	− 1·9	− 1·5	− 1·0	− 1·5	− 1·4
20	− 2·4	− 1·7	− 1·0	− 1·8	+ 0·3	− 2·7	− 2·1	− 1·4	− 2·2	− 2·0
30	− 3·0	− 2·1	− 1·3	− 2·3	+ 0·4	− 3·3	− 2·6	− 1·7	− 2·7	− 2·5
50	− 3·9	− 2·7	− 1·7	− 2·9	+ 0·5	− 4·4	− 3·3	− 2·2	− 3·4	− 3·2
70	− 4·6	− 3·2	− 1·9	− 3·5	+ 0·6	− 5·2	− 3·9	− 2·6	− 4·1	− 3·8
100	− 5·5	− 3·9	− 2·3	− 4·2	+ 0·7	− 6·2	− 4·7	− 3·1	− 4·9	− 4·6
150	− 6·7	− 4·7	− 2·9	− 5·1	+ 0·9	− 7·6	− 5·8	− 3·8	− 6·0	− 5·6
200	− 7·8	− 5·5	− 3·3	− 5·9	+ 1·0	− 8·8	− 6·7	− 4·4	− 7·0	− 6·5
250	− 8·7	− 6·1	− 3·7	− 6·6	+ 1·2	− 9·9	− 7·5	− 4·9	− 7·7	− 7·3
300	− 9·5	− 6·7	− 4·1	− 7·3	+ 1·3	−10·8	− 8·2	− 5·3	− 8·5	− 8·0
350	−10·3	− 7·3	− 4·4	− 7·9	+ 1·4	−11·7	− 8·9	− 5·8	− 9·2	− 8·6
400	−11·0	− 7·8	− 4·7	− 8·4	+ 1·5	−12·5	− 9·5	− 6·2	− 9·9	− 9·2
500	−12·3	− 8·7	− 5·2	− 9·4	+ 1·7	−14·0	−10·6	− 6·9	−11·0	−10·3
1000	−17·5	−12·3	− 7·4	−13·3	+ 2·4	−19·8	−15·3	− 9·8	−16·0	−14·6

It will be seen that these corrections are in every case smaller than the probable error of the means of two measures on eight-inch photographs (as given on p. xxiii. of this Introduction and also in the Introduction to the Greenwich Observations, 1885). It seems, therefore, unnecessary to apply them to the measured areas as printed, except in cases of special discussions of changes of area from day to day where extreme accuracy is desired.

As the two senior observers, M and H, have both been engaged in the measurement of eight-inch photographs since 1882, it appeared interesting to enquire whether a comparison of their measures made in different years showed any progressive change of personality. The following table shows that though considerable differences are indicated in the mode of observation of the one observer relative to the other from year to year, yet there has been no regular progressive change. Eight-inch sun pictures were first taken at the Dehra Dûn Observatory, India, during the period 1882 November 7 to December 8. They were then discontinued for about six months, but since 1883 June, the four-inch photographs have been entirely discarded at Dehra Dûn, and the daily series of sun pictures has been always taken on the eight-inch scale. The change from the four-inch to the eight-inch scale was made at the Royal Observatory, Greenwich, on 1884 April 2, and at the Royal Alfred Observatory, Mauritius, on 1885 March 11. As during the year 1883 the measurement of the Greenwich photographs was effected by M with one computer, and that of the Indian photographs by H with another computer, it happens that in no case did M and H both measure the same eight-inch photograph in that year, and there are, therefore, no materials available for determining their personality at that time.

FOR M AND H.

Year	Umbræ. No. of Obs.	Umbræ. Total Area as measured by M	Umbræ. Total Area as measured by H	Umbræ. $\frac{H}{M}$	Umbræ. $\sqrt{H}-\sqrt{M}$	Whole Spots. No. of Obs.	Whole Spots. Total Area as measured by M	Whole Spots. Total Area as measured by H	Whole Spots. $\frac{H}{M}$	Whole Spots. $\sqrt{H}-\sqrt{M}$	Faculæ. No. of Obs.	Faculæ. Total Area as measured by M	Faculæ. Total Area as measured by H	Faculæ. $\frac{H}{M}$	Faculæ. $\sqrt{H}-\sqrt{M}$
1882	40	1224·2	1130·0	0·897	−0·193	64	7860·3	7844·1	0·999	−0·004	52	7265·0	6596·0	0·973	−0·319
1884	96	1407·9	1153·6	0·800	−0·305	137	8851·7	8621·4	0·933	−0·165	73	11893·0	11679·0	1·069	+0·103
1885	14	94·2	94·7	0·931	−0·038	26	734·9	754·5	1·068	+0·110	31	2213·0	2581·0	1·205	+0·700
1886	15	153·6	142·1	0·832	−0·190	34	976·4	987·0	0·997	+0·002	28	2121·0	1934·0	1·045	−0·148
1887	85	1123·1	934·0	0·809	−0·304	138	7135·4	6681·2	0·938	−0·183	98	5798·0	6056·0	1·087	+0·232
1888	14	167·4	135·3	0·863	−0·304	31	1128·2	1090·8	1·085	+0·034	48	2555·0	2445·0	1·062	+0·107

A more detailed comparison, giving the separate results for spots and faculæ of different sizes, is given in the following tables :—

For 1882.

UMBRÆ.

	No. of Obs.	Total Area as measured by M	Total Area as measured by H	$\frac{H}{M}$	$\sqrt{H} - \sqrt{M}$
Under 5 squares	17	59·7	54·8	0·918	− 0·080
Above 5 & under 10	11	87·4	75·9	0·868	− 0·193
Above 10 & under 20	6	94·1	81·3	0·864	− 0·279
Above 20 & under 40	2	57·0	51·0	0·895	− 0·289
Above 40 & under 80					
Above 80 squares....	4	926·0	867·0	0·936	− 0·493
Total & Means ..	40	30·61	28·25	0·897	− 0·193

WHOLE SPOTS.

	No. of Obs.	Total Area as measured by M	Total Area as measured by H	$\frac{H}{M}$	$\sqrt{H} - \sqrt{M}$
Under 10 squares....	18	88·2	88·9	1·007	+ 0·009
Above 10 & under 20	14	227·8	226·6	0·995	− 0·011
Above 20 & under 40	9	236·3	243·8	1·032	+ 0·080
Above 40 & under 100	12	785·0	732·3	0·933	− 0·276
Above 100 & under 200	6	755·0	800·5	1·060	+ 0·334
Above 200 & under 400	1	276·0	288·0	1·043	+ 0·358
Above 400 squares ..	4	5492·0	5464·0	0·995	− 0·009
Total & Means ..	64	122·82	122·56	0·999	− 0·004

FACULÆ.

	No. of Obs.	Total Area as measured by M	Total Area as measured by H	$\frac{H}{M}$	$\sqrt{H} - \sqrt{M}$
Under 50 squares....	14	459·0	480·0	1·046	+ 0·130
Above 50 & under 100	16	1173·0	1100·0	0·938	− 0·271
Above 100 & under 200	12	1721·0	1772·0	1·030	+ 0·176
Above 200 & under 400	5	1292·0	1212·0	0·938	− 0·506
Above 400 squares ..	5	2620·0	2032·0	0·776	− 2·732
Total & Means ..	52	139·71	126·85	0·973	− 0·319

For 1884.

		M	H	$\frac{H}{M}$	$\sqrt{H} - \sqrt{M}$
Under 5 squares	37	104·5	83·5	0·798	− 0·176
Above 5 & under 10	25	195·9	153·6	0·784	− 0·222
Above 10 & under 20	18	258·7	205·5	0·795	− 0·412
Above 20 & under 40	8	258·3	212·0	0·821	− 0·535
Above 40 & under 80	5	285·5	240·5	0·842	− 0·621
Above 80 squares....	3	305·0	258·5	0·848	− 0·800
Total & Means ..	96	14·66	12·02	0·800	− 0·305

		M	H	$\frac{H}{M}$	$\sqrt{H} - \sqrt{M}$
Under 10 squares....	46	231·7	215·3	0·929	− 0·082
Above 10 & under 20	23	306·1	289·6	0·946	− 0·099
Above 20 & under 40	19	667·2	583·5	0·875	− 0·385
Above 40 & under 100	30	2100·7	1962·0	0·934	− 0·281
Above 100 & under 200	6	797·0	759·0	0·952	− 0·278
Above 200 & under 400	7	1795·0	1733·0	0·966	− 0·279
Above 400 squares ..	6	2954·0	3079·0	1·042	+ 0·465
Total & Means ..	137	64·61	62·93	0·933	− 0·165

		M	H	$\frac{H}{M}$	$\sqrt{H} - \sqrt{M}$
Under 50 squares....	20	537·0	645·0	1·201	+ 0·497
Above 50 & under 100	14	955·0	1050·0	1·099	+ 0·401
Above 100 & under 200	21	2986·0	3148·0	1·054	+ 0·319
Above 200 & under 400	12	3715·0	3376·0	0·909	− 0·821
Above 400 squares ..	6	3700·0	3460·0	0·935	− 0·819
Total & Means ..	73	162·92	159·99	1·069	+ 0·103

For 1885.

		M	H	$\frac{H}{M}$	$\sqrt{H} - \sqrt{M}$
Under 5 squares	9	22·2	18·7	0·842	− 0·130
Above 5 & under 10	1	8·0	7·0	0·875	− 0·182
Above 10 & under 20	3	37·0	46·0	1·243	+ 0·405
Above 20 & under 40	1	27·0	23·0	0·852	− 0·400
Above 40 & under 80					
Above 80 squares....					
Total & Means ..	14	6·73	6·76	0·931	− 0·038

		M	H	$\frac{H}{M}$	$\sqrt{H} - \sqrt{M}$
Under 10 squares....	13	61·0	64·5	1·057	+ 0·061
Above 10 & under 20	3	38·7	41·0	1·059	+ 0·106
Above 20 & under 40	3	68·2	88·0	1·290	+ 0·649
Above 40 & under 100	5	322·0	326·0	1·012	+ 0·050
Above 100 & under 200	2	245·0	235·0	0·959	− 0·228
Above 200 & under 400					
Above 400 squares ..					
Total & Means ..	26	28·27	29·02	1·068	+ 0·110

		M	H	$\frac{H}{M}$	$\sqrt{H} - \sqrt{M}$
Under 50 squares....	9	261·0	357·0	1·368	+ 0·914
Above 50 & under 100	15	916·0	1050·0	1·146	+ 0·553
Above 100 & under 200	5	586·0	644·0	1·099	+ 0·523
Above 200 & under 400	2	450·0	530·0	1·178	+ 1·279
Above 400 squares ..					
Total & Means .	31	71·39	83·26	1·205	+ 0·700

For 1886.

UMBRÆ.	No. of Obs.	Total Area as measured by M	Total Area as measured by H	$\frac{H}{M}$	$\sqrt{H} - \sqrt{M}$
Under 5 squares....	7	18·3	15·2	0·831	− 0·143
Above 5 & under 10	6	44·3	33·9	0·765	− 0·340
Above 10 & under 20					
Above 20 & under 40	1	25·0	27·0	1·080	+ 0·196
Above 40 & under 80	1	66·0	66·0	1·000	0·000
Above 80 squares....					
Total & Means ..	15	10·24	9·47	0·832	− 0·190

WHOLE SPOTS.	No. of Obs.	Total Area as measured by M	Total Area as measured by H	$\frac{H}{M}$	$\sqrt{H} - \sqrt{M}$
Under 10 squares....	16	71·1	72·0	1·013	+ 0·014
Above 10 & under 20	8	121·5	109·0	0·897	− 0·205
Above 20 & under 40	6	165·3	177·0	1·071	+ 0·182
Above 40 & under 100	2	90·5	93·0	1·028	+ 0·072
Above 100 & under 200	1	122·0	122·0	1·000	0·000
Above 200 & under 400					
Above 400 squares..	1	406·0	414·0	1·020	+ 0·198
Total & Means ..	34	28·72	29·03	0·997	+ 0·002

FACULÆ.	No. of Obs.	Total Area as measured by M	Total Area as measured by H	$\frac{H}{M}$	$\sqrt{H} - \sqrt{M}$
Under 50 squares....	12	283·0	353·0	1·247	+ 0·568
Above 50 & under 100	8	568·0	556·0	0·979	− 0·089
Above 100 & under 200	7	1050·0	845·0	0·805	− 1·260
Above 200 & under 400	1	220·0	180·0	0·81	− 1·416
Above 400 squares..					
Total & Means ..	28	75·75	69·07	1·046	− 0·148

For 1887.

		M	H	$\frac{H}{M}$	$\sqrt{H} - \sqrt{M}$
Under 5 squares....	33	81·4	66·6	0·818	− 0·151
Above 5 & under 10	23	189·2	144·4	0·763	− 0·367
Above 10 & under 20	17	276·0	227·5	0·824	− 0·372
Above 20 & under 40	6	182·5	153·5	0·841	− 0·458
Above 40 & under 80	6	394·0	342·0	0·868	− 0·553
Above 80 squares....					
Total & Means ..	85	14·48	10·99	0·809	− 0·304

		M	H	$\frac{H}{M}$	$\sqrt{H} - \sqrt{M}$
Under 10 squares....	55	269·5	253·2	0·939	− 0·067
Above 10 & under 20	22	312·4	298·0	0·954	− 0·087
Above 20 & under 40	15	444·5	418·0	0·940	− 0·164
Above 40 & under 100	27	1812·0	1678·0	0·926	− 0·309
Above 100 & under 200	11	1401·0	1277·0	0·912	− 0·489
Above 200 & under 400	6	1866·0	1807·0	0·968	− 0·281
Above 400 squares..	2	1030·0	950·0	0·922	− 0·899
Total & Means ..	138	51·71	48·41	0·938	− 0·183

		M	H	$\frac{H}{M}$	$\sqrt{H} - \sqrt{M}$
Under 50 squares....	59	1574·0	1774·0	1·127	+ 0·317
Above 50 & under 100	22	1455·0	1532·0	1·053	+ 0·213
Above 100 & under 200	14	1929·0	1920·0	0·995	− 0·025
Above 200 & under 400	3	840·0	830·0	0·988	− 0·100
Above 400 squares..					
Total & Means ..	98	59·16	61·80	1·087	+ 0·232

For 1888.

		M	H	$\frac{H}{M}$	$\sqrt{H} - \sqrt{M}$
Under 5 squares....	3	7·8	7·3	0·936	− 0·053
Above 5 & under 10	4	27·6	28·5	1·033	+ 0·043
Above 10 & under 20	6	106·0	72·5	0·684	− 0·728
Above 20 & under 40	1	26·0	27·0	1·038	+ 0·097
Above 40 & under 80					
Above 80 squares....					
Total & Means ..	14	11·96	9·66	0·863	− 0·304

		M	H	$\frac{H}{M}$	$\sqrt{H} - \sqrt{M}$
Under 10 squares....	13	75·2	90·3	1·201	+ 0·232
Above 10 & under 20	6	78·0	87·5	1·122	+ 0·214
Above 20 & under 40	2	67·0	60·0	0·896	− 0·311
Above 40 & under 100	6	378·0	369·0	0·976	− 0·095
Above 100 & under 200	4	530·0	484·0	0·913	− 0·511
Above 200 & under 400					
Above 400 squares..					
Total & Means ..	31	36·39	35·19	1·085	+ 0·034

		M	H	$\frac{H}{M}$	$\sqrt{H} - \sqrt{M}$
Under 50 squares....	26	551·0	624·0	1·132	+ 0·296
Above 50 & under 100	18	1164·0	1187·0	1·020	+ 0·079
Above 100 & under 200	3	490·0	414·0	0·845	− 0·033
Above 200 & under 400	1	350·0	220·0	0·629	− 3·876
Above 400 squares..					
Total & Means ..	48	53·23	50·94	1·062	+ 0·107

ROYAL OBSERVATORY, GREENWICH.

SPECTROSCOPIC OBSERVATIONS

MADE AT THE

ROYAL OBSERVATORY, GREENWICH,

1888.

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 1888.

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 $18\frac{1}{2}°$ 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, 1888. 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. 1. 20. 8	M	β Persei	F	0·230	−0·084	$-\frac{1}{3}$	+ 17·1	− 42·6	− 52·0	Spectrum steady, but rather faint. Star-line broad, faint, and diffused. Definition good.
20. 12	M	,,	F	0·230	−0·131	$-\frac{1}{3}$	+ 17·1	− 56·9	− 52·0	
20. 20	M	α Persei	F	0·230	+0·041	$+\frac{1}{10}$	+ 15·5	− 3·1	− 5·0	Spectrum steady and bright. Definition fair. The displacement was evidently small, practically *nil*, and the measures showed a tendency to stop short of the centre of the line, since the two displacements towards the red were recorded when the micrometer was moved from the red side, and the two towards the blue when moved from the other side.
20. 26	M	,,	F	0·230	−0·050	$-\frac{1}{10}$	+ 15·5	− 30·7	− 26·0	
20. 29	M	,,	F	0·230	−0·003	$+\frac{1}{5}$	+ 15·5	− 16·4	+ 5·5	
20. 33	M	,,	F	0·230	−0·059	$-\frac{1}{4}$	+ 15·5	− 33·4	− 41·7	
21. 0	M	Aldebaran.....	F	0·230	+0·076	$+\frac{2}{5}$	+ 16·9	+ 6·2	+ 25·0	Spectrum fairly bright and steady. Star-line narrow and faint.
21. 4	M	,,	F	0·230	+0·098	$+\frac{1}{3}$	+ 16·9	+ 12·9	+ 18·0	
21. 20	M	Rigel	F	0·230	+0·012	$+\frac{1}{10}$	+ 13·6	− 10·0	− 3·1	Spectrum bright and fairly steady. Star-line rather faint, but seen well occasionally.
21. 23	M	,,	F	0·230	+0·159	$+\frac{1}{2}$	+ 13·6	+ 34·7	+ 38·8	
21. 26	M	,,	F	0·230	+0·089	$+\frac{1}{3}$	+ 13·6	+ 13·4	+ 21·3	
21. 28	M	,,	F	0·230	+0·064	$+\frac{1}{4}$	+ 13·6	+ 5·8	+ 12·6	
21. 42	M	γ Orionis	F	0·230	+0·088	$+\frac{2}{5}$	+ 14·5	+ 12·2	+ 27·4	Spectrum bright, but tremulous. Star-line rather faint.
21. 45	M	,,	F	0·230	−0·010	0	+ 14·5	− 17·5	− 14·5	
21. 47	M	,,	F	0·230	+0·034	$+\frac{1}{10}$	+ 14·5	− 4·2	− 4·0	
21. 50	M	,,	F	0·230	+0·098	$+\frac{1}{3}$	+ 14·5	+ 15·3	+ 20·4	
22. 7	M	β Tauri	F	0·230	+0·032	$+\frac{1}{5}$	+ 14·7	− 5·0	+ 6·3	
22. 10	M	,,	F	0·230	+0·014	$+\frac{1}{10}$	+ 14·7	− 10·4	− 4·2	
22. 24	M	δ Orionis	F	0·230	+0·082	$+\frac{1}{3}$	+ 13·6	+ 11·3	+ 21·3	Spectrum steady and fairly bright. Star-line very faint.
22. 27	M	,,	F	0·230	+0·049	$+\frac{1}{5}$	+ 13·6	+ 1·3	+ 7·4	
22. 33	M	ε Orionis	F	0·230	−0·005	0	+ 13·3	− 14·8	− 13·3	Spectrum bright and steady. Star-line fairly well seen. Definition good.
22. 36	M	,,	F	0·230	+0·021	$+\frac{1}{5}$	+ 13·3	− 6·9	+ 7·7	
22. 48	M	ζ Orionis	F	0·230	−0·101	$-\frac{1}{3}$	+ 13·0	− 43·7	− 47·9	
22. 50	M	,,	F	0·230	−0·081	$-\frac{1}{5}$	+ 13·0	− 37·6	− 34·0	Spectrum bright and fairly steady. Star-line faint.
22. 52	M	,,	F	0·230	−0·034	$-\frac{1}{5}$	+ 13·0	− 23·3	− 34·0	
22. 53	M	,,	F	0·230	−0·088	$-\frac{1}{3}$	+ 13·0	− 39·7	− 47·9	

Date, 1888. 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					
Feb. 1. 23. 35	M	Sirius	F	0·230	−0·007	0	+ 7·3	− 9·4	− 7·3	Spectrum very bright, and very unsteady; neither the C, D, nor *b* lines were visible. Direct comparison seemed to show a small but distinct displacement to *red*, about ¼.
	M	,,	F	0·230	−0·108	− ⅓	+ 7·3	− 40·1	− 42·2	
	M	,,	F	0·230	−0·091	− ¼	+ 7·3	− 34·9	− 33·5	
	M	,,	F	0·230	−0·063	− ⅙	+ 7·3	− 26·4	− 28·3	
	M	,,	F	0·230	−0·044	− 1/10	+ 7·3	− 20·7	− 17·8	
2. 0. 0	M	,,	F	0·230	−0·027	− 1/10	+ 7·3	− 15·5	− 17·8	
0. 18	M	Moon	F	0·230	+0·005			+ 1·5		The coincidence of the two spectra appeared perfect.
	M	,,	F	0·230	+0·008			+ 2·4		
	M	,,	F	0·230	+0·001			+ 0·3		
	M	,,	F	0·230	−0·016			− 4·9		
0. 30	M	,,	F	0·230	−0·002			− 0·6		
										Position Circle, 6°.
Mar. 5. 21. 10	M	Rigel	F	0·140	+0·131	+ ½	+ 16·0	+ 23·8	+ 24·6	Spectrum faint and very tremulous. Observations made with difficulty.
21. 20	M	,,	F	0·140	+0·125	+ ⅖	+ 16·0	+ 22·0	+ 16·4	
21. 30	M	Sirius	F	0·140	−0·068	− ¼	+ 12·8	− 33·5	− 33·1	Spectrum bright, but tremulous. Star-line seen well. Direct comparison gave a small but unmistakable displacement towards the blue, estimated as about ¼.
21. 35	M	,,	F	0·140	−0·136	− ½	+ 12·8	− 54·1	− 53·4	
21. 45	M	,,	F	0·140	−0·128	− ⅖	+ 12·8	− 51·7	− 45·2	
21. 50	M	,,	F	0·140	−0·048	− ⅓	+ 12·8	− 27·4	− 29·0	
22. 5	M	,,	F	0·140	−0·070	− ¼	+ 12·8	− 34·1	− 33·1	
22. 10	M	,,	F	0·140	−0·035	− 1/10	+ 12·8	− 23·4	− 20·9	
22. 25	M	Procyon	F	0·140	−0·052	− ⅙	+ 14·0	− 29·8	− 30·2	Spectrum bright and fairly steady. Definition good. Star-line seen well. Direct comparison failed to show any displacement.
22. 30	M	,,	F	0·140	+0·040	+ ⅙	+ 14·0	− 1·9	+ 2·2	
22. 40	M	,,	F	0·140	−0·027	− 1/10	+ 14·0	− 22·2	− 22·1	
22. 45	M	,,	F	0·140	−0·009	0	+ 14·0	− 16·7	− 14·0	
23. 0	M	Pollux	F	0·140	−0·137	− ½	+ 15·0	− 56·6	− 55·6	Spectrum bright and steady, but star-line faint. Measures made with some difficulty.
23. 15	M	,,	F	0·140	−0·080	− 3/10	+ 15·0	− 39·3	− 39·3	
23. 30	M	Castor	F	0·140	+0·061	+ ¼	+ 15·4	+ 3·1	+ 4·9	Spectrum bright and steady. Star-line dark, but very broad and diffused.
23. 40	M	,,	F	0·140	−0·005	0	+ 15·4	− 16·9	− 15·4	
										Position Circle, 6°.
Mar. 21. 22. 10	M	Moon	F	0·116	−0·013			− 4·0		The coincidence of the two spectra appeared perfect.
	M	,,	F	0·116	+0·018			+ 5·5		
	M	,,	F	0·116	+0·017			+ 5·2		
	M	,,	F	0·116	−0·020			− 6·1		
22. 30	M	,,	F	0·116	−0·032			− 9·7		
22. 35	M	Procyon	F	0·116	+0·023	+ 1/10	+ 16·4	− 9·4	− 8·6	Spectrum faint and tremulous. Star-line faint. Definition bad. Measures made with difficulty.
22. 50	M	,,	F	0·116	+0·062	+ ¼	+ 16·4	+ 2·4	+ 3·0	
23. 5	M	Pollux	F	0·116	−0·072	− ¼	+ 17·3	− 39·2	− 36·7	Spectrum faint and tremulous. Star-line faint. Definition bad. Measures made with difficulty.
23. 20	M	,,	F	0·116	−0·099	− ⅓	+ 17·3	− 47·4	− 43·2	
23. 30	M	Castor	F	0·116	+0·086	+ ⅓	+ 17·4	+ 8·8	+ 8·5	Spectrum faint, but fairly steady. Star-line seen fairly well.
23. 40	M	,,	F	0·116	+0·026	+ 1/10	+ 17·4	− 9·5	− 9·6	
22. 0. 0	M	Regulus	F	0·116	+0·044	+ ⅕	+ 10·2	+ 3·2	+ 5·4	Spectrum fairly bright, but tremulous. Star-line seen fairly well. The star-line is rather faint for a spectrum of the first type, but not very broad.
0. 10	M	,,	F	0·116	+0·042	+ ⅕	+ 10·2	+ 2·5	+ 5·4	
										Position Circle, 6°.
May 7. 22. 15	M	Regulus	F	0·238	+0·041	+ ⅕	+ 17·7	− 5·3	+ 3·2	Spectrum fairly bright and steady. Star-line specially ill-defined and diffused.
22. 30	M	,,	F	0·238	+0·020	+ 1/10	+ 17·7	− 11·6	− 7·3	
22. 40	M	β Leonis	F	0·238	+0·192	+ ⅗	+ 14·9	+ 43·4	+ 47·7	Spectrum faint, but steady. Star-line dark, but diffused.
22. 50	M	,,	F	0·238	+0·209	+ ⅗	+ 14·9	+ 48·6	+ 47·7	
22. 58	M	Spica	F	0·238	−0·078	− ¼	+ 7·7	− 30·4	− 33·7	Spectrum fairly bright and steady. Star-line not very broad and but little diffused.
23. 2	M	,,	F	0·238	−0·080	− ⅓	+ 7·7	− 32·0	− 42·4	
23. 12	M	Arcturus	F	0·238	−0·074	− ⅖	+ 6·6	− 29·1	− 48·3	Spectrum bright and steady. Star-line narrow, but rather faint.
23. 18	M	,,	F	0·238	−0·129	− ⅖	+ 6·6	− 45·8	− 48·3	

Date, 1888. 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 7. 23. 24	M	Mars	F	0·238	−0·011	− 1/10		− 3·3	− 10·4	Spectrum bright and steady. F line in the spectrum of the planet rather faint, and very similar in breadth to that in Arcturus. Calculated motion + 3·7 miles per second.
23. 27	M	,,	F	0·238	+0·008	0		+ 2·4	0·0	
23. 30	M	,,	F	0·238	+0·019	+ 1/10		+ 5·8	+ 10·4	
23. 33	M	,,	F	0·238	+0·025	+ 1/10		+ 7·6	+ 10·4	
23. 36	M	,,	F	0·238	−0·012	0		− 3·6	0·0	
23. 41	M	α Coronæ	F	0·238	+0·073	+ 1/3	+ 1·6	+ 23·8	+ 36·3	Spectrum bright and steady. Star-line dark, and somewhat diffused.
23. 46	M	,,	F	0·238	+0·136	+ 1/2	+ 1·6	+ 42·9	+ 53·7	
23. 51	M	,,	F	0·238	+0·085	+ 1/3	+ 1·6	+ 27·4	+ 36·3	
23. 56	M	,,	F	0·238	+0·065	+ 2/5	+ 1·6	+ 21·3	+ 43·3	
8. 0. 5	M	α Ophiuchi ...	F	0·238	−0·143	− 3/5	− 8·0	− 35·4	− 54·6	Spectrum fairly bright and steady. Star-line broad and diffused, and fairly dark near the centre. Position Circle, 6°.
0. 10	M	,,	F	0·238	−0·071	− 1/3	− 8·0	− 13·6	− 26·7	
May 23. 22. 15	M	α Canum Ven..	F	0·165	−0·115	− 1/2	+ 12·9	− 47·8	− 45·1	Spectrum steady and fairly bright. Star-line seen well. A good direct comparison gave a displacement of 2/3 towards the blue.
22. 25	M	,,	F	0·165	−0·094	− 1/2	+ 12·9	− 41·5	− 45·1	
22. 40	M	Spica	F	0·165	−0·101	− 1/3	+ 11·7	− 42·4	− 33·2	Spectrum very tremulous. Star-line rather faint. Measures made with difficulty.
23. 0	M	,,	F	0·165	−0·074	− 1/4	+ 11·7	− 34·2	− 27·8	
23. 20	M	Arcturus	F	0·165	−0·118	− 1/2	+ 10·0	− 45·8	− 42·2	Spectrum very bright, but rather tremulous. Star-line faint and seen with difficulty.
23. 35	M	,,	F	0·165	−0·086	− 1/3	+ 10·0	− 36·1	− 31·5	
23. 55	M	γ Boötis.....	F	0·165	−0·038	− 1/5	+ 8·5	− 20·1	− 21·4	Spectrum bright but rather tremulous. Star-line faint and diffused. Measures made with great difficulty.
May 24. 0. 10	M	,,	F	0·165	−0·086	− 2/5	+ 8·5	− 34·6	− 34·2	
0. 30	M	Moon	F	0·165	−0·018			− 5·5		The coincidence of the two spectra appeared perfect, both spectra being seen particularly well.
	M	,,	F	0·165	+0·004			+ 1·2		
	M	,,	F	0·165	+0·014			+ 4·3		
	M	,,	F	0·165	−0·013			− 4·0		
0. 42	M	,,	F	0·165	−0·024			− 7·3		
1. 0	M	β Libræ	F	0·165	−0·109	− 1/2	+ 4·7	− 37·8	− 36·9	Spectrum rather faint and tremulous. Star-line ill-defined and bisected with difficulty.
	M	,,	F	0·165	−0·142	− 2/3	+ 4·7	− 47·8	− 47·6	
1. 30	M	α Coronæ Bor..	F	0·165	+0·113	+ 1/2	+ 4·9	+ 29·4	+ 27·3	Spectrum fairly bright and steady. Definition good.
2. 5	M	,,	F	0·165	+0·063	+ 1/4	+ 4·9	+ 14·2	+ 11·2	
2. 20	M	Vega	F	0·165	−0·152	− 2/3	− 5·5	− 40·6	− 37·4	Spectrum bright and steady. Star-line seen well. Definition good. Position Circle, 6°.
2· 30	M	,,	F	0·165	−0·143	− 2/3	− 5·5	− 37·9	− 37·4	
Dec. 7. 19. 40	M	β Persei.....	F	0·185	−0·345	−1½	+ 6·4	−111·2	−142·7	Spectrum rather faint and tremulous. Definition poor. Displacement undoubtedly large towards the blue.
19. 45	M	,,	F	0·185	−0·283	−1	+ 6·4	− 92·4	− 97·3	
20. 15	M	α Persei	F	0·185	−0·012	0	+ 4·4	− 8·0	− 4·4	Spectrum bright and steady, but definition of star-line not very good, being broad and diffused. Displacement apparently *nil*.
20. 30	M	,,	F	0·185	−0·008	0	+ 4·4	− 6·8	− 4·4	
20. 55	M	Capella	F	0·185	+0·125	+ 2/5	− 1·2	+ 39·2	+ 37·5	Spectrum bright and steady, but the F line, though narrow and sharp, was faint and difficult to observe.
21. 10	M	,,	F	0·185	+0·066	+ 1/5	− 1·2	+ 21·2	+ 19·4	
21. 30	M	β Aurigæ	F	0·185	+0·039	+ 1/5	− 3·7	+ 15·5	+ 21·9	Spectrum faint, but definition fair. Star-line very broad and diffused.
21. 45	M	,,	F	0·185	+0·151	+ 3/5	− 3·7	+ 49·5	+ 58·2	
22. 5	M	β Tauri	F	0·185	−0·021	− 1/10	− 1·6	− 4·8	− 7·5	Observation interrupted by passing-cloud.
22. 15	M	,,	F	0·185	−0·016	− 1/10	− 1·6	− 3·3	− 7·5	Spectrum seen well eventually. Star-line diffused and not very broad.
22. 30	M	γ Orionis	F	0·185	−0·134	− 1/2	− 1·0	− 39·7	− 44·4	Spectrum fairly bright and steady. Star-line rather faint and difficult to hold.
22. 40	M	,,	F	0·185	−0·041	− 1/5	− 1·0	− 11·4	− 17·2	
22. 50	M	Aldebaran	F	0·185	+0·149	+ 1/2	+ 2·7	+ 42·6	+ 42·7	Spectrum bright and steady. Star-line rather faint and difficult to hold.
23. 0	M	,,	F	0·185	+0·052	+ 1/5	+ 2·7	+ 13·1	+ 15·5	
23. 15	M	Rigel	F	0·185	+0·082	+ 2/5	+ 0·3	+ 24·6	+ 36·0	Spectrum tremulous, but bright. Star-line seen well; fairly narrow and sharp.
23. 25	M	,,	F	0·185	+0·088	+ 2/5	+ 0·3	+ 26·4	+ 36·0	
23. 40	M	Sirius.....	F	0·185	+0·041	+ 1/5	− 6·4	+ 18·8	+ 24·6	Spectrum bright, but very tremulous. Star-line very broad, ill-defined and diffused.
23. 50	M	,,	F	0·185	+0·035	+ 1/10	− 6·4	+ 17·0	+ 15·5	

Date, 1888. 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.
				r	r					
Dec. 8. 0. 0	M	Procyon.....	F	0·185	+0·055	+ $\frac{1}{5}$	− 11·2	+ 27·9	+ 29·4	Spectrum bright and steady. Star-line well seen. It was but little diffused and not very broad. Position Circle, 6°.
0. 10	M	,,	F	0·185	+0·041	+ $\frac{1}{10}$	− 11·2	+ 23·6	+ 20·3	
Dec. 10. 12. 45	M	Sun.....	F	0·185	+0·018			+ 5·5		Direct comparison showed no perceptible want of coincidence between the two spectra. Position Circle, 6°.
	M	,,	F	0·185	+0·003			+ 0·9		
	M	,,	F	0·185	+0·011			+ 3·3		
	M	,,	F	0·185	+0·030			+ 9·1		
13. 0	M	,,	F	0·185	+0·027			+ 8·2		
Dec. 13. 19. 35	M	γ Cassiopeiæ...	F	0·156	+0·017	+ $\frac{1}{10}$	+ 8·0	− 3·1	+ 0·4	The spectrum was faint and very tremulous, and the star-line held with great difficulty; but nevertheless the bisections were considered satisfactory. There appeared to be a small but distinct displacement towards the red. The F line in the star was *feebly* bright, narrow, but a little ragged at both edges. It was fainter than usual, but not fainter than it has been seen. There could be no doubt as to its existence as a bright line. Position Circle, 6°.
19. 55	M	,,	F	0·156	+0·083	+ $\frac{1}{3}$	+ 8·0	+ 17·2	+ 20·0	

COLLECTED RESULTS for MOTIONS of STARS in the line of Sight, from SPECTROSCOPIC OBSERVATIONS made at the ROYAL OBSERVATORY, GREENWICH, in the Year 1888.

(F for the Star or Moon is compared with Hβ of Hydrogen.)

(+ denotes Recession ; — Approach.)

Date, 1888.	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 CASSIOPEIÆ. F line feebly bright, narrow, and a little ragged at the edges.									
December 13	M	2	1	6	0·156	F	+ 8·0	+ 7·1	+ 10·2
β PERSEI. F line broad, dark, and diffused ; estimated breadth, 9 tenth-metres.									
February 1	M	2	1	6	0·230	F	+ 17·1	— 49·8	— 52·0
December 7	M	2	1	6	0·185	F	+ 6·4	—101·8	—120·0
α PERSEI. F line broad and diffused, without any marked central condensation. Estimated breadth, 13 tenth-metres on Feb. 1 ; 8 on Dec. 7									
February 1	M	4	1	6	0·230	F	+ 15·5	— 20·9	— 16·8
December 7	M	2	1	6	0·185	F	+ 4·4	— 7·4	— 4·4
α TAURI (*Aldebaran*). F line narrow and sharp, but rather faint.									
February 1	M	2	1	6	0·230	F	+ 16·9	+ 9·6	+ 21·5
December 7	M	2	1	6	0·185	F	+ 2·7	+ 27·9	+ 29·1
α AURIGÆ (*Capella*). F line narrow and sharp, but rather faint.									
December 7	M	2	1	6	0·185	F	— 1·2	+ 30·2	+ 28·5

Date, 1888.	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 ORIONIS (*Rigel*). F line narrow and sharp, but not very dark. Estimated breadth on March 5, 2·5 tenth-metres.									
February 1	M	4	1	6	0·230	F	+ 13·6	+ 11·0	+ 17·4
March 5	M	2	1	6	0·140	F	+ 16·0	+ 22·9	+ 20·5
December 7	M	2	1	6	0·185	F	+ 0·3	+ 25·5	+ 36·0
β TAURI. F line estimated 16 tenth-metres in breadth on Feb. 1; 8 on Dec. 7. Line dark; no marked central condensation seen on Feb. 1.									
February 1	M	2	1	6	0·230	F	+ 14·7	− 7·7	+ 1·1
December 7	M	2	1	6	0·185	F	− 1·6	− 4·1	− 7·5
γ ORIONIS. F line fairly dark, but not very narrow, and slightly diffused at the edges. Estimated breadth, 6 tenth-metres. No marked central condensation.									
February 1	M	4	1	6	0·230	F	+ 14·5	+ 1·5	+ 7·3
December 7	M	2	1	6	0·185	F	− 1·0	− 25·6	− 30·8
δ ORIONIS. F line very faint; breadth about 4 tenth-metres.									
February 1	M	2	1	6	0·230	F	+ 13·6	+ 6·3	+ 14·4
ε ORIONIS. F line narrow and fairly dark; breadth about 1 tenth-metre.									
February 1	M	2	1	6	0·230	F	+ 13·3	− 10·9	− 2·8
ζ ORIONIS. F line narrow but faint; breadth about 1 tenth-metre.									
February 1	M	4	1	6	0·230	F	+ 13·0	− 36·1	− 41·0

Date, 1888.	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 AURIGÆ. F line very broad and diffused. Estimated breadth, 21 tenth-metres.									
December 7	M	2	1	6	0·185	F	− 3·7	+ 32·5	+ 40·1
α CANIS MAJORIS (*Sirius*). F line dark, but very broad and diffused at the edges. The extreme breadth of the line is 30 tenth-metres; it is fairly dark for a breadth of about 18 tenth-metres, the central condensation is about 5 tenth-metres in breadth.									
February 2	M	6	1	6	0·230	F	+ 7·3	− 24·5	− 24·5
March 5	M	6	1	6	0·140	F	+ 12·8	− 37·4	− 35·8
December 7	M	2	1	6	0·185	F	− 6·4	+ 17·9	+ 20·1
α GEMINORUM (*Castor*). The two components of this double star have been observed together as one star. F line very broad and nebulous. Estimated breadth about 16 tenth-metres, with a faint shading on either side to a total breadth of about 32 tenth-metres; no central condensation.									
March 5	M	2	1	6	0·140	F	+ 15·4	− 6·9	− 5·3
21	M	2	1	6	0·116	F	+ 17·4	− 0·4	− 0·6
α CANIS MINORIS (*Procyon*). F line narrow, but rather faint and on a back ground of a faint diffused shading. Estimated breadth of line about 3 tenth-metres.									
March 5	M	4	1	6	0·140	F	+ 14·0	− 17·7	− 16·0
21	M	2	1	6	0·116	F	+ 16·4	− 3·5	− 2·8
December 8	M	2	1	6	0·185	F	− 11·2	+ 25·8	+ 24·9
β GEMINORUM (*Pollux*). F line narrow but faint.									
March 5	M	2	1	6	0·140	F	+ 15·0	− 48·0	− 47·5
21	M	2	1	6	0·116	F	+ 17·3	− 43·3	− 40·0
α LEONIS (*Regulus*). F line rather faint, ill defined, and diffused at the edges. Estimated breadth about 21 tenth-metres. No central condensation.									
March 22	M	2	1	6	0·116	F	+ 10·2	+ 2·9	+ 5·4
May 7	M	2	1	6	0·238	F	+ 17·7	− 8·5	− 2·1

Date, 1888.	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 LEONIS. F line dark, but diffused at the edges. Estimated breadth about 18 tenth-metres.									
May 7	M	2	1	6	0·238	F	+ 14·9	+ 46·0	+ 47·7
α CANUM VENATICORUM. line very dark, broad, and well defin									
May 23	M	2	1	6	0·165	F	+ 12·9	− 44·7	− 45·1
α VIRGINIS (*Spica*). F line neither very broad nor very diffused. Estimated breadth about 6 tenth-metres.									
May 7	M	2	1	6	0·238	F	+ 7·7	− 31·2	−38·1
23	M	2	1	6	0·165	F	+ 11·7	− 38·3	−30·5
α BOÖTIS (*Arcturus*). F line narrow and sharp.									
May 7	M	2	1	6	0·238	F	+ 6·6	− 37·5	− 48·3
23	M	2	1	6	0·165	F	+ 10·0	− 41·0	− 36·9
γ BOÖTIS. F line faint and diffused at the edges.									
May 24	M	2	1	6	0·165	F	+ 8·5	− 27·4	− 27·8
β LIBRÆ. F line faint and narrow.									
May 24	M	2	1	6	0·165	F	+ 4·7	− 42·8	− 42·3

Date, 1888.		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 CORONÆ BOREALIS.										
F line dark and broad, but not very diffused at the edges. Estimated breadth, 13 tenth-metres.										
May	7	M	4	1	6	0·238	F	+ 1·6	+ 28·9	+ 42·4
	24	M	2	1	6	0·165	F	+ 4·9	+ 21·8	+ 19·3
α OPHIUCHI.										
F line broad and diffused, but fairly dark near the centre. Estimated breadth, 18 tenth-metres.										
May	8	M	2	1	6	0·238	F	− 8·0	− 24·5	− 40·7
α LYRÆ (*Vega*).										
F line dark, broad, and diffused at the edges. Estimated breadth, 16 tenth-metres; central condensation, 4 tenth-metres.										
May	24	M	2	1	6	0·165	F	− 5·5	− 39·3	− 37·4
MARS.										
May	7	M	5	1	6	0·238	F	...	+ 1·8	+ 2·1
Calculated relative motion of Mars, + 3·7 miles per second.										
MOON.										
February	2	M	5	1	6	0·230	F	...	− 0·3	...
March	21	M	5	1	6	0·116	F	...	− 1·8	...
May	24	M	5	1	6	0·165	F	...	− 2·3	...
SUN.										
December	10	M	5	1	6	0·185	F	...	+ 5·4	...

OBSERVATIONS of the SPECTRA of γ CASSIOPEIÆ, MIRA CETI, α ORIONIS, α HERCULIS, β LYRÆ, R CYGNI, P CYGNI, and β PEGASI, and of COMETS *a* and *c* 1888.

γ CASSIOPEIÆ.

1888, September 19d. 22h. to 23h.

Single-prism Spectroscope.

Observer, M.

The C line was found to be very bright; quite unmistakeable on the most hasty inspection. F was seen to be a bright line, but was detected with some little difficulty. There could be no doubt that it was present as a bright line, but it would probably have been overlooked if its exact place had not been known. So too with D_3 which was indeed if anything a little more difficult to detect than F had been. A long time was spent in trying to get measures of D_3, but without success.

1888, December 13.

Half-prism Spectroscope. One prism direct.

Observer, M.

The F line was seen as a bright line. It was only feebly bright, was narrow, and slightly diffused at both edges. Although it was fainter than usual, it was not fainter than it has been sometimes seen, and there could be no possible doubt as to its existence as a bright line. The C and D_3 lines were not looked for.

o (*Mira*) CETI.

1888, October 5.

Single-prism Spectroscope.

Observer, M.

The following three sets of measures of the more refrangible edges of the dark shaded bands as compared with the sodium lines were obtained :—

WAVE-LENGTH EXPRESSED IN TENTH-METRES.

Dunér's Numeration.	First Series.	Second Series.	Third Series.	Mean.
I.	6581	6598	6581	6587
II.	6148	6158	6153	6153
III.	5847	5838	5842	5842
IV.	5607	5608	5602	5606
V.	5447	5448	5450	5448
VII.	5171	5171	5170	5171
VIII.	4957	4955	4956	4956
IX.	4763	4763	4766	4764

The wave-length of the sodium lines has been taken as 5892 tenth-metres.

The following ten measures of a bright line in the violet were obtained, Micrometer A having been set on the sodium lines and Micrometer B on the bright line in the stellar spectrum. The instrumental constant was determined next day by taking ten readings of Micrometer A on the D lines in the solar spectrum, and of Micrometer B on the line 2796K (the third line of hydrogen), the means being $0^{r}\cdot4355$ for D and $1^{r}\cdot1313$ for 2796K respectively and the instrumental constant $1^{r}\cdot5668$. The wave-length of 2796K has been assumed as 4340·10 tenth-metres :—

	Bright Line in Stellar Spectrum.	D Lines, Sodium Flame.	Sum.	Diff. from Constant.	Diff. in Wave-length.	Wave-length.
	r	r	r	r	Tenth-metres	Tenth-metres.
	0·881	0·401	1·282	— 0·285	5·87	4345·97
	·913	·481	1·394	·173	3·56	4343·66
	·944	·479	1·423	·144	2·96	4343·06
	·877	·538	1·415	·152	3·13	4343·23
	·972	·497	1·469	·098	2·02	4342·12
	1·009	·503	1·512	·055	1·13	4341·23
	·879	·458	1·337	·230	4·74	4344·84
	·981	·500	1·481	·086	1·77	4341·87
	·977	·466	1·443	·124	2·55	4342·65
	·825	·501	1·326	·241	4·96	4345·06
Mean ...	0·9158	0·4824	...	...	...	4343·37

The spectrum of this star had a remarkably clean appearance, the "zones" or bright interspaces between the dark shaded bands being quite free from absorption lines. Bands II., V., VII., and VIII. were very distinct, and all were sharp towards the violet, and shaded towards the red. Band IV. was faint, but appeared to be of the same character. Band III. was as usual a little shaded at both edges, and darkest at the middle, but more nearly uniform in depth of shade than any of the other bands. Band IX. was a rather puzzling object, being far in the blue it was a little difficult to make out, but it seemed at times to be just one revolution further to the red than at others; probably it was really two bands close together, one being measured as at $36^{r}\cdot8$, and another as at about $35^{r}\cdot8$, corresponding to wave-lengths of 4764 and 4797 tenth-metres respectively. Band IX. was faint. Bands VII. and VIII. were the darkest in the spectrum. Beyond Band IX., the bands in the violet were most difficult to see, for they were extremely faint. The spectrum could be traced for an unusually great distance into the violet. The violet was very free from selective or general absorption. Bright lines at F and D_3 were searched for, but without success. A bright line was, however, very distinctly seen in the violet, and its place was measured, as above, the measures indicating that it was the third line of hydrogen.

α ORIONIS.

1888, March 28.

Half-prism Spectroscope. One-prism train direct.

Observer, M.

An attempt was made to make a satisfactory comparison of Band VII. of the star with the green band (λ 5164) of the Bunsen flame, but without success. No satisfactory measures could be obtained, but the sharp edges of the two bands were, with this dispersion, very nearly coincident. No interval could be detected with certainty. The star-spectrum was however faint and ill-defined, and the *b* lines in Band VII. could not be isolated at any time, so that it was not found practicable to make any displacement comparison with the magnesium spectrum.

α HERCULIS.

1888, April 19.

Single-prism Spectroscope.

Observer, M.

The spectrum of this star was compared with those of carbon and manganese as given by a Bunsen flame. The comparison spectra were exceedingly difficult to manage, and so though the star spectrum was seen very well the comparison was made with great difficulty, and under disadvantageous circumstances.

The green band of the carbon spectrum accorded, both as to position and appearance, with the bright interspace or "zone" to the blue of Band VII. (Dunér's numeration). So far as the dispersion employed would show, no accordance could be more complete, both as to the position of the edge and gradation of the fading; an accordance rendered more striking when the flickering of the Bunsen flame brought a feeble continuous spectrum into view. For not only was there the bright band seen, but by effect of contrast a very fair representation of Band VII. itself. A long time was spent in trying to make similar comparisons for the yellow, blue, and violet bands, but no satisfactory conclusion was arrived at in either case.

In the case of the manganese spectrum, four bands were seen in the flame, two bright, and two very feeble. The two brighter bands were those measured on 1887 December 16, during the observation of the spectrum of α Orionis. The more refrangible of these had nothing to correspond to it in the spectrum of the star. The less refrangible was near, if not coincident with, a band in this spectrum, though not with any in that of α Orionis. Of the other two, the feeble bands, the more refrangible was not coincident with a stellar band, but the other was nearly coincident with the more refrangible edge of Band III. (Dunér's numeration), but so far as could be made out was slightly but decidedly nearer the violet.

There was a general similarity between the character of these manganese bands and those in the star, but certainly not the close similarity noted above in the case of the green carbon band.

1888, April 30.

Single-prism Spectroscope.

Observer, M.

The star spectrum was seen fairly well, but only two manganese bands were seen in the comparison spectrum. These were not coincident with any band in the spectrum of α Herculis. The two outer fainter manganese bands were not seen, nor any band which could have coincided with them, except the band round D, which bore its accustomed character. The sky clouded over before a satisfactory set of measures could be obtained for the bands in the star, but the following set of measures was obtained of the two manganese bands in the comparison spectrum as compared with the sodium lines given by a Bunsen flame :—

MANGANESE SPECTRUM.

Band. Bright Sharp Edge.	Wave-length in Tenth-Metres.						
	First Measure.	Second Measure.	Third Measure.	Fourth Measure.	Fifth Measure.	Sixth Measure.	Mean.
Mn_1.....	5576	5575	5573	5576	5586	5588	5579
Mn_2.....	5350	5355	5351	5357	5362	5363	5356

1888, May 2.

Single-prism Spectroscope.

Observer, M.

Six sets of readings were obtained for the sharp edges of the dark bands. The work was very rough and very slow as the micrometer had to be continually watched as it was turned, there being no other method of counting the revolutions. The continual use of the lamp which this involved spoiled the eye very much for observation of the star. Both the green and blue bands of the carbon spectrum as given by a Bunsen flame corresponded closely with bright zones in this spectrum, the green band quite exactly, so far as the dispersion employed could show, and this not only in the position of the edge, but also in the character and degree of the shading, in short, in general appearance. The blue carbon band appeared to present only an approximation in position and appearance to the zone in the blue. The connection with the manganese spectrum did not appear to be made out.

The following were the positions obtained for the more refrangible edges of the dark bands in the spectrum of the star :—

WAVE-LENGTH IN TENTH-METRES.

Dunér's Band.	First Series.	Second Series.	Third Series.	Fourth Series.	Fifth Series.	Sixth Series.	Mean.
II.	6131	6164	6181	6158	6132	6152	6153
III.	5874	5852	5877	5874	5862	5851	5865
IV.	5592	5602	5595	5572	5584	5609	5592
V.	5452	5447	5464	5463	5452	5436	5452
VII.	5169	5162	5182	5170	5150	5158	5167
VIII.	4960	4956	4972	4968	4958	4944	4960
IX.	4767	4765	4778	4787	4784	4776	4776
X.	4611	4613	4609	4609	4606	4606	4609

β LYRÆ.

1888, August 10 ($21^{h.}$ to $23^{h.}$).

Single-prism Spectroscope.

Observer, M.

The following measures made with Micrometer B were of the distance between a bright line, supposed to be D_3, in the star spectrum, and the two D lines given by the sodium flame. Position Circle 6°. Slit just wide enough for the two D lines to overlap at their inner edges.

	Bright Line in Stellar Spectrum.	D Lines, Sodium Flame.	Difference.	Difference in Wave-length.	Wave-Length Inferred.
	r	r	r	Tenth-metres.	Tenth-metres.
	1·279	0·994	0·285	17·67	5874·46
	1·321	1·056	0·265	16·43	5·70
	1·315	1·008	0·307	19·03	3·10
	1·400	1·068	0·332	20·58	1·55
	1·353	1·054	0·299	18·54	3·59
	1·305	1·046	0·259	16·06	6·07
	1·379	1·113	0·266	16·49	5·64
	1·361	1·039	0·322	19·96	2·17
	1·375	1·072	0·303	18·79	3·34
	1·419	1·120	0·299	18·54	3·59
Mean	1·3507	1·0570	0·2937	18·21	5873·92

The wave-length of the sodium lines has been assumed as 5892·13 tenth-metres, and the value of a revolution at D has been deduced from the curve as 62 tenth-metres. The above measures point to the line observed having really been D_3, and not the manganese fluting at λ 5869.

The star spectrum was very bright and steady, and the definition good. The D lines were seen dark in the star but could not readily be measured. D_3, or what was supposed to be D_3, was bright. It was not always seen, often being lost for three or four minutes at a time, but when seen was quite unmistakeable, and far too sharp, well defined, distinct and bright to be a mere effect of contrast. Much difficulty was experienced in making measures for two reasons. (1.) The bright line could only be seen when no cylindrical lens was used, and the spectrum therefore was a mere line. (2.) There were no means for illuminating the pointer. The measures, therefore, were much rougher than should have been the case with so sharp a line.

A considerable part of the evening was spent in trying the cylindrical lens in different positions so as to give different widths of spectrum, but it was impossible to see D_3 when the cylindrical lens was used at all. Several dark lines or bands were, however, noticed in the region of the stellar spectrum beyond D, towards the red. C was not seen as either a bright or dark line. F was suspected to be present as a faint bright line, but the point could not be made certain. The line supposed to be D_3, however, was quite unmistakeable every now and then.

The star was at maximum August $9^{d.}$ $21^{h.}$, and at secondary minimum August $13^{d.}$ $3^{h.}$

1888, September $10^{d.}$ $21^{h.}$

Single-prism Spectroscope.

Observer, M.

The bright line near D was seen occasionally in the spectrum of β Lyræ, but much less distinctly than on August 10, and no measures could be obtained as it could not be held long enough to bisect.

The star was at secondary minimum September $7^{d.}$ $23^{h.}$ and at maximum September $11^{d.}$ $4^{h.}$

1888, September $19^{d.}$ ($20^{h.}$ to $22^{h.}$).

Single-prism Spectroscope.

Observer, M.

The bright line near D was found to be quite distinct, and the following measures were obtained pretty readily; owing to the flickering of the flame the measures of the sodium line were much harder to obtain, and were less certain

	Bright Line in Stellar Spectrum.	D Lines, Sodium Flame.	Difference.	Difference in Wave-length.	Wave-length Inferred.
	r	r	r	Tenth-metres.	Tenth-metres.
	1·255	0·991	0·264	16·37	5875·76
	1·242	0·979	0·263	16·31	5875·82
	1·273	0·990	0·283	17·55	5874·58
	1·290	0·946	0·344	21·33	5870·80
	1·268	0·956	0·312	19·34	5872·79
	1·291	1·009	0·282	17·48	5874·65
	1·275	1·029	0·246	15·25	5876·88
	1·295	0·989	0·306	18·97	5873·16
	1·289	1·031	0·258	16·00	5876·13
	1·290	1·019	0·271	16·80	5875·33
Mean ...	1·2768	0·9939	0·2829	17·54	5874·59

The wave-length of the sodium lines has been assumed as D = 5892·13 tenth-metres, and the value of a revolution at D has been deduced from the curve as 62 tenth-metres.

The above measures point to the line observed having really been D_3.

C and F lines were searched for very carefully, but neither were seen. Either from some lack of sensitiveness in the observer's eye, or from absorption in the atmosphere or spectroscope, the spectrum could not be traced quite down to C. At F nothing was seen. So far as could be judged the bright line near D was a little more distinct than on August 10, and decidedly more distinct than on September 10.

The star was at maximum September $17^{d.}$ $15^{h.}$

1888, September $21^{d.}$ ($20^{h.}$ to $21^{h.}$).

Single-prism Spectroscope.

Observer, M.

The bright line near D in the spectrum of this star was brighter than the observer had ever seen it before. C was also distinctly seen as a bright point when no cylindrical lens was used, but could not be made out when the lens was inserted, the spectrum then not being traceable quite so far. F was also seen both with the cylindrical lens and without it.

D_3 was by far the most distinct of the three lines, and was a narrow, sharp, well-defined, bright line. F was a little brighter than C, but appeared somewhat ill-defined. It was not only much fainter than D_3, but also appeared not quite so sharp nor so narrow. C appeared to be narrow and sharp. No other bright lines were detected.

A dark band, probably D_1 and D_2 confused together, was detected close to D_3.

The star was at secondary minimum September $20^{d.}$ $21^{h.}$, and at maximum September $24^{d.}$ $2^{h.}$

1888, October 1 ($19\frac{1}{2}^{h.}$ to $21^{h.}$).

Single-prism Spectroscope.

Observer, M.

D_3 was visible, but fainter than on September 21. F could not be seen. C was suspected once or twice. D_3 could not be held steadily enough for measurement.

The star was at maximum September $30^{d.}$ $13^{h.}$ and at secondary minimum October $3^{d.}$ $19^{h.}$

1888, October 19^{d} 20^{h}

Single-prism Spectroscope.

Observer, M.

The spectrum was examined carefully. C and F were not visible as bright lines, but were just suspected as dark lines; that is, by moving the spectrum to and fro there seemed to be a very faint dark line at or near F, and another fainter still near C. But it was impossible to take any measure, or to ascertain more than that the suspected lines were near the places of C and F. D_3 was glimpsed occasionally as a feeble bright line. The D lines formed a broad diffused band, and D_3 was just visible every now and then as a feeble but very narrow and sharp bright line on the more refrangible side of D, and apparently just touching it. The two D lines were not separated, but were seen as one broad diffused band.

It was attempted to determine the precise position of the bright line supposed to be D_3, but it was too faint, and was continually being lost. Nevertheless there was no doubt about its presence, for it was unquestionably seen every now and then.

The star was at maximum October $19^{d.}$ $22^{h.}$, and at principal minimum October $23^{d.}$ $4^{h.}$

R CYGNI.

1888, September 21 ($21^{h.}$ to $23^{h.}$).

Single-prism Spectroscope.

Observer, M.

When the star was brought into the field of the spectroscope it was readily identified by the bright lines in its spectrum, of which D_3 was identified with probability and F with certainty. A mist sprang up, however, before any measures could be obtained.

1888, October 1 ($21^{h.}$ to $22\frac{1}{2}^{h.}$).

Single-prism Spectroscope.

Observer, M.

A long time was spent in trying to broaden the spectrum with a cylindrical lens sufficiently to measure the dark bands. The spectrum was, however, too faint, and the attempt had to be given up. Apparently the spectrum was of Secchi's fourth type, plus a bright line near F. The bright line was not quite so bright as on September 21. After many trials the following measure of the bright line was obtained, Micrometer A being set on the sodium lines, and Micrometer B on the line in the star spectrum. The instrumental constant was determined next day by taking ten readings of Micrometer A on the D lines in the solar spectrum, and of Micrometer B on the F line, the means being $0^{r}\cdot0408$ for D, and $0^{r}\cdot2790$ for F respectively, and the instrumental constant $0^{r}\cdot3198$. The wave-length of F has been assumed as 4860·74 tenth-metres.

Bright Line in Stellar Spectrum.	D Lines, Sodium Flame.	Sum.	Diff. from Constant.	Diff. in Wave-length.	Wave-length Inferred.
r	r	r	r	Tenth-metres.	Tenth-metres.
0·104	0·039	0·143	0·177	5·52	4866·26

P CYGNI.

1888, October 1.

Single-prism Spectroscope

Observer, M.

The bright line in this star was measured without much difficulty. No other bright lines were detected, and no cylindrical lens being used the dark bands, if any, could not be made out. The line near F appeared a little diffused at the edges. Micrometer A in the following measures was set upon the sodium lines, and micrometer B upon the bright line in the star spectrum. The instrumental constant was determined next day by taking ten readings of Micrometer A on the D lines in the solar spectrum, and of Micrometer B on the F line, the means being $0^{r}\cdot0408$ for D, and $0^{r}\cdot2790$ for F respectively, and the instrumental constant $0^{r}\cdot3198$. The wave-length of F has been assumed as 4860·74 tenth-metres.

	Bright line in Stellar Spectrum.	D Lines, Sodium Flame.	Sum.	Diff. from Constant.	Diff. in Wave-length.	Wave-length Inferred.
	r	r	r	r	Tenth-metres.	Tenth-metres.
	0·300	0·019	0·319	− 0·001	+ 0·03	4860·77
	·322	·042	0·364	+ 0·044	− 1·37	4859·37
	·363	·019	0·382	+ 0·062	− 1·93	4858·81
	·270	·007	0·277	− 0·043	+ 1·34	4862·08
	·323	·007	0·330	+ 0·010	− 0·31	4860·43
	·308	·051	0·359	+ 0·039	− 1·22	4859·52
	·327	·002	0·329	+ 0·009	− 0·28	4860·46
	·353	·046	0·399	+ 0·079	− 2·46	4858·28
	·558	·042	0·600	+ 0·280	− 8·74	4852·00
	·528	·049	0·577	+ 0·257	− 8·02	4852·72
Mean	0·3652	0·0284	...	...	...	4858·44

COMET 1888 *a* (SAWERTHAL).

1888, April 10.

Single-prism Spectroscope.

Observer, M.

The comet was searched for from its rising to dawn, and a momentary glimpse of it was caught through cloud. The green band in the spectrum was seen of the last degree of faintness, but no continuous spectrum. It was far too faint for measurement, had it remained visible long enough for such to be attempted.

1888, April 19.

Single-prism Spectroscope.

Observer, M.

The comet was seen with great difficulty always through cloud, and daylight had begun to be troublesome before it could be seen at all.

All that could be made out of its spectrum was :—

(1.) The spectrum as seen—probably from the nucleus, and its immediate neighbourhood only, was *mainly* continuous.

(2.) Two feeble bands were just glimpsed, nearly, if not quite, coincident with the bands in the green and yellow of the spectrum of the Bunsen flame. The band in the blue could not be satisfactorily made out, but its presence was suspected as a slight local brightening of the spectrum. A little later a very fair direct comparison was obtained in the case of the green band, and no doubt was left of its coincidence with the corresponding band of the Bunsen flame, but no satisfactory measures could be obtained.

The spectrum of the comet was mainly continuous.

It is not unlikely that what was supposed to be the green carbon band in the observation of April 10 was really only the central and brightest part of the continuous spectrum.

1888, May 3.

Single-prism Spectroscope.

Observer, M.

The spectrum of the comet was practically wholly continuous. The green band was searched for with every variety of slit width, but was only very faintly suspected in the envelope immediately outside the nucleus, as a very feeble brightening of the continuous spectrum. No trace of the bands in the blue and yellow could be detected.

The continuous spectrum ended rather abruptly at or near D.

The comet showed in the finder a long, straight, narrow tail, stretching right across the field.

The spectrum of the tail was detected for a considerable distance from the nucleus, but showed no difference, except its greater faintness, from that of the nucleus.

COMET 1888 *e* (BARNARD).

1888, November 27.

Single-prism Spectroscope.

Observer, M.

The comet was observed with considerable difficulty as it moved quickly off the slit, and was hard to find again when lost. Cloud was passing at the time which further interrupted and hindered observation.

The spectrum was, however, seen from time to time very well with a wide slit, and it then appeared to be perfectly continuous, both from the nucleus and coma. By gradually closing the slit, however, it was possible to see that there was a local ill-defined brightening corresponding nearly to the green carbon band, but apparently further towards the blue.

On closing the slit further the brightening was lost, and only the continuous spectrum was seen; now from the nucleus and its immediate neighbourhood only, for the fainter outlying portions of the coma were too faint to give a perceptible spectrum with the narrowed slit. On the whole, the evidence for anything beyond a pure continuous spectrum was but small; the hydro-carbon spectrum was evidently quite an unimportant and subordinate feature.

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ROYAL OBSERVATORY, GREENWICH.

MEASURES OF POSITIONS AND AREAS

OF

SPOTS AND FACULÆ

UPON THE SUN'S DISK

ON

PHOTOGRAPHS

TAKEN WITH THE

PHOTOHELIOGRAPHS

AT GREENWICH, IN INDIA, AND IN MAURITIUS,

WITH THE DEDUCED

HELIOGRAPHIC LONGITUDES AND LATITUDES.

1888.

MEASURES of POSITIONS and AREAS of SPOTS and FACULÆ upon the SUN'S DISK on PHOTOGRAPHS taken at the ROYAL OBSERVATORY, GREENWICH, at DEHRA DÚN in INDIA, and at the ROYAL ALFRED OBSERVATORY, MAURITIUS, in the Year 1888.

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 Greenwich 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 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).
1888.				°	°	°			
0d.484	H,M	2026*a*	0·841	96·8	227·6	−7·4	32	183	128 *s f*
Jan. 1		Centre			(284·7)	(−3·2)	(32)	(183)	(128)
1·450	H,M	2026*a*	0·701	97·1	227·7	−7·3	25	178	
Jan. 2		Centre			(272·1)	(−3·3)	(25)	(178)	(0)
2·451	H,EP	2026*a*	0·519	98·8	227·8	−7·5	28	176	
Jan. 3		Centre			(258·8)	(−3·5)	(28)	(176)	(0)
3·241	M,H		0·887	248·9	310·1	−20·3			20
I.		2026*a*	0·361	101·6	227·6	−7·5	30	167	
		2027	0·711	73·1	205·0	+9·3	3	29	} 81*c*
		2027	0·744	72·0	202·5	+10·8	1	19	
Jan. 4		Centre			(248·4)	(−3·6)	(34)	(215)	(101)
4·468	H,EP	2026*a*	0·099	134·9	228·3	−7·7	16	123	
		2027	0·486	63·4	206·3	+9·2	0	8	
Jan. 5		Centre			(232·3)	(−3·7)	(16)	(131)	(0)
5·271	M,H		0·952	182·8	232·4	−75·5			128
I.		2026*a*	0·135	234·5	228·0	−8·3	20	133	
			0·910	98·3	156·1	−9·2			149
Jan. 6		Centre			(221·7)	(−3·8)	(20)	(133)	(277)
6·183	M,H	2026*a*	0·326	255·6	228·2	−8·4	15	102	
I.		2026	0·272	249·2	224·6	−9·3	0	8	
			0·949	94·6	137·9	−5·6			139
Jan. 7		Centre			(209·7)	(−3·9)	(15)	(110)	(139)
7·218	M,H		0·961	265·4	270·0	−5·6			57
			0·853	264·2	254·6	−7·1			166
I.			0·944	191·3	230·4	−70·9			82
			0·946	179·6	194·4	−75·9			35
		2026*a*	0·536	260·7	228·2	−8·4	16	88	
1888.				°	°	°			
7d.218	M,H		0·879	91·7	134·6	−3·5			165
I.			0·908	104·3	130·8	−14·6			95
Jan. 8		Centre			(196·0)	(−4·0)	(16)	(88)	(600)
8·196	EP,H		0·939	264·7	253·1	−6·4			188
			0·945	191·0	217·6	−71·4			100
I.		2026*a*	0·708	261·7	228·2	−8·8	10	70	
			0·947	91·3	112·1	−2·5			84
			0·952	107·6	110·9	−18·0			59
Jan. 9		Centre			(183·2)	(−4·1)	(10)	(70)	(431)
9·321	EP,M		0·919	281·3	233·9	+8·6			45
			0·849	272·3	221·3	−0·7			187
I.		2026*a*	0·863	262·4	228·1	−8·7	8	49	218 *s*
		2028*a*	0·945	87·6	97·8	+0·9	0	7	} 858 *c*
		2028*b*	0·965	87·8	93·9	+1·0	10	96	
		2028*c*	0·979	89·1	90·4	0·0	0	12	
		2029*a*	0·994	97·5	84·4	−7·9	28	186	422 *c*
Jan. 10		Centre			(168·4)	(−4·2)	(46)	(350)	(1730)
10·283	H,M		0·937	260·9	225·5	−10·1			256
			0·921	271·7	227·0	+14·0			105
I.		2028*a*	0·843	85·8	98·7	+1·2	0	13	} 587 *c*
		2028*b*	0·876	86·7	94·9	+0·8	14	75	
		2029*a*	0·944	97·0	84·8	−8·1	28	134	496 *s*
			0·870	95·3	95·2	−6·7			187
Jan. 11		Centre			(155·7)	(−4·3)	(42)	(222)	(1631)
11·185	H,EP		0·971	270·5	219·8	−0·7			87
			0·966	258·0	219·3	−12·7			89
I.			0·882	282·0	204·4	+8·4			84
		2030*a*	0·171	194·1	146·4	−14·0	4	9	

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.

Jan. 1 and 5. Photograph taken through mist. Definition poor.

Group 2026, 1887 Dec. 31–1888 Jan. 10. A regular spot. *a*. A faint companion is seen near it on Jan 7.

Group 2027, 1888 Jan. 4–5. Three small spots, of which the first two are measured together on Jan. 4. One small spot on Jan. 5.

Group 2028, Jan. 10–12. Three small spots, *a*, *b*, and *c*, on Jan. 10. *c* has disappeared by Jan. 11. The group consists on Jan. 12 of four small spots in a short stream.

Group 2029, Jan. 10–21. A regular spot, *a*, with one very small companion on Jan. 14 and 17, and two or three on Jan. 15, 16, and 18.

Group 2030, Jan. 12–16. A small spot, *a*, with one small companion on Jan. 13 and 14, and two on Jan. 15 and 16.

Measures of Positions and Areas of Spots and Faculæ upon the Sun's Disk—*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).
1888.				°	°	°			
11d·185	H,EP	2028	0·690	86·9	100·6	− 1·1	0	2	
		2028	0·707	84·3	99·4	+ 0·9	0	5	
I.		2028	0·734	85·6	97·1	+ 0·3	0	6	304 c
		2028	0·758	84·9	95·1	+ 1·0	9	26	
		2029a	0·857	96·9	84·9	− 8·2	23	151	655 c
			0·749	94·3	95·4	− 6·2			103
Jan. 12		Centre			(143·9)	(−4·4)	(36)	(199)	(1322)
12·307	H,EP		0·953	258·4	201·7	−12·4			109
			0·961	282·4	201·5	+10·6			76
I.			0·372	245·7	149·3	−13·0	4	11	
		2030	0·339	239·4	146·4	−14·2	3	7	
		2030a	0·702	97·6	84·5	− 8·5	26	138	
		2029a	0·934	176·1	116·7	−72·7	7		120
			0·789	101·9	77·0	−12·1			284
Jan. 13		Centre			(129·0)	(−4·5)	(33)	(156)	(589)
13·283	H,EP	2030	0·571	254·2	150·3	−12·7	2	6	
		2030a	0·528	251·5	147·1	−13·6	0	13	
I.		2029a	0·529	98·7	84·4	− 8·5	23	129	
		2029	0·533	94·9	84·0	− 6·5	0	5	
Jan. 14		Centre			(116·2)	(−4·6)	(25)	(153)	(0)
14·476	H,EP	2030	0·787	257·5	152·3	−12·7	3	16	
		2030	0·770	256·9	150·7	−13·1	0	3	78 c
M.		2030a	0·742	256·6	148·1	−13·1	1	15	
		2029a	0·288	106·3	84·3	− 9·1	29	132	
		2029	0·293	98·9	84·0	− 7·1	0	4	
		2029	0·331	98·1	81·3	− 7·1	0	4	
Jan. 15		Centre			(100·5)	(−4·7)	(33)	(174)	(78)
15·216	H,EP		0·940	254·6	161·0	−16·1			103
		2030	0·882	258·6	152·7	−12·3	4	15	
M.		2030	0·863	258·5	150·4	−12·4	0	2	190 c
		2030a	0·843	257·1	148·1	−13·4	2	23	
		2029	0·147	140·5	85·2	−11·3	0	1	
		2029a	0·130	126·1	84·6	− 9·2	17	134	
		2029	0·162	134·1	83·9	−11·3	0	1	
		2029	0·176	128·5	82·7	−11·0	0	7	
Jan. 16		Centre			(90·7)	(−4·8)	(23)	(183)	(293)
1888.				°	°	°			
16d·172	EP,H		0·950	258·1	150·3	−12·8			376
			0·882	266·8	140·0	− 5·2			80
I.		2029a	0·136	235·3	84·6	− 9·3	27	144	
		2029	0·136	210·1	82·1	−11·7	0	4	
Jan. 17		Centre			(78·1)	(−4·9)	(27)	(148)	(456)
17·271	EP,H		0·994	256·1	148·4	−14·4			144
			0·956	267·8	136·7	− 3·6			43
I.			0·890	254·6	126·7	−16·0			37
		2029	0·395	258·9	86·7	− 8·9	0	5	
		2029	0·385	255·1	85·8	−10·3	0	3	
		2029a	0·366	257·8	85·1	− 9·1	18	115	
		2029	0·349	247·3	82·9	−12·5	0	8	
		2031	0·891	97·7	0·5	− 9·2	0	7	
		2031	0·885	97·1	1·3	− 8·6	1	6	71 c
		2031	0·900	96·4	359·4	− 8·0	1	6	
Jan. 18		Centre			(63·7)	(−5·0)	(20)	(150)	(295)
18·193	H,EP		0·789	274·6	103·3	+ 0·5			169
		2029a	0·553	261·6	85·1	− 8·9	16	97	
I.		2031a	0·755	97·4	2·5	− 9·0	20	89	
		2031	0·771	97·9	1·1	− 9·3	0	2	
		2031	0·796	97·1	358·7	− 8·8	4	15	
Jan. 19		Centre			(51·6)	(−5·1)	(40)	(203)	(169)
19·476	H,EP		0·890	270·7	97·4	− 1·8			313
		2029a	0·771	263·4	85·2	− 8·4	10	81	57 c
		2031a	0·531	99·7	2·8	− 9·6	14	85	
		2031	0·570	101·7	0·2	−11·0	0	8	
		2031	0·591	98·5	358·5	− 9·2	3	19	
Jan. 20		Centre			(34·7)	(−5·2)	(27)	(193)	(370)
20·228	EP,H		0·964	270·0	99·2	− 1·5			668
			0·915	259·7	91·3	−11·6			48
I.		2029a	0·869	263·2	85·3	− 8·5	11	63	338sf
		2031a	0·378	102·1	2·9	− 9·5	11	51	
		2031	0·432	105·2	359·8	−11·3	0	3	
		2031	0·449	100·0	358·3	− 9·2	1	12	
Jan. 21		Centre			(24·8)	(−5·3)	(23)	(129)	(1054)
22·503	H,EP	2031a	0·167	239·2	3·2	−10·3	2	10	
Jan. 23		Centre			(354·9)	(−5·5)	(2)	(1·0)	(0)

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

Jan. 23. Photograph taken through mist. Definition poor.
Group 2031, Jan. 18–24. Three very small spots on Jan. 18. A regular spot, *a*, on Jan. 19, and the succeeding days, generally accompanied by one or two small companions.

1888

pg 23, Ln 13, Col 6, Fm 84.5 to 184.5

23, Ln 13 Col 7, Fm -72.7 to -7.3

Measures of Positions and Areas of Spots and Faculæ upon the Sun's Disk—*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).
1888.				°	°	°			
23d·389	EP,H	2031*a*	0·347	255·5	3·1	−10·2	2	4	
		2031	0·318	255·6	1·3	− 9·8	0	2	
I.		2032	0·679	88·5	300·5	− 3·1	1	10	
			0·943	174·9	324·6	−74·8			80
Jan. 24		Centre			(343·2)	(−5·5)	(3)	(16)	(80)
24·450	H,EP	2032	0·465	85·8	301·1	− 3·1	0	9	
Jan. 25		entre			(328·6)	(−5·6)	(0)	(9)	(0)
25·192	H,EP		0·850	95·9	260·5	− 9·9			44
			0·886	112·7	257·3	−22·7			17
M.			0·950	79·6	238·8	+ 8·0			96
Jan. 26		Centre			(319·4)	(−5·7)	(0)	(0)	(157)
26·475									
Jan. 27		Centre			(302·5)	(−5·8)	(0)	(0)	(0)
27·452									
Jan. 28		Centre			(290·0)	(−5·9)	(0)	(0)	(0)
28·509									
Jan. 29		Centre			(275·8)	(−6·0)	(0)	(0)	(0)
29·494	H,EP	2033*a*	0·483	268·3	291·7	− 6·1	0	4	
Jan. 30		Centre			(262·8)	(−6·0)	(0)	(4)	(0)
30·391	EP,H	2033*a*	0·667	267·8	292·8	− 6·0	15	36	
		2033*b*	0·606	268·4	288·3	− 6·0	8	20	
I.			0·944	81·3	181·3	+ 6·2			35
			0·965	100·7	175·4	−11·9			171
Jan. 31		Centre			(250·9)	(−6·1)	(23)	(56)	(206)
31·445	H,EP	2033*a*	0·845	267·3	294·9	− 5·6	5	39	100 *c*
		2033	0·821	268·2	292·4	− 5·1	0	12	
		2033*b*	0·785	268·2	288·9	− 5·2	0	29	
Feb. 1		Centre			(237·1)	(−6·2)	(5)	(80)	(100)
32·216	H,EP	2033*a*	0·929	266·3	295·4	− 5·8	4	25	} 214 *c*
		2033*b*	0·883	266·2	289·1	− 6·3	3	26	
M.			0·914	108·7	160·4	−19·6			63
			0·934	101·1	157·3	−12·6			140
Feb. 2		Centre			(226·9)	(−6·2)	(7)	(51)	(417)
1888				°	°	°			
33d·184	EP,H		0·969	265·0	290·2	− 6·5			368
		2034	0·169	98·7	204·5	− 7·7	0	8	
I.		2034	0·205	101·5	202·5	− 8·5	0	6	
			0·821	99·2	158·7	−11·1			103
			0·883	107·3	151·8	−18·3			66
Feb. 3		Centre			(214·2)	(−6·3)	(0)	(14)	(537)
34·204									
I.									
Feb. 4		Centre			(200·8)	(−6·3)	(0)	(0)	(0)
35·559	H,EP		0·960	86·0	109·8	+ 2·0			121
Feb. 5		Centre			(182·9)	(−6·4)	(0)	(0)	(121)
36·289	EP,H		0·876	259·1	234·9	−12·7			158
			0·910	172·9	153·8	−70·4			81
I.			0·928	89·5	105·3	− 2·0			588
Feb. 6		Centre			(173·3)	(−6·5)	(0)	(0)	(827)
37·184	EP,H		0·931	260·8	230·7	−11·0			150
			0·844	97·1	103·6	− 9·5			114
I.			0·894	86·5	98·6	+ 0·2			87
			0·967	95·4	85·8	− 6·9			215
			0·972	106·5	84·0	−17·5			157
Feb. 7		Centre			(161·5)	(−6·5)	(0)	(0)	(723)
38·258	EP,H		0·869	264·6	208·0	− 8·0			81
			0·880	93·5	85·6	− 6·2			202
I.			0·931	105·8	78·1	−17·1			360
Feb. 8		Centre			(147·4)	(−6·6)	(0)	(0)	(643)
39·284	H,EP		0·952	263·3	206·5	− 8·4			105
			0·735	93·7	86·4	− 7·2			136
I.			0·861	110·7	74·4	−21·2			172
Feb. 9		Centre			(133·9)	(−6·6)	(0)	(0)	(413)
40·211	H,EP		0·952	189·8	160·4	−75·0			61
			0·919	180·9	124·5	−73·1			90
M.			0·814	110·0	67·4	−20·1			134
Feb. 10		Centre			(121·7)	(−6·7)	(0)	(0)	(285)
41·347									
Feb. 11		e re			(106·7)	(−6·7)	(0)	(0)	(0)

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

Group 2032, Jan. 24–25. A small spot.
Group 2033. Jan. 30–Feb. 2. A very small spot, *a*, on Jan. 30, followed by a second, *b*, on Jan. 31, and the succeeding days. A third spot is seen between *a* and *b* on Feb. 1.
Group 2034, Feb. 3. Two very small faint spots.

Measures of Positions and Areas of Spots and Faculæ upon the Sun's Disk—*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).
1888.				°	°	°			
42d·237	H, EP		0·915	257·1	161·9	−14·5			117
			0·950	192·3	139·2	−73·2			67
I.			0·934	183·5	107·9	−75·2			76
Feb. 12		Centre			(95·0)	−(6·8)	(0)	(0)	(260)
43·312	EP, M		0·960	258·6	155·5	−12·8			68
			0·949	265·7	152·8	− 6·3			50
I.			0·935	186·6	104·7	−74·6			63
Feb. 13		Centre			(80·9)	−(6·8)	(0)	(0)	(181)
44·289	M, EP		0·871	252·6	129·0	−18·5			33
			0·968	195·0	128·8	−73·4			31
I.			0·947	189·2	103·8	−75·0			44
			0·887	197·0	103·6	−63·6			19
			0·912	177·2	59·6	−72·4			41
Feb. 14		Centre			(68·0)	−(6·9)	(0)	(0)	(168)
45·149	H, EP		0·836	277·0	112·5	+ 2·0			169
			0·737	262·8	103·5	−10·0			47
I.			0·912	178·4	51·8	−72·4			98
Feb. 15		Centre			(56·6)	−(6·9)	(0)	(0)	(314)
46·272	H, EP		0·899	270·3	105·8	− 2·8			315
I.			0·940	177·6	35·5	−69·2			93
Feb. 16		Centre			(41·9)	−(6·9)	(0)	(0)	(408)
47·291	H, EP		0·974	262·0	106·0	− 9·3			97
			0·973	272·5	104·7	+ 0·8			109
I.			0·838	259·1	85·9	−13·0			283
Feb. 17		Centre			(28·5)	−(7·0)	(0)	(0)	(489)
48·168	H, EP		0·916	262·6	83·8	− 9·6			199
			0·894	253·2	80·9	−18·1			198
I.			0·874	272·2	77·6	− 1·6			48
		2035	0·982	92·6	297·6	− 3·9	29	177	123 *c*
Feb. 18		Centre			(16·9)	−(7·0)	(29)	(177)	(568)
50·485	H, EP	2035*a*	0·720	89·5	300·3	− 4·6	12	85	
		2035	0·741	89·7	298·6	− 4·6	0	10	
		2035	0·779	90·9	295·3	− 3·8	0	13	211 *c*
		2035	0·815	90·0	291·8	− 4·2	0	27	
		2035*b*	0·830	93·0	290·1	− 6·5	11	55	
		2035*c*	0·839	90·4	289·3	− 4·3	16	162	
Feb. 20		Centre			(346·4)	(−7·1)	(39)	(352)	(211)
1888.				°	°	°			
51d·323	H, EP	2035*a*	0·562	87·1	301·2	− 4·3	10	89	
		2035	0·597	88·5	298·7	− 4·8	0	4	
I.		2035	0·695	88·0	291·4	− 3·7	0	10	185 *c*
		2035	0·694	91·2	291·3	− 5·9	0	11	
		2035*c*	0·718	88·8	289·5	− 4·1	27	142	
		2035*b*	0·717	92·0	289·4	− 6·4	22	84	
Feb. 21		Centre			(335·3)	(−7·1)	(59)	(340)	(185)
52·177	H, EP	2035*a*	0·379	83·5	302·0	− 4·2	16	86	
		2035	0·420	86·3	299·3	− 4·9	0	3	
I.		2035	0·493	87·9	294·6	− 5·2	5	85	
		2035	0·545	90·4	291·0	− 6·2	0	6	
		2035*c*	0·564	86·6	289·9	− 4·0	13	108	
		2035*b*	0·572	91·3	289·1	− 6·6	8	44	
			0·934	96·4	254·6	− 8·5			71
Feb. 22		Centre			(324·1)	(−7·1)	(42)	(332)	(71)
53·166	H, EP		0·961	275·7	24·2	+ 3·5			91
			0·935	191·3	347·8	−72·2			89
I.		2035*a*	0·154	67·0	303·0	− 3·6	17	87	
		2035	0·263	84·0	295·9	− 5·3	4	42	
		2035	0·327	86·7	292·0	− 5·6	6	46	
		2035	0·363	83·0	290·0	− 4·1	9	51	
		2035*c*	0·378	94·2	288·8	− 8·2	6	31	
			0·889	97·7	247·8	−10·1			111
Feb. 23		Centre			(311·1)	(−7·1)	(42)	(257)	(291)
54·519	H, EP		0·940	189·9	331·8	−73·7			53
		2035*a*	0·197	290·9	304·5	− 3·1	6	63	
		2035	0·068	305·6	296·4	− 5·0	2	43	
		2035	0·026	16·9	292·8	− 5·8	0	11	
		2035	0·065	16·7	292·1	− 3·7	0	7	
		2035*c*	0·072	47·0	290·2	− 4·4	7	43	
		2035	0·075	65·6	289·3	− 5·4	0	13	
		2035	0·074	104·2	289·1	− 8·2	2	9	
		2035	0·083	82·2	288·5	− 6·6	0	3	
			0·895	98·8	232·5	−11·1			192
			0·936	79·1	228·8	+ 7·5			66
Feb. 24		Centre			(293·2)	(−7·2)	(17)	(192)	(311)
55·208	H, EP	2035*a*	0·349	280·7	304·2	− 3·1	13	68	
		2035	0·342	275·2	304·1	− 5·0	0	5	
I.		2035	0·284	280·2	300·4	− 4·0	0	2	

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 2035, Feb. 18–29. A number of spots, mostly small, in a long straggling stream. The group is measured as one spot on Feb. 18, as the individual spots are confused together through foreshortening. The first spot, *a*, and the last two, *b* and *c*, are regular spots on Feb. 20, and the succeeding days; but *b* and *c* have both broken up by Feb. 22, though *c* is recognisable up to Feb. 26. A wide gap is seen between *a* and the following portion of the group on Feb. 23 and Feb. 24, but fresh spots have formed round *a* by Feb. 25, and other spots have appeared by Feb. 26. These undergo repeated changes, and by Feb. 29 only *a* and one small companion remain in the preceding portion of the group, and three small spots in the following portion.

Measures of Positions and Areas of Spots and Faculæ upon the Sun's Disk—*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).
1888.				°	°	°			
55d·208	H,EP	2035	0·247	275·0	298·5	− 5·8	0	1	
		2035	0·227	280·0	297·1	− 4·8	3	13	
I.		2035	0·154	278·8	293·0	− 5·8	0	2	
		2035c	0·124	293·5	290·7	− 4·3	5	30	
		2035	0·093	287·7	289·3	− 5·6	0	3	
		2035	0·095	262·3	289·6	− 8·0	7	21	
Feb. 25		Centre			(284·2)	(−7·2)	(28)	(145)	(0)
56·218	H, M		0·956	291·4	340·0	+18·0			58
		2035	0·587	273·5	306·6	− 3·9	1	14	
I.		2035a	0·552	275·0	304·1	− 3·3	9	58	
		2035	0·549	271·4	304·1	− 5·3	0	9	
		2035	0·537	272·3	303·2	− 4·9	0	10	
		2035c	0·344	277·6	290·7	− 4·2	1	9	
		2035	0·340	269·0	290·7	− 7·1	0	11	
		2035	0·331	280·3	289·8	− 3·5	0	2	
		2035	0·326	274·5	289·8	− 5·4	0	6	
		2035	0·319	265·5	289·5	− 8·3	0	4	
Feb. 26		Centre			(270·8)	(−7·2)	(11)	(123)	(58)
57·193	H,EP	2035	0·760	271·7	307·4	− 5·5	0	71	
		2035a	0·725	271·8	304·4	− 3·7	11	46	
I.		2035	0·722	269·6	304·3	− 5·3	9	37	
		2035	0·699	271·4	302·3	− 4·2	18	57	
		2035	0·535	268·2	290·4	− 7·1	0	14	
Feb. 27		Centre			(258·0)	(−7·2)	(38)	(225)	(0)
58·179	EP,M	2035	0·890	270·0	307·8	− 3·3	0	17	
		2035a	0·861	269·6	304·5	− 4·0	8	37	
I.		2035	0·846	269·1	302·8	− 4·6	5	17	
		2035	0·848	268·0	303·1	− 5·5	3	12	
		2035	0·766	268·1	295·2	− 6·1	7	41	128c
		2035	0·735	266·1	292·5	− 7·7	2	14	
		2035	0·732	267·9	292·2	− 6·5	6	37	
		2035	0·720	273·1	290·8	− 2·8	0	7	
		2035	0·709	265·7	290·4	− 8·2	0	12	
Feb. 28		Centre			(245·0)	(−7·2)	(31)	(194)	(128)
59·212	H,EP	2035a	0·957	267·9	304·7	− 4·2	0	28	
		2035	0·950	266·1	303·5	− 6·0	0	14	645c
I.		2035	0·902	266·5	296·1	− 6·3	5	15	
1888.				°	°	°			
59d·212	H,EP	2035	0·876	266·6	292·8	− 6·5	0	17	
I.		2035	0·868	269·3	291·7	− 4·3	0	4	
Feb. 29		Centre			(231·4)	(−7·2)	(5)	(78)	(645)
60·405	H,EP		0·963	266·4	290·3	− 5·4			327
		2036	0·567	262·8	250·4	−10·0	0	6	
		2036	0·560	264·6	249·9	− 9·0	0	3	
Mar. 1		Centre			(215·7)	(−7·2)	(0)	(9)	(327)
61·464	H,EP		0·942	130·9	131·8	−40·9			64
Mar. 2		Centre			(201·8)	(−7·2)	(0)	(0)	(64)
62·403									
Mar. 3		Centre			(188·2)	(−7·3)	(0)	(0)	(0)
63·196	H,EP		0·918	178·6	174·3	−73·7			86
			0·912	167·9	146·1	−69·4			28
I.			0·934	100·2	109·1	−12·1			111
			0·887	86·3	116·8	− 0·1			133
Mar. 4		Centre			(178·9)	(−7·3)	(0)	(0)	(358)
64·287	H,M		0·925	257·8	233·0	−14·1			95
			0·916	281·7	229·1	+ 7·6			27
I.			0·818	99·4	219·8	−11·9			65
			0·940	190·4	201·7	−73·7			53
			0·952	107·8	91·2	−19·1			112
			0·956	97·6	90·9	− 9·4			187
Mar. 5		Centre			(164·5)	(−7·3)	(0)	(0)	(539)
65·513									
Mar. 6		Centre			(148·4)	(−7·3)	(0)	(0)	(0)
66·417									
Mar. 7		Centre			(136·5)	(−7·2)	(0)	(0)	(0)
67·287	H,M		0·874	74·8	66·4	+ 9·6			181
I.									
Mar. 8		Centre			(125·0)	(−7·2)	(0)	(0)	(181)
68·276	H,M		0·910	265·1	46·2	− 7·4			28
		2037a	0·970	86·0	36·7	+ 2·1	25	50	305c
I.			0·951	165·0	60·7	−71·6			76
			0·965	65·7	41·6	+21·2			243
Mar. 9		Centre			(112·0)	(−7·2)	(25)	(50)	(652)

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

Group 2036, March 1. Two very small faint spots.
Group 2037, March 9–20. A large regular spot, *a*, followed on March 10 and the succeeding days by a number of small spots in a straggling stream. These change continually from day to day, but one of the most stable, *b*, can be identified on three successive days, and two others, *c* and *d*, on two days.

Measures of Positions and Areas of Spots and Faculæ upon the Sun's Disk—*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).
1888.				°	°	°			
69d·565	H, EP	2038	0·575	59·0	65·0	+11·0	0	5	
		2038*a*	0·585	57·6	64·8	+12·0	1	11	
		2037*a*	0·845	82·8	38·2	+ 2·1	25	162	
		2037	0·884	83·4	33·7	+ 2·4	0	4	163 *c*
		2037	0·885	85·2	33·3	+ 0·8	1	27	
		2037	0·906	84·6	30·7	+ 1·7	0	37	
Mar. 10		Centre			(95·0)	(−7·2)	(27)	(246)	(163)
70·221	H, M		0·938	259·7	156·8	−12·1			59
			0·973	184·5	119·2	−81·9			32
I.			0·870	185·4	98·4	−66·8			61
		2038	0·455	49·4	65·9	+10·4	6	20	
		2038*a*	0·495	47·8	64·4	+12·7	18	51	
		2037*a*	0·755	80·6	39·8	+ 2·3	41	172	
		2037	0·795	80·7	34·8	+ 2·9	0	7	
		2037	0·809	81·9	33·3	+ 2·3	0	16	220 *c*
		2037	0·813	83·5	32·7	+ 1·1	4	19	
		2037	0·832	82·9	30·9	+ 1·9	6	56	
			0·971	95·0	11·1	− 2·8			75
Mar. 11		Centre			(86·4)	(−7·2)	(75)	(341)	(447)
72·156	H, EP	2038	0·324	334·6	68·9	+ 9·8	0	10	
		2037*a*	0·396	65·7	39·7	+ 2·7	33	194	
I.		2037*b*	0·481	73·2	33·5	+ 1·6	0	12	
		2037	0·506	74·7	31·7	+ 1·4	0	24	
			0·900	162·3	21·1	−64·7			39
Mar. 13		Centre			(60·8)	(−7·2)	(33)	(240)	(39)
73·400	H, EP	2037*a*	0·187	324·4	40·0	+ 2·7	33	184	
		2037	0·186	46·5	36·7	+ 0·4	0	2	
		2037*b*	0·245	54·2	33·0	+ 1·3	3	39	
		2037	0·302	47·0	31·6	+ 5·0	0	1	
Mar. 14		Centre			(44·4)	(−7·1)	(36)	(226)	(0)
74·466	H, EP	2037*a*	0·249	313·6	40·8	+ 2·9	35	197	
		2037	0·197	317·7	38·0	+ 1·3	0	4	
		2037*b*	0·158	340·0	33·5	+ 1·5	0	17	
			0·963	90·8	316·0	− 2·7			367
Mar. 15		Centre			(30·4)	(−7·1)	(35)	(218)	(367)
1887.				°	°	°			
75d·175	H, EP		0·928	267·3	89·4	− 5·2			46
			0·867	253·8	81·7	−17·6			156
I.		2037*a*	0·379	295·5	41·0	+ 2·7	34	179	
		2039*a*	0·944	91·2	310·4	− 3·5	0	10	
		2039*b*	0·954	92·3	308·4	− 4·4	0	11	666 *c*
		2039*c*	0·968	92·9	305·4	− 4·7	5	51	
Mar. 16		Centre			(21·1)	(−7·1)	(39)	(251)	(868)
76·150	H, EP		0·937	253·5	78·7	−18·0			184
			0·883	286·5	67·6	+11·0			124
I.			0·933	184·4	24·5	−75·2			83
		2037*a*	0·568	285·4	41·3	+ 2·7	37	188	
		2037*c*	0·517	285·2	38·0	+ 1·6	0	10	
		2037*d*	0·492	285·3	36·4	+ 1·2	1	10	
		2039*a*	0·850	89·3	310·1	− 3·2	0	18	
		2039*b*	0·867	90·9	308·1	− 4·3	2	13	690 *c*
		2039*c*	0·887	91·5	305·6	− 4·7	2	26	
			0·944	171·0	334·0	−74·8			73
Mar. 17		Centre			(8·2)	(−7·1)	(42)	(265)	(1154)
77·188	H, EP		0·970	283·6	68·4	+11·3			170
			0·943	246·4	66·0	−24·5			90
I.			0·932	190·0	27·5	−72·7			97
			0·882	183·2	2·2	−68·4			54
		2037*a*	0·751	280·2	42·1	+ 2·9	37	165	
		2037*c*	0·716	279·2	39·3	+ 1·6	0	3	
		2037*d*	0·677	279·5	36·2	+ 1·2	0	17	
		2039*a*	0·693	86·7	310·8	− 2·8	0	3	
		2039*b*	0·717	88·7	308·7	− 4·0	0	10	501 *c*
		2039*c*	0·749	90·0	306·0	− 4·7	3	20	
			0·938	176·2	339·7	−75·9			108
Mar. 18		Centre			(354·5)	(−7·0)	(40)	(218)	(1020)
78·256	H, EP		0·943	180·4	342·1	−77·4			125
		2037*a*	0·889	277·1	42·3	+ 3·1	35	164	250 *c*
I.		2037	0·877	278·8	40·5	+ 4·3	0	4	
		2039	0·510	86·0	309·9	− 4·0	0	2	
		2039*c*	0·552	87·7	306·9	− 4·6	3	20	
		2040	0·692	86·2	296·9	− 2·5	0	3	174 *s.f*
			0·913	161·1	296·2	−65·0			58
Mar. 19		Centre			(340·4)	(−7·0)	(38)	(193)	(607)

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

Group 2038, March 10–13. A small spot, *a*, with a faint companion on March 10. Two small companions, measured together, are seen on March 11. Two small faint spots, measured together, are seen on March 13, *a* having disappeared.

Group 2039, March 16–19. Three small spots, *a*, *b*, and *c*. *a* has disappeared by March 19, and *b* cannot be certainly identified with the small spot seen on that day.

Group 2040, March 19. A very small faint spot, connected with Group 2039 by faculous markings.

Measures of Positions and Areas of Spots and Faculæ upon the Sun's Disk—*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).
1888.				°	°	°			
79d·173	H,EP		0·922	188·3	354·0	−72·2			80
I.		2037*a*	0·966	275·1	42·6	+ 3·1	29	154	400 *f*
			0·911	166·5	293·3	−68·3			54
Mar. 20		Centre			(328·3)	(−7·0)	(29)	(154)	(534)
80·465	H, M	2041*a*	0·949	98·5	239·2	−10·2	0	45	178 *c*
		2041*b*	0·965	98·3	235·9	− 9·8	0	20	
Mar. 21		Centre			(311·4)	(−6·9)	(0)	(65)	(178)
81·150	H,EP	2041*a*	0·888	97·8	239·2	−10·1	5	41	271 *c*
I.		2041	0·890	98·8	238·9	−11·0	0	2	
		2041*b*	0·915	97·7	235·6	− 9·8	5	39	
			0·901	106·1	237·4	−17·5			41
Mar. 22		Centre			(302·3)	(−6·9)	(10)	(82)	(312)
82·175	H,EP	2041*a*	0·757	97·6	239·3	−10·2	7	35	124 *c*
I.		2041	0·768	95·3	238·4	− 8·4	0	2	
		2041*b*	0·796	97·0	235·7	− 9·7	0	42	
Mar. 23		Centre			(288·8)	(−6·8)	(7)	(79)	(124)
83·490	H,EP		0·939	96·2	196·8	− 8·2			116
Mar. 24		Centre			(271·4)	(−6·8)	(0)	(0)	(116)
84·229	H,EP		0·814	270·2	316·1	− 3·7			439
I.		2042	0·607	271·3	299·0	− 4·6	0	3	
			0·854	95·0	202·8	− 7·8			189
Mar. 25		Ce .tre			(261·7)	(−6·7)	(0)	(3)	(628)
85·414	H,EP		0·884	267·7	308·3	− 5·2			404
I.									
Mar. 26		Centre			(246·0)	(−6·7)	(0)	(0)	(404)
86·157	H,EP		0·898	269·3	300·1	− 3·6			536
I.									
Mar. 27		Centre			(236·2)	(−6·7)	(0)	(0)	(536)
87·588	H,EP		0·973	88·9	141·0	− 0·5			227
Mar. 28		Centre			(217·3)	(−6·6)	(0)	(0)	(227)
88·422	H, M		0·918	87·0	140·1	+ 0·1			145
Mar. 29		Centre			(206·3)	(−6·6)	(0)	(0)	(145)
1888.				°	°	°			
89d·225	H,EP		0·683	260·7	239·6	−11·1			179
I.			0·824	85·0	140·8	+ 0·4			259
Mar. 30		Centre			(195·8)	(−6·5)	(0)	(0)	(438)
90·161	H,EP		0·822	261·1	239·1	−11·0			139
I.		2043	0·666	84·1	142·2	− 1·0	0	7	61 *c*
Mar. 31		Centre			(183·5)	(−6·5)	(0)	(7)	(200)
91·414	M,EP		0·950	260·0	239·4	−11·5			101
		2044*a*	0·411	55·0	147·1	+ 7·5	0	10	
		2044*b*	0·445	59·5	144·3	+ 7·1	0	13	
Apr. 1		Centre			(166·9)	(−6·4)	(0)	(23)	(101)
92·156	H,EP		0·865	264·1	217·3	− 8·2			184
I.		2044*a*	0·289	33·2	148·0	+ 7·7	0	7	
		2044*b*	0·322	44·2	144·1	+ 7·1	0	10	
			0·938	109·5	86·7	−20·4			75
Apr. 2		Centre			(157·1)	(−6·3)	(0)	(17)	(259)
93·438	H,EP		0·904	263·4	205·2	− 8·6			60
		2045*a*	0·294	58·5	125·7	+ 2·7	3	22	
		2045*b*	0·321	61·5	123·9	+ 2·8	5	26	
Apr. 3		Centre			(140·2)	(−6·3)	(8)	(48)	(60)
94·617	H,EP	2045*a*	0·156	346·4	126·8	+ 2·5	0	6	
		2045*b*	0·160	4·4	124·0	+ 2·9	0	12	
Apr. 4		Centre			(124·7)	(−6·2)	(0)	(18)	(0)
95·453	H,EP	2045	0·291	304·9	127·4	+ 3·6	0	1	
		2045*b*	0·247	309·5	124·6	+ 3·1	1	7	
			0·942	86·3	63·7	+ 1·4			233
Apr. 5		Centre			(113·6)	(−6·1)	(1)	(8)	(233)
96·430	M,H		0·858	83·6	42·3	+ 2·3			95
Apr. 6		Centre			(100·7)	(−6·1)	(0)	(0)	(95)
97·573	H,M		0·928	242·6	153·7	−27·6			51
			0·880	274·5	146·7	+ 1·1			110
Apr. 7		Centre			(85·6)	(−6·0)	(0)	(0)	(161)
98·656	H,M		0·953	272·5	359·3	+ 0·5			73
Apr. 8		Centre			(71·3)	(−5·9)	(0)	(0)	(73)

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 2041, March 21–23. Several small spots, measured for the most part in two clusters, *a* and *b*.
Group 2042, March 25. A very small faint spot.
Group 2043, March 31. A very small faint spot.
Group 2044, April 1–2. Two small faint spots, *a* and *b*.
Group 2045, April 3–5. Two small spots, *a* and *b*, on April 3. Only the more northern part of *a* remains by April 5.

Measures of Positions and Areas of Spots and Faculæ upon the Sun's Disk—*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).
1888.				°	°	°			
99d·293	H,EP		0·904	274·2	127·1	+ 1·3			125
I.			0·923	173·6	43·5	−72·0			105
Apr. 9		Centre			(62·9)	(−5·9)	(0)	(0)	(230)
100·398									
Apr. 10		Centre			(48·3)	(−5·8)	(0)	(0)	(0)
101·296	H,EP		0·912	177·0	28·1	−70·9			53
I.			0·942	94·6	325·9	− 6·3			301
Apr. 11		Centre			(36·5)	(−5·7)	(0)	(0)	(354)
102·280	H,EP		0·899	263·6	87·8	− 8·2			56
			0·920	321·3	74·6	+42·4			29
I.			0·953	193·0	68·6	−72·4			93
			0·832	94·0	327·1	− 6·5			207
			0·959	93·9	309·8	− 5·4			479
			0·945	175·1	4·8	−75·5			112
Apr. 12		Centre			(23·5)	(−5·6)	(0)	(0)	(976)
103·472	H,M		0·942	250·4	78·7	−20·3			60
			0·882	92·9	305·8	− 5·2			396
Apr. 13		Centre			(7·8)	(−5·5)	(0)	(0)	(456)
104·479	H,M		0·770	89·2	304·3	− 2·9			119
			0·891	95·4	291·3	− 7·3			47
Apr. 14		Centre			(354·5)	(−5·5)	(0)	(0)	(166)
105·453									
Apr. 15		Centre			(341·6)	(−5·4)	(0)	(0)	(0)
106·406	EP,H	2046	0·965	94·4	254·1	− 5·5	0	20	98 *c*
Apr. 16		Centre			(329·0)	(−5·3)	(0)	(20)	(98)
107·477	EP,H	2046	0·859	93·5	255·6	− 5·7	2	12	212 *c*
Apr. 17		Centre			(314·9)	(−5·2)	(2)	(12)	(212)
108·444	EP,H	2047	0·853	94·7	243·5	− 6·7	0	15	122 *c*
Apr. 18		Centre			(302·1)	(−5·1)	(0)	(15)	(122)
109·476									
Apr. 19		Centre			(288·4)	(−5·0)	(0)	(0)	(0)
1888.				°	°	°			
110d·567									
Apr. 20		Centre			(274·0)	(−5·0)	(0)	(0)	(0)
111·478	EP,H		0·891	267·0	325·0	− 4·9			11
		2048	0·974	91·9	185·1	− 3·0	9	62	168 *c*
Apr. 21		Centre			(262·0)	(−4·9)	(9)	(62)	(179)
112·158	EP,M		0·965	267·8	327·8	− 3·4			154
			0·930	258·1	321·7	−12·8			136
I.			0·826	267·1	308·7	− 5·1			490
		2048	0·933	91·1	184·2	− 2·8	13	72	244 *f*
Apr. 22		Centre			(253·0)	− 4·8	(13)	(72)	(1024)
113·293	EP,M		0·931	266·8	306·6	− 4·7			628
			0·895	276·4	300·8	− 3·6			55
I.			0·830	263·1	294·2	− 8·4			44
		2048	0·809	89·7	184·1	− 2·5	10	49	261 *f*
Apr. 23		Centre			(238·0)	(−4·7)	(10)	(49)	(988)
114·305	EP,M		0·968	268·5	300·1	− 2·6			63
			0·936	262·6	294·3	− 8·6			128
I.		2048	0·653	88·5	184·1	− 2·5	10	37	36 *c*
		2049*a*	0·940	102·6	154·4	−13·4	15	76	
		2049*b*	0·971	102·1	148·1	−12·9	0	36	269 *c*
		2049*c*	0·975	103·3	147·1	−14·0	0	12	
			0·702	84·4	180·6	+ 0·7			37
			0·978	90·3	146·9	− 1·3			283
Apr. 24		Centre			(224·7)	(−4·6)	(25)	(161)	(816)
115·626	EP,M		0·943	344·8	238·5	+61·6			23
		2048	0·394	87·2	184·1	− 3·1	5	15	
		2049*a*	0·798	103·6	154·4	−13·6	11	49	172 *f*
		2049*b*	0·850	102·0	149·0	−12·6	0	7	
		2050	0·895	90·4	143·8	− 2·4	4	27	158 *np*
			0·923	178·1	131·7	−71·6			27
Apr. 25		Centre			(207·2)	(−4·5)	(20)	(98)	(380)
116·532	EP,M		0·867	265·4	255·4	− 6·2			56
		2048	0·196	83·5	184·1	− 3·1	4	9	
		2049*a*	0·665	105·8	154·3	−13·7	7	40	60 *c*
		2049	0·678	105·1	153·2	−13·4	0	6	
		2049*b*	0·719	103·8	149·7	−13·0	0	2	

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 2046, April 16–17. A small spot. Group 2047, April 18. A small spot. Group 2048, April 21–27. A regular spot.
Group 2049, April 24–29. Three spots, *a*, *b*, and *c*. *c* has disappeared by April 25, and *b* by April 27. A small companion is seen close to *a* on April 26 and the succeeding days.
Group 2050, April 25–29. A small spot, *a*, on April 25. A second small spot, *b*, has appeared by April 26. *a* has disappeared by April 27.

Measures of Positions and Areas of Spots and Faculæ upon the Sun's Disk—*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).
1888.				°	°	°			
116d·532	EP, M	2050*b*	0·779	88·3	144·3	− 1·5	0	4	} 103 *c*
		2050*a*	0·785	89·8	143·7	− 2·6	0	8	
			0·777	103·7	144·6	−13·4			73
Apr. 26		Centre			(195·3)	(−4·4)	(11)	(69)	(292)
117·709	EP, M	2048	0·084	287·1	184·2	− 2·9	2	10	
		2049*a*	0·458	111·3	153·7	−13·4	5	27	
		2049	0·469	110·2	152·9	−13·1	0	15	
		2050*b*	0·572	85·5	145·0	− 1·0	4	13	
Apr. 27		Centre			(179·6)	− 4·3	(11)	(65)	(0)
118·115	EP, M		0·944	255·2	245·2	−15·3			60
		2051	0·956	263·4	247·4	− 7·5	0	5	178 *c*
I.		2049*a*	0·375	115·8	154·1	−13·3	0	8	
		2049	0·390	114·7	153·1	−13·3	0	1	
		2050*b*	0·486	84·4	145·5	− 1·0	0	12	
Apr. 28		Centre			(174·3)	(−4·2)	(0)	(26)	(238)
119·168	EP, M	2049*a*	0·185	148·0	154·5	−13·1	0	3	
I.		2049	0·204	133·8	151·7	−12·1	1	2	
		2050*b*	0·259	78·4	145·7	− 1·0	0	12	
Apr. 29		Centre			(160·3)	(−4·1)	(1)	(17)	(0)
120·464	EP, M		0·915	109·1	77·4	−19·0			108
Apr. 30		Centre			(143·3)	(−4·0)	(0)	(0)	(108)
121·418									
May 1		Centre			(130·7)	(−3·9)	(0)	(0)	(0)
122·182	EP, M		0·890	268·8	183·3	− 2·8			86
			0·815	122·6	69·4	−28·4			23
I.			0·865	136·1	68·3	−40·8			26
			0·906	98·5	55·5	− 9·3			57
			0·924	87·7	53·4	+ 0·7			77
May 2		Centre			(120·5)	(−3·8)	(0)	(0)	(269)
123·277	EP, M		0·972	267·7	182·3	− 3·1			70
I.			0·881	84·2	44·8	+ 3·3			96
May 3		Centre			(106·0)	(−3·7)	(0)	(0)	(166)
124·490	EP, M		0·912	256·7	155·7	−13·6			72
			0·887	271·1	152·3	− 0·7			210
May 4		Centre			(90·0)	(−3·6)	(0)	(0)	(282)
1888.				°	°	°			
125d·430	EP, M		0·953	269·7	149·8	− 1·4			112
			0·933	257·9	146·5	−12·6			122
May 5		Centre			(77·6)	(−3·5)	(0)	(0)	(234)
127·556									
May 7		Centre			(49·5)	(−3·3)	(0)	(0)	(0)
128·466									
May 8		Centre			(37·5)	(−3·1)	(0)	(0)	(0)
129·388									
May 9		Centre			(25·3)	(−3·0)	(0)	(0)	(0)
130·603	EP, M		0·910	95·3	303·8	− 6·0			273
May 10		Centre			(9·2)	(−2·9)	(0)	(0)	(273)
131·575	FP, M	2052*a*	0·990	97·2	274·4	− 7·5	89	380	
			0·816	95·4	301·7	− 6·0			203
May 11		Centre			(356·3)	(−2·8)	(89)	(380)	(203)
132·446	EP, M	2052*a*	0·942	97·0	274·5	− 7·5	82	378	} 314 *c*
		2052	0·981	98·8	265·9	− 9·2	21	86	
May 12		Centre			(344·8)	(−2·7)	(103)	(464)	(314)
133·490	EP, M		0·911	358·4	334·2	+62·8			30
		2052*a*	0·832	97·4	274·9	− 7·6	83	402	
		2052	0·861	97·4	271·7	− 7·7	10	52	
		2052	0·872	98·6	270·5	− 8·8	0	13	
		2052	0·887	99·3	268·6	− 9·5	3	20	
		2052	0·890	97·3	268·2	− 7·7	5	47	} 480 *c*
		2052	0·899	101·3	267·2	−11·3	0	15	
		2052	0·907	99·2	266·0	− 9·5	28	200	
		2052*b*	0·919	97·5	264·3	− 8·0	0	3	
May 13		Centre			(331·0)	(−2·6)	(129)	(752)	(510)
134·438	EP, M	2052*a*	0·694	98·2	274·8	− 7·5	84	416	
		2052	0·732	97·9	271·7	− 7·5	4	49	
		2052	0·778	100·8	267·8	−10·0	0	23	} 394 *c*
		2052	0·788	102·2	267·0	−11·1	0	14	
		2052*b*	0·797	99·8	266·0	− 9·3	28	284	
			0·916	99·5	252·3	− 9·8			149
May 14		Centre			(318·5)	(−2·5)	(116)	(786)	(543)

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

May 5, 8, 9, and 10. Photograph over-exposed. Definition bad.

Group 2051, April 28. A very small spot.

Group 2052, May 11–23. A large regular spot, *a*, followed by a considerable number of spots in an irregular stream. The largest of these, *b*, at the end of the stream, is a large spot at first, but it undergoes several changes of shape, and has broken up by May 18. *a* has divided into two portions, *c* and *d*, by May 21. The following portion of the group has disappeared by May 20, but some small spots have appeared preceding *a* by that date.

Measures of Positions and Areas of Spots and Faculæ upon the Sun's Disk—*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).
1888.				°	°	°			
135d·602	EP, M	2052*a*	0·484	101·2	274·6	− 7·5	62	368	
		2052	0·526	101·1	271·8	− 7·9	5	28	
		2052	0·551	100·5	270·1	− 7·8	0	18	
		2052	0·589	104·3	267·8	−10·3	0	14	
		2052*b*	0·612	103·0	266·0	− 9·8	30	207	
May 15		Centre			(303·1)	(−2·4)	(97)	(635)	(0)
136·296	EP, M	2052*a*	0·341	104·6	274·6	− 7·1	67	335	
		2052	0·389	105·2	271·7	− 8·0	9	28	
I.		2052	0·411	104·4	270·3	− 8·0	4	38	
		2052	0·446	103·8	268·1	− 8·2	0	9	
		2052	0·459	108·2	267·7	−10·3	7	36	
		2052*b*	0·486	106·5	265·8	− 9·9	32	160	
May 16		Centre			(293·9)	(−2·3)	(119)	(606)	(0)
137·300	EP, M		0·791	261·6	332·6	− 8·0			384
		2052*a*	0·137	131·0	274·6	− 7·3	72	296	
I.		2052	0·176	140·3	274·1	−10·0	0	9	
		2052	0·191	124·4	271·5	− 8·4	0	16	
		2052	0·254	123·4	268·2	−10·2	0	28	
		2052*b*	0·287	119·7	266·0	−10·3	18	91	
May 17		Centre			(280·6)	(−2·2)	(90)	(440)	(384)
138·509	EP, M		0·924	264·1	332·1	− 6·3			75
		2052*a*	0·198	242·1	274·8	− 7·4	66	281	
		2052	0·174	236·7	273·1	− 7·5	0	5	
		2052	0·179	201·9	268·6	−11·6	0	6	
		2052	0·137	206·2	268·2	− 9·1	0	28	
		2052	0·157	193·5	266·8	−10·9	2	19	
		2052	0·133	191·1	266·2	− 9·6	2	11	
May 18		Centre			(264·7)	(−2·1)	(70)	(350)	(75)
139·221	EP, M		0·851	264·0	313·3	− 6·2			351
			0·826	275·1	310·5	− 3·1			167
I.			0·840	294·0	309·2	+18·9			49
			0·846	196·3	280·2	−55·9			105
		2052*a*	0·346	254·0	274·7	− 7·3	68	288	
		2052	0·320	246·1	272·4	− 9·2	0	8	

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).
1888.				°	°	°			
139d·221	EP, M	2052	0·294	250·6	271·4	− 7·4	0	10	
		2052	0·266	246·8	269·4	− 7·8	0	5	
I.		2052	0·280	239·7	269·3	−10·0	0	1	
		2052	0·287	233·4	268·7	−11·7	0	2	
		2052	0·261	241·4	268·6	− 9·0	2	15	
		2052	0·260	235·7	267·8	−10·3	0	25	
		2052	0·234	236·0	266·5	− 9·3	0	10	
May 19		Centre			(255·2)	(−1·9)	(70)	(364)	(672)
140·556	EP, M		0·939	272·0	307·2	+ 1·3			60
			0·901	259·8	301·6	−10·0			82
		2052	0·656	262·5	278·3	− 6·3	0	22	
		2052*a*	0·621	260·3	275·5	− 7·4	61	282	
		2052	0·596	264·0	274·0	− 5·0	0	24	
		2052	0·569	260·5	271·9	− 6·9	0	6	
May 20		Centre			(237·6)	(−1·8)	(61)	(334)	(142)
141·554	EP, M		0·945	261·2	295·1	− 8·9			79
		2052	0·812	263·1	278·4	− 6·6	0	13	
		2052*c*	0·787	262·0	276·0	− 7·3	30	176	152 *c*
		2052*d*	0·764	261·3	273·9	− 7·7	10	75	
		2052	0·759	264·3	273·5	− 5·4	0	6	
May 21		Centre			(224·4)	(−1·7)	(40)	(270)	(231)
142·150	WR, M		0·986	260·6	296·8	− 9·6			131
		2052	0·899	263·4	280·3	− 6·6	0	12	
I.		2052*c*	0·871	262·1	276·8	− 7·7	29	149	1245 *f*
		2052*d*	0·849	261·4	274·3	− 8·2	12	61	
			0·862	112·7	158·8	−20·3			40
May 22		Centre			(216·5)	(−1·6)	(41)	(222)	(1416)
143·402	EP, M	2052*c*	0·978	262·8	277·7	− 7·3	15	104	486 *f*
		2052*d*	0·965	262·4	274·5	− 7·7	0	47	
May 23		Centre			(199·9)	(−1·4)	(15)	(151)	(486)
144·496	WR, M		0·996	259·4	270·3	−10·7			590
			0·931	258·6	253·7	−11·1			101
May 24		Centre			(185·5)	(−1·3)	(0)	(0)	(691)
145·503	WR, M		0·961	263·2	246·0	− 6·9			78
May 25		Centre			(172·2)	(−1·2)	(0)	(0)	(78)

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

May 18. Photograph over-exposed. Definition bad.

Measures of Positions and Areas of Spots and Faculæ upon the Sun's Disk—*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).
1888.				°	°	°			
146d·178	WR,M		0·993	263·5	246·2	−6·6			69
I.			0·793	287·2	213·9	+12·8			59
May 26		Centre			(163·1)	(−1·1)	(0)	(0)	(128)
147·477									
May 27		Centre			(146·0)	(−0·9)	(0)	(0)	(0)
148·130									
I.									
May 28		Centre			(137·3)	(−0·8)	(0)	(0)	(0)
149·568									
May 29		Centre			(118·3)	(−0·7)	(0)	(0)	(0)
150·591									
May 30		Centre			(107·2)	(−0·6)	(0)	(0)	(0)
151·419									
May 31		Centre			(93·8)	(−0·5)	(0)	(0)	(0)
152·538									
June 1		Centre			(79·0)	(−0·4)	(0)	(0)	(0)
153·482									
June 2		Centre			(66·5)	(−0·3)	(0)	(0)	(0)
154·494	WR,M		0·753	105·7	5·5	−11·8			239
June 3		Centre			(53·1)	(−0·1)	(0)	(0)	(239)
155·646									
June 4		Centre			(37·9)	(0·0)	(0)	(0)	(0)
156·304									
I.									
June 5		Centre			(28·2)	(+0·2)	(0)	(0)	(0)
157·276									
I.									
June 6		Centre			(15·2)	(+0·3)	(0)	(0)	(0)
158·429	WR,M		0·911	101·2	295·1	−10·0			55
			0·939	95·3	290·5	−4·9			154
June 7		Centre			(0·0)	(+0·4)	(0)	(0)	(209)
1888.				°	°	°			
159d·243	WR,M		0·787	99·3	299·0	−7·0			202
I.			0·922	98·2	283·6	−7·4			476
June 8		Centre			(350·3)	(+0·5)	(0)	(0)	(678)
160·169	EP,WR	2053	0·649	96·5	297·8	−4·7	15	69	} 64 *c*
		2053	0·688	96·7	294·8	−4·2	0	14	
I.			0·859	100·7	279·4	−8·9			486
June 9		Centre			(337·9)	(+0·6)	(15)	(83)	(550)
161·565	WR,M	2053*a*	0·335	105·4	300·8	−4·4	2	40	
		2053	0·356	100·9	299·2	−3·2	0	7	
		2053	0·365	102·9	298·8	−4·0	0	6	
		2053	0·387	103·2	297·5	−4·4	0	3	
		2053	0·423	103·4	295·3	−5·0	2	22	
June 10		Centre			(319·6)	(+0·7)	(4)	(78)	(0)
162·447	WR,M	2053*a*	0·143	133·3	301·8	−4·7	5	40	
		2053	0·154	116·8	299·9	−3·1	0	6	
		2053	0·242	115·4	295·2	−5·1	0	13	
June 11		Centre			(307·8)	(+0·9)	(5)	(59)	(0)
163·434	WR,M	2053	0·191	233·6	303·6	−5·5	4	22	
		2053	0·178	235·9	303·3	−4·7	0	12	
		2053	0·163	235·0	302·5	−4·4	2	17	
		2053	0·106	222·0	298·9	−3·5	0	12	
		2053	0·090	198·0	296·4	−3·9	0	16	
June 12		Centre			(294·8)	(+1·0)	(6)	(79)	(0)
164·450	WR,M	2053	0·417	253·4	305·0	−5·9	0	10	
		2053	0·351	255·7	301·2	−3·9	0	5	
		2053	0·278	253·5	296·8	−3·5	0	12	
June 13		Centre			(281·4)	(+1·1)	(0)	(27)	(0)
165·657	WR,M	2053	0·653	261·0	305·5	−5·0	6	31	
		2053	0·640	260·7	304·5	−5·0	0	10	
		2053	0·593	261·3	301·1	−4·2	2	10	
June 14		Centre			(265·3)	(+1·2)	(8)	(51)	(0)
166·144	WR,M	2053	0·747	262·5	306·7	−4·7	9	27	} 256 *c*
		2053	0·683	263·9	301·6	−3·2	0	10	
I.		2054*a*	0·197	175·0	257·9	−10·0	4	20	
		2054	0·206	171·3	257·1	−10·4	0	2	
		2054*b*	0·220	165·6	255·7	−11·0	5	19	
June 15		Centre			(258·9)	(+1·3)	(18)	(78)	(256)

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.

May 31, and June 10, 11, 12, and 13. Photograph over-exposed. Definition bad.
Group 2053, June 9–16. A number of small spots in an irregular stream; *a*, the first spot, is the largest. The group undergoes constant change from day to day.
Group 2054, June 15–19. Two small spots, *a* and *b*, on June 15 and 16, with two or three smaller spots between them. Only *b* is seen on June 17. *b* has disappeared by June 18, but two small spots are seen near the place which on June 16 had been occupied by *a*. Three small spots are seen in this locality on June 19.

Measures of Positions and Areas of Spots and Faculæ upon the Sun's Disk—*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. Longitude.	Heliographic Spots. 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).
1888.				°	°	°			
167d·491	WR,M	2053	0·921	264·3	307·7	− 4·7	0	5	340 f
		2054a	0·364	238·9	259·4	− 9·4	2	13	
		2054	0·346	237·0	258·1	− 9·4	0	5	
		2054	0·346	229·2	256·5	−11·6	0	8	
		2054	0·328	227·7	255·4	−11·3	0	3	
		2054b	0·317	226·7	254·6	−11·0	5	20	
			0·978	103·4	164·1	−12·7			85
June 16		Centre			(241·1)	(+ 1·5)	(7)	(54)	(425)
168·330	WR,M		0·929	264·8	297·7	− 4·3			379
I.			0·790	257·8	281·1	− 8·6			213
		2054b	0·473	241·7	254·9	−11·4	2	11	
			0·933	104·7	162·2	−13·1			181
June 17		Centre			(229·9)	(+ 1·6)	(2)	(11)	(773)
169·212	WR,M		0·874	259·0	278·3	− 8·7			496
		2054	0·676	255·5	259·6	− 8·5	6	17	} 322 c
I.		2054	0·676	254·6	259·4	− 9·1	0	3	
			0·833	106·1	163·5	−12·3			238
			0·897	90·0	154·8	+ 0·8			215
June 18		Centre			(218·3)	(+ 1·7)	(6)	(20)	(1271)
170·356	WR,M		0·943	258·9	272·8	− 9·8			243
		2054	0·855	258·3	261·0	− 9·1	4	24	
I.		2054	0·855	257·5	260·9	− 9·8	0	3	} 272 c
		2054	0·845	257·9	259·8	− 9·2	0	3	
		2055	0·672	111·2	163·4	−12·7	2	11	239 c
			0·895	88·4	139·9	+ 2·3			102
June 19		Centre			(203·2)	(+ 1·8)	(6)	(41)	(856)
171·161	WR,M		0·921	257·6	258·4	−10·6			471
I.			0·781	88·5	141·2	+ 2·4			33
June 20		Centre			(192·4)	(+ 1·9)	(0)	(0)	(504)
172·130	WR,M		0·984	258·9	258·6	−10·6			174
I.									
June 21		Centre			(179·6)	(+ 2·0)	(0)	(0)	(174)
173·619									
June 22		Centre			(159·9)	(+ 2·2)	(0)	(0)	(0)
174·433									
June 23		Centre			(149·2)	(+ 2·3)	(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 Spots. Longitude.	Heliographic Spots. 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).
1888.				°	°	°			
175d·644	EP,WR	2056a	0·083	293·6	137·6	+ 4·3	4	14	
		2056	0·053	289·1	136·1	+ 3·4	0	4	
		2056	0·041	306·3	135·1	+ 3·8	1	8	
June 24		Centre			(133·2)	(+ 2·4)	(5)	(26)	(0)
176·452	EP,WR		0·723	269·7	168·5	+ 1·5			73
		2056a	0·298	277·2	139·6	+ 4·6	6	28	
		2056	0·279	275·5	138·5	+ 4·0	0	3	
		2056	0·258	275·3	137·3	+ 3·8	0	3	
		2056	0·241	272·9	136·3	+ 3·1	0	6	
		2056	0·220	279·0	134·9	+ 4·4	0	10	
		2056	0·216	274·6	134·8	+ 3·5	0	23	
June 25		Centre			(122·4)	(+ 2·5)	(6)	(73)	(73)
177·201	WR,M		0·832	269·8	168·6	+ 1·3			159
			0·818	253·1	165·5	−12·2			266
I.		2056a	0·482	275·7	141·2	+ 5·1	8	39	
		2056	0·463	277·5	139·9	+ 5·8	0	3	
		2056	0·461	274·0	139·8	+ 4·2	1	17	
		2056	0·404	272·3	136·2	+ 3·3	0	4	
		2056	0·381	277·2	134·7	+ 5·2	0	13	
June 26		Centre			(112·5)	(+ 2·6)	(9)	(76)	(425)
178·311	EP,M		0·916	270·7	164·1	+ 1·8			145
			0·909	254·2	161·6	−13·1			360
I.		2056a	0·709	274·2	142·9	+ 5·0	8	27	
		2056	0·696	272·1	141·9	+ 3·5	0	5	
		2056	0·684	273·6	140·9	+ 4·6	2	12	
		2056	0·661	273·7	139·2	+ 4·6	2	6	
		2056	0·634	273·2	137·1	+ 4·2	0	9	
		2056	0·607	274·5	135·2	+ 5·0	2	11	
			0·943	175·2	86·3	−66·9			99
June 27		Centre			(97·9)	(+ 2·8)	(14)	(70)	(604)
179·211	EP,M		0·965	272·6	160·6	+ 3·3			64
			0·962	255·4	158·6	−13·2			158
I.		2056a	0·846	274·0	143·6	+ 5·0	5	27	
		2056	0·829	273·4	141·8	+ 4·5	0	55	
		2056	0·813	274·5	140·2	+ 5·4	0	10	} 317 c
		2056	0·778	273·8	136·8	+ 4·8	1	6	
		2056	0·761	273·6	135·4	+ 4·7	0	11	
			0·929	183·4	93·3	−64·8			42
June 28		Centre			(85·9)	(+ 2·9)	(6)	(109)	(581)

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

Group 2055, June 19. A small spot.
Group 2056, June 24–29. A small spot, *a*, followed by a number of smaller spots in an irregular stream. *a* appears on June 29 to have coalesced, or to be confused through the effect of foreshortening, with the spot immediately following it.

Measures of Positions and Areas of Spots and Faculæ upon the Sun's Disk—*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).
1888.				°	°	°			
180d·381	EP, WR	2056	0·954	274·8	143·0	+5·5	8	40	578 *f*
June 29		Centre			(70·5)	(+3·0)	(8)	(40)	(578)
181·517	EP, WR		0·988	274·2	136·5	+ 4·7			171
			0·903	262·1	119·2	− 5·8			113
			0·945	5·2	38·5	+72·9			38
June 30		Centre			(55·4)	(+3·1)	(0)	(0)	(322)
182·301									
I.									
July 1		Centre			(45·0)	(+3·2)	(0)	(0)	(0)
183·464	EP, M		0·850	266·1	87·5	− 1·6			69
			0·832	246·8	82·6	−17·1			33
I.			0·859	90·0	330·7	+ 1·7			27
			0·967	94·1	314·9	− 3·1			114
July 2		Centre			(29·7)	(+3·3)	(0)	(0)	(243)
184·556	M, W		0·865	98·9	316·2	− 5·9			128
			0·953	98·1	303·6	− 6·7			198
July 3		Centre			(15·2)	(+3·4)	(0)	(0)	(326)
185·433	EP, WR		0·886	100·3	302·3	− 7·4			206
July 4		Centre			(3·6)	(+3·5)	(0)	(0)	(206)
186·625	EP, WR		0·904	98·6	284·1	− 6·2			318
July 5		Centre			(347·9)	(+3·6)	(0)	(0)	(318)
187·216	EP, WR	2057	0·642	247·3	17·0	−11·3	0	2	
		2057	0·637	246·2	16·4	−11·9	0	4	
M.		2057	0·625	246·2	15·6	−11·6	4	8	
		2057	0·614	244·7	14·5	−12·1	0	12	
		2058	0·934	99·0	271·9	− 7·1	0	15	74 *c*
			0·975	101·0	263·9	− 9·8			138
July 6		Centre			(340·0)	(+3·7)	(4)	(41)	(212)
188·332	EP, M	2057	0·812	252·5	17·3	−11·8	4	23	} 191 *c*
		2057	0·784	252·6	14·7	−11·1	7	22	
I.		2058	0·800	101·2	273·2	− 6·6	0	5	
			0·955	6·3	301·4	+75·0			110
			0·811	88·0	271·1	+ 3·9			54
			0·955	22·0	269·4	+64·4			45
			0·896	103·4	263·1	−10·2			347
July 7		Centre			(325·2)	(+3·8)	(11)	(50)	(747)
1888.				°	°	°			
189d·450	EP, WR		0·920	255·8	15·8	−11·4			191
July 8		Centre			(310·5)	(+3·9)	(0)	(0)	(191)
190·435	EP, M		0·982	257·5	15·1	−11·5			86
			0·829	254·8	351·5	−10·2			126
			0·954	95·6	225·4	− 4·2			43
July 9		Centre			(297·3)	(+4·0)	(0)	(0)	(255)
191·661	WR, M	2059	0·296	140·8	270·3	− 9·2	0	6	
		2059	0·385	130·9	264·1	−10·6	0	5	
July 10		Centre			(281·2)	(+4·1)	(0)	(11)	(0)
192·505	M, M	2059	0·283	159·7	264·3	−11·2	0	2	
I.									
July 11		Centre			(270·0)	(+4·2)	(0)	(2)	(0)
193·206									
M.									
July 12		Centre			(260·6)	(+4·3)	(0)	(0)	(0)
194·458	EP, WR	2059	0·475	239·6	268·6	− 9·9	3	12	
		2059*a*	0·442	236·6	266·0	−10·0	6	22	
		2059	0·442	234·3	265·4	−10·8	0	4	
		2059	0·422	233·8	264·3	−10·2	0	14	
July 13		Centre			(244·1)	(+4·4)	(9)	(52)	(0)
195·200	EP, M	2059	0·611	248·5	269·4	− 9·2	0	10	
M.		2059*a*	0·565	245·5	265·7	− 9·7	4	37	
		2059	0·549	244·0	264·3	−10·0	0	5	
July 14		Centre			(234·4)	(+4·5)	(4)	(52)	(0)
196·230	EP, M		0·951	262·8	291·9	− 5·4			102
		2059	0·779	254·5	270·0	− 9·0	0	21	} 329 *c*
I.		2059	0·774	252·8	269·2	−10·2	0	7	
		2059*a*	0·737	251·7	265·8	−10·2	21	127	
		2060	0·942	85·7	150·2	+ 5·6	0	17	206 *f*
			0·956	91·1	148·0	+ 0·4			52
July 15		Centre			(220·7)	(+4·6)	(21)	(172)	(689)
197·193	EP, M	2059	0·903	257·9	270·8	− 8·8	0	11	} 488 *c*
		2059	0·891	256·2	269·3	−10·0	0	15	
I.		2059*a*	0·862	255·3	265·7	−10·1	15	130	
		2060	0·845	86·2	150·3	+ 5·8	0	12	229 *f*
			0·855	92·5	149·6	+ 0·4			46
July 16		Centre			(208·0)	(+4·7)	(15)	(168)	(763)

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

July 14. Photograph over-exposed. Definition poor.
Group 2057, July 6–7. Four very small spots on July 6; two small spots on July 7.
Group 2058, July 6–7. A small faint spot.
Group 2059, July 10–17. Two very small faint spots on July 10. Only one is seen on July 11, and nothing is visible on July 12. The group has broken out afresh by July 13, and consists of a small regular spot, *a*, with a few small companions near. *a* increases in size very rapidly on the succeeding days.
Group 2060, July 15–19. A small spot not seen on July 18.

Measures of Positions and Areas of Spots and Faculæ upon the Sun's Disk—*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).
1888.				°	° ′	°			
198d·359	EP, M	2059*a*	0·966	258·1	266·2	−10·2	9	95	461 *c*
		2060	0·667	86·1	150·8	+ 6·2	4	15	
I.			0·709	108·4	149·8	− 9·4			38
			0·755	87·7	143·6	+ 4·9			138
			0·915	100·4	127·6	− 7·5			62
July 17		Centre			(192·6)	(+4·8)	(13)	(110)	(699)
199·195 M. July 18		Centre			(181·4)	(+4·9)	(0)	(0)	(0)
200·496	M, M	2060	0·250	84·2	149·9	+ 6·3	0	6	
July 19		Centre			(164·3)	(+5·0)	(0)	(6)	(0)
201·717 July 20		Centre			(153·8)	(+5·0)	(0)	(0)	(0)
202·495 July 21		Centre			(137·8)	(+5·1)	(0)	(0)	(0)
203·543 July 22		Centre			(125·0)	(+5·2)	(0)	(0)	(0)
204·417 July 23		Centre			(112·4)	(+5·3)	(0)	(0)	(0)
205·419 July 24		Centre			(99·2)	(+5·4)	(0)	(0)	(0)
206·203 M. July 25		Centre			(88·7)	(+5·5)	(0)	(0)	(0)
207 409	EP, WR		0·876	275·0	134·1	+ 7·1			220
July 26		Centre			(72·8)	(+5·6)	(0)	(0)	(220)
208·387	EP, WR		0·939	103·2	351·8	−10·3			109
I.			0·948	85·8	348·3	+ 5·8			74
			0·982	94·2	341·4	− 3·1			216
July 27		Centre			(59·9)	(+5·6)	(0)	(0)	(399)
209·561	M, WR		0·883	96·0	343·1	− 2·6			184
July 28		Centre			(44·4)	(+5·7)	(0)	(0)	(184)

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).
1888.				°	°	°			
210d·534	M, WR		0·827	95·1	336·2	− 0·9			18
			0·937	90·7	322·2	+ 1·5			48
		2061	0·956	96·5	319·4	− 4·5	0	12	321 *c*
July 29		Centre			(31·5)	(+5·8)	(0)	(12)	(387)
211·477 July 30	M, WR	2061 Centre	0·869	99·1	319·8 (19·0)	− 4·9 (+5·8)	0 (0)	12 (12)	316 *f* (316)
212·311 I.	EP, M		0·868	99·2	308·9	− 5·0			423
July 31		Centre			(8·0)	(+5·9)	(0)	(0)	(423)
213·179	EP, WR	2062	0·769	101·6	307·6	− 5·0	0	4	
I.		2062	0·785	100·8	306·0	− 4·7	0	2	125 *c*
		2062	0·807	101·0	304·0	− 5·2	6	12	
Aug. 1		Centre			(356·5)	(+6·0)	(6)	(18)	(125)
214·465	M, WR	2062	0·602	109·3	304·8	− 6·5	0	16	
			0·937	104·1	272·0	−11·0			137
Aug. 2		Centre			(339·5)	(+6·0)	(0)	(16)	(137)
215·455 Aug. 3	WR, EP	Centre	0·854	107·1	270·3 (326·4)	−11·1 (+6·1)	(0)	(0)	172 (172)
216·426 M. Aug. 4		Centre			(313·7)	(+6·2)	(0)	(0)	(0)
217·442 Aug. 5		Centre			(300·2)	(+6·2)	(0)	(0)	(0)
218·182 M. Aug. 6		Centre			(290·4)	(+6·3)	(0)	(0)	(0)
219·459 Aug. 7		Centre			(273·4)	(+6·4)	(0)	(0)	(0)
220·397	EP, WR		0·891	262·7	323·1	− 3·5			222
		2063*a*	0·350	225·2	275·5	− 8·0	3	20	
		2063*b*	0·330	219·4	273·2	− 8·5	0	28	
Aug. 8		Centre			(261·0)	(+6·4)	(3)	(48)	(222)

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

July 22. Photograph fogged. Definition poor.
Group 2061, July 29-30. A small spot.
Group 2063, Aug. 8–10. Two small spots, *a* and *b*. *a* has moved forward in longitude by Aug. 9, and has disappeared by Aug. 10.

July 30. Photograph over-exposed. Definition poor.
Group 2062. Aug. 1–2. Three small spots on Aug. 1; one on Aug 2.

Measures of Positions and Areas of Spots and Faculæ upon the Sun's Disk—*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).
1888.				°	°	°			
221d.417	EP, WR		0·906	262·4	311·6	− 4·1			263
		2063*a*	0·540	244·8	277·0	− 7·7	3	23	
		2063*b*	0·495	240·3	273·2	− 8·3	3	11	
Aug. 9		Centre			(247·6)	(+6·5)	(6)	(34)	(263)
222·409	EP, WR		0·965	263·3	308·4	− 4·7			295
		2063*b*	0·664	250·2	273·5	− 8·0	0	2	
			0·920	108·9	170·6	−14·6			52
Aug. 10		Centre			(234·5)	(+6·5)	(0)	(2)	(347)
223·214	EP,M		0·829	252·2	277·0	−10·7			251
I.			0·909	112·2	162·3	−17·0			243
Aug. 11		Centre			(223·8)	(+6·6)	(0)	(0)	(494)
224·625	EP, WR		0·899	248·3	265·5	−16·2			64
			0·925	257·2	271·0	− 9·2			287
		2064*a*	0·893	96·8	142·8	− 3·1	6	37	} 171 *c*
		2064	0·920	96·1	139·1	− 2·9	0	21	
Aug. 12		Centre			(205·2)	(+6·6)	(6)	(58)	(522)
225·402	EP, WR		0·964	255·9	267·3	−11·6			250
		2064*a*	0·787	98·9	144·0	− 2·8	5	30	} 231 *c*
		2064	0·831	97·9	139·6	− 2·8	3	19	
Aug. 13		Centre			(194·9)	(+6·7)	(8)	(49)	(481)
226·638	EP, WR	2064*a*	0·575	103·8	144·8	− 2·3	4	22	
Aug. 14		Centre			(178·6)	(+6·7)	(4)	(22)	(0)
227·629	WR, EP	2064*a*	0·375	113·8	145·5	− 2·3	5	15	
Aug. 15		Centre			(165·5)	(+6·8)	(5)	(15)	(0)
228·406	EP, WR	2064*a*	0·231	134·4	145·7	− 2·6	0	16	
		2064	0·320	124·3	139·9	− 3·8	0	5	
Aug. 16		Centre			(155·2)	(+6·8)	(0)	(21)	(0)
229·205									
M.									
Aug. 17		Centre			(144·6)	(+6·8)	(0)	(0)	(0)
230·553	M, M	2064	0·349	244·5	145·1	− 2·0	0	7	
Aug. 18		Centre			(126·8)	(+6·9)	(0)	(7)	(0)

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1888.				°	°	°			
231d.168									
I.									
Aug. 19		Centre			(118·6)	(+6·9)	(0)	(0)	(0)
232·303									
I.									
Aug. 20		Centre			(103·8)	(+7·0)	(0)	(0)	(0)
233·605	EP,M	2064*b*	0·853	263·3	144·2	− 2·0	9	35	} 202 *c*
		2064*c*	0·824	261·1	140·9	− 3·2	13	52	
			0·948	103·4	17·1	−10·3			74
			0·991	99·0	5·6	− 7·9			165
Aug. 21		Centre			(86·5)	(+7·0)	(22)	(87)	(441)
234·439	EP,M	2064*b*	0·945	265·4	145·8	− 2·0	0	22	} 219 *c*
		2064*c*	0·913	263·0	140·5	− 3·5	11	42	
			0·872	106·2	17·4	−10·4			61
			0·951	100·9	5·1	− 8·1			236
Aug. 22		Centre			(75·5)	(+7·0)	(11)	(64)	(516)
235·187	EP,M		0·890	102·9	4·6	− 8·1			108
M.									
Aug. 23		Centre			(65·6)	(+7·1)	(0)	(0)	(108)
236·447									
Aug. 24		Centre			(48·9)	(+7·1)	(0)	(0)	(0)
237·487	EP,M	2065*a*	0·027	56·6	33·9	+ 8·0	0	6	
		2065*b*	0·052	89·6	32·2	+ 7·1	0	6	
Aug. 25		Centre			(35·2)	(+7·1)	(0)	(12)	(0)
238·303	EP,M	2065*a*	0·157	274·8	33·4	+ 7·8	0	16	
		2065*b*	0·122	271·6	31·4	+ 7·3	0	21	
I.			0·818	109·7	332·7	−11·6			62
			0·861	99·1	326·1	− 4·2			54
			0·950	99·9	314·1	− 7·1			268
Aug. 26		Centre			(24·4)	(+7·1)	(0)	(37)	(384)
239·271	EP,M	2065*a*	0·376	273·7	33·8	+ 8·0	6	29	
I.		2065*b*	0·341	271·0	31·6	+ 7·0	6	19	
			0·850	99·9	312·9	−12·2			67
Aug. 27		Centre			(11·6)	(+7·1)	(12)	(48)	(67)

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

Group 2064. Aug. 12–22. Several very small faint spots in two compact clusters. Only one spot, *a*, remains by Aug. 14. A small companion is seen near *a* on Aug. 16. The group is not seen on Aug. 17, but a very faint marking occupies its place on Aug. 18. No sign of the group can be detected on Aug. 19 and 20; but two well-marked spots, *b* and *c*, are seen on Aug. 21. *b* has divided into two small faint spots by Aug. 22, but is still measured as one.
Group 2065. Aug. 25–28. Two small spots, *a* and *b*. Both spots show an extension towards each other on Aug. 26, which is not seen on other days.

Measures of Positions and Areas of Spots and Faculæ upon the Sun's Disk—*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).
1888.				°	°	°			
240d·161	EP,M	2065*a*	0·563	273·9	34·3	+ 8·2	0	9	
		2065*b*	0·528	271·9	31·9	+ 7·1	1	22	
1.		2066	0·993	96·5	277·8	− 5·5	0	229	93 *sp*
			0·967	104·0	286·8	−11·6			49
Aug. 28		Centre			(359·9)	(+7·2)	(1)	(260)	(142)
241·480	EP,M	2066*a*	0·913	99·5	277·9	− 5·6	49	248	
		2066*b*	0·928	97·4	275·4	− 4·1	10	65	713 *c*
		2066	0·949	99·4	272·4	− 6·3	0	12	
Aug. 29		Centre			(342·5)	(+7·2)	(59)	(325)	(713)
242·437	EP,M		0·884	275·7	32·3	+ 8·4			77
		2067	0·792	251·8	19·4	− 9·7	8	29	
		2067	0·777	248·7	17·3	−11·6	5	26	
		2067	0·764	249·9	16·4	−10·3	0	4	
		2066*a*	0·818	102·2	276·5	− 5·6	49	328	
		2066*b*	0·836	99·7	274·3	− 4·0	9	76	538 *c*
		2066	0·860	102·0	272·2	− 6·5	0	12	
Aug. 30		Centre			(329·8)	(+7·2)	(71)	(475)	(615)
243·423	EP,M	2067	0·939	257·2	21·6	− 9·3	0	9	
		2067	0·910	258·3	17·5	− 7·5	0	3	111 *f*
		2068	0·266	129·6	301·9	− 2·7	0	4	
		2068	0·281	131·8	301·6	− 3·7	2	6	
		2066*a*	0·634	108·6	276·7	− 5·9	46	352	
		2066*b*	0·649	105·1	275·0	− 4·1	9	43	
		2066	0·677	105·5	272·9	− 5·0	0	3	
		2066	0·690	106·8	272·2	− 6·1	0	5	
Aug. 31		Centre			(313·7)	(+7·2)	(57)	(425)	(111)
244·504	EP,M		0·919	256·9	7·4	− 9·0			183
		2066	0·462	120·9	279·2	− 7·1	0	4	
		2066*a*	0·483	115·9	276·8	− 5·7	42	304	
		2066*b*	0·506	111·8	274·6	− 4·5	4	54	
		2066	0·540	113·9	272·9	− 6·3	0	4	
		2066	0·537	111·7	272·6	− 5·2	0	7	
			0·902	167·6	283·0	−54·8			38
Sept. 1		Centre			(302·6)	(+7·2)	(46)	(373)	(221)
245·201	EP,M		0·946	247·9	0·4	−18·2			18
		2066	0·373	132·9	277·4	− 7·8	0	4	
M.		2066*a*	0·352	128·2	277·2	− 5·6	29	209	
		2066	0·387	129·5	275·9	− 7·3	0	8	
		2066	0·380	126·3	275·4	− 6·1	2	23	
1888.				°	°	°			
245d·201	EP,M	2066	0·363	120·3	275·1	− 3·7	0	4	
		2066	0·389	123·1	274·3	− 5·4	0	22	
M.		2066	0·412	124·4	273·4	− 6·7	0	15	
		2066	0·420	119·8	271·9	− 5·3	0	2	
			0·845	100·2	236·9	− 4·7			29
Sept. 2		Centre			(293·3)	(+7·2)	(31)	(287)	(47)
246·592	EP,M	2066	0·228	196·8	278·7	− 5·4	0	5	
		2066	0·263	188·3	277·1	− 7·8	0	3	
		2066*a*	0·225	189·7	277·1	− 5·6	34	174	
		2066	0·228	179·7	274·8	− 5·9	0	90	
		2066	0·292	167·4	271·2	− 9·3	0	2	
Sept. 3		Centre			(274·9)	(+7·2)	(34)	(274)	(0)
247·426	EP,M	2066	0·373	228·6	280·2	− 7·4	0	9	
		2066*a*	0·319	225·0	277·0	− 6·0	28	141	
		2066	0·301	218·9	274·8	− 6·4	4	59	
		2066	0·267	224·8	274·7	− 3·8	0	2	
		2066	0·256	221·1	273·6	− 4·0	0	2	
		2066	0·282	216·2	273·5	− 6·0	0	3	
		2066	0·312	211·4	273·3	− 8·3	0	5	
			0·986	91·5	183·9	− 0·3			200
Sept. 4		Centre			(263·9)	(+7·2)	(32)	(221)	(200)
248·381	EP,M	2066*a*	0·486	243·2	277·1	− 6·1	23	107	
		2066	0·478	240·9	276·1	− 6·8	5	20	
I.		2066	0·457	240·4	274·8	− 6·3	0	53	
			0·920	92·7	184·7	+ 0·4			360
Sept. 5		Centre			(251·3)	(+7·3)	(28)	(180)	(360)
249·627	EP,H	2066*a*	0·700	252·5	276·9	− 6·7	21	108	
		2066	0·691	250·9	275·8	− 7·6	0	9	106 *c*
		2066	0·674	251·3	274·6	− 6·9	0	7	
		2069	0·733	98·6	188·5	− 1·2	6	23	
		2069	0·790	96·0	183·2	− 0·3	0	7	193 *c*
		2070	0·944	107·5	167·1	−13·8	7	55	
		2070*a*	0·976	107·1	160·1	−14·9	18	62	361 *c*
Sept. 6		Centre			(234·8)	(+7·3)	(52)	(271)	(660)
250·498	EP,H		0·912	256·0	286·9	− 9·5			57
		2066*a*	0·824	256·1	276·8	− 7·1	15	105	263 *c*
		2069	0·576	102·9	189·3	− 1·3	4	13	
		2069	0·623	99·5	185·5	− 0·1	0	4	
		2069	0·654	96·7	183·0	+ 1·2	4	10	

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Group 2066, Aug. 28–Sept. 9. A fine large spot, *a*, with a close companion, *b*, and a number of very small spots. *a* changes in shape and increases in size day by day until Aug. 31, after which it begins to break up. Only the southern and preceding portion of the spot, now of regular form, remains by Sept. 6, but it suffers no great further change on the succeeding days. Only *a* remains by Sept. 7.
Group 2067, Aug. 30–31. Three small spots on Aug. 30. Two small spots on Aug. 31. Group 2068, Aug. 31. Two very small spots.
Group 2069, Sept. 6–10. Two small spots. A third is seen between the two others on Sept. 7. The group is not seen on Sept. 9. Only one spot is seen on Sept. 10.
Group 2070, Sept. 6–16. A regular spot, *a*, preceded by a close pair which are measured as one spot on Sept. 6 and 7, but separately on Sept. 8 as *b* and *c*. *c* has disappeared by Sept. 9, *b* by Sept. 11, but a small spot is seen near its place on Sept. 12, and again, as *d*, on Sept. 14 and the succeeding days. *a* has broken up by Sept. 11 into an irregular cluster of small spots which change very rapidly in arrangement, shape and size on the succeeding days, and have all disappeared by Sept. 15.

Measures of Positions and Areas of Spots and Faculæ upon the Sun's Disk—*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).
1888.				°	°	°			
250d·498	EP,H	2070	0·865	110·7	167·1	−13·8	8	33	} 590 *c*
		2070*a*	0·919	110·0	160·1	−15·1	10	58	
			0·965	93·2	149·0	− 1·1			171
Sept. 7		Centre			(223·3)	(+7·3)	(41)	(223)	(1081)
259·203	EP,M	2066*a*	0·905	258·4	277·1	− 7·2	27	130	389 *c*
		2069	0·430	108·0	190·0	− 0·9	9	10	
I.		2069	0·522	99·1	183·1	+ 1·6	1	9	
		2070*b*	0·773	114·6	167·8	−13·7	3	14	}
		2070*c*	0·783	113·5	166·6	−13·3	0	4	} 472 *c*
		2070*a*	0·848	112·9	160·2	−15·0	12	59	}
			0·911	94·3	148·9	− 0·9			106
Sept. 8		Centre			(214·0)	(+7·3)	(52)	(226)	(967)
252·635	EP,H		0·976	255·8	270·2	−12·1			167
			0·953	244·7	262·6	−21·4			65
		2066*a*	0·992	262·0	276·7	− 6·9	20	153	117 *f*
		2070*b*	0·566	128·1	167·9	−13·9	5	10	
		2070	0·673	127·6	161·1	−18·2	0	1	
		2070*a*	0·663	123·3	160·2	−15·4	5	28	
Sept. 9		Centre			(195·1)	(+7·3)	(30)	(192)	(349)
253·593	EP,H	2069	0·133	180·9	182·6	− 0·4	0	3	
		2070	0·428	149·3	169·5	−14·6	0	8	
		2070*b*	0·434	145·9	168·0	−14·0	4	14	
		2070*a*	0·522	135·9	160·5	−15·3	3	12	
		2070	0·514	134·2	160·2	−14·3	0	2	
Sept. 10		Centre			(182·5)	(+7·2)	(7)	(39)	(0)
254·493	EP,H	2070	0·392	161·2	163·1	−14·6	0	3	
		2070	0·411	161·1	162·7	−15·7	0	2	
		2070	0·427	158·3	161·2	−16·2	6	17	
		2070	0·412	156·9	161·0	−15·1	4	11	
		2070	0·407	154·4	160·2	−14·4	0	5	
Sept. 11		Centre			(170·6)	(+7·2)	(10)	(38)	(0)
255·391	EP,H	2070	0·397	202·1	167·5	−14·4	1	6	
		2070	0·403	199·7	166·8	−15·1	0	2	
		2070	0·387	191·6	163·3	−15·0	0	4	
		2070	0·411	186·7	161·6	−16·8	7	18	
		2070	0·384	185·1	160·7	−15·2	17	75	
Sept. 12		Centre			(158·7)	(+7·2)	(25)	(105)	(0)

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1888.				°	°	°			
256d·443	EP,H	2070	0·485	223·8	165·0	−13·7	0	5	
		2070	0·490	214·5	161·7	−16·9	0	4	
		2070	0·461	217·2	161·6	−14·6	7	49	
		2070	0·461	213·5	160·2	−15·6	1	9	
Sept. 13		Centre			(144·9)	(+7·2)	(8)	(67)	(0)
257·416	EP,M		0·816	265·4	186·2	+ 0·5			229
		2070*d*	0·681	238·2	168·7	−15·3	7	23	
		2070	0·604	234·8	162·5	−14·1	0	4	
		2070	0·587	233·3	160·9	−14·2	0	7	
		2070	0·557	232·6	158·9	−13·3	1	10	
Sept. 14		Centre			(132·0)	(+7·2)	(8)	(44)	(229)
258·527	EP,H		0·926	266·2	184·5	− 0·8			377
		2070*d*	0·826	245·8	168·5	−15·3	0	11	313 *f*
			0·770	240·1	161·5	−17·5			43
Sept. 15		Centre			(117·3)	(+7·2)	(0)	(11)	(733)
259·201	EP,M		0·968	266·9	183·4	− 1·2			125
			0·823	237·9	156·6	−21·2			42
I.		2070*d*	0·897	249·1	168·5	−15·2	0	2	427 *c*
			0·984	100·5	30·3	− 8·9			151
Sept. 16		Centre			(108·4)	(+7·1)	(0)	(2)	(745)
260·457	EP,M		0·961	252·1	162·9	−15·0			353
I.			0·905	103·4	29·1	− 8·9			127
Sept. 17		Centre			(91·9)	(+7·1)	(0)	(0)	(480)
261·498 M.									
Sept. 18		Centre			(78·1)	(+7·1)	(0)	(0)	(0)
262·381									
Sept. 19		Centre			(66·5)	(+7·1)	(0)	(0)	(0)
263·413									
Sept. 20		Centre			(52·8)	(+7·0)	(0)	(0)	(0)
264·466	EP,M	2071*a*	0·660	106·2	359·5	− 5·2	0	17	
		2071	0·703	107·6	356·6	− 7·1	0	3	
		2071	0·712	106·0	355·6	− 6·2	0	10	
Sept 21		Centre			(38·9)	(+7·0)	(0)	(30)	(0)

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

Group 2071, Sept. 21–29. A regular spot, *a*, with one or two small spots following it. The smaller spots have disappeared by Sept. 24, but some very small companions are seen near *a* on Sept. 28.

Measures of Positions and Areas of Spots and Faculæ upon the Sun's Disk—*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).
1888.				°	°	°			
265d·483	EP, M	2071*a*	0·452	115·5	1·4	− 4·8	11	48	
		2071	0·530	113·5	356·4	− 6·0	0.	6	
Sept. 22		Centre			(25·5)	(+7·0)	(11)	(54)	(0)
266·687	EP, M	2071*a*	0·235	149·8	2·8	− 4·8	10	64	
		2071	0·280	140·9	359·4	− 5·8	0	7	
Sept. 23		Centre			(9·6)	(+6·9)	(10)	(71)	(0)
267·340	EP, M	2071*a*	0·212	192·4	3·6	− 5·1	17	67	
I.			0·883	88·5	298·9	+ 4·6			61
			0·948	103·0	291·6	− 9·9			99
Sept. 24		Centre			(1·0)	(+6·9)	(17)	(67)	(160)
268·332	EP, M	2071*a*	0·347	235·0	4·4	− 4·8	10	65	
I.			0·918	110·7	284·9	−15·9			118
			0·959	100·0	275·9	− 7·5			287
Sept. 25		Centre			(347·9)	(+6·9)	(10)	(65)	(405)
269·130	EP, M	2071*a*	0·500	247·9	5·0	− 4·8	10	41	
I.			0·906	101·5	274·1	− 7·4			144
Sept. 26		Centre			(337·4)	(+6·8)	(10)	(41)	(144)
270·421	EP, M		0·935	255·8	27·3	−10·6			94
			0·861	251·3	16·7	−12·3			60
		2071*a*	0·726	257·6	5·4	− 4·2	12	37	65 *c*
Sept. 27		Centre			(320·3)	(+6·8)	(12)	(37)	(219)
271·298	EP, M		0·966	254·8	21·5	−12·7			67
		2071*a*	0·850	260·9	5·9	− 4·1	0	12	
I.		2071	0·828	260·4	3·5	− 4·1	0	4	221 *c*
		2071	0·809	258·5	1·4	− 5·2	0	3	
		2071	0·806	259·5	1·2	− 4·4	0	2	
Sept. 28		Centre			(308·8)	(+6·7)	(0)	(21)	(288)
272·137	EP, M	2071*a*	0·933	263·4	5·7	− 3·6	5	22	196 *f*
I.			0·991	101·3	217·0	−10·2			79
Sept. 29		Centre			(297·7)	(+6·7)	(5)	(22)	(275)
273·523	EP, M		0·918	43·3	216·5	+45·1			48
			0·926	104·3	213·8	−10·6			168
Sept. 30		Centre			(279·4)	(+6·6)	(0)	(0)	(216)

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).
1888.				°	°	°			
274d·492	EP, M		0·744	39·1	228·6	+40·5			32
			0·838	108·1	212·5	−11·3			135
Oct. 1		Centre			(266·0)	(+6·6)	(0)	(0)	(167)
275·141	EP, M		0·963	173·0	240·8	−66·6			88
			0·791	110·8	209·1	−12·0			117
I.			0·918	93·8	191·9	− 0·9			258
Oct. 2		Centre			(258·0)	(+6·5)	(0)	(0)	(463)
276·430	EP, M	2072	0·973	106·7	166·8	−14·5	0	22	306 *c*
Oct. 3		Centre			(240·9)	(+6·5)	(0)	(22)	(306)
277·232	EP, M		0·942	109·1	163·1	−15·6			61
M.									
Oct. 4		Centre			(230·4)	(+6·4)	(0)	(0)	(61)
278·419	EP, M		0·901	255·6	277·1	−10·0			162
			0·805	113·6	165·4	−14·7			175
Oct. 5		Centre			(214·9)	(+6·3)	(0)	(0)	(337)
279·487	EP, M		0·954	257·8	271·6	− 9·6			95
			0·927	250·6	265·6	−15·3			27
Oct. 6		Centre			(200·8)	(+6·3)	(0)	(0)	(122)
280·144									
I.									
Oct. 7		Centre			(192·1)	(+6·2)	(0)	(0)	(0)
281·441									
Oct. 8		Centre			(175·0)	(+6·2)	(0)	(0)	(0)
282·495	EP, M		0·838	253·3	215·6	−10·4			241
Oct. 9		Centre			(161·1)	(+6·1)	(0)	(0)	(241)
283·139	EP, M		0·911	254·8	216·0	−11·1			143
I.			0·879	262·8	213·3	− 3·4			39
Oct. 10		Centre			(152·6)	(+6·0)	(0)	(0)	(182)
284·339	EP, M		0·941	254·8	204·7	−12·1			59
I.			0·848	266·1	194·3	− 0·1			59
Oct. 11		Centre			(136·7)	(+6·0)	(0)	(0)	(118)
285·429									
Oct. 12		Centre			(122·3)	(+5·9)	(0)	(0)	(0)

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

Oct. 1. Photograph under-exposed. Definition poor.

Group 2072, Oct. 3. A small spot.

Measures of Positions and Areas of Spots and Faculæ upon the Sun's Disk—*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).
1888.				°	°	°			
286d·488	EP,M		0·875	248·7	165·9	−15·5			90
Oct. 13		Centre			(108·3)	(+ 5·8)	(0)	(0)	(90)
287·545	EP,M		0·962	252·3	166·0	−15·3			73
Oct. 14		Centre			(94·4)	(+ 5·7)	(0)	(0)	(73)
288·306 I.									
Oct. 15		Centre			(84·3)	(+ 5·7)	(0)	(0)	(0)
289·241	EP,M		0·928	107·4	6·5	−13·8			15
I.			0·943	97·3	2·5	− 5·0			62
Oct. 16		Centre			(72·1)	(+ 5·6)	(0)	(0)	(77)
290·126	EP,M		0·871	155·9	28·4	−48·0			22
I.			0·920	149·5	15·6	−48·6			55
Oct. 17		Centre			(60·4)	(+ 5·5)	(0)	(0)	(77)
291·560									
Oct. 18		Centre			(40·5)	(+ 5·4)	(0)	(0)	(0)
292·453									
Oct. 19		Centre			(28·7)	(+ 5·3)	(0)	(0)	(0)
293·450									
Oct. 20		Centre			(16·6)	(+ 5·2)	(0)	(0)	(0)
294·577									
Oct. 21		Centre			(3·7)	(+ 5·2)	(0)	(0)	(0)
295·355									
I.									
Oct. 22		Centre			(351·4)	(+ 5·1)	(0)	(0)	(0)
296·535									
Oct. 23		Centre			(336·7)	(+ 5·0)	(0)	(0)	(0)
297·518	EP,M		0·873	84·2	262·0	+ 7·5			112
Oct. 24		Centre			(322·9)	(+ 4·9)	(0)	(0)	(112)
298·475	EP,M	2073*a*	0·732	256·8	355·9	− 6·3	9	33	
		2073	0·723	254·0	354·7	− 8·1	0	4	
		2073*b*	0·701	254·8	353·1	− 7·1	4	27	
Oct. 25		Centre			(310·3)	(+ 4·8)	(13)	(64)	(0)
1888.				°	°	°			
299d·303	EP,M	2073*a*	0·850	259·4	356·4	− 6·5	4	30	101 *c*
I.		2073*b*	0·813	258·1	352·5	− 6·9	10	44	
Oct. 26		Centre			(299·4)	(+ 4·7)	(14)	(74)	(101)
300·533	EP,M	2073*a*	0·965	262·1	357·1	− 6·4	0	30	206 *c*
		2073*b*	0·942	261·2	352·6	− 6·7	33	136	
			0·892	104·3	221·9	−10·5			160
Oct. 27		Centre			(283·2)	(+ 4·6)	(33)	(166)	(366)
301·451	EP,M		0·784	105·6	221·3	− 9·3			87
I.									
Oct. 28		Centre			(271·0)	(+ 4·5)	(0)	(0)	(87)
302·184									
I.									
Oct. 29		Centre			(261·3)	(+ 4·4)	(0)	(0)	(0)
303·314									
I.									
Oct. 30		Centre			(246·4)	(+ 4·3)	(0)	(0)	(0)
304·172	EP,M		0·919	106·9	170·5	−13·7			106
I.									
Oct. 31		Centre			(235·1)	(+ 4·2)	(0)	(0)	(106)
305·281									
I.									
Nov. 1		Centre			(220·5)	(+ 4·1)	(0)	(0)	(0)
306·168	EP,M		0·909	251·0	271·7	−15·4			31
I.			0·825	277·8	264·4	+ 8·7			73
Nov. 2		Centre			(208·8)	(+ 4·0)	(0)	(0)	(104)
307·220	EP,M		0·950	260·6	265·8	− 7·7			58
I.			0·935	277·7	264·3	+ 8·6			71
			0·953	81·3	122·5	+ 9·5			67
Nov. 3		Centre			(195·0)	(+ 3·9)	(0)	(0)	(196)
308·200	EP,M		0·929	190·8	203·8	−62·1			17
			0·849	192·4	199·3	−52·2			22
I.			0·869	82·1	121·7	+ 8·8			80
Nov. 4		Centre			(182·0)	(+ 3·8)	(0)	(0)	(119)

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

Oct. 14 and 23. Photograph under-exposed. Definition poor.
Group 2073, Oct. 25–27. Two regular spots, *a* and *b*, with a very small spot between them.

Measures of Positions and Areas of Spots and Faculæ upon the Sun's Disk—*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).
1888.				°	°	°			
309d·179	EP,M								
I.									
Nov. 5		Centre			(169·1)	(+3·7)	(0)	(0)	(0)
310·194	EP,M	2074*a*	0·859	79·9	96·6	+10·5	48	262	
		2074	0·873	78·2	95·0	+12·1	5	46	
M. and I.		2074	0·876	80·9	94·6	+ 9·8	0	19	209*c*
		2074	0·891	79·2	92·7	+11·3	0	11	
		2074*b*	0·894	78·5	92·4	+11·9	12	35	
Nov. 6		Centre			(155·7)	(+3·6)	(65)	(373)	(209)
311·483	EP,M	2074*a*	0·670	78·6	97·1	+10·2	52	310	
		2074	0·697	76·6	95·1	+11·9	6	55	
M. and I.		2074	0·702	80·0	94·5	+ 9·5	0	24	234*c*
		2074*b*	0·735	77·6	91·9	+11·5	13	88	
Nov. 7		Centre			(138·8)	(+3·5)	(71)	(477)	(234)
312·502	EP,M		0·977	267·0	205·4	− 2·2			34
			0·956	181·4	131·9	−69·4			36
M. and I.		2074*a*	0·491	75·8	96·6	+ 9·8	56	303	
		2074*c*	0·537	74·4	93·7	+11·1	4	12	
		2074	0·543	76·8	93·1	+ 9·9	0	3	
		2074*b*	0·566	75·1	91·7	+11·1	21	111	
Nov. 8		Centre			(125·4)	(+3·3)	(81)	(429)	(70)
313·231	EP,M	2074*a*	0·343	68·9	96·8	+10·2	43	274	
M. and I.		2074*c*	0·392	69·0	93·9	+11·0	3	26	
		2074*b*	0·424	69·8	91·7	+11·4	27	144	
Nov. 9		Centre			(115·7)	(+3·2)	(73)	(444)	(0)
314·202	EP,M	2074*a*	0·168	42·7	96·3	+10·2	36	253	
		2074*c*	0·210	48·7	93·7	+11·0	0	22	
M. and I.		2074	0·213	55·0	92·7	+10·0	0	2	
		2074*b*	0·235	53·6	91·8	+11·1	15	73	
Nov. 10		Centre			(102·9)	(+3·1)	(51)	(350)	(0)
315·448	EP,M	2074*a*	0·202	307·5	95·8	+10·0	55	256	
		2074	0·172	326·1	92·1	+11·2	12	76	
M. and I.		2075*a*	0·957	94·3	13·8	− 3·3	36	209	410*c*
			0·922	161·2	54·1	−58·2			18
Nov. 11		Centre			(86·5)	(+3·0)	(103)	(541)	(428)
1888.				°	°	°			
316d·168	EP,M	2074	0·359	282·3	97·6	+ 7·1	3	7	
		2074*a*	0·343	290·8	95·9	+ 9·8	45	288	
I.		2074	0·307	298·3	92·9	+11·1	9	56	
		2074	0·257	300·0	90·0	+10·2	0	2	
		2075	0·888	91·8	14·6	− 0·3	0	3	
		2075*a*	0·896	94·5	13·8	− 2·7	37	196	410*f*
		2075*b*	0·908	91·7	12·1	− 0·4	0	4	
Nov. 12		Centre			(77·0)	(+2·9)	(94)	(556)	(410)
317·216	EP,M	2074	0·554	284·0	96·1	+10·0	0	3	
		2074*a*	0·550	283·9	95·9	+ 9·9	55	317	
M. and I.		2074	0·511	285·6	93·1	+10·3	0	14	
		2075	0·742	96·2	15·8	− 2·7	3	10	
		2075*a*	0·760	97·2	14·3	− 3·6	30	204	186*c*
		2075*b*	0·782	93·9	12·1	− 1·3	11	41	
			0·834	95·8	6·4	− 3·3			193
Nov. 13		Centre			(63·2)	(+2·8)	(99)	(589)	(379)
318·182	EP,M	2074*a*	0·722	280·9	96·3	+ 9·7	42	277	
		2074	0·723	285·0	96·0	+12·6	0	4	85*c*
M. and I.		2074	0·685	283·1	93·1	+10·9	0	6	
		2075	0·567	99·4	16·6	− 3·2	0	13	
		2075*a*	0·595	99·8	14·7	− 3·7	33	191	
		2075*b*	0·614	95·9	13·0	− 1·6	0	17	
Nov. 14		Centre			(50·5)	(+2·6)	(75)	(508)	(85)
319·246	EP,M	2074*a*	0·867	279·4	96·3	+ 9·4	33	220	325*c*
		2075	0·338	107·1	17·6	− 3·3	0	6	
M. and I.		2075*a*	0·381	106·2	15·0	− 3·8	30	174	
		2075*b*	0·397	99·6	13·5	− 1·5	0	7	
Nov. 15		Centre			(36·4)	(+2·5)	(63)	(407)	(325)
320·220	EP,M	2074*a*	0·955	279·2	96·3	+ 9·5	10	209	309*c*
		2075	0·136	135·8	18·2	− 3·2	0	5	
M. and I.		2075*a*	0·176	127·4	15·6	− 3·7	42	179	
		2075*b*	0·180	110·7	13·9	− 1·3	0	4	
Nov. 16		Centre			(23·6)	(+2·4)	(52)	(397)	(309)
321·486	EP,M	2075*a*	0·200	234·3	16·2	− 4·4	34	176	
M. and I.									
Nov. 17		Centre			(6·9)	(+2·3)	(34)	(176)	(0)

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

Nov. 6. For this day, and for the subsequent days to which the two letters M. and I. are attached, two photographs were measured: the one, a Mauritius photograph, from which the positions of the spots are taken; the other, an Indian photograph, from which the areas are taken. The Mauritius photographs at that time do not give sufficiently good definition for the areas to be measured upon them with accuracy; whilst the position-angles of the wires on the Indian photographs are affected by a considerable and undetermined error. The Indian photographs show very good definition.

Group 2074, Nov. 6–16. A large regular spot, *a*, followed by a stream of smaller spots. The smaller spots coalesce or fade away, so that on Nov. 8 and the succeeding days the group consists almost wholly of three spots, *a* and *b* being the first and last, and *c* a smaller spot between them; *c* has disappeared and *b* has broken up by Nov. 11, and by Nov. 15 *a* remains alone.

Group 2075, Nov. 11–22. A regular spot, *a*. Small companions are seen from time to time in its neighbourhood, the principal one, *b*, from Nov. 12 to Nov. 16.

Measures of Positions and Areas of Spots and Faculæ upon the Sun's Disk—*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).
1888.				°	°	°			
322d·174	EP,M	2075	0·356	256·0	17·9	− 2·9	1	3	
		2075*a*	0·340	250·0	16·4	− 4·6	41	190	
M. and I.		2075	0·302	248·0	14·0	− 4·4	0	8	
			0·975	96·4	280·9	− 5·7			222
Nov. 18		Centre			(357·8)	(+2·2)	(42)	(201)	(222)
323·204	EP,M	2075*a*	0·549	258·7	16·8	− 4·4	37	170	
		2075	0·516	260·6	14·8	− 3·1	0	1	
M. and I.			0·881	96·7	281·9	− 5·0			236
			0·944	103·1	273·5	−11·6			37
			0·968	115·2	270·1	−23·8			19
Nov. 19		Centre			(344·3)	(+2·1)	(37)	(171)	(292)
324·474	EP,M	2075*a*	0·767	262·4	17·0	− 4·6	35	183	265 *c*
			0·823	136·4	283·7	−35·1			58
M. and I.			0·767	100·3	278·3	− 6·7			152
Nov. 20		Centre			(327·5)	(+1·9)	(35)	(183)	(475)
325·214	EP,M	2075*a*	0·865	263·7	17·2	− 4·6	32	162	269 *c*
M. and I.									
Nov. 21		Centre			(317·8)	(+1·8)	(32)	(162)	(269)
326·210	EP,M	2075*a*	0·957	264·2	17·3	− 5·1	20	167	319 *c*
M. and I.			0·973	96·7	277·9	− 6·1			61
Nov. 22		Centre			(304·6)	(+1·7)	(20)	(167)	(380)
327·198	EP,M		0·902	277·1	355·8	+ 7·1			58
I.			0·976	263·4	8·5	− 6·1			89
			0·977	178·7	286·4	−75·9			28
Nov. 23		Centre			(291·6)	(+1·6)	(0)	(0)	(175)
330·474									
Nov. 26		Centre			(248·4)	(+1·2)	(0)	(0)	(0)
331·488	EP,M		0·718	261·1	284·3	− 5·6			34
M. and I.		2076*a*	0·959	103·5	162·5	−12·7	0	29	
		2076*b*	0·978	101·6	157·9	−11·1	0	15	
Nov. 27		Centre			(235·1)	(+1·0)	(0)	(44)	(34)
332·185	EP,M		0·861	262·6	284·8	− 5·9			78
I.			0·806	258·9	278·8	− 8·4			45
		2076	0·888	103·8	164·3	−11·8	0	4	268 *c*
		2076*a*	0·905	103·0	162·1	−11·3	12	134	
1888.				°	°	°			
332d·185	EP,M	2076	0·916	101·2	160·3	− 9·9	0	8	
I.		2076*b*	0·930	100·7	158·2	− 9·6	12	103	
Nov. 28		Centre			(225·9)	(+0·9)	(24)	(249)	(391)
333·287	EP,M		0·918	260·8	277·4	− 8·1			109
			0·910	252·2	275·4	−15·8			29
I.		2076*a*	0·773	105·7	162·2	−11·5	21	138	
		2076	0·798	104·1	159·6	−10·7	2	18	639 *c*
		2076*b*	0·815	102·3	157·8	− 9·5	25	223	
Nov. 29		Centre			(211·4)	(+0·8)	(48)	(379)	(777)
334·182	EP,M		0·974	260·0	276·0	− 9·6			144
		2076*a*	0·627	110·0	162·7	−11·8	31	199	238 *c*
I.		2076*b*	0·672	105·1	158·6	− 9·5	37	206	
			0·929	77·5	131·9	+11·9			26
Nov. 30		Centre			(199·6)	(+0·7)	(68)	(405)	(408)
335·431	EP,M	2076*a*	0·394	124·7	163·8	−12·4	33	168	
		2076	0·426	118·7	160·8	−11·3	0	5	
		2076*b*	0·435	114·9	159·6	−10·0	20	140	
		2076	0·454	116·7	158·8	−11·3	0	9	
Dec. 1		Centre			(183·1)	(+0·5)	(53)	(322)	(0)
336·512	EP,M		0·890	263·0	231·3	− 6·0			33
		2076	0·240	169·0	166·1	−13·2	0	4	
		2076*a*	0·238	161·5	164·4	−12·6	33	180	
		2076*b*	0·239	141·3	160·1	−10·3	28	106	
		2076	0·261	144·0	159·8	−11·7	0	20	
		2076	0·298	131·3	155·7	−10·9	0	4	
			0·948	82·2	97·7	+ 7·5			67
			0·955	75·4	96·8	+14·0			41
Dec. 2		Centre			(168·8)	(+0·4)	(61)	(314)	(141)
337·513	EP,M	2076	0·286	220·0	166·9	−12·0	0	4	
		2076	0·304	215·9	166·2	−13·9	0	5	
		2076*a*	0·273	215·7	165·0	−12·5	51	192	
		2076	0·239	219·0	164·5	−10·4	0	3	
		2076	0·229	203·3	161·0	−11·8	0	8	
		2076*b*	0·203	204·3	160·6	−10·3	2	33	
		2076	0·207	190·7	157·9	−11·4	0	2	
			0·847	80·3	98·4	+ 8·4			106
			0·894	73·0	93·5	+15·3			34
Dec. 3		Centre			(155·7)	(+0·3)	(53)	(247)	(140)

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

Group 2076. Nov. 27–Dec. 9. Two small spots, *a* and *b*, on Nov. 27. Both have greatly increased in size by Nov. 28, and some small spots are seen near them; *a* is rather a close cluster of small spots than a single spot, until Nov. 30, by which day its components have coalesced to form a large regular spot; *b* decreases in size after Nov. 29, and has disappeared by Dec. 5. A number of small spots are seen near *a* on Dec. 1, and the succeeding days, but have all disappeared by Dec. 7; *a* has disappeared by Dec. 9, but a new spot is seen on that day.

Measures of Positions and Areas of Spots and Faculæ upon the Sun's Disk—*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. Longitude.	Heliographic Spots. 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).
1888.				°	°	°			
338d·180	EP,M	2076*a*	0·377	233·6	164·9	−12·7	39	213	
		2076	0·336	233·4	162·8	−11·3	0	17	
I.		2076*b*	0·302	231·5	160·8	−10·6	5	24	
		2076	0·306	228·5	160·4	−11·5	0	5	
		2076	0·273	233·0	159·6	− 9·3	0	1	
			0·769	75·7	97·7	+11·0			75
			0·776	77·0	96·9	+10·2			79
Dec. 4		Centre			(146·9)	(+0·2)	(44)	(260)	(154)
339·238	EP,M	2076	0·583	245·2	165·8	−14·1	0	6	
		2076*a*	0·574	247·3	165·6	−12·7	30	129	
I.		2076	0·554	246·7	164·2	−12·6	6	18	
		2076	0·531	247·3	162·8	−11·7	0	7	
		2076	0·506	247·5	161·2	−11·0	0	7	
		2076	0·481	244·5	159·1	−11·8	0	5	
		2076	0·432	245·5	156·3	−10·2	0	3	
Dec. 5		Centre			(132·9)	(+0·1)	(36)	(175)	(0)
340·241	EP,M	2076*a*	0·744	252·3	166·2	−13·1	24	144	
		2076	0·722	252·5	164·4	−12·6	2	11	
I.		2076	0·708	253·4	163·4	−11·7	0	2	287 *c*
		2076	0·666	251·7	159·8	−12·1	0	4	
			0·859	251·6	177·3	−15·7			60
Dec. 6		Centre			(119·7)	(−0·1)	(26)	(161)	(347)
341·496	EP,M	2076*a*	0·905	255·6	167·1	−13·1	20	95	361 *f*
M. and I.									
Dec. 7		Centre			(103·2)	(−0·2)	(20)	(95)	(361)
342·200	EP,M	2076*a*	0·962	256·7	167·4	−12·8	19	120	425 *f*
M. and I.			0·961	94·0	20·8	− 3·9			119
Dec. 8		Centre			(93·9)	(−0·3)	(19)	(120)	(544)
343·193	EP,M	2076	0·993	259·8	163·7	−10·2	0	51	245 *f*
M. and I.		2077	0·878	94·0	19·7	− 3·7	0	9	188 *c*
Dec. 9		Centre			(80·8)	(−0·5)	(0)	(60)	(433)
344·233	WR, M		0·952	188·3	91·8	−70·7			32
I.			0·823	98·5	12·3	− 7·3			30
Dec. 10		Centre			(67·2)	(−0·6)	(0)	(0)	(62)
345·518	EP,M		0·897	278·5	113·4	+ 7·3			57
Dec. 11		Centre			(50·2)	(−0·8)	(0)	(0)	(57)
1888.				°	°	°			
346d·296	WR,M		0·874	278·2	100·3	+ 6·7			69
			0·859	287·2	97·6	+14·2			31
I.			0·845	237·2	93·2	−27·7			31
			0·916	93·8	333·9	− 3·9			124
Dec. 12		Centre			(40·0)	(−0·9)	(0)	(0)	(255)
347·214	WR,M		0·958	278·2	100·7	+ 7·5			105
I.			0·925	240·6	92·9	−27·4			47
Dec. 13		Centre			(27·9)	(−1·0)	(0)	(0)	(152)
348·214									
I.									
Dec. 14		Centre			(14·6)	(−1·1)	(0)	(0)	(0)
349·272	WR,M	2078	0·277	111·7	345·7	− 7·1	1	9	
I.		2078	0·316	104·9	342·9	− 5·9	0	4	
Dec. 15		Centre			(0·7)	(−1·3)	(1)	(13)	(0)
350·242	EP,M		0·926	304·3	50·7	+30·8			26
		2078	0·107	167·9	346·7	− 7·4	4	23	
I.		2078	0·118	144·6	344·1	− 6·9	0	8	
		2078	0·110	120·9	342·6	− 4·6	0	2	
		2078	0·124	128·8	342·5	− 5·8	4	21	
			0·907	97·4	283·2	− 7·3			65
Dec. 16		Centre			(348·0)	(−1·4)	(8)	(54)	(91)
351·318	EP,M	2078*a*	0·278	251·1	349·1	− 6·6	5	15	
		2078	0·242	244·7	346·5	− 7·4	0	9	
I.		2078	0·181	243·6	343·1	− 6·1	3	37	
		2078	0·124	248·8	340·4	− 4·1	2	9	
Dec. 17		Centre			(333·8)	(−1·5)	(10)	(70)	(0)
352·196	EP,M		0·923	271·3	29·3	+ 0·6			41
			0·866	265·4	22·0	− 4·8			57
I.		2078*a*	0·476	259·3	350·1	− 6·5	6	21	
		2078	0·439	256·8	347·6	− 7·2	0	4	
		2078	0·377	255·1	343·6	− 7·1	0	21	
		2078	0·363	253·8	342·7	− 7·3	3	9	
Dec 18.		Centre			(322·2)	(−1·6)	(9)	(55)	(98)

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

Group 2077, Dec. 9. A small spot.
Group 2078, Dec. 15–22. A number of small spots in a straggling stream. The individual spots undergo many changes from day to day; the most stable spot is *a*, the leader on Dec. 17. The group consists mainly on Dec. 19 and 20 of three spots, *a*, *b*, and *c*. Both *a* and *b* have divided into two portions by Dec. 21. Only *b* remains by Dec. 22.

Measures of Positions and Areas of Spots and Faculæ upon the Sun's Disk—*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 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).
1888.				°	°	°			
353d·496	EP,M		0·807	255·2	358·1	−12·9			56
		2078*a*	0·719	263·2	350·8	− 6·1	6	37	
		2078*b*	0·674	261·2	347·0	− 7·1	0	29	
		2078	0·627	262·2	343·6	− 6·2	0	4	
		2078*c*	0·626	260·7	343·4	− 7·1	5	54	
Dec. 19		Centre			(305·1)	(−1·7)	(11)	(124)	(56)
354·496	EP,M	2078	0·869	262·7	352·1	− 7·3	0	5	
		2078*a*	0·866	264·6	351·8	− 5·6	6	32	158 *c*
		2078*b*	0·832	263·4	348·1	− 6·6	11	64	
		2078*c*	0·784	262·5	343·4	− 7·1	2	14	
Dec. 20		Centre			(292·0)	(−1·9)	(19)	(115)	(158)
355·197	ST,M	2078	0·943	267·7	353·0	− 2·8	5	23	
		2078*a*	0·937	266·2	352·1	− 4·3	0	15	
M.		2078*a*	0·926	264·4	350·3	− 5·9	0	14	473 *c*
		2078*b*	0·922	263·4	349·7	− 6·9	0	11	
		2078*b*	0·904	264·5	347·2	− 5·8	13	79	
		2078	0·876	264·2	343·7	− 6·0	0	9	
Dec. 21		Centre			(282·7)	(−2·0)	(18)	(151)	(473)
356·528	EP,M	2078*b*	0·992	263·8	347·9	− 6·5	0	44	209 *f*
Dec. 22		Centre			(265·1)	(−2·1)	(0)	(44)	(209)
357·205									
I.									
Dec. 23		Centre			(256·2)	(−2·2)	(0)	(0)	(0)
1888.				°	°	°			
358d·255	EP,M		0·940	99·2	172·5	− 9·5			50
I.									
Dec. 24		Centre			(242·4)	(−2·4)	(0)	(0)	(50)
359·175	EP,M		0·897	271·0	293·8	− 0·2			75
I.			0·908	100·6	165·3	−10·7			75
Dec. 25		Centre			(230·3)	(−2·5)	(0)	(0)	(150)
360·403									
Dec. 26		Centre			(214·1)	(−2·6)	(0)	(0)	(0)
362·280									
I.									
Dec. 28		Centre			(189·4)	(−2·9)	(0)	(0)	(0)
363·252									
I.									
Dec. 29		Centre			(176·6	(−3·0)	(0)	(0)	(0)
364·545	M,M	2079	0·732	222·0	196·4	−35·5	0	7	0
Dec. 30		Centre			(159·6)	(−3·1)	(0)	(7)	(0)
365·207									
I.									
Dec. 31		Centre			(150·8)	(−3·2)	(0)	(0)	(0)

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

Dec. 30 and 31. Photograph under-exposed. Definition poor.
Group 2079, Dec. 30. A very small spot.

ROYAL OBSERVATORY, GREENWICH.

LEDGERS

OF

AREAS AND POSITIONS OF SPOT GROUPS

UPON THE SUN'S DISK,

DEDUCED FROM THE MEASUREMENT

OF THE

SOLAR PHOTOGRAPHS,

FOR EACH DAY IN THE YEAR

1888.

AREAS and HELIOGRAPHIC POSITIONS of the SPOT GROUPS on the SUN'S DISK DEDUCED FOR EACH DAY from the MEASUREMENTS of the PHOTOGRAPHS taken at the ROYAL OBSERVATORY, GREENWICH, at DEHRA DÚN IN INDIA, and at the ROYAL ALFRED OBSERVATORY, MAURITIUS, in the YEAR 1888.

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 2026.							
1887. d					°	°	°
Dec. 31·231	24	108	44	195	227·0	− 7·7	− 74·2
1888.							
Jan. 1·484	35	200	32	183	227·6	− 7·4	− 57·1
2·450	36	257	25	178	227·7	− 7·3	− 44·4
3·451	49	306	28	176	227·8	− 7·5	− 31·0
4·241	56	312	30	167	227·6	− 7·5	− 20·8
5·468	31	247	16	123	228·3	− 7·7	− 4·0
6·271	40	262	20	133	228·0	− 8·3	+ 6·3
7·183	27	207	15	110	227·9	− 8·5	+ 18·2
8·218	27	147	16	88	228·2	− 8·4	+ 32·2
9·196	14	98	10	70	228·2	− 8·8	+ 45·0
10·321	8	50	8	49	228·1	− 8·7	+ 59·7
Means ...	...	...	22	134	227·85	− 7·98	...
Group 2027.							
Jan. 4·241	6	65	4	48	204·0	+ 9·9	− 44·4
5·468	0	14	0	8	206·3	+ 9·2	− 26·0
Means ...	...	...	2	28	205·15	+ 9·55	...
Group 2028.							
Jan. 10·321	5	60	10	115	93·8	+ 0·9	− 74·6
11·283	14	86	14	88	95·5	+ 0·9	− 60·2
12·185	11	52	9	39	96·2	+ 0·9	− 47·7
Means ...	...	...	11	81	95·17	+ 0·90	...
Group 2029.							
1888. d					°	°	°
Jan. 10·321	6	42	28	186	84·4	− 7·9	− 84·0
11·283	19	90	28	134	84·8	− 8·1	− 70·9
12·185	24	156	23	151	84·9	− 8·2	− 59·0
13·307	37	196	26	138	84·5	− 8·5	− 44·5
14·283	39	225	23	134	84·4	− 8·4	− 31·8
15·476	56	270	29	140	84·3	− 9·0	− 16·2
16·216	34	282	17	143	84·5	− 9·3	− 6·2
17·172	54	294	27	148	84·5	− 9·4	+ 6·4
18·271	33	241	18	131	85·0	− 9·3	+ 21·3
19·193	27	161	16	97	85·1	− 8·9	+ 33·5
20·476	13	103	10	81	85·2	− 8·4	+ 50·5
21·228	11	62	11	63	85·3	− 8·5	+ 60·5
Means ...	...	...	21	128	84·74	− 8·66	...
Group 2030.							
Jan. 12·185	7	18	4	9	146·4	−14·0	+ 2·5
13·307	14	33	7	18	148·2	−13·5	+ 19·2
14·283	3	30	2	19	148·1	−13·3	+ 31·9
15·476	5	44	4	34	150·3	−12·9	+ 49·8
16·216	5	42	6	40	149·9	−12·9	+ 59·2
Means ...	...	...	5	24	148·58	−13·32	...
Group 2031.							
Jan. 18·271	1	17	2	19	0·4	− 8·6	− 63·3
19·193	31	136	24	106	1·9	− 9·0	− 49·7
20·476	28	191	17	112	1·9	− 9·6	− 32·8
21·228	20	121	12	66	2·0	− 9·5	− 22·8

AREAS and HELIOGRAPHIC POSITIONS of SPOT GROUPS on the SUN'S DISK—*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 2031—*continued.*							
1888. d					°	°	°
Jan. 22	No photograph.						
23·503	4	19	2	10	3·2	−10·3	+ 8·3
24·389	5	12	2	6	2·5	−10·1	+ 19·3
Means ...	...	...	10	53	1·98	− 9·52	...
Group 2032.							
Jan. 24·389	2	15	1	10	300·5	− 3·1	− 42·7
25·450	0	16	0	9	301·1	− 3·1	− 27·5
Means ...	...	...	1	10	300·8	− 3·1	...
Group 2033.							
Jan. 30·494	0	7	0	4	291·7	− 6·1	+ 28·9
31·391	36	85	23	56	291·2	− 6·0	+ 40·3
Feb. 1·445	6	92	5	.80	292·3	− 5·4	+ 55·2
2·216	5	43	7	51	292·2	− 6·1	+ 65·3
Means ...	...	...	9	48	291·85	− 5·90	...
Group 2034.							
Feb. 3·184	0	27	0	14	203·6	− 8·0	− 10·6
Means ...	...	...	0	14	203·6	− 8·0	...
Group 2035.							
Feb. 18·168	11	68	29	177	297·6	− 3·9	− 79·3
19	No photograph.						
20·485	46	418	39	352	292·8	− 4·7	− 53·6
21·323	85	498	59	340	292·8	− 4·8	− 42·5
22·177	71	573	42	332	294·2	− 4·8	− 29·9
23·166	81	493	42	257	295·6	− 4·9	− 15·5
24·519	33	380	17	192	296·4	− 4·4	+ 3·2
25·208	54	282	28	145	298·1	− 4·4	+ 13·9
26·218	19	207	11	123	300·7	− 4·3	+ 29·9
27·193	53	312	38	225	303·9	− 4·2	+ 45·9
28·179	38	233	31	194	298·0	− 5·5	+ 53·0
29·212	4	58	5	78	299·6	− 5·4	+ 68·2
Means ...	...	...	31	220	297·25	− 4·66	...
Group 2036.							
1888. d					°	°	°
Mar. 1·405	0	15	0	9	250·2	− 9·7	+ 34·5
Means ...	...	...	0	9	250·2	− 9·7	...
Group 2037.							
Mar. 9·276	12	25	25	50	36·7	+ 2·1	− 75·3
10·565	28	234	26	230	36·3	+ 1·9	− 58·7
11·221	65	335	51	270	36·9	+ 2·1	− 49·5
12	No photograph.						
13·156	61	416	33	230	38·5	+ 2·5	− 22·3
14·400	70	442	36	226	38·7	+ 2·4	− 5·7
15·466	68	421	35	218	40·2	+ 2·8	+ 9·8
16·175	63	330	34	179	41·0	+ 2·7	+ 19·9
17·150	62	342	38	208	40·9	+ 2·6	+ 32·7
18·188	49	246	37	185	41·5	+ 2·7	+ 47·0
19·256	32	156	35	168	42·3	+ 3·1	+ 61·9
20·173	15	81	29	154	42·6	+ 3·1	+ 74·3
Means ...	...	...	34	193	39·60	+ 2·55	...
Group 2038.							
Mar. 10·565	2	26	1	16	64·9	+11·7	− 30·1
11·221	41	123	24	71	64·8	+12·1	− 21·6
12	No photograph.						
13·156	0	18	0	10	68·9	+ 9·8	+ 8·1
Means ...	...	...	8	32	66·20	+11·20	...
Group 2039.							
Mar. 16·175	2	40	5	72	306·6	− 4·5	− 74·5
17·150	4	56	4	57	307·6	− 4·1	− 60·6
18·188	4	44	3	33	307·2	− 4·3	− 47·3
19·256	5	36	3	22	307·2	− 4·5	− 33·2
Means ...	...	...	4	46	307·15	− 4·35	...
Group 2040.							
Mar. 19·256	0	4	0	3	296·9	− 2·5	− 43·5
Means ...	...	...	0	3	296·9	− 2·5	...

AREAS and HELIOGRAPHIC POSITIONS of SPOT GROUPS on the SUN'S DISK—*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 2041.							
1888. d					°	°	°
Mar. 21·465	0	39	0	65	238·2	−10·1	− 73·2
22·150	8	71	10	82	237·5	−10·0	− 64·8
23·175	10	98	7	79	237·4	− 9·9	− 51·4
Means ...	...	...	6	75	237·70	−10·00	...
Group 2042.							
Mar. 25·229	0	5	0	3	299·0	− 4·6	+ 37·3
Means ...	...	...	0	3	299·0	− 4·6	...
Group 2043.							
Mar. 31·161	0	11	0	7	142·2	− 1·0	− 41·3
Means ...	...	...	0	7	142·2	− 1·0	...
Group 2044.							
Apr. 1·414	0	41	0	23	145·5	+ 7·3	−21·4
2·156	0	33	0	17	145·7	+ 7·3	−11·4
Means ...	...	...	0	20	145·60	+ 7·3	...
Group 2045.							
Apr. 3·438	16	90	8	48	124·7	+ 2·8	− 15·5
4·617	0	37	0	18	124·9	+ 2·8	+ 0·2
5·453	2	16	1	8	125·0	+ 3·2	+ 11·4
Means ...	...	...	3	25	124·87	+ 2·93	...
Group 2046.							
Apr. 16·406	0	11	0	20	254·1	− 5·5	− 74·9
17·477	2	12	2	12	255·6	− 5·7	− 59·3
Means ...	...	...	1	16	254·85	− 5·60	...
Group 2047.							
1888. d					°	°	°
Apr. 18·444	0	16	0	15	243·5	− 6·7	− 58·6
Means ...	...	...	0	15	243·5	− 6·7	...
Group 2048.							
Apr. 21·478	4	29	9	62	185·1	− 3·0	−76·9
22·158	10	52	13	72	184·2	− 2·8	−68·8
23·293	12	57	10	49	184·1	− 2·5	−53·9
24·305	16	57	10	37	184·1	− 2·5	−40·6
25·626	10	28	5	15	184·1	− 3·1	−23·1
26·532	8	17	4	9	184·1	− 3·1	−11·2
27·709	4	19	2	10	184·2	− 2·9	+ 4·6
Means ...	...	...	8	36	184·27	− 2·84	...
Group 2049.							
Apr. 24·305	11	75	15	124	151·9	−13·3	− 72·8
25·626	13	66	11	56	153·7	−13·5	− 53·5
26·532	10	71	7	48	154·0	−13·6	− 41·3
27·709	9	74	5	42	153·4	−13·3	− 26·2
28·115	0	18	0	9	154·0	−13·3	− 20·3
29·168	1	11	1	5	153·4	−12·7	− 6·9
Means ...	...	...	7	47	153·40	−13·28	...
Group 2050.							
Apr. 25·626	4	24	4	27	143·8	− 2·4	− 63·4
26·532	0	16	0	12	143·9	− 2·2	− 51·4
27·709	6	22	4	13	145·0	− 1·0	− 34·6
28·115	0	20	0	12	145·5	− 1·0	− 28·8
29·168	0	22	0	12	145·7	− 1·0	− 14·6
Means ...	...	...	2	15	144·78	− 1·52	...
Group 2051.							
Apr. 28·115	0	3	0	5	247·4	− 7·5	+ 73·1
Means ...	...	...	0	5	247·4	− 7·5	...

AREAS and HELIOGRAPHIC POSITIONS of SPOT GROUPS on the SUN'S DISK—*continued.*

Date. Greenwich Civil Time.	Projected Area of Umbra.	Projected Area of Whole Spot.	Area for Group. Umbra.	Area for Group. Whole Spot.	Mean Longitude of Group.	Mean Latitude of Group.	Longitude from Central Meridian.
Group 2052.							
1888. d					°	°	°
May 11·575	26	111	89	380	274·4	− 7·5	− 81·9
12·446	65	292	103	464	272·9	− 7·8	− 71·9
13·490	135	763	129	752	271·5	− 8·3	− 59·5
14·438	161	1061	116	786	271·1	− 8·3	− 47·4
15·602	165	1072	97	635	271·4	− 8·3	− 31·7
16·296	216	1102	119	606	271·4	− 8·1	− 22·5
17·300	175	858	90	440	272·3	− 8·2	− 8·3
18·509	137	680	70	350	273·4	− 7·9	+ 8·7
19·221	133	643	70	364	273·5	− 7·7	+ 18·3
20·556	95	521	61	334	275·5	− 7·1	+ 37·9
21·554	50	335	40	270	275·5	− 7·3	+ 51·1
22·150	42	225	41	222	276·3	− 7·8	+ 59·8
23·402	6	68	15	151	276·7	− 7·4	+ 76·8
Means ...	...	...	80	443	273·53	− 7·82	...
Group 2053.							
June 9·169	22	125	15	83	297·3	− 4·6	− 40·6
10·565	7	143	4	78	298·8	− 4·4	− 20·8
11·447	11	116	5	59	300·2	− 4·6	− 7·6
12·434	11	153	6	79	301·1	− 4·5	+ 6·3
13·450	0	50	0	27	300·7	− 4·5	+ 19·3
14·657	12	78	8	51	304·4	− 4·8	+ 39·1
15·144	13	51	9	37	305·3	− 4·3	+ 46·4
16·491	0	4	0	5	307·7	− 4·7	+ 66·6
Means ...	...	...	6	52	301·94	− 4·55	...
Group 2054.							
June 15·144	19	80	9	41	256·8	−10·5	− 2·1
16·491	13	91	7	49	256·6	−10·5	+ 15·5
17·330	4	19	2	11	254·9	−11·4	+ 25·0
18·212	9	30	6	20	259·6	− 8·6	+ 41·3
19·356	4	32	4	30	260·9	− 9·2	+ 57·7
Means ...	...	...	6	30	257·76	−10·04	...
Group 2055.							
June 19·356	3	16	2	11	163·4	− 12·7	+ 39·8
Means ...	...	...	2	11	163·4	− 12·7	...
Group 2056.							
1888. d					°	°	°
June 24·644	10	53	5	26	136·6	+ 4·0	+ 3·4
25·452	12	143	6	73	137·0	+ 4·0	+ 14·6
26·201	15	136	9	76	139·5	+ 4·9	+ 27·0
27·311	20	104	14	70	140·2	+ 4·7	+ 42·3
28·211	7	125	6	109	141·2	+ 4·7	+ 55·3
29·381	5	24	8	40	143·0	+ 5·5	+ 72·5
Means ...	...	...	8	66	139·58	+ 4·63	...
Group 2057.							
July 6·216	6	41	4	26	15·3	− 11·9	+ 35·3
7·332	13	54	11	45	16·0	− 11·5	+ 50·8
Means ...	...	...	8	36	15·65	− 11·70	...
Group 2058.							
July 6·216	0	11	0	15	271·9	− 7·1	−68·1
7·332	0	6	0	5	273·2	− 6·6	−52·0
Means ...	...	...	0	10	272·55	− 6·85	...
Group 2059.							
July 10·661	0	21	0	11	267·5	− 9·8	− 13·7
11·505	0	3	0	2	264·3	−11·2	− 5·7
12·206	0	0	0	0	...	...	...
13·458	16	91	9	52	266·1	−10·1	+ 22·0
14·200	6	84	4	52	266·3	− 9·6	+ 31·9
15·230	29	213	21	155	266·5	−10·0	+ 45·8
16·193	15	155	15	156	266·4	−10·0	+ 58·4
17·359	5	50	9	95	266·2	−10·2	+ 73·6
Means ...	...	...	7	65	266·19	−10·13	...
Group 2060.							
July 15·230	0	11	0	17	150·2	+ 5·6	− 70·5
16·193	0	13	0	12	150·3	+ 5·8	− 57·7
17·359	6	22	4	15	150·8	+ 6·2	− 41·8
18·195	0	0	0	0	...	...	...
19·496	0	13	0	6	149·9	+ 6·3	− 14·4
Means ...	...	...	1	10	150·30	+ 5·98	...

AREAS and HELIOGRAPHIC POSITIONS of SPOT GROUPS on the SUN'S DISK—*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 2061.							
1888. d					°	°	°
July 29·534	0	7	0	12	319·4	− 4·5	− 72·1
30·477	0	12	0	12	319·8	− 4·9	− 59·2
Means ...	...	...	0	12	319·60	− 4·70	...
Group 2062.							
Aug. 1·179	7	22	6	18	305·0	− 5·1	− 51·5
2·465	0	25	0	16	304·8	− 6·5	− 34·7
Means ...	...	...	3	17	304·90	− 5·80	...
Group 2063.							
Aug. 8·397	6	90	3	48	274·2	− 8·3	+ 13·2
9·417	11	56	6	34	275·8	− 7·9	+ 28·2
10·409	0	2	0	2	273·5	− 8·0	+ 39·0
Means ...	...	...	3	28	274·50	− 8·07	...
Group 2064.							
Aug. 12·625	5	50	6	58	141·5	− 3·0	− 63·7
13·402	10	58	8	49	142·3	− 2·8	− 52·6
14·638	7	35	4	22	144·8	− 2·3	− 33·8
15·629	9	28	5	15	145·5	− 2·3	− 20·0
16·406	0	42	0	21	144·3	− 2·9	− 10·9
17·205	0	0	0	0	...	...	...
18·553	0	12	0	7	145·1	− 2·0	+ 18·3
19·168	0	0	0	0	...	...	...
20·303	0	0	0	0	...	...	...
21·605	24	96	22	87	142·2	− 2·7	+ 55·7
22·439	9	49	11	64	142·3	− 3·0	+ 66·8
Means ...	...	...	5	29	143·50	− 2·62	...
Group 2065.							
1888. d					°	°	°
Aug. 25·487	0	23	0	12	33·0	+ 7·5	− 2·2
26·303	0	74	0	37	32·3	+ 7·5	+ 7·9
27·271	22	90	12	48	32·9	+ 7·6	+ 21·3
28·161	2	52	1	31	32·6	+ 7·4	+ 32·7
Means ...	...	...	3	32	32·70	+ 7·5	...
Group 2066.							
Aug. 28·161	0	48	0	229	277·8	− 5·5	− 82·1
29·480	48	259	59	325	277·2	− 5·3	− 65·3
30·437	66	475	58	416	276·0	− 5·3	− 53·8
31·423	87	634	55	403	276·4	− 5·7	− 37·3
Sept. 1·504	79	648	46	373	276·4	− 5·5	− 26·2
2·201	57	535	31	287	276·5	− 5·7	− 16·8
3·592	67	530	34	274	276·3	− 5·7	+ 1·4
4·426	60	417	32	221	276·4	− 6·2	+ 12·5
5·381	50	315	28	180	276·3	− 6·2	+ 25·0
6·627	30	179	21	124	276·7	− 6·8	+ 41·9
7·498	18	121	15	105	276·8	− 7·1	+ 53·5
8·203	23	112	27	130	277·1	− 7·2	+ 63·1
9·635	5	40	20	153	276·7	− 6·9	+ 81·6
Means ...	...	...	33	248	276·66	− 6·08	...
Group 2067.							
Aug. 30·437	16	73	13	59	18·3	− 10·6	+ 48·5
31·423	0	9	0	12	20·6	− 8·8	+ 66·9
Means ...	...	...	6	35	19·45	− 9·70	...
Group 2068.							
Aug. 31·423	5	19	2	10	301·7	− 3·3	− 12·0
Means ...	...	...	2	10	301·7	− 3·3	...

AREAS and HELIOGRAPHIC POSITIONS of SPOT GROUPS on the SUN'S DISK—*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 2069.							
1888. d					°	°	°
Sept. 6·627	9	40	6	30	187·3	− 1·0	− 47·5
7·498	13	43	8	27	186·4	− 0·2	− 36·9
8·203	2	33	10	19	186·7	+ 0·3	− 27·3
9·635	0	0	0	0	...	...	...
10·593	0	6	0	3	182·6	− 0·4	+ 0·1
Means ...	...	...	5	16	185·75	− 0·33	...
Group 2070.							
Sept. 6·627	13	64	25	117	163·4	−14·4	− 71·4
7·498	16	80	18	91	162·6	−14·6	− 60·7
8·203	17	86	15	77	161·9	−14·7	− 52·1
9·635	15	60	10	39	162·2	−15·1	− 32·9
10·593	14	63	7	36	165·4	−14·6	− 17·1
11·493	17	70	10	38	161·2	−15·5	− 9·4
12·391	45	192	25	105	161·5	−15·4	+ 2·8
13·443	14	118	8	67	161·7	−14·8	+ 16·8
14·416	12	67	8	44	164·7	−14·6	+ 32·7
15·527	0	12	0	11	168·5	−15·3	+ 51·2
16·201	0	2	0	2	168·5	−15·2	+ 60·1
Means ...	...	...	11	57	163·78	−14·93	...
Group 2071.							
Sept. 21·466	0	45	0	30	357·9	− 5·7	− 41·0
22·483	20	96	11	54	0·8	− 4·9	− 24·7
23·687	18	135	10	71	2·5	− 4·9	− 7·1
24·340	33	131	17	67	3·6	− 5·1	+ 2·6
25·332	19	123	10	65	4·4	− 4·8	+ 16·5
26·130	17	71	10	41	5·0	− 4·8	+ 27·6
27·421	17	52	12	37	5·4	− 4·2	+ 45·1
28·298	0	22	0	21	4·4	− 4·3	+ 55·6
29·137	4	16	5	22	5·7	− 3·6	+ 68·0
Means ...	...	...	8	45	3·30	− 4·70	...
Group 2072.							
Oct. 3·430	0	10	0	22	166·8	−14·5	− 74·1
Means ...	...	...	0	22	166·8	−14·5	...

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 2073.							
1888. d					°	°	°
Oct. 25·475	17	89	13	64	354·6	− 6·7	+ 44·3
26·303	16	83	14	74	354·1	− 6·7	+ 54·7
27·533	22	108	33	166	353·4	− 6·6	+ 70·2
Means ...	...	...	20	101	354·03	− 6·67	...
Group 2074.							
Nov. 6·194	69	396	65	373	95·8	+ 10·9	− 59·9
7·483	98	660	71	477	95·8	+ 10·6	− 43·0
8·502	134	715	81	429	95·2	+ 10·2	− 30·2
9·231	135	817	73	444	95·0	+ 10·6	− 20·7
10·202	100	689	51	350	95·2	+ 10·5	− 7·7
11·448	131	656	67	332	94·9	+ 10·3	+ 8·4
12·168	106	662	57	353	95·4	+ 10·0	+ 18·4
13·216	91	553	55	334	95·8	+ 9·9	+ 32·6
14·182	54	370	42	287	96·2	+ 9·8	+ 45·7
15·246	34	227	33	220	96·3	+ 9·4	+ 59·9
16·220	5	116	10	209	96·3	+ 9·5	+ 72·7
Means ...	...	...	55	346	95·63	+ 10·15	...
Group 2075.							
Nov. 11·448	19	110	36	209	13·8	− 3·3	− 72·7
12·168	33	182	37	203	13·8	− 2·6	− 63·2
13·216	58	336	44	255	14·0	− 3·2	− 49·2
14·182	55	372	33	221	14·7	− 3·5	− 35·8
15·246	56	342	30	187	15·0	− 3·7	− 21·4
16·220	83	381	42	188	15·6	− 3·6	− 8·0
17·486	66	349	34	176	16·2	− 4·4	+ 9·3
18·174	78	376	42	201	16·3	− 4·6	+ 18·5
19·204	62	282	37	171	16·8	− 4·4	+ 32·5
20·474	45	235	35	183	17·0	− 4·6	+ 49·5
21·214	31	156	32	162	17·2	− 4·6	+ 59·4
22·210	11	93	20	167	17·3	− 5·1	+ 72·7
Means ...	...	...	35	193	15·64	− 3·97	...

AREAS and HELIOGRAPHIC POSITIONS of SPOT GROUPS on the SUN'S DISK—*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 2076.							
1888. d					°	°	°
Nov. 27·488	0	18	0	44	160·9	−12·2	−74·2
28·185	19	201	24	249	160·5	−10·6	−65·4
29·287	59	454	48	379	159·5	−10·3	−51·9
30·182	103	614	68	405	160·6	−10·6	−39·0
Dec. 1·431	98	600	53	322	161·8	−11·3	−21·3
2·512	116	607	61	314	162·6	−11·8	− 6·2
3·513	101	477	53	247	164·3	−12·2	+ 8·6
4·180	82	479	44	260	164·3	−12·4	+17·4
5·238	51	289	36	175	164·8	−12·6	+31·9
6·241	35	218	26	161	165·9	−13·0	+46·2
7·496	17	81	20	95	167·1	−13·1	+63·9
8·200	11	71	19	120	167·4	−12·8	+73·5
9·193	0	13	0	51	163·7	−10·2	+82·9
Means ...	...	...	35	217	163·34	−11·78	...
Group 2077.							
Dec. 9·193	0	9	0	9	19·7	− 3·7	− 61·1
Means ...	...	...	0	9	19·7	− 3·7	...

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 2078.							
1888. d					°	°	°
Dec. 15·272	3	25	1	13	344·8	− 6·7	−15·9
16·242	15	106	8	54	344·5	− 6·6	− 3·5
17·318	19	139	10	70	344·5	− 6·1	+10·7
18·196	15	101	9	55	346·1	− 6·9	+23·9
19·496	16	184	11	124	346·5	− 6·8	+41·4
20·496	20	126	19	115	348·7	− 6·4	+56·7
21·197	15	123	18	151	348·7	− 5·4	+66·0
22·528	0	11	0	44	347·9	− 6·5	+82·8
Means ...	...	...	10	78	346·46	− 6·43	...
Group 2079.							
Dec. 30·545	0	9	0	7	196·4	− 35·5	+ 36·8
Means ...	...	...	0	7	196·4	− 35·5	...

ROYAL OBSERVATORY, GREENWICH.

TOTAL PROJECTED AREAS OF SUN SPOTS

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

1888.

TOTAL PROJECTED AREAS OF UMBRÆ, WHOLE SPOTS, AND FACULÆ UPON THE SUN'S DISK FOR EACH DAY IN THE YEAR 1888.

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.		
		Umbræ.	Whole Spots.	Faculæ.
Jan.	d 1·5	35	200	128
	2·5	36	257	0
	3·5	49	306	0
	4·2	62	378	129
	5·5	31	261	0
	6·3	40	262	205
	7·2	27	207	89
	8·2	27	147	521
	9·2	14	98	289
	10·3	20	152	1175
	11·3	32	176	1356
	12·2	42	226	1297
	13·3	50	229	544
	14·3	41	255	0
	15·5	61	313	101
	16·2	40	324	267
	17·2	54	294	314
	18·3	34	259	155
	19·2	58	298	207
	20·5	41	295	364
	21·2	31	183	767
	22·	...	...	...
	23·5	4	19	0
	24·4	7	27	54
	25·5	0	16	0
	26·2	0	0	123
	27·5	0	0	0
	28·5	0	0	0
	29·5	0	0	0
	30·5	0	7	0
	31·4	36	85	114
Feb.	1·4	6	92	118
	2·2	5	43	338
	3·2	0	27	364
	4·2	0	0	0
	5·6	0	0	69
	6·3	0	0	667
	7·2	0	0	498
	8·3	0	0	540
	9·3	0	0	426
	10·2	0	0	260
	11·3	0	0	0
	12·2	0	0	193
	13·3	0	0	115
	14·3	0	0	130
	15·1	0	0	329
	16·3	0	0	341
	17·3	0	0	405
	18·2	11	68	454
	19·	...	...	...
	20·5	46	418	256
	21·3	85	498	266
	22·2	71	573	51

Greenwich Civil Time.		Projected Area.		
		Umbræ.	Whole Spots.	Faculæ.
Feb.	d 23·2	81	493	218
	24·5	33	380	257
	25·2	54	282	0
	26·2	19	207	34
	27·2	53	312	0
	28·2	38	233	128
	29·2	4	58	556
March	1·4	0	15	179
	2·5	0	0	44
	3·4	0	0	0
	4·2	0	0	296
	5·3	0	0	386
	6·5	0	0	0
	7·4	0	0	0
	8·3	0	0	176
	9·3	12	25	324
	10·6	31	261	159
	11·2	107	457	415
	12·	...	...	...
	13·2	61	434	35
	14·4	70	442	0
	15·5	68	421	200
	16·2	65	370	623
	17·2	66	398	982
	18·2	53	291	941
	19·3	37	195	642
	20·2	15	81	395
	21·5	0	39	105
	22·2	8	71	275
	23·2	10	98	152
	24·5	0	0	80
	25·2	0	5	707
	26·4	0	0	379
	27·2	0	0	475
	28·6	0	0	107
	29·4	0	0	115
	30·2	0	0	556
	31·2	0	11	249
April	1·4	0	41	64
	2·2	0	33	239
	3·4	16	90	52
	4·6	0	37	0
	5·5	2	16	157
	6·4	0	0	97
	7·6	0	0	144
	8·7	0	0	45
	9·3	0	0	189
	10·4	0	0	0
	11·3	0	0	249
	12·3	0	0	710
	13·5	0	0	418
	14·5	0	0	196

Greenwich Civil Time.		Projected Area.		
		Umbræ.	Whole Spots.	Faculæ.
April	d 15·5	0	0	0
	16·4	0	11	49
	17·5	2	12	176
	18·4	0	16	127
	19·5	0	0	0
	20·6	0	0	0
	21·5	4	29	164
	22·2	10	52	894
	23·3	12	57	848
	24·3	26	132	508
	25·6	27	118	370
	26·5	18	103	365
	27·7	19	115	0
	28·1	0	41	151
	29·2	1	33	0
	30·5	0	0	88
May	1·4	0	0	0
	2·2	0	0	242
	3·3	0	0	125
	4·5	0	0	253
	5·4	0	0	156
	6·	...	...	...
	7·6	0	0	0
	8·5	0	0	0
	9·4	0	0	0
	10·6	0	0	229
	11·6	26	111	234
	12·4	65	292	187
	13·5	135	763	483
	14·4	161	1061	646
	15·6	165	1072	0
	16·3	216	1102	0
	17·3	175	858	470
	18·5	137	680	57
	19·2	133	643	727
	20·6	95	521	112
	21·6	50	335	239
	22·2	42	225	1419
	23·4	6	68	314
	24·5	0	0	185
	25·5	0	0	44
	26·2	0	0	89
	27·5	0	0	0
	28·1	0	0	0
	29·6	0	0	0
	30·6	0	0	0
	31·4	0	0	0
June	1·5	0	0	0
	2·5	0	0	0
	3·5	0	0	315
	4·6	0	0	0
	5·3	0	0	0

Greenwich Civil Time.		Projected Area.		
		Umbræ.	Whole Spots.	Faculæ.
June	d 6·3	0	0	0
	7·4	0	0	153
	8·2	0	0	622
	9·2	22	125	595
	10·6	7	143	0
	11·4	11	116	0
	12·4	11	153	0
	13·5	0	50	0
	14·7	12	78	0
	15·1	31	131	356
	16·5	13	95	353
	17·3	4	19	679
	18·2	9	30	1425
	19·4	7	49	896
	20·2	0	0	414
	21·1	0	0	64
	22·6	0	0	0
	23·4	0	0	0
	24·6	10	53	0
	25·5	12	143	101
	26·2	15	136	484
	27·3	20	104	486
	28·2	7	125	522
	29·4	5	24	435
	30·5	0	0	177
July	1·3	0	0	0
	2·5	0	0	195
	3·6	0	0	251
	4·4	0	0	193
	5·6	0	0	275
	6·2	6	52	114
	7·3	13	60	692
	8·5	0	0	151
	9·4	0	0	202
	10·7	0	21	0
	11·5	0	3	0
	12·2	0	0	0
	13·5	16	91	0
	14·2	6	84	0
	15·2	29	224	627
	16·2	15	169	713
	17·4	11	72	524
	18·2	0	0	0
	19·5	0	13	0
	20·7	0	0	0
	21·5	0	0	0
	22·5	0	0	0
	23·4	0	0	0
	24·4	0	0	0
	25·2	0	0	0
	26·4	0	0	214
	27·4	0	0	207
	28·6	0	0	174

TOTAL PROJECTED AREAS OF UMBRÆ, WHOLE 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.
July	d 29·5	0	7	216	Sept.	d 5·4	50	315	284	Oct.	d 14·5	0	0	40	Nov.	d 22·2	11	93	268
	30·5	0	12	238		6·6	52	283	603		15·3	0	0	0		23·2	0	0	102
	31·3	0	0	423		7·5	46	243	958		16·2	0	0	52		24·	...	...	...
						8·2	43	231	950		17·1	0	0	65		25·	...	...	...
Aug.	1·2	7	22	155		9·6	20	100	160		18·6	0	0	0		26·5	0	0	0
	2·5	0	25	96		10·6	14	70	0		19·5	0	0	0		27·5	0	18	47
	3·5	0	0	180		11·5	17	70	0		20·5	0	0	0		28·2	19	201	346
	4·4	0	0	0		12·4	45	192	0		21·6	0	0	0		29·3	59	454	888
	5·4	0	0	0		13·4	14	118	0		22·4	0	0	0		30·2	103	614	447
	6·2	0	0	0		14·4	12	67	267		23·5	0	0	0	Dec.	1·4	98	600	0
	7·5	0	0	0		15·5	0	12	703		24·5	0	0	111		2·5	116	607	99
	8·4	6	90	203		16·2	0	2	574		25·5	17	89	0		3·5	101	477	144
	9·4	11	56	225		17·5	0	0	307		26·3	16	83	113		4·2	82	479	195
	10·4	0	2	197		18·5	0	0	0		27·5	22	108	271		5·2	51	289	0
	11·2	0	0	483		19·4	0	0	0		28·5	0	0	108		6·2	35	218	454
	12·6	5	50	418		20·4	0	0	0		29·2	0	0·	0		7·5	17	81	345
	13·4	10	58	405		21·5	0	45	0		30·3	0	0	0		8·2	11	71	369
	14·6	7	35	0		22·5	20	96	0		31·2	0	0	84		9·2	0	22	269
	15·6	9	28	0		23·7	18	135	0							10·2	0	0	54
	16·4	0	42	0		24·3	33	131	121	Nov.	1·3	0	0	0		11·5	0	0	51
	17·2	0	0	0		25·3	19	123	260		2·2	0	0	108		12·3	0	0	232
	18·6	0	12	0		26·1	17	71	123		3·2	0	0	128		13·2	0	0	98
	19·2	0	0	0		27·4	17	52	224		4·2	0	0	116		14·2	0	0	0
	20·3	0	0	0		28·3	0	22	281		5·2	0	0	0		15·3	3	25	0
	21·6	24	96	312		29·1	4	16	184		6·3	69	396	215		16·2	15	106	75
	22·4	9	49	366		30·5	0	0	168		7·5	98	660	321		17·3	19	139	0
	23·2	0	0	99							8·5	134	715	36		18·2	15	101	89
	24·4	0	0	0	Oct.	1·5	0	0	192		9·2	135	817	0		19·5	16	184	66
	25·5	0	23	0		2·1	0	0	401		10·5	100	689	0		20·5	20	126	177
	26·3	0	74	297		3·4	0	10	167		11·4	150	767	208		21·2	15	123	374
	27·3	22	90	71		4·2	0	0	35		12·2	140	844	310		22·5	0	11	74
	28·2	2	100	67		5·4	0	0	351		13·2	149	889	460		23·2	0	0	0
	29·5	48	259	549		6·5	0	0	78		14·2	109	743	109		24·3	0	0	35
	30·4	83	549	652		7·1	0	0	0		15·2	90	569	342		25·2	0	0	130
	31·4	91	662	85		8·4	0	0	0		16·2	89	487	189		26·4	0	0	0
						9·5	0	0	263		17·5	66	344	0		27·	...	...	...
Sept.	1·5	79	648	178		10·1	0	0	156		18·2	78	376	101		28·3	0	0	0
	2·2	57	535	43		11·3	0	0	104		19·2	62	282	243		29·3	0	0	0
	3·6	67	530	0		12·4	0	0	0		20·5	45	235	599		30·5	0	9	0
	4·4	60	417	68		13·5	0	0	88		21·2	31	156	260		31·2	0	0	0

MEAN AREAS of UMBRÆ, WHOLE SPOTS, and FACULÆ upon the SUN'S DISK, as measured on PHOTOGRAPHS taken at the ROYAL OBSERVATORY, GREENWICH, at DEHRA DÚN, INDIA, and in MAURITIUS, for each ROTATION of the SUN, from 1887 December 26 to 1888 December 15.

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, and 1887 printed in the Greenwich Observations for 1884, 1885, 1886, and 1887) 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.		
					Umbræ.	Whole Spots.	Faculæ.	Umbræ.	Whole Spots.	Faculæ.
			d							
458	1887	December	26·77	26	33	202	366	24	145	465
459	1888	January	23·11	27	3	14	205	3	15	255
460		February	19·45	26	37	241	215	24	157	272
461		March	17·77	27	5	37	279	5	34	314
462		April	14·06	26	5	28	190	4	26	223
463		May	11·30	28	50	276	203	37	206	226
464		June	7·51	27	7	58	305	5	36	326
465		July	4·71	27	4	30	177	3	25	214
466		July	31·91	27	4	28	130	3	20	158
467		August	28·15	28	31	208	235	23	152	279
468		September	24·42	27	2	11	120	1	8	143
469		October	21·70	27	51	304	120	34	206	135
470		November	18·01	26	36	204	216	24	143	234

MEAN AREAS of UMBRÆ, WHOLE SPOTS, and FACULÆ upon the SUN'S DISK, as measured on PHOTOGRAPHS taken at the ROYAL OBSERVATORY, GREENWICH, at DEHRA DÚN, INDIA, and in MAURITIUS, for the YEAR 1888.

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
1888	359	20	125	204	14	89	239

MEAN HELIOGRAPHIC LATITUDE of the SPOTS upon the SUN'S DISK, as measured on PHOTOGRAPHS taken at the ROYAL OBSERVATORY, GREENWICH, at DEHRA DÛN, INDIA, and in MAURITIUS, for each ROTATION of the SUN, from 1887 December 26 to 1888 December 15.

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			°		°	°	°
458	1887 Dec. 26·77	26	11	2·65	134	8·50	− 7·67	8·06
459	1888 Jan. 23·11	27	0	...	15	5·10	− 5·10	5·10
460	Feb. 19·45	26	66	2·99	91	4·66	− 1·46	3·96
461	Mar. 17·77	27	23	3·18	11	8·61	− 0·61	4·93
462	Apr. 14·06	26	0	...	26	7·48	− 7·48	7·48
463	May 11·30	28	0	...	206	8·01	− 8·01	8·01
464	June 7·51	27	15	4·75	22	6·15	− 1·74	5·59
465	July 4·71	27	2	5·95	24	9·80	− 8·65	9·52
466	July 31·91	27	4	7·48	16	4·07	− 1·99	4·68
467	Aug. 28·15	28	2	5·03	150	7·25	− 7·10	7·22
468	Sept. 24·42	27	0	1·95	8	5·62	− 5·58	5·60
469	Oct. 21·70	27	141	10·20	65	4·07	+ 5·72	8·27
470	Nov. 18·01	26	0	...	143	9·98	− 9·98	9·98

MEAN HELIOGRAPHIC LATITUDE of SPOTS upon the SUN'S DISK, as measured on the PHOTOGRAPHS taken at the ROYAL OBSERVATORY, GREENWICH, at DEHRA DÛN, INDIA, and in MAURITIUS, for the YEAR 1888.

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.		
			°		°	°	°
1888	358	20	7·10	69	7·46	− 4·27	7·39

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:—

$$-0^\circ\cdot05 \times \frac{\text{Mean Area N.} - \text{Mean Area S.}}{\text{Mean Area N.} + \text{Mean Area S.}}$$

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

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ROYAL OBSERVATORY, GREENWICH.

TOTAL PROJECTED AREAS

OF

UMBRÆ, WHOLE SPOTS, AND FACULÆ

FOR EACH DAY,

AND

MEAN PROJECTED AREAS

FOR EACH ROTATION OF THE SUN

AND

FOR EACH YEAR

FROM

1882 to 1885,

DEDUCED FROM THE MEASUREMENT

OF

SOLAR PHOTOGRAPHS.

TOTAL PROJECTED AREAS OF UMBRÆ, WHOLE SPOTS, AND FACULÆ, UPON THE SUN'S DISK FOR EACH DAY IN THE YEARS 1882, 1883, 1884, AND 1885.

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, reckoning from Greenwich Mean Midnight.

Greenwich Civil Time.		Projected Area.		
		Umbræ.	Whole Spots.	Faculæ.
1882.	d			
Jan.	1·2	53	241	1033
	2·2	83	339	348
	3·5	75	461	1075
	4·2	40	198	971
	5·2	115	492	724
	6·2	134	709	595
	7·4	119	713	1372
	8·2	42	353	1142
	9·4	23	126	1914
	10·	...	...	...
	11·	...	...	...
	12·	...	...	...
	13·5	114	701	1022
	14·2	70	481	1480
	15·2	82	360	1091
	16·2	73	394	1197
	17·2	59	358	1618
	18·2	52	300	2134
	19·3	41	480	1653
	20·2	74	506	1671
	21·5	161	559	1096
	22·4	58	444	3069
	23·3	61	426	1768
	24·6	204	553	513
	25·3	51	457	155
	26·3	60	570	1344
	27·2	86	601	2988
	28·4	169	887	284
	29·2	101	661	1848
	30·	...	...	...
	31·	...	...	...
Feb.	1·4	135	687	1125
	2·2	96	734	2797
	3·5	129	650	2343
	4·2	85	636	2634
	5·2	79	533	2294
	6·2	115	728	2041
	7·3	122	1166	569
	8·3	207	1498	1018
	9·	...	...	...
	10·5	249	1710	1359
	11·5	317	1499	2169
	12·5	368	1665	1787
	13·1	177	1291	3409
	14·5	360	1618	1182
	15·5	348	1833	762
	16·4	295	1500	1720
	17·6	307	1148	1069
	18·5	206	1008	2366
	19·6	120	553	805
	20·3	52	604	1584

Greenwich Civil Time.		Projected Area.		
		Umbræ.	Whole Spots.	Faculæ.
1882.	d			
Feb.	21·	...	...	...
	22·4	192	695	1339
	23·3	58	449	1554
	24·2	61	390	3038
	25·2	25	259	798
	26·5	22	135	652
	27·4	46	174	780
	28·3	59	180	1091
March	1·4	55	273	1414
	2·4	98	500	1638
	3·6	179	928	1671
	4·5	265	1079	1453
	5·2	144	815	1728
	6·2	123	929	1513
	7·3	138	1004	937
	8·2	203	1240	1379
	9·3	246	1384	3749
	10·2	258	1363	5680
	11·2	282	1686	4414
	12·3	233	1592	3524
	13·6	425	1635	1598
	14·4	418	1472	1888
	15·6	182	889	1010
	16·4	158	791	895
	17·6	133	691	560
	18·5	176	778	862
	19·5	160	858	0
	20·4	314	1576	493
	21·5	414	2250	2222
	22·4	537	2370	2457
	23·5	496	2330	2170
	24·4	253	1802	2379
	25·4	495	2028	752
	26·5	385	1994	2142
	27·4	312	1931	2811
	28·2	130	1082	2689
	29·2	113	817	1622
	30·4	127	771	2210
	31·4	201	762	4680
April	1·4	136	661	2551
	2·6	92	585	1683
	3·6	131	549	1374
	4·5	213	894	4393
	5·6	178	874	1918
	6·6	167	1070	3076
	7·3	285	1155	1489
	8·4	277	1124	4936
	9·5	147	734	3507
	10·1	87	591	3947

Greenwich Civil Time.		Projected Area.		
		Umbræ.	Whole Spots.	Faculæ.
1882.	d			
April	11·5	344	1635	2525
	12·1	195	1257	3224
	13·2	225	2141	2628
	14·5	666	3907	1659
	15·3	383	3513	2615
	16·5	615	5025	312
	17·6	1388	6750	2861
	18·5	1534	7638	3625
	19·2	638	6537	2467
	20·4	1175	6809	3629
	21·4	1364	6892	2162
	22·2	489	3839	3130
	23·5	183	862	2215
	24·5	371	1836	3490
	25·2	100	793	2607
	26·4	74	459	1439
	27·2	51	597	2683
	28·6	118	462	1141
	29·	...	...	...
	30·6	54	170	1295
May	1·5	82	320	718
	2·5	109	613	2873
	3·6	210	730	1409
	4·3	121	663	1581
	5·5	326	1102	2475
	6·5	416	1565	2518
	7·5	444	1848	3472
	8·4	514	2158	3391
	9·1	269	1961	3325
	10·5	593	2469	3933
	11·5	481	2466	1304
	12·6	589	3051	2860
	13·4	802	3269	3514
	14·5	801	4009	2996
	15·4	893	4169	3895
	16·5	1197	4792	4113
	17·6	974	4927	6693
	18·4	872	5104	2760
	19·6	578	3731	1236
	20·4	461	3114	1729
	21·5	586	2483	2746
	22·1	203	1676	4178
	23·1	122	1136	3300
	24·1	82	830	1433
	25·1	44	483	2758
	26·5	77	270	1127
	27·4	72	292	826
	28·1	52	298	1106
	29·5	98	479	1373
	30·4	124	615	362
	31·4	179	711	585

Greenwich Civil Time.		Projected Area.		
		Umbræ.	Whole Spots.	Faculæ.
1882.	d			
June	1·3	125	676	1144
	2·3	123	720	1058
	3·4	177	678	1903
	4·5	127	590	1739
	5·5	96	448	874
	6·1	74	400	1500
	7·5	41	264	1098
	8·1	32	154	750
	9·5	78	346	2915
	10·2	59	313	1130
	11·4	121	735	2336
	12·4	211	947	3745
	13·3	100	946	1139
	14·5	259	1531	1797
	15·5	280	1553	1621
	16·4	330	1755	2892
	17·5	433	1843	5385
	18·	...	...	...
	19·	...	...	...
	20·4	138	963	2127
	21·3	37	620	1024
	22·2	58	572	1053
	23·4	99	519	1972
	24·4	58	294	1644
	25·5	52	263	1968
	26·4	55	278	898
	27·5	276	896	2865
	28·4	180	1609	963
	29·2	167	1408	1100
	30·3	136	1431	1982
July	1·4	325	1545	5096
	2·5	207	894	4203
	3·5	200	826	2382
	4·	...	...	...
	5·5	134	525	2857
	6·	...	...	...
	7·4	36	140	2841
	8·1	17	70	2550
	9·6	0	0	2145
	10·4	25	91	2628
	11·3	39	219	2358
	12·5	110	515	1303
	13·2	55	447	1127
	14·5	168	762	2019
	15·6	198	1247	2192
	16·5	116	1023	4643
	17·4	135	923	3698
	18·5	226	1157	3215
	19·5	256	1084	2082
	20·5	209	1033	2220
	21·5	200	1151	2935

TOTAL PROJECTED AREAS OF UMBRÆ, WHOLE SPOTS, AND FACULÆ—*continued.*

Greenwich Civil Time.		Projected Area. Umbræ.	Whole Spots.	Faculæ.
1882.	d			
July	22·1	138	954	1647
	23·6	185	972	2802
	24·4	171	773	4668
	25·2	60	343	1596
	26·4	81	302	2880
	27·4	59	299	1726
	28·2	0	171	1228
	29·4	34	399	2441
	30·	...	...	...
	31·5	48	617	2021
Aug.	1·	...	...	...
	2·4	200	908	1922
	3·6	112	735	2369
	4·5	84	673	1349
	5·	...	...	...
	6·5	39	271	1843
	7·	...	...	...
	8·6	0	15	2257
	9·6	52	200	987
	10·4	89	646	1985
	11·6	263	1261	2913
	12·4	237	1118	3655
	13·	...	...	...
	14·5	138	648	1297
	15·5	132	548	1100
	16·6	42	271	736
	17·2	16	199	1975
	18·1	62	326	1339
	19·	...	...	...
	20·5	338	1663	4584
	21·5	433	1844	3775
	22·4	488	2505	1719
	23·5	458	2254	1796
	24·6	312	1813	812
	25·6	341	1457	881
	26·4	287	1133	2488
	27·4	123	943	1363
	28·	...	...	...
	29·4	158	616	1075
	30·6	43	339	1173
	31·4	21	185	2031
Sept.	1·3	58	267	2230
	2·4	311	1243	1723
	3·6	336	1260	1719
	4·5	405	1667	1568
	5·3	775	2997	1000
	6·5	399	2118	2471
	7·4	404	1416	1286
	8·4	170	698	1341
	9·5	133	514	2591
	10·	...	...	...
	11·4	27	247	2981
	12·5	42	239	3452
	13·5	84	482	1369
	14·	...	...	...
	15·4	194	1055	2036
	16·2	85	926	1934
	17·	...	...	...
	18·4	341	1468	1399
	19·1	162	1134	3959
	20·4	216	958	779

Greenwich Civil Time.		Projected Area. Umbræ.	Whole Spots.	Faculæ.
1882.	d			
Sept.	21·3	107	874	1206
	22·6	185	788	1896
	23·2	98	666	1265
	24·2	84	417	1626
	25·6	269	1995	1107
	26·4	428	1691	3146
	27·4	510	2294	3381
	28·4	732	2712	3583
	29·2	527	3147	2264
	30·4	778	3694	1067
Oct.	1·5	927	3948	1170
	2·6	854	3561	2646
	3·4	878	3121	2713
	4·1	450	2633	1778
	5·3	300	1805	1673
	6·1	260	1107	1934
	7·5	45	269	980
	8·5	28	85	2419
	9·4	7	38	1845
	10·2	17	116	899
	11·2	22	147	1007
	12·2	34	259	1584
	13·4	115	519	1579
	14·3	92	783	2164
	15·2	130	849	2096
	16·2	118	1165	2523
	17·3	250	1204	716
	18·3	273	1786	751
	19·3	264	1855	965
	20·5	523	2165	1495
	21·2	338	1745	1469
	22·6	369	1934	2548
	23·5	762	2988	3279
	24·2	391	2653	5105
	25·5	587	3032	1997
	26·5	657	2914	2496
	27·3	452	2554	3476
	28·2	373	2541	2208
	29·6	749	3174	564
	30·2	458	2567	1239
	31·4	611	2714	2909
Nov.	1·6	509	2161	2595
	2·4	401	1864	2067
	3·4	224	1473	1687
	4·4	253	1568	1667
	5·2	338	1663	3250
	6·4	295	1828	2278
	7·2	300	1663	5679
	8·6	461	1996	2358
	9·4	449	2230	1759
	10·6	534	1571	1351
	11·5	594	2421	2101
	12·2	294	1888	1993
	13·2	483	2307	1820
	14·2	609	2887	1662
	15·2	807	3342	2445
	16·1	873	4005	1563
	17·3	784	4640	2507
	18·5	1649	5422	3129
	19·6	1324	5370	1478

Greenwich Civil Time.		Projected Area. Umbræ.	Whole Spots.	Faculæ.
1882.	d			
Nov.	20·4	756	4229	1840
	21·5	528	3261	485
	22·3	367	3441	2575
	23·4	337	2853	2749
	24·5	474	2158	2139
	25·4	478	1947	1997
	26·5	363	1665	1608
	27·5	453	2079	1368
	28·5	550	2292	3236
	29·2	275	1808	3110
	30·3	131	1533	2959
Dec.	1·2	132	1161	1600
	2·2	43	352	1851
	3·2	4	92	2783
	4·4	0	0	1486
	5·2	0	44	1108
	6·2	7	89	705
	7·2	31	117	1138
	8·2	36	172	792
	9·5	121	558	1112
	10·2	97	660	935
	11·2	78	747	1538
	12·3	119	818	1100
	13·4	144	745	1044
	14·3	40	607	76
	15·3	51	735	1283
	16·2	78	722	2186
	17·2	61	623	1851
	18·2	76	704	1131
	19·5	106	473	650
	20·4	58	393	1669
	21·5	52	229	2482
	22·5	77	304	1150
	23·5	38	122	0
	24·2	23	242	1134
	25·2	37	142	1838
	26·3	41	244	823
	27·2	48	226	1770
	28·2	64	388	1756
	29·3	88	431	2863
	30·2	196	802	3310
	31·2	303	1461	4070
1883.				
Jan.	1·2	360	2020	4367
	2·4	644	2758	1337
	3·2	385	2475	2549
	4·2	331	2363	2448
	5·2	354	2196	2020
	6·5	300	1500	1073
	7·2	145	1014	2086
	8·4	53	337	558
	9·4	82	329	1357
	10·3	106	713	2984
	11·2	102	629	2280
	12·2	134	803	2805
	13·2	177	1267	2042
	14·2	248	1631	2571
	15·5	284	1630	77
	16·6	400	2439	1436
	17·2	239	2342	2517

Greenwich Civil Time.		Projected Area. Umbræ.	Whole Spots.	Faculæ.
1883.	d			
Jan.	18·2	234	2297	2112
	19·2	364	2121	766
	20·	...	...	...
	21·2	150	927	1202
	22·4	135	726	1897
	23·4	74	390	582
	24·	...	...	...
	25·	...	...	...
	26·4	93	464	2908
	27·2	69	515	1094
	28·2	57	405	2376
	29·2	90	502	1827
	30·4	83	514	899
	31·4	55	295	324
Feb.	1·2	124	576	1141
	2·2	123	654	1915
	3·4	147	846	1243
	4·5	157	782	263
	5·6	186	816	648
	6·5	292	1235	2409
	7·2	222	1497	4074
	8·2	190	1535	2569
	9·5	373	2234	1744
	10·2	229	1929	1451
	11·5	288	1777	974
	12·2	204	1856	1183
	13·4	307	2154	2226
	14·2	211	1943	2639
	15·2	202	2178	2191
	16·6	382	1677	1388
	17·3	246	1499	2498
	18·2	195	1224	3316
	19·2	122	1119	1795
	20·2	93	644	2088
	21·2	56	445	2928
	22·2	43	365	1713
	23·5	0	0	212
	24·2	0	55	920
	25·2	9	63	1871
	26·5	69	318	1264
	27·6	53	372	733
	28·5	55	316	753
March	1·2	36	221	268
	2·6	32	88	692
	3·5	0	38	250
	4·5	0	20	1365
	5·5	0	0	1029
	6·4	0	0	940
	7·5	27	125	595
	8·6	37	255	1262
	9·4	86	184	2111
	10·4	28	360	2189
	11·	...	...	...
	12·6	72	819	1621
	13·4	189	1044	1197
	14·2	122	976	1390
	15·4	196	923	453
	16·5	151	1102	2241
	17·4	186	1167	2079
	18·2	136	1301	2383

TOTAL PROJECTED AREAS OF UMBRÆ, WHOLE SPOTS, AND FACULÆ—*continued.*

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.
1883. d				1883. d				1883. d				1883. d			
March 19·2	133	1083	1792	May 16·5	181	948	540	July 13·4	364	2648	1903	Sept. 9·6	308	1671	1079
20·2	126	1195	1574	17·4	246	1099	307	14·	...	...	...	10·4	275	1666	1291
21·2	125	1246	1251	18·5	137	777	417	15·5	470	2532	1527	11·	...	...	...
22·6	259	1738	1457	19·5	113	684	686	16·2	256	2116	997	12·5	429	2355	2832
23·5	238	1711	339	20·1	66	456	2795	17·	...	...	...	13·5	517	2698	1861
24·5	283	1978	290·	21·4	30	160	1082	18·	...	...	...	14·4	597	3027	2258
25·6	197	1231	763	22·4	0	12	542	19·6	623	3841	5326	15·5	616	2929	118
26·5	158	1137	1314	23·4	18	109	316	20·2	434	3849	3292	16·5	572	2621	589
27·4	51	743	800	24·5	0	48	1395	21·5	638	4358	3569	17·4	418	2353	665
28·4	144	967	647	25·4	0	36	926	22·	...	...	...	18·5	349	1879	2811
29·4	169	1374	1556	26·	...	...	...	23·	...	...	...	19·5	174	1351	2325
30·2	241	1562	2382	27·6	0	0	68	24·4	783	5053	4269	20·3	154	1031	792
31·6	289	1640	2746	28·4	0	0	156	25·6	752	4548	2036	21·2	105	624	636
				29·4	0	8	231	26·4	508	2710	1167	22·3	73	610	1438
				30·6	9	31	58	27·4	544	2917	1090	23·5	70	302	1300
April 1·5	287	1929	304	31·4	26	185	167	28·4	456	2560	1892	24·6	0	0	382
2·4	328	2065	641					29·4	307	1695	2085	25·4	0	0	667
3·4	351	2203	1150					30·	...	...	...	26·6	0	48	444
4·1	319	1823	1264	June 1·4	104	482	257	31·5	207	1393	827	27·4	19	80	808
5·6	405	2403	2331	2·5	399	2024	1309					28·4	42	226	542
6·4	347	2546	1703	3·4	385	2349	1795					29·4	33	256	983
7·5	138	1359	551	4·4	470	2956	690	Aug. 1·4	83	564	986	30·1	39	274	764
8·6	234	1214	760	5·4	340	2199	180	2·2	39	279	1622				
9·4	200	1125	1745	6·4	227	1743	1204	3·6	20	91	274				
10·6	136	847	1183	7·1	150	1355	1614	4·	...	...	...	Oct. 1·5	28	227	592
11·1	75	529	1332	8·6	227	1103	566	5·	...	...	...	2·6	68	536	1193
12·4	288	1507	1084	9·4	64	748	0	6·	...	...	...	3·3	90	520	936
13·3	321	2550	2910	10·1	48	492	1061	7·4	40	191	1347	4·3	93	677	644
14·2	391	3339	4858	11·1	28	474	860	8·3	95	1119	5201	5·5	150	663	982
15·	...	...	...	12·5	87	724	966	9·4	31	315	1100	6·5	180	922	1602
16·5	551	2971	1639	13·4	111	1169	571	10·4	39	576	2106	7·3	186	1126	1662
17·1	421	3331	1219	14·5	174	1315	1029	11·4	114	657	804	8·1	279	1436	1927
18·4	274	3432	591	15·4	74	998	1487	12·5	156	825	547	9·3	368	2190	2145
19·1	369	2970	1349	16·5	70	681	576	13·4	139	818	1093	10·5	677	3585	2548
20·5	165	1632	0	17·4	88	670	830	14·4	122	798	1038	11·2	543	3926	2191
21·4	222	1402	0	18·6	197	1132	731	15·4	84	482	1595	12·2	628	4171	2001
22·4	138	1337	715	19·2	111	1119	2480	16·5	118	513	4256	13·4	1091	5399	2121
23·6	117	677	1410	20·6	358	2040	1161	17·1	70	600	3469	14·5	1569	7382	3559
24·6	104	431	1284	21·4	497	2572	1662	18·4	125	696	4043	15·4	1145	6142	4012
25·5	207	816	1145	22·2	308	2731	1907	19·4	78	504	1410	16·5	701	4546	2750
26·4	120	704	1100	23·4	496	3021	2066	20·4	70	394	366	17·4	499	3335	5351
27·2	92	482	1330	24·2	231	3605	2014	21·4	88	629	851	18·4	376	2601	1683
28·2	102	520	926	25·6	434	2895	1830	22·4	86	870	1177	19·3	358	2555	2455
29·1	121	496	2270	26·4	392	3020	977	23·4	175	1048	1590	20·5	370	2355	1056
30·5	49	313	505	27·4	590	3798	1339	24·4	172	1119	504	21·5	386	2105	870
				28·4	664	4429	1589	25·4	182	1004	2874	22·5	321	1692	1611
				29·4	1003	5089	517	26·5	244	1196	425	23·2	214	1338	2544
May 1·4	35	297	791	30·4	925	5296	288	27·4	155	1224	704	24·3	173	967	3003
2·2	42	208	2172					28·4	503	1762	308	25·4	125	1273	1209
3·4	10	192	754					29·	...	...	...	26·3	132	1497	1740
4·5	15	139	296	July 1·4	766	4111	181	30·5	447	2728	1039	27·5	271	2057	1266
5·5	17	142	729	2·1	468	3826	3029	31·3	480	3057	1554	28·6	315	2147	1805
6·4	20	169	1671	3·2	472	3336	1790					29·6	361	2209	1693
7·1	38	337	2209	4·5	500	2856	1085					30·3	396	1531	2800
8·1	88	493	1145	5·4	411	2228	1184	Sept. 1·4	546	3194	382	31·3	461	2648	2842
9·1	124	828	1540	6·4	313	1669	1093	2·	...	...	...				
10·1	103	789	1564	7·5	147	1473	603	3·4	632	3381	986				
11·4	173	1025	1216	8·	...	...	...	4·4	514	3072	1455	Nov. 1·3	302	2495	2470
12·2	169	932	3898	9·6	152	1201	792	5·5	472	2830	1141	2·3	245	1990	3435
13·5	192	1267	697	10·6	236	1485	696	6·	...	...	...	3·2	312	1936	2975
14·2	89	1207	1607	11·5	316	1993	2437	7·1	269	1879	245	4·3	304	1832	4549
15·4	187	918	603	12·3	209	2090	1701	8·5	334	1823	2072	5·4	339	1811	2132

TOTAL PROJECTED AREAS OF UMBRÆ, WHOLE SPOTS, AND FACULÆ—*continued.*

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.
1883. d				1884. d				1884. d				1884. d			
Nov. 6·3	253	1568	2708	Jan. 4·4	75	961	2157	March 2·6	373	2377	2195	May 1·3	184	2095	1353
7·2	149	1152	2534	5·3	147	1643	3053	3·3	230	2152	1906	2·4	168	1208	1335
8·2	98	723	2273	6·2	242	2515	2963	4·	...	...	...	3·6	29	886	134
9·5	164	1156	1183	7·2	388	3406	3197	5·5	349	2039	2362	4·5	39	641	367
10·5	383	1830	1380	8·3	348	3633	3445	6·3	187	2021	1683	5·4	50	846	238
11·	...	...	...	9·3	337	3531	2210	7·5	299	1691	1237	6·4	27	589	393
12·5	524	2441	1400	10·3	425	4246	1840	8·	...	...	...	7·2	54	642	2493
13·5	382	3094	654	11·5	781	4351	566	9·5	306	2132	793	8·3	35	299	1351
14·6	600	3584	605	12·5	411	3302	959	10·6	315	2256	1052	9·5	94	974	457
15·6	897	4701	1516	13·2	461	2713	3319	11·2	183	1994	2276	10·	...	...	...
16·2	591	4543	2291	14·3	163	1944	2321	12·6	288	1616	316	11·2	323	2328	1848
17·5	805	4523	944	15·2	232	1778	2461	13·	...	...	...	12·3	279	2344	1985
18·2	548	4188	1882	16·	...	...	...	14·6	234	1762	915	13·2	316	2020	1412
19·5	651	4050	3655	17·3	279	2303	4739	15·5	423	2677	1233	14·3	292	1847	825
20·4	560	3864	3096	18·4	330	2326	3502	16·4	316	2366	676	15·3	245	1597	1416
21·4	447	2760	1663	19·3	278	2164	2967	17·5	376	2146	1097	16·3	322	1542	2725
22·4	402	2705	1304	20·5	425	2272	4490	18·4	348	2318	2551	17·3	227	1687	2769
23·5	317	2562	3309	21·4	311	2215	960	19·5	338	2251	1374	18·1	292	1712	1866
24·4	233	2209	2046	22·3	226	1894	2606	20·4	326	2172	1229	19·3	316	2014	3309
25·2	132	1574	1849	23·1	229	1574	2241	21·5	335	1839	2696	20·	...	...	...
26·5	173	908	1933	24·5	239	1345	825	22·2	315	1949	3150	21·3	282	1591	2648
27·5	142	854	904	25·4	189	1574	1667	23·6	289	1785	1327	22·3	314	1793	2270
28·5	154	803	1225	26·	...	...	...	24·3	225	1739	2326	23·3	300	1797	1768
29·4	149	891	700	27·5	430	1844	7019	25·3	288	1562	1964	24·6	204	1803	260
30·3	176	1236	2406	28·5	498	2618	2195	26·3	203	1291	2568	25·1	357	1989	1530
				29·4	278	2128	3248	27·3	178	978	2027	26·2	280	1953	2062
				30·3	252	2243	1958	28·3	116	815	2505	27·1	361	1952	3277
Dec. 1·	...	...	...	31·3	269	2668	3528	29·3	66	712	2898	28·3	375	2395	2581
2·2	107	717	2086					30·2	42	509	1418	29·2	397	2363	1734
3·	...	...	...					31·3	54	614	2916	30·6	113	1832	1484
4·4	29	207	842	Feb. 1·4	515	3287	4176					31·2	202	1942	1875
5·5	0	0	1205	2·3	317	2783	1801								
6·5	14	180	597	3·	...	...	...	April 1·3	129	810	2439	June 1·2	229	1831	1789
7·6	73	400	1270	4·5	580	3189	1068	2·4	222	2177	755	2·	...	...	...
8·3	78	620	1537	5·2	315	2713	1609	3·2	562	3431	2969	3·2	186	1402	3193
9·2	85	764	1299	6·2	333	2682	2342	4·5	415	3907	1676	4·3	120	1241	2369
10·3	147	1314	1426	7·4	309	2368	2199	5·4	499	4047	5055	5·	...	...	...
11·5	480	2219	2705	8·3	264	1858	1983	6·2	467	3474	3588	6·2	238	1288	1024
12·3	295	1942	3210	9·2	165	1498	3260	7·3	279	2426	1057	7·2	198	1137	827
13·5	393	2464	2317	10·5	312	1735	4233	8·3	310	2385	3645	8·	...	...	...
14·3	260	1883	1408	11·4	302	1604	4469	9·6	279	2034	707	9·	...	...	...
15·5	170	1156	597	12·5	240	1521	973	10·6	261	2091	838	10·	...	...	...
16·5	165	1045	557	13·4	314	1862	3460	11·3	335	2302	2765	11·4	58	525	1094
17·3	125	1185	3223	14·6	580	2478	3093	12·	...	...	...	12·5	95	614	488
18·3	97	782	2648	15·5	453	2577	2404	13·4	108	1255	2423	13·1	95	592	1298
19·3	115	1026	4653	16·5	416	2246	2388	14·3	86	864	3191	14·6	87	602	703
20·3	164	1728	5646	17·	...	...	...	15·3	97	716	2884	15·4	103	594	501
21·5	384	2751	2631	18·4	397	2263	4002	16·4	105	764	1817	16·6	61	561	0
22·3	371	3721	2666	19·	...	...	...	17·3	187	920	558	17·	...	...	...
23·2	568	4467	2749	20·5	289	1868	2139	18·3	184	1275	2830	18·	...	...	...
24·3	545	4401	1520	21·5	196	1606	192	19·5	157	1696	1166	19·	...	...	...
25·2	547	4778	1998	22·3	150	1626	1331	20·2	202	1892	2826	20·6	64	566	0
26·2	730	4348	2229	23·4	231	1455	1695	21·5	186	1476	930	21·5	43	325	0
27·2	587	3659	2145	24·5	225	1576	3619	22·6	319	2135	390	22·1	51	552	871
28·2	518	2927	2606	25·5	289	1364	3735	23·4	251	2811	1118	23·4	39	362	0
29·2	402	2523	3946	26·5	360	1853	3980	24·4	370	2801	803	24·5	18	213	149
				27·2	205	1543	2529	25·3	511	2695	2662	25·6	16	300	0
				28·	...	...	...	26·5	450	2945	172	26·5	0	366	330
1884.				29·6	422	2460	3726	27·2	446	2918	1689	27·5	49	538	799
Jan. 1·	...	...	...					28·	...	...	...	28·4	72	627	435
2·2	87	820	3205					29·5	233	2443	191	29·4	85	846	394
3·1	66	773	2009	March 1·4	305	2469	4539	30·4	141	2322	77	30·5	165	1287	1239

TOTAL PROJECTED AREAS OF UMBRÆ, WHOLE SPOTS, AND FACULÆ—*continued.*

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.
1884. d				1884. d				1884. d				1884. d			
July 1·	...	...	...	Aug. 30·	...	...	...	Oct. 27·4	286	2104	1035	Dec. 24·3	266	1901	1556
2·	...	...	...	31·	...	...	...	28·3	255	1872	1697	25·2	283	2331	2799
3·3	156	1356	1613					29·6	332	1876	468	26·3	250	1819	1387
4·2	417	2457	1713					30·4	267	1701	895	27·2	200	1838	2601
5·4	259	2061	2537	Sept. 1·	...	..	...	31·4	293	1621	2665	28·2	253	1512	2097
6·	...	...	...	2·4	0	205	393					29·2	174	1227	1700
7·	...	...	...	3·4	0	127	1139					30·2	112	925	2174
8·3	70	584	1260	4·2	9	101	1412	Nov. 1·2	266	1341	3706	31·3	72	734	1968
9·2	115	620	1333	5·4	0	41	555	2·2	86	656	2388				
10·2	56	474	1509	6·3	21	282	1113	3·4	34	244	827				
11·2	49	374	1106	7·7	125	560	2157	4·6	30	197	771	1885.			
12·3	136	635	1504	8·4	81	636	1107	5·4	18	116	2173	Jan. 1·2	36	434	1750
13·	...	...	...	9·2	115	1061	1384	6·3	21	110	1675	2·3	58	339	2980
14·	...	...	...	10·5	196	1634	1723	7·4	8	40	542	3·2	118	488	1740
15·	...	...	...	11·5	288	1927	2144	8·5	0	0	783	4·2	83	454	3803
16·	...	...	...	12·4	473	2503	1702	9·2	0	15	2785	5·2	40	525	1915
17·	...	...	...	13·4	498	2804	1060	10·5	96	640	1179	6·5	5	127	0
18·	...	...	...	14·	...	...	...	11·3	167	1078	2605	7·5	0	70	0
19·2	19	310	1649	15·4	492	2937	1462	12·3	189	1269	2978	8·5	0	59	0
20·4	44	296	1450	16·5	340	2383	1903	13·2	157	1101	2826	9·5	0	35	41
21·	...	...	...	17·4	429	2415	3305	14·5	73	778	322	10·3	4	40	1917
22·	...	...	...	18·4	348	1763	1488	15·5	26	315	0	11·	...	...	...
23·	...	...	...	19·6	293	1848	944	16·2	38	254	1995	12·5	11	99	1943
24·4	111	704	1118	20·4	297	1925	1443	17·3	17	176	1150	13·5	46	167	945
25·5	124	682	612	21·4	248	1806	1714	18·3	30	213	2633	14·2	30	161	1716
26·5	124	856	1171	22·5	300	1980	1459	19·5	80	417	1049	15·2	36	104	2372
27·2	96	743	1140	23·4	309	1932	1775	20·3	64	724	3078	16·3	18	145	1007
28·	...	...	...	24·6	232	1705	1289	21·3	132	713	1661	17·2	27	262	1238
29·	...	...	...	25·5	304	2098	1091	22·2	113	834	1161	18·2	40	475	2650
30·	...	...	...	26·	...	...	...	23·2	134	996	1623	19·	...	...	...
31·4	153	1270	1132	27·2	264	1652	2886	24·3	141	1216	884	20·2	350	2019	2211
				28·	...	...	...	25·3	168	1052	1385	21·2	313	2223	3328
				29·	...	...	...	26·3	98	959	2584	22·2	322	1890	3073
Aug. 1·4	289	2259	1790	30·5	259	1568	1497	27·	...	...	...	23·4	224	1855	724
2·4	297	1996	1557					28·3	98	701	2847	24·2	282	1289	1874
3·6	363	1842	1118					29·5	102	581	832	25·5	148	923	220
4·3	244	1954	624	Oct. 1·	...	...	...	30·	...	...	...	26·2	165	1090	2660
5·5	68	822	1234	2·4	265	1602	1838					27·5	165	1191	705
6·5	56	550	1273	3·5	367	2042	2088					28·2	224	1398	2311
7·5	28	332	554	4·4	326	1961	1051	Dec. 1·2	156	1622	2513	29·1	246	1345	2650
8·5	69	535	1108	5·1	346	2146	2937	2·3	218	1575	1479	30·6	149	1076	0
9·4	60	533	712	6·3	308	1801	3509	3·3	231	1476	857	31·2	304	1344	2521
10·6	127	729	349	7·5	337	1980	1667	4·5	239	1440	403				
11·5	76	834	756	8·5	381	1979	433	5·5	202	1338	685				
12·6	78	738	1014	9·5	194	1922	350	6·3	156	1324	2482	Feb. 1·4	322	1492	1958
13·5	138	1101	1333	10·3	207	1579	1953	7·4	128	995	873	2·5	217	1478	0
14·4	96	962	1511	11·2	197	1538	2474	8·3	117	863	1825	3·2	293	1906	1300
15·5	82	756	1007	12·2	142	1126	3181	9·2	136	848	2374	4·4	286	2238	243
16·4	47	427	1221	13·4	71	711	1313	10·3	155	961	1495	5·5	336	1825	276
17·5	61	428	449	14·5	10	363	2025	11·3	124	979	1765	6·2	313	1713	1076
18·6	54	372	1149	15·2	39	306	3001	12·3	96	791	905	7·5	258	1785	373
19·	...	...	...	16·2	36	344	1406	13·6	117	699	1589	8·2	328	2353	902
20·4	54	565	969	17·2	14	263	355	14·4	93	582	2157	9·5	322	2076	1812
21·4	191	970	1707	18·4	66	458	971	15·3	65	346	1998	10·5	308	1809	1261
22·4	217	1384	1856	19·5	21	313	422	16·5	64	456	350	11·2	180	1825	2868
23·4	112	983	1098	20·2	63	330	1166	17·2	108	763	2329	12·5	265	1642	1620
24·5	69	1044	1277	21·2	83	443	1239	18·2	108	805	2159	13·3	262	1608	1945
25·2	218	1225	666	22·5	90	908	1501	19·5	118	1351	149	14·3	256	1849	1651
26·4	94	1457	1186	23·5	191	1238	2580	20·2	175	1439	939	15·2	297	2105	737
27·2	272	1838	1768	24·	...	...	...	21·5	320	1812	1054	16·2	336	2591	1640
28·4	191	1317	2066	25·5	572	2676	1131	22·5	351	2154	1455	17·4	432	2498	743
29·5	165	1635	500	26·5	550	2755	653	23·	...	...	...	18·5	272	2026	0

TOTAL PROJECTED AREAS OF UMBRÆ, WHOLE SPOTS, AND FACULÆ—*continued.*

Greenwich Civil Time.		Projected Area.		
		Umbræ.	Whole Spots.	Faculæ.
1885.	d			
Feb.	19·1	240	1870	1356
	20·2	240	1292	4137
	21·4	157	925	1215
	22·2	128	1051	2199
	23·5	77	671	926
	24·5	62	538	1337
	25·2	25	414	1610
	26·2	33	196	1078
	27·2	54	283	2481
	28·2	106	760	3067
March	1·4	155	1222	1566
	2·6	147	1609	1119
	3·2	291	1749	896
	4·5	402	2744	673
	5·6	244	3252	726
	6·2	470	3235	1595
	7·5	346	2737	1293
	8·2	324	2668	2967
	9·5	178	1389	4180
	10·5	114	1016	1716
	11·5	100	993	2795
	12·4	150	986	1503
	13·5	207	1074	1404
	14·3	139	997	1816
	15·5	130	991	658
	16·3	85	785	1110
	17·4	88	527	502
	18·5	42	384	950
	19·4	22	261	760
	20·6	11	127	1265
	21·2	27	76	2177
	22·2	2	21	2169
	23·4	0	0	303
	24·4	2	35	0
	25·4	10	99	412
	26·5	27	390	916
	27·5	58	575	1258
	28·5	114	870	1303
	29·2	119	874	1089
	30·4	77	748	0
	31·4	139	1019	49
April	1·4	175	964	553
	2·4	68	1069	64
	3·4	88	886	0
	4·4	113	1091	261
	5·5	129	1261	227
	6·2	264	1445	3788
	7·4	166	1477	284
	8·2	210	2104	2321
	9·2	271	2614	1844
	10·1	430	3081	1022
	11·5	306	2521	393
	12·2	229	2445	968
	13·3	206	2165	1559
	14·5	96	1070	337
	15·5	70	612	311
	16·2	72	524	1937
	17·4	40	458	1268

Greenwich Civil Time.		Projected Area.		
		Umbræ.	Whole Spots.	Faculæ.
1885.	d			
April	18·4	36	402	238
	19·5	40	376	90
	20·4	59	443	1118
	21·4	78	588	1879
	22·4	101	850	1999
	23·4	107	925	1685
	24·2	83	789	825
	25·4	116	794	1846
	26·5	112	782	1180
	27·4	120	883	1363
	28·4	190	1186	979
	29·3	196	1306	1472
	30·4	143	1465	1156
May	1·4	199	1594	2341
	2·4	194	1694	1620
	3·6	163	1551	1420
	4·5	135	1801	2197
	5·2	330	1910	2241
	6·5	302	2271	1295
	7·5	214	2128	1805
	8·4	312	2240	1370
	9·4	191	1763	1569
	10·5	62	1081	638
	11·4	70	870	295
	12·4	62	615	1213
	13·	...	...	...
	14·4	29	223	498
	15·4	17	139	515
	16·4	15	172	802
	17·5	12	208	580
	18·4	80	589	591
	19·4	95	896	575
	20·5	351	2030	1895
	21·6	362	2432	2897
	22·5	450	2745	1323
	23·4	349	2614	1796
	24·4	382	2857	2221
	25·	...	...	...
	26·3	377	2514	2644
	27·4	220	2009	2345
	28·5	128	1117	3208
	29·4	71	895	3671
	30·4	64	507	2414
	31·2	86	603	3144
June	1·4	100	894	1570
	2·4	147	1413	956
	3·4	162	1853	1436
	4·4	288	2063	1932
	5·4	193	2045	408
	6·2	374	2299	1566
	7·4	287	2187	1094
	8·3	520	2642	1932
	9·2	491	2553	2479
	10·4	295	2443	470
	11·4	288	2195	282
	12·4	357	2375	2121
	13·4	190	1915	512
	14·5	163	1567	1562

Greenwich Civil Time.		Projected Area.		
		Umbræ.	Whole Spots.	Faculæ.
1885.	d			
June	15·5	188	1811	2508
	16·4	324	2536	2223
	17·2	403	3030	2537
	18·5	370	3434	366
	19·5	381	3339	252
	20·4	329	3980	651
	21·5	377	4483	219
	22·4	300	3921	933
	23·4	399	3504	2314
	24·4	164	2771	2419
	25·3	117	2015	2767
	26·	...	...	...
	27·4	97	1551	314
	28·4	207	1635	652
	29·6	120	1726	470
	30·4	148	2107	953
July	1·5	250	2281	1715
	2·4	246	2571	2158
	3·5	205	1761	1633
	4·5	216	1522	780
	5·3	335	1656	3413
	6·5	320	2113	1187
	7·5	197	2669	752
	8·4	292	2355	1123
	9·5	206	1975	2382
	10·4	166	2883	3874
	11·4	82	1244	1828
	12·2	184	1003	3206
	13·5	188	1338	1834
	14·5	186	1542	1798
	15·5	153	1664	907
	16·5	126	1678	1102
	17·5	251	2068	1583
	18·2	429	2177	1877
	19·6	246	1709	1743
	20·6	181	1657	2163
	21·5	154	1588	1094
	22·5	102	1462	711
	23·4	234	1508	1168
	24·5	186	1361	1275
	25·6	205	1046	673
	26·5	88	986	669
	27·4	151	839	1024
	28·4	169	870	3600
	29·5	51	619	2730
	30·5	56	556	1642
	31·5	33	581	690
Aug.	1·4	103	642	776
	2·5	84	577	1169
	3·2	57	491	1193
	4·4	18	387	585
	5·5	65	560	1849
	6·4	48	516	468
	7·5	103	817	3037
	8·4	138	1191	3323
	9·2	190	1281	1319
	10·5	213	1528	934
	11·5	190	1644	2267

Greenwich Civil Time.		Projected Area.		
		Umbræ.	Whole Spots.	Faculæ.
1885.	d			
Aug.	12·4	137	1254	1446
	13·4	151	1225	963
	14·5	123	1017	649
	15·4	109	800	718
	16·4	106	899	1817
	17·4	78	690	925
	18·2	171	709	2679
	19·5	141	627	2180
	20·5	79	566	1055
	21·5	72	346	1563
	22·5	58	353	200
	23·2	82	477·	1185
	24·6	47	555	1867
	25·5	37	518	900
	26·5	43	514	891
	27·5	99	753	313
	28·5	40	965	577
	29·4	99	1202	587
	30·	...	...	...
	31·	...	...	...
Sept.	1·4	157	1969	433
	2·4	314	2580	1854
	3·4	147	1678	1281
	4·5	93	1273	185
	5·4	153	1301	287
	6·4	57	734	873
	7·3	142	770	1749
	8·4	66	557	870
	9·4	91	673	564
	10·3	196	948	2453
	11·2	229	954	1682
	12·2	154	1187	413
	13·2	194	1377	586
	14·6	128	1332	459
	15·4	95	816	734
	16·6	96	802	738
	17·2	139	743	1969
	18·5	62	468	1324
	19·2	45	412	891
	20·6	0	5	228
	21·4	12	189	807
	22·4	54	386	396
	23·4	21	262	345
	24·6	4	246	0
	25·4	80	754	959
	26·4	80	935	370
	27·1	238	1064	751
	28·5	121	952	579
	29·2	165	1031	1144
	30·2	146	709	1588
Oct.	1·4	70	791	1439
	2·2	201	1068	2482
	3·4	121	1118	1408
	4·6	172	1124	366
	5·2	268	1481	525
	6·4	202	1472	363
	7·4	216	1474	435

TOTAL PROJECTED AREAS OF UMBRÆ, WHOLE 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.
1885. d				1885. d				1885. d				1885. d			
Oct. 8·2	254	1327	1610	Oct. 30·2	201	1306	1833	Nov. 19·2	166	1439	1002	Dec. 10·5	4	52	118
9·4	130	1000	69	31·2	192	1184	1426	20·1	217	1074	657	11·4	25	148	761
10·4	141	955	1950					21·5	104	726	530	12·2	33	259	853
11·2	148	769	2342					22·2	104	645	1318	13·2	50	374	896
12·3	32	306	119	Nov. 1·4	72	729	671	23·2	76	400	1467	14·2	48	324	1222
13·2	15	121	1527	2·4	70	542	95	24·2	15	216	1357	15·5	49	280	0
14·2	4	28	850	3·1	95	545	1163	25·2	0	0	403	16·5	53	275	0
15·4	0	0	222	4·1	92	455	1157	26·3	0	32	638	17·2	49	268	791
16·4	0	0	754	5·1	75	325	581	27·5	0	0	246	18·2	35	201	990
17·2	5	133	1589	6·1	72	372	1568	28·2	13	52	411	19·1	68	303	827
18·1	84	414	1697	7·1	67	314	945	29·1	4	27	438	20·2	74	396	839
19·4	58	741	972	8·1	48	228	873	30·1	0	0	821	21·3	49	429	1920
20·5	73	715	1271	9·1	51	356	415					22·2	67	420	1797
21·3	91	826	1424	10·1	124	728	1102	Dec. 1·5	0	0	296	23·1	73	426	1278
22·4	129	1064	1166	11·1	88	776	1223	2·5	2	77	113	24·5	78	592	931
23·2	184	1299	1532	12·1	77	565	1541	3·2	20	147	528	25·1	123	711	898
24·2	265	1278	523	13·2	125	625	1838	4·6	0	51	256	26·1	121	647	463
25·6	108	1363	240	14·1	187	890	1134	5·3	1	68	177	27·1	126	746	371
26·3	226	1798	2430	15·5	197	1272	0	6·1	0	0	272	28·1	86	641	285
27·4	208	1666	2690	16·4	212	1534	287	7·2	0	0	443	29·5	54	423	88
28·4	126	1313	1329	17·5	238	1575	222	8·2	0	0	653	30·1	64	461	509
29·4	139	1274	1031	18·4	228	1514	545	9·2	3	28	675	31·2	50	383	731

MEAN PROJECTED AREAS of UMBRÆ, WHOLE SPOTS, and FACULÆ upon the SUN'S DISK, as measured on PHOTOGRAPHS taken at the ROYAL OBSERVATORY, GREENWICH, at DEHRA DÛN, INDIA, and in MAURITIUS, for each ROTATION of the SUN from 1882 January 5 to 1885 December 20.

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.

The rotations adopted in the following table 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 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 Projected Areas.		
			d		Umbræ.	Whole Spots.	Faculæ.
378	1882	January	4·77	22	89	506	1395
379		February	1·11	26	163	898	1626
380		February	28·45	27	262	1340	1901
381		March	27·76	27	425	2536	2708
382		April	24·03	26	442	2168	2671
383		May	21·26	27	143	790	1757
384		June	17·46	24	125	697	2270
385		July	14·66	23	117	691	2379
386		August	10·88	24	257	1195	1893
387		September	7·12	25	347	1627	2079
388		October	4·40	27	305	1591	1923
389		October	31·69	27	553	2664	2154
390		November	28·00	28	88	589	1498
391		December	25·32	26	224	1359	2238
392	1883	January	21·66	25	182	1160	1699
393		February	18·00	26	64	426	1354
394		March	17·33	28	220	1506	1369
395		April	13·62	26	151	1094	1277
396		May	10·86	26	137	833	889
397		June	7·07	27	335	2287	1227
398		July	4·27	20	421	2691	1937
399		July	31·47	25	109	716	1608
400		August	27·71	23	385	2124	1269
401		September	23·97	27	353	2044	1704
402		October	21·26	27	352	2179	2016
403		November	17·56	25	242	1653	1835
404		December	14·88	24	317	2584	2662
405	1884	January	11·22	25	346	2411	2591
406		February	7·56	23	307	1914	2792
407		March	5·89	25	247	1680	1787
408		April	2·19	25	292	2217	1941
409		April	29·45	26	208	1575	1426
410		May	26·68	19	162	1174	1321
411		June	22·88	17	101	789	1034
412		July	20·08	21	130	976	1074
413		August	16·30	24	127	947	1281
414		September	12·55	22	324	2011	1690
415		October	9·83	26	162	1041	1615
416		November	6·13	26	98	725	1670
417		December	3·44	26	170	1211	1588

MEAN PROJECTED AREAS OF UMBRÆ, WHOLE SPOTS, AND FACULÆ FROM 1882 TO 1885—*concluded.*

No. of Rotation.	Date of Commencement of each Rotation.			No. of Days on which Photographs were taken.	Mean of Daily Projected Areas.		
					Umbræ.	Whole Spots.	Faculæ.
418	1884	December	31·27	25	97	640	1683
419	1885	January	26·11	27	264	1715	1389
420		February	22·45	28	137	1094	1533
421		March	22·76	27	130	1141	841
422		April	18·04	26	139	1164	1331
423		May	15·27	27	242	1747	1717
424		June	12·47	26	252	2470	1415
425		July	9·67	27	146	1224	1584
426		August	5·89	25	108	897	1292
427		September	2·13	28	113	872	875
428		September	29·40	27	124	866	1144
429		October	26·70	27	132	888	1007
430		November	23·01	28	22	142	589

MEAN PROJECTED AREAS of UMBRÆ, WHOLE SPOTS, and FACULÆ upon the SUN'S DISK, as measured on PHOTOGRAPHS taken at the ROYAL OBSERVATORY, GREENWICH, at DEHRA DÚN, INDIA, and in MAURITIUS, for the years 1882, 1883, 1884, and 1885.

Year.	No. of Days on which Photographs were taken.	Mean of Daily Projected Areas.		
		Umbræ.	Whole Spots.	Faculæ.
1882	343	254	1326	2014
1883	340	249	1595	1598
1884	315	208	1478	1731
1885	358	145	1122	1241

For 1882.

UMBRÆ.

	No. of Obs.	Total Area as measured by M	Total Area as measured by H	$\frac{H}{M}$	$\sqrt{H} - \sqrt{M}$
Under 5 squares	17	59·7	54·8	0·918	− 0·080
Above 5 & under 10	11	87·4	75·9	0·868	− 0·193
Above 10 & under 20	6	94·1	81·3	0·864	− 0·279
Above 20 & under 40	2	57·0	51·0	0·895	− 0·289
Above 40 & under 80					
Above 80 squares....	4	926·0	867·0	0·936	− 0·493
Total & Means ..	40	30·61	28·25	0·897	− 0·193

WHOLE SPOTS.

	No. of Obs.	Total Area as measured by M	Total Area as measured by H	$\frac{H}{M}$	$\sqrt{H} - \sqrt{M}$
Under 10 squares....	18	88·2	88·9	1·007	+ 0·009
Above 10 & under 20	14	227·8	226·6	0·995	− 0·011
Above 20 & under 40	9	236·3	243·8	1·032	+ 0·080
Above 40 & under 100	12	785·0	732·3	0·933	− 0·276
Above 100 & under 200	6	755·0	800·5	1·060	+ 0·334
Above 200 & under 400	1	276·0	288·0	1·043	+ 0·358
Above 400 squares ..	4	5492·0	5464·0	0·995	− 0·009
Total & Means ..	64	122·82	122·56	0·999	− 0·004

FACULÆ.

	No. of Obs.	Total Area as measured by M	Total Area as measured by H	$\frac{H}{M}$	$\sqrt{H} - \sqrt{M}$
Under 50 squares....	14	459·0	480·0	1·046	+ 0·130
Above 50 & under 100	16	1173·0	1100·0	0·938	− 0·271
Above 100 & under 200	12	1721·0	1772·0	1·030	+ 0·176
Above 200 & under 400	5	1292·0	1212·0	0·938	− 0·506
Above 400 squares ..	5	2620·0	2032·0	0·776	− 2·732
Total & Means ..	52	139·71	126·85	0·973	− 0·319

For 1884.

		M	H	$\frac{H}{M}$	$\sqrt{H} - \sqrt{M}$
Under 5 squares	37	104·5	83·5	0·798	− 0·176
Above 5 & under 10	25	195·9	153·6	0·784	− 0·222
Above 10 & under 20	18	258·7	205·5	0·795	− 0·412
Above 20 & under 40	8	258·3	212·0	0·821	− 0·535
Above 40 & under 80	5	285·5	240·5	0·842	− 0·621
Above 80 squares....	3	305·0	258·5	0·848	− 0·800
Total & Means ..	96	14·66	12·02	0·800	− 0·305

		M	H	$\frac{H}{M}$	$\sqrt{H} - \sqrt{M}$
Under 10 squares....	46	231·7	215·3	0·929	− 0·082
Above 10 & under 20	23	306·1	289·6	0·946	− 0·099
Above 20 & under 40	19	667·2	583·5	0·875	− 0·385
Above 40 & under 100	30	2100·7	1962·0	0·934	− 0·281
Above 100 & under 200	6	797·0	759·0	0·952	− 0·278
Above 200 & under 400	7	1795·0	1733·0	0·966	− 0·279
Above 400 squares ..	6	2954·0	3079·0	1·042	+ 0·465
Total & Means ..	137	64·61	62·93	0·933	− 0·165

		M	H	$\frac{H}{M}$	$\sqrt{H} - \sqrt{M}$
Under 50 squares....	20	537·0	645·0	1·201	+ 0·497
Above 50 & under 100	14	955·0	1050·0	1·099	+ 0·401
Above 100 & under 200	21	2986·0	3148·0	1·054	+ 0·319
Above 200 & under 400	12	3715·0	3376·0	0·909	− 0·821
Above 400 squares ..	6	3700·0	3460·0	0·935	− 0·819
Total & Means ..	73	162·92	159·99	1·069	+ 0·103

For 1885.

		M	H	$\frac{H}{M}$	$\sqrt{H} - \sqrt{M}$
Under 5 squares	9	22·2	18·7	0·842	− 0·130
Above 5 & under 10	1	8·0	7·0	0·875	− 0·182
Above 10 & under 20	3	37·0	46·0	1·243	+ 0·405
Above 20 & under 40	1	27·0	23·0	0·852	− 0·400
Above 40 & under 80					
Above 80 squares....					
Total & Means ..	14	6·73	6·76	0·931	− 0·038

		M	H	$\frac{H}{M}$	$\sqrt{H} - \sqrt{M}$
Under 10 squares....	13	61·0	64·5	1·057	+ 0·061
Above 10 & under 20	3	38·7	41·0	1·059	+ 0·106
Above 20 & under 40	3	68·2	88·0	1·290	+ 0·649
Above 40 & under 100	5	322·0	326·0	1·012	+ 0·050
Above 100 & under 200	2	245·0	235·0	0·959	− 0·228
Above 200 & under 400					
Above 400 squares ..					
Total & Means ..	26	28·27	29·02	1·068	+ 0·110

		M	H	$\frac{H}{M}$	$\sqrt{H} - \sqrt{M}$
Under 50 squares....	9	261·0	357·0	1·368	+ 0·914
Above 50 & under 100	15	916·0	1050·0	1·146	+ 0·553
Above 100 & under 200	5	586·0	644·0	1·099	+ 0·523
Above 200 & under 400	2	450·0	530·0	1·178	+ 1·279
Above 400 squares ..					
Total & Means .	31	71·39	83·26	1·205	+ 0·700

For 1886.

UMBRÆ.

	No. of Obs.	Total Area as measured by M	Total Area as measured by H	$\frac{H}{M}$	$\sqrt{H} - \sqrt{M}$
Under 5 squares....	7	18·3	15·2	0·831	− 0·143
Above 5 & under 10	6	41·3	33·9	0·765	− 0·340
Above 10 & under 20					
Above 20 & under 40	1	25·0	27·0	1·080	+ 0·196
Above 40 & under 80	1	66·0	66·0	1·000	0·000
Above 80 squares....					
Total & Means ..	15	10·24	9·47	0·832	− 0·190

WHOLE SPOTS.

	No. of Obs.	Total Area as measured by M	Total Area as measured by H	$\frac{H}{M}$	$\sqrt{H} - \sqrt{M}$
Under 10 squares....	16	71·1	72·0	1·013	+ 0·014
Above 10 & under 20	8	121·5	109·0	0·897	− 0·205
Above 20 & under 40	6	165·3	177·0	1·071	+ 0·182
Above 40 & under 100	2	90·5	93·0	1·028	+ 0·092
Above 100 & under 200	1	122·0	122·0	1·000	0·000
Above 200 & under 400					
Above 400 squares..	1	406·0	414·0	1·020	+ 0·198
Total & Means ..	34	28·72	29·03	0·997	+ 0·002

FACULÆ.

	No. of Obs.	Total Area as measured by M	Total Area as measured by H	$\frac{H}{M}$	$\sqrt{H} - \sqrt{M}$
Under 50 squares....	12	283·0	353·0	1·247	+ 0·568
Above 50 & under 100	8	568·0	556·0	0·979	− 0·089
Above 100 & under 200	7	1050·0	845·0	0·805	− 1·260
Above 200 & under 400	1	220·0	180·0	0·81	− 1·416
Above 400 squares..					
Total & Means ..	28	75·75	69·07	1·045	− 0·148

For 1887.

UMBRÆ.

		M	H	$\frac{H}{M}$	$\sqrt{H} - \sqrt{M}$
Under 5 squares....	33	81·4	66·6	0·818	− 0·151
Above 5 & under 10	23	189·2	144·4	0·763	− 0·367
Above 10 & under 20	17	276·0	227·5	0·824	− 0·372
Above 20 & under 40	6	182·5	153·5	0·841	− 0·458
Above 40 & under 80	6	394·0	342·0	0·868	− 0·553
Above 80 squares....					
Total & Means ..	85	14·48	10·99	0·809	− 0·304

WHOLE SPOTS.

		M	H	$\frac{H}{M}$	$\sqrt{H} - \sqrt{M}$
Under 10 squares....	55	269·5	253·2	0·939	− 0·067
Above 10 & under 20	22	312·4	298·0	0·954	− 0·087
Above 20 & under 40	15	444·5	418·0	0·940	− 0·164
Above 40 & under 100	27	1812·0	1678·0	0·926	− 0·309
Above 100 & under 200	11	1401·0	1287·0	0·912	− 0·489
Above 200 & under 400	6	1866·0	1807·0	0·968	− 0·281
Above 400 squares..	2	1030·0	950·0	0·922	− 0·899
Total & Means ..	138	51·71	48·41	0·938	− 0·183

FACULÆ.

		M	H	$\frac{H}{M}$	$\sqrt{H} - \sqrt{M}$
Under 50 squares....	59	1574·0	1774·0	1·127	+ 0·317
Above 50 & under 100	22	1455·0	1532·0	1·053	+ 0·213
Above 100 & under 200	15	1929·0	1920·0	0·995	− 0·025
Above 200 & under 400	3	840·0	830·0	0·988	− 0·100
Above 400 squares..					
Total & Means ..	98	59·16	61·30	1·087	+ 0·232

For 1888.

UMBRÆ.

		M	H	$\frac{H}{M}$	$\sqrt{H} - \sqrt{M}$
Under 5 squares....	3	7·8	7·3	0·936	− 0·053
Above 5 & under 10	4	27·6	28·5	1·033	+ 0·043
Above 10 & under 20	6	106·0	72·5	0·684	− 0·728
Above 20 & under 40	1	26·0	27·0	1·038	+ 0·097
Above 40 & under 80					
Above 80 squares....					
Total & Means ..	14	11·96	9·60	0·263	− 0·304

WHOLE SPOTS.

		M	H	$\frac{H}{M}$	$\sqrt{H} - \sqrt{M}$
Under 10 squares....	13	75·2	90·3	1·201	+ 0·232
Above 10 & under 20	6	78·0	87·5	1·122	+ 0·214
Above 20 & under 40	2	67·0	60·0	0·896	− 0·311
Above 40 & under 100	6	378·0	369·0	0·976	− 0·095
Above 100 & under 200	4	530·0	484·0	0·913	− 0·511
Above 200 & under 400					
Above 400 squares..					
Total & Means ..	31	36·39	35·19	1·085	+ 0·034

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		M	H	$\frac{H}{M}$	$\sqrt{H} - \sqrt{M}$
Under 50 squares....	26	551·0	624·0	1·132	+ 0·296
Above 50 & under 100	18	1164·0	1187·0	1·020	+ 0·079
Above 100 & under 200	3	490·0	414·0	0·845	− 0·033
Above 200 & under 400	1	350·0	220·0	0·629	− 3·876
Above 400 squares..					
Total & Means ..	48	53·23	50·94	1·062	+ 0·107

GREENWICH

SPECTROSCOPIC AND PHOTOGRAPHIC RESULTS.

1888.