PHILOSOPHICAL TRANSACTIONS OF THE ROYAL SOCIETY A MATHEMATICAL, PHYSICAL & ENGINEERING SCIENCES

Determinations of Wave-Length from Spectra Obtained at the Total Solar Eclipses of 1900, 1901 and 1905

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Phil. Trans. R. Soc. Lond. A 1906 **206**, 403-452
doi: 10.1098/rsta.1906.0022

VIII. *Determinations of Wave-length from Spectra Obtained at the Total Solar Eclipses of* 1900, 1901 *and* 1905.

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Received April 25,—Read May 17, 1906.

[Plate 9.]

The following paper consists of a discussion of the photographs of the spectra of the chromosphere and corona obtained in three eclipse expeditions from the Royal Observatory, Greenwich. Preliminary reports of the expeditions of 1900 and 1905, where I was one of Sir William Christie's party, are given in the 'Proceedings,' vol. 67, p. 393, and A, vol. 77, p. 28, and a preliminary report of the expedition to Sumatra in 1901 is given by me in the 'Proceedings,' vol. 69, p. 235. For these eclipse expeditions two spectroscopes were kindly lent by Major Hills, the same spectroscopes he used for photographing the chromosphere and corona at the Indian eclipse of 1898. Reference is made in the preliminary reports to the large amount of assistance received by voluntary helpers in these expeditions; for special assistance in the spectrographic observations I am greatly indebted to Mr. J. J. Atkinson, Mr. Arthur Berry, and Captain Brett. The spectrograms were measured at the Royal Observatory, Greenwich, by Mr. Davidson and myself, and I have profited by Mr. Davidson's assistance and advice in the preliminary arrangement and adjustments of the spectroscopes as well as in the subsequent measurements and discussion.

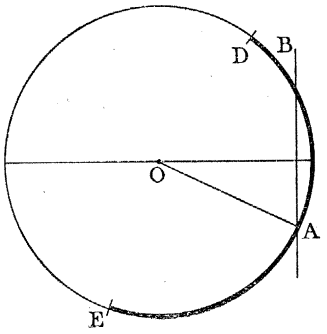
1. Details of the observations and of the adjustments of the spectroscopes are given in the 'Proceedings,' vols. 67, 69, and 77. The following is a brief account of the spectrograms of the chromosphere measured:—

Taken at Ovar, 1900, *May* 28. *Second Contact. Slit a few minutes inside the Tangent to Limb.*

Flint Glass Spectroscope.—Minimum deviation at H_γ.

(No. 6.) Spectrum consists entirely of bright lines and extends from H_β (4862) to K (3933). Only 50 of the brightest lines are shown.

(No. 5.) Spectrum shows between 250 and 300 bright lines, but shows also continuous spectrum and some absorption lines. The definition is good from 4580 to 4100.



(No. 2.) About 150 lines are very strongly shown on the violet side of H_γ. They are short lines standing out from a perfectly black continuous spectrum. If in the diagram A be the point of second contact, and DE be the crescent a little before totality, the image of the sun was adjusted so that the slit might pass through A. Spectrum No. 2 is the spectrum at B, while (5) and (6) are at A.

Quartz Spectroscope.—Minimum deviation at 3650. Quartz objective focussed for 3750.

(No. 8.) Taken after totality and contains 17 lines from h (4101) to Ti (3685). Measured for the wave-lengths of the hydrogen series.

(No. 7.) Taken after totality. Contains 36 lines extending from h (4101) to Ti at 3685.

(No. 6.) Extends from h (4101) to Sc at 3572. This photograph contains 300 lines in excellent definition and free from any continuous spectrum.

(No. 5.) This photograph shows a continuous spectrum with very few absorption lines and 500 bright lines extending from 4180 to 3460.

(No. 4.) Contains about 300 lines between 4170 and 3474. The brightest lines run through the whole spectrum, but, generally speaking, it consists of a continuous spectrum alongside a solar spectrum.

(No. 3.) Contains about 150 lines extending from 4101 to 3510, and approximates in character somewhat to (No. 2).

(No. 2.) Contains about 150 lines from 4101 to 3460 by the side of a solar spectrum, which is over exposed at the blue end, but not in the extreme ultra-violet.

(No. 1.) Shows a few of the strong chromospheric lines in the extreme ultra-violet, between 3510 and 3341. The photograph has been measured and wave-lengths deduced, but as this part of the spectrum was obtained better in Sumatra, the deduced wave-lengths have not been used.

Ovar, 1900, *May* 28. *Third Contact.*

Flint Spectroscope.

(No. 52.) This photograph contains about 300 lines, extending from 4670 to 4026. There is a continuous spectrum with a very occasional absorption line. There are a few lines to the red of 4670 and the violet of 4026, but the definition is not good and they have not been measured.

Quartz Spectroscope.

(No. 14.) Contains 20 lines from 4101 to 3685.

(No. 15.) Contains 100 lines from 4179 to 3613. No continuous spectrum.

(No. 16.) Contains 160 lines from 4179 to 3572. Beyond this point the definition is bad and the spectrum not used. The lines are seen on a continuous spectrum in which practically no absorption lines are seen.

(No. 17.) Contains about 130 lines and extends from 4101 to 3474. The chromospheric lines are short tips by the side of a continuous spectrum which shows absorption lines at the violet end, but is much over-exposed in the blue.

The programme of observations in 1901 was arranged to supplement as far as possible those made in 1900 with the flint glass spectroscope towards the red and with the quartz spectroscope in the ultra-violet. A suggestion of Mr. DAVIDSON'S was used to give a longer piece of spectrum in focus, two plates inclined at a suitable angle being used instead of one.

1901, *May* 17, *Sumatra.*

Flint Spectroscope.—Minimum deviation H_γ.

(No. 5.) Contains 200 lines from 5670 to 4426 and 70 lines from 4401 to 4077. This photograph consists entirely of bright lines with no continuous spectrum.

(No. 4.) Contains 180 lines from 5658 to 4460 and 60 lines from 4401 to 4101. The spectrum is measured on the edge of a continuous spectrum.

Quartz Spectroscope.—Minimum deviation 3400. Objective focussed for 3400.

(No. 7.) Contains 20 lines from 3970 to 3685 with no continuous spectrum.

(No. 6.) Contains 160 lines from 4036 to 3641 with no continuous spectrum.

(No. 5.) Contains 160 lines from 4042 to 3600. The chromospheric spectrum is measured on the two edges of the continuous spectrum.

(No. 3.) About 100 lines are measured on the sides of the continuous spectrum from 4035 to 3510. At about this point the band divides into two parts, the continuous spectrum disappears, and the chromospheric spectrum is seen as two series of dots or very short lines. About 100 lines are shown between these limits. The explanation of this spectrum is that the crescent was cut by the slit in two points, each of which furnishes a chromospheric spectrum; these spectra are quite clear and distinct from 3500 to 3300 (the quartz objective being focussed for wave-length 3400), but nearer the blue end of the spectrum the want of focus of the objective introduces the solar spectrum as well.

The measurement of the spectra in which there was no continuous spectrum presented no difficulties, and, generally speaking, where there was a continuous spectrum the bright lines were sufficiently strong across it and showed tips at the edges to make their identification and measurement quite certain. In cases where the absorption lines in the solar spectrum are very strong, the corresponding chromospheric lines were to some extent weakened and uncertain in parts of the spectrum for which the objective was not in focus. Some of these lines, *e.g.*, 4063·76 Fe 20 (in ⊙), 4071·91 Fe 15 (in ⊙), are not shown as strongly as in Sir NORMAN LOCKYER'S and other spectra, where an objective prism was used.

2. The spectra were measured by comparison with a glass scale whose division errors had been previously determined. Wave-lengths were determined from each photograph, in some cases by interpolation from a table and in others by HARTMANN'S formula. It seemed impracticable to give all the results from the separate photographs, and the means only are given. The number of photographs on which a line has been measured is given as well as the intensity. The scale of intensities must be considered as applying to lines in neighbouring parts of the spectrum.

The following table, extending from the titanium line at 3685 to the end of the series of hydrogen lines, is given as a specimen of the results of the separate photographs. The numbers at the head of the columns refer to the separate photographs taken with the quartz spectroscope :—

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Wave-length.											Intensity.										Deduced wave-length and intensity.	
Sumatra.			Ovar.								Sumatra.			Ovar.								
			Second contact.					Third contact.						Second contact.					Third contact.			
5.	3.	6.	2.	3.	4.	5.	6.	15.	16.	17.	5.	3.	6.	2.	3.	4.	5.	6.	15.	16.	17.	
—	—	—	·80	·97	·88	·88	·88	—	·93	·84	—	—	—	1	1	3	2	2	—	1	1	3659·88 2
—	—	—	—	—	—	·73	—	—	—	—	—	—	—	—	—	—	0	—	—	—	—	3660·73 0
—	—	—	—	·28	—	·44	·46	—	—	—	—	1	—	—	—	—	0	0	—	—	—	3661·39 1
—	·24	—	·36	·36	·35	·35	·40	—	·37	·37	—	1	—	3	1	3	3	2	—	2	2	3662·35 3
—	—	—	—	—	—	·11	—	—	·99	—	—	—	—	—	—	—	1	—	—	0	—	3663·05 1
—	·49	—	—	·51	·59	·51	·62	—	·72	·60	—	1	—	—	0	2	1	0	—	1	1	3663·58 2
—	·86	—	·73	·78	·75	·73	·82	—	·75	·81	—	1	—	2	1	3	2	1	—	1	1	3664·78 3
—	—	—	—	—	—	·33	—	—	—	—	—	—	—	—	—	—	0	—	—	—	—	3665·33 0
—	·31	—	·22	·16	·13	·18	·15	—	·30	—	—	1	—	2	1	1	2	1	—	1	—	3666·21 2
—	—	—	—	—	—	·23	·26	—	—	—	—	—	—	—	—	—	1	1	—	—	—	3667·25 1
—	·99	—	·84	·81	·89	·90	·89	—	·96	·85	—	1	—	2	1	1	1	1	—	1	1	3667·89 2
—	—	—	—	—	—	·61	—	—	—	—	—	—	—	—	—	—	0	—	—	—	—	3668·61 0
·47	·51	—	·50	·61	·58	·54	·60	—	·67	·70	1	0	—	2	2	2	2	2	—	1	1	3669·58 2
—	—	—	—	—	—	·62	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	3670·62 1
·34	·42	—	·43	·41	·50	·51	·58	—	·48	·50	1	1	—	2	1	3	2	2	—	2	2	3671·46 3
—	—	—	—	·75	—	·71	—	—	—	—	—	—	—	—	1	—	0	—	—	—	—	3671·73 0
—	—	—	—	—	·37	·48	—	—	·45	—	—	—	—	—	—	1	1	—	—	0	—	3672·43 1
—	—	—	—	—	—	—	·81	—	—	—	—	—	—	—	—	—	—	0	—	—	—	3672·81 0
·83	·91	—	—	·92	·92	·87	·95	—	·85	·97	1	1	—	—	2	2	2	2	—	1	2	3673·90 2
—	·75	—	·82	·80	·85	·85	·93	—	·85	·96	—	1	—	1	1	2	2	1	—	0	2	3674·85 2
—	—	—	—	—	—	·87	—	—	—	—	—	—	—	—	—	—	0	—	—	—	—	3675·87 0
·45	·51	·54	·50	·53	·56	·57	·52	·57	·62	·54	2	2	1	2	2	3	2	3	0	2	2	3676·54 3
—	—	—	·69	—	—	—	—	—	·58	—	—	—	—	1	—	—	—	—	—	0	—	3677·64 1
·01	·82	·82	·93	·89	·87	·91	·89	·97	·99	·99	0	1	1	1	1	3	2	3	0	1	2	3677·92 3
·46	·57	·54	·45	·48	·48	·47	·46	·53	·53	·52	1	2	1	2	2	3	2	3	0	1	2	3679·50 3
—	—	—	·95	·08	—	·99	·02	—	—	—	—	—	—	1	1	—	1	1	—	—	—	3680·01 1
—	—	—	·95	—	·00	·00	—	—	·09	—	—	—	—	1	—	1	1	—	—	0	—	3681·01 1
—	—	—	—	—	—	·50	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	3681·50 0
—	—	—	—	—	·38	·35	—	—	—	—	—	—	—	—	—	0	1	—	—	—	—	3682·37 1
·87	·75	·88	·02	·92	·96	·94	·98	·94	·89	·97	1	3	1	2	3	3	3	4	1	2	2	3682·92 4
—	—	—	—	—	·68	·67	·74	—	—	—	—	—	—	—	—	0	0	0	—	—	—	3683·70 0
—	—	—	·30	—	·37	·29	·35	—	·36	·37	—	—	—	1	—	3	1	2	—	0	1	3684·34 2
·36	·38	·33	·41	·34	·34	·34	·34	·33	·38	·41	8	9	7	6	6	10	10	15	10	10	6	3685·35 15

As regards the identification of the lines, ROWLAND'S Solar Spectrum was first compared with the chromospheric spectrum, and was, to a certain extent, a very good guide. Comparison with arc spectra—*e.g.*, the titanium, chromium, &c., spectra of HASSELBERG—was generally speaking a complete failure. Comparison was next made with EXNER and HASCHEK'S Spark Spectra, and the great majority of the stronger lines of the chromospheric spectrum were at once seen to be strong spark-lines of titanium, chromium, scandium, yttrium, iron, manganese, and zirconium.

It seemed desirable to give with the wave-lengths the intensities in the sun and in the spark, and for completeness the intensity in the arc is also given. The intensities in the sun were taken from ROWLAND, in the spark from EXNER and HASCHEK, in the arc from KAYSER and RUNGE for iron, Ca, Mg, Al, &c.; from HASSELBERG for titanium, chromium, manganese, nickel and cobalt; from ROWLAND and TATNALL for zirconium, vanadium and lanthanum. The intensities in the arc spectra were revised and many additions to the intensities both in the arc and spark were afterwards made from Mr. JEWELL'S discussion of his observations at Pinehurst (Publications of U.S. Naval Observatory, Washington, 1905). In the column giving the intensity in the arc, 0 denotes that the line is not found in the list with which comparison has been made to distinguish from —, where no information has been found. I have not attempted to push the identification of the lines further than seemed reasonably probable.

For the part of the spectrum from H_β to D_3, which depends entirely on photographs taken in Sumatra, I have given Mr. LORD'S results for comparison. The definition of my spectra in this part was not very good.

Spectrum of chromosphere.			Probable identification.					
					Intensity.			
Wave-length.	No. of photos.	Intensity.	Element.	Wave-length.	Spark.	Arc.	Sun.	
3295·91	1	2	—	—	—	—	—	
3302·98	1	2	—	—	—	—	—	} Probably Na.
3303·48	1	1	—	—	—	—	—	
3313·92	1	0	—	—	—	—	—	
3321·54	1	1	—	—	—	—	—	
3323·00	2	2	Ti	3323·06	30	—	5	
3324·14	1	0	—	3324·20	—	—	4N	
3326·87	1	1	Ti	3326·91	10	—	5	
3329·53	2	2	Ti	3329·57	20	—	5	
3332·18	2	1	Ti	3332·24	15	—	3	
3335·29	2	2	Ti	3335·30	20	—	4	
3336·51	1	1	Cr	3336·48	8	—		
3339·99	1	1	Cr	3339·99	10	—	3	
3340·48	2	3	Ti	3340·46	15	—	3	
3341·98	2	4	Ti	3341·97	20	—	4	
3342·72	1	1	Cr	3342·72	10	—	3	
3343·90	1	0	Ti	3343·91	7	3	4	
3346·95	1	1	Ti	3346·90	7	8	2	

Spectrum of chromosphere.			Probable identification.					
					Intensity.			
Wave-length.	No. of photos.	Intensity.	Element.	Wave-length.	Spark.	Arc.	Sun.	
3347·98	1	1	Cr	3347·97	6	—	3	
3349·14	2	5	Ti	3349·17	20	3	9	
3349·55	2	5	Ti	3349·60	10	—	7	
3349·81	1	0	—	—	—	—	—	
3353·84	1	1	Sc	3353·88	20	—	4	
3358·65	1	2	Cr	3358·65	9	—	4	Identified in sun as Ti, Cr.
3360·36	1	2	Cr	3360·48	10	3	1	
3361·34	2	6	Ti	3361·33	50	10	8	
3368·20	2	5	Cr	3368·19	10	5	5	
3369·04	1	1	Sc	3369·08	10	—	3	
3372·37	2	1	Sc	3372·31	10	—	0	
			Ti	3372·36	4	—	2	
3372·95	2	10	Ti	3372·95	30	10	10	Identified in sun as Ti, Pd.
3374·46	1	0	Ti	3374·49	4	—	2	Identified in sun as Ti, Co.
3378·51	2	1	Cr	3378·51	8	—	2	Identified in sun as Cr, Co ?
3379·98	2	1	Cr	3379·96	9	3	3	
3380·49	2	2	Ti	3380·40	15	7	3	
3381·59	1	0	—	—	—	—	—	
3382·85	2	2	Cr	3382·83	9	—	4	Identified in sun as Cr, Mn.
3383·91	2	8	Ti	3383·89	50	10	3	
3387·99	2	5	Ti	3387·99	15	5	—	
3391·56	1	0	Cr	3391·58	8	—	2	
3392·12	2	1	Zr	3392·11	15	10	2	
3392·75	1	0	Fe	3392·76	3	8	2	Identification doubtful.
3393·18	2	1	Cr	3393·16	8	—	1	
3393·95	1	1	Cr	3393·98	8	—	2	
3394·68	2	5	Ti	3394·69	30	5	3	
3399·11	1	0	—	—	—	—	—	3399·3 (Evershed).
3402·53	2	2	Ti	3402·55	8	—	3	
3403·48	2	3	Cr	3403·40	10	—	2	
3404·95	1	1	Zr	3404·97	6	5	0	
3406·72	1	0	—	3406·70	—	—	0	
3407·46	1	1	—	3407·45	—	—	2	
3408·92	2	4	Cr	3408·91	10	3	3	
3409·96	1	0	Ti	3409·95	4	—	2	
3410·39	1	2	Zr	3410·39	8	1	1	
3411·52	1	0	—	—	—	—	—	
3412·63	1	0	Co	3412·63	10	—	5	
					10	—	4	
3413·19	1	0	—	—	—	—	—	3413·0 (?) (Evershed).
3415·37	1	0	—	—	—	—	—	3415·01 (Evershed).
3416·07	1	0	—	—	—	—	—	Very faint and somewhat doubtful.
3417·94	1	0	—	3417·95	—	—	2	
3418·88	1	0	—	—	—	—	—	
3419·57	1	0	—	—	—	—	—	

Spectrum of chromosphere.			Probable identification.					
					Intensity.			
Wave-length.	No. of photos.	Intensity.	Element.	Wave-length.	Spark.	Arc.	Sun.	
3420·31	1	1	—	—	—	—	—	
3421·37	2	4	Cr	3421·35	10	3	4	
3422·86	2	4	Cr	3422·89	10	4	4	
3424·87	2	0	—	—	—	—	—	
3425·72	1	0	—	3425·72	—	—	1s	
3428·47	1	0	—	—	—	—	—	
3429·85	1	0	—	—	—	—	—	
3430·71	1	1	Zr	3430·67	10	3	1	
3431·63	1	1	Co	3431·72	10	—	4	
3432·41	1	1	Co	3432·45	4	—	0	? Identification.
3433·42	2	5	Cr	3433·45	10	3	3	
3437·15	2	1	—	—	—	—	—	
3438·38	2	2	Zr	3438·38	15	5	2	
3439·20	1	2	—	—	—	—	—	
3440·04	1	0	—	—	—	—	—	
3440·72	2	1	Fe	3440·76	7	10	20	
3441·20	1	1	Fe	3441·15	6	10	15	
3442·14	2	4	Mn	3442·12	40	7	6	
3443·48	2	1	—	3443·52	—	—	1	
3444·46	2	2	Ti	3444·47	15	5	4	
3452·61	1	1	Ti	3452·61	9	—	1	
3456·14	1	1	—	—	—	—	—	
3458·99	1	1	—	—	—	—	—	
3460·46	4	3	Mn	3460·46	40	5	4	
3461·68	3	2	Ti	3461·63	15	5	5	
3462·42	1	1	—	—	—	—	—	
3463·06	2	1	Co	3462·95	20	—	6	
			Zr	3463·15	12	3	0	
3465·83	1	1	Co	3465·90	20	7	4	
3474·30	5	2	Mn	3474·20	30	0	2	
				3474·29			2	
3475·75	4	0	Fe	3475·59	10	8	10	
3477·32	4	2	Ti	3477·32	15	5	5	
3479·02	1	0	—	—	—	—	—	
3479·48	2	1	Zr	3479·53	10	0	2	
3481·31	3	2	Zr	3481·30	10	5	2	Identified in sun as Pd, Ti-Zr.
3482·99	3	2	Mn	3483·05	30	4	5	
3488·01	2	1	—	—	—	—	—	
3488·84	5	2	Mn	3488·82	30	4	4	
3489·88	2	1	Ti	3489·89	4	3	2	Identified in sun as Ti, Pd.
3491·18	5	2	Ti	3491·20	10	5	5	
3491·99	1	0	—	—	—	—	—	
3492·79	1	0	—	—	—	—	—	
3494·71	5	1	—	—	—	—	—	3494·60 (EVERSHED).
3496·33	5	2	Zr	3496·35	20	7	2	

Spectrum of chromosphere.			Probable identification.					
					Intensity.			
Wave-length.	No. of photos.	Intensity.	Element.	Wave-length.	Spark.	Arc.	Sun.	
3497·67	4	2	Mn	3497·67	20	3	3	
3499·17	2	1	—	—	—	—	—	3499·14 (Evershed).
3500·45	1	1	Ti	3500·47	5	3	3	
3501·70	1	1	—	—	—	—	—	
3505·02	4	2	Ti	3505·06	50	6	2	
3505·77	3	1	Zr	3505·81	8	4	1	Identified in sun as Zr V.
3507·50	2	1	—	—	—	—	—	
3509·23	1	0	—	—	—	—	—	
3510·50	2	1	Ni	3510·47	10	8	8	
3511·00	5	3	Ti	3510·99	50	5	5	
3511·68	2	0	—	—	—	—	—	
3512·18	1	0	—	—	—	—	—	
3512·65	1	0	—	—	—	—	—	
3514·33	1	1	—	—	—	—	—	
3517·21	1	1	La	(3517·26)	50	0	—	
3517·51	3	1	V	3517·45	10	1	3	
3519·94	1	0	Ni	3519·90	15	3	7	
3520·21	1	0	V	3520·17	7	0	2	
3520·44	2	1	Ti	3520·40	20	4	2	
3524·77	2	1	Ni	3524·68	15	30	20	
3526·04	1	1	Fe	3525·98	4	—	4	
			Fe	3526·18	4	4	6	
3526·75	1	0	—	—	—	—	—	3526·59 (Evershed).
3527·64	1	0	—	—	—	—	—	
3528·68	1	0	—	—	—	—	—	
3530·14	1	1	—	—	—	—	—	
3530·90	4	2	V	3530·92	10	0	3	
3531·85	4	1	—	3531·85	—	—	1	3531·83 (Evershed).
3532·77	1	0	—	—	—	—	—	
3533·81	1	0	—	—	—	—	—	
3535·06	1	1	—	—	—	—	—	
3535·58	3	2	Ti	3535·55	20	4	4	
3535·95	3	1	Sc	3535·87	15	—	3	
3536·68	2	1	Fe	3536·71	6	4	7	
3537·05	1	0	—	—	—	—	—	
3542·58	1	0	—	—	—	—	—	
3543·50	1	0	—	—	—	—	—	
3544·31	3	1	—	3544·37	—	—	1	
3545·27	3	1	V	3545·34	10	1	4	
3546·09	1	0	—	—	—	—	—	
3546·92	1	0	—	—	—	—	—	
3547·79	1	1	—	—	—	—	—	3548·08 (Evershed).
3549·17	4	2	Y	3549·15	20	7	2	
3549·60	2	1	Gd	(3549·53)	10	—	—	? Identification.
3550·41	1	1	—	—	—	—	—	

Spectrum of chromosphere.			Probable identification.					
					Intensity.			
Wave-length.	No. of photos.	Intensity.	Element.	Wave-length.	Spark.	Arc.	Sun.	
3551·22	1	0	—	—	—	—	—	
3552·11	3	2	Zr	3552·10	10	3	1	
3553·20	3	2	—	—	—	—	—	3553·5 (Evershed).
3553·84	1	1	—	—	—	—	—	
3554·39	1	0	—	—	—	—	—	
3555·28	1	1	—	—	—	—	—	3555·02 (Evershed).
3556·81	3	3	Zr	3556·74	15	5	2	
3558·54	1	0	Fe	3558·67	4	9	8	
3563·25	1	0	—	—	—	—	—	
3565·56	3	1	Fe	3565·54	8	10	12	
3566·21	3	1	Ti	3566·11	5	3	1	}
			V	3566·31	6	0	2N	}
3566·48	1	0	Ni	3566·52	20	9	10	
3567·86	4	1	Sc	3567·84	20	—	4	
3568·34	2	1	—	—	—	—	—	
3569·44	1	0	Co	3569·52	20	10	5	
3570·30	4	1	Fe	3570·27	10	{ 8 8 }	20	
3571·01	1	0	—	—	—	—	—	
3571·69	1	0	—	—	—	—	—	
3572·10	1	0	Ni	3572·01	10	7	6	}
			Fe	3572·16	2	2	5	}
3572·68	9	2	Zr	3572·62	12	10	4	} Probably Sc.
			Sc	3572·71	50	—	6	} Probably Sc.
3573·19	1	0	—	—	—	—	—	
3573·52	1	1	—	—	—	—	—	
3573·83	3	1	Ti	3573·79	7	4	2	
3574·88	1	0	—	—	—	—	—	
3575·33	2	0	—	—	—	—	—	
3575·64	1	0	—	—	—	—	—	
3575·95	1	0	—	—	—	—	—	
3576·48	9	4	Sc	3576·53	30	20	7	
3577·00	5	2	Zr	3577·00	10	0	1	
3577·67	2	0	—	—	—	—	—	
3578·23	2	0	—	—	—	—	—	
3578·89	4	1	Cr	3578·83	10	30	10	
3579·35	1	0	—	—	—	—	—	
3581·08	1	1	Sc	3581·07	20	—	5	
3581·29	7	1	Fe	3581·35	10	10	20	
3582·01	1	0	—	—	—	—	—	
3583·81	1	0	—	—	—	—	—	
3584·67	2	1	Y	3584·66	10	6	2	
3584·91	1	0	—	—	—	—	—	
3587·13	2	0	Fe	3587·13	5	8	8	
3587·71	1	1	—	—	—	—	—	3587·61 (Evershed).

Spectrum of chromosphere.			Probable identification.					
					Intensity.			
Wave-length.	No. of photos.	Intensity.	Element.	Wave-length.	Spark.	Arc.	Sun.	
3588·33	2	1	—	—	—	—	—	
3588·97	2	1	—	—	—	—	—	
3589·83	6	3	Sc	3589·77	10	—	5	
			V	3589·91	9	1	5d ?	
3590·64	7	3	Sc	3590·63	10	—	4	
3591·51	1	0	—	—	—	—	—	3591·72 (EVERSHED).
3592·16	7	3	V	3592·17	9	1	2	
3592·78	2	1	—	—	—	—	—	
3593·60	6	2	Cr	3593·64	10	30	9	
3595·10	3	1	Co	3595·02	10	7	3	
3596·20	7	2	Ti	3596·20	10	3	4	
3597·91	2	1	Ni	3597·86	10	7	8	
3600·89	9	3	Y	3600·88	50	10	3	
3602·05	8	3	Y	3602·06	20	6	1	
3602·94	1	1	—	—	—	—	—	
3603·32	1	1	—	—	—	—	—	3603·38. Wide line (EVERSHED).
3603·69	1	1	—	—	—	—	—	
3603·90	4	2	Cr	3603·92	9	0	3	
3605·48	4	1	Cr	3605·48	10	20	7	
3606·73	3	1	—	—	—	—	—	3606·83 (EVERSHED).
3607·55	2	0	Zr	(3607·60)	6	0	—	Identification doubtful.
3609·01	4	1	Fe	3609·01	20	8	9	
3609·79	3	2	—	—	—	—	—	
3611·15	7	3	Y	3611·19	30	7	2	
3611·94	4	1	Co —	3611·86	7	5	2	
			Zr	3612·04	10	1	00	
3612·65	3	0	—	—	—	—	—	
3613·27	6	2	Cr	(3613·35)	6	0	—	
3613·98	10	4	Sc	3613·95	100	4	4	
3614·88	7	3	Zr	3614·92	10	5	2	
3615·68	1	1	—	—	—	—	—	
3616·83	1	0	—	—	—	—	—	
3617·44	1	0	—	—	—	—	—	
3618·88	6	2	Fe	3618·92	10	8	20	
3619·54	6	2	Ni	3619·54	15	20	8	
3620·56	1	0	—	—	—	—	—	
3621·38	2	2	Co	3621·34	10	0	2	
3622·23	2	0	Fe	3622·15	3	6	6	
3623·37	2	0	Fe	3622·36	2	6	5	
3624·03	2	1	Zr	3624·06	8	4	1	
3624·97	9	4	Ti	3624·98	15	5	5	
3625·78	2	0	—	—	—	—	—	
3626·29	1	0	—	—	—	—	—	
3627·00	1	0	—	—	—	—	—	
3627·91	1	0	—	—	—	—	—	3627·9 (EVERSHED).

Spectrum of chromosphere.			Probable identification.					
					Intensity.			
Wave-length.	No. of photos.	Intensity.	Element.	Wave-length.	Spark.	Arc.	Sun.	
3628·89	5	2	Y	3628·85	10	7	2	
3629·60	2	0	—	—	—	—	—	
3630·13	3	1	Zr	3630·16	5	1	1	
3630·88	8	4	Sc	3630·88	100	3	4	
3631·64	9	2	Fe	3631·61	10	6n	15	
3631·90	1	0	—	—	—	—	—	Possibly enh. Cr.
3633·26	9	2	Y	3633·28	30	4	2	
3633·62	2	1	Zr	(3633·70)	6	—	—	
3634·41	4	1	He	(3634·39)	2	—	—	
3635·55	3	1	Ti	3635·61	8	9	4	Identified in sun as Ti, Fe.
3636·69	2	0	Zr	3636·62	4	1	1	
3637·42	1	0	—	—	—	—	—	
3639·66	2	1	Pb	3639·66	20	10	1	
3640·50	3	1	Fe Cr	3640·54	5 2	6 —	6	
3641·45	11	4	Ti	3641·47	20	4	4	
3641·96	1	0	Cr	3641·97	4n	—	1	
3642·92	11	4	Sc	3642·91	50	3	2	
3643·27	2	1	—	—	—	—	—	
3643·90	4	1	—	3643·95	—	—	3	
3644·51	1	0	—	—	—	—	—	As one line, 3644·74, intensity, 1 on another photo.
3644·80	1	0	—	—	—	—	—	
3645·48	9	3	Sc	3645·47	15	1	3	
3646·32	2	0	Ti Gd	3646·34 (3646·36)	4 12	5 —	1 —	
3647·29	1	0	—	—	—	—	—	
3647·92	6	2	Fe	3647·99	9	8	12	
3649·66	3	1	Fe La	3649·65	4 1	4 5	5	Probably Fe.
3650·50	2	1	Cr	(3650·50)	5	0	—	
3651·64	1	1	Fe	3651·62	4	6	7	
3651·89	7	3	Sc	3651·94	20	1	4	
3654·07	1	0	—	—	—	—	—	
3654·78	1	0	—	—	—	—	—	
3655·14	1	0	—	—	—	—	—	
3655·93	3	1	—	—	—	—	—	
3656·39	1	1	—	—	—	—	—	
3658·17	2	0	—	—	—	—	—	
3658·87	2	0	—	—	—	—	—	
3659·88	7	3	Ti	3659·90	15	4	5	Identified in sun as Fe, Ti.
3660·73	1	0	Ti	3660·77	4	6	2	
3661·39	3	1	$H_{\epsilon'}$	(3661·35)	—	—	—	
3662·35	8	3	Ti	3662·38	15	5	5	
3663·05	2	1	—	3662·98	—	—	4	Identified in sun as Fe, Cr.
3663·58	6	2	$H_{\gamma'}$	(3663·54)	—	—	—	

Spectrum of chromosphere.			Probable identification.					
					Intensity.			
Wave-length.	No. of photos.	Intensity.	Element.	Wave-length.	Spark.	Arc.	Sun.	
3664·78	8	3	Y	3664·76	20	8	2	
3665·33	1	0	—	—	—	—	—	
3666·21	7	2	$H_{a'}$	(3666·24)	—	—	—	
3667·25	2	1	—	—	—	—	—	
3667·89	8	2	H_{ω}	(3667·82)	—	—	—	
3668·61	1	0	Zr	3668·60	4	0	00	
3669·58	9	2	H_{ψ}	(3669·60)	—	—	—	
3670·62	1	1	Ni	3670·57	7	5	5	
3671·46	9	3	Zr	3671·41	8	2	0	Coincides with H_{χ} (3671·48).
3671·73	2	0	—	—	—	—	—	
3672·43	3	0	—	—	—	—	—	
3672·81	1	0	—	—	—	—	—	
3673·90	8	2	H_{ϕ}	(3673·90)	—	—	—	
3674·85	8	2	Zr	3674·87	10	3	1	
3675·85	1	0	—	—	—	—	—	
3676·54	11	3	H_{υ}	(3676·50)	—	—	—	
3677·64	2	1	—	3677·65	—	—	3	
3677·92	11	3	Cr	3677·83	6	1·5	3	
				3677·95	8		3	
3679·50	11	3	H_{τ}	(3679·49)	—	—	—	
3680·01	4	1	Fe	3680·07	5	4	9	
3681·01	4	1	—	3681·08	—	—	3	
3681·50	1	0	—	—	—	—	—	
3682·37	2	1	Fe	3682·38	6	4	8	
3682·92	12	4	H_{σ}	(3682·95)	—	—	—	
3683·70	3	0	—	—	—	—	—	
3684·34	6	2	Fe	3684·26	4	4	7d ?	
			Cr	(3684·39)	5	0	—	
3685·35	15	15	Ti	3685·34	50	8	10d	
3686·18	3	1	Fe	3686·14	3	6	6	
					2			
3687·00	11	7	H_{ρ}	(3686·97)	—	—	—	
3687·67	2	0	Fe	3687·61	6	6	6	
				3687·80	4	6	4	
3691·70	12	8	H_{π}	(3691·70)	—	—	—	
3692·42	3	1	—	—	—	—	—	
3692·78	3	1	—	—	—	—	—	
3693·60	2	1	Co	3693·62	7	5	1	
3694·29	8	4	Yb	3694·34	200	10	3	
3695·09	4	2	—	—	—	—	—	
3695·98	1	1	—	—	—	—	—	
3696·61	1	1	—	—	—	—	—	
3697·29	12	8	H_{θ}	(3697·29)	—	—	—	
3698·28	9	3	Zr	3698·30	10	0	2	
3699·15	1	1	—	—	—	—	—	

Spectrum of chromosphere.			Probable identification.					
					Intensity.			
Wave-length.	No. of photos.	Intensity.	Element.	Wave-length.	Spark.	Arc.	Sun.	
3699·86	2	1	—	3699·96	—	—	1	
3700·41	2	1	V	3700·48	6	0	1	
3701·15	2	1	Fe	3701·23	4	6	8	
3702·38	3	1	—	—	—	—	—	
3703·13	2	1	—	—	—	—	—	
3704·00	12	10	H_ξ	(3704·00)	—	—	—	
3704·75	1	0	—	—	—	—	—	
3705·09	3	1	He	(3705·15)	3	—	—	
3705·69	3	2	Fe	3705·71	6	4	9	
3706·25	11	6	Ca	3706·18	10	2	6d ?	Separate photos. range from 3706·18 to 3706·31. Compound line, but mainly Ca.
			Ti	3706·36	9	5	3	
3707·20	1	1	Fe	3707·19	2	4	5	
3707·98	3	2	Fe	3707·96	2	6	5d ?	
			—	3708·07	5		5	
3709·38	5	2	Fe	3709·39	6	6	8	
3710·43	10	6	Y	3710·43	100	7	3	
3710·97	1	0	—	—	—	—	—	
3711·40	4	2	Fe	3711·36	1	2	4	? Identification.
3712·13	13	10	H_ν	(3712·12)	—	—	—	
3713·05	6	3	Cr	3713·09	9	2	3	
3713·72	2	1	La	3713·71	6	0	—	
3714·43	2	0	—	—	—	—	—	
3714·92	4	2	Zr	3714·93	6	0	0	
3715·60	8	3	V	3715·62	10	0	4	
3716·55	2	1	Fe	3716·59	3	6	7	
3717·33	2	0	—	—	—	—	—	
3718·44	2	1	V	(3718·35)	5	0	—	3718·55, Fe, 4, in solar spectrum.
3718·95	2	1	—	—	—	—	—	
3720·08	11	6	Fe	3720·08	8	10	40	
3721·06	1	0	—	—	—	—	—	
3721·70	1	2	Ti	3721·78	8	4	4d ?	
3722·05	13	12	H_μ	(3722·08)	—	—	—	
3722·74	3	4	Fe	3722·73	6	6	6	Identified in sun as Ti, Fe.
3723·64	1	1	—	—	—	—	—	
3724·36	1	0	—	—	—	—	—	
3724·97	3	1	—	—	—	—	—	
3725·62	1	0	—	—	—	—	—	
3727·46	2	1	V	3727·49	8	0	1	
3727·78	1	1	Fe	3727·78	7	6	4	
3728·49	2	1	V	(3728·51)	5	0	—	
3728·96	1	0	—	—	—	—	—	
3729·85	2	1	Ti	3729·95	8	7	3	
3730·71	1	1	—	—	—	—	—	
3731·37	3	2	Zr	3731·40	10	0	0	Identified in sun as Co, Zr.
3732·61	1	1	Fe	3732·55	4	6	6	Identified in sun as Co, Fe.

Spectrum of chromosphere.			Probable identification.					
					Intensity.			
Wave-length.	No. of photos.	Intensity.	Element.	Wave-length.	Spark.	Arc.	Sun.	
3732·86	5	2	V	3732·89	14	4	2	
3733·52	4	4	Fe	3733·47	6	4	7d	
3734·52	13	12	H_λ	(3734·51)	—	—	—	
3734·91	1	5	Fe	3735·01	10	8	40	Only separated from H_λ on one photo.
3735·83	2	1	Nd	(3735·76)	5	—	—	
3736·11	3	1	V	(3736·16)	5	0	—	
3737·14	12	10	Ca	3737·06	15r	3	5	Identified in sun as Ca, Mn.
			Fe	3737·28	8	8	30	
3738·37	2	3	Fe	3738·45	3	6	3	
3739·43	2	1	—	—	—	—	—	
3740·19	2	0	—	—	—	—	—	
3740·55	1	0	—	—	—	—	—	
3741·35	1	0	—	—	—	—	—	
3741·78	12	6	Ti	3741·79	30	4	4	
3743·55	6	4	Fe	3743·51	7	6	6	
3744·57	3	0	—	—	—	—	—	
3745·87	9	10	Fe	3745·72	7	8	8	Double on one photo.
				3746·06	7	6	6	
3746·99	1	0	—	—	—	—	—	
3747·72	2	1	Y	3747·69	8	—	1	
3748·38	10	7	Fe	3748·41	7	6	10	
3749·32	3	1	—	—	—	—	—	
3749·63	5	4	Fe	3749·63	10	8	20	
3750·32	13	10	H_κ	(3750·30)	—	—	—	
3751·11	2	1	—	—	—	—	—	
3751·79	4	2	Zr	3751·80	10	0	00	
3752·75	4	1	—	—	—	—	—	
3753·79	2	0	Fe	3753·73	3	4	6d ?	Identified in sun as Fe, Ti.
3754·71	2	1	Cr	3754·72	5	0	1	
3755·69	2	1	—	—	—	—	—	
3756·72	1	0	—	—	—	—	—	
3757·84	11	5	Ti	3757·82	10	5	4	
3758·44	6	4	Fe	3758·38	8	8	15	
3759·44	13	12	Ti	3759·45	50	7	12d ?	
3760·44	3	3	Fe	3760·20	3	4	5	Double on one photo.
				3760·68	2	4	4	
3761·47	13	12	Ti	3761·46	50	7	7	
3762·95	1	1	—	—	—	—	—	
3763·92	4	7	Fe	3763·95	7	8	10	
3764·29	1	0	—	—	—	—	—	
3764·81	1	0	—	—	—	—	—	
3765·65	1	3	Fe	3765·69	5	8	6	
3766·64	3	1	—	—	—	—	—	
3766·94	1	1	Zr	3766·96	10	0	1	
3767·30	4	6	Fe	3767·34	7	8	8	

Spectrum of chromosphere.			Probable identification.					
					Intensity.			
Wave-length.	No. of photos.	Intensity.	Element.	Wave-length.	Spark.	Arc.	Sun.	
3768·46	6	3	Gd	3768·54	20	20	0	
3769·66	4	3	Ni	3769·60	10	2	3	
3770·79	13	15	H_ι	(3770·77)	—	—	—	
3771·06	1	0	V	3771·12	10	0	2	
3771·83	1	1	Ti	3771·80	7	5	2	Identified in sun as Ti, C.
3773·58	1	0	—	—	—	—	—	
3774·45	10	8	Y	3774·47	100	5	3	
3775·69	1	1	Ni	3775·72	5	4	7	
3776·22	4	1	Ti	3776·20	8	2	2	
3776·72	1	0	Y	3776·70	8	—	1	Identified as Mn in sun.
3777·91	3	1	—	—	—	—	—	
3778·56	1	0	Fe	3778·46	1	4	3	
				3778·65	—	—	2	
3779·61	2	0	Fe	3779·57	1	6	4	
				3779·66	—	—	2	
3780·75	1	1	—	3780·84	—	—	3	
3781·63	1	0	—	—	—	—	—	
3782·45	2	1	Gd	(3782·49)	12	—	—	
3783·42	5	1	—	3783·48	—	—	2	
3783·60	1	2	Ni	3783·67	5	6	6	
3783·96	2	1	—	—	—	—	—	
3784·57	1	0	—	—	—	—	—	
3785·42	3	1	—	—	—	—	—	
3785·98	1	0	Fe	3786·09	3	4	3	
3786·29	1	0	Fe	3786·31	2	4	4d ?	
3786·88	1	0	Fe	3786·82	2	4	5	
3787·34	1	1	V	(3787·39)	8	0	—	
3787·96	2	3	Fe	3788·05	5	6	9	
3788·86	9	5	Y	3788·84	30	5	2	
3790·19	1	3	Fe	3790·24	3	6	5	
3790·97	1	2	La	3790·97	50	6	1	Identified in sun as La-Ca.
3792·58	2	2	—	—	—	—	—	
3793·82	3	1	—	—	—	—	—	
3795·13	1	3	Fe	3795·15	8	6	8	
3796·44	1	1	—	—	—	—	—	
3797·00	1	1	—C	3797·03	—	—	2	
3798·06	13	19	H_θ	(3798·04)	—	—	—	
3799·71	2	4	Fe	3799·69	7	6	7	
3800·15	5	2	—	—	—	—	—	
3801·02	1	0	—	—	—	—	—	
3801·62	7	2	Ce	3801·68	8	—	0	Line in sun identified —C.
3803·13	5	2	C	3803·14	—	—	2	Different photos. discordant 3802·98, 3803·21, 3803·17, 3803·09, 3803·02 ? d, and 3803·32.
3805·71	2	1	—	—	—	—	—	
3806·35	2	1	—	—	—	—	—	
3807·38	1	1	Ni	3807·29	7	5	6	

Spectrum of chromosphere.			Probable identification.					
					Intensity.			
Wave-length.	No. of photos.	Intensity.	Element.	Wave-length.	Spark.	Arc.	Sun.	
3809·63	3	1	Mn	3809·72	6	5	4	
3810·79	4	1	—	—	—	—	—	
3811·45	2	1	—	—	—	—	—	
3812·17	3	1	—	—	—	—	—	
3813·17	2	4	Fe	3313·10	8	5	5	
3813·57	2	2	Ti	3813·54	4	1	2	
3814·67	7	6	Ti	3814·70	5	4	8	Identified in sun as Fe, C. Lockyer identifies line in chromosphere as Ti.
3816·00	7	6	Fe	3815·99	9	8	15	
3817·69	2	0	—	—	—	—	—	
3818·49	2	0	Y	3818·49	10	—	1	
3819·39	2	0	—	—	—	—	—	
3819·73	3	1	He	(3819·75)	4	—	—	
3820·59	7	7	Fe	3820·59	9	8	25	Identified in sun as Fe, C.
3821·27	1	0	Fe	3821·33	4	4	4	
3821·88	2	1	—	—	—		—	
3823·47	1	0	—	—	—	—	—	
3824·02	1	0	—	—	—	—	—	
3824·58	5	7	Fe	3824·59	7	8	6	
3825·45	2	0	—	—	—	—	—	
3826·02	6	8	Fe	3826·03	9	8	20	
3826·97	1	0	—C	3826·99	—	—	2	
3828·00	5	7	Fe	3827·98	9	8	8	
3829·13	1	0	—	—	—	—	—	
3829·51	10	10	Mg	3829·50	200	30	10	
3830·60	2	2	—	—	—	—	—	} Also single line at 3830·87 on five other photos.
3831·12	2	2	C	3831·17	—	—	3d	
3832·15	1	1	—	—	—	—	—	
3832·46	11	16	Mg	3832·45	200	50	15	
3833·20	3	1	—	—	—	—	—	
3833·79	1	0	—	—	—	—	—	
3834·33	7	3	Fe	3834·36	8	8	10	
3835·53	13	20	H_η	(3835·53)	—	—	—	
3836·62	1	5	C	3836·64	—	—	1	} A single line 3836·82 on five photos.
				3836·69	—	—	1	
3836·92	1	4	Zr	3836·91	12	0	1	
3837·50	1	1	—	—	—	—	--	
3838·43	13	10	Mg	3838·44	500	100	25	Identified in sun as Mg-C.
3839·33	2	1	Fe	3839·40	4	6	3	
3839·99	1	0	—	—	—	—	—	
3840·54	4	3	Fe	3840·58	8	8	8	Identified in sun as Fe, C.
3841·20	4	3	Fe	3841·20	8	8	10	
			Mn		6	8		
3842·05	4	1	—	—	—	—	—	
3843·24	4	2	Zr	3843·20	8	0	2	Identified in sun as Fe-C.
3844·39	2	1	C	3844·38	—	—	4d ?	

Spectrum of chromosphere.			Probable identification.					
					Intensity.			
Wave-length.	No. of photos.	Intensity.	Element.	Wave-length.	Spark.	Arc.	Sun.	
3845·47	2	1	—	—	—	—	—	
3846·88	2	1	Fe	3846·94	3	6	5	
3847·56	1	0	—	—	—	—	—	
3848·22	3	0	Ti	3848·14	6	4	1	
3848·94	3	1	—	—	—	—	—	
3850·12	2	2	Fe	3850·12	6	8	12	
3850·91	3	1	Fe	3850·96	3	6	4	
3851·69	2	0	—	—	—	—	—	
3852·64	1	2	—	—	—	—	—	
3853·61	1	1	—	—	—	—	—	
3854·41	1	1	—	—	—	—	—	
3854·84	3	1	C	3854·71	—	—	2	Fourth edge of C. band.
				3854·99	—	—	1	
3855·87	1	1	—	—	—	—	—	
3856·52	6	4	Fe	3856·52	8	8	8	
3857·10	1	0	—	—	—	—	—	
3858·35	4	1	Ni	3858·44	8	20	7	
3858·70	1	2	—	—	—	—	—	
3859·34	2	1	—	—	—	—	—	
3860·10	8	5	Fe	3860·06	9	10	20	
3861·03	1	2	—	—	—	—	—	
3861·71	4	2	C	3861·98	—	—	1N	Third edge of C. band.
3862·79	4	2	Si	(3862·80)	4	—	—	
3863·66	2	1	—	—	—	—	—	
3864·64	1	0	—	—	—	—	—	
3865·72	3	1	Fe	3865·67	6	8	7	
3867·60	1	1	He	(3867·61)	2	—	—	Broad.
3870·93	1	1	—	—	—	—	—	Broad band? Several lines.
3871·43	3	1	C	3871·53	—	—	2d?	Second edge of C. band.
3872·63	1	1	Fe	3872·64	6	8	6	
3873·21	2	1	Co	3873·22	15	10	2	
3873·85	2	0	Fe	3873·90	4	6	4	
3876·30	3	1	—	—	—	—	—	
3877·26	2	1	—	—	—	—	—	
3878·73	5	4	Fe	3878·72	8	8	7Nd?	
3880·53	1	1	C	3880·53	—	—	2	
3882·51	3	2	C—	3882·44	—	—	2	
3883·38	3	3	C	3883·41	—	—	2	Broad. First edge of C. band.
				3883·53	—	—	1N	
3884·53	1	0	Fe	3884·52	2	4	2	
3885·50	2	0	—	—	—	—	—	
3886·49	9	4	Fe	3886·43	8	6	15	
3887·18	1	2	Fe	3887·20	5d?	6	7	
3887·95	2	0	—	—	—	—	—	
3888·72	1	3	He	(3888·79)	10	—	—	Separated on one photo.
3889·15	13	20	H_ζ	(3889·20)	—	—	—	

Spectrum of chromosphere.			Probable identification.					
					Intensity.			
Wave-length.	No. of photos.	Intensity.	Element.	Wave-length.	Spark.	Arc.	Sun.	
3890·30	1	1	—	—	—	—	—	
3891·06	7	2	—	—	—	—	—	
3892·08	3	1	Fe	3892·07	1	0	4	
3892·29	1	0	—	—	—	—	—	
3893·09	2	1	—	—	—	—	—	
3893·46	3	1	Fe	3893·45	3	4	2	? Identification.
3894·25	2	1	Co	3894·24	30	10	5	
3894·98	1	0	—	—	—	—	—	
3895·81	5	3	Fe	3895·80	5	6	7	
3896·36	2	1	Er	(3896·42)	6	15	?	
3898·11	1	0	Fe	3898·03	2	2	3	
3899·84	4	3	Fe	3899·85	6	6	8	
3900·67	9	7	Ti	3900·68	50	6	5	Identified in sun as Ti, Fe.
3901·74	1	0	—	3901·74	--	—	1	
3902·18	1	0	—	3902·11	--	—	1	
3903·04	2	1	Fe	3903·09	7	8	10	Identified in sun as Cr, Fe.
3905·63	2	0	Si	3905·66	5	15	12	
3906·03	2	0	Nd	3906·04	4	—	3	
3906·53	2	0	—	—	—	—	—	
3907·28	6	2	Eu	(3907·3)	30	—	—	
3908·54	6	2	—	—	—	—	—	
3911·29	2	0	Nd	3911·32	7	—	0	
3912·46	2	1	—	—	—	—	—	
3912·71	1	0	—	—	—	—	—	
3913·61	10	7	Ti	3913·61	30	6	5d ?	Identified in sun as Ti, Fe.
3914·58	6	2	Zr	3914·57	4	0	1	
3915·20	1	0	—	—	—	—	—	
3916·21	5	2	La	3916·21	10	0	0	Identified in sun as Zr-La.
3918·05	1	0	—	—	—	—	—	
3918·48	3	1	Fe	3918·46	4	4	4	
3919·24	1	1	Cr	3919·31	8	3	3	
3919·97	1	0	—	—	—	—	—	
3920·39	5	2	Fe	3920·41	5	6	10	
3921·84	1	1	—	—	—	—	—	
3923·09	5	2	Fe	3923·05	6	8	12d ?	
3924·16	1	0	—	—	—	—	—	
3926·00	2	0	Fe	3925·79 3926·09 3926·16	2	4	5 4 3	
3927·28	1	1	—	—	—	—	—	
3928·10	5	4	Fe	3928·08	7	8	8	
3929·35	1	0	La	3929·36	15	0	2	Fe, Mn, La, Co, in sun.
3930·46	5	4	Fe	3930·45	6	8	8	
3931·47	1	2	—	—	—	—	—	

Spectrum of chromosphere.			Probable identification.					
					Intensity.			
Wave-length.	No. of photos.	Intensity.	Element.	Wave-length.	Spark.	Arc.	Sun.	
3932·14	3	3	Ti	3932·16	6	0	1	
3933·84	13	100	Ca	3933·83	1000	100	1000	
3937·34	1	1	—	—	—	—	—	
3938·42	7	2	—	3938·44	—	—	2	Identification —, Cr in sun.
3939·63	1	1	—	—	—	—	—	
3940·62	1	0	—	—	—	—	—	
3941·57	1	0	Cr Nd	3941·64	5 8	—	3	
3942·63	2	0	Fe	3942·56	2	6	5	
3944·14	7	3	Al	3944·16	20	800	15	
3945·38	4	1	—	3945·36	—	—	1	
3946·59	4	1	—	—	—	—	—	
3947·98	2	0	Ti	3947·93	10	5	2	
3949·22	6	2	La	3949·20	50	6	1	
3949·72	1	1	—	—	—	—	—	
3950·45	5	2	Y	3950·50	20	5	2	
3951·78	1	0	Y	3951·77	3	—	0kd ?	
3952·36	4	1	Nd	3952·34	3	—	0	
3952·82	1	0	Fe	3952·80	2	6	4 3	
3956·60	4	1	Ti	3956·48	9	8	4	Identified in sun as Ce, Co Ti.
			Fe	3956·82	4	6	8	
3958·29	8	2	Ti Zr	3958·36	10 15	7 8	5	
3959·43	2	0	—	—	—	—	—	
3960·51	2	0	—	—	—	—	—	
3961·64	8	5	Al	3961·67	20	1000	20	
3964·04	2	1	—	—	—	—	—	
3964·66	1	1	Ti p He	3964·42 (3964·88)	2 4	5 —	2 —	
3965·16	4	1	—	—	—	—	—	
3967·15	2	1	—	—	—	—	—	
3968·60	13	70	Ca	3968·63	500	80	700	
3970·21	13	30	H_ϵ	3970·18	—	—	—	
3972·02	5	2	Eu	3972·13	50	50	0 ?	
3973·32	4	1	—	—	—	—	—	
3974·29	2	1	—	—	—	—	—	
3975·14	1	0	—	—	—	—	—	
3975·64	2	1	—	—	—	—	—	
3977·34	1	0	—	—	—	—	—	
3979·01	1	0	—	—	—	—	—	
3980·01	1	0	—	—	—	—	—	
3981·87	2	2	Ti	3981·92	15	9	4	A very broad band extending from 3981·8 to 3982·7. On two photos. lines are separated. There is probably another line between Ti and Y.
(3982·59)	(4)	(3)	—	—	—	—	—	
3982·75	2	2	Y	3982·74	20	6	3	

Spectrum of chromosphere.			Probable identification.					
					Intensity.			
Wave-length.	No. of photos.	Intensity.	Element.	Wave-length.	Spark.	Arc.	Sun.	
3984·13	3	1	Cr	3984·06	7	5	3	Probably Fe.
			Fe	3984·11	3	6	4	
3988·67	8	2	La	3988·66	30	5	0	
3990·11	6	2	Ti	3989·91	20	8	4	Not entirely due to Ti. The line 3990·13 identified as Mn-Cr in the sun.
			—	3990·13	—	—	1	
3990·42	1	1	—	—	—	—	—	
3991·42	5	2	Cr, Zr	3991·33	9, 15	4, 8	3	
3991·85	2	1	Co, Cr	3991·87	8, 2	2, 3	2	
3992·50	2	1	—	—	—	—	—	
3993·03	2	0	Cr, V	3992·97	5, 12	3, 6	3d ?	
3994·14	1	0	—	—	—	—	—	
3994·87	3	2	Nd	3994·83	5	—	2	
3995·90	6	2	La	3995·90	5	5	1Nd	
3996·48	1	1	—	—	—	—	—	
3997·09	3	1	—	—	—	—	—	
3997·95	2	1	Co	3998·05	10	9	4d ?	
3999·28	9	6	Zr	3999·12	15	0	1	Identified in sun as Zr, Fe.
			V	3999·37	6	0	0	
4000·51	5	1	—	—	—	—	—	
4002·75	1	1	Fe	4002·65	1	1	0d	Identified in sun as Fe, Ti.
4003·62	1	0	Cr	(4003·48)	5	0	—	
4004·13	2	1	—	—	—	—	—	
4004·84	2	0	—	—	—	—	—	
4005·44	1	2	Fe	4005·41	8	8	7	
4005·86	2	1	V	4005·86	20	0	3	
4006·70	1	0	—	—	—	—	—	
4007·51	2	0	Fe	4007·43	2	4	5	
4008·16	1	0	—	—	—	—	—	
4008·92	3	1	—	—	—	—	—	
4009·85	1	0	Fe	4009·86	3	6	3	
4010·47	1	1	—	—	—	—	—	
4011·41	1	0	—	—	—	—	—	
4012·50	9	10	Ti	4012·54	7	2	4	
4013·77	1	1	—	—	—	—	—	
4014·77	4	1	Sc, Fe	4014·68	8, 2	—, 2	5d ?	
4015·71	3	1	—	4015·76	—	—	3	
4017·72	2	1	—	—	—	—	—	
4019·24	2	1	—	—	—	—	—	
4020·50	5	2	Sc	4020·55	8	4	1	
4021·92	6	2	Ti	4022·02	4+	6	4	Identified in sun as Ti-Fe-V.
4023·55	6	2	V	4023·53	10	1	3	Identified in sun as V Co.

Spectrum of chromosphere.			Probable identification.					
					Intensity.			
Wave-length.	No. of photos.	Intensity.	Element.	Wave-length.	Spark.	Arc.	Sun.	
4024·13	1	1	Zr	4024·15	3	1	1	
4024·76	3	1	Ti	4024·73	5	10	3	
4025·31	5	1	Ti	4025·29	4	2	3	
4026·52	7	2	He	(4026·34)	5	—	—	
			Ti	4026·69	4	5	1	
4027·67	1	1	—	—	—	—	—	
4028·63	8	2	Ti	4028·50	10	3	4	
4029·95	4	1	Fe	4029·78	1	1	5	
			Si	4030·1	2	—	—	
4030·87	7	2	Mn	4030·92	20	30	9	
4031·92	9	3	La	4031·87	20	7	2	
4032·73	1	1	Fe	4032·79	2	2	4	? Identification.
4033·23	4	1	Mn	4033·22	20	25	8	
4034·01	3	1	—	—	—	—	—	
4034·62	6	1	Mn	4034·64	10	20	6	
4035·87	6	1	V	(4035·77)	16	4	—	
			Mn	4035·88	8	5	4d ?	
4037·03	2	1	—	—	—	—	—	
4040·36	1	0	—	—	—	—	—	
4041·05	8	3	Nd	4040·94	7	—	1d ?	Identified in sun as Ce, Nd, Co.
4041·94	2	0	—	—	—	—	—	
4042·97	8	3	La	4043·05	20	8	0	
4045·97	7	3	Fe	4045·98	10	10	30	
4048·82	5	2	Zr	4048·82	10	7	1	
4053·85	6	1	V	4053·80	8	0	0	
			Ti	4053·98	8	3	3	
4055·18	3	1	Ti	4055·19	6	4	3	Identified in sun as Cr, Ti, Zr.
4056·67	2	1	—	—	—	—	—	
4058·02	2	1	Pb	4058·04	300	1000	0	
4059·01	1	0	—	—	—	—	—	
4061·28	5	1	Nd	4061·24	10	10	3	
4062·68	2	1	Fe	4062·60	3	8	5	
4063·75	2	2	Fe	4063·76	10	10	20	
4065·48	2	0	—	—	—	—	—	
4067·23	2	2	Ni	(4067·2)	4	0	—	
4068·88	1	0	—	—	—	—	—	
4069·33	3	1	—	—	—	—	—	
4071·8	3	2	Fe	4071·91	10	10	15	Very diffused.
4073·8	3	2	Fe	4073·92	2	4	4	Very diffused. ? Identification.
4075·42	3	1	—	—	—	—	—	
4076·03	6	2	—	4076·10	—	—	3	
4077·86	9	15	Sr	4077·89	1000	10	8	
4078·66	2	3	Ti	4078·63	7	6	3	
4079·84	1	2	—	—	—	—	—	
4080·62	1	2	—	—	—	—	—	
4081·46	1	2	Zr	4081·39	10	5	0	Possibly Sc.

Spectrum of chromosphere.			Probable identification.					
					Intensity.			
Wave-length.	No. of photos.	Intensity.	Element.	Wave-length.	Spark.	Arc.	Sun.	
4082·62	2	1	Ti	4082·59	3	7	5	Solar line Sc-Ti-Fe.
4083·52	5	2	—	—	—	—	—	
4084·60	1	1	—	—	—	—	—	
4085·63	1	1	—	—	—	—	—	
4086·88	6	4	La	4086·86	20	10	1	
4087·82	3	1	—	—	—	—	—	
4089·01	3	2	Si	(4089·1)	2	—	—	? Identification.
4089·57	1	0	—	—	—	—	—	
4090·06	2	2	—	—	—	—	—	
4090·78	3	2	V	4090·73	8	5	1	
4092·87	4	2	V Ca	4092·82	15 1	3 4	3d ? —	
4094·56	1	2	—	—	—	—	—	
4095·58	1	0	V	4095·63	6	5	0	
4097·05	1	0	Si	(4096·9)	1	—	—	
4099·09	1	1	—	—	—	—	—	
4100·16	1	1	—	—	—	—	—	
4101·92	7	30	H_δ	—	—	—	—	
4103·15	1	2	Si	4103·10	1	—	5	Identified in sun as Si, Mn.
4105·09	3	2	La	4105·10	1	10	1	? Identification.
4106·61	1	1	—	—	—	—	—	
4107·58	5	1	Fe	4107·65	4	8	5	Identified in sun as Ce-Fe.
4109·61	6	4	Nd	4109·61	8	—	1	
4110·64	2	1	Co	4110·69	10	8	4	
4112·14	2	1	—	—	—	—	—	
4113·07	1	0	—	—	—	—	—	
4114·13	3	2	—	—	—	—	—	
4115·43	2	1	—	—	—	—	—	
4116·66	1	1	—	—	—	—	—	
4118·58	4	2	Fe	4118·71	5	10	5	
4119·37	1	1	—	—	—	—	—	
4120·10	3	1	—	—	—	—	—	
4121·27	2	1	He Co	(4120·97) 4121·48	— 10	— 4	— 6d ?	Identified in sun as Cr-Co.
4122·70	3	1	Fe	4122·67	2	6	3	
4123·56	6	3	La Ti	4123·38 4123·70	30 5	10 5	1 0	Double on one photo., 4123·45 and 4124·01.
4125·05	6	2	Y	4125·06	6	—	1	
4126·22	1	2	—	—	—	—	—	
4127·67	4	2	Ti	4127·69	7	5	0	
4128·31	4	2	Si V	4128·21 4128·25	5 10	— 7	— 6d ?	Identified in sun as Ce-V.
4128·93	1	0	—	—	—	—	—	
4129·87	5	4	Eu	4129·88	100	100	1	
4130·97	6	2	—	—	—	—	—	
4131·93	1	0	—	—	—	—	—	

Spectrum of chromosphere.			Probable identification.					
					Intensity.			
Wave length.	No. of photos.	Intensity.	Element.	Wave-length.	Spark.	Arc.	Sun.	
4132·59	3	1	Fe	4132·23	6	8	10	
			—	4132·69	—	—	3	
4133·08	1	0	Fe	4133·06	4	8	4	
4133·83	4	1	Ce	4133·97	8	10	0	Measures discordant, 4133·73, 4133·75, 4134·01, 4133·84.
4134·81	3	1	Fe	4134·84	5	10	5	
4135·58	7	2	—	—	—	—	—	
4137·54	7	3	—	4137·57	—	—	2	
4138·62	1	0	—	—	—	—	—	
4143·27	2	1	Nd	4143·30	8	—	—	
4143·91	1	1	p He	4143·92	2	—	—	
			Fe	4144·04	7	10	15	
4143·27	4	3	—	—	—	—	—	On four photos. there are two bright lines separated by an absorption line.
4144·04	Absn.	line	—	—	—	—	—	
4144·88	4	2	—	—	—	—	—	
4146·36	4	2	—	—	—	—	—	
4149·33	6	3	Zr	4149·36	20	10	2	
4150·10	4	2	Ce	4150·06	10	—	00	
4151·07	5	2	Ti, Zr	4151·13	5	5	1	
					6	4		
4152·14	5	2	La	4152·11	10	8	2	Identified in sun as Fe, La. Possibly Ce.
4153·96	1	1	Fe	4154·07	2	4	4	
4154·71	4	1	Fe	4154·67	4	6	4	
				4154·98	3	6	4	
4155·66	2	1	—	—	—	—	—	
4156·33	7	5	Nd	4156·24	10	—	0	
			Zr	4156·39	10	8	1	
4157·26	2	1	—	—	—	—	—	
4158·05	3	1	Fe	4157·95	2	6	5	
4161·51	4	3	Zr	4161·37	10	7	2	
			Ti	4161·68	2	2	4	
4162·73	1	1	—	—	—	—	—	
4163·80	5	4	Ti	4163·82	20	2	4	Identified in sun as Ti-Cr.
4164·43	2	1	—	—	—	—	—	
4165·71	3	2	Ce	4165·76	10	4	1	
4166·93	1	0	—	—	—	—	—	
4167·42	3	3	—	4167·44	—	—	8	Very broad. ? Double.
4168·80	1	0	—	—	—	—	—	
4169·58	1	0	—	—	—	—	—	
4169·95	3	1	—	—	—	—	—	
4170·89	2	1	—	—	—	—	—	
4172·05	7	3	Ti	4172·07	10	1	2	
4172·81	1	0	—	—	—	—	—	
4173·53	8	5	Fe	4173·53	2	1	1	
4174·48	2	1	—	—	—	—	—	
4175·62	3	1	Fe	4175·81	4	8	5	Wave-length of arc line 4175·71 (K. and R.).

Spectrum of chromosphere.			Probable identification.					
					Intensity.			
Wave-length.	No. of photos.	Intensity.	Element.	Wave-length.	Spark.	Arc.	Sun.	
4176·56	3	1	—	—	—	—	—	
4177·66	9	6	Y	4177·70	50	5	3	
4179·03	9	6	Fe	4179·03	2	1	3	
4179·69	3	2	—	—	—	—	—	
4181·01	2	0	C	4180·97	—	—	2N	
4183·53	1	1	—	—	—	—	—	
4184·32	1	1	—	—	—	—	—	
4186·76	1	1	Ce	4186·78	10	—	2N	Identified in sun as Ce-Zr.
4188·18	2	0	—	—	—	—	—	
4188·32	1	0	—	—	—	—	—	
4192·61	1	1	—	—	—	—	—	
4193·45	3	1	—	—	—	—	—	
4194·08	1	0	—	—	—	—	—	
4194·58	1	0	—	—	—	—	—	
4195·10	1	0	—	—	—	—	—	
4195·52	1	1	Fe	4195·49	3	6	5	
4196·75	3	2	La	4196·70	10	0	2	
4197·15	1	1	—	—	—	—	—	
4198·15	2	1	—	—	—	—	—	
4198·73	1	0	—	—	—	—	—	
4199·18	3	1	Fe	4199·27	8	10	5	Identified in sun as Zr-Fe.
4200·73	1	1	—	—	—	—	—	
4202·10	2	2	Fe	4202·20	9	10	8	
4203·35	2	1	—	—	—	—	—	
4205·21	4	6	Eu	4205·19	100	50	1	
4206·57	2	1	—	—	—	—	—	
4209·15	3	2	Zr	4209·14	10	0	1	
4211·46	1	1	—	—	—	—	—	
4212·17	3	1	Zr	4212·05	5	0	2	
4215·71	5	12	Sr	4215·70	100	10	5d ?	
4217·22	1	0	—	—	—	—	—	
4217·57	3	0	—	—	—	—	—	
4218·61	1	0	Zr	4218·56	2	0	1Nd	
4220·43	1	0	—	—	—	—	—	
4220·73	1	0	—	—	—	—	—	
4222·72	1	1	—	—	—	—	—	
4223·08	3	2	—	—	—	—	—	
4225·49	3	2	V	(4225·41)	4	1	—	
4226·85	4	6	Ca	4226·90	100	75	20d ?	
4227·42	1	1	Fe	4227·61	7	10	4	? Enh. Ti, 27·40 (L).
4231·96	1	0	Zr	4231·86	6	0	1	
4232·60	3	1	—	—	—	—	—	
4233·36	5	7	Fe	4233·33	4	1	4	
4235·40	1	1	Mn	4235·30 4235·45	20	10 10	2 3	

Spectrum of chromosphere.			Probable identification.					
					Intensity.			
Wave-length.	No. of photos.	Intensity.	Element.	Wave-length.	Spark.	Arc.	Sun.	
4236·04	3	1	Fe	4236·11	8	10	8	
4236·93	1	1	—	—	—	—	—	
4237·75	1	0	—	—	—	—	—	
4238·28	1	0	—	—	—	—	—	
4238·51	1	1	La	4238·55	10	10	1Nt	
4238·91	1	1	Fe	4238·97	4	8	5	
4240·13	1	0	—	—	—	—	—	
4242·53	2	1	Cr	4242·54	8	1	2	
4243·59	3	1	—	—	—	—	—	
4244·93	2	0	—	—	—	—	—	
4247·00	5	10	Sc	4247·00	100	10	5	
4248·92	2	1	—	—	—	—	—	
4250·19	2	1	Fe	4250·29	7	10	8	
4250·85	1	0	Fe	4250·95	8	10	8	
4251·82	1	1	—	—	—	—	—	
4254·51	5	3	Cr	4254·51	50	50	8	
4256·31	2	1	—	—	—	—	—	
4258·24	3	2	Zr	4258·20	7	5	0	
4260·51	2	2	Fe	4260·64	10	10	10	
4262·14	3	2	Cr	4262·14	4	0	1	
4271·87	3	2	Fe	4271·93	10	10	15	
4273·02	1	0	—	—	—	—	—	
4273·55	2	2	—	—	—	—	—	
4274·99	5	3	Cr	4274·96	30	50	7	
4275·71	3	1	—	—	—	—	—	
4280·39	1	0	—	—	—	—	—	
4282·76	3	2	—	—	—	—	—	
4284·13	1	0	—	—	—	—	—	
4285·96	1	0	—	—	—	—	—	
4286·48	1	0	—	—	—	—	—	
4287·29	1	0	La	4287·16	20	10	2	Identification doubtful
4288·10	4	2	Ti	4288·04	2	1	2	
4289·06	1	1	—	—	—	—	—	
4289·77	1	1	Cr	4289·89	30	15	5	On one photo. 4289·77, intensity 1; 4290·32, intensity 5.
4290·21	5	5	Ti	4290·37	9	5	2	On the others only one line.
4291·19	2	1	Ti	4291·11	4	3	3	
				4291·28	4	3	2	
4292·14	2	1	—	—	—	—	—	
4293·09	2	1	—	—	—	—	—	? Double.
4294·22	5	2	Ti	4294·20	10	5	2	
4295·20	2	1	—	—	—	—	—	
4296·11	2	1	Ti	4295·91	4	10	3	Identified in sun as Cr-Ti.
			La	4296·24	10	8	0N	
4296·83	4	4	Fe	4296·74	1	—	3	
			Zr	4296·84	5	—	1	

Spectrum of chromosphere.			Probable identification.					
					Intensity.			
Wave-length.	No. of photos.	Intensity.	Element.	Wave-length.	Spark.	Arc.	Sun.	
4298·03	2	1	—	—	—	—	—	
4298·72	1	1	—	—	—	—	—	As a single line 4298·86 on another photo.
4299·07	1	1	—	—	—	—	—	
4300·22	5	5	Ti	4300·21	8	5	3	
4300·70	1	0	Ti	4300·73	4	7	2	
4301·17	1	1	Ti	4301·17	6	7	2	
4302·07	3	2	Ti	4302·09	6	2	2	
4302·55	2	1	—	—	—	—	—	
4302·94	1	3	—	—	—	—	—	
4303·51	4	3	Fe	4303·34	2	1	2	4303·63, 4303·52 br, 4303·43 ? d, 4303·44, are separate results.
				4303·58	—	—	1N	
4305·30	1	1	—	—	—	—	—	
4305·83	2	3	Sr	4305·61	30	6	3	Identified in sun as Fe, Cr, Sr, Ti.
			Ti	4306·08	15	15	4	
4308·02	4	4	Ca	4307·91	20	3	3	
			Fe	4308·08	10	10	6	
4309·86	4	2	Y	4309·79	20	6	1	
4312·54	1	1	—	—	—	—	—	
4313·02	5	2	Ti	4313·03	8	2	3	
4314·31	4	2	Sc	4314·25	30	3	3	
4315·13	5	3	Ti	4315·14	7	4	3	
4317·29	2	1	—	—	—	—	—	
4319·03	2	1	—	—	—	—	—	
4320·98	5	4	Sc	4320·91	20	3	3	
			Ti	4321·12	2	1	2	
4323·15	1	0	—	—	—	—	—	Diffused.
4323·72	1	1	—	—	—	—	—	
4325·25	2	1	Sc	4325·15	20	3	4	
4325·88	5	4	Fe	4325·94	10	10	8	
4329·20	2	1	—	—	—	—	—	
4330·58	4	2	Ti	4330·40	2	3	1	
				4330·87	2		2	
4331·47	1	1	—	—	—	—	—	
4333·05	1	1	V	4332·90	12	6	0	? Identification.
4333·98	3	3	La	4333·93	15	15	1N	
4335·49	1	0	—	—	—	—	—	
4336·12	1	0	—	—	—	—	—	
4336·70	2	0	—	—	—	—	—	
4338·05	5	5	Ti	4338·08	10	6	4	
4340·65	5	100	H_γ	4340·64	—	—	20	
4342·85	1	0	—	—	—	—	—	
4343·74	1	0	—	—	—	—	—	
4344·55	3	2	Ti	4344·45	2	1	2	
			Cr	4344·67	10	7	4	

Spectrum of chromosphere.			Probable identification.					
					Intensity.			
Wave-length.	No. of photos.	Intensity.	Element.	Wave-length.	Spark.	Arc.	Sun.	
4346·40	2	0	—	4346·45	—	—	1	
4348·06	3	1	Zr	4348·13	8	3	1	
4350·00	2	0	—	—	—	—	—	
4352·00	4	4	Fe	4351·93	4	2	—	
			Cr	4351·93	10	9	5	
			Mg	4352·08	4	8	5	
4353·10	2	0	V	4353·04	12	7	0	
4354·61	3	1	—	—	—	—	—	
4356·28	2	1	—	—	—	—	—	
4358·39	2	1	—	—	—	—	—	
4358·89	3	1	Y	4358·88	8	5	0	
4359·82	3	2	Cr	4359·78	7	8	3	
			Zr	4359·90	10	8	0	
4364·77	3	2	Ce	4364·83	4	—	0	? Identification.
4366·71	1	2	—	—	—	—	—	
4367·85	2	2	Ti	4367·84	6	3	2	
4369·86	2	2	Fe	4369·94	3	8	4	
4371·32	3	2	—	4371·24	—	—	1	
			Cr	4371·44	7	10	2	
4372·59	2	1	—	—	—	—	—	
4373·97	1	1	—	—	—	—	—	
4375·14	4	7	Y	4375·10	100	8	2	
4379·94	1	2	Zr	4379·93	12	7	0	
4383·72	3	5	Fe	4383·72	10	10	15	
4385·63	3	4	Fe	4385·55	1	0	2	
4387·01	2	1	Ti	4387·01	5	2	1	
4388·17	2	1	p He	(4388·10)	5	—	—	
4390·28	1	1	—	—	—	—	—	
4391·03	3	2	—	—	—	—	—	
4391·99	3	1	—	—	—	—	—	
4393·34	1	0	—	—	—	—	—	
4394·08	2	1	—	—	—	—	—	
4395·24	4	8	Ti	4395·20	15	8	3	
4398·20	3	2	Y	4398·18	15	5	1	
4399·90	3	2	Ti	4399·94	10	2	3	Identified in sun as Ti-Cr.
4400·67	3	3	Sc	4400·56	20	3	3	
4401·49	1	1	—	—	—	—	—	
4403·49	2	2	Zr	4403·53	4	1	0	
4404·51	1	0	—	—	—	—	—	
4404·89	2	1	Fe	4404·93	10	10	10	
4406·66	1	0	—	—	—	—	—	
4408·97	2	3	—	—	—	—	—	Broad band.
4411·15	2	2	Ti	4411·24	6	0	1	Identified in sun as — Cr.
4412·33	2	1	—	—	—	—	—	
4413·93	1	1	—	—	—	—	—	

Spectrum of chromosphere.			Probable identification.					
					Intensity.			
Wave-length.	No. of photos.	Intensity.	Element.	Wave-length.	Spark.	Arc.	Sun.	
4415·17	1	1	Fe	4415·29	8	10	8	
4415·65	2	2	Sc	4415·72	15	2	3	
4416·98	2	3	—	4416·98	—	—	2	
4417·93	3	3	Ti	4417·88	6	5	3	
4418·73	1	0	—	—	—	—	—	
4421·83	2	1	Ti	4421·93	3	4	00	
4422·92	2	1	Y	4422·74	10	—	3	
4424·53	2	2	—	—	—	—	—	
4427·30	2	2	Ti	4427·27	8	10	2	
4429·41	1	1	—	—	—	—	—	
4430·08	2	2	La	4430·07	8	10	00N	
4434·30	2	1	—	—	—	—	—	*
4435·53	2	2	Ca	4435·13	20	5	5	Possibly Eu 4435·7.
				4435·85	15	3	4	
4443·98	4	6	Ti	4443·98	15	3	5	
4446·55	2	3	—	—	—	—	—	
4447·93	2	1	Fe	4447·89	3R	8	6	
4449·48	2	2	Ti	4449·31	10	10	2	
4450·50	4	2	—	4450·48	—	—	1	
			Ti	4450·65	6	1	2	
4454·96	2	1	Ce	4454·95	30	8	5	
4457·48	2	1	—	—	—	—	—	
4458·51	2	1	—	—	—	—	—	
4459·65	1	0	—	—	—	—	—	
4460·37	3	1	—	—	—	—	—	
4461·44	2	1	—	—	—	—	—	
4462·45	3	1	—	—	—	—	—	
4463·31	2	1	—	—	—	—	—	
4464·65	3	1	Ti	4464·62	2	3	2	
4466·65	1	0	Fe	4466·73	5	8	5	
4468·71	5	5	Ti	4468·66	15	6	5	
4469·57	2	1	Fe	4469·55	2	8	4	
4471·51	5	7	He	(4471·65)	6	—	—	
4472·98	3	1	—	—	—	—	—	
4474·11	1	0	—	—	—	—	—	
4474·99	1	0	—	—	—	—	—	
4476·06	3	1	Fe	4476·19	5	10	4	
4479·61	1	1	—	—	—	—	—	
4481·33	2	1	Mg	4481·30	100	0	00	Separate measures, 4481·23, 4481·43.
			Ti	4481·43	7	5	1	
4482·14	2	1	Fe	4482·34	4	8	5	
4483·93	1	1	—	—	—	—	—	
4485·61	1	1	—	—	—	—	—	
4487·05	1	1	—	—	—	—	—	
4487·73	1	0	—	—	—	—	—	

Spectrum of chromosphere.			Probable identification.					
					Intensity.			
Wave-length.	No. of photos.	Intensity.	Element.	Wave-length.	Spark.	Arc.	Sun.	
4488·44	1	1	Ti	4488·49	7	3	1	
4489·36	4	3	Fe	4489·35	1	0	2	
4491·68	4	3	Fe	4491·57	1	0	2	
4494·37	1	1	—	—	—	—	—	
4494·87	1	1	—	—	—	—	—	
4496·87	4	2	Cr	4497·02	6	5	3	
4499·19	2	0	—	—	—	—	—	
4501·51	5	6	Ti	4501·46	15	6	5	
4505·97	1	0	—	—	—	—	—	
4507·05	1	0	—	—	—	—	—	
4508·45	4	3	Fe	4508·46	2	1	4	
4512·32	1	1	—	—	—	—	—	
4514·61	1	1	—	—	—	—	—	
4515·54	4	3	Fe	4515·51	1	1	3	
4518·51	1	2	—	—	—	—	—	
4520·41	4	4	Fe	4520·40	1	1	3	
4522·84	5	5	Fe	4522·80	2	1	3	
4527·82	1	0	—	—	—	—	—	
4528·96	2	1	Fe	4528·80	6R	10	8	
4529·79	1	0	Al	(4529·80)	10	0	—	(LOCKYER.)
4531·24	3	1	Co	4531·12	20	9	2	
			Fe	4531·33	1	3	5	
4534·18	5	6	Ti	4534·14	8	4	6	
4535·94	4	2	Ti	(4535·95)	6, 6	6, 6, 6	3, 2, 2	
4539·89	4	1	—	—	—	—	—	
4541·50	3	1	Fe	(4541·40)	3	1	—	(LOCKYER.)
4542·03	1	0	—	—	—	—	—	
4544·26	1	0	—	—	—	—	—	
4545·33	3	2	—	—	—	—	—	? Double.
4547·64	2	0	—	—	—	—	—	
4549·79	5	8	Ti	4549·81	15	4	6d ?	Identified in sun as Ti, Co.
4550·99	1	0	—	—	—	—	—	
4552·64	2	1	Ti	4552·63	4	5	2	
			Si	4552·73	8	—	1	
4554·18	5	7	Ba	4554·21	1,000	10	8	
4556·05	4	4	Fe	4556·06	1	1	3	
4558·71	5	2	Cr	4558·83	10	2	3	
4560·73	4	1	—	—	—	—	—	? Double.
4563·14	1	0	—	—	—	—	—	
4563·96	5	6	Ti	4563·94	15	4	4	
4565·82	3	2	—	—	—	—	—	
4567·02	2	0	—	—	—	—	—	
4569·22	1	1	—	—	—	—	—	
4572·20	5	7	Ti	4572·16	20	5	6	
4574·95	1	1	—	—	—	—	—	

Spectrum of chromosphere.			Probable identification.					
					Intensity.			
Wave-length.	No. of photos.	Intensity.	Element.	Wave-length.	Spark.	Arc.	Sun.	
4576·52	3	1	Fe	4576·51	1	—	2	
4577·56	2	0	—	—	—	—	—	
4578·86	2	0	—	—	—	—	—	
4580·59	3	1	V	4580·59	10	8	1	
4581·80	2	1	Co	4581·69	10	7	4	
4583·03	1	1	—	—	—	—	—	
4584 06	5	6	Fe	4584·02	4	2	4	
4586·79	1	0	—	—	—	—	—	
4588·29	3	1	Cr	4588·38	10	1	3	
4590·11	3	1	Ti	4590·13	7	1	3	
4592·55	3	1	Cr	4592·25	4	0	1	Enh. Cr (L).
				4592·71	1	0	—	
4594·19	4	1	—	—	—	—	—	
4595·77	1	1	—	—	—	—	—	
4596·95	1	1	—	—	—	—	—	
4598·34	2	0	Fe	4598·30	1	6	3	
4600·70	3	2	—	—	—	—	—	
4609 71	1	0	—	—	—	—	—	
4611·58	2	1	—	—	—	—	—	
4613 64	2	2	—	—	—	—	—	
4616 45	2	1	Cr	4616·31	7	6	4	
4619·20	2	1	Cr	4618·97	5	0	4d ?	
			Cr	4619·47	5	0	3	
4620·40	2	1	—	—	—	—	—	
4622·89	3	2	—	—	—	—	—	
4624·90	1	0	—	—	—	—	—	
4626·58	1	0	—	—	—	—	—	
4629·49	3	6	Fe	4629·52	1	1	6	Identified in sun as Ti, Co, Fe.
4632·76	1	1	—	—	—	—	—	
4634·07	1	2	Cr	4634·25	6	1·5	2	
4637·90	1	1	—	—	—	—	—	
4639 88	2	3	Ti	(4639·86)	5, 4, 5	5, 5, 5	2, 2, 1	
4643·13	1	0	—	—	—	—	—	
4646·36	2	3	Cr	4646·35	7	8	5	
4648·75	2	2	Ni	4648·84	6	3	4	
4652·12	2	1	Cr	4651·46	6	7	4	}
				4652·34	7	7	5	}
4654·63	3	1	Fe	4654·67	—	10	4	
				4654·80	—	—	5	
4657·00	3	2	Ti	(4657·08)	6, 3	3	3, 1, 2	
4662·32	1	0	—	—	—	—	—	
4663·64	2	3	Al	(4663·70)	10	0	—	
4667·16	3	3	—	—	—	—	—	
4669·46	1	0	—	—	—	—	—	
4670·45	3	2	Sc	4670·59	7	0	2	

Spectrum of chromosphere.			Probable identification.					Lord.		
					Intensity.					
Wave-length.	No. of photos.	Intensity.	Element.	Wave-length.	Spark.	Arc.	Sun.	Wave-length.	Intensity.	
4672·85	1	0	—	—	—	—	—			
4678·78	1	1	Fe	4679·03	1	8	6			
4680·36	1	1	Zn	4680·32	—	20	1			
4682·20	2	2	—	—	—	—	—			
4689·45	1	0	—	—	—	—	—			
4697·26	1	2	—	—	—	—	—			
4698·90	2	3	—	—	—	—	—			
4703·65	2	1	—	—	—	—	—			
4707·25	1	1	—	—	—	—	—			
4708·89	2	1	—	—	—	—	—			
4710·21	2	1	—	—	—	—	—			
4713·37	1	1	He	(4713·25)	3	—	—			
4714·47	2	2	Ni	4714·60	3	—	6			
4715·48	1	1	—	—	—	—	—			
4722·49	2	2	Zn	4722·34	—	20	3			
4728·05	2	2	—	—	—	—	—			
4731·64	2	3	Fe	4731·64	—	1	4			
4737·05	2	3	Fe	4736·96	1	10	6			
4740·42	2	1	—	—	—	—	—			
4743·45	1	1	—	—	—	—	—			
4746·04	1	0	—	—	—	—	—			
4749·53	1	1	—	—	—	—	—			
4751·87	1	0	—	—	—	—	—			
4754·46	1	0	Mn	4754·23	—	10	7			
4756·63	1	0	—	—	—	—	—			
4758·20	1	0	—	—	—	—	—			
4762·62	1	1	Mn	4762·57	—	8	5			
4764·39	1	1	—	—	—	—	—			
4766·13	1	1	Mn	4766·05 4766·62	— —	7	3 4			
4768·54	1	0	—	—	—	—	—			
4773·99	1	0	—	—	—	—	—			
4776·37	2	1	—	—	—	—	—	4776·00	1	
4778·06	2	1	—	—	—	—	—	—	—	
4780·39	2	1	—	—	—	—	—	4780·10	1	
4783·69	2	2	Mn	4783·61	—	10	6	4783·45	1	
4786·83	2	2	Y	4786·80	—	—	—	4786·52	1	
4789·70	2	2	—	—	—	—	—	4789·51	1	
4792·93	2	2	—	—	—	—	—	—	—	
4796·18	1	0	—	—	—	—	—	—	—	
4798·67	2	2	—	—	—	—	—	4798·76	1	
4800·97	2	1	—	—	—	—	—	—	—	
4805·30	3	3	Ti	4805·29	4	1	3	4805·16	2	
4811·04	1	2	Zn	4810·72	—	20	3	4810·90	1	
4815·97	1	0	—	—	—	—	—	—	—	

Spectrum of chromosphere.			Probable identification.					Lord.		
					Intensity.					
Wave-length.	No. of photos.	Intensity.	Element.	Wave-length.	Spark.	Arc.	Sun.	Wave-length.	Intensity.	
4824·11	2	3	Cr	4824·33	8	1	3	4823·95	2	
4829·24	1	1	—	—	—	—	—	—	—	
4832·59	2	1	—	—	—	—	—	—	—	
4836·53	2	1	—	—	—	—	—	—	—	
4840·53	1	1	Co	4840·45	—	9	2	—	—	
			Fe	4840·50	—	1	3	—	—	
4844·02	1	1	—	—	—	—	—	—	—	
4846·71	1	1	—	—	—	—	—	—	—	
4848·83	1	2	Cr	4848·44	—	1	2	4848·39	1	
4849·30	1	1	—	—	—	—	—	—	—	
4855·50	2	2	Ni	4855·60	—	—	3	4855·22	1	
4861·53	2	100	H_β	4861·53	—	—	30	4861·51	20	
4866·15	1	1	—	—	—	—	—	—	—	
4868·20	2	2	—	—	—	—	—	—	—	
4871·74	2	2	Fe	4871·51	—	8	5	4871·74	1	
				4872·33	—	8	4			
4881·66	2	1	—	—	—	—	—	—	—	
4883·77	2	2	Y	4883·87	—	—	2	4883·74	2	
4885·91	1	1	—	—	—	—	—	—	—	
4891·59	2	3	Fe	4891·69	5	10	8	4891·24	2	
4894·04	1	1	—	—	—	—	—	—	—	
4900·26	2	4	Y	4900·30	—	6	2	4900·05	2	
4904·04	1	1	—	—	—	—	—	4904·37	1	
4909·94	1	0	—	—	—	—	—	4910·54	1	
4911·14	1	0	Ti	4911·38	—	3	1			
4911·98	1	0	—	—	—	—	—	—	—	
4913·10	1	0	—	—	—	—	—	—	—	
4914·34	1	1	—	—	—	—	—	4913·91	1	
4919·17	2	1	Fe	4919·17	—	8	6	4919·16	1	
4921·17	2	3	Fe	4920·69	12	9	10	4920·61	1	
			p He	4922·10	4	—	—			
4924·11	2	8	Fe	4924·11	15	1	5	4924·12	5	
4928·11	1	0	—	—	—	—	—	—	—	
4930·87	1	1	—	—	—	—	—	—	—	
4934·17	2	3	Ba	4934·25	—	100	7	4934·21	5	
4938·70	2	1	Fe	4939·00	—	6	4	4938·92	1	
4952·48	1	0	—	—	—	—	—	—	—	
4957·58	2	2	Fe	4957·49	2	6	5	4957·57	3	
				4957·79	10	8	8			
5013·95	1	1	—	—	—	—	—	5013·28	1	
								5014·59	1	
5018·56	2	7	Fe	5018·63	10	3	4	5018·67	5	
5022·07	1	0	—	—	—	—	—	—	—	
5030·80	1	1	—	5031·20	—	—	3	5031·20	2	

Spectrum of chromosphere.			Probable identification.					Lord.		
					Intensity.					
Wave-length.	No. of photos.	Intensity.	Element.	Wave-length.	Spark.	Arc.	Sun.	Wave-length.	Intensity.	
5097·07	1	0	Fe	5097·17	—	4	3	5097·0	1	
5100·16	1	0	—	—	—	—	—	5101·0	1	
5154·44	1	0	Ti	5154·24	—	0	2	5154·12	1	
5162·93	1	0	Fe	5162·45	—	6	5	5162·05	1	
5164·25	1	1	—	—	—	—	—	—	—	
5167·70	1	0	Mg	5167·50	—	10	15	5167·39	5	
			Fe	5167·68	5	4	5			
5169·01	2	4	Fe	5169·07	5	4	3	5169·14	5	
				5169·22	10	2	4			
5173·01	2	4	Mg	5172·86	—	15	20	5173·22	5	
5178·14	2	1	—	—	—	—	—	—	—	
5183·80	2	5	Mg	5183·79	—	20	30	5184·18	8	
5188·38	1	0	—	—	—	—	—	5188·78	1	
5192·98	1	0	Fe	5192·52	—	10	5	5192·10	1	
5196·80	1	0	—	—	—	—	—	5195·29	1	
								5197·56	1	
5205·99	2	1	Cr	5206·22	—	10	5	5205·43	1	
5219·74	1	1	—	—	—	—	—	—	—	
5227·21	2	2	Fe	5227·04	—	10	3	5226·95	1	
5234·88	2	2	—	5234·79	—	—	2	5234·42	2	
5249·80	1	0	—	—	—	—	—	5250·68	1	
5254·96	1	1	—	—	—	—	—	5254·98	1	
5265·59	1	1	Ca	5265·73	—	—	—	5261·0 band	1	
								5267·0 band	1	
5270·03	2	1	Fe	5269·72	—	10	8d ?	5270·02	5	
				5270·56	—	10	4			
5276·24	2	2	Fe	5276·17	—	3	3	5276·16	4	
			—Cr	5276·24	—	6	2			
5280·84	1	0	—	—	—	—	—	5281·39	1	
5284·66	2	2	—	—	—	—	—	5283·92	2	
5289·46	1	0	—	—	—	—	—	—	—	
5293·82	1	1	—	—	—	—	—	—	—	
5299·00	1	0	—	—	—	—	—	5297·97	1	
5302·97	1	1	Fe	5302·48	—	10	5	5302·38	1	
5312·53	1	0	—	—	—	—	—	—	—	
5316·94	2	4	Fe	5316·79	3	2	4	5316·88	4	Enh. sp. 3. Arc 0. Lockyer.
				5316·96	—	—	2			
5329·03	2	2	—	—	—	—	—	5328·33	4	
5337·39	2	1	Ti	5336·97	—	3	4	5336·84	1	
5341·05	1	0	Fe	5341·21	—	8	7	5340·95	1	
5362·83	2	1	—	—	—	—	—	5262·92	2	
5371·72	2	2	Cr	5371·66	—	0	2	5371·58	3	
			Fe	5371·73	—	10	3			
5377·65	1	0	—	—	—	—	—	—	—	
5381·18	1	0	—	—	—	—	—	5381·00	1	

Spectrum of chromosphere.			Probable identification.					Lord.	
					Intensity.				
Wave-length.	No. of photos.	Intensity.	Element.	Wave-length.	Spark.	Arc.	Sun.	Wave-length.	Intensity.
5404·65	1	0	Fe	5404·36	—	8	5	5404·25	1
5406·37	2	1	Fe	5405·99	—	10	6	5405·79	2
5410·65	2	1	—	—	—	—	—	5410·02	1
5415·12	2	1	Fe	5415·42	—	10	5	5415·03	1
5419·63	1	0	—	—	—	—	—	5419·12	1
5425·49	2	2	—	5425·47	—	—	1	5425·06	1
5430·00	2	2	Fe	5429·91	—	10	6d?	5429·65	2
5434·58	2	1	Fe	5434·70	—	8	5	5434·69	2
5447·19	2	2	Fe	5447·13	—	10	6d?	5447·08	2
5451·94	2	1	—	—	—	—	—	—	—
5456·36	2	2	Fe	5455·83	—	10	4	5455·86	3
5463·35	2	2	Fe	5463·17	—	1	3	5462·70	1
				5463·49	—	8	3		
5466·83	2	1	Fe	5466·61	—	4	3	—	—
5473·43	2	1	—	—	—	—	—	—	—
5477·21	2	3	—	—	—	—	—	5476·86	2
5482·52	2	1	—	—	—	—	—	—	—
5488·31	1	0	—	—	—	—	—	—	—
5493·41	1	0	—	—	—	—	—	—	—
5498·16	1	0	Fe	5497·74	—	1	5	5497·73	1
5503·08	1	0	Fe	5501·68	—	8	5	5501·62	1
5507·14	1	0	Fe	5507·00	—	8	5	5506·69	1
5510·85	1	0	—	—	—	—	—	—	—
5514·15	1	1	—	—	—	—	—	—	—
5527·23	2	3	Sc	5527·03	—	—	3	5527·65	2
5535·37	2	3	—	—	—	—	—	5535·30	2
5540·96	1	0	—	—	—	—	—	—	—
5544·92	2	2	—	—	—	—	—	—	—
5555·39	1	0	Fe	5555·12	—	6	3	—	—
5588·23	1	0	—	—	—	—	—	5588·09	1
5600·15	1	0	—	—	—	—	—	—	—
5602·73	1	2	—	—	—	—	—	5602·57	1
5615·59	1	2	Fe	5615·88	—	10	6	5615·52	1
5616·95	1	1	—	—	—	—	—	—	—
5619·97	1	1	—	—	—	—	—	—	—
5623·40	1	0	—	—	—	—	—	—	—
5625·33	1	2	Fe	5624·77	—	8	4	5624·98	1
5635·16	1	1	—	—	—	—	—	—	—
5642·52	2	1	—	—	—	—	—	5641·17	1
5647·57	1	0	—	—	—	—	—	—	—
5658·42	2	2	Y	5658·10	—	—	2	5658·02	1
5663·17	1	1	Y	5663·15	—	—	1	5663·56	1
5668·02	1	1	—	—	—	—	—	—	—
5875·87	2	3	He	5875·87	10	—	—	—	—

PHILOSOPHICAL TRANSACTIONS OF THE ROYAL SOCIETY A MATHEMATICAL, PHYSICAL & ENGINEERING SCIENCES

Hydrogen.

In the following table a comparison is given of the measured wave-lengths of the hydrogen lines with those computed by the formula

$$\lambda = \frac{1}{\alpha} \cdot \frac{n^2}{n^2-4} \left[\text{where } \alpha = \frac{1}{27418{\cdot}75} \text{ and is derived from ROWLAND'S values for } H_\alpha, H_\beta, H_\gamma \right]$$

and corrected for air :—

Line.	Intensity.	Wave-length.	Tabular.	T – O.	
δ	30	4101·92	1·90	– 0·02	
ϵ	30	3970·21	0·22	+ 0·01	
ζ	20	3889·15	9·20	+ 0·05	He line at 3888·72.
η	20	3835·53	5·53	0·00	
θ	19	3798·06	8·04	– 0·02	
ι	15	3770·79	0·77	– 0·02	
κ	10	3750·32	0·30	– 0·02	
λ	12	3734·52	4·51	– 0·01	
μ	12	3722·05	2·08	+ 0·03	
ν	10	3712·12	2·11	– 0·01	
ξ	10	3704·00	4·00	0·00	
o	8	3697·29	7·29	0·00	
π	8	3691·70	1·70	0·00	
ρ	7	3687·00	6·97	– 0·03	
σ	4	3682·92	2·95	+ 0·03	
τ	3	3679·50	9·49	– 0·01	
υ	3	3676·54	6·50	– 0·04	
ϕ	3	3673·90	3·90	0·00	
χ	3	3671·46	1·48	+ 0·02	Zr line at 3671·41.
ψ	2	3669·58	9·60	+ 0·02	
ω	2	3667·89	7·82	– 0·07	
α'	2	3666·21	6·24	+ 0·03	
β'	3	3664·78	4·82	+ 0·04	Y line at 3664·76.
γ'	2	3663·58	3·54	– 0·04	
δ'	2	3662·35	2·40	+ 0·05	Ti line at 3662·38.
ϵ'	1	3661·39	1·35	– 0·04	

The agreement with the formula is very close: there is a mean difference of –·010 which could be corrected by a slight change in the constant, but it is open to doubt whether this is a real difference. It seems that BALMER'S law for the hydrogen lines holds to within about ·01 of a tenth-metre.

Helium.

The helium lines are strongly shown, but those of par-helium are doubtful. There is a line at 4388·10 which may coincide with 4388·15, intensity 3. The line at 3964 possibly occurs as a compound line. The lines at 5015 and 4922 are not shown.

Argon, Xenon, Neon, Krypton.

There is no evidence of the presence of these gases in the chromosphere.

Carbon.

A number of carbon lines including the heads of the band at 3833 are shown, but not very strongly.

Sodium.

The lines D_1 and D_2 can be seen faintly on one of the Sumatra photographs, and the lines at 3303 are probably shown.

Magnesium.

The *b* lines and the triplet at 3838, 3832, 3829 are very strongly shown, but that at 3336, 3332, 3329 is not shown. The arc lines at 4352 and 4703 may possibly be represented in compound lines. The strongly enhanced line at 4481·3 may possibly be shown by a line of intensity 1, but the latter line measured can be satisfactorily identified with a titanium line.

Aluminium.

The strong arc lines at 3944 and 3961 are shown fairly strongly. The three strong spark lines at 3581·02, 3601·95, and 3612·68 are possibly faintly shown; but the line at 3587·15, intensity 0, may well be due to Fe, and the line at 3602·05 is easily accounted for as Y. There still remains a line 3612·65, intensity 0, which may be the Al line.

Silicon.

The following table gives a detailed comparison of all the lines in EXNER and HASCHEK's list with the lines in the chromosphere which are possibly coincident with them :—

Spark lines (EXNER and HASCHEK).		Chromosphere.			
Wave-length.	Intensity.	Wave-length.	No. of photos.	Intensity.	
3796·50	2	3796·44	1	1	
3806·90	3	Not shown			
3853·62	1	3853·61	1	1	Possibly C.
3854·02	1	Not shown			
3856·19	6	3855·87	1	1	C. at 3855·77, intensity 3 in sun.
3862·80	4	3862·79	4	2	
3883·46	1	3883·38	3	3	Coincides with head of first C. band.
3905·71	5	3905·68	4	0	In ⊙ 3905·66 Si, 12. Chrom. line possibly enh. Cr.
4021·0	1	Not shown			
4030·1	2	4029·95	4	1	
4096·8	1	4097·05	1	0	
4103·2	1	4103·15	1	2	In ⊙ 4103·10 Si, Mn 5. Probably not Mn in chrom.
4128·208*	5	4128·31	4	2	Possibly 4128·25 V.
4131·040*	6	4130·96	6	2	Possibly 4130·88 Ba.
4552·7	3	4552·64	2	0	
4567·95	1	Not shown			
4574·9	1	4574·95	1	1	
4764·20	2	4764·39	1	2	Possibly enh. Ti 4764·11.

* Wave-lengths determined by HARTMANN.

A good deal of caution is necessary in establishing the identical origin of the weak lines, but the cumulative evidence of the close agreement of the wave-lengths of the lines 3862, 3905, 4103, 4128, 4131, and 4552 gives a fair degree of probability for the existence of Si in the chromosphere.

Calcium.

The calcium lines are very strongly shown, and the intensities follow closely those given by EXNER and HASCHEK for the spark spectrum.

Chromosphere.			Intensity in—		Chromosphere.			Intensity in—	
Wave-length.	No. of photos.	Intensity.	Spark.	Arc (K. and R.).	Wave-length.	No. of photos.	Intensity.	Spark.	Arc (K. and R.).
3706·18	11	5*	10	4	4302·68	2	1 ?	6	10
3737·08	11	8*	15	4	4307·92	4	4*	2	8
3933·84	13	100	100	10	4318·79	—	—	3	8
3968·63	13	80	80	10	4425·62	—	—	3	10
4226·91	4	5	10	10	4435·12	2	2	4	10
					4435·84			3	8
					4454·93	2	1	5	10

* Compound lines.

Comparison of the two sides of the above table shows the relative behaviour of enhanced and unenhanced lines, the 7 strong arc lines on the right being only just shown, if at all, in the chromosphere spectrum.

Scandium.

Scandium is very strong in the chromospheric spectrum. EXNER and HASCHEK give 23 lines of intensity 10 or greater. The only one of these not found in the chromospheric spectrum is 3558·72, intensity 20. The intensities agree well with the spark. All the lines are present in the solar spectrum.

Titanium.

Titanium is very strong in the chromospheric spectrum. Analysing the results, taking EXNER and HASCHEK's spark spectrum as argument, it is found that: (i) The 7 lines of intensity 50 are all strongly shown. These are all fairly strong arc lines, but two of them, 3383·91 and 3505·06, are weak in the solar spectrum. (ii) The 5 lines of intensity 30 are well shown. They are all strong in the solar spectrum. The lines 3741 and 3913 are decidedly "enhanced." (iii) Of the lines of intensity 20 the weakest in the chromosphere is 3989·91, a line strong in the arc and the sun. (iv) The lines of intensity 15 are strongly shown, with three exceptions, viz.—3653·64 and 3998·79 very strong in the arc and strong in the sun, and 3456·53 of intensity 3 in the sun and outside the limit of HASSELBERG's arc spectrum. (v) The lines of

intensity 10, 9, 8 and 7 are generally well shown, except at the red end of the spectrum. The strongest lines in the chromosphere are "enhanced," *e.g.*, 4012·54, 3757·82, 4172·07. The lines 3753·00, 3924·67, 3948·82, 3956·48 may be instanced as lines strong in the arc and the sun, but missing in the chromosphere.

The behaviour of the titanium lines may be instanced from almost any part of the spectrum. A good variety of lines is shown between 3900 and 3950.

Wave-length.	Chromosphere.	Spark.	Arc.	Sun.
3900·68	7	50	2·3	5
3904·93	—	10	3·4	3
3913·61	7	30	2·3	5
3924·67	—	7	2·3	4
3932·16	3	6	—	1
3947·92	0	9	3·0	2

Vanadium.

Vanadium is not at all strong in the chromosphere. The strongest arc lines, 4379 and 4384, are not shown. There is, however, reason to think some of the "enhanced" lines are present, as will be seen from the following table :—

Chromosphere.			Solar spectrum.		Spark* intensity.	Arc* intensity.	
Wave-length.	No. of photos.	Intensity.	Wave-length.	Intensity.			
3517·51	3	1	3517·45	– V 3	20	4	
3520·21	1	0	3520·17	2	14	4	
3530·90	4	2	3530·92	3	20	4	
3545·27	3	1	3545·34	– V 4	20	4	
3566·21	3	1	3566·11 3566·31	Ti 1 – 2N	12	3	
3592·16	7	3	3592·17	V ? 2	18	4	
3700·41	2	1	3700·48	1	12	—	
3715·60	8	3	3715·62	Mn ? 4	20	4	
3718·44	2	1	—	—	10	—	Wave-length 3718·35 in spark.
3727·46	2	1	3727·49	1	16	4	
3728·49	2	1	—	—	10	—	„ 3728·51 „
3736·11	3	1	—	—	10	—	„ 3736·16 „
3771·06	1	0	3771·12	2	20	4	
3787·34	1	1	—	—	16	2	„ 3787·39 „
4023·55	6	2	4023·53	V-Co 3	20	4	
4090·78	3	2	4090·73	V ? 1	16	6	
4095·58	1	0	4095·63	V 0	12	6	
4116·66	1	1	4116·63 4116·71	V 1 V, Fe ? 0	14	6 3	

* From 'WATTS' Index,' Appendix M.

It should at the same time be noted that a number of enhanced lines are not seen, but this may be expected when the lines which are shown are all weak.

Chromium.

Chromium is very strong in the chromospheric spectrum. The only strong spark line in EXNER and HASCHEK's list which is missing is 3976·82 of intensity 9. Strong arc lines are shown, but it is the enhanced lines which are strongest. In the following table the intensities in the sun, spark, and arc, are taken from Mr. JEWELL's paper :—

Enhanced lines.					Strong arc lines.				
Wave-length.	Chromo-sphere.	Sun.	Spark.	Arc.	Wave-length.	Chromo-sphere.	Sun.	Spark.	Arc.
3408	4	3	20	3	3578	1	10	20	30
3421	4	4	10	3	3593	2	9	10	30
3422	4	4	10	4	3605	1	7	20	20
3433	5	3	10	3	4254	3	8	50	50
3603	2	3	10	0	4274	3	7	30	50

Manganese.

Manganese is not so strong as chromium, and only some of the strongest spark lines of EXNER and HASCHEK's list are shown. Some strong arc lines from 4754 to 4823 are feebly shown, the strongest arc lines near 4030 are well shown. The strongest chromospheric lines are given below.

Enhanced lines.					Strongest arc lines.				
Wave-length.	Chromo-sphere.	Sun.	Spark.	Arc.	Wave-length.	Chromo-sphere.	Sun.	Spark.	Arc.
3442	4	6	40	7	4030	2	12	20	30
3460	3	4	40	3	4033	1	10	20	25
3474	2	4	40	—	4034	1	8	10	20
3483	2	5	30	3					
3488	2	4	30	3					

Iron.

The following table gives some of the stronger iron lines from 3735 to 3930. Lines are avoided whose origin either in the sun or chromosphere is ambiguous. The intensities of the arc lines are taken from KAYSER and RUNGE's list :—

Wave-length.	Intensity in the—				Wave-length.	Intensity in the—			
	Chromo-sphere.	Sun.	Spark.	Arc.		Chromo-sphere.	Sun.	Spark.	Arc.
3733	4	7	10	8	3816	6	15	9	8
3738	3	3	3	6	3824	7	6	7	8
3745	10	8	7	8	3826	8	20	9	8
		6	7	6	3828	7	8	9	8
3748	7	10	7	6	3834	8	10	8	8
3749	4	20	8	10	3856	4	8	8	8
3758	4	15	8	8	3860	5	20	9	10
3763	7	10	7	8	3873	4	7	8	8
3765	3	6	5	8	3886	4	15	8	6
3767	6	8	7	8	3895	3	7	5	6
3788	3	9	5	6	3899	3	8	6	6
3790	3	5	3	6	3923	2	12	6	8
3795	3	8	8	6	3928	4	8	7	8
3799	4	7	7	6	3930	4	8	6	8

The intensities of the lines in the chromosphere on the whole follow the spark spectrum most nearly. It may be noticed, too, that the lines which are specially strong in the sun (compare, *e.g.*, 3826 and 3828) are not specially strong in the chromosphere, spark, or arc.

The most striking enhanced lines are not in this part of the spectrum. The following list gives some of those which are very faint in the spark with a comparison with neighbouring arc lines :—

Enhanced lines.					Arc lines.				
Wave-length.	Intensity in the—				Wave-length.	Intensity in the—			
	Chromo-sphere.	Sun.	Spark.	Arc.		Chromo-sphere.	Sun.	Spark.	Arc.
4385	4	2	1	—	4383	5	15	10	10
4489	3	2	1	—	4405	1	10	10	10
4491	3	2	1	—	4415	1	8	10	8
4508	3	4	2	1	4482	1	5	4	8
4515	3	3	1	1	4528	1	8	6	10
4520	4	3	1	1					
4522	5	3	2	1					
4556	4	3	1	1					

Nickel.

Nickel is very weak in the chromospheric spectrum. About a dozen lines can with considerable probability be attributed to it. These are the strongest spark lines of

EXNER and HASCHEK, and are generally strong in the arc and the sun. Enhanced lines are possibly shown at 4067 and 4245, but the identification is not certain. The line at 3769 may well be enhanced Ni.

Chromosphere.			Wave-length.	Sun.	Spark.	Arc.
Wave-length.	No. of photos.	Intensity.				
3769·66	4	3	3769·60	3	20	1

A considerably enhanced line at 3484 is not shown.

Cobalt.

Cobalt, like nickel, is very weak. There are enough lines to assert its existence in the chromosphere with certainty. They are all of intensity 1 or 0, with the exception of an enhanced line at 3621. There are 16 arc lines of intensity 9 or 10 given by HASSELBERG, and 3502·4 and 4118·9 are the only ones certainly not shown.

Chromosphere.			Wave-length.	Sun.	Spark.	Arc.
Wave-length.	No. of photos.	Intensity.				
3621·38	3	2	3621·34	2	10	—

Zinc.

The strong arc triplet, 4680, 4722, 4810, is possibly shown, though faintly, in the chromospheric spectrum.

Chromosphere.		Wave-length.	Sun.	Arc.
Wave-length.	Intensity.			
4680·26	1	4680·32	Zn 1	20
4722·49	2	4722·34	Zn 3	20
4811·04	2	4810·72	Zn 3	20

Mr. LORD gives lines at 4722·23 and 4810·90 of intensity 1. The line at 3345·4 is not shown, and it is impossible to say whether 3302·90 is shown owing to the proximity of Na.

Strontium.

Two of the strongest lines in the chromosphere are due to Sr. These are strong arc lines and extremely strong in the spark. Two other lines, almost equally strong in the spark and arc, are not shown.

Wave-length.	Spark.	Arc.	Chromosphere.	Sun.
3380·89	80	8	—	Sr ? 1
3464·58	100	8	—	1
4077·88	100	10	15	Sr 8
4215·66	100	10	12	Sr 5d ?

Possibly a line at 4305·61 is also shown.

Yttrium.

Yttrium is strongly shown, all the strong spark lines of EXNER and HASCHEK being present. At least 20 lines may be safely identified as yttrium.

Zirconium.

A few of the stronger arc lines given by ROWLAND and HARRISON occur in the chromosphere, while practically all the strong spark lines given by EXNER and HASCHEK are shown. As this element furnishes a good illustration of the relationship of the chromospheric and solar spectra to those of the spark and arc, the lines assigned to zirconium in the chromosphere are given below.

Wave-length.	Intensity in the—				Wave-length.	Intensity in the—			
	Chromosphere.	Sun.	Spark.	Arc.		Chromosphere.	Sun.	Spark.	Arc.
3392·11	1	2	15	10	3668·61	0	00	4	—
3404·95	1	0	6	5	3674·85	2	1	10	3
3410·39	2	1	8	1	3698·28	3	2*	10	—
3430·71	1	1	10	3	3714·92	2	0	6	—
3438·38	2	2	15	5	3731·37	2	0*	10	—
3479·48	1	2	10	—	3751·80	2	00	12	—
3481·31	2	2*	10	5	3766·94	2	1*	10	—
3496·33	2	2	20	7	3836·91	4	1*	12	—
3505·77	1	1*	8	4	3914·58	2	1	4	—
3552·11	2	1	10	3	4048·82	2	1	10	7
3556·81	3	2	15	5	4149·33	3	2	20	10
3577·00	2	1	10	—	4209·15	2	1	10	—
3614·92	3	2	10	5	4258·24	2	0	5	7
3624·03	1	1	8	4	4348·06	1	1	8	3
3630·13	1	1	5	1	4379·94	2	0	12	7
3636·69	0	1	4	1	4403·49	2	0	4	1

* Compound lines.

The arc spectrum with which comparison was made contains 250 lines, including 8 of intensity 10 and about 30 of intensity 7 or 8. Yet of the 32 lines given above, 11 are not found in the arc spectrum and 4 are of intensity 1, while only 6 can be called strong arc lines.

The line 3542·77, of intensity 12 in the spark and absent in the arc, and of intensity 00 in the sun, is an exceptional case where an enhanced line does not appear in the chromosphere.

Barium.

The arc lines at 4554 and 4934 are strongly shown, and probably the line at 5535·37, intensity 2, is the Barium line 5535·69. None of the enhanced lines are shown.

Lanthanum.

A number of strong arc lines are shown. These lines are all strong in the spark except (if due to La) 4105·07, which is of intensity 1 in the spark and 10 in the arc. But as there is an unidentified solar line at 4105·10 and the La arc line is given by ROWLAND as 4105·03, it is possible that these lines are not identical, and that the chromospheric line agrees with the former. Enhanced lines at 3737·67 and 3871·89 are not shown, but 3517, 3713, 3790, 3949, 4196 are shown.

Cerium.

The spark spectrum of cerium has no very strong lines. Ten of intensity 10, 9, or 8 are given by EXNER and HASCHEK in the region considered, but the places of two are occupied by enhanced Ti and Fe lines. The remaining 8 are as follows:—

Spark.		Chromosphere.			Sun.	
Wave-length.	Intensity.	Wave-length.	No. of photos.	Intensity.	Wave-length.	Intensity.
3801·71	8	3801·62	7	3	3801·68	– C 0 Nd ?
4133·98	10	4133·83	4	1	4133·97	Ce 0
4137·78	9	4137·54	7	3	4137·57	2
4150·09	10	4150·10	4	2	4150·06	Ce 00
4152·13	9	4152·14	5	2	4152·11	Fe-La 2
4165·75	10	4165·71	3	2	4165·76	Ce – 2
4186·71	10	4186·76	1	1	4186·78	Ce-Zr, 2N
4360·38	8	—	—	—	—	—

The line 4137 is probably the solar line 4137·57, but not cerium; cerium may have contributed to the lines at 4152 and 4186. The other lines are probably due to cerium, though the line 4133 is somewhat doubtful. The conclusion, slightly strengthened by the lines of intensity 5, 6, 7 in the spark, is that cerium is present, but very weak, in the chromospheric spectrum.

Præsodymium.

Some strong spark lines appear to be shown, but an equal number not.

Neodymium.

There seem to be a large number of lines which can be identified with this element. Few of them are very strong, and there is frequently doubt about the identifications. The following lines are, however, probably due to neodymium :—

Chromosphere.			Wave-length.	Sun.	Spark.
Wave-length.	No. of photos.	Intensity.			
3906·03	2	0	3906·04	Nd −3	4
3911·29	2	0	3911·32	Nd 0	7
3994·87	3	2	3994·83	Nd 2	5
4061·28	5	1	4061·24	Nd 3	10
4109·61	6	4	4109·61	Nd ? 1	8

Samarium.

Possibly some of the strongest spark lines are shown.

Gadolinium.

There is a strong line at 3768·46 in the chromosphere which has been attributed with some hesitation to the strongest line in the spectrum of gadolinium.

Chromosphere.			Wave-length.	Sun.	Arc.	Spark.
Wave-length.	No. of photos.	Intensity.				
3768·46	6	3	3768·54	Gd ? 0	20	20

Several of the strong lines are possibly shown, but two of intensity 12 at 3422 and 3719 are missing.

Ytterbium.

The very strong spark line at 3694·35 is shown. The next strongest spark line is also seen.

Chromosphere.			Wave-length.	Sun.	Spark.	Arc.
Wave-length.	No. of photos.	Intensity.				
3479·02	1	0	3479·05	000	20	—
3694·29	8	4	3694·34	Yb 3	200	10

Tantalum.

The strongest spark lines are possibly shown.

Lead.

The strongest arc lines appear to be faintly shown, but not the enhanced lines. The following table gives all the strongest lines in EXNER and HASCHEK :—

Spark.		Chromosphere.			Wave-length.	Sun.	Arc.
Wave-length.	Intensity.	Wave-length.	No. of photos.	Intensity.			
3572·95	20	3573·19	1	0 ?	—	—	8r
3639·72	20	3639·66	1	1	3639·66	Pb 1	10r
3683·60	20	3683·70	3	0	3683·62	Pb 000	10r
—	—	—	—	—	3683·76	Fe 2	—
3740·10	20	3740·19	2	0	—	—	8r
3786·37	20	3786·29	1	1	3786·31	Fe 4d ?	—
3854·05	20	Not shown					
4058·05	20	4058·02	2	1	4058·04	Pb 0	10r
4245·2	20	Not shown					
4387·0	20	4387·01	2	1	4387·01	Ti ? 1	—

The evidence, such as it is, is in favour of the presence in the chromosphere of the three lines of intensity 10 in the arc, though the line at 4058·05 may just as well be a spark line of tantalum.

Europium.

'WATTS' Dictionary of Spectra' (Appendix M.) gives the intensities in the spark and arc of the strongest lines.

Wave-length.	Intensity.		Chromosphere.			
	Spark.	Arc.	Wave-length.	No. of photos.	In-tensity.	
4662·1	50	5	4662·32	1	0	
4627·4	100	8	—	—	—	
4522·8	20	15	4522·80	5	5	Enh. Fe.
4435·7	50	30	4435·53	2	2	
4205·2	100	50	4205·21	5	4	
4129·9	100	100	4129·87	5	4	In sun 29·88, intensity 1.
3972·2	50	50	3972·02	5	2	In sun 72·13, intensity 0 ?
3930·7	50	50	3930·46	5	4	Fe.
3907·3	30	30	3907·28	6	2	
3819·8	50	50	3819·73	3	1	He.
3725·1	30	20	3724·97	3	1	
3688·6	20	10	—	—	—	

The strongest spark lines, 4205·2 and 4129·9, are strongly shown.

Aluminium, magnesium, barium, zinc and lead appear to show the arc lines, but not the enhanced lines, or at most very faintly. They are exceptions to the very general rule, and the important part the enhanced lines and strong spark lines take in the chromospheric spectrum is amply demonstrated for the different metals discussed wherever it has been possible to compare with both an arc and spark spectrum, particularly for titanium, iron, chromium, scandium, yttrium and zirconium.

The extent of spectrum considered and the accuracy with which the wave-lengths have been determined makes the identification of nearly all the brighter lines tolerably certain. I have compared the results with those obtained by Sir N. Lockyer, Mr. Evershed, Professor Frost, Professor Lord, Dr. Humphreys, Dr. Mitchell and Dr. Jewell, and have without scruple availed myself of their opinions of the identification of lines which I might otherwise have overlooked. The method of identification of lines pursued has been, generally speaking, by comparison with the strongest spark lines given by Exner and Haschek. When the enhanced lines as given in Sir N. Lockyer's identification of the chromospheric spectrum obtained in the 1898 eclipse are added, the principal lines are well accounted for.

Spectrum of the Higher Chromosphere.

At the eclipse of 1905, August 30, the photographs taken for the spectrum of the corona contain a number of chromospheric lines. The slit of the spectroscope which was set nearly tangential to the sun passed through the large prominence which was near the point of second contact.

The following table gives the observed wave-lengths determined by means of Hartmann's formula. One photograph extends from 4026 to 4501, and the other from 4685 to 5875. It will be seen that the helium lines and the line 4685·86 are stronger in the higher than the lower chromosphere. The enhanced iron lines appear to be weakened in the higher chromosphere in comparison with the Mg arc lines and the enhanced titanium lines.

Spectrum of the Higher Chromosphere.

Observed wave-length.	Identification.		Intensity.	Intensity in lower chromosphere.	
4026·20	4026·34	He	6	?	+
4077·84	4077·89	Sr	8	15	
4101·88	4101·91	H	20	60	
4120·95	4120·97	He	1	?	+
4215·71	4215·70	Sr	8	12	
4226·93	4226·90	Ca	4	6	
4233·47	4233·33	Fe	2	7	– Enh. Fe.
4247·00	4247·00	Sc	6	10	
4254·50	4254·51	Cr	2	3	
4272·09	4271·93	Fe	1	2	
4274·93	4274·96	Cr	1	3	
4290·25	4290·37	Ti	2	5	Enh. Ti.
4294·26	4294·27	Ti and Fe	2	2	
4300·21	4300·20	Ti	4	5	Enh. Ti.
4308·11	4308·08	Fe	2	4	
4312·81	4313·02	Ti	1	3	Enh. Ti.
4315·29	4315·14	Ti	1	3	Enh. Ti.
4320·92	4320·91	Sc	2	4	
4325·98	4325·94	Fe	2	4	
4338·06	4338·08	Ti	2	5	Enh. Ti.
4340·64	4340·63	H	30	100	
4351·75	4351·93	Fe, Cr	1	4	– Enh. Fe.
4383·63	4383·72	Fe	4	5	
4387·98	4388·10	He	4	1	+
4395·14	4395·20	Ti	8	8	Enh. Ti.
4404·79	4404·89	Fe	3	1	+
4415·69	4415·72	Sc	1	2	
4417·89	4417·88	Ti	2	3	Enh. Ti.
4420·37	—	—	1	—	+
4443·93	4443·98	Ti	4	6	Enh. Ti.
4468·67	4468·66	Ti	4	5	Enh. Ti.
4471·64	4471·65	He	20	7	+
4501·39	4501·44	Ti	4	6	Enh. Ti.
4685·86	—	—	2	—	+
4713·29	4713·25	He	6	1	+
4861·53	4861·53	H	40	100	
4921·92	4922·10	Parh	2	?	+
4924·03	4924·11	Fe	2	8	– Enh. Fe.
5015·69	5015·73	Parh	2	—	+
5018·85	5018·63	Fe	1	7	– Enh. Fe.
5167·53	5167·50	Mg	1	0	
5169·48	5169·22	Fe	1	4	– Enh. Fe.
5172·88	5172·86	Mg	4	4	
5183·79	5183·79	Mg	6	5	
5875·87	5875·87	He	20	3	+

Spectrum of the Corona.

The following are the wave-lengths determined at the three eclipses of 1900, 1901, and 1905 :—

1900.	1901.	1905.	Mean.	Intensity.
—	—	5535·8	5535·8	2
—	5304	5303·1	5303·1	20
—	—	5117·7	5117·7	2
5073	—	—	5073	1
4779	—	—	4779	1
4725 ?	—	—	4725	—
4722 ?	—	—	4722	—
4586·3	—	—	4586	4
4566·5	4565	—	4566	6
4400	—	—	4400	1
4358·8	—	—	4359	4
4311·3	—	—	4311	2
4230·6	4230·9	4231·1	4231·0	5
4130	—	—	4130	—
—	—	4087·4	4087	—
3987·2	3987	3987·1	3987·1	3
—	3891·2	—	3891	—
3800·8	3801·1	3800·8	3800·9	3
3642·9	—	3642·0	3642·5	2
—	3505 ?	—	3505 ?	—
3461·3	—	—	3461	1
—	3454	—	3454	9
—	3387·9	—	3387·9	12
—	3361 ?	—	3361 ?	—

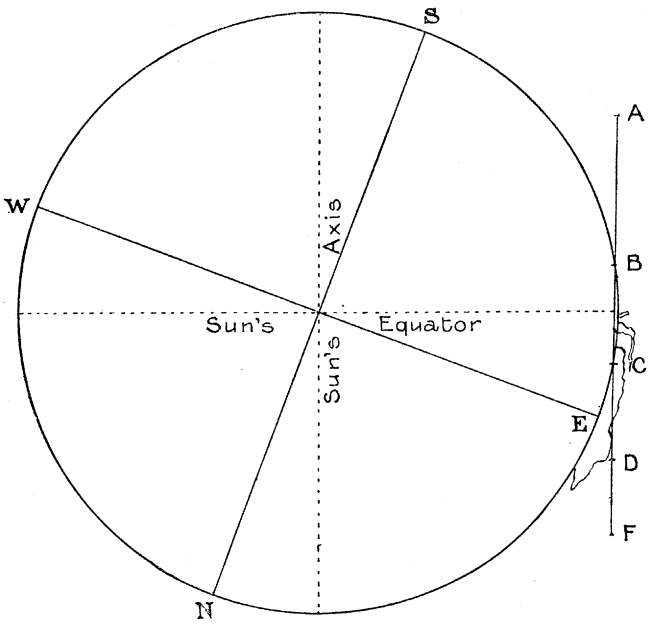
The photographs taken in 1905 are in excellent definition in the green and at the line 4231. The part from 4500 to 4685 is, unfortunately, not given, as the plates were carried back from Sfax separated by thin pieces of card and fogged where these were in contact. The lines in the extreme ultra-violet were only obtained in Sumatra. The wave-lengths were determined by reference to chromospheric lines by means of HARTMANN'S formula.

Experience gained in these three eclipses shows that a slit spectroscope is most advantageously used when tangential as nearly as possible to the sun at the point of second contact. This applies both to the chromospheric and the corona spectrum.

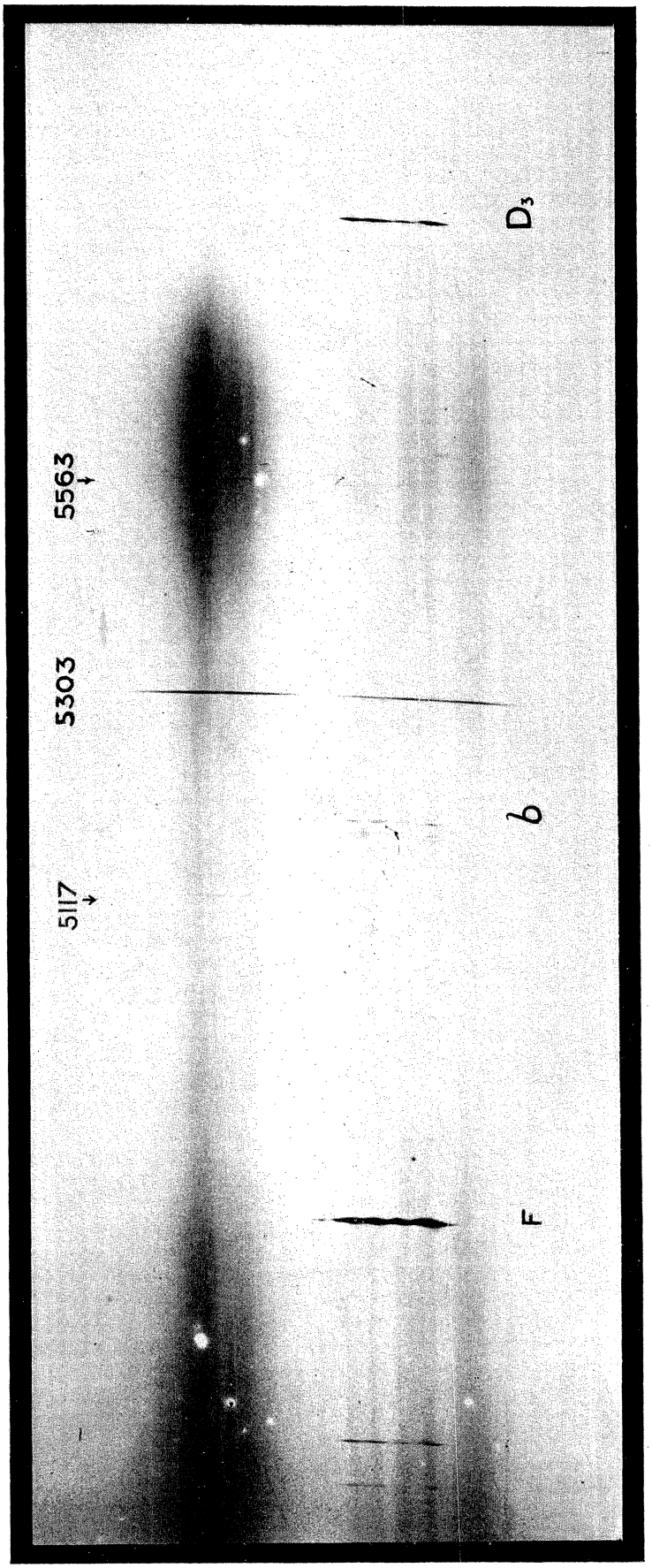
DESCRIPTION OF PLATE 9.

Spectrum of the Corona and higher Chromosphere, obtained at Sfax at the Total Eclipse of 1905, August 30.

The photograph was exposed from about 15 seconds after the beginning of totality to about 15 seconds from the end, the slit being nearly tangential to the sun at the point of second contact and passing through a large prominence. The plate is made from a copy on glass (enlarged about four times) of the original negative. The two corona lines at 5117 and 5563 have been slightly accentuated to make them clearly visible on the plate.



In the above diagram, which is drawn to scale, the line ABCDF gives the breadth of the spectrum obtained. The continuous spectrum is shown corresponding to AB and CF, but is strongest in the part AB, which shows two faint lines at 5563 and 5117. The chromospheric lines are shown in the part corresponding to CD and end sharply. No chromospheric lines are seen in the part AB.



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