A PHOTOMETRIC SURVEY OF THE STARS OF THE HUYGENIAN REGION OF THE GREAT NEBULA OF ORION.

---*---**

BY

CHAS. N. WUNDER.

****---*****---****

PRESENTED TO THE FACULTY OF THE UNIVERSITY OF VIRGINIA AS A PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY. c1913

-----***####*####***-----

CONTENTS.

---*---

INTRODUCTION.

****#***

A large number of observers have published results of research, the primary object of which was the determination of the positions of the stars of the Orion Region. In the majority of cases however little attention was paid to the brightness of the stars. Sir John Herschel made the first survey of the Huygenian Region at the Cape of Good Hope in the years 1834-8. In the years 1847-8 Professor W. C. Bond at Harvard College Observatory, made a series of micrometrical observation of 96 stars in the nebula. His results are published in H. C. O. Annals Vol. V. Lassell determined the position of 59 stars in this region and his results are published in the Memoirs of the Royal Astronomical Society for the year 1854. He determined the relative magnitudes of the stars giving the brightest in the region as 1st. and the faintest as 9th. magnitude and grading the others in the eight grades between. Struve and Liapunoff, at St. Petersburg in 1862, made a more extensive and more accurate determination of positions in the region than had been previously attempted.

In his extensive survey of the region at the Harvard college Observatory in the years 1859-65 (H. C. O. Annals Vol. V.) Professor G. P. Bond gives the brightness of all the stars catalogued in the terms of the Argelander scale. The general plan was to arrange the stars in a sequence beginning with the brightest. This sequence was finally connected with the

Argelander scale by estimating the position in the sequence of these Stars given in the Sternverzeichniss (Argelander). In a remark following the table containing the observations Professor Bond says:

"The plan proposed in the foregoing observations was to observe a certain number of stars in Argelander's Sternverzeichniss (without knowledge of his magnitudes), at near altitudes of the nebula, and then observe a few in each zone of the nebula, afterwards returning to the Sternverzeichniss. The sky was so full of light, that there was not much confidence felt in the estimate of magnitudes; but I should anticipate that the 12th magnitudes would be pretty consistent, as the illuminated scale was employed as usual. The fainter stars, called 15th, 16th, and 17th, in the zones about θ, c, and i Orionis, were invisible. Probably also the 14th.

N.B. The identity of systems of magnitudes here, as well as in zones about θ, c, and i Orionis, has not been intentionally deviated from."

In the year 1896 Professor Ormond Stone published a photometric catalogue of the stars of the region in Publications of the Leander McCormick Observatory. The observations were made by the Argelander method of comparison and the results were based on the magnitudes as determined by Struve and Liapunoff, G. P. Bond, and Herschel. Contemporaneously Professor W. H. Pickering (H. C. O. Annals Vol. XXXII) determined the brightness of these stars from proto-

graphic plates. The final magnitudes are based on visual values. The publications of the Potsdam Observatory for the year 1898 contains a photographic determination of the magnitudes of the same stars by J. Scheiner. In the year 1910 R. E. Wilson published an accurate determination of the positions of the stars but made no determination of magnitudes. This paper is published in Vol. 1 No. 4 of the Bulletin of the Philosophical Society, of the University of Virginia.

The present work was undertaken with a view to determining which of the stars of the brighter region of the nebula are variables and where possible the periods and light curves of those which show variability as well as the magnitudes of the other stars of the Huygenian Region. The observations were begun in January, 1911, and extends to March 1913. During this time about 850 observations were made. (Many more might have been secured except for very unfavorable weather conditions.) All the comparisons were made with the Rumford Photometer attached to the twenty-six inch McCormick Equatorial. This photometer was constructed according to the specifications of Prof. Pickering of the Harvard College Observatory and was sent to the Leander McCormick Observatory as one of the observatories engaged in a conserted work on variables. The instrument, as then constructed, consists of an artificial star the ray from which is made to pass through a tube perpendicular to the telescope tube. The light used for this artificial star is a two candle power incandescent electric lamp, the current being supplied by a pri-

mary battery. Between the artificial star and the telescope a sliding wedge of photographic plate is inserted. In the tube of the telescope is placed a piece of plate glass making a 45° angle with the focal axis and the same angle with the ray from the artificial star. By this means the ray is reflected to the eyepiece. The photographic wedge can be made to slide back and forth through the tube containing the artificial light in a direction perpendicular to the light ray, and thus the brightness of the image may be varied. The tube containing the wedge is graduated in divisions from one to sixty. Originally this tube was moved by a small cog and a thumb screw. Several years ago Mr. John A. Brashear, from directions given by Professor Stone attached a recording device to the instrument. This consists of a cylinder about $1\frac{1}{2}$ inches in diameter the axis of which produced is attached to the cog for moving the wedge. A sheet of paper is fastened around the cylinder and a sliding stylus is so arranged that by perforations of the paper a record of the amount of turning of the cylinder and hence the amount of sliding of the wedge is made. The star to be observed is brought into the field of view of the telescope and the wedge and cylinder are moved until the real and artificial star appear to have the same brightness, then the button operating the stylus is pressed and a record made. The zero of the scale must be recorded on the paper and then the brightness of the star observed can be found in terms of the grades of the photographic wedge. These grades

are measured to half unites and estimated to tenth unites by means of a scale graduated for the purpose. The zero and sixtieth unit points of the scale of the wedge were recorded on a sheet of recording paper and trasnferred to a brass scale the space between was divided into the sixty divisions, and also the half divisions marked, on a dividing engine. The values of the scale divisions expressed in magnitudes were determined by Professor Stone from observations made by himself and assistants of scale readings for objects having known differences of magnitude. Three sets of observations were employed. In the first a screen was drawn at will over the object glass by means of a cord extending to the eye end of the telescope. This screen had two equal sectors cut out on opposite sides of the center of the object glass allowing a portion of the light to pass through, The sector was of such dimensions that when the screen was drawn over the object glass the brightness of any given star was reduced by three magnitudes.

In the second series two small shades at the eye end of the telescope were employed singly and in combination of such density that the brightness of a star was reduced by 0.86 and 0.89 of a magnitude, respectively, as determined by Dr. H. D. Curtis by means of a photometer in the Rouss Physical Laboratory of the University of Virginia.

In the third series, the brightness of an artificial star was reduced by means of a polarizing apparatus consisting of two Nichols prisms the angle between whose axes was determined by means of a divided circle.

SCALE VALUE.

Scale Div.	Magnitude.	Scale Div.	Magnitude.
0	(0.00 up to 8.50)	25	2.35
1		26	.48
2		27	.62
3		28	.75
4		29	2.88
5		30	3.01
6		31	.14
7		32	.27
8		33	.39
9	0.08	34	.52
10	.22	35	.64
11	.37	36	.77
12	.52	37	3.89
13	.67	38	4.02
14	.82	39	.14
15	0.96	40	.26
16	1.10	41	.38
17	.24	42	.50
18	.39	43	.62
19	.53	44	.74
20	.67	45	.85
21	.81	46	4.97
22	1.94	47	5.08
23	2.08	48	.20
24	.22	49	.31
25	.35	50	.42

In observing the plan was to make four comparisons of each star with the artificial star and take the mean as the scale value of its brightness. (The number of comparisons in some instances differed from the four however.) The grades thus obtained ~~were~~ was trasnformed into magnitudes by the table given on a previous page. This when corrected for the screen used gave the number of magnitudes of the observed star above or below the zero of the scale. The scale zero was found for each observation from the observation of standard stars the magnitudes of which are given in the Harvard Photometry (H (H. C. O. Annals Vols. 45 and 57). The standard stars and their magnitudes are as follows:

Star.	Mag.	Star.	Mag.
523	9.28	724	9.18
570	8.28	784	11.40
685	4.87	924	8.72
708	5.31		

In order to avoid any error that might arise from a variation in the brightness of the artificial star and to make the zero of the scale depend on as many observations of standard stars as possible, the following plan was used. The observations were made in groups. Each group contained two or more standard stars and in some cases the observations of the same standard star was repeated. The observation of a group was continuous. In case of any delay a new group was started. The zero of the scale for each observation was obtained by a least square solution of equations of the form

$$x + ay = c$$

One equation was formed for each standard star observed in a group. In the equations c is the zero of the scale as found from the observation and the magnitude of the standard star for which it is formed, y is the amount of variation in the brightness of the artificial star during the interval between two successive observations, a the number of intervals from the middle time, and x the most probable value of the zero at the mean time. From the values of x,y given by the least square solution the value of the zero of the scale is found for each observation from the value of the expression $x + ay$. This value being thus based on all observations of standard stars in the group and the light variation, where there is any, allowed for. The magnitude of each star was computed from the equation:

$$M = Z + O$$

where M is the magnitude, Z the zero of the scale, and O the observed magnitude of the star as referred to the zero of the scale.

One operation as described above was considered only as an approximation from which new values were found for the standard stars and also values of other stars which were added to the list of standards for the next reduction. A second approximation was then made in the same manner as the first. After this second approximation all stars that were at first supposed to show no variation, and hence were used as comparison stars, but which now showed indications of variation were

excluded from the list of standards and a third approximation made.

From the values obtained from the third computation the final values of the constant stars and the periods of the variables were obtained and the curves, were possible, drawn. A comparison with results of former observers was also made in order to detect slow continuous change.

Due to the reflection of a portion of the light of the stars by the plate glass reflector mentioned previously some of the fainter stars of the region could not be observed.

I wish to express my appreciation and thanks to Professor Stone for his valuable suggestions and assistance during the preparation of this paper.

THE OBSERVATIONS.

---***---

In the table which follows the observations are given under the date on which they were made. The first column contains the number assigned to the star by Bond in his work published in H. C. O. Annals Vol. V. The second column gives the grades in terms of the scale of the wedge. The third column gives the value of the grade in magnitudes. The fourth gives the shade used. s in this column refers to the screen mentioned previously which reduced the brightness three magnitudes, S to a similar screen which causes a reduction of two magnitudes, 1 and 2 refer to the shades which reduce the light 0.86 and .89 of a magnitude, respectively. The fifth gives the magnitude as corrected for the shade. The sixth gives the zero of the scale. And the seventh gives the final magnitude of the star.

Star.	Grade.	Scale in Mags.	Shade.	Corrected Magnitude.	Zero of Scale	Resultant Magnitude
	1911, Jan. 23					
669	10.3	0.26	2	-0.43	10.23	9.80
635	13.2	0.69	2	-0.20	10.26	10.06
657	18.6	1.47		+1.47	10.29	11.76
652	19.1	1.54		+1.54	10.32	11.86
709	13.4	0.73		+0.73	10.34	11.07
707	8.2	0.47		+0.47	10.37	10.84
558	14.8	0.91		+0.91	10.49	11.40
573	18.1	1.40		+1.40	10.52	11.92
581	14.5	0.89		+0.89	10.55	11.44
671	14.4	0.88		+0.88	10.58	11.46
676	18.7	1.49		+1.49	10.61	12.10
663	14.3	0.86		+0.86	10.64	11.50
575	12.8	0.64		+0.64	10.72	11.36
			--***--			
	1911, Jan. 24.					
652	20.3	1.71		+1.71	9.95	11.66
681	25.0	2.35		+ 2.35	10.06	12.41
663	21.1	1.82		+1.82	10.18	12.00
647	16.2	1.13		+1.13	10.30	11.43
709	14.0	0.82		+0.82	10.41	11.23
671	11.5	0.45		+0.45	10.88	11.33
573	15.6	1.09		+1.09	10.99	12.08
581	17.8	1.36		+1.36	11.11	12.47
558	12.5	0.60		+0.60	11.23	11.83
			--***--			
	1911, Jan. 25.					
741	13.0	0.67	2S	-2.22	10.25	8.03
724	19.3	1.59	2S	-1.30	10.25	8.96
570	13.9	0.81	2S	-2.08	10.28	8.20
523	20.9	1.80	2S	-1.09	10.29	9.20
708	12.1	0.54	12S	-3.21	10.31	7.10
			--***--			
	1911, Jan. 30					
724	20.4	1.73	12	-0.02	9.17	9.15
669	22.5	2.01	12	+0.26	9.08	9.34
635	26.1	2.49	12	+0.74	9.00	9.74
602	19.1	1.54		+1.54	8.91	10.45
558	26.0	2.48		+2.48	8.83	11.31
709	23.5	2.15		+2.15	8.74	10.89
707	27.6	2.70		+2.70	8.66	11.36
567	17.4	1.30		+1.30	8.57	9.87
652	32.1	3.28		+ 3.28	8.49	11.77
724	25.3	2.39	12	+0.64	8.39	9.03
			--***--			
	1911, Feb. 4.					
822	29.4	2.93	2	+2.04	8.01	10.05
784	34.6	3.59	2	+ 2.70	8.01	10.71
724	19.0	1.53	2	+ 0.64	8.02	8.66
709	41.0	4.38		+ 4.38	8.02	12.40
707	31.2	3.17		+ 3.17	8.03	11.20
573	44.3	4.77		+ 4.77	8.03	12.80

1911 Feb. 4. Con'td.

Star.	Grade.	Scale in Mags.	Shade.	Corrected Magnitude.	Zero of Scale	Resultant Magnitude.
581	44.0	4.74		+ 4.74	8.04	12.78
558	35.1	3.65		+ 3.65	8.04	11.69
657	41.1	4.39		+ 4.39	8.05	12.44
641	42.1	4.51		+ 4.51	8.05	12.56
647	43.1	4.63		+ 4.63	8.06	12.69
681	34.8	3.62		+ 3.62	8.06	11.68
575	39.7	4.22		+ 4.22	8.06	12.29
602	33.8	3.49		+ 3.49	8.08	11.57
635	24.9	2.34	1	+ 1.48	8.08	10.56
669	21.6	1.87	1	+ 1.01	8.09	9.10
784	34.2	3.54	1	+ 2.68	8.09	10.77
741	14.8	0.93	12	—0.82	8.10	7.28
523	29.0	2.88	12	+ 1.13	8.10	9.23

--***--

1911 Feb.10.

784	17.1	1.26		+ 1.26	8.97	10.23
822	11.0	0.37		+ 0.37	8.95	9.12
707	31.0	3.14		+ 3.14	8.93	12.07
709	25.7	2.44		+ 2.44	8.91	11.35
724	13.9	0.81	1	-0.05	8.89	8.84
741	9.7	0.18	12	-1.57	8.87	7.30
669	25.1	2.36	12	+ 0.61	8.85	9.46
635	29.0	2.88	12	+1.13	8.83	9.96
624	10.2	0.25	12	-1.50	8.81	7.31
523	24.6	2.30	12	+0.55	8.79	9.34
641	29.0	2.88		+2.88	8.77	11.65
657	30.4	3.06		+3.06	8.75	11.81
681	36.4	3.82		+3.82	8.73	12.55
663	36.9	3.88		+3.88	8.71	12.59
652	33.1	3.40		+3.40	8.69	12.09
647	21.6	1.89		+1.89	8.67	10.56
651	33.2	3.42		+3.42	8.65	12.07
671	29.1	2.89		+2.89	8.63	11.59
676	33.2	3.42		+3.42	8.61	12.03
602	29.4	2.93		+2.93	8.59	11.52
589	33.1	3.40		+3.40	8.57	11.97
622	30.7	3.10		+3.10	8.55	11.65
575	29.1	2.89		+2.89	8.53	11.42
642	33.4	3.44		+3.44	8.51	11.95
612	36.1	3.78		+3.78	8.49	12.27
558	30.7	3.10		+3.10	8.37	11.47
666	38.9	4.13		+4.13	8.35	12.48
677	43.0	4.62		+4.62	8.33	12.95
617	17.3	1.28		+1.28	8.31	9.59
784	19.7	1.63		+1.63	8.29	9.92
685	11.7	0.47	S12	-3.28	8.27	4.91
708	18.8	1.50	S12	-2.25	8.25	6.00
741	28.6	2.83	S1	-0.03	8.23	8.20
570	31.0	3.14	S1	+0.28	8.21	7.93
523	37.5	3.95	S1	+1.09		

Star.	Grade.	Scale in Mags.	Shade.	Corrected Magnitude.	Zero of Scale	Resultant Magnitude
	1911, Feb.21.					
784	11.6	0.46		+0.46		
822	8.4	0.00	2	-0.89	10.74	9.39
			--***--			
	1911, Feb.23.					
784	15.5	1.03		+1.03	9.41	10.44
822	16.2	1.12	1	+0.26	9.44	9.70
724	9.4	0.14		+0.14	9.47	9.61
707	24.4	2.27		+2.27	9.50	11.77
635	15.8	1.05		+1.05	9.53	10.58
652	20.5	1.47		+1.47	9.56	11.30
657	17.4	1.30		+1.30	9.59	10.89
663	22.3	1.98		+ 1.98	9.62	11.60
681	16.5	1.17		+1.17	9.65	10.82
641	22.8	2.03		+2.03	9.68	11.71
671	13.0	0.67		+0.67	9.71	10.38
676	21.6	1.89		+1.89	9.74	11.63
709	18.0	1.39		+1.39	9.77	11.16
573	17.2	1.26		+1.26	9.80	11.06
581	21.4	1.84		+1.84	9.83	11.67
784	12.3	0.56		+0.56	9.98	10.54
523	12.4	0.58	1	-0.28	10.01	9.73
558	13.3	0.71		+0.71	10.04	10.75
647	15.2	0.99		+0.99	10.07	11.06
589	20.0	1.67		+1.67	10.10	11.77
595	22.2	1.97		+1.97	10.13	12.10
			--***--			
	1911, Feb. 27.					
784	17.9	1.38		+1.38	9.25	10.63
822	13.6	0.76		+0.76	9.26	10.02
681	29.5	2.94		+2.94	9.26	12.20
652	26.1	2.49		+2.49	9.27	11.76
709	21.0	1.81		+1.81	9.28	11.09
707	13.3	0.71		+0.71	9.29	10.00
558	14.7	0.92		+0.92	9.30	10.22
575	17.0	1.24		+1.24	9.31	10.55
784	11.3	0.41		+0.41	10.10	10.51
663	22.0	1.94		+1.94	10.11	12.05
641	24.5	2.28		+2.28	10.12	12.40
647	18.7	1.49		+1.49	10.13	11.62
724	14.4	0.88		+0.88	10.14	10.16
589	16.2	1.13		+1.13	10.15	11.28
617	9.1	0.09		+0.09	10.16	10.25
784	21.9	1.93	1	+1.07	10.17	11.24
523	13.3	0.71	12	-1.04	10.18	9.14
669	16.9	1.23	12	-0.52	10.19	9.67
			--***--			
	1911, Mar. 1.					
784	19.1	1.54		++1.54	10.45	11.99
618	24.0	2.22		+2.22	10.48	12.70
612	21.6	1.87		+1.87	10.51	12.40
651	19.9	1.66		+1.66	10.54	12.20
647	11.3	0.41		+0.41	10.56	10.97

1911, Mar. 1. con'td.

Star.	Grade.	Scale in Mags.	Shade	Corrected Magnitude.	Zero of Scale	Resultant Magnitude.
573	15.7	1.06		+1.06	10.59	11.65
581.	19.9	1.66		+1.66	10.62	12.28
666	22.0	1.94		+1.94	10.65	12.59
677	24.3	2.26		+2.26	10.68	12.94
784	8.7	0.03		+0.03	10.71	10.74
784	9.2	0.11		+0.11	10.63	10.74
822	17.2	1.27	12	-0.48	10.66	10.18
709	17.1	1.26		+1.26	10.69	11.95
676	20.2	1.70		+1.70	10.72	12.42
671	11.3	0.41		+0.41	10.75	11.16
622	17.4	1.30		+1.30	10.78	12.08
595	13.7	0.77		+0.77	10.81	11.58
589	12.0	0.52		+0.52	10.84	11.36
784	13.6	0.76	1	-0.10	10.89	10.79
784	17.1	1.26	1	+0.40	10.40	10.80
707	16.3	1 14		+1.14	10.48	11.62
575	12.8	0.64		+0.64	10.56	11.20
558	13.8	0.79		+0.79	10.64	11.43
635	7.0	0.00		+0.00	10.72	10.72
641	16.4	1.16		+1.16	10.80	11.96
663	16.7	1.16		+1.16	10.88	12.08
681	16.2	1.12		+1.16	10.96	12.08
657	12.6	0.61		+0.61	11.04	11.65
784	13.2	0.70	1	-0.16	11.12	10.96
784	18.7	1.49	1	+0.63	10.26	10.89
652	15.9	1.09		+1.09	10.25	11.34
669	10.7	0.32	12	-1.43	10.25	8.82
523	14.4	0.88	12	-0.87	10.25	9.38
784	19.0	1.53	1	+0.55	10.25	10.92
			--***--			
	1911, Mar. 2.					
784	33.7	3.46	S	+1.46	10.23	
822	22.2	1.97	S	-0.03		
741	17.6	1.33	S1	-1.53		
708	8.6	0.01	S12	-3.74		
523	29.3	2.92	S12	-0.83		
570	13.3	0.71	S12	-3.04		
784	25.6	2.43	S	+0.43		
724	10.3	0.26	S	- 1.74		
669	12.8	0.64	S	-1.36		
635	16.0	1.10	S	-0.90		
			--***--			
	1911, Sept. 6.					
558	25.3	2.39		+2.39	7.85	10.24
938	28.1	2.76		+2.76	7.85	10.54
924	20.2	1.70	2	+0.81	7.71	8.52
635	31.3	3.18	2	+2.29	7.64	9.93
709	31.4	3.19		+3.19	7.57	10.75
570	19.0	1.53	2	+0.64	7.50	8.14
			--***--			
	1911, Sept. 11.					
924	18.6	1.47	12	-0.28	9.09	8.81
669	21.0	1.81	12	+0.06	9.02	9.08
523	19.2	1.56	12	-0.19	8.95	8.76

1911, Sept. 11 con'td.

Star.	Grade.	Scale in Mags.	Shade	Corrected Magnitude.	Zero of Scale	Resultant Magnitude.
724	21.4	1.86	12	+ 0.11	8.88	8.99
635	21.0	1.81	1	+ 0.81	8.81	9.76
709	28.3	2.79		+ 2.79	8.74	11.35
707	27.6	2.68		+ 2.68	8.67	11.35
558	24.2	2.25		+ 2.25	8.60	10.85
652	32.8	3.37		+ 3.37	8.53	11.90
647	29.2	2.91		+ 2.91	8.46	11.37
784	19.9	1.66	S	-1.34	9.76	8.42
741	18.4	1.45	S	-1.55	9.71	8.16
624	20.4	1.73	S	-1.27	9.67	8.40
708	21.4	1.86	S12	-2.89	9.62	6.73
570	37.6	3.97	S12	-0.78	9.58	8.80
685	12.0	0.52	S12	-4.23	9.54	5.31
628 e	13.6	0.76	S12	-3.99	9.49	5.50
640	21.1	2.89	S12	-1.86	9.45	7.59
619	29.0	2.88	S12	-1.87	9.40	7.35
938	14.7	0.92		+ 0.92	9.36	10.28
			--***--			
	1911, Sept. 13.					
924	26.6	2.56	12	+ 0.81	7.86	8.67
709	32.0	3.27		+ 3.27	7.82	11.09
573	34.5	3.58		+ 3.58	7.78	11.36
663	38.3	4.06		+ 4.06	7.74	11.80
641	42.0	4.50		+ 4.50	7.70	12.20
938	31.3	3.18		+ 3.18	7.67	10.85
707	35.8	3.74		+ 3.74	7.63	11.37
647	35.1	3.65		+ 3.65	7.59	11.24
671	35.8	3.74		+ 3.74	7.55	11.29
			--***--			
	1911, Oct. 12.					
924	23.3	2.12	12	+ 0.37	8.43	8.80
938	22.1	1.95		+ 1.95	8.46	10.41
709	20.8	1.78		+ 1.78	8.49	10.27
741	16.7	1.20	12	-0.55	8.52	7.97
724	22.4	2.00	12	+0.25	8.55	8.80
707	23.6	2.16		+ 2.16	8.57	10.73
558	18.8	1.50		+ 1.50	8.60	10.11
635	21.7	1.90	1	+ 1.04	8.63	9.67
669	21.3	1.85	12	+ 0.10	8.66	8.76
624	16.0	1.10	12	-0.65	8.69	8.04
924	21.1	1.82	12	+ 0.07	8.72	8.79
628 e	9.8	0.19	S12	-4.56	8.81	4.25
640	15.7	1.06	S2	-2.83	8.84	6.01
			--***--			
	1911. Oct.18.					
924	19.6	1.61	12	-0.14	9.30	9.16
707	17.2	1.27		+ 1.27	9.40	10.67
709	15.8	1.07		+ 1.07	9.50	10.57
666	22.8	2.05		+ 2.05	9.60	11.65
573	20.6	1.75		+ 1.75	9.71	11.46
581	24.2	2.25		+ 2.25	9.81	12.06
558	16.7	1.20		+ 1.20	9.92	11.12

1911, Oct. 18.

Star.	Grade.	Scale in Mags.	Shade	Corrected Magnitude.	Zero of Scale	Resultant Magnitude.
671	23.0	2.08		+ 2.08	10.02	12.10
676	23.0	2.08		+ 2.08	10.12	12.20
641	24.6	2.30		+ 2.30	10.23	12.53
663	18.8	1.50		+ 1.50	10.33	11.83
924	17.4	1.30	12	-0.40	9.16	8.76
938	14.9	0.95		+ 0.95	9.35	10.30
681	27.7	2.71		+ 2.71	9.55	12.26
657	21.0	1.81		+ 1.81	9.74	11.56
652	21.8	1.91		+ 1.91	9.95	11.86
647	17.1	1.26		+ 1.26	10.14	11.40
651	22.6	2.02		+ 2.02	10.34	12.36
618	20.2	1.70		+ 1.70	10.53	12.23
612	22.6	2.02		+ 2.02	10.73	12.75
617	11.1	0.39		+ 0.39	10.92	11.31
924	14.4	0.88	12	-0.87	9.75	7.88
575	17.2	1.27		+ 1.27	9.79	11.06
	19.4	1.59		+ 1.59	9.82	11.41
669	11.4	0.43		+ 0.43	9.86	10.29
724	13.5	0.75	12	-1.00	9.90	8.90
523	13.9	0.81	12	-0.94	9.93	8.99
924	20.3	1.71	S	-1.29	9.97	8.68
741	18.3	1.43	S1	-2.43	10.00	7.57
708	14.4	0.87	S12	-3.88	10.04	6.16
570	31.2	3.17	S12	-1.53	10.08	8.50
624	19.5	1.60	S1	-2.26	10.11	7.85
			--***--			
	1911, Oct. 23.					
924	17.2	1.27	12	-0.48	9.21	8.73
709	23.3	2.12		+ 2.12	9.20	11.32
707	20.4	1.73		+ 1.73	9.19	10.92
573	32.0	3.27		+ 3.27	9.18	12.45
581	31.8	3.24		+ 3.24	9.17	12.41
641	29.6	2.96		+ 2.96	9.17	12.13
663	26.3	2.52		+ 2.52	9.16	11.68
681	30.2	3.04		+ 3.04	9.15	12.19
657	28.9	2.84		+ 2.84	9.14	11.98
652	28.3	2.79		+ 2.79	9.14	11.93
924	22.9	2.07	12	+ 0.32	8.54	8.86
938	27.2	2.64	1	+ 1.78	8.67	10.45
671	25.5	2.32		+ 2.32	8.80	11.12
676	32.0	3.27		+ 3.27	8.93	12.20
647	25.4	2.32		+ 2.32	9.06	11.36
556	20.5	1.74		+ 1.74	9.19	10.93
575	23.0	2.08		+ 2.08	9.32	11.40
589	22.8	2.05		+ 2.05	9.45	11.50
651	32.7	3.35		+ 3.35	9.58	12.93
618	26.7	2.58		+ 2.58	9.70	12.28
924	21.7	1.90	12	+ 0.15	8.68	8.83
724	25.8	2.45	12	+ 0.70	8.69	9.39
669	23.5	2.15	12	+ 0.40	8.70	9.10
635	31.1	3.15	12	+ 1.40	8.70	10.10
523	22.9	2.07	12	+ 0.32	8.71	9.03

1911, Oct. 23. con'td.

Star.	Grade.	Scale in Mags.	Shade.	Corrected Magnitude.	Zero of Scale	Resultant Magnitude.
741	23.0	2.08	s	-0.92	8.72	7.80
708	26.8	2.59	s12	-2.16	8.73	6.57
685	14.4	0.88	s12	-3.87	8.74	4.87
570	40.2	4.32	s	-0.43	8.74	8.31
628 θ	13.5	0.74	s12	-4.01	8.75	4.74
619	25.4	2.40	s12	-2.35	8.76	6.41

--***--

1911, Oct. 24.

924	14.9	0.95	12	-0.80	9.43	8.63
681	29.7	2.97		+2.97	9.44	12.41
652	25.6	2.43		+2.43	9.45	11.88
657	23.6	2.16		+2.16	9.46	11.62
663	20.9	1.80		+1.80	9.47	11.27
641	23.9	2.21		+2.21	9.48	11.69
635	18.2	1.43	1	+0.57	9.49	10.06
647	18.5	1.46		+1.46	9.50	10.96
671	21.7	1.90		+1.90	9.51	11.41
676	26.9	2.61		+2.61	9.53	12.13
924	18.1	1.40	12	-0.35	9.25	8.90
934	21.2	1.84	1	+0.09	9.32	9.41
709	18.4	1.45		+1.45	9.39	10.84
575	21.7	1.90		+ 1.90	9.47	11.37
589	24.5	2.28		+2.28	9.54	11.82
573	21.9	1.93		+1.93	9.61	11.54
635	16.7	1.20	1	+0.34	9.69	10.03
558	17.1	1.26		+1.26	9.83	11.09
707	18.8	1.50		+1.50	9.90	11.40
924	15.6	1.04	s	-1.96	10.67	8.71
741	22.7	2.04	s1	-1.82	10.46	8.64
624	20.5	1.75	s1	-2.11	10.26	8.15
619	18.3	1.43	s12	-3.32	10.05	6.73
640	15.3	1.00	s12	-3.75	9.84	6.09
708	17.7	1.34	s12	-3.41	9.64	6.23
570	32.9	3.38	S12	-1.37	9.43	8.04

--***--

1911, Oct. 25.

635	9.6	0.16	1	-0.70	10.84	10.14
618	14.0	0.82		+0.82	10.95	11.77
612	17.7	1.34		+1.34	11.06	12.40
617	11.8	0.49		+0.46	11.17	11.66
633	10.9	0.36		-0.36	11.28	11.64
635	26.3	2.52	1	+1.66	8.34	10.00
622	24.9	2.34		+2.34	8.49	10.83
567	34.6	3.59		+3.59	8.65	12.24
581	24.5	2.28		+2.28	8.80	11.08
573	19.7	1.63		+1.63	8.96	10.59
666	32.9	3.38		+3.38	9.12	12.50
677	34.4	3.57		+3.57	9.27	12.84
635	18.4	1.45	1	+0.59	9.39	9.98

Star.	Grade.	Scale in Mags.	Shade.	Corrected Magnitudes.	Zero of Scale.	Resultant Magnitude.
	1911, Oct.25, con'td.					
641	29.3	2.92		+ 2.29	9.18	12.10
663	25.9	2.47		+ 2.47	9.22	11.69
709	20.2	1.70		+ 1.70	9.26	10.96
589	25.4	2.40		+ 2.40	9.31	11.71
575	22.6	2.02		+ 2.02	9.35	11.37
651	33.5	3.46		+ 3.46	9.40	12.86
676	28.3	2.79		+ 2.79	9.44	12.23
636	28.9	2.87		+ 2.87	9.48	12.35
671	21.3	1.85		+ 1.85	9.53	11.38
681	30.8	3.11		+ 3.11	9.57	12.68
			--***--			
	1911, Oct. 26.					
784	12.6	0.61		+ 0.61	10.26	10.87
822	15.0	0.96	1	+ 0.10	10.31	10.41
635	9.6	0.16	1	-0.70	10.35	9.65
681	20.3	1.71		+1.71	10.40	12.11
657	14.0	0.82		+0.82	10.44	11.26
652	17.5	1.32		+1.32	10.49	11.81
663	13.6	0.76		+0.76	10.53	11.29
641	14.2	0.85		+0.85	10.58	11.43
681	16.4	1.16		+1.16	10.62	11.78
647	10.4	0.28		+0.28	10.67	10.95
671	13.4	0.73		+0.73	10.71	11.44
676	18.2	1.42		+0.73	10.76	12.18
681	24.3	2.26		+2.26	10.80	13.06
573	18.3	1.43		+1.43	10.85	12.28
784	26.6	2.56	1	+1.70	9.04	10.74
709	23.6	2.16		+2.16	9.08	11.24
			--***--			
	1911, Nov. 2.					
784	13.0	0.67	1	-0.19	10.53	10.34
822	13.8	0.79	12	-0096	10.60	9.64
709	10.4	0.28		+0.28	10.68	10.96
663	13.0	0.67		+0.67	10.75	11.42
641	18.0	1.39		+1.39	10.82	12.21
741	12.6	0.62	S1	-3.25	10.89	7.64
808	19.3	1.57	s12	-3.18	10.96	7.78
640	8.9	0.07	s12	-4.68	11.04	6.36
624	9.5	0.15	s1	-3.71	11.11	7.40
619	8.8	0.05	s12	-4.70	11.18	6.48
			--***--			
	1911, Nov.10.					
784	17.2	1.27	1	+ 0.41	10.39	10.80
822	15.2	0.99	12	+ 0.76	10.34	9.58
709	12.0	0.52		+ 0.52	10.28	10.80
581	19.0	1.53		+ 1.53	10.22	11.75
573	13.1	0.69		+ 0.69	10.17	10.86
641	18.2	1.42		+ 1.42	10.11	11.53
663	16.9	1.23		+ 1.23	10.06	11.29
681	23.2	2.11		+ 2.11	10.00	12.11

1911, Nov. 10. Con'td.

Star.	Grade.	Scale in Mags.	Shade.	Corrected Magnitude.	Zero of Scale.	Resultant Magnitude.
652	23.2	1.82		+ 1.82	9.94	11.76
657	22.8	2.05		-2.05	9.89	11.94
651	25.5	2.42		+ 2.42	9.83	12.25
647	16.5	1.17		-1.17	9.78	10.95
671	19.7	1.63		+1.63	9.72	11.35
676	26.6	2.56		-2.56	9.66	12.22
784	16.6	1.18	1	+0.32	10.44	10.76
707	15.6	1.04		+1.04	10.42	11.46
677	26.2	2.51		+2.51	10.40	12.91
666	26.6	2.56		+2.56	10.38	12.94
575	16.8	1.21		+1.21	10.36	11.57
589	18.0	1.39		+1.39	10.34	11.73
741	20.9	1.80	s12	-2.95	10.33	7.38
724	33.2	3.42	s12	-1.33	10.31	8.98
570	18.2	1.42	s12	-3.33	10.29	6.96
640	17.4	1.32	s12	-3.43	10.27	6.84
624	19.9	1.66	s12	-2.20	10.26	8.06
619	14.6	0.90	s12	-3.85	10.24	6.39
708	13.6	0.76	s12	-3.99	10.22	6.23

--***--

1911, Nov. 16.

784	26.6	2.56	12	+0.81	8.14	8.95
822	20.2	1.70	12	-0.05	8.25	8.20
709	25.6	2.43		+2.43	8.35	10.69
573	26.8	2.59		+ 2.59	8.46	11.05
581	33.0	3.39		+3.39	8.56	11.95
641	30.0	3.01		+3.01	8.67	11.68
663	21.6	1.89		+1.89	8.77	10.66
681	32.2	3.29		+3.29	8.88	12.17
652	28.8	2.85		+2.85	8.98	11.83
657	27.6	2.70		+2.70	9.09	11.79
647	24.7	2.31		+2.31	9.19	11.50
671	25.7	2.34		+2.34	9.30	11.64
707	21.6	1.89		+1.89	9.40	11.29
938	15.1	0.97		+ 0.97	9.51	10.48
784	22.2	1.97	1	+1.11	9.61	10.72
575	32.2	3.29		+3.29	9.08	12.37
784	42.2	4.54	s	+1.54	9.08	10.62
669	21.0	1.81	s	-1.19	9.07	7.88
635	38.6	4.09	s1	+ 1.09	9.07	10.16
784	24.5	2.28	s	-0.62	11.25	10.63
741	14.8	0.93	s12	-3.82	11.31	7.49
724	24.5	2.28	s12	-2.47	11.37	8.90
708	10.2	0.25	s12	-4.50	11.43	6.93
640	10.8	0.34	s12	-4.41	11.49	6.84
619	11.3	0.41	s12	-4.34	11.55	7.21
624	12.0	0.52	s12	-3.34	11.61	8.27
570	14.8	0.93	s12	-3.82	11.67	7.85

Star.	Grade.	Scale in Mags.	Shade.	Corrected Magnitudes.	Zero of Scale.	Resultant Magnitude.
	1911, Nov.18.					
784	9.5	0.15	12	-1.60	12.34	10.74
822	9.4	0.14	12	-1.61	12.34	10.73
784	10.4	0.28	12	-1.47	11.77	10.30
573	14.5	0.89		+ 0.89	11.76	11.65
581	17.5	1.32		+ 1.32	11.76	13.08
641	12.3	0.56		+ 0.56	11.76	12.32
663	10.7	0.32		+ 0.32	11.75	12.07
681	11.4	0.43		+ 0.43	11.75	12.18
652	13.8	0.79		+ 0.79	11.74	12.53
657	9.6	0.19		+ 0.19	11.74	11.93
647	8.5	0.00		+ 0.00	11.74	11.74
558	15.5	1.03	1	-0.17	11.73	11.56
741	20.8	1.78	s12	-2.97	11.73	8.76
724	17.3	1.28	s12	-3.47	11.72	8.25
784	22.9	2.04	s	-0.96	11.72	10.76
			--***--			
	1911, Nov.21.					
784	17.9	1.38	12	-0.37	11.11	10.74
822	12.2	0.55	12	-1.20	11.15	9.95
558	8.5	0.00		0.00	11.18	11.18
707	8.5	0.00		0.00	11.20	11.20
784	26.3	2.52	s	-0.48	11.23	10.75
741	11.4	0.43	s12	-4.32	11.26	6.94
			--***--			
	1911, Nov. 22.					
784	17.4	1.32	12	-0.43	11.29	10.86
822	8.5	0.00	12	-1.75	11.30	9.55
709	13.3	0.71		+0.71	11.31	12.02
573	11.3	0.41		+0.41	11.32	11.73
581	15.9	1.09		+1.09	11.33	12.42
558	11.7	0.47	1	-0.39	11.33	10.94
641	12.6	0.61		+0.61	11.34	11.95
663	9.4	0.14		+0.14	11.35	11.49
681	13.1	0.69		+0.69	11.36	12.05
652	11.8	0.48		+0.48	11.37	11.85
657	10.6	0.30		+0.30	11.37	11.67
651	14.6	0.90		+0.90	11.38	12.28
575	9.0	0.08		+0.08	11.39	11.47
589	10.4	0.28		+0.28	11.40	11.68
671	9.8	0.17		+0.17	11.41	11.58
676	16.3	1.13		+1.13	11.41	12.54
784	16.0	1.10	12	-0.65	11.42	10.77
			--***--			
	1911, Nov.25.					
784	30.3	3.05	12	+1.39	9.41	10.71
663	23.1	2.09		+2.09	9.37	11.46
558	16.2	1.13		+1.13	9.34	10.47
938	22.6	2.02	1	+1.16	9.30	10.46

1911, Nov. 25. Con'td.

Star.	Grade.	Scale in Mags.	Shade.	Corrected Magnitudes.	Zero of Scale.	Resultant Magnitude.
822	21.0	1.81	s	-1.19	9.26	8.07
741	22.8	2.05	s12	-2.70	9.23	6.53

--***--

1911, Nov. 29.

784	18.4	1.45	1	+ 0.59	10.08	10.67
822	18.2	1.41	12	-0.34	10.12	9.78
709	17.8	1.32		+ 1.32	10.16	11.48
573	16.3	1.14		+ 1.14	10.20	11.34
581	20.4	1.73		+ 1.73	10.25	11.98
641	19.7	1.63		+ 1.63	10.29	11.92
663	16.6	1.18		+ 1.18	10.33	11.51
681	22.8	2.05		+ 2.05	10.37	12.42
558	12.0	0.52		+ 0.52	10.41	10.93
707	12.8	0.64		+ 0.64	10.45	11.09
741	15.4	1.02	s1	-2.84	10.49	7.65
724	17.5	1.32	s1	-2.54	10.53	7.99
640	15.3	1.00	s12	-3.75	10.57	6.82
619	15.2	0.99	s12	-3.74	10.62	6.88
624	16.6	1.18	s1	-2.68	10.67	7.99
784	32.4	3.32	s	+ 0.32	10.78	11.10
669	15.1	0.97	s	-2.03	11.13	9.10
635	20.8	1.78	s	-1.22	11.48	10.26
570	16.7	1.20	s12	-3.55	11.73	8.28

--***--

1911, Dec. 19.

784	24.3	2.26	12	+ 0.51	10.23	10.74
709	15.2	0.99		+ 0.99	10.33	11.32
573	16.3	1.14		+ 1.14	10.43	11.57
581	19.2	1.56		+ 1.56	10.53	12.09
641	17.0	1.24		+ 1.24	10.63	11.87
663	15.3	1.00		+ 1.00	10.73	11.73
651	17.2	1.27		+ 1.27	10.83	12.10
647	10.8	0.34		+ 0.34	0.92	11.26
676	16.3	1.14		+ 1.14	11.02	12.16
558	10.0	1.22	1	-0.64	11.12	10.48
784	31.2	3.17	s	+ 0.17	10.57	10.74
822	22.2	1.97	s	-1.03	10.63	9.60
741	13.3	0.71	s1	-3.15	10.74	9.03
724	23.5	2.15	s1	-1.71	10.80	6.59

--***--

1912, Jan. 13.

784	19.0	1.53		+1.53	9.21	10.74
709	16.6	1.18		+1.18	9.37	10.55
641	22.4	2.00		+ 2.00	9.53	11.53
558	19.1	1.66		+ 1.66	9.70	11.36
784	13.7	0.77	1	-0.09	10.68	10.59
573	8.5	0.00		+0.00	10.84	10.84
707	11.3	0.41	1	-0.45		
741	15.2	0.09	s12	-3.76		
822	18.8	1.50	s1	-2.36		
784	23.5	2.15	s	-0.65		

Star.	Grade.	Scale in Mags.	Shade.	Corrected Magnitude.	Zero of Scale.	Resultant Magnitude.
	1912, Jan. 16.					
784	21.8	1.91	1	+ 1.05	9.70	10.75
709	15.1	0.97		+ 0.97	9.92	10.89
573	16.4	1.16		+ 1.16	10.12	11.28
581	19.2	1.56		+ 1.56	10.33	11.89
558	16.8	1.21		+ 1.21	10.53	11.74
681	18.6	1.47		+ 1.47	10.74	12.21
663	18.9	1.52		+ 1.52	10.94	12.46
641	17.0	1.24		+ 1.24	11.14	12.38
784	20.3	1.71	1	+ 0.85	9.95	10.80
822	18.0	1.39	12	-0.36	10.14	9.78
724	25.1	2.36	s1	-1.50	10.34	8.84
741	20.9	1.80	s12	-2.95	10.52	7.57
570	23.4	2.14	s12	-2.61	10.71	8.10
			--***--			
	1912, Jan. 19.					
784	26.6	2.56	12	+ 0.81	9.93	10.74
822	19.6	1.61	12	-0.14	9.87	9.73
709	14.8	0.93		+ 0.93	9.82	10.75
573	18.4	1.43		+ 1.43	9.76	11.19
581	21.1	1.93		+ 1.93	9.71	11.64
641	19.3	1.57		+ 1.57	9.65	11.22
663	22.3	1.98		+ 1.98	9.59	11.57
681	20.8	1.78		+ 1.78	9.54	11.32
784	30.0	3.01	12	+ 1.26	9.48	10.74
667	25.0	2.35		+ 2.35	9.45	11.78
666	20.4	1.73		+ 1.73	9.37	11.10
			--***--			
	1912, Feb. 5.					
784	11.2	0.40		+ 0.40	10.51	10.91
709	15.4	1.02		+ 1.02	10.57	11.59
558	9.7	0.18		+ 0.18	10.63	10.81
573	14.2	0.85		+ 0.85	10.69	11.54
581	18.7	1.49		+ 1.49	10.75	12.24
641	12.7	0.62		+ 0.62	10.81	11.43
663	18.5	1.46		+ 1.46	10.88	12.34
681	13.7	0.77		+ 0.77	10.94	11.71
647	11.0	0.37		+ 0.37	11.00	11.37
784	8.9	0.07		+ 0.07	11.06	11.13
			--***--			
	1912, Feb. 8.					
784	11.1	0.39		+ 0.39	10.07	10.46
822	11.4	0.43	12	-1.32	10.07	8.75
709	11.4	0.43		+ 0,43	10.07	10.50
677	19.9	1.80		+ 1.80	10.07	11.15
666	22.2	1.97		+ 1.97	10.07	12.04
573	16.9	1.23		+ 1.23	10.08	11.31
581	21.2	1.84		+ 1.84	10.08	11.92
641	21.2	1.84		+ 1.84	10.08	11.92
663	24.0	2.22		+ 2.22	10.08	12.30
657	17.0	1.24		+ 1.24	10.08	11.32
652	20.2	1.70		+ 1.70	10.08	11.78

1912, Feb. 8, Con'td.

Star.	Grade.	Scale in Mags	Shade.	Corrected Magnitude.	Zero of Scale	Resultant Magnitude.
681	19.1	1.54		+ 1.54	10.08	11.62
784	17.9	1.37	1	+ 0.51	10.08	10.59
784	17.3	1.28	1	+ 0.42	10.34	10.76
676	22.0	1.94		+ 1.94	10.34	12.28
671	14.3	0.86		+ 0.86	10.34	11.20
618	17.7	1.34		+ 1.34	10.35	11.69
612	17.4	1.30		+ 1.30	10.35	11.65
575	14.2	0.85		+ 0.85	10.35	11.20
567	22.4	1.00		+ 1.00	10.36	11.36
589	16.8	1.21		+ 1.21	10.36	11.57
784	17.2	1.27	1	+ 0.41	10.36	10.77
784	8.9	0.07	1.	-0.79	11.53	10.74
707	9.2	0.11	1	-0.75	11.53	10.78
622	9.3	0.12		+ 0.12	11.54	11.66
784	13.2	0.70		+ 0.70	10.04	10.74
617	14.7	0.92	1	+ 0.06	10.04	10.10
			--***--			
	1912, Feb. 13.					
708	13.6	0.76	s12	-3.99	10.53	6.54
741	21.2	1.84	s	-1.16	10.38	9.54
724	19.0	1.53	s	-1.47	10.24	8.77
640	22.2	1.97	s12	-2.78	10.10	7.32
619	10.9	0.35	s12	-4.40	9.95	5.55
784	18.2	1.42		+ 1.42	9.66	11.08
709	22.3	1.89		+ 1.98	9.52	11.50
581	28.9	2.87		+ 2.87	9.37	12.24
573	25.8	2.45		+ 2.45	9.22	11.67
641	26.6	2.56		+ 2.56	9.08	11.64
663	33.8	3.49		+ 3.49	8.94	12.43
784	20.7	1.77		+ 1.77	8.79	10.56
			--***--			
	1912, Feb. 22.					
784	21.6	1.89	1	+ 1.03	9.68	10.71
822	16.5	1.17	12	+ 0.58	9.70	10.28
709	16.4	1.16		+ 1.16	9.72	10.88
677	25.5	2.42		+ 2.42	9.74	12.16
666	21.8	1.91		+ 1.91	9.76	11.67
581	21.5	1.88		+ 1.88	9.78	11.66
573	14.8	0.95		+ 0.95	9.81	10.76
641	24.0	2.22		+ 2.22	9.83	12.05
663	28.1	2.76		+ 2.76	9.85	12.61
618	20.4	1.73		+ 1.73	9.87	11.50
612	29.4	2.93		+ 2.93	9.89	12.82
617	10.0	0.22		+ 0.22	9.91	10.13
622	19.0	1.53		+ 1.53	9.93	11.46
784	13.6	0.76		+ 0.76	9.95	10.71
784	21.5	1.88	1	+ 1.02	9.85	10.87
676	26.1	2.49		+ 2.49	9.80	12.29
671	19.2	1.56		+ 1.56	9.76	11.32

1912, Feb. 22, Con'td.

Star.	Grade.	Scale in Mags.	Shade.	Corrected. Magnitude	Zero of Scale.	Resultant Magnitude.
589	24.0	2.22		+2.22	9.71	11.93
575	19.5	1.60		+1.60	9.67	11.27
558	14.4	0.88		+0.88	9.62	10.50
707	15.9	1.09		+ 1.09	9.57	10.66
784	26.2	2.53	1	-1.67	9.53	11.20
			--***--			
	1912, Mar. 16.					
784	14.1	0.83	1	-0.03	10.74	10.71
822	15.6	1.04	12	-0.70	10.47	9.76
709	19.6	1.61		+1.61	10.21	11.82
573	19.6	1.61		+1.61	9.95	11.56
581	26.5	2.55		+2.55	9.68	12.23
641	28.0	2.75		+2.75	9.42	12.17
784	19.2	1.56		+1.56	9.15	10.71
741	25.2	2.38	s12	-2.37	8.88	6.51
			--***--			
	1912, Oct. 1.					
784	11.7	0.47	1	-0.39	11.10	10.71
707	10.5	0.30	1	-0.56	11.77	11.21
709	8.5	0.00		0.00	12.44	12.44
			--***--			
	1912, Oct. 4.					
784	8.5	0.00	1	-0.86		
707	8.5	0.00		0.00		
709	8.5	0.00		0.00		
573	12.2	0.55		+0.55		
581	16.0	1.10		+1.10		
681	11.6	0.46		+0.46		
663	14.8	0.93		+0.93		
641	8.9	0.07		+0.07		
558	14.4	0.88	12	-0.87		
651	8.9	0.07		+0.07		
671	10.2	0.25		+0.25		
784	15.2	0.98	12	-0.77		
			--***--			
	1912, Oct. 6.					
784	11.7	0.47	12	-1.28	12.02	10.74
822	8.5	0.00	12	-1.75	12.02	10.27
709	11.2	0.40	1	-0.46	12.02	11.56
573	12.0	0.52		+0.52	12.02	12.54
581	9.9	0.21		+0.21	12.02	12.23
			--***--			
	1912, Oct. 8.					
784	31.2	3.17		+3.17	6.71	9.88
822	16.8	1.21		+1.21	6.90	8.11

1912, Oct. 8. Con'td.

Star.	Grade.	Scale Mags.	Shade.	Corrected Magnitude.	Zero of Scale.	Resultant Magnitude.
707	37.8	3.99		+ 3.99	7.08	11.07
724	19.2	1.56		‡1.56	7.26	8.82
709	37.4	3.94		+3.94	7.45	11.39
581	45.8	4.95		+4.95	7.63	12.58
573	41.8	4.48		+4.48	7.82	12.30
652	39.4	4.19		+4.19	8.00	12.19
657	35.2	3.67		+3.67	8.18	11.85
647	27.7	2.71		+2.71	8.37	11.08
784	29.1	2.89		+2.89	7.82	10.71
741	18.6	1.47	12	-0.28	7.86	7.58
708	12.4	0.58	12	-1.17	7.90	6.73
685	8.5	0.00	12	-1.75	7.94	6.19
628 θ	8.5	0.00	12	-1.75	7.98	6.23
619	13.9	0.80	12	-0.95	8.02	7.07
624	23.1	2.09	12	+0.34	8.06	8.40
640	9.8	0.19	12	-1.56	8.09	6.53
523	30.8	3.11	12	+1.36	8.13	9.49
784	31.8	3.24	1	+2.38	8.17	10.55

--***--

1912. Oct. 15.

784	16.7	1.20		+1.20	9.36	10.52
709	28.7	2.82		+2.82	9.35	12.17
573	28.2	2.78		+2.78	9.38	12.16
581	30.3	3.04		+3.04	9.41	12.45
641	33.2	3.42		+3.42	9.44	12.86
741	18.6	1.47	s	-1.53	9.47	7.94
708	18.7	1.49	s12	-3.26	9.50	6.24
685	11.5	0.44	s12	-4.31	9.53	5.22
628 θ	12.9	0.65	s12	-4.10	9.56	5.46
619	11.6	0.46	s	-2.54	9.60	7.07
784	41.1	4.39	s	+1.39	9.63	11.02
784	40.2	4.28	s	+1.28	9.61	10.89
822	28.7	2.84	s	-0.16	9.63	9.47
640	12.6	0.61	s	-2.39	9.65	7.26
624	20.2	1.70	s	-1.30	9.67	8.37
669	20.1	1.68	s	-1.32	9.68	8.36
635	9.5	0.15	+	+0.15	9.70	9.85
784	15.2	1.00		+1.00	9.72	10.72

--***--

1912, Nov. 18.

784	33.4	3.44	2	+2.55	8.20	10.75
822	33.5	3.45	12	+1.70	8.20	9.90
724	23.8	2.19	12	+0.34	8.20	8.50
784	20.9	1.80		+1.80	8.20	10.00
709	41.8	4.48		+4.48	8.20	12.68
581	39.5	4.20		+4.20	8.20	12.40
573	36.1	3.78		+3.78	8.20	11.98
558	21.4	1.86		+1.86	8.20	10.06
641	38.6	4.09		+4.09	8.20	12.29
663	40.1	4.39		+4.39	8.20	12.59

1912, Nov. 18. Con't'd.

Star.	Grade.	Scale in Magnitude.	Shade.	Corrected Magnitude.	Zero of Scale	Resultant Magnitude.
681	41.2	4.40		+ 4.40	8.20	12.60
647	31.8	3.24		+ 3.24	8.20	11.44
671	33.8	3.49		+ 3.49	8.20	11.69
618	43.6	4.69		+ 4.69	8.20	10.89
633	23.3	2.12		+ 2.12	8.20	10.32
784	26.1	2.49		+ 2.49	8.20	10.59
784	53.2	5.77	s	+ 2.77	7.70	10.47
741	30.3	3.05	s	+ 0.05	7.70	7.75
708	23.5	2.15	sl	-1.71	7.70	5.99
523	53.1	5.76	sl	+ 2.10	7.70	9.80
784	53.3	5.79	s	+ 2.79	7.70	10.49

--***--

1912, Dec.9.

784	10.5	0.30		+ 0.30	10.41	10.71
822	10.1	0.24	1	-0.62	10.43	9.81
709	16.2	1.13		+ 1.13	10.45	11.58
558	13.2	0.70		+ 0.70	10.48	11.18
663	21.8	1.91		+ 1.91	10.50	12.41
784	22.8	1.05	1	+ 0.19	10.52	10.71

--***--

1913, Jan. 9.

784	29.7	2.97	1	+ 2.11	8.60	10.71
822	35.0	3.64	1	+ 2.78	8.65	11.43
707	34.1	3.53	1	+ 2.87	8.70	11.57
724	23.0	2.08	12	+ 0.33	8.75	9.08
709	23.6	2.16		+ 2.16	8.80	10.96
581	27.4	2.67		+ 2.67	8.85	11.52
573	36.6	3.84		+ 3.84	8.90	12.74
558	36.3	3.81		+ 3.81	8.95	12.76
523	22.4	2.00	12	+ 0.25	9.00	9.25
635	23.2	2.11	12	+ 0.36		
669	27.6	2.71	12	+ 0.96		
641	24.1	2.23		+ 2.23		
663	33.3	3.43		+ 3.43		
681	34.2	3.54		+ 3.54		
784	38.2	4.04	12	+ 2.29		
784	29.7	2.98	s	-0.02	10.27	10.25
724	30.0	3.01	s	-0.01	9.70	9.71
741	35.6	3.72	sl	-0.14	9.13	8.99
708	26.0	2.48	s12	-2.27	8.54	6.27

--***--

1913, Jan. 29.

635	22.4	2.00	1	+1.14	8.76	9.90
784	35.8	3.47	12	+1.99	8.85	10.84
822	20.0	1.67	1.	+0.71	8.93	9.64
707	23.5	2.15		+2.15	9.02	11.17
709	30.1	3.02		+ 3.02	9.10	12.12
573	25.9	2.47		+ 2.47	9.18	11.65
558	30.0	3.01	1	+2.15	8.17	10.32

1913, Jan. 29, Con'td.

Star.	Grade.	Scale in Mags.	Shade.	Corrected Magnitude	Zero of Scale	Resultant Magnitude.
523	22.0	1.94	1	+ 2.15	8.17	10.32
681	35.8	3.73		+ 3.73	8.33	12.06
724	25.5	2.42	12	+ 0.67	8.41	9.08
741	41.4	4.48	s12	-0.32	8.50	8.18
708	22.2	1.97	s12	-2.78	8.58	5.80
570	39.1	4.15	s12	-0.60	8.66	8.06

--***--

1913, Feb. 1.

784	24.8	2.32	1	+ 1.46	9.00	10.46
822	22.7	2.04	1	+1.18	9.05	10.23
709	24.2	2.25		+ 2.25	9.09	11.34
707	20.4	1.73		+ 1.73	9.12	10.85
523	19.1	1.54	1	+ 0.68	9.16	9.84
635	19.4	1.59	1	+ 0.73	9.20	9.93
669	22.0	1.94	12	+ 0.19	9.24	9.43
724	28.0	2.75	s	-1.11	9.28	9.03
741	36.0	3.77	s12	-0.98	9.31	8.43
708	21.1	1.82	s12	-2.93	9.35	6.42
570	37.7	3.98	s12	-0.77	9.39	8.62
784	46.2	4.99	s	+ 1.99	9.43	10.42

THE RESULTING MAGNITUDE AND DATE OF OBSERVATION.

----*****----

The following table gives the date of observation to the tenth of a day, the corresponding observed magnitude, and the Julian day in the number of days to be added to 2419000. All determinations marked (*) are excluded from the computation of the final results on account of errors noted at the time of observation.

Bond Star 523.

Date		J. Day	Mag.	Date.		J.Day	Mag.
1911,	Jan. 25.4	660	9.20	1911,	Mar. 2.4	98	9.69
	Feb. 4.4	72	9.23		Sept.11.6	291	8.76*
	10.4	78	9.34		Oct. 23.6	333	9.03
	10.4	78	9.28	1912	Oct. 8.6	684	9.48
	23.4	91	9.73		Nov. 18.5	725	9.80
	27.4	95	9.14	1913	Jan. 9.4	777	9.25
	Mar. 1.4	97	9.34				

---*****--

Bond Star 558.

1911	Jan. 30.4	67	11.31	1911	Oct. 24.5	334	11.09
	Feb. 23.4	95	10.75		Nov. 18.5	359	11.56
	27.4	95	10.22		29.5	370	10.93
	Mar. 1.4	97	11.43		Dec. 19.4	390	10.48
	Sept. 6.6	286	10.24	1912	Jan. 13.4	415	11.36
	11.6	291	10.85		16.4	418	11.74
	Oct. 12.6	322	10.11		Feb. 5.4	438	10.81
	Oct 18.5	328	11.12		Feb. 22.4	455	10.50
	23.5	333	10.93		Oct. 4.6	680	10.18
					Nov. 18.5	725	10.06

---*****---

Bond Star 567.

1912	Feb. 8.4	441	11.36	

---*****---

Bond Star 570

1911	Jan. 25.4	62	8.20	1911	Nov. 10.5	351	6.96	*
	Feb. 10.4	78	7.93		16.5	357	7.85	
	Mar. 2.4	98	7.55		29.5	370	8.28	
	Sept. 6.6	286	8.14	1912	Jan. 16.4	418	8.10	
	11.6	291	8.80	1913	29.4	797	8.06	
	Oct. 18.6	328	8.50		Feb. 1.4	799	8.62	
	23.6	333	8.31					

Bond Star 573 ✓

Date			J.Day	Mag.	Date			J. Day	Mag.
1911	Jan.	23.4	60	11.92	1911	Dec.	19.5	390	11.57
		24.4	61	12.08	1912	Jan.	13.4	415	10.84
	Feb.	4.4	72	12.80			16.4	418	11.28
		23.4	91	11.06			19.4	421	11.19
	Mar.	3.4	99	11.65		Feb.	5.4	438	11.54
	Sept.	13.6	293	11.36			8.4	441	11.31
	Oct.	18.6	328	11.46			13.4	446	11.64
		23.6	333	12.45			22.4	455	10.76*
		24.6	334	11.54		Mar.	16.4	478	11.56
		25.6	335	10.59*		Oct.	4.6	680	11.68
		26.5	336	12.28			6.6	682	12.54
	Nov.	10.5	351	10.86			8.6	684	12.30
		16.5	357	11.05			15.6	691	12.16
		18.5	359	11.65		Nov.	18.6	725	11.98
		22.5	363	11.73					
		29.5	370	11.34					

---****---

Bond Star 575.

1911									
	Jan.	23.4	60	11.36	1911	Oct.	24.6	334	11.37
	Feb.	4.4	72	12.29*			25.6	335	11.56
		10.4	88	11.42		Nov.	10.6	351	11.57
		27.4	95	10.55*			16.6	357	12.37*
	Mar.	1.4	97	11.20			22.6	362	11.47
	Oct.	18.6	328	11.00	1912	Feb.	8.4	441	11.36
		23.6	333	11.40			22.4	455	11.27

---****---

Bond Star 581

1911	Jan.	23.4	60	11.17*	1911	Dec.	19.5	390	12.09
		24.4	61	12.47	1912	Jan.	16.4	418	11.89
	Feb.	4.4	72	12.78			19.4	421	11.64
		23.4	91	11.67		Feb.	5.4	438	12.24
	Mar.	1.4	97	12.28			8.4	441	11.92
	Oct.	18.6	328	12.06			13.4	446	12.47
		23.6	333	12.41			22.4	455	11.66
		25.6	335	10.08*		Mar.	16.4	478	12.23
		26.6	336	13.06*		Oct.	4.6	680	12.21
	Nov.	10.6	351	11.75			6.7	682	12.23
		16.6	357	11.95			8.6	684	12.58
		18.5	359	12.08*			15.6	691	12.45
		22.5	363	12.42		Nov.	16.6	725	12.40
		29.6	370	11.98	1913	Jan.	9.4	777	11.52

Bond Star 589.

Date		J.Day	Mag.	Date		J.Day	Mag.
1911	Feb. 23.4	91	11.77	1911	Oct. 25.6	335	11.87
	27.4	95	11.28		Nov. 10.5	351	11.73
	Mar. 1.4	97	11.36		22.6	363	11.68
	Oct. 23.6	333	11.50	1912	Feb. 8.4	441	11.57
	24.6	334	11.82		22.4	455	11.93

---*****---

Bond Star 595

1911	Feb. 23.4	91	12.10	1911	Mar. 1.3	97	11.58

---*****---

Bond Star 612

1911	Feb. 10.4	78	12.27	1911	Oct. 25.6	335	12.30
	Mar. 1.3	97	12.40	1912	Feb. 8.4	441	11.65*
	Oct. 18.6	328	11.65		Nov. 18.6	725	10.89*

---*****---

Bond Star 617

1911	Sept. 11.6	291	7.53*	1911	Nov. 16.5	357	6.98
	Oct. 23.6	333	6.41		29.6	370	6.88
	24.6	334	6.73	1912	Feb. 13.4	446	5.56*
	Nov. 10.6	351	6.39		Oct. 8.6	684	7.07

---*****---

Bond Star 618

1911	Feb. 10.4	78	11.95	1911	Oct. 23.6	333	12.28
	Mar. 1.3	97	12.70		25.6	335	11.70
	Oct. 18.6	328	12.13	1912	Feb. 8.4	441	11.69

---*****---

Bond Star 619.

1911	Feb. 10.4	78	9.70	1911	Oct. 25.6	335	11.52*
	27.4	95	10.25	1912	Feb. 8.4	441	10.10
	27.4	95	10.10				

---*****---

Bond Star 622

1911	Feb. 10.4	78	11.65	1912	Feb. 8.4	441	11.68
	Mar. 1.4	97	12.08				

Bond Star 624.

Date		J.Day	Mag.	Date		J.Day	Mag.
1911	Feb. 10.4	78	7.31*	1911	Nov. 10.6	351	8.06
	Sept.11.6	291	8.40		16.6	357	8.00
	Oct. 12.6	322	8.04		29.6	370	7.99
	18.6	328	7.85	1912	Oct. 8.6	684	8.40
	24.6	334	8.15		15.6	691	8.37
	Nov. 2.5	343	7.40*				

---****---

Bond Star 628/ 8.

1911	Oct. 12.6	322	4.25	1912	Oct. 8.6	684	6.23
	23.6	333	4.74		15.6	691	5.46

---****---

Bond Star 633.

1911	Oct. 25.6	335	11.64	1911	Nov. 18.5	359	10.32

---****---

Bond Star 635.

1911	Jan..23.4	60	10.06	1911	Oct. 24.6	334	10.03
	30.4	67	9.74		25.6	335	10.14
	Feb. 4.4	72	9.80		25.6		10.00
	10.4	78	9.96		25.6		8.98
	23.4	91	10.58		26.6	336	9.65
	Mar. 1.4	97	10.72*		Nov. 16.5	357	10.16
	2.4	98	9.88		29.6	370	10.26
	Sept. 6.6	286	9.93	1912	Oct. 15.6	691	9.85
	11.6	291	9.76	1913	Jan. 29.4	797	9.90
	Oct. 12.6	322	9.67		Feb. 1.4	799	9.93
	23.6	333	10.10				
	24.6	334	10.06				

---****---

Bond Star 636.

1911	Oct. 25.6	335	12.35				

---****---

Bond Star 640

1911	Sept.11.6.	291	7.59*	1911	Nov. 29.6	370	6.82
	Oct. 12.6	322	6.01		Dec. 19.5	390	6.59
	24.6	334	6.09	1912	Feb. 13.4	446	7.32*
	Nov. 2.6	343	6.36		Oct. 8.6	684	6.35
	10.5	351	6.84		15.6	691	7.26
	16.5	357	6.99				

Bond Star 641

Date.		J.Day	Mag.	Date		J.Day	Mag.
1911	Feb. 4.4	72	12.56	1911	Nov. 22.6	363	11.95
	10.4	78	11.65		29.6	370	11.92
	23.4	91	11.71		Dec. 19.5	390	11.87
	27.4	95	12.40	1912	Jan. 13.4	415	11.53
	Mar. 1.4	97	11.96		16.4	418	12.38
	Sept.13.6	293	12.20		19.4	421	11.22
	Oct. 18.6	328	12.53		Feb. 5.4	438	11.43
	23.6	333	12.13		8.4	441	11.92
	24.6	334	11.69		13.4	446	11.64
	25.6	335	12.10		22.4	455	12.05
	26.6	336	11.43		Mar.16.4	478	12.17
	Nov. 10.6	351	11.53		Oct.15.6	691	12186
	16.6	357	11.68		Nov.18.6	725	12.29
	18.6	359	12.32				

---****---

Bond Star 647.

1911	Jan. 24.4	61	11.43	1911	Oct. 24.6	334	10.96
	Feb. 4.4	72	12.69*		26.6	336	10.95
	10.4	78	10.56*		Nov. 10.6	351	10.95
	23.4	91	11.06		16.6	357	11.42
	27.4	95	11.62		18.6	359	11.74*
	Mar. 1.4	97	10.97		Dec. 19.5	390	11.26
	Sept.11.6	291	11.37	1912	Feb. 5.4	438	11.37
	13.6	293	11.24		Oct. 4.6	680	11.10
	Oct. 18.6	328	11.40		8.6	684	11.08
	23.6	333	11.36		Nov. 18.6	725	11.44

0--****---

Bond Star 651.

1911	Feb. 10.4	78	12.07	1911	Oct. 26.6	336	11.78*
	Mar. 1.4	97	12.20		Nov. 10.6	351	12.25
	Oct. 18.6	328	12.26		22.6	363	12.28
	23.6	333	12.93*		Dec. 19.5	390	12.10

---****---

Bond Star 652.

1911	Jan. 23.4	60	11.86	1911	Oct. 23.6	333	11.93
	24.4	61	11.66		24.6	334	11.88
	30.4	67	11.77		26.6	336	11.81
	Feb. 4.4	72	12.44*		Nov. 10.6	351	11.76
	10.4	78	12.09		16.6	357	11.83
	23.4	91	11.30*		18.6	359	12.53*
	27.4	95	11.76		22.6	363	11.85
	Mar. 1.4	97	11.34*	1912	Feb. 8.4	441	11.78
	Sept.11.6	291	11.90		Oct. 8.6	684	12.19*
	Oct. 18.6	328	11.86				

Bond Star 657.

Date			J.Day.		Date			J.Day	
1911	Jan.	23.4	60	11.76	1911,	Oct.	26.6	336	11.26*
	Feb.	4.6	72	12.44*		Nov.	10.6	351	11.94
		10.4	78	11.81			16.6	357	11.81
		23.4	91	10.89			18.6	359	11.93
	Mar.	1.4	97	11.65			22.5	363	11.67
	Oct.	18.6	329	11.56	1912	Feb.	8.4	441	11.32*
		23.6	333	11.98		Oct.	8.6	684	11.85
		24.6	334	11.62					

-----*****-----

Bond Star 663.

1911,									
	Jan.	23.4	60	11.50	1911,	Nov.	18.6	359	12.07
		24.4	61	12.00			22.6	363	11.49
	Feb.	10.4	78	12.59			25.5	366	11.45
		23.4	91	11.60			29.6	370	11.51
		27.4	95	12.05		Dec.	19.5	390	11.73
	Mar.	1.4	97	12.08	1912,	Jan.	16.4	418	12.46
	Sep.	13.6	293	11.80			19.5	421	11.57*
	Oct.	18.6	328	11.83		Feb.	5.4	438	12.34
		23.6	333	11.68			13.4	446	12.43
		24.6	334	11.27			22.4	455	12.61
		25.6	335	11.69		Oct.	4.6	680	12.01
		26.6	336	11.29		Nov.	18.6	725	12.59
	Nov.	2.6	343	11.42		Dec.	9.5	746	12.41
		10.5	351	11.29	1913	Jan.	9.4	777	12.03
		16.6	357	11.02					

----*****----

Bond Star 666.

1911	Feb.	10.4	78	12.48	1911	Nov.	10.6	351	12.94
	Mar.	1.4	97	12.59	1912	Jan.	19.4	421	11.10*
	Oct.	18.6	328	11.65*		Feb.	8.4	441	12.04
		25.6	335	12.40					

----*****----

Bond Star 669.

1911	Jan.	23.4	60	9.80	1911	Oct.	12.6	322	8.76*
		30.4	67	9.34			18.6	328	10.29*
	Feb.	4.4	72	9.10			23.6	333	9.10
		10.4	78	9.46		Nov.	16.6	357	7.88*
		27.4	95	9.67			29.5	370	9.22
	Mar.	1.4	97	8.82*	1912	Oct.	15.6	691	8.36*
		2.4	98	9.45	1913	Feb.	1.4	799	9.43
	Sep.	11.6	291	9.08					

Bond Star 671

Date			J.Day	Mag.	Date.			J. Day	Mag.
1911	Jan.	23.4	60	11.46	1911	Oct.	25.6	335	11.38
		24.5	61	11.53			26.6	336	11.44
	Feb.	10.4	78	11.59		Nov.	10.6	351	11.35
		23.4	91	10.38*			16.5	357	11.45
	Mar.	1.4	97	11.76			28.4	369	11.57
	Sep.	13.5	293	11.29	1912	Feb.	8.4	441	11.20
	Oct.	18.6	328	12.10*			22.4	455	11.32
		23.6	333	11.12		Oct.	4.6	680	11.27
		24.6	334	11.41		Nov.	18.5	725	11.69

----*****----

Bond Star 676.

1911	Jan.	23.4	60	12.10	1911	Oct.	25.6	335	12.23
	Feb.	10.4	78	12.03			26.6	336	12.18
		23.4	91	11.63*		Nov.	10.6	351	12.22
	Mar.	1.4	97	12.42			22.6	363	12.54
	Oct.	18.6	328	12.20		Dec.	19.5	390	12.16
		23.6	333	12.20	1912	Feb.	18.4	441	12.28
		24.6	334	12.13			22.4	455	12.29

----*****----

Bond Star 677.

1911	Feb.	10.4	78	12.95	1911	Nov.	10.6	351	12.91
	Mar.	1.4	97	12.94	1912	Jan.	19.5	421	11.88*
	Oct.	25.6	335	12.67		Feb.	8.4	441	11.15*

----*****----

Bond Star 681.

1911	Jan.	24.5	61	12.41	1911	Nov.	10.6	351	12.11
	Feb.	4.4	72	11.68*			16.6	357	12.41
		10.4	78	12.55			18.5	359	12.18
		23.4	91	10.82*			22.6	363	12.05
		27.4	95	12.20			29.6	370	12.42
	Mar.	1.4	97	12.08	1912	Jan.	16.5	418	12.21
	Oct.	18.6	328	12.26			19.6	421	11.32*
		23.6	333	12.19		Feb.	5.4	438	11.71*
		24.6	334	12.41			8.4	441	11.62*
		25.6	335	12.68		Oct.	4.6	680	11.56*
		26.6	336	12.11		Nov.	18.6	725	12.60

----*****----

Bond Star 685.

1911,	Feb.	10.4	78	4.91	1911	Oct.	23.6	333	4.78
	Sep.	11.6	291	5.31	1912	Oct.	8.6	441	6.19*

Bond Star 707.

Date			J. Day.	Mag	Date.			J. Day	Mag.
1911,	Jan.	23.4	60	10.84	1911	Oct.	24.6	334	11.40
		30.5	67	11.36		Nov.	10.6	351	11.46
	Feb.	4.4	72	11.20			16.5	357	11.29
		10.4	78	12.07*			27.6	368	11.20
		23.4	91	11.77			29.5	370	11.09
		27.4	95	10.00*	1912	Jan.	13.4	415	11.43
	Mar.	1.4	97	11.62		Feb.	8.4	441	10.78
	Sep.	9.6	289	11.35			22.4	455	10.66
		13.6	293	11.37		Oct.	1.6	677	11.16
	Oct.	12.6	322	10.73			8.6	684	11.07
		18.6	328	10.67	1913	Jan.	9.5	777	11.57
		23.6	333	10.92			29.4	797	11.17
						Feb.	1.4	799	10.85

----*****----

Bond Star 708.

1911,	Jan.	25.4	62	7.10*	1911,	Nov.	10.6	351	6.23
	Feb.	10.4	78	6.00*			16.6	357	6.93
	Mar.	2.4	98	6.71	1912	Feb.	13.4	446	6.54
	Sep.	11.6	291	6.73		Oct.	8.6	684	6.73
	Oct.	18.6	328	6.16	1913	Jan.	9.4	727	6.27
		23.6	333	6.57			29.4	797	5.80*
		24.6	334	6.23		Feb.	1.4	799	6.42
	Nov.	2.6	343	7.78*					

----*****----

Bond Star 709.

1911,	Jan.	23.4	60	11.07	1911	Nov.	29.5	370	11.48
		24.4	61	11.23		Dec.	19.5	390	11.32
		30.4	67	10.89	1912	Jan.	13.5	415	10.55
	Feb.	4.4	72	12.40			16.4	418	10.89
		10.4	78	11.35			19.4	421	10.75
		23.4	91	11.16		Feb.	5.4	438	11.59
		27.4	95	11.09			8.4	441	10.50
	Mar.	1.4	97	11.95			13.4	446	11.50
	Sep.	6.6	286	10.75			22.4	455	10.88
		11.6	291	11.53		Oct.	1.6	677	12.44
		13.6	293	11.09			6.6	682	11.56
	Oct.	12.6	322	10.27			8.6	684	11.39
		18.6	328	11.57			15.6	691	11.17
		23.5	333	11.35		Nov.	18.6	725	12.68
		24.6	334	10.84		Dec.	9.5	746	11.58
		25.5	335	10.96	1913	Jan.	9.5	777	10.96
		26.6	336	11.94			29.4	797	12.12
	Nov.	2.6	343	10.96		Feb.	1.4	799	11.34
		10.5	351	10.80					
		16.6	357	10.89					
		22.6	363	12.02					

Bond Star 724.

Date			J. Day	Mag.				J.Day	Mag.
1911,	Jan.	25.4	62	8.96	1911	Nov.	10.6	351	8.98
	~~30.~~	30.4	67	9.15			16.6	357	8.90
		30.4		9.03			18.6	359	8.25
	Feb.	4.4	72	8.66			29.5	370	7.99*
		10.4	78	8.84		Dec.	19.5	390	6.59*
		23.4	91	9.61*	1912	Jan.	16.4	418	8.84
		27.4	95	10.16*		Feb.	13.4	446	8.77
	Mar.	2.4	98	9.00		Oct.	8.6	684	8.82
	Sep.	11.6	291	8.99		Nov.	18.6	725	8.50*
	Oct.	12.6	322	8.80	1913	Jan.	9.4	777	9.08
		18.6	328	8.90			9.5		9.71*
		23.6	333	9.39			29.4	797	9.08
						Feb.	1.4	799	9.03

----*****----

Bond Star 741

1911,	Jan.	25.4	62	8.03	1911	Nov.	21.6	362	6.94*
	Feb.	4.4	72	7.28			25.6	366	6.53*
		10.4	78	7.30			29.5	370	7.65
		10.4		8.20		Dec.	19.5	390	7.53
	Mar.	2.4	98	8.85	1912	Jan.	13.5	415	7.41
	Sep.	11.6	291	8.16			16.4	418	7.52
	Oct.	12.6	322	7.97		Feb.	13.4	446	9.22*
		18.6	322	7.57		Mar.	16.4	478	6.51*
		23.6	333	7.80		Oct.	8.6	684	7.58
		24.6	334	8.64			15.6	691	7.94
	Nov.	2.6	343	7.64		Nov.	18.6	725	7.75
		10.6	351	7.38	1913	Jan.	9.5	777	8.99
		16.6	357	7.44			29.4	797	8.18
		18.6	359	8.76		Feb.	1.4	799	8.43

----*****----

Bond Star 784.

1911,	Feb.	4.4	72	10.71	1911	Mar.	2.4	98	11.69*
		4.4		10.77		Oct.	26.6	336	10.87
		10.4	78	10.23*		Nov.	10.6	351	10.80
		23.4	91	10.44			10.6		10.76
		23.4		10.54			18.6	359	10.30*
		27.4	95	10.63			18.6		10.76
		27.4		11.24*			21.6	362	10.74
	Mar.	1.4	97	10.74			21.6		10.75
		1.4		10.74			22.6	363	10.86
		1.4		10.79			22.6		10.77
		1.5		10.80			29.6	370	10.67
		1.5		10.96			29.6		11.10*
		1.5		10.89		Dec.	19.5	390	10.74
		1.5		10.92	1912	Jan.	13.5	415	10.59

Bond Star 784. (con'td).

Date			J.Day	Mag.	Date			J.Day	Mag.
1912	Jan.	13.4	415	10.64	1912	Oct.	8.6	684	9.88*
		16.4	418	10.75			8.6		10.71
		16.5		10.80			8.6		10.55
	Feb.	5.4	438	10.91			15.6	691	10.89
		5.5		11.13*			15.6		10.72
		8.4	441	10.46		Nov.	18.6	725	10.01*
		8.4		10.59			18.6		10.83
		8.5		10.76			18.6		10.75
		8.5		10.77			18.6		10.00*
		13.4	446	11.08			18.6		10.19*
		13.4		10.56			18.6		10.47
		22.4	445	10.87			18.6		10.49
		22.4		11.20*					

----*****----

Bond Star 822.

1911,	Feb.	4.4	72	10.05	1911,	Nov.	29.5	370	10.78
		10.4	78	9.12		Dec.	19.5	390	9.60
		21.4	89	9.39	1912,	Jan.	16.4	418	9.78
		23.4	91	9.70			19.4	421	9.73
		27.4	95	10.02		Feb.	8.4	441	8.75
	Mar.	1.4	97	11.18			22.4	455	10.28
		2.4	98	10.28		Mar.	16.4	478	9.76
	Oct.	26.6	336	10.41		Oct.	6.6	682	10.27
	Nov.	2.6	343	9.64			8.6	684	8.11*
		10.6	351	9.58			15.6	691	9.47
		16.6	357	8.20		Nov.	18.6	725	9.90
		18.6	359	10.73		Dec.	9.5	746	9.81
		22.5	363	9.55	1913	Jan.	8.5	777	11.43
		25.6	366	8.07			29.4	797	9.64
						Feb.	1.4	799	10.23

----*****----

Bond Star 924.

1911,	Sep.	6.6	286	8.52	1911,	Oct.	18.6	328	7.88*
		11.6	291	8.81			18.6		8.68
		11.6		8.42			23.6	333	8.73
		13.6	293	8.67			23.6		8.86
	Oct.	12.6	322	8.80			23.6		8.83
		12.6		8.79			24.6	334	8.63
		18.6	328	9.16			24.6		8.90
		18.6		8.76			24.6		8.71

----*****----

Bond Star 938.

1911,	Sep.	6.6	286	10.54	1911	Oct.	18.6	328	10.30
		11.6	291	10.28			23.6	333	10.45
		13.6	293	10.85*			24.6	334	9.41*
	Oct.	12.6	322	10.41		Nov.	25.6	335	10.36

ADOPTED MAGNITUDES AND PROBABLE ERROR.

-----****-----

The following table contains, in the first column the Bond number assigned to the star, in the second column the adopted magnitudes of the constant stars, in the third the number of observations on which this determined magnitude depends, and in the fourth the probable error. The magnitude was found by simply taking the mean of the values as given by the several determinations. As stated before, all those observations which were thought to be unreliable on account of poor seening as noted at the time of observation or on account of difficulties arising from an inability to secure a good artificial star have been excluded from the number used in determining the adopted values of the magnitudes.

The probable error was obtained by the application of the following formula as given in "Elements of Practical Astronomy" by W. W. Campbell page 247. The formula is

$$r=\pm 0.6745\sqrt{\frac{(vv)}{n(n-1)}}$$

were r is the probable error, (vv) the sum of the squares of all the differences from the mean value, and n the number of observations involved. In most cases where the error is large this fact is due to an uncertainty caused by the star being surrounded by nebulosity. In a few cases as can be seen by the table it is due to the small number of observations on which the determination depends.

Bond Number.	Magnitude.	Number of Observation.	Prob. Error.
523	9.38	12	±0.05
558	v		
567	11.36	1	
570	8.20	12	0.06
573	v		
575	11.36	11	0.03
581	v		
589	11.65	10	0.05
595	11.84	2	0.18
612	12.40	4	0.06
617	6.74	6	0.08
618	11.95	5	0.08
619	10.04	4	0.08
622	11.80	3	0.10
624	8.13	10	0.04
629B	5.24	5	0.23
633	10.98	2	0.44
635	9.98	21	0.03
636	12.49	2	0.09
640	6.49	8	0.08
641	v		
647	11.23	17	0.04
651	12.19	6	0.02
652	11.85	14	0.02
657	11.78	11	0.03
663	v		
666	12.49	5	0.04
669	9.36	10	0.05
671	11.38	16	0.03
676	12.23	13	0.02
677	12.87	4	0.04
681	12.30	16	0.03
685	5.00	3	0.11
707	v		
708	6.50	11	0.05
709	v		
724	8.96	18	0.03
741	v		
784	10.74	43	0.02
822	v		
924	8.75	15	0.03
938	10.39	6	0.03

COMPARISON WITH OTHER OBSERVERS.

In the table which follows is given a comparison of the magnitudes found in this paper with those found by Stone, Scheiner, and Pickering in their publications mentioned in the introduction. The first column contains the Bond number, the second the magnitude as found in this paper, the third Stone's magnitude as reduced to the scale of the present work, the fourth, Scheiner's magnitude, the fifth Pickering's magnitude and Stone's magnitude, the seventh the difference for Scheiner's magnitude and the eighth the difference for Pickering's magnitudes. There are several cases where the differences are sufficient to warrant a suspicion os variability, but the discussion of this will be taken up under Variables.

Bond Number.	Ob. Mag.	Stone.	Scheiner.	Pickering.	Obs.- St.	-Sc.	-P.
523	9.38	---	9.0	9.0	------	+0.38	+0.38
558	v	10.72	12.8	10.0	------	---	---
567	11.36	13.65	---	12.0	-1,29	---	-0.64
570	8.20	----	7.5	8.0	------	-0.70	+0.20
573	v	12.15	---	11.0	-----	---	---
575	11.36	11.64	---	12.0	+0.45	----	-0.64
581	v	13.09	---	12.0	------	----	----
589	11.65	11.79	0--	12.0	-0.14	----	-0.35
595	11.84	12.76	---	n	-0.92	----	----
612	12.40	12.15	---	n	+0.25	----	----
617	6.74	10.21	6.5	11.0	-3.47	+0.24	-4.26
618	11.95	12.21	---	13.0	-0.26	----	-1.05
619	10.04	8.07	---	7.0	+1.97	----	+3.04
622	11.80	11.56	---	n	+0.24	----	----
624	8.13	8.12	7.5	8.0	+0.1	+0.63	+0.13
628	5.24	5.24	---	6.0	0.00	----	-0.76
633	10.98	10.60	---	11.0	+0.38	----	-0.02
635	12.49	12.32	---	n	+0.17	----	----
640	6.49	6.80	---	7.0	-0.31	----	-0.51
641	v	12.81	---	13.0	------	----	----
647	11.23	11.25	---	11.0	-0.02	----	+0.25
651	12.19	11.52	---	11.0	+0.67	--- -	+1.19
652	11.85	11.69	---	12.0	+0.16	----	-0.15
657	11.78	11.27	12.2	11.0	+0.21	-0.24	+0.78
663	v	12.85	---	12.0	----	----	----
666	12.49	13.45	---	12.0	-0.96	----	+0.49
669	9.36	9.26	8.8	9.0	+0.10	+0.48	+0.36
671	11.38	11.38	---	11.0	0.00	----	+0.38
676	12.23	12.37	---	n	-0.14	----	----
677	12.87	13.80	---	12.0	-0.97	----	+0.87
681	12.30	12.43	---	13.0	-0.13	----	-0.70
685	5.00	5.00	4.0	6.0	0.00	+1.00	-1.00
707	v	10. 11	12.2	11.0	----	0---	----
708	6.50	6.53	5.5	7.0	-0 .03	+1.00	-0.50
709	v	11.14	---	11.0	----	----	----
724	8.96	8.69	8.8	9.0	+0.27	+0.08	-0.04
741	v	7.96	7.3	8.0	----	----	----
784	10.74	-----	11.5	11.0	----	-0.76	-0.26
822	v	-----	9.3	10.0	----	----	----
924	8.75	-----	8.0	9.0	----	+0.75	-0.25
938	10.39	-----	11.0	11.0	----	-0.61	-0.61

VARIABLES.

The variables and suspected variables are discussed in the order of the Bond numbers. Where it was found possible, the periods were found in the following manner. Using the magnitude as ordinate and the time interval as abscissa points were ploted on co-ordinate paper. From these the interval between successive maxima and also between successive minima were found as nearly as possible. The mean of these determinations was adopted as a first approximation of the period. The value thus obtained was then divided into the whole interval between the time of the first and last maximum to obtain the whole number of periods included, the quantity being taken to the nearest unit. The whole interval between the maxima was then divided by the number of periods to obtain the true length of the period and the value thus obtained adopted as the correct determination.

558 which was suspected by Leavitt and Burns has been confirmed as a regular variable with a period of 29.2 days. The variation is between the magnitudes 10.09 and 11.74 The period is determined from observations extending over eleven periods. The minimum on Mar. 1 and that on Jan. 30, 1911, were not used in this determination as they were not supported by observations before and after and could not be certainly recongized as the minimum. As seen from a comparison with the table of minima given below these observations were made very near the time of

a minimum. With ~~only~~ the exception of Dec. 18.2 only the dates as computed agree well with the observations and the observation of Dec. 19.5, which is the only one near, is not reliable. The maxima are not well determined but seem to come a little nearer the end of the period than the middle. The computed dates of the minima are as follows, only those being given which occur near the time of a recorded observation:-

1911--Jan. 31.0, Mar. 1.2, Sept. 21.6, Oct. 20,8, Nov. 19.0, Dec. 18.2.

1912--Jan. 16.4, Feb. 14.6, Mar. 14.8, Oct. 5.2, Nov. 3.4.

567 has not not been previously announced as a variable, However the brightness as here determined by a single observation of ~~mine~~ the present observer, is 1.29 magnitudes brighter than determined by Stone and 0.64 brighter than Pickering's determination, thus indicating a possible variability. This needs confirmation.

573 was suspected by Burns. It is confirmed as a regular variable with a period of 29.0 days. The determination is made from observations extending over eleven periods. The minima previous to Nov. 22, 1911, were not well determined and hence were excluded from the computations. The observation on Feb. 4, 1911 is not good, being somewhat too faint, but the other observations fit in well with the computed periods. The dates of the minima are as follows:

1911, Jan.7.5, Feb. 5.5, Mar.6.5, Sept. 25.5, Oct. 24.5, Nov.22.5, Dec. 21.5.

1912: Jan.19.5, Feb.17.5, Mar.17.5, Oct. 6.5, Nov. 4.5. The maxima of this star like those of 558 are not well determined.

575 was announced by Stone as almost certainly variable. The evidence at present is not sufficient to confirm or disprove this statement.

581 was suspected by Burns and seems to show a slight but irregular variation. The range is between the magnitudes 11.64 and 12.24.

589 was suspected of variation by Stone and seems to vary slightly but this needs confirmation.

595 is possibly variable as indicated by the comparison with Stone's determination of the magnitude. The star is observed as 0.92 of a magnitude brighter than his determination. Also it was not seen by Pickering, tho he saw other stars as faint as the 13th magnitude, while the present observations give its magnitude as 11.84.

612 was suspected by Stone from comparisons with 618.

617 as shown by comparison with other observers is almost certainly a variable. The magnitude observed here and that determined by Scheiner differ only by o.24 of a magnitude, but the determinations of Stone and Pickering differ from mine by 3.47 and 4.36 respectively. The observations in the present paper taken alone give some indication of variability, but are not sufficient to determine a period.

618 suspected as variable by Stone, seems to show variation but the number of observations is small, due to the failure to see the star except on the nights of very good seeing. It is surrounded by nebulosity. The variability needs confirmation.

619 has not been previously announced as a variable but the comparison with the other observers gives strong evidence of such variability. The observation given in the previous table do not indicate variability within themselves however. The observed magnitude is 1.97 fainter than Stone's magnitude and 3.04 fainter than that of Pickering.

622 was suspected by Stone. The observations are not sufficient to either prove or disprove its variability.

628 shows some signs of variability but the observations on this star are not very accurate due to the nebulosity surrounding it.

641 was announced as variable by Stone. It has a regular period of 29.4 days as determined from observations extending over eleven periods. The observations fit in well with this period the minima occurring on the following dates:-
1911-- Feb. 26.4, Sept. 21.2, Oct. 20.6, Nov. 19.0, Dec. 18.6,
1912-- Jan. 16.8, Feb. 15.2, Mar. 15.6, Oct. 7.4, Nov. 5.8.
The maxima are not well determined.

647 is said by Stone to be "much brighter than formerly" and so appears in his table of comparison of his observed magnitudes with the values as given in his photometric catalogue, the difference being 1.51 magnitudes. The present observations ~~of this star show no evidence of variation among observations~~ of this star show no evidence of variation among themselves and the magnitude as determined does not differ essentially from that of Stone or Pickering. The star was not observed by Scheiner.

651 as indicated by the comparison with other observers shows a slight evidence of variation. The observed brightness differing 0.67 of a magnitude from Stone's determination and 1.19 from that of Pickering.

654 is stated by Stone to be a star in which there is little doubt of variability. His comparison with his photometric cata-

logue indicates it as being 1.24 magnitudes fainter than formerly. The star was seen by neither Pickering, nor the present observer so that in fact it is almost certainly a variable.

663 announced as varaible by Leavitt, is an irregular variable with a range of magnitude from 11.02 to 12.59.

671 suspected by Stone is possibly variable with a short period, but this needs confirmation.

707 has not been previously announced as a variable but is indicated by the present observations to vary with an irregular period. The variation is between the magnitudes 10.66 and 11.62. Also Scheiner and Pickering differ by 1.20 magnitudes in their determinations.

708, suspected by Burns is probably not variable,

709 was announced as variable by Stone and confirmed by both Leavit and Burns. This star seems to be an irregular variable with the period ranging from about ten up to thirty-five or forty days. The range in magnitude is between 10.50 and 12.68.

741 was announced as variable by Burns. This star seems to be an irregular variable but the fact needs confirmation.

784 was announced as variable by Leavitt. Though the star was observed on 43 nights there is very little if any evidence of variability among the observations themselves. The star was not observed by Stone and the values of the brightness as given by Scheiner, Pickering and myself, do not differ essentially. In H. C. O. Annals Vol. 32 the magnitude is given. The magnitude found by the present observer is 10.74, a difference

of 0.66.

822 was announced as a variable by Bond and confirmed by Leavitt as well as a large number of other observers. This star has an irregular period. The magnitude ranges from 8.07 to 11.43.

CONCLUSION.

The region of the Great Nebula of Orion is rich in variable stars. Of the forty-two stars observed, the course of the work in preparation for this paper, there are five variables with a determined regular period, five irregular variables, and thirteen of which the variability is not yet certainly determined but is strongly suspected. In the case of several of the suspected variables a long period or slow continuous change is indicated. This is shown by the fact that the change in brighness can only be detected by a comparison with the values as determined by former observers.

There is undoubtedly much interesting data to be gathered in the Huygenian Region of the Great Nebula of Orion by any astromomer interested in and equiped for variable star work.

Leander McCormick Observatory
University Va.
June 1913. ########## Chas D Wunder