23, 27, December 7 and 10, and that the elongation in the case of *Capella* was noted as being quite as distinct as in the case of *κ Pegasi*, for which Mr. Lewis estimated the distance as under 0″·1. On December 10 Mr. Lewis (though unable to get a satisfactory measure of position-angle owing to unsteadiness of the image shortly before the sky clouded over) satisfied himself of a distinct elongation in *Capella*, the definition being very fine momentarily, so that he was able to *count* eight rings round the star, using a magnifying power of 1120, there being at least ten or more complete rings visible.

The two components of *Capella* do not differ much in brightness, but there is a consensus of opinion amongst the observers that the position-angles as given indicate the direction of the fainter star. Mr. Bryant in particular has noted his impression as to this on several occasions, and I can confirm this on July 13, when the star appeared distinctly egg-shaped, with the smaller end in the position-angle given. On September 19 I had the impression that the fainter star was in the first quadrant, not the third, but the elongation was then smaller, and I do not feel so much confidence as to which end of the elongated image was the smaller.

In making the observations, neutral-tinted or deep-blue shades were used to reduce the brightness of the star. Many of the observations were made in the daytime, when the brightness was naturally much reduced.

Royal Observatory, Greenwich:
1900 *December* 14.

ζ Herculis. By T. Lewis.

R.A.	$16^h\ 37^m\ 31^s$	1900.	Mag. A.	3·0	Yellow.
N.P.D.	58° 13′ 1″		Mag. B.	6·5	Bluish Green.

Sir William Herschel found this star to be double on 1782 July 18, and on July 21 he measured the position-angle as 69°·3. In 1795 he noted that it was in the n.f. quadrant, and remarked that the distance was smaller than in 1782. In 1802 and 1803 he failed to separate the pair, but measured the angle on three occasions :—

1802·74	219°·2
1802·81	5°·7
1803·29	116°·8

Thus, while it was evident that the pair formed a binary system of short period, these observations left the matter in a very unsatisfactory state, which did not improve by the failure of Sir J.

Herschel and South to see the companion from 1821 to 1825. With regard to the failure in 1802 and 1803, Dr. See states that "at this time the position-angle was 174°·5 and distance 1″·24," and it therefore seems strange that Herschel could not make any satisfactory measures.

Since Herschel's time three revolutions of the companion have been completed, and yet there are certain circumstances connected with the system which require elucidation. For instance, Dr. See computed an orbit in 1895, and so recently as 1900 Dr. Doolittle, using observations down to 1897·6, made a careful investigation, and deduced what may be considered as the most satisfactory orbit. Yet, when the ephemerides are compared we see that they both fail, *e.g.* :—

	See.		Doolittle.		Observed.	
	°	″	°	″	°	″
1899·5	289·7	0·47	273·9	0·59	263	0·60
1900·5	258·4	·58	247·7	·77	240	0·78
1901·5	233·0	·80	230·6	·92		

It must, however, be understood that as periastron passage occurred in 1898, the ephemeris is here subject to large errors, due in great measure to the inequality of the components and their closeness. Still, the errors are too large.

The present paper is an attempt to set forth the peculiarities of motion in this system, and by an appeal to the Greenwich Transit Circle observations get some idea of the causes. For convenience the subject is dealt with in three distinct parts.

(1) Discussion of micrometric measures.

(2) Discussion of meridian observations and their combination with the micrometric measures.

(3) Discussion of circumstances arising from these, and remarks on magnitude, colour, and proper motion.

Part I.

Discussion of Micrometer Measures.

All the micrometric measures of this pair which could be found have been tabulated in the order of date and yearly means formed according to the following plan :—

The result of	1 night's	measures	received	a	weight	1
,,	2 or 3 nights'	,,	,,	,,	,,	2
,,	4, 5 or 6	,,	,,	,,	,,	3
,,	over 6	,,	,,	,,	,,	4

The yearly means thus obtained differ but little from those obtained by adopting any other similar system of weighting. These means were then plotted and a line drawn through them in such a manner as to make individual residuals as small as possible, no regard being paid to the number of inflexions. From these smoothed means the position-angles and distances at the commencement of each year were read off and tabulated. These positions were then laid down as in fig. 1, where N represents the true north point and A the principal component, which is assumed

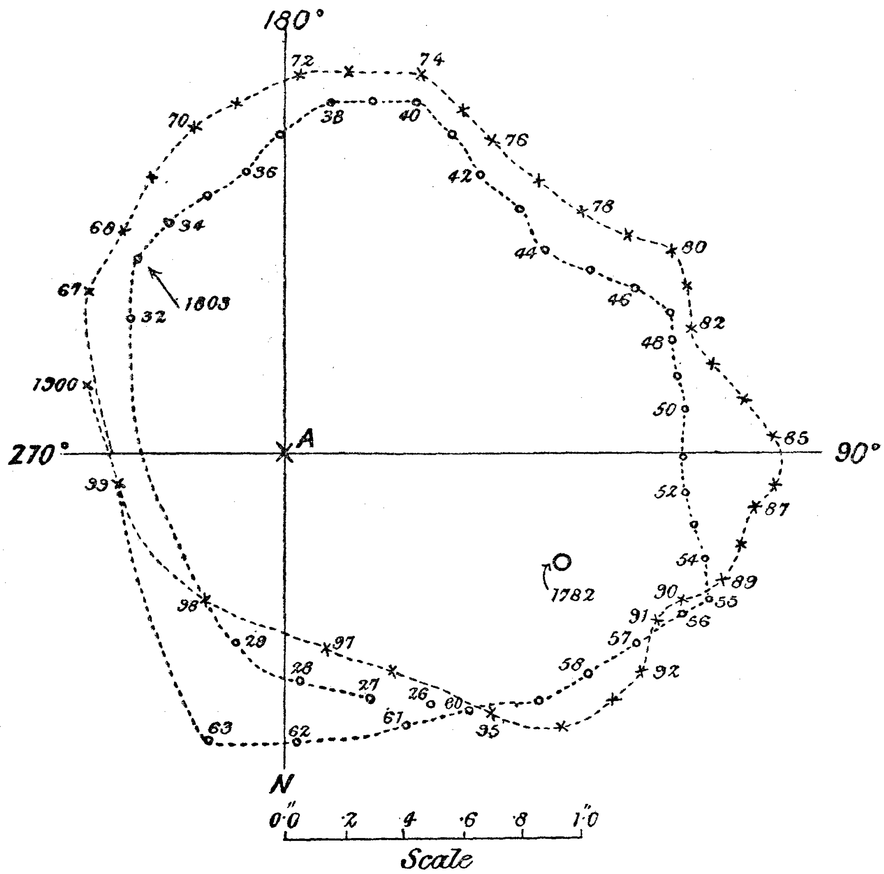


FIG. 1.—Positions from yearly means of angles and distances, A being the principal component and assumed fixed.

at rest. It is at once apparent that no single ellipse could satisfy these positions, for

(1) The series of positions 1832 to 1860 are inside those for the period 1867 to 1895.

(2) A radius vector from A passes through

1832	and	1867,	giving a period of		35	years
1837	„	1871½	„	„	34½	„
1844	„	1878	„	„	34	„
1851	„	1885½	„	„	34½	„
1859	„	1893	„	„	35	„

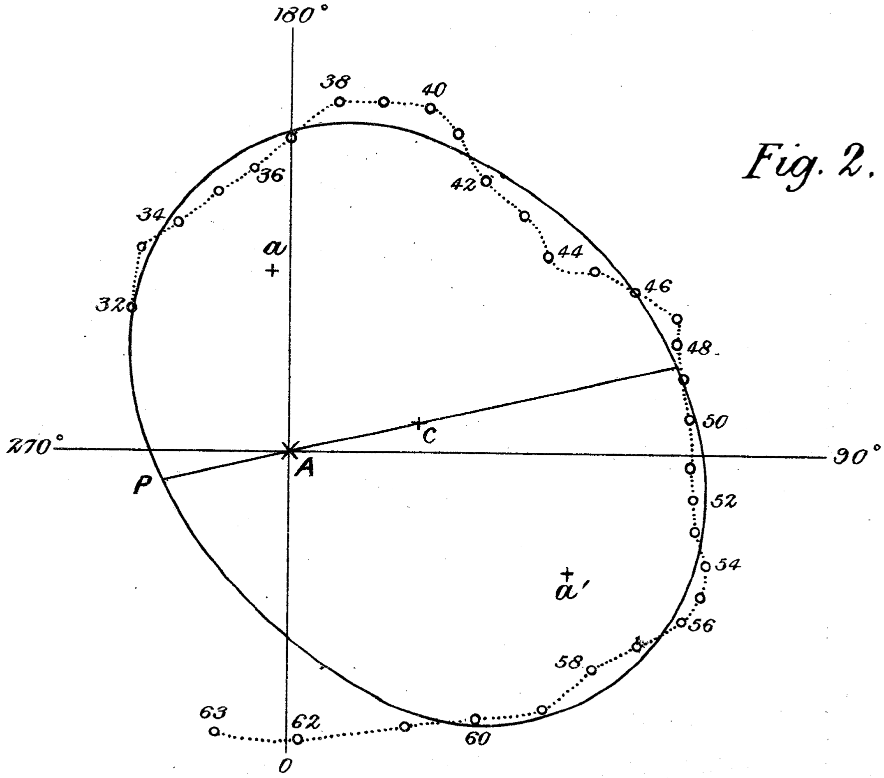

180°
38
40
36
34
32
42
44
46
48
50
52
54
56
58
60
62
63
0
270°
90°
A
C
P
a
a′

Fig. 2.

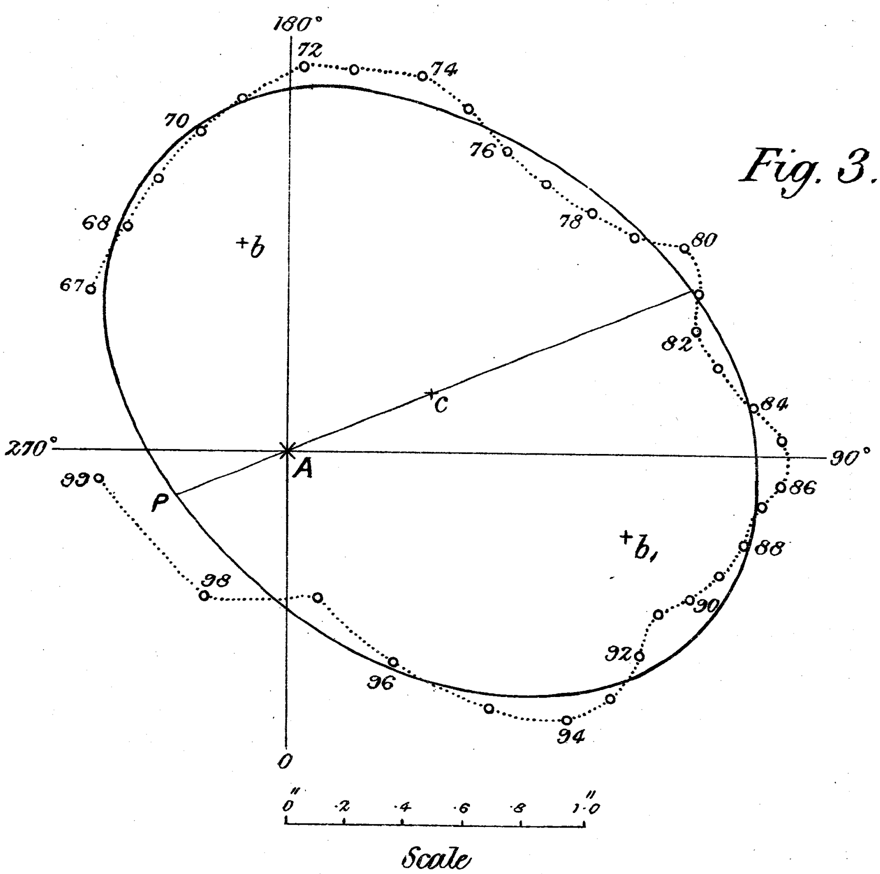

180°
72
74
70
76
68
67
78
80
82
84
86
88
90
92
94
96
98
99
0
270°
90°
A
C
P
b
b,
0″ ·2 ·4 ·6 ·8 1·0″
Scale

Fig. 3.

Consequently, each period has been treated separately and quite independently. Thus, in fig. 2 (Plate 2) the positions from 1832 to 1863 are laid down and an ellipse drawn which appears to best satisfy the measures. Similarly, fig. 3 (Plate 2) shows the positions from 1867 to 1899 with the ellipse best representing them.

These ellipses represent the apparent orbits, the elements of which are

	Fig. 2.	Fig. 3.
Length of major axis	2″·19	2″·40
Length of minor axis	1·67	1·75
Angle of major axis	224°·6	232°·5
Angle of periastron	283·6	293·8
Distance of star A from centre	0″·45	0″·52

and the corresponding elements of the true orbits :

τ	Periastron	1864·03	1898·09
P	Period in years	32·4	33·9
a	Semi-major axis	1″·25	1″·40
e	Eccentricity	·504	·560
☊	Node	35° 29′	40° 59′
γ	Inclination	46 42	50 18
λ	Angle in true ellipse between node and periastron	254 36	258 48

It will be noticed that in fig. 1 observations are laid down for the years 1782, 1803, 1826 and 1829. I have made no use of these, the meagre material leaving too much room for individual prejudice. It so happens, however, that Maedler computed two orbits—one in 1842 and another in 1847—in which these measures necessarily have great weight, at least, this is so in the 1842 orbit. We may hence adopt Maedler's orbit for the period anterior to the two now given, provided we bear in mind the slender material from which it is deduced.

The three periods then give, in chronological order :

	τ	P	a	e	☊	γ	λ
(1)	1829·50	31·46	1″·19	·455	39°	51°	262°
(2)	1864·03	32·4	1·25	·504	35	47	255
(3)	1898·09	33·9	1·40	·560	41	50	259

in which the chief points noticeable are

1. The increase in P, a, e.

2. The discrepancy between the period obtained from considerations of motion in each ellipse by itself and that deduced from one periastron passage to another.

3. The apparent constancy of the line of nodes and of the inclination.

The discrepancy in (2) is still more remarkable when we take into account the motion of Periastron, from which a decrease in the time from one periastron passage to the next might be expected. The discussion of the varying period led, amongst other things, to the interesting curve in fig. 4 (Plate 3). This curve results from the following process:—Using the smooth curve already obtained from the observed position-angles, the angles at the commencement of each year beginning at 1832 were tabulated, and the time noted when such angle recurred. Thus the angle for 1832·0 is 229°·0, and it occurs again in 1867·1, or 35·1 years later. A whole series of such time-intervals being obtained and laid down with the initial years as abscissæ.

To make this portion complete the computed orbits are appended.

P	τ	ε	a	☊	γ	λ	Authority.	Date
			″	°	°	°		
31·47	1829·50	0·455	1·19	39·4	50·9	262·1	Maedler	1842
30·22	1830·42	·432	1·21	19·4	44·1	276·7	,,	1847
36·36	1830·48	·448	...	214·4	43·7	284·9	Villarceau	...
37·21	1830·56	·438	...	37·2	39·4	266·9	Fletcher	1853
36·71	1830·24	·483	1·35	41·9	49·1	290·6	Villarceau	1854
34·22	1830·01	·424	1·22	45·9	34·9	209·5	Dunér	1871
36·61	1829·64	·551	1·37	27·0	50·2	266·7	Plummer	1871
34·58	1864·90	·405	1·36	26·1	51·1	261·0	Flammarion	1874
34·4	1864·8	·463	1·28	41·7	43·2	252·8	Doberck	1880
34·41	1864·78	·467	1·35	44·1	44·5	251·8	,,	1881
35·0	1864·80	·497	1·43	37·5	51·8	258·3	See	1895
34·53	1863·89	·457	1·36	54·1	47·8	247·4	Doberck	1899
34·55	1864·46	·456	1·38	48·7	45·0	249·6	Doolittle	1900

Micrometric Measures. Yearly Means.

The following Table is a summary of the yearly means of micrometer measures, weights being given according to the number of nights, as follows:

1	night=weight		1
2, 3	nights	,,	2
4, 5, 6	,,	,,	3
over 6	,,	,,	4

also giving a weight of 1 to Smyth.

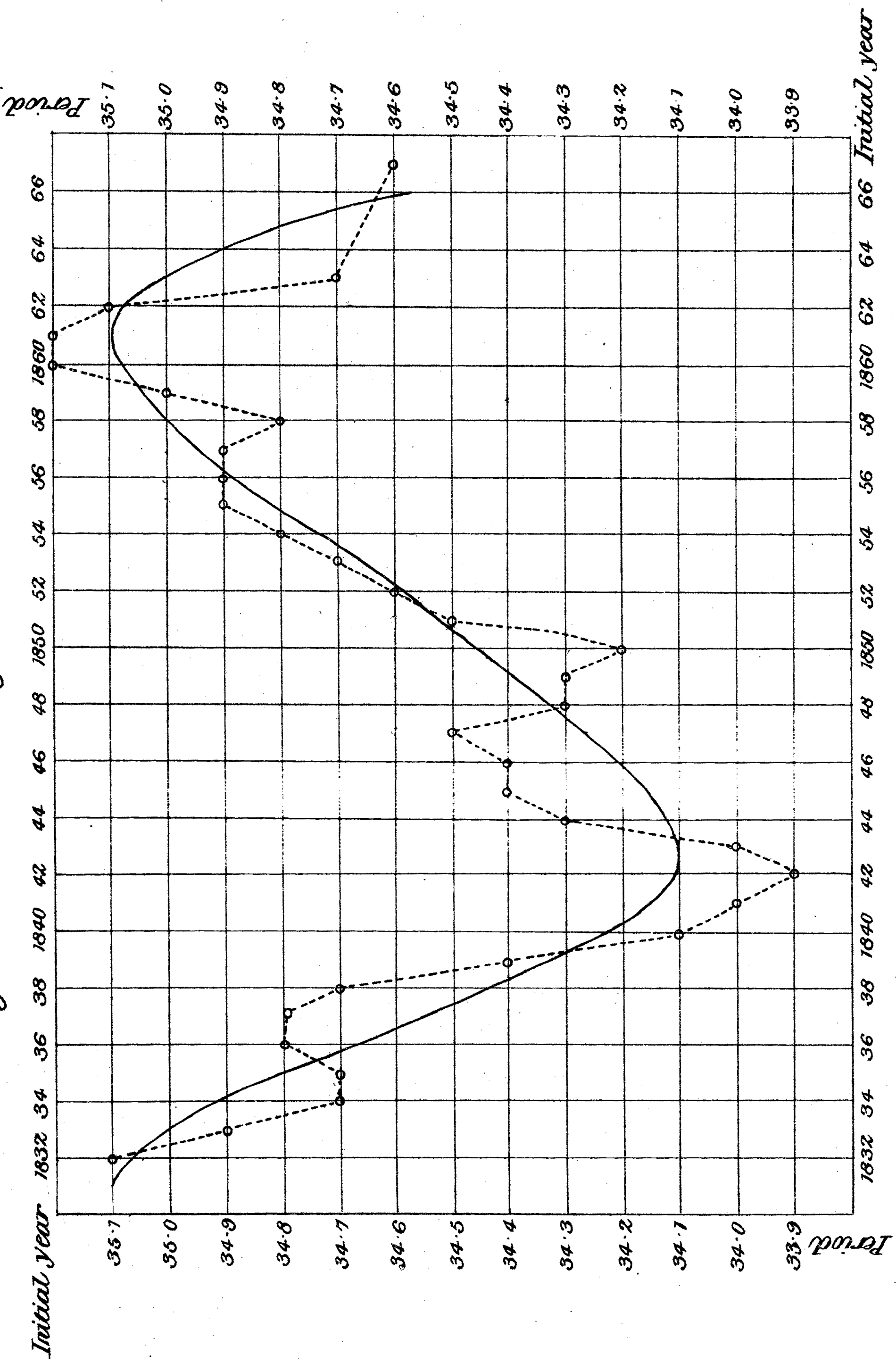


Fig. 4. Curve showing variation of Period

Date.	Angle.	Dist.	w
	°	″	
1782·55	69·3	< 1·0	1
1802·74	219	...	1
26·63	23·4	0·91	3
28·73	352·6	0·65	1
32·75	220·5	0·81	1
34·45	203·5	0·90	2
35·51	195·2	0·94	4
36·64	183·7	1·00	4
37·47	175·5	1·10	3
38·62	168·6	1·19	5
39·73	161·3	1·20	5
40·65	156·0	1·28	6
41·57	147·0	1·21	7
42·60	141·0	1·08	11
43·65	130·1	1·06	6
44·50	122·7	1·12	4
45·52	119·3	1·26	4
46·76	110·2	1·36	4
47·51	107·6	1·36	12
48·55	102·2	1·33	7
49·65	97·5	1·56	3
50·54	91·4	1·36	6
51·61	86·9	1·36	15
52·64	82·6	1·38	10
53·45	78·2	1·42	18
54·47	74·4	1·48	11
55·62	69·6	1·48	9
56·48	63·7	1·38	12
57·59	57·8	1·32	17
58·56	49·0	1·17	12
59·65	39·6	1·15	15
60·69	30·0	0·97	4
61·57	11·2	0·95	4
62·64	350·3	1·02	4
1863·49	343·1	...	3
1866·70	232·1	0·81	12
67·57	224·2	0·93	9
68·56	207·2	1·02	12
69·64	200·0	1·08	9
70·54	192·0	1·16	8
71·52	182·5	1·19	12
72·54	174·3	1·24	10
73·55	164·7	1·35	11
74·58	155·4	1·27	9
75·57	148·5	1·30	12
76·53	140·3	1·28	16
77·57	132·7	1·28	10
78·54	126·5	1·36	14
79·56	119·3	1·48	8
80·52	113·9	1·34	11
81·53	109·5	1·49	16
82·54	103·0	1·48	15
83·60	99·3	1·49	15
84·59	93·0	1·67	14
85·58	90·0	1·69	9
86·60	86·6	1·48	9
87·60	81·4	1·56	7
88·58	75·7	1·68	8
89·56	72·9	1·50	13
90·54	68·8	1·37	9
91·56	62·5	1·38	14
92·60	56·0	1·41	8
93·74	47·6	1·34	5
94·70	40·7	1·14	20
95·38	37·1	1·01	3
96·53	10·2	0·59	3
97·51	1·2	0·66	6
98·58	297·0	0·54	6
99·30	267·2	0·57	6
1900·60	239·0	0·79	3

Position at Commencement of each Year as read from the Curves.

Date.	Angle.	Dist.	Date.	Angle.	Dist.
	°	"		°	"
1826·0	30·0	1·00	1860	36·5	1·07
27	20·0	0·88	61	24·0	1·00
28	5·0	0·78	62	1·0	0·98
29	348·0	0·72	63	346·0	1·00
30	...	...	64	...	...
31	...	...	65	...	...
32	229·0	0·73	66	...	...
33	217·5	0·83	67	230·0	0·87
34	207·5	0·88	68	215·5	0·96
35	197·5	0·93	69	204·0	1·04
36	188·5	0·97	70	195·0	1·11
37	180·5	1·04	71	187·0	1·18
38	173·0	1·15	72	178·5	1·25
39	166·0	1·21	73	170·5	1·29
40	159·5	1·22	74	160·5	1·32
41	153·0	1·20	75	152·5	1·29
42	145·5	1·14	76	145·0	1·27
43	137·5	1·09	77	137·0	1·27
44	128·0	1·11	78	130·0	1·31
45	121·0	1·18	79	123·5	1·40
46	115·0	1·30	80	117·5	1·49
47	109·5	1·37	81	112·0	1·50
48	105·0	1·34	82	107·0	1·49
49	100·0	1·35	83	101·5	1·48
50	95·5	1·37	84	96·5	1·57
51	90·0	1·36	85	92·0	1·65
52	85·5	1·37	86	88·0	1·64
53	80·5	1·43	87	83·5	1·58
54	76·0	1·45	88	79·0	1·57
55	71·5	1·48	89	75·0	1·53
56	67·0	1·45	90	71·0	1·44
57	62·0	1·36	91	66·5	1·38
58	54·0	1·27	92	60·0	1·39
59	45·5	1·18	93	53·0	1·39
60	36·5	1·07	94	46·0	1·29
61	24·0	1·00	95	38·5	1·09
62	1·0	0·98	96	27·5	0·86
1863	346·0	1·00	97	11·0	0·65
			98	328·0	0·56
			99	280·0	0·56
			1900	252·0	0·65

Fig. 5.

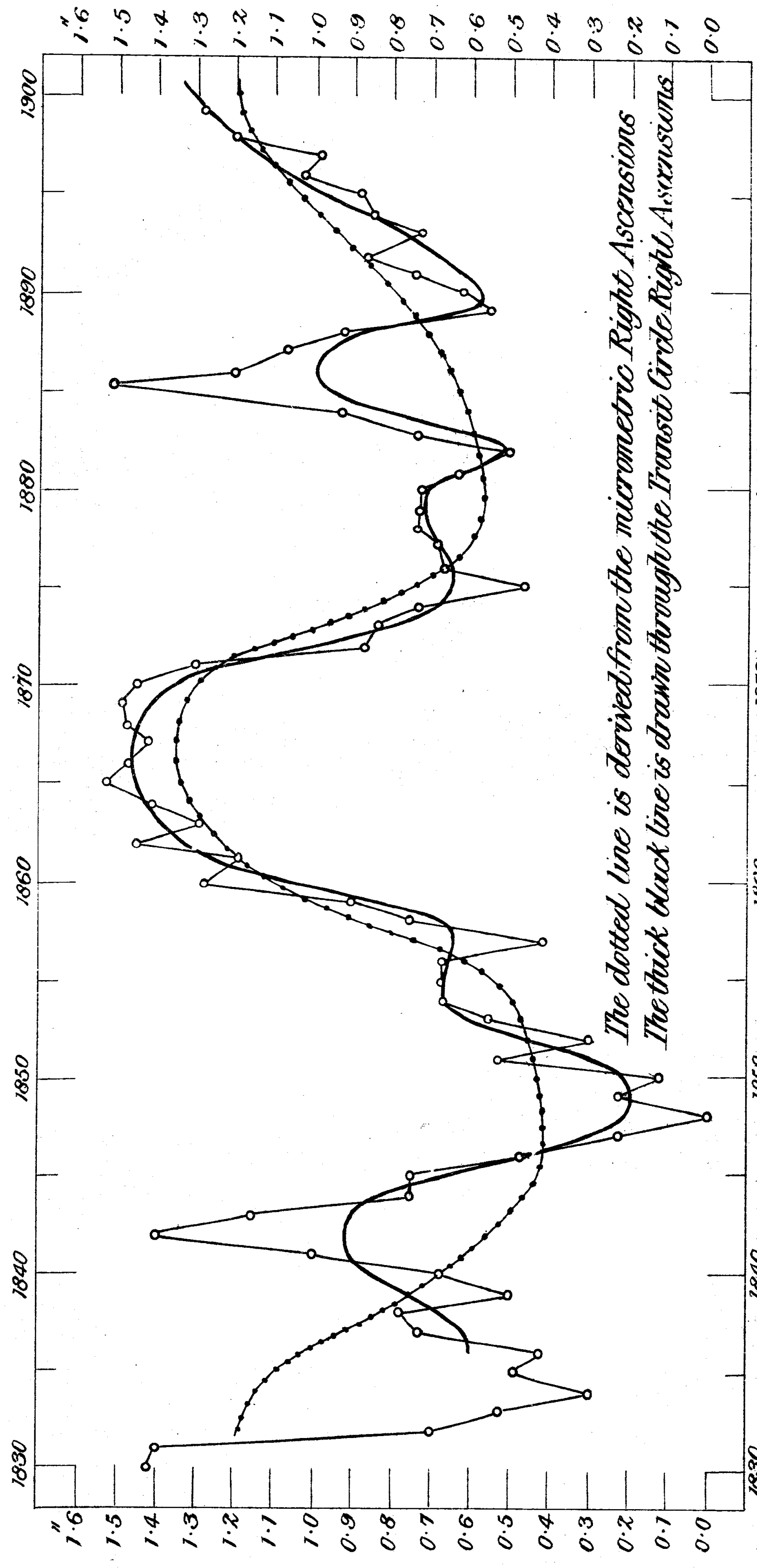
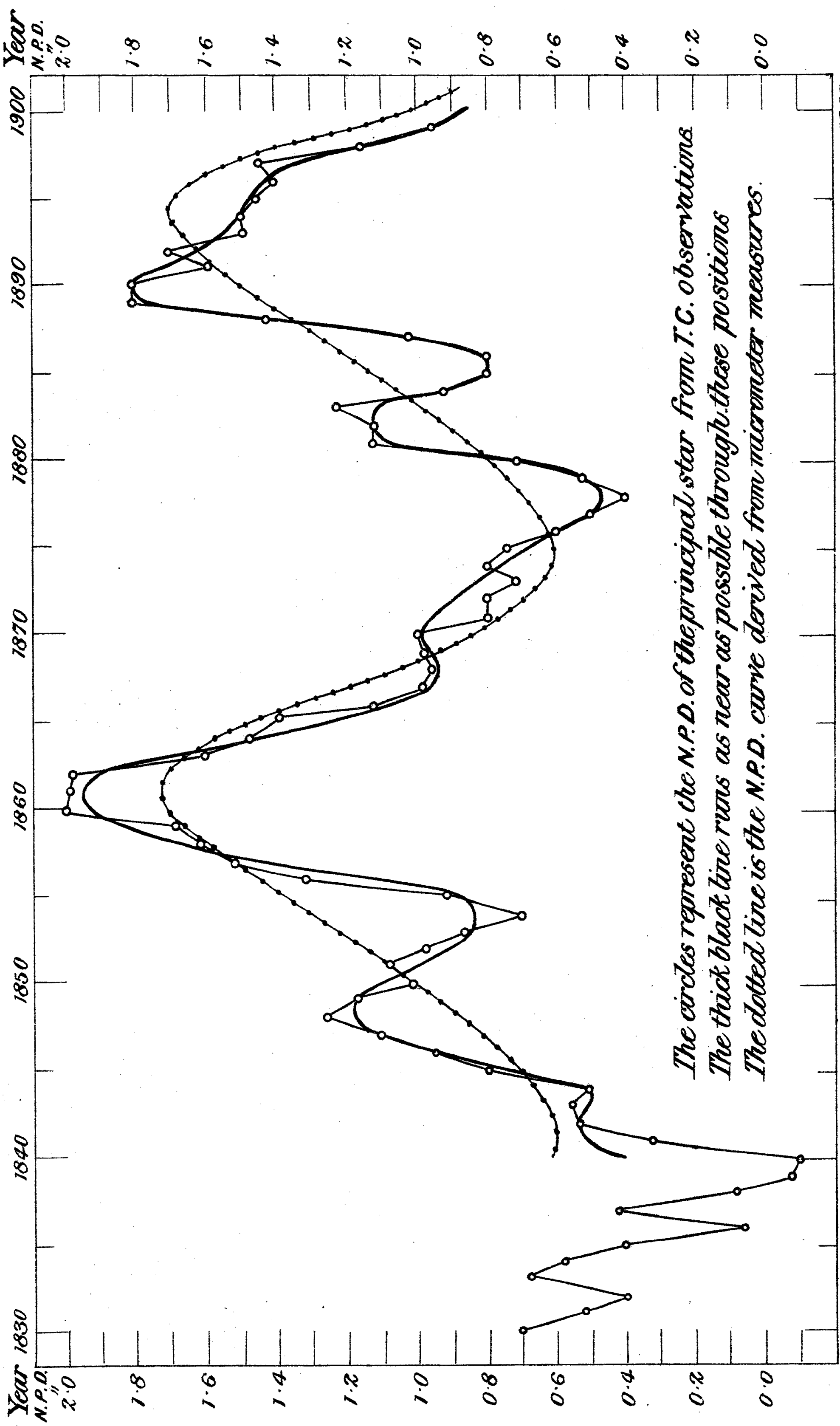

The dotted line is derived from the micrometric Right Ascensions
The thick black line is drawn through the Transit Circle Right Ascensions
1830
1840
1850
1860
1870
1880
1890
1900
″ 1·6
1·5
1·4
1·3
1·2
1·1
1·0
0·9
0·8
0·7
0·6
0·5
0·4
0·3
0·2
0·1
0·0

Fig. 6.


Year
N.P.D.
1830
1840
1850
1860
1870
1880
1890
1900
2·0
1·8
1·6
1·4
1·2
1·0
0·8
0·6
0·4
0·2
0·0
The circles represent the N.P.D. of the principal star from T.C. observations
The thick black line runs as near as possible through these positions
The dotted line is the N.P.D. curve derived from micrometer measures.

Part II.

Discussion of Meridian Observations, and their Combination with the Micrometer Measures.

Having found the micrometric measures so interesting, the observations of the principal star, made on the meridian at Greenwich, were then collected. These were found so meagre before 1850 that in the initial stage they were not used. Starting, then, at 1850 the Greenwich Right Ascensions and North Polar Distances were tabulated and reduced to 1900. It was at once seen that every possible observation previous to 1850 was desirable. Consequently observations were collected from all sources (before 1850) and reduced to 1900. Although not made use of, they have been tacked on the ends of the Greenwich series, and it must be understood that agreement or non-agreement with that series must not be taken too seriously. For convenience the Right Ascensions and N.P.D.'s are kept separate and treated independently of each other.

In reducing the R.A.'s a proper motion of $-0^s{\cdot}0375$ has been used, and originally the yearly results were used direct, as were also the N.P.D.'s, but finally it was decided to smooth them by taking the means of every three. Considering the nature of the observations, this appears quite legitimate, and results in having a less complicated series of dots to deal with.

These smoothed means are shown in fig. 5 (Plate 4).

The N.P.D.'s have been reduced with a proper motion of $+0''{\cdot}385$, the yearly means smoothed and laid down in fig. 6 (Plate 5).

The periodic nature of the curves both of R.A. and N.P.D. is evident, and similar to that deduced from the micrometric measures; consequently the positions and distances were converted into R.A. and N.P.D. The amplitude, however, seemed just about twice that of the transit Right Ascensions. At a venture the curve was then reduced one-half, and after reversion was fitted on to the transit Right Ascensions, and is shown by the continuous line in fig. 5, where it might well be mistaken for the curve really drawn through them.

Similarly, the N.P.D. curve deduced from the micrometric means was reduced one-half and fitted on the transit circle N.P.D.'s, as shown in fig. 6 (Plate 5).

In both cases the two sets of measures agree in a remarkable manner.

Hence it may be conceded that the real motion of the system is shown in fig. 7, where the left-hand ellipse is the apparent orbit of the principal star and the right-hand ellipse that of the fainter component.

The elements of the transit circle ellipse are :

☊	42° 32′	$\epsilon = {\cdot}500$.
γ	47 18	$a = 0''{\cdot}686$.
λ	76 50	P = 34 years (assumed).

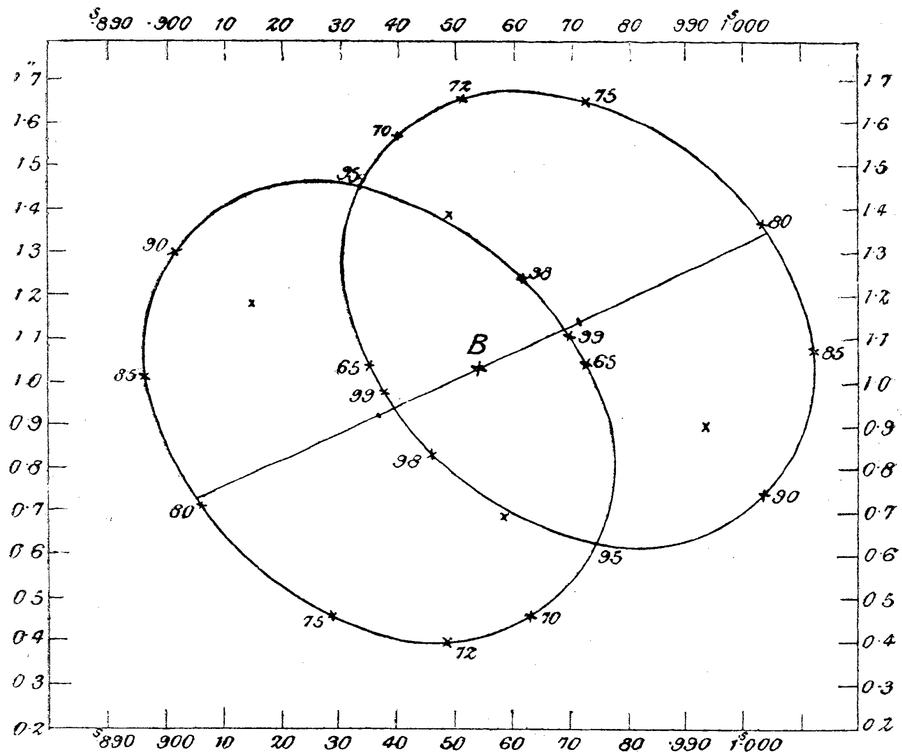


FIG. 7.—The left-hand ellipse represents the transit-circle observations from 1867 to 1869 as shown by the curves 6 and 7.
The right-hand ellipse is deduced from the first by laying off, from the several positions in that ellipse, the position-angles and distances derived from micrometric measures.

Meridian Observations collected from all Sources, reduced to 1900.

Year.	R.A. m	s	Seconds, 1900. s	Source.		N.P.D. ′	″	Seconds, 1900. ″	Source.	
1825	34	41·468	30·877	Σ		4	29·39	58·32	Σ.	
26		43·735	·886	Σ		.	.	.	.	
27		46·093	·987	Σ, Abœ			42·87	7·98	Σ, Abœ.	
28		48·33	·966		G.		50·06	8·27		G.
29		50·553	30·932	Σ, Cam.,	G.	4	56·40	7·71	Σ,	G.
30		52·919	31·039	Σ,	G.	5	4·62	9·05	Σ.	
31		55·08	30·941	Madras			8·74	6·26	Madras.	
32		57·305	·907	Madras,	G.		16·55	7·18	Munich.	
33	34	59·510	·855	Munich			24·21	7·75	Σ, Munich, G., Madras	
34	35	1·840	·927		G.		31·10	7·96		G.
35		4·030	·860	Munich			36·70	6·68	Munich.	
36		...	...				...	...		
37		8·620	·933	R.			51·30	7·54	R.	
38		10·860	·915	R.		5	58·50	7·88	R.	

Year.	R.A. m s	Seconds, 1900. s	Source.	N.P.D. ′ ″	Seconds, 1900. ″	Source.
1839	35 13·110	30·908	R., Munich	6 4·72	7·23	R., Cam., G.
40	15·310	·850	R.	10·22	5·88	R.
41	17·690	·973	R.	19·09	7·88	R.
42	19·935	·959	R., Cam.	25·86	7·79	R., Cam., Poulkova.
43	22·200	·966	R.	32·35	7·42	R., Cam.
44				39·00	7·02	Cam.
45	26·682	·888	Madras, G.	46·78	8·17	Madras, Poulkova.
46	28·938	·913	R., G.	6 53·55	8·12	R., Cam., Poulkova.
47	...	...		...	...	
48	33·367	·839	G.	7 7·50	8·45	Brussels, G.
1849	35·627	30·842	G.	7 14·07	58·14	Brussels.

Σ = W. Struve, R. = Rumker, G. = Greenwich, Cam. = Cambridge.

Greenwich Transit Circle Observations.

Year.	R.A. m s	No. of Obs.	Seconds, 1900. s	N.P.D. ′ ″	No. of Obs.	Seconds, 1900. ″
1850	35 37·99	5	30·947	7 21·04	11	{ 57·70 + 1·19
1	40·12	9	·819	27·50	20	0·80
2	42·47	7	·917	34·75	30	1·22
3	44·72	15	·902	41·01	17	0·66
4	46·96	2	·880	...	...	...
5	49·28	7	·942	7 55·00	8	0·81
6	51·50	8	·892	8 2·50	13	1·51
7	53·76	5	·895	9·36	7	1·56
8	56·01	7	·886	16·15	9	1·54
9	35 58·35	6	·968	23·30	5	1·87
1860	36 0·57	5	·929	30·02	5	1·78
1	2·86	5	·971	37·03	10	2·19
2	5·09	3	·942	43·42	4	1·79
3	7·39	3	·984	49·92	3	1·50
4	9·62	5	·954	8 56·72	5	1·52
5	11·91	4	·976	9 3·39	3	1·40
6	14·17	9	·987	9·99	6	1·22
7	16·40	10	·960	16·20	6	0·94
8	18·67	11	·973	22·74	18	0·91
9	20·94	13	·985	29·68	8	1·17
1870	23·16	5	·945	36·42	6	1·04
1	25·43	3	·958	...	...	...

Year.	R.A.	No. of Obs.	Seconds, 1900.	N.P.D.	No. of Obs.	Seconds, 1900.
	m s		s	′ ″		″
1872	36 27·66	3	30·928	9 49·62	6	0·59
3	29·90	7	·913	9 56·62	4	0·92
4	32·22	2	·970	10 3·39	3	0·83
5	34·38	1	·871	...	...	...
6	36·65	6	·877	16·77	6	0·71
7	38·97	9	·940	23·59	7	0·28
8	41·20	7	·905	30·64	5	0·58
9	43·44	4	·893	37·19	9	0·38
1880	45·74	7	·935	44·23	8	0·69
1	47·97	9	·909	51·43	6	1·15
2	...	...	...	10 57·85	6	0·84
3	52·48	5	30·890	11 5·17	7	1·43
4	54·86	3	31·014	11·70	2	1·24
5	57·04	3	30·934	17·98	2	0·75
6	36 59·37	1	31·003	24·71	4	0·81
7	37 1·57	6	30·951	31·42	5	0·80
8	3·79	1	·906	38·08	2	0·74
9	6·06	1	·917	45·72	3	1·66
1890	8·30	7	·898	11 52·32	4	1·55
1	10·59	2	·930	12 0·02	2	2·56
2	12·86	6	·938	5·24	4	1·09
3	15·10	23	·922	12·56	16	1·74
4	17·34	22	·905	18·93	22	1·38
5	19·65	20	·950	25·66	18	1·40
6	21·88	20	·926	...	12	1·66
7	24·16	16	·939	39·19	9	1·52
8	26·44	13	·957	45·53	11	1·18
1899	28·70	31	30·955	52·00	18	0·97

Part III.

Remarks on Colour, Magnitude, Irregular Motion, &c.

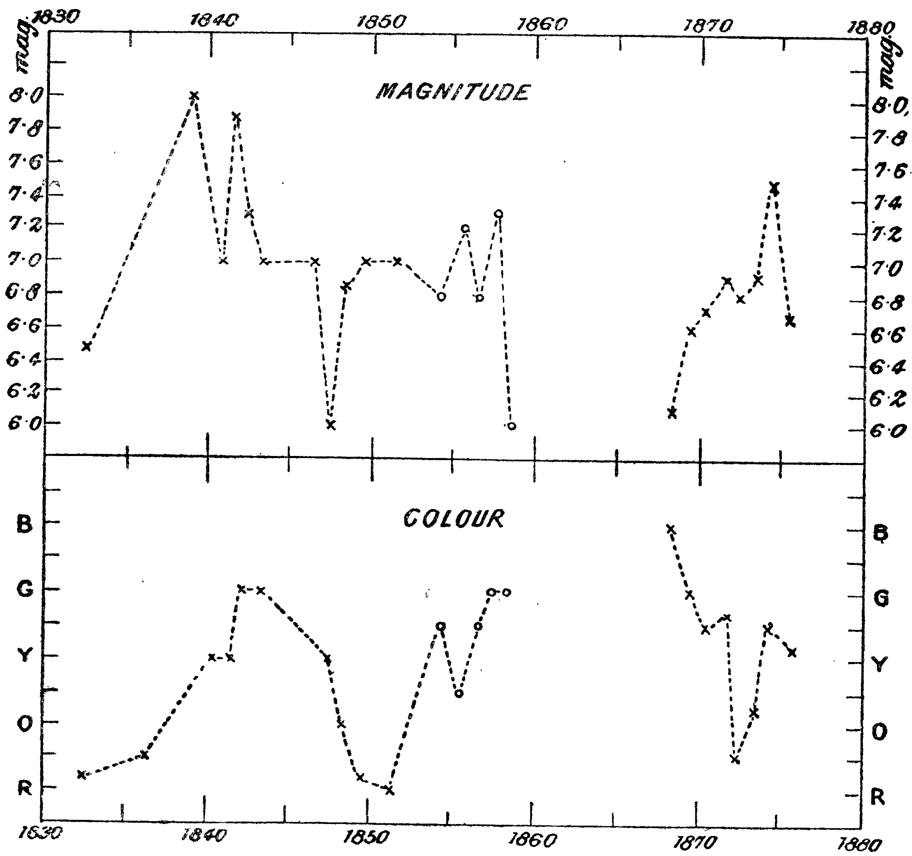
The most natural cause of the opening out of the ellipse, its rotation, and the discrepancies in the period would be the duplicity of either star. While the micrometer measures were under discussion there seemed abundant evidence that such was in truth the case with the secondary star, and the idea was somewhat strengthened by its apparent variation in colour and magnitude; but since the discussion of the meridian observations and an investigation of the colour and magnitude the evidence is all in favour of the primary being double, and this is suggested, with some diffidence, as the cause of all the peculiarities of motion in the system.

The grounds upon which this suggestion is based are the wavy lines in figs. 2, 3, 5, and 6 in the first instance, and since the residuals from the meridian observations are more marked than those from the micrometric measures the duplicity is ascribed to the principal star.

The period of this component is about twelve years and the semi-major axis 0″·25.

Magnitude and Colour.

All observers agree in calling the principal star yellow and 3·0 magnitude. The evidence in the case of the small component is not so satisfactory. The personal equation of the observer, the state of the atmosphere, and the colour correction of the object-glass and eyepiece enter so largely into estimations of magnitude, and more especially colour, that the results even of two such careful observers as Dembowski and Dunér are often in conflict. If we confine ourselves to the results of Dawes as a base, and tack those of Struve on one end, and on the other the early estimations of Dembowski, followed by those of Dunér, we obtain what may possibly be a period of seventeen or eighteen years both in colour and magnitude.



To me the colour from 1895 to 1898 was dark blue, whereas it is now a decided green; and, so far as they go, these observations fall in with those just mentioned. If we accept these results, then the magnitude seems to vary from 6·5 to 7·5 and the colour from red to blue.

1826	Struve	7·0	
32	,,	6·5	
33	,,	...	Reddish
36	,,	...	,,
39	Dawes	8·0	
40	,,	7·0	Yellow
41	,,	7·9	,,
42	,,	7·3	Blue, yellow
43	,,	7·0	,,
46	,,	7·0	
47	,,	6·0	Yellow
48	,,	6·9	Reddish yellow
49	,,	7·0	Pale red
51	,,	7·0	Red
54	Dembowski	6·8	Olive
55	,,	7 2	Orange yellow
56	,,	6·9	Olive
57	,,	7·3	Greenish olive
58	,,	6·0	Yellowish olive
68	Dunér	6·1	Blue
69	,,	6·6	Green
70	,,	6·7	Olive
71	,,	6·9	,,
72	,,	6·8	,,
73	,,	6·9	Orange
74	,,	7·5	Olive
1875	,,	7·0	,,

Spectroscopic Observations.

The spectroscopic determinations of the motion in the line of sight are:—

1893 May	18,	Belopolsky *	−68	km./sec.
,,	22,		−84	

* *Ast. Nach.* 133, 257.

1893 June	2,		−75 km./sec.
„	3,		−67
„	4.		−66
„	14,		−64
„	16,		−69
1897 April	29,	Campbell *	−69·1
June	14,	Newall †	−71·4
1898 May	11,	Campbell	−70·4
„	16,	Newall	−68·4
„	23,	Campbell	−70·0
Aug.	19,	Campbell	−70·9
1899 April	29,	Newall	−74·3

If we neglect the determination on 1893 May 22, these reduce to

1893·4	−68·0	km./sec.	= −42·2	miles/sec.
97·9	−69·9	„	= −43·4	„
98·7	−71·6	„	= −44·5	„

From these values the computed parallaxes are 0″·157 and 0″·134, which, seeing that the true anomaly varies 76°, may be regarded with more favour than one is at first disposed to show. Adopting then

0″·14 as the parallax, we obtain :
0·89 as the combined mass,
0·44 as the mass of each star,
925,000,000 miles as the mean distance apart,
2·7 miles the average velocity in orbit,
1·8 the velocity in line of sight at the node,
42·5 miles the observed velocity in line of sight at node,
44·3 „ of approach to our system,
27·9 „ velocity in line of sight due to proper motion,
8·6 „ velocity of proper motion in N.P.D.,
10·0 „ velocity of proper motion in R.A.,
31·0 „ resultant velocity in space.

It is clearly evident that great reliance cannot be placed on the parallax deduced in this way, and the figures above must be regarded as merely giving a general idea of the system. I must say that the consistency of spectroscopic measures has come as a great surprise to me, and no doubt in cases where the change of velocity is large, a fair value of the parallax could be deduced. In the present case a change of even one kilometre in $v - v_1$ has a large effect on the parallax.

* *Astrophysical Journal*, viii. 157.
† Hitherto unpublished.

1900 *December* 10.

Magnitude of Wide Companion of ζ Lyræ.
By the Rev. S. J. Johnson, M.A.

In the case of this wide object, almost one suitable for the binocular, the impressions recorded of magnitude seem singularly discordant; and if these estimations have been made with care, they seem to suggest the idea of variability with a long period.

In the *Intellectual Observer*, 1862 December, the Rev. T. Webb says, "In 1850·77 and 1865·68 with $3\frac{7}{10}$ inches, I thought the smaller star 7 and 6. It now appears as in Smyth," that is to say, magnitudes 5, $5\frac{1}{2}$.

In 1876 Plummer gives 4, $6\frac{1}{2}$, an immense difference between the components.

Even in so trustworthy a work as the *Washington Observations of Double Stars, made at the U.S. Naval Observatory*, Part ii., 1880–1891, they are given as "4 and 6."

The following are extracts from my own notes:—

"1884 September 19. Mags. 5, 6, nearly, if not quite, a whole magnitude difference. Colours, yellow, brownish-yellow.

"1887 October 10. Mags. 5, 6. Yellow, lilac-tint.

"1891 January 21. Yellow, bluish. Mags. 5, 6, or more strictly speaking, not above $\frac{3}{4}$ magn. difference.

"1897 May 21. Barely $\frac{1}{2}$ magnitude difference in the stars, the smaller somewhat bluish."

And on November 15 this year, 1900, the same impression: mags. 5, $5\frac{1}{3}$.

The fact that I know of no list of variables in which this star is included seems to make it worth while to remark on the matter.

Melplash Vicarage, Bridport:
December 10.

Observations of the Leonid Meteors of 1900 *made at the Royal Observatory, Greenwich.*

(*Communicated by the Astronomer Royal.*)

On the night of November 13–14 twenty-five meteors were observed by three observers between midnight and 5^h A.M., five of which were Leonids. The watch was occasionally interrupted by cloud. On the night of November 14–15 the effective watch was limited to two hours only (the sky clouding up completely before 3^h A.M.), and twenty meteors, of which six were Leonids, were seen by two observers. On the night of November 15–16 a watch was maintained by three observers from 11^h P.M. until $3^h\ 30^m$ A.M. (when the sky became overcast), and fifty-five meteors were observed, twenty-three of which were conformable to the *Leo* radiant. There was no appearance of a shower on any of the nights of observation.

Royal Observatory, Greenwich:
1900 *December* 29.