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On the elements of the orbit of γ Virginis.

By *W. Doberck*.

This system forms a striking exception to the rule that large excentricities are associated with large periods of revolution, for though at first this latter was thought to be over six centuries it has since been proved to be less than two. I commenced investigations by drawing two interpolating curves with the angles θ_0 and distances ϱ_0 as ordinates, taking the epochs as abscissae. The part of the interpolating curve which it was possible to construct had two points of contrary flexure, whose tangents were almost perpendicular to each other. The curve for the distances has a point about 1836, that is not to be distinguished from a cusp. Following Herschel the distances were also calculated from the angles according to the formula :

$$\varrho_0 = \sqrt{x \frac{d\tau}{d\theta}},$$

where

$$x = \frac{1}{2} \varrho^2 \frac{d\theta}{d\tau}$$

and

$$\sqrt{x} = 3.44.$$

These indicated that W. Struve's distances were nearly correct and great weight was therefore attributed to them. Following Mädler and Thiele I also calculated the angles from the distances :

$$\theta_p = 11.81 \int \frac{d\theta}{\varrho^2} + \theta_0$$

where for 1820-1835, $\theta_0 = 265^\circ 57'$ for 1830.0, and for 1838-1880 $\theta_0 = 358^\circ 60'$ for 1850.0. Between 1720 and 1820 I had to depend exclusively upon the interpolated angles and the distances computed from them. I then projected the points of both curves and drew the ellipse that most nearly satisfied them. I found it impossible to reconcile the old observations with the modern measures, and when they were excluded I obtained Elements I given below. From 10 normal angles of position I then corrected Ω , e and γ ; and subsequently λ , T and n separately from the former elements. Both systems of equations of con-

dition were solved by the method of least squares. Thus Elements II were obtained. Hitherto precession was neglected, as it amounts to only $0^\circ 0247$ in thirty years, but in the further calculations, supposing all elements to refer to 1900.00 it was strictly applied. The observations were compared with Elements II and the following 17 normal places obtained.

It is not justifiable to attribute weights to the annual means of the different double star observers' results proportional to the number of nights, nor should weights be given to each night's result proportional to the number of measures made. An observer ceases to pay attention to an object as soon as he feels confident that the observations already secured are sufficient, and the number of nights spent on an object is no measure of the accuracy. The result depends upon the state of the weather and the state of the instrument, especially upon the clock, and defective driving clocks are probably the main cause of the differences between different observers' results except in case of eyes affected by astigmatism of some kind. No attention is paid to whether the nights were consecutive or months apart, which makes a great difference. I therefore did not attribute different weights to the observations (annual means), and thus avoided to give the systematic errors of certain observers more influence than others. By taking the mean of many observers' measures in forming normal places we may eliminate many systematic errors but not all. In fact physiological reasons could be given why the personal errors committed by experienced observers must have much in common.

The observations made by Baxendell, Brünnow, Carpenter, Main, and Talmage were excluded, also the observations made by Challis in 1843 and by Schmidt in 1857, and the distances measured by Jacob in 1860 and 1861, by Peirce in 1871, by Wilson in 1871 and 1872, and by Tebbutt in 1880. O. Struve's uncorrected angles were adopted up to 1853 inclusive, and his corrected angles after that year. His uncorrected distances were adopted up to 1842 inclusive, and his corrected distances after that year.

No.	Epoch	$\theta_0 - \theta_2$	n	\sqrt{p}	θ_0	$\theta_0 - \theta_3$	$\varrho_0 - \varrho_2$	n	\sqrt{p}	ϱ_0	$\varrho_0 - \varrho_3$
I	1718.20	+ 0.95 —	1	1	330.63	+ 1.21	— —	—	—	—	—
II	1772	+ 2.47 ± 1.0608	3	$\frac{1}{2}$	315.13	+ 1.44	- 0.585 ± 0.748	2	0	5.331	- 0.553
III	1803	- 0.13 ± 1.310	2	1	299.36	- 1.48	— —	—	—	—	—
IV	1824	+ 0.09 ± 0.197	6	$\frac{5}{2}$	279.87	- 0.65	+ 0.364 ± 0.123	7	$\frac{1}{6}$	2.995	+ 0.521

No.	Epoch	$\theta_0 - \theta_2$	n	\sqrt{p}	θ_0	$\theta_0 - \theta_3$	$\varrho_0 - \varrho_2$	n	\sqrt{p}	ϱ_0	$\varrho_0 - \varrho_3$
V	1830	$-0^{\circ}33 \pm 0^{\circ}342$	11	3	264.37	$+0^{\circ}33$	$+0^{\circ}112 \pm 0^{\circ}055$	9	$\frac{1}{3}$	1.870	$+0^{\circ}263$
VI	1833	-2.59 ± 0.693	9	$1\frac{1}{2}$	245.25	$+0.32$	$+0.084 \pm 0.054$	9	$\frac{3}{8}$	1.266	$+0.193$
VII	1835	-10.28 ± 0.933	12	1	209.06	-3.58	-0.070 ± 0.035	6	$\frac{3}{5}$	0.618	-0.020
VIII	1837	$+4.07 \pm 2.162$	11	$\frac{1}{2}$	100.34	$+0.46$	$+0.092 \pm 0.041$	5	$\frac{1}{2}$	0.523	$+0.093$
IX	1840	-0.44 ± 0.328	24	3	29.76	-0.78	$+0.052 \pm 0.017$	23	$\frac{6}{5}$	1.274	$+0.122$
X	1845.5	-1.37 ± 0.177	22	6	5.75	-1.03	$+0.142 \pm 0.047$	18	$\frac{4}{3}$	2.364	$+0.201$
XI	1851	-0.51 ± 0.111	28	8	356.79	-0.33	$+0.030 \pm 0.013$	27	$1\frac{1}{2}$	2.981	$+0.071$
XII	1856	-0.08 ± 0.094	42	10	351.64	$+0.05$	-0.032 ± 0.012	40	$1\frac{3}{4}$	3.458	-0.004
XIII	1863	$+0.34 \pm 0.117$	32	8	346.17	$+0.07$	$+0.018 \pm 0.023$	31	$\frac{8}{9}$	4.128	$+0.028$
XIV	1871.5	$+0.81 \pm 0.142$	23	7	341.46	$+0.25$	-0.090 ± 0.026	20	$\frac{4}{5}$	4.624	-0.094
XV	1877	$+0.92 \pm 0.095$	39	11	338.82	$+0.19$	-0.062 ± 0.020	37	1	4.972	-0.076
XVI	1884	$+1.28 \pm 0.120$	26	9	336.12	$+0.36$	-0.007 ± 0.021	26	$\frac{19}{20}$	5.369	-0.040
XVII	1890	$+1.20 \pm 0.122$	22	8	333.69	$+0.11$	-0.005 ± 0.031	22	$\frac{2}{3}$	5.613	-0.038

The first column of the table exhibits the number of the normal place, the second the epoch, the third the correction to the calculated angle and the probable error of the normal angle, the fourth the number of annual means used, the fifth the square root of the weight, the sixth the normal angle, the seventh the correction to the next orbit, the eighth the correction to the calculated distance and the probable error of the normal distance, the ninth the number of observed annual means used, the tenth the square root of the weight, the eleventh the normal distance, and the twelfth the correction to the next orbit.

The probable errors in column 3 are nearly represented by the quantity

$$\frac{2^{\circ}50}{\varrho'' \sqrt{n}},$$

which shows that the probable error varies inversely as the distance. The probable error of a normal angle of weight 1 is $\pm 1^{\circ}016$ and this nearly corresponds to a single

annual mean for $\varrho = 2^{\circ}5$. But the probable error of a normal angle of weight 1 is according to column 7 $\pm 2^{\circ}028$, which includes the constant errors common to different observers, and shows that in this case these are as great as the accidental errors. The probable error of a normal distance of weight 1 is $\pm 0^{\circ}0204$. The probable errors of the distances are 3 times as great as the probable errors of the angles, and the systematic errors of the distances are very great. The too large distances with which observers commence have their origin in irradiation, and it is now a well known fact that earlier observers also measured small distances (and diameters of planets) larger than modern astronomers. In consequence the orbit that represents the angles does not represent the distances equally well and vice versa, but the errors finally left are of the order of the constant errors of observation and do not with any certainty indicate any deviation from Kepler's second law.

The equations of condition multiplied by the square roots of the weights are as follows:

$$\begin{aligned}
 &+ 2.00 \Delta\delta + 2.34 \Delta\lambda + 0.91 \Delta\gamma - 0.72 \Delta e + 3.06 \Delta n + 0.34 \Delta T - 0^{\circ}95 = 0 \\
 &+ 1.00 \quad + 1.19 \quad - 0.11 \quad + 0.33 \quad + 0.82 \quad + 0.18 \quad - 1.23 = 0 \\
 &+ 2.00 \quad + 2.34 \quad - 1.07 \quad + 1.71 \quad + 1.43 \quad + 0.58 \quad + 0.13 = 0 \\
 &+ 11.00 \quad + 11.77 \quad - 10.28 \quad + 18.04 \quad + 8.69 \quad + 9.52 \quad - 0.50 = 0 \\
 &+ 6.00 \quad + 5.88 \quad - 5.76 \quad + 13.35 \quad + 5.61 \quad + 12.09 \quad + 0.99 = 0 \\
 &+ 3.00 \quad + 2.67 \quad - 2.04 \quad + 8.57 \quad + 3.29 \quad + 15.40 \quad + 3.89 = 0 \\
 &+ 2.00 \quad + 1.68 \quad + 0.46 \quad + 7.48 \quad + 2.82 \quad + 25.56 \quad + 10.28 = 0 \\
 &+ 1.00 \quad + 1.05 \quad - 0.97 \quad - 3.68 \quad - 1.40 \quad + 32.11 \quad - 2.03 = 0 \\
 &+ 6.00 \quad + 5.19 \quad + 3.09 \quad - 16.50 \quad - 6.21 \quad + 23.82 \quad + 1.32 = 0 \\
 &+ 12.00 \quad + 11.70 \quad + 11.46 \quad - 21.90 \quad - 9.90 \quad + 14.76 \quad + 8.22 = 0 \\
 &+ 16.00 \quad + 16.64 \quad + 15.52 \quad - 23.20 \quad - 11.92 \quad + 11.04 \quad + 4.08 = 0 \\
 &+ 20.00 \quad + 21.50 \quad + 18.60 \quad - 24.30 \quad - 14.10 \quad + 9.80 \quad - 0.80 = 0 \\
 &+ 16.00 \quad + 17.68 \quad + 13.60 \quad - 15.92 \quad - 11.20 \quad + 5.60 \quad - 2.72 = 0 \\
 &+ 14.00 \quad + 15.82 \quad + 10.43 \quad - 11.20 \quad - 9.73 \quad + 3.71 \quad - 5.67 = 0 \\
 &+ 22.00 \quad + 25.19 \quad + 14.96 \quad - 15.07 \quad - 15.51 \quad + 5.17 \quad - 10.12 = 0 \\
 &+ 18.00 \quad + 20.79 \quad + 10.80 \quad - 10.44 \quad - 13.23 \quad + 3.69 \quad - 11.52 = 0 \\
 &+ 16.00 \quad + 18.64 \quad + 8.56 \quad - 7.60 \quad - 12.00 \quad + 3.04 \quad - 9.60 = 0
 \end{aligned}$$

The normal equations were:

$$\begin{aligned}
 &+ 2532.00 \Delta\delta + 2786.50 \Delta\lambda + 1646.24 \Delta\gamma - 1953.74 \Delta e - 1562.40 \Delta n + 1371.73 \Delta T - 522.89 = 0 \\
 &+ 2786.50 \quad + 3076.56 \quad + 1813.59 \quad - 2122.22 \quad - 1732.13 \quad + 1415.32 \quad - 635.35 = 0 \\
 &+ 1646.24 \quad + 1813.59 \quad + 1581.33 \quad - 2125.93 \quad - 1435.88 \quad + 635.81 \quad - 310.06 = 0
 \end{aligned}$$

$$\begin{aligned}
 -1953.74 \Delta\Omega - 2122.22 \Delta\lambda - 2125.93 \Delta\gamma + 3303.49 \Delta e + 1975.40 \Delta n - 941.83 \Delta T + 297.93 &= 0 \\
 -1562.40 &- 1732.13 &- 1435.88 &+ 1975.40 &+ 1396.98 &- 597.77 &+ 425.38 &= 0 \\
 +1371.73 &+ 1415.32 &+ 635.81 &- 941.83 &- 597.77 &+ 3256.69 &+ 293.91 &= 0
 \end{aligned}$$

The corrections are:

$$\begin{aligned}
 \Delta\Omega &= (-6.6208 \pm 1.368) \times 2^\circ \\
 \Delta\lambda &= (+6.3636 \pm 1.275) \times 2^\circ \\
 \Delta\gamma &= (-0.99965 \pm 0.24031) \times 6^\circ \\
 \Delta e &= (-0.36402 \pm 0.1801) \times 0.015 \\
 \Delta n &= (-0.34924 \pm 0.34535) \times 0.015 \\
 \Delta T &= (-0.04132 \pm 0.05388) \times 1 \text{ year}
 \end{aligned}$$

The correction Δn is expressed numerically and being negative decreases n .

A further correction of $+0.57$ was applied to Ω .

Δa was obtained separately by aid of the quantities given in the previous table.

The elements are as follows (equinox 1900.0):

Elements I	Elements II	Elements III
$\Omega = 45^\circ 49'$	$46^\circ 0'$	$33^\circ 21' \pm 2^\circ 44'$
$\lambda = 93 \ 59$	$93 \ 55$	$106 \ 39 \pm 2 \ 17$
$\gamma = 37 \ 0$	$33 \ 9$	$27 \ 9 \pm 1 \ 26$
$e = 0.8978$	0.8904	0.88494 ± 0.00270
$P = 180754$	179765	184747 ± 4783
$T = 1836.47$	1836.45	1836.409 ± 0.054
$a = 4.09$	3.94	3.7208 ± 0.0061
$n = -1.9940$	-2.0039	-1.9515 ± 0.05180

Some astronomers determine constant corrections to be applied to the results of different observers and relative weights to be attributed to observations made by them from a discussion of their observations of a single object. That is hardly justifiable for the object may be an easy one, that may have been looked up only when the weather was bad, or a difficult one that was never attempted except on the finest nights and when conditions were unusually favourable. It seems preferable to leave the observations as they are. Researches on orbits are occasionally published where the final comparison is made with only one mean

each year of several observers' measures; and when different weights, and corrections to, and rejection of observations have been freely introduced, it is of importance that a comparison with all observers' measures (unimproved) be given at the end, or the true amount of accuracy of the new orbit may be more or less hidden. In the following table the names of observers are given in full. In case of observers like Herschel and Struve that is perhaps not necessary but in case of other observers, who are less known, it is advisable. Mr. *J. I. Plummer* has kindly assisted in the calculations.

Observer	Epoch	θ_o	ϱ_o	$\theta_o - \theta_c$	$\varrho_o - \varrho_c$
Bradley	1700+				
	18.20	330.8	—	+ 1.2	—
Cassini	20.31	319.0	7.49	— 9.9	+ 1.41
Tob. Mayer	56.20	324.4	6.50	+ 5.8	+ 0.28
Chr. Mayer	77 ±	310 ±	9.8	— 2.1	...
W. Herschel	80.18	—	4.2	—	— 1.41
"	81.89	310.7	—	+ 0.3	—
"	1800+				
"	02.08	298.4	—	— 3.1	—
"	03.37	300.8	—	+ 0.1	—
W. Struve	19.40	—	3.56	—	+ 0.55
"	20.28	284.9	2.76	— 1.7	— 0.15
"	22.02	282.8	—	— 1.4	—
J. Herschel	22.25	283.4	3.79	— 0.4	+ 1.11
Amici	23.19	—	3.30	—	+ 0.73
W. Struve	23.32	281.6	2.95	— 0.4	+ 0.40
South	25.32	276.9	3.26	— 0.9	+ 0.96
W. Struve	25.32	277.9	2.37	+ 0.1	+ 0.07
J. Herschel	28.35	270.3	—	+ 0.4	—
W. Struve	28.38	271.5	2.07	+ 1.7	+ 0.21
J. Herschel	29.22	267.7	1.79	+ 0.7	+ 0.05
W. Struve	29.39	268.3	1.78	+ 1.9	+ 0.06
J. Herschel	30.24	262.8	2.22	— 0.3	+ 0.63
Dawes	30.39	261.5	—	— 0.9	—

Observer	Epoch	θ_o	ϱ_o	$\theta_o - \theta_c$	$\varrho_o - \varrho_c$
Bessel	1800+				
	30.59	262.2	1.59	+ 0.8	+ 0.06
Dawes	31.30	258.3	1.99	+ 0.7	+ 0.59
J. Herschel	31.32	257.2	1.74	— 0.4	+ 0.34
W. Struve	31.36	260.9	1.49	+ 3.6	+ 0.10
Smyth	31.38	254.9	1.6	— 2.3	+ 0.22
J. Herschel	32.27	250.2	1.21	— 0.9	— 0.03
Dawes	32.30	249.9	1.33	— 1.1	+ 0.09
Cooper	32.33	—	1.94	—	+ 0.72
Smyth	32.40	251.4	1.2	+ 1.3	— 0.01
W. Struve	32.52	253.5	1.26	+ 4.1	+ 0.09
J. Herschel	33.20	241.8	1.41	— 1.2	+ 0.37
Smyth	33.34	243.1	1.3	+ 1.6	+ 0.29
Mädler	33.35	236.4	—	— 4.8	—
Dawes	33.36	240.1	1.14	— 1.2	+ 0.14
W. Struve	33.37	245.5	1.05	+ 4.4	+ 0.05
Dawes	34.29	227.3	—	— 0.8	—
Smyth	34.30	227.1	0.9	— 1.0	+ 0.09
Mädler	34.34	214.8	—	— 12.6	—
J. Herschel	34.37	223.1	0.51	— 3.8	— 0.28
W. Struve	34.38	231.6	0.91	+ 5.0	+ 0.12
J. Herschel	34.54	214.9	—	— 8.8	—
W. Struve	34.84	213.6	—	— 3.3	—
J. Herschel	35.11	201.4	—	— 8.2	—

Observer	Epoch	θ_o	ϱ_o	$\theta_o - \theta_c$	$\varrho_o - \varrho_c$
W. Struve	1800+				
Senff	35.38	195.5	0.51	- 5.0	- 0.05
Smyth	35.39	195.2	0.57	- 4.9	+ 0.02
O. Struve	35.40	195.0	0.5	- 4.7	- 0.05
Dawes	35.42	197.1	—	- 1.8	—
Smyth	36.28	169.5	—	+ 18.3	—
W. Struve	36.35	169.7	—	+ 23.4	—
O. Struve	36.41	151.6	0.26	+ 9.7	- 0.12
Sabler	36.41	158.2	—	+ 16.3	—
Encke	36.41	153.8	—	+ 11.9	—
Mädler	36.59	113.9	—	- 14.5	—
Smyth	36.59	117.5	—	- 10.9	—
Mädler	37.21	85.4	0.6	- 3.1	+ 0.13
O. Struve	37.37	75.5	0.81	- 5.1	+ 0.31
Encke	37.41	77.9	0.58	- 1.1	+ 0.07
J. Herschel	37.46	76.3	0.67	- 0.5	+ 0.14
Smyth	38.08	57.4	—	0.0	—
Dawes	38.28	55.7	0.8	+ 2.5	+ 0.07
Lamont	38.32	53.4	—	+ 1.1	—
W. Struve	38.36	—	1.24	—	+ 0.48
O. Struve	38.40	51.9	0.86	+ 1.2	+ 0.09
Mädler	38.43	51.1	0.80	+ 1.0	+ 0.02
Galle	38.44	47.0	0.90	- 2.9	+ 0.11
Dawes	38.46	49.0	0.70	- 0.5	- 0.09
Galle	39.31	34.6	1.26	- 2.8	+ 0.27
Smyth	39.35	35.5	1.30	- 1.4	+ 0.30
Kaiser	39.40	37.2	1.0	+ 0.8	- 0.01
Dawes	40.26	27.9	1.30	- 0.6	+ 0.09
O. Struve	40.38	25.7	1.24	- 1.8	0.00
Challis	40.45	25.4	1.30	- 1.7	+ 0.05
Dawes	41.19	20.9	1.42	- 1.5	+ 0.01
Mädler	41.34	20.0	1.58	- 1.6	+ 0.13
O. Struve	41.35	20.1	1.73	- 1.4	+ 0.28
Mädler	41.41	16.7	1.50	- 4.5	+ 0.04
Main	42.21	16.6	1.58	- 0.7	- 0.03
Airy	42.34	17.4	1.67	+ 0.6	+ 0.04
Challis	42.35	17.6	1.83	+ 0.8	+ 0.20
Dawes	42.35	12.2	1.85	- 4.6	+ 0.22
O. Struve	42.38	14.9	1.73	- 1.8	+ 0.09
Kaiser	42.41	13.6	1.73	- 2.9	+ 0.08
Mädler	42.82	14.5	1.76	- 0.5	+ 0.04
Challis	42.88	14.7	1.84	0.0	+ 0.11
Mädler	43.30	0.7	2.05	- 12.5	+ 0.25
Main	43.35	12.1	—	- 0.9	—
Dawes	43.39	13.6	2.08	+ 0.7	+ 0.26
Encke	43.40	12.2	1.82	- 0.7	0.00
Challis	43.48	11.4	2.45	- 1.2	+ 0.61
Richardson	44.33	9.0	2.63	- 1.0	+ 0.65
Mädler	44.34	2.9	2.20	- 7.0	+ 0.21
Encke	44.36	8.9	—	- 1.0	—
»	44.38	8.6	2.27	- 1.2	+ 0.28
Smyth	45.28	8.9	2.41	+ 1.4	+ 0.28
Mädler	45.34	5.4	2.10	- 1.9	- 0.04
O. Struve	45.37	7.0	—	- 0.2	—
Hind	45.46	5.5	2.23	- 1.5	+ 0.07
Jacob	46.28	5.0	—	- 0.2	—
	46.32	2.2	2.89	- 2.9	+ 0.60

Observer	Epoch	θ_o	ϱ_o	$\theta_o - \theta_c$	$\varrho_o - \varrho_c$
Main	1800+				
O. Struve	46.39	6.3	2.25	+ 1.4	- 0.05
Mitchell	46.39	3.3	2.35	- 1.6	+ 0.05
Dawes	46.49	4.1	1.83	- 0.6	- 0.48
Hind	46.90	3.7	2.45	0.0	+ 0.03
Dawes	47.07	1.9	2.62	- 1.5	+ 0.22
Main	47.35	2.5	2.40	- 0.3	- 0.04
Smyth	47.41	13.0	2.37	+ 10.3	- 0.07
O. Struve	47.42	1.9	2.6	- 0.8	+ 0.16
Mitchell	47.42	3.0	2.40	- 0.2	- 0.04
Jacob	47.56	2.5	3.09	0.0	+ 0.63
Mädler	47.94	359.9	2.88	- 1.8	+ 0.37
Smyth	48.34	360.8	2.71	- 0.2	+ 0.15
Dawes	48.36	359.5	2.8	- 1.4	+ 0.23
O. Struve	48.37	360.6	2.62	- 0.3	+ 0.05
Bond	48.43	360.5	2.55	- 0.4	- 0.02
Mitchell	48.45	360.4	2.6	- 0.4	+ 0.02
Main	48.45	360.6	2.80	- 0.2	+ 0.22
Dawes	48.48	360.5	2.60	- 0.2	+ 0.02
O. Struve	49.37	359.0	2.85	- 0.3	+ 0.15
Bond	49.41	355.5	2.64	- 3.8	- 0.07
Main	49.45	359.8	3.0	+ 0.6	+ 0.28
Johnson	49.50	357.0	2.92	- 2.1	+ 0.19
Hartnup	50.23	359.7	2.85	+ 1.6	+ 0.03
Fletcher	50.30	357.5	2.90	- 0.5	+ 0.07
O. Struve	50.36	356.7	2.95	- 1.2	+ 0.12
Mädler	50.39	356.8	2.74	- 1.0	- 0.10
Main	50.42	359.1	—	+ 1.3	—
Philpot	50.48	359.7	2.94	+ 2.0	+ 0.09
Mädler	51.17	356.8	2.92	- 0.1	- 0.01
Main	51.28	357.9	2.99	+ 1.2	+ 0.05
Fletcher	51.36	356.3	3.04	- 0.3	+ 0.09
Dawes	51.40	356.0	3.05	- 0.6	+ 0.10
O. Struve	51.40	356.5	2.99	- 0.1	+ 0.04
Miller	51.42	355.9	2.88	- 0.7	- 0.07
Mädler	51.47	355.9	3.04	- 0.6	+ 0.08
Jacob	51.98	356.6	3.30	+ 0.8	+ 0.28
Miller	52.24	355.4	3.12	- 0.2	+ 0.07
Dawes	52.26	355.5	3.12	0.0	+ 0.07
Fletcher	52.32	355.2	3.01	- 0.3	- 0.05
Smyth	52.42	355.4	3.14	0.0	+ 0.08
Mädler	52.42	355.5	3.2	+ 0.1	+ 0.14
O. Struve	52.43	354.6	3.17	- 0.7	+ 0.11
Main	52.43	356.0	3.00	+ 0.7	- 0.06
Jacob	52.47	359.7	3.20	+ 4.4	+ 0.13
Powell	53.24	353.2	3.12	- 1.1	- 0.05
Miller	53.24	354.7	—	+ 0.4	—
Fletcher	53.27	354.9	3.10	+ 0.6	- 0.07
Smyth	53.32	354.6	3.18	+ 0.4	0.00
Dawes	53.35	353.9	3.2	- 0.3	+ 0.02
Main	53.36	354.1	3.06	- 0.1	- 0.12
Mädler	53.38	357.4	3.30	+ 3.2	+ 0.12
O. Struve	53.39	354.2	3.25	0.0	+ 0.07
Jacob	53.40	354.6	3.13	+ 0.4	- 0.05
Mädler	53.91	353.0	3.06	- 0.7	- 0.18
Dawes	54.39	352.0	3.45	- 1.2	+ 0.16
	54.39	352.7	3.21	- 0.5	- 0.08

Observer	Epoch	θ_o	ϱ_o	$\theta_o - \theta_c$	$\varrho_o - \varrho_c$
Morton	1800+				
Dembowski	54.40	352.1	3.40	- 1.1	+ 0.11
O. Struve	54.47	353.6	3.23	+ 0.5	- 0.07
Dembowski	55.18	351.6	3.36	- 0.9	- 0.02
Philpot	55.19	351.3	3.51	- 1.2	+ 0.13
Main	55.30	353.4	—	+ 1.0	—
Secchi	55.39	353.5	3.45	+ 1.2	+ 0.05
Smyth	55.40	352.6	3.37	+ 0.3	- 0.03
Mädler	55.40	351.6	3.4	- 0.7	0.00
Dawes	55.45	354.1	3.42	+ 1.9	+ 0.01
Morton	55.46	351.2	3.31	- 1.0	- 0.10
Jacob	55.53	353.3	3.51	+ 1.1	+ 0.10
Main	56.10	350.5	3.45	- 1.1	- 0.02
Secchi	56.29	349.0	3.54	- 2.4	+ 0.05
Mädler	56.38	351.6	3.54	+ 0.3	+ 0.04
Dembowski	56.39	351.7	3.59	+ 0.4	+ 0.09
Carpenter	56.39	350.5	3.56	- 0.8	+ 0.06
Morton	56.96	353.0	3.64	+ 2.2	+ 0.08
Schmidt	56.97	351.3	3.66	+ 0.5	+ 0.10
Dawes	57.07	—	4.50	—	+ 0.93
Secchi	57.35	350.1	3.59	- 0.4	0.00
Baxendell	57.39	350.8	3.74	+ 0.4	+ 0.14
Smyth	57.40	352.9	3.58	+ 2.5	- 0.02
Fletcher	57.41	350.6	3.5	+ 0.2	- 0.10
Mädler	57.41	351.6	3.54	+ 1.2	- 0.06
Dawes	57.42	350.2	3.59	- 0.2	- 0.01
O. Struve	57.42	349.9	3.56	- 0.5	- 0.10
Jacob	57.44	350.2	3.63	- 0.2	+ 0.03
Dembowski	57.96	350.6	3.50	+ 0.7	- 0.16
Mädler	58.34	348.4	3.76	- 1.2	+ 0.07
Fletcher	58.37	349.9	4.01	+ 0.4	+ 0.32
Smyth	58.39	350.0	3.57	+ 0.5	- 0.13
Secchi	58.39	349.9	3.8	+ 0.4	+ 0.10
O. Struve	58.40	352.0	3.61	+ 2.5	- 0.09
Dawes	58.44	349.3	3.67	- 0.2	- 0.03
Carpenter	58.45	348.8	3.68	- 0.7	- 0.02
Morton	58.47	348.0	3.85	- 1.5	+ 0.15
"	58.48	350.7	3.40	+ 1.2	- 0.30
Mädler	59.15	350.7	3.95	+ 1.8	+ 0.15
O. Struve	59.37	349.2	3.88	+ 0.5	+ 0.10
Wakelin	59.38	347.9	3.76	- 0.8	- 0.02
Secchi	59.39	350.0	4.18	+ 1.3	+ 0.39
Dawes	59.44	349.5	3.91	+ 0.9	+ 0.12
Jacob	59.46	348.2	3.77	- 0.4	- 0.02
Mädler	60.30	348.0	2.9	0.0	- 0.97
Knott	60.35	345.9	3.90	- 2.1	+ 0.03
O. Struve	60.44	349.3	4.05	+ 1.4	+ 0.17
Jacob	61.15	346.9	3.93	- 0.5	- 0.01
Main	61.19	347.7	3.12	+ 0.3	- 0.83
Powell	61.28	347.8	3.99	+ 0.5	+ 0.04
Auwers	61.31	346.1	3.94	- 1.2	- 0.01
Mädler	61.36	348.5	4.12	+ 1.3	+ 0.16
Dawes	61.41	347.8	4.11	+ 0.6	+ 0.15
Powell	62.03	346.5	3.95	- 0.4	- 0.07
Mädler	62.32	345.3	3.90	- 1.4	- 0.15
Main	62.38	345.5	4.39	- 1.1	+ 0.34
	62.38	346.6	4.00	0.0	- 0.05

Observer	Epoch	θ_o	ϱ_o	$\theta_o - \theta_c$	$\varrho_o - \varrho_c$
O. Struve	1800+				
Main	62.41	346.0	3.97	- 0.6	- 0.08
Romberg	63.25	346.7	4.06	+ 0.7	- 0.06
O. Struve	63.27	345.1	4.34	- 0.9	+ 0.22
Dembowski	63.46	347.3	3.90	+ 1.4	- 0.24
Main	63.63	345.6	4.08	- 0.1	- 0.07
Secchi	64.40	345.7	4.27	+ 0.4	+ 0.06
O. Struve	64.41	345.5	4.28	+ 0.2	+ 0.07
Dawes	64.42	345.0	4.06	- 0.3	- 0.15
Knott	64.44	345.4	4.10	+ 0.1	- 0.11
Engelmann	64.44	345.4	4.27	+ 0.1	+ 0.06
Main	65.14	346.3	4.01	+ 1.5	- 0.26
Dawes	65.36	345.2	4.28	+ 0.5	- 0.01
Knott	65.42	344.0	4.37	- 0.7	+ 0.08
Dembowski	65.45	344.3	4.34	- 0.3	+ 0.04
Secchi	65.74	344.3	4.18	- 0.1	- 0.14
Winlock	66.31	344.3	4.39	+ 0.2	+ 0.03
O. Struve	66.37	—	5.00	—	+ 0.64
Main	66.42	344.0	4.29	- 0.1	- 0.08
Kaiser	66.45	345.2	4.35	+ 1.2	- 0.02
Talmage	66.46	345.9	4.01	+ 1.9	- 0.36
"	66.48	343.4	4.53	- 0.6	+ 0.16
Searle	67.24	342.9	5.28	- 0.8	+ 0.85
Winlock	67.27	344.8	4.51	+ 1.3	+ 0.08
Main	67.30	344.1	4.49	+ 0.6	+ 0.06
Dembowski	67.38	341.4	4.40	- 2.2	- 0.04
Searle	67.80	343.2	4.30	0.0	- 0.17
Talmage	68.16	344.8	4.59	+ 1.8	+ 0.10
Main	68.26	340.6	5.06	- 2.4	+ 0.55
O. Struve	68.42	341.0	4.63	- 1.9	+ 0.11
Brünnow	68.45	343.3	4.30	+ 0.4	- 0.22
Talmage	69.22	344.9	4.77	+ 2.4	+ 0.10
Main	69.25	339.6	5.34	- 2.9	+ 0.77
Dunér	69.49	339.8	4.74	- 2.5	+ 0.15
Gledhill	69.98	341.8	4.43	- 0.2	- 0.19
Main	70.33	342.6	4.65	+ 0.8	+ 0.01
Talmage	70.38	340.6	4.76	- 1.2	+ 0.12
Dembowski	70.39	338.6	—	- 3.2	—
O. Struve	70.72	342.1	4.63	+ 0.5	- 0.05
Peirce	70.77	343.3	4.44	+ 1.8	- 0.23
Main	71.21	339.8	5.31	- 1.6	+ 0.61
Talmage	71.35	340.9	4.54	- 0.3	- 0.16
Knott	71.38	343.1	4.76	+ 1.9	+ 0.06
Wilson	71.38	339.8	4.49	- 1.4	- 0.21
Gledhill	71.38	339.7	5.35	- 1.5	+ 0.65
Dunér	71.53	341.8	4.77	+ 0.7	+ 0.06
Gledhill	72.12	341.1	4.59	+ 0.2	- 0.16
Wilson	72.30	339.7	4.4	- 1.1	- 0.36
Talmage	72.34	342.2	5.59	+ 1.4	+ 0.83
Knott	72.37	338.6	4.80	- 2.2	+ 0.04
O. Struve	72.40	341.5	4.82	+ 0.7	+ 0.06
Main	72.41	340.0	4.64	- 0.8	- 0.12
Dembowski	72.41	340.3	4.78	- 0.5	+ 0.02
Wilson	72.86	340.8	4.59	+ 0.2	- 0.21
Main	73.23	341.9	4.9	+ 1.5	+ 0.08
Gledhill	73.40	340.2	4.83	- 0.1	0.00
	73.41	339.7	4.65	- 0.8	- 0.18

Observer	Epoch	θ_o	ρ_o	$\theta_o - \theta_c$	$\rho_o - \rho_c$
	1800+				
O. Struve	73.43	340.8	4.54	+ 0.5	- 0.29
Lindstedt	73.46	340.5	4.96	+ 0.2	+ 0.12
Gledhill	74.27	340.5	5.08	+ 0.6	+ 0.20
Wilson	74.31	341.1	5.01	+ 1.3	+ 0.12
Talmage	74.32	339.3	5.39	- 0.5	+ 0.50
Main	74.33	338.5	5.23	- 1.3	+ 0.34
O. Struve	74.41	340.4	4.87	+ 0.6	- 0.02
Dunér	75.14	339.1	4.66	- 0.3	- 0.28
Gledhill	75.22	338.5	4.86	- 0.9	- 0.08
Main	75.29	339.8	5.09	+ 0.4	+ 0.14
Wilson	75.30	340.5	4.97	+ 1.1	+ 0.02
Dembowski	75.32	339.2	4.80	- 0.2	- 0.15
Schiaparelli	75.41	339.6	4.86	+ 0.3	- 0.09
Doberck	76.24	338.7	5.34	- 0.2	+ 0.34
Gledhill	76.27	338.5	4.78	- 0.4	- 0.21
Talmage	76.36	340.0	—	+ 1.1	—
O. Stone	76.38	339.8	5.30	+ 1.0	+ 0.29
Waldo	76.40	339.7	4.64	+ 0.9	- 0.37
Hall	76.41	340.2	5.15	+ 1.4	+ 0.14
Schiaparelli	76.45	339.0	4.84	+ 0.2	- 0.18
Main	76.48	338.2	5.18	- 0.6	+ 0.16
Gledhill	77.07	338.5	—	- 0.1	—
Plummer	77.24	340.0	4.65	+ 1.4	- 0.42
Doberck	77.28	335.8	5.04	- 2.8	- 0.03
Knott	77.29	338.5	4.84	- 0.1	- 0.23
O. Stone	77.30	338.1	5.19	- 0.4	+ 0.12
Jedrzejewicz	77.40	339.5	4.91	+ 1.0	- 0.17
Schiaparelli	77.42	337.9	4.91	- 0.6	- 0.16
Flammarion	77.43	338.4	4.96	- 0.1	- 0.12
Dembowski	77.83	338.1	4.98	- 0.2	- 0.11
Seabroke	78.27	340.1	5.02	+ 2.0	- 0.10
Goldney	78.37	337.1	5.06	- 0.9	- 0.07
Pritchett	79.01	336.3	5.07	- 1.5	- 0.09
O. Stone	79.12	337.3	5.20	- 0.4	+ 0.03
Schiaparelli	79.13	337.5	4.97	- 0.2	- 0.20
Gledhill	79.35	338.6	5.00	+ 1.0	- 0.18
Hall	79.37	338.3	5.20	+ 0.8	+ 0.02
Seabroke	79.38	338.3	5.05	+ 0.7	- 0.13
Burton	80.19	336.7	5.3	- 0.6	+ 0.08
Burnham	80.30	337.5	5.37	+ 0.2	+ 0.15
Hall	80.30	338.2	5.27	+ 0.9	+ 0.06
O. Stone	80.32	336.9	5.13	- 0.4	- 0.09
Gledhill	80.32	337.3	4.90	0.0	- 0.32
Doberck	80.37	338.1	4.95	+ 0.8	- 0.27
Tebbutt	80.39	337.2	5.74	0.0	+ 0.51
Seabroke	80.40	337.5	4.89	+ 0.3	- 0.34
Gledhill	81.24	336.3	5.40	- 0.6	+ 0.15
Doberck	81.24	337.1	5.02	+ 0.2	- 0.23

Observer	Epoch	θ_o	ρ_o	$\theta_o - \theta_c$	$\rho_o - \rho_c$
	1800+				
Hall	81.35	337.7	5.33	+ 0.8	+ 0.05
Schiaparelli	81.39	336.8	5.20	0.0	- 0.08
Hough	81.42	338.7	5.28	+ 1.9	0.00
H. C. Wilson	82.25	335.0	5.46	- 1.5	+ 0.14
Doberck	82.28	337.4	5.36	+ 1.0	+ 0.04
Seabroke	82.34	335.9	5.52	- 0.5	+ 0.20
Schiaparelli	82.41	336.7	5.23	+ 0.3	- 0.10
Engelmann	83.07	335.6	5.22	- 0.5	- 0.13
Hall	83.36	336.8	5.45	+ 0.8	+ 0.08
Küstner	83.41	336.5	5.33	+ 0.5	- 0.04
Schiaparelli	83.41	335.6	5.23	- 0.4	- 0.14
H. C. Wilson	84.32	335.2	5.57	- 0.5	+ 0.16
Hall	84.37	336.1	5.42	+ 0.4	+ 0.01
Perrotin	84.38	335.7	5.43	0.0	+ 0.01
Schiaparelli	84.40	335.6	5.19	- 0.1	- 0.23
Seabroke	84.40	337.1	5.53	+ 1.4	+ 0.11
Engelmann	84.89	336.1	5.32	+ 0.7	- 0.13
H. C. Wilson	85.32	333.7	5.36	- 0.6	- 0.10
Tarrant	85.38	336.8	5.35	+ 1.5	- 0.12
Schiaparelli	85.44	335.2	5.30	0.0	- 0.15
Doberck	86.00	337.3	5.73	+ 2.3	+ 0.24
Glasenapp	86.28	335.0	5.08	+ 0.1	- 0.42
H. C. Wilson	86.30	336.5	5.38	+ 1.6	- 0.12
Hall	86.37	334.9	5.57	0.0	+ 0.07
Glasenapp	87.26	335.7	5.63	+ 1.2	+ 0.09
Hall	87.35	334.8	5.58	+ 0.3	+ 0.03
Tebbutt	87.39	335.5	5.65	+ 1.0	+ 0.10
Schiaparelli	87.41	334.2	5.43	- 0.3	- 0.12
Glasenapp	88.27	334.5	5.66	+ 0.2	+ 0.08
Hall	88.33	334.6	5.50	+ 0.4	- 0.09
Maw	88.41	335.1	5.29	+ 0.9	- 0.30
Tebbutt	88.48	334.9	5.77	+ 0.7	+ 0.18
Glasenapp	89.27	333.6	5.93	- 0.3	+ 0.31
Leavenworth	89.29	333.9	5.45	0.0	- 0.17
Burnham	89.31	333.4	5.72	- 0.5	+ 0.10
Hall	89.43	333.0	5.54	- 0.8	- 0.09
Glasenapp	90.37	333.3	5.10	- 0.2	- 0.56
Hall	90.43	332.8	5.59	- 0.6	- 0.08
Hayn	90.44	336.0	6.13	+ 2.6	+ 0.46
Hall	91.39	333.1	5.64	0.0	- 0.06
Maw	91.46	333.8	5.48	+ 0.8	- 0.22
Tebbutt	92.52	332.3	5.56	- 0.5	- 0.18
Cohn	93.11	331.2	5.64	- 1.3	- 0.12
Hough	93.25	331.5	5.82	- 1.1	+ 0.06
Glasenapp	93.28	333.0	5.49	+ 0.5	- 0.28
Lewis	93.32	331.7	5.86	- 0.8	+ 0.09
Bigourdan	94.49	330.3	5.68	- 1.7	- 0.13
Doberck	96.03	333.8	5.60	+ 2.3	- 0.26

The following ephemeris, corrected for precession, has been calculated from Elements III, but Elements II give for 1920

$$\theta = 322^{\circ}56 \quad \rho = 6''.23$$

which agrees closely with the distance

$$\rho = 6''.29$$

given in the ephemeris, from which we may conclude that a considerable time will lapse before any great improvement in the elements can be effected.

Ephemeris from Elements III.

Year	θ_3	ρ_3	$\Delta\alpha$	$\Delta\delta$	Year	θ_3	ρ_3	$\Delta\alpha$	$\Delta\delta$
1895	331°87	5"83	-0°183	+5"14	1908	327°81	6"15	-0°218	+5"20
1896	331.56	5.86	0.186	5.15	1909	327.52	6.16	0.220	5.20
1897	331.23	5.88	0.189	5.16	1910	327.23	6.18	0.223	5.20
1898	330.91	5.91	0.192	5.17	1911	326.94	6.19	0.225	5.19
1899	330.59	5.94	0.195	5.18	1912	326.65	6.21	0.228	5.19
1900	330.28	5.97	0.197	5.18	1913	326.36	6.22	0.230	5.18
1901	329.97	5.99	0.200	5.19	1914	336.06	6.23	0.232	5.17
1902	329.66	6.02	0.203	5.19	1915	325.77	6.25	0.234	5.17
1903	329.34	6.04	0.205	5.20	1916	325.49	6.25	0.236	5.15
1904	329.03	6.06	0.208	5.20	1917	325.21	6.26	0.238	5.14
1905	328.73	6.08	0.210	5.20	1918	324.93	6.27	0.240	5.13
1906	328.42	6.11	0.213	5.20	1919	324.63	6.28	0.242	5.12
1907	328.11	6.13	-0.216	+5.20	1920	324.34	6.29	-0.244	+5.11

Hongkong Observatory, 1896 Jan. 28.

W. Doberck.

Osservazioni di Comete

fatte a Padova coll' equatoriale Dembowski (187 mm) da G. Ciscato.

1896	T. m. Pad.	$\Delta\alpha$	$\Delta\delta$	Cf.	α app.	$\log p.A$	δ app.	$\log p.A$	Red. ad l. app.	*
Cometa 1896 I.										
Febb. 16	17 ^h 7 ^m 44 ^s	-0 ^m 53 ^s 06	+ 0' 50" 1	10.5	19 ^h 35 ^m 14 ^s 55	9.592 _n	+ 2° 4' 1" 4	0.791	-0° 19' -12" 5	1
17	17 9 38	-1 2.63	+ 8 0.2	10.5	19 45 10.13	9.596 _n	+ 5 35 41.6	0.782	-0.24 -12.7	2
18	17 15 0	+0 57.63	+ 7 3.4	10.5	19 56 34.40	9.601 _n	+ 9 30 6.7	0.768	-0.30 -12.9	3
Mar. 5	10 37 43	-0 48.10	+ 8 45.9	10.5	1 43 28.42	9.771	+51 34 17.1	0.790	-0.85 +14.8	4
6	10 6 48	+1 3.60	+ 4 36.8	10.5	1 58 36.24	9.802	+51 16 26.1	0.729	-0.73 +15.5	5
7	10 15 16	-2 8.18	+ 4 41.5	10.5	2 12 23.66	9.799	+50 53 44.7	0.729	-0.56 +16.2	6
9	10 9 46	-0 18.29	- 0 44.3	10.5	2 35 16.33	9.801	+50 0 41.7	0.699	-0.35 +16.8	7
Cometa 1896 III (Swift Aprile 13).										
Apr. 28	9 5 11	+1 33.80	- 2 57.4	10.5	3 10 54.76	9.699	+47 50 57.0	0.839	-0.37 + 9.6	8
29	8 55 34	+1 35.44	—	5	3 6 24.81	9.719	—	—	-0.45 —	9
29	9 15 49	—	+ 0 20.8	5	—	—	+49 52 40.3	0.854	— + 9.3	9
Mag. 5	10 25 38	+0 55.78	+ 0 47.7	10.5	2 32 32.43	9.388	+59 24 5.5	0.919	-1.04 + 6.7	10
6	9 11 12	-0 52.24	+ 2 3.0	9.5	2 26 47.56	9.672	+60 41 15.3	0.880	-1.14 + 6.2	11
8	10 5 16	+0 39.28	+ 0 14.0	7.5	2 13 18.90	8.746	+62 52 39.7	0.914	-1.34 + 4.8	12
10	10 52 46	-1 32.52	+10 46.0	6.5	1 59 18.94	8.634 _n	+64 43 21.5	0.919	-1.50 + 3.5	13
12	9 56 14	+0 40.25	- 0 11.4	10.5	—	—	—	—	— —	14
19	10 9 37	+0 8.81	—	5	0 54 47.50	9.540 _n	—	—	-1.86 —	15
19	10 24 45	—	- 4 17.4	5	—	—	+69 53 18.1	0.889	— — 3.1	15

Stelle di confronto pel 1896.o.

*	α	δ	Autorità	*	α	δ	Autorità
1	19 ^h 36 ^m 7 ^s 80	+ 2° 3' 23" 8	AG. Alb. 6790	9	3 ^h 4 ^m 49 ^s 82	+49° 52' 10" 2	AG. Bonn 2667
2	19 46 13.00	+ 5 27 54.1	$\frac{1}{2}(M_1 22047 + G\ddot{o}tt_2 5038)$	10	2 31 37.69	+59 23 11.1	AG. Hels. 2395
3	19 55 37.07	+ 9 23 16.2	$\frac{1}{2}(BB.VI 4364 + M_1 22610)$	11	2 27 40.94	+60 39 6.1	AG. Hels. 2337
4	1 44 17.37	+51 25 16.4	AG. Cambr. 846	12	2 12 40.96	+62 52 20.9	AG. Hels. 2111
5	1 57 33.37	+51 11 33.8	AG. Cambr. 963	13	2 0 52.96	+64 32 32.0	AG. Hels. 1887
6	2 14 32.40	+50 48 47.0	AG. Cambr. 1096	14	—	—	BD. +66° 167
7	2 35 34.97	+50 1 9.2	AG. Cambr. 1246	15	0 54 40.55	+69 57 38.6	AG. Christ. Z. 75, 115, 198
8	3 9 21.33	+47 53 44.8	AG. Bonn 2730				