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On the orbits of ζ Cancri, ω Leonis and H I 39.

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The following three orbits were in the first instance investigated by aid of Sir John Herschel's first method. The observed angles θ_o and distances ρ_o were separately projected on square-ruled paper. Interpolation curves were drawn and the angles were read off at intervals of five years. The distances were measured too roughly to allow the corresponding curves to be similarly constructed. The values of the distance were therefore obtained from the angles, projected on the diagram containing the measured distances, and curves drawn through the points. Little, if any use, has therefore been made of the measured distances in obtaining the following orbits. The elements were then

compared with all the observed angles, and normal places determined. Their weights p were supposed proportional to the number of observations and to the square of the distance, but several observations had generally to be excluded. The differential coefficients and the equations of condition were now constructed and solved by the method of least squares. The resulting values of the elements were compared with all the observed angles and new values of the normal places thus obtained. Their differences from the calculated values were substituted in the equations of condition, the solution of which by the method of least squares furnished the final values of the elements.

I. ζ Cancri.

t	θ_o	$\theta_o - \theta_1$	n	$\sqrt{p}$	t	θ_o	$\theta_o - \theta_1$	n	$\sqrt{p}$	t	θ_o	$\theta_o - \theta_1$	n	$\sqrt{p}$
1781.9	4°0	+ 5°6	1	$\frac{1}{4}$	1860.3	284°3	+ 3°5	12	1	1884.3	64°2	+ 1°4	16	1
1826.3	53.8	+ 0.6	3	$\frac{1}{2}$	1863.3	263.4	+ 5.8	9	1	1887.3	49.0	- 0.7	16	$1\frac{1}{4}$
1832.3	28.1	- 2.3	10	1	1866.3	235.4	+ 8.4	12	$\frac{6}{5}$	1890.3	37.8	- 0.3	27	2
1836.3	16.5	- 0.5	6	$\frac{3}{4}$	1869.3	199.3	+ 10.0	10	1	1894.3	24.4	+ 0.3	32	$2\frac{1}{2}$
1842.3	358.6	+ 1.0	13	$1\frac{1}{2}$	1871.3	175.4	+ 11.8	11	$\frac{6}{5}$	1898.3	11.0	0.0	27	$1\frac{3}{4}$
1846.3	346.7	+ 2.3	15	$1\frac{1}{2}$	1874.3	140.9	+ 10.8	15	$1\frac{1}{4}$	1901.3	1.7	+ 0.3	25	$1\frac{3}{4}$
1851.3	329.3	+ 3.1	17	$1\frac{1}{2}$	1877.3	108.8	+ 4.8	20	$1\frac{1}{2}$					
1856.3	306.8	+ 2.7	20	$1\frac{1}{4}$	1881.3	81.3	+ 3.2	17	$1\frac{1}{2}$					

The normal equations were as follows:

$$\begin{aligned}
 &+ 1026.7 \Delta Q + 1034.0 \Delta \lambda - 27.0 \Delta \gamma - 97.9 \Delta e + 154.8 \Delta P + 529.2 \Delta T - 508.6 = 0 \\
 &+ 1034.0 \quad + 1041.5 \quad - 27.0 \quad - 98.8 \quad + 158.1 \quad + 531.3 \quad - 506.8 = 0 \\
 &- 27.0 \quad - 27.0 \quad + 106.8 \quad - 43.6 \quad + 40.8 \quad - 6.0 \quad + 53.6 = 0 \\
 &- 97.9 \quad - 98.8 \quad - 43.6 \quad + 192.7 \quad - 136.2 \quad - 51.9 \quad + 40.2 = 0 \\
 &+ 154.8 \quad + 158.1 \quad + 40.8 \quad - 136.2 \quad + 280.7 \quad + 61.3 \quad - 9.3 = 0 \\
 &+ 529.2 \quad + 531.3 \quad - 6.0 \quad - 51.9 \quad + 61.3 \quad + 356.1 \quad - 454.4 = 0
 \end{aligned}$$

where the units ΔQ 5°, $\Delta \lambda$ 5°, $\Delta \gamma$ 24°, Δe 0.03, ΔP 2 years, and ΔT $\frac{1}{2}$ year.

The solution of these equations furnished Elements II, the comparison of which with amended normal places is shown in the following table:

t	θ_o	$\theta_o - \theta_2$	t	θ_o	$\theta_o - \theta_2$	t	θ_o	$\theta_o - \theta_2$
1781.9	4°0	+ 4°7	1860.3	284°7	+ 0°2	1884.3	63°9	- 0°5
1826.3	53.7	- 0.9	1863.3	263.0	+ 0.1	1887.3	49.0	- 1.6
1832.3	28.1	- 2.9	1866.3	235.2	- 0.1	1890.3	37.8	- 0.8
1836.3	16.4	- 1.0	1869.3	199.4	- 1.2	1894.3	24.4	0.0
1842.3	358.5	+ 0.3	1871.3	175.4	0.0	1898.3	10.6	- 0.7
1846.3	346.5	+ 1.3	1874.3	140.6	+ 1.1	1901.3	1.7	0.0
1851.3	328.7	+ 1.2	1877.3	109.0	- 1.1			
1856.3	306.5	+ 0.2	1881.3	80.7	- 0.3			

The normal equations were as follows, where the units $\Delta \lambda$ 3°, Δe 0.03, ΔP 2 years, and ΔT $\frac{1}{2}$ year.

$$\begin{aligned}
 &+ 369.6 \Delta\lambda - 65.5 \Delta e + 76.8 \Delta P + 323.1 \Delta T + 22.7 = 0 \\
 &- 65.5 + 199.5 - 139.6 - 56.4 - 36.3 = 0 \\
 &+ 76.8 - 139.6 + 281.4 + 52.1 + 26.9 = 0 \\
 &+ 323.1 - 56.4 + 52.1 + 368.4 + 20.4 = 0
 \end{aligned}$$

These equations furnished Elements III.

The values of the elements for 1900.0 are as follows:

	I	II	III
$\Omega =$	$112^\circ 4'$	—	—
$\lambda =$	$75^\circ 12'$	$183^\circ 37'$	$183^\circ 33'$
$\gamma =$	$11^\circ 45'$	$0^\circ 0'$	$0^\circ 0'$
$e =$	0.3373	0.3340	0.3391
$P =$	60716	60709	607083
$T =$	1869.48	1870.65	1870.65
$a =$	—	—	0.856

The anomalies are considered positive before and negative after the periastron passage. The hypothetical parallax is 0.056. According to Burnham's system λ in the first set of elements should be written $284^\circ 48'$.

The following formulae are calculated from Elements III:

The comparison with the observations is as follows:

Observer	Epoch	θ_3	ϱ_3	$\theta_0 - \theta_3$	$\varrho_0 - \varrho_3$
W. Herschel	1781.90	358.6	—	+4.8	—
South	1825.27	58.3	0.95	-0.4	+0.05
W. Struve	26.22	54.1	0.97	+3.5	+0.17
"	28.80	43.3	1.03	-4.9	+0.01
J. Herschel	30.45	37.0	1.06	-1.4	-0.05
W. Struve	31.28	34.0	1.07	-4.2	-0.02
Dawes	31.30	33.9	—	-3.1	+0.02
"	32.12	30.9	1.09	-3.9	—
Bessel	32.19	30.7	"	+0.6	+0.23
Smyth	32.23	30.5	"	-2.2	+0.21
J. Herschel	32.25	"	"	-3.0	+0.41
W. Struve	32.28	30.4	"	-2.9	+0.06
Dawes	33.21	27.1	1.10	-0.9	+0.09
W. Struve	33.27	27.0	"	-4.9	+0.05
"	35.31	20.2	1.12	0.0	+0.02
Mädler	35.52	19.5	"	-0.5	—
W. Struve	36.27	17.1	1.13	-1.7	+0.07
Mädler	36.31	17.0	"	-1.9	—
Dawes	36.68	15.8	"	+0.3	—
Smyth	37.11	14.3	1.14	-1.5	+0.06
"	39.32	7.4	"	-2.2	+0.16
Kaiser	40.15	4.7	1.15	+1.4	+0.09
Dawes	40.20	4.6	"	-0.2	+0.04
O. Struve	40.29	4.4	"	+3.1	-0.15
Dawes	41.16	1.5	"	-0.6	+0.03
Mädler	41.31	1.0	"	0.0	-0.10
Dawes	42.22	358.1	1.14	-1.9	+0.04
Mädler	42.26	358.0	"	+0.9	-0.07
O. Struve	42.29	357.9	"	+1.4	+0.15
Smyth	43.11	355.3	"	-0.2	+0.06
Kaiser	43.12	—	"	—	+0.13
Dawes	43.18	355.1	"	-0.1	-0.02

$$\varrho \cos \theta = + 0.2897 + 0.8559 \sin (E - 86^\circ 40')$$

$$\varrho \sin \theta = + 0.0180 - 0.8056 \sin (E + 3^\circ 46')$$

$$z = 0.0000$$

The following ephemeris shows the angle referred to the equinox at each epoch:

t	θ_3	ϱ_3	t	θ_3	ϱ_3
1907.2	342.7	1.11	1917.2	302.7	0.91
1908.2	339.2	1.10	1918.2	297.6	0.88
1909.2	335.7	1.08	1919.2	292.0	0.85
1910.2	332.2	1.07	1920.2	286.0	0.82
1911.2	328.5	1.05	1921.2	279.6	0.79
1912.2	324.7	1.02	1922.2	272.7	0.76
1913.2	320.8	1.01	1923.2	265.0	0.72
1914.2	316.6	0.98	1924.2	256.5	0.69
1915.2	312.2	0.96	1925.2	247.6	0.66
1916.2	307.6	0.94	1926.2	237.8	0.63

Observer	Epoch	θ_3	ϱ_3	$\theta_0 - \theta_3$	$\varrho_0 - \varrho_3$
Mädler	1843.19	355.1	1.14	+1.8	-0.08
O. Struve	43.30	354.8	"	-0.5	+0.03
"	44.28	351.7	"	-1.4	+0.02
Mädler	44.39	351.3	"	+3.1	-0.12
"	45.25	348.5	1.13	+1.9	-0.08
O. Struve	45.31	348.3	"	-0.4	-0.16
Jacob	45.83	346.6	1.12	+2.8	-0.10
"	46.00	346.1	"	+0.4	+0.08
Mädler	46.27	345.2	"	+2.3	-0.10
O. Struve	46.29	345.1	"	-0.3	-0.17
Mädler	47.18	342.1	1.11	+2.5	-0.02
Smyth	47.28	341.9	"	+3.6	-0.11
O. Struve	47.33	341.7	"	+0.5	-0.15
Dawes	48.13	338.9	1.10	-0.6	-0.04
W. C. Bond	48.25	338.4	"	+4.4	-0.10
Mädler	48.28	"	"	+1.6	-0.07
O. Struve	48.30	338.3	"	-0.6	-0.19
Dawes	49.29	334.9	1.08	-0.7	+0.03
O. Struve	49.32	334.8	"	+1.3	-0.28
"	50.29	331.3	1.06	+1.6	-0.12
Mädler	50.71	329.7	1.05	+0.3	-0.02
Fletcher	51.18	328.0	"	+5.5	+0.05
Mädler	51.21	327.9	"	+1.1	0.00
Dawes	51.25	327.8	1.04	+0.1	-0.03
O. Struve	51.28	327.6	"	-0.4	-0.02
Fletcher	52.16	324.2	1.02	+4.8	-0.02
Dawes	52.23	323.9	"	+0.5	+0.04
Mädler	52.25	"	"	+3.0	+0.04
O. Struve	52.32	323.6	"	-1.9	-0.13
Smyth	53.17	320.3	1.01	+2.4	-0.11
Jacob	53.20	320.2	"	+1.8	+0.21
Mädler	53.24	320.0	1.00	+3.5	+0.06

Observer	Epoch	θ_3	ϱ_3	$\theta_o - \theta_3$	$\varrho_o - \varrho_3$	Observer	Epoch	θ_3	ϱ_3	$\theta_o - \theta_3$	$\varrho_o - \varrho_3$
Fletcher	1853.30	319.6	1.00	+1.5	+0.10	O. Struve	1868.28	213.2	0.59	+1.5	+0.13
O. Struve	53.30	»	»	+0.2	-0.03	Peirce	69.26	200.8	0.57	-3.2	+0.07
Dawes	54.20	315.9	0.98	-0.6	0.00	O. Struve	69.32	200.4	»	-2.0	+0.05
Mädler	54.27	315.6	»	+3.0	+0.10	Dunér	69.37	199.8	»	+3.8	-0.09
Morton	54.29	315.5	»	+4.7	+0.04	Harvard	70.08	190.7	»	-2.6	+0.07
Powell	54.37	315.1	»	+6.8	-	Dembowski	70.15	189.7	»	-2.4	-0.07
Dembowski	55.10	311.9	0.96	-3.3	-	O. Struve	70.28	188.0	»	-1.7	+0.09
Secchi	55.19	311.6	0.95	+0.7	+0.12	Dunér	70.30	187.8	»	+0.5	-0.14
Mädler	55.26	311.2	»	-0.6	+0.11	Gledhill	70.56	184.6	»	-3.6	-0.37
O. Struve	55.31	311.0	»	-0.7	-0.04	Dembowski	71.15	177.0	»	-1.5	-
Winnecke	55.31	»	»	-5.1	+0.09	Brünnow	71.20	176.3	»	+1.4	-
Dembowski	56.07	307.5	0.94	-3.3	-	Gledhill	71.26	175.6	»	-0.5	-0.37
Jacob	56.20	306.9	»	-0.6	+0.27	Dunér	71.29	175.2	»	+3.0	-0.02
Morton	56.23	306.8	»	+2.6	+0.22	O. Struve	71.31	174.9	»	-3.6	+0.02
Secchi	56.25	306.7	0.93	+0.5	-0.16	Gledhill	72.05	165.7	»	+1.1	-0.07
Mädler	56.28	306.5	»	+1.0	+0.07	Knott	72.13	164.5	0.58	+2.2	+0.02
Winnecke	56.31	306.4	»	+0.9	+0.08	Brünnow	72.16	164.1	»	+10.9	-
Dembowski	56.93	303.4	0.92	-6.9	-	Wilson	72.21	163.5	»	+4.3	+0.12
O. Struve	57.27	301.7	0.91	-3.3	+0.07	Dembowski	72.23	163.3	»	-0.5	-
Secchi	57.29	301.6	»	+2.3	-0.13	O. Struve	72.31	162.3	»	+0.7	0.00
Mädler	57.29	»	»	+2.9	+0.05	Dunér	72.33	162.0	»	+1.3	+0.11
Jacob	57.89	298.5	0.89	+1.2	+0.25	Brünnow	73.14	152.0	0.59	+7.5	+0.12
Dembowski	58.18	296.9	0.88	-2.7	-	Dembowski	73.19	151.5	»	-1.3	-0.09
Mädler	58.20	»	»	+0.7	+0.17	Wilson	73.22	151.1	»	-0.2	-0.09
O. Struve	58.28	296.4	»	-0.9	+0.10	O. Struve	73.28	150.4	»	+1.6	+0.02
Mädler	59.26	290.8	0.85	+4.1	+0.13	Gledhill	73.63	146.3	0.60	+3.0	-0.05
O. Struve	59.30	290.6	»	-4.1	+0.06	Burnham	73.96	142.5	»	+0.8	0.00
Dawes	60.26	284.8	0.82	-3.8	-0.12	Dembowski	74.09	141.1	»	+0.5	+0.14
O. Struve	60.27	»	»	-3.5	-0.01	Gledhill	74.13	140.6	0.61	-0.4	-0.16
Winnecke	60.28	»	»	+0.2	-	Wilson	74.18	140.0	»	+1.3	-0.03
Mädler	60.30	284.6	»	+1.4	+0.20	O. Struve	74.28	138.9	»	+5.6	+0.03
Powell	61.14	279.2	0.79	+3.6	-	Dunér	74.29	138.7	»	+4.1	0.00
Mädler	61.26	278.4	»	+3.8	+0.18	Dembowski	75.14	129.6	0.63	+0.5	+0.11
O. Struve	61.27	278.3	0.78	-3.0	+0.09	Schiaparelli	75.26	128.4	»	+0.5	+0.07
»	62.31	271.0	0.75	-3.5	-0.01	O. Struve	75.28	128.2	»	+4.2	-0.01
Mädler	62.32	»	»	+3.4	+0.22	Seabroke	75.29	128.1	»	+5.3	+0.14
Knott	63.13	264.7	0.72	+3.4	-0.02	Dunér	75.33	127.8	»	+1.7	-0.04
Dembowski	63.13	»	»	-1.6	+0.02	Dembowski	76.14	119.7	0.66	-0.3	+0.06
Romberg	63.25	263.7	»	+3.6	+0.23	Doberck	76.21	119.0	»	+3.1	-
Dawes	63.25	»	»	-1.2	-0.05	O. Struve	76.29	118.3	»	+1.1	0.00
Dembowski	64.15	256.2	0.68	-1.2	-0.13	Dembowski	77.17	110.4	0.69	-1.7	-0.01
Dawes	64.29	255.1	»	-1.9	+0.03	Schiaparelli	77.23	109.9	»	-2.0	+0.10
O. Struve	64.30	255.0	»	-1.7	+0.04	Plummer	77.23	»	»	+0.4	+0.12
Dembowski	65.21	246.6	0.65	-0.9	-0.15	Doberck	77.25	109.7	»	-1.3	+0.18
Dawes	65.30	245.7	»	-2.3	-0.02	O. Struve	77.27	109.5	»	-1.5	+0.03
Secchi	65.33	245.4	»	-0.1	-0.01	Pritchett	77.32	109.1	»	-1.8	+0.05
Knott	65.36	245.1	»	-3.4	-0.04	Doberck	78.08	102.7	0.72	+1.4	+0.20
Engelmann	65.88	240.0	0.64	+0.4	+0.10	Dembowski	78.18	102.0	»	-1.7	-0.06
Dembowski	66.19	236.8	0.62	+1.6	-0.10	Jedrzejewicz	78.26	101.4	»	-0.6	-0.02
O. Struve	66.27	235.9	»	+1.9	+0.08	Seabroke	78.26	»	»	+1.5	+0.14
Secchi	66.28	235.8	»	-1.2	-0.22	O. Struve	78.29	101.2	0.73	-2.1	+0.03
Talmage	66.38	234.8	»	-3.3	+0.10	Hall	78.32	101.0	»	+1.3	+0.08
Knott	66.40	234.6	»	-2.3	+0.14	Schiaparelli	79.27	93.8	0.76	-0.7	+0.11
Harvard	67.08	227.3	0.61	+2.4	-0.02	Seabroke	79.28	93.7	»	+2.3	+0.10
Dembowski	67.22	225.6	0.60	-1.2	-	O. Struve	79.29	93.6	»	-1.8	-0.02
»	68.20	214.2	0.59	-3.3	-0.09	Burnham	79.70	90.7	0.77	-3.9	-0.11

Observer	Epoch	θ_3	ϱ_3	$\theta_0 - \theta_3$	$\varrho_0 - \varrho_3$	Observer	Epoch	θ_3	ϱ_3	$\theta_0 - \theta_3$	$\varrho_0 - \varrho_3$
Hall	1880.21	87°2	0°79	-2°0	-0°18	O. Struwe	1889.28	42°0	1°03	+1°7	+0°20
Jedrzejewicz	80.22	»	»	+2.6	+0.10	Maw	89.29	»	»	-1.1	+0.04
Doberck	80.24	87.1	»	+1.8	—	Highton	90.13	38.7	1.05	+1.6	-0.01
Burnham	80.29	86.7	»	-1.5	-0.06	Schiaparelli	90.23	38.4	»	-1.2	+0.06
Seabroke	80.32	86.5	»	+0.3	+0.09	Comstock	90.24	38.3	»	-1.2	-0.07
Jedrzejewicz	81.24	80.6	0.82	+0.5	+0.09	Hall	90.28	38.2	»	-1.3	-0.06
Doberck	81.25	»	»	+4.3	+0.02	Flint	91.05	35.4	1.06	-3.1	-0.02
Seabroke	81.26	80.5	»	-0.8	+0.13	Gledhill	91.13	35.1	»	-2.1	+0.04
O. Struve	81.28	80.4	»	+6.4	+0.06	Highton	91.14	35.0	»	+2.2	-0.20
Hall	81.30	80.3	0.83	-1.3	-0.12	Schiaparelli	91.21	34.8	»	-0.5	+0.08
Schiaparelli	81.30	»	»	-0.1	+0.09	Hall	91.22	»	»	+0.9	-0.02
Pritchett	81.31	80.2	»	-6.5	-0.06	Bigourdan	91.24	34.7	»	-0.6	+0.08
Bigourdan	82.09	75.6	0.85	+0.1	-0.11	Maw	91.25	»	»	-1.0	+0.16
Hall	82.20	74.9	»	-1.5	-0.06	Collins	91.64	33.2	1.07	+0.3	+0.29
Engelmann	82.22	»	»	+1.3	+0.20	Burnham	92.17	31.3	1.09	+1.7	-0.06
Schiaparelli	82.25	74.7	»	+0.4	+0.13	Maw	92.25	31.1	»	+0.5	0.00
Seabroke	82.26	74.6	»	+1.6	+0.20	Knorre	92.25	»	»	+0.2	+0.17
Jedrzejewicz	82.27	74.5	0.86	+0.5	+0.08	Schiaparelli	92.26	31.0	»	-0.9	+0.02
Engelmann	83.24	69.2	0.88	+3.3	+0.17	Bigourdan	92.28	»	»	-0.6	+0.01
Schiaparelli	83.29	68.9	»	+0.4	+0.12	Gledhill	92.42	30.5	»	-3.3	-0.09
Hall	83.31	68.8	0.89	-2.4	-0.06	Jones	92.89	28.9	»	-0.2	-0.10
Küstner	83.34	68.7	»	+0.3	+0.01	»	93.15	28.0	1.10	-1.6	0.00
Seabroke	83.35	68.6	»	+1.1	+0.12	Glaserapp	93.15	»	»	+0.2	+0.15
Perrotin	84.19	64.3	0.91	-1.6	+0.15	Comstock	93.20	27.8	»	-0.5	-0.12
Bigourdan	84.22	64.2	»	-2.3	—	Lewis	93.21	»	»	-1.3	+0.05
Schiaparelli	84.25	64.0	»	-0.1	+0.07	Gledhill	93.22	»	»	+0.4	-0.10
O. Struve	84.26	»	»	-3.4	+0.07	Highton	93.22	»	»	+1.1	-0.29
Hall	84.27	63.9	»	+0.6	-0.03	Maw	93.22	»	»	-1.4	-0.03
Engelmann	84.28	63.8	»	+3.2	+0.03	Schiaparelli	93.24	27.7	»	-0.1	+0.02
Seabroke	84.38	63.3	0.92	+2.7	—	Gledhill	94.06	24.9	1.11	-1.6	-0.11
Smith	84.38	»	»	+0.3	—	Ebell	94.15	24.6	»	+1.4	+0.36
Seabroke	85.27	59.1	0.94	-0.1	+0.31	H. C. Wilson	94.16	»	»	-0.8	+0.13
Schiaparelli	85.29	59.0	»	-1.0	+0.10	Comstock	94.23	24.3	»	-1.4	-0.18
Engelmann	85.29	»	»	+0.4	+0.11	Schiaparelli	94.24	»	»	-0.8	-0.03
Tarrant	86.08	55.6	0.96	+1.6	+0.13	Maw	94.25	»	»	+0.7	-0.06
Seabroke	86.24	54.7	»	-3.5	+0.10	Bigourdan	94.39	23.8	»	-0.6	+0.29
Smith	86.25	54.6	»	-2.9	—	Lewis	95.23	21.0	1.12	+0.9	+0.11
Hall	86.28	54.5	»	+0.5	+0.07	Comstock	95.23	»	»	-0.1	-0.11
Jedrzejewicz	86.29	54.4	»	-3.2	+0.02	Coleman	95.23	»	»	+5.5	-0.11
Engelmann	86.30	»	»	+1.9	+0.11	Davidson	95.27	20.8	»	-3.7	-0.03
Hall	87.24	50.2	0.98	+0.2	-0.09	See	95.28	»	»	+2.0	+0.01
Schiaparelli	87.25	»	»	-1.8	-0.01	Hough	95.28	»	»	-1.2	-0.10
Jedrzejewicz	87.27	50.1	»	-1.8	+0.13	Gledhill	95.29	»	»	+0.7	-0.12
Seabroke	87.35	49.8	0.99	-2.0	+0.23	Maw	95.32	20.6	»	+0.5	-0.11
Smith	87.36	»	»	-4.4	—	Knorre	95.34	»	»	-0.4	+0.05
Hall	88.25	46.0	1.01	+0.6	+0.02	Doberck	96.07	18.2	1.13	+4.4	—
Schiaparelli	88.27	45.9	»	-2.2	+0.03	Collins	96.08	»	»	-0.8	+0.12
Smith	88.28	»	»	+3.4	—	Coleman	96.09	»	»	+4.0	-0.13
O. Struve	88.33	45.7	»	+0.1	+0.08	Lewis	96.18	17.8	»	+0.3	-0.10
Maw	88.36	45.6	»	-4.2	+0.12	Maw	96.20	»	»	+0.9	-0.06
Seabroke	89.12	42.6	1.03	+1.8	+0.09	Seabroke	96.24	17.6	»	+1.3	-0.05
Highton	89.19	42.3	»	-1.1	+0.20	Comstock	96.25	»	»	+0.1	-0.07
Leavenworth	89.19	»	»	-2.0	+0.02	Gledhill	96.26	»	»	+0.6	-0.03
Glaserapp	89.21	42.2	»	+1.2	—	Lewis	97.13	14.8	1.14	-6.6	+0.29
Schiaparelli	89.21	»	»	-1.5	+0.05	Bowyer	97.13	»	»	-1.9	-0.07
Hall	89.23	»	»	+1.4	-0.04	Knorre	97.13	»	»	-1.5	+0.18

Observer	Epoch	θ_3	ϱ_3	$\theta_0 - \theta_3$	$\varrho_0 - \varrho_3$	Observer	Epoch	θ_3	ϱ_3	$\theta_0 - \theta_3$	$\varrho_0 - \varrho_3$
Seabroke	1897.20	14°6	1"14	+1°0	-0"02	Coleman	1899.32	7°9	1"15	+4°0	-0"14
Aitken	97.21	»	»	-1.1	+0.02	Doolittle	1900.24	5.0	»	-1.3	+0.07
Hussey	97.21	»	»	+2.8	-0.14	Bryant	00.24	»	»	+0.8	-0.07
Brown	97.25	14.4	»	+0.9	-0.18	Gledhill	00.30	4.8	»	+1.0	-0.15
Maw	97.26	»	»	+0.8	-0.02	Maw	00.34	4.7	»	+1.4	-0.01
Doolittle	97.49	13.7	»	+0.3	+0.16	Seabroke	00.35	»	»	+0.2	-0.30
Aitken	97.85	12.6	»	-2.9	-0.05	Doberck	00.87	2.9	»	+0.2	0.00
Hussey	97.89	12.4	»	-0.4	-0.01	Doolittle	01.05	2.3	»	-0.4	+0.02
Seabroke	98.15	11.6	»	-0.7	+0.05	Lewis	01.18	2.0	»	+3.6	-0.31
Bowyer	98.19	11.4	»	-0.3	-0.09	Aitken	01.20	1.9	»	-1.8	-0.06
Maw	98.25	11.3	»	-1.1	-0.02	Seabroke	01.25	1.8	»	+2.1	-0.06
Lewis	98.25	»	»	+3.3	-0.02	Bowyer	01.27	1.7	»	+0.5	-0.07
Doolittle	98.27	11.2	»	-0.6	+0.17	Maw	01.31	1.5	»	0.0	+0.02
Aitken	98.31	11.1	»	-2.1	+0.03	Doberck	02.08	359.1	»	-4.0	-0.11
Solá	98.97	9.0	»	+4.8	+0.14	Bowyer	02.26	358.6	1.14	-1.1	+0.06
Gledhill	99.09	8.6	»	+2.5	-0.14	Bryant	02.30	358.5	»	+4.1	-0.07
Lewis	99.12	8.5	»	-0.3	-0.06	Doberck	03.13	355.8	»	-4.1	-0.03
Bowyer	99.15	»	1.15	-1.2	-0.01	Doolittle	03.18	355.7	»	-1.7	+0.07
Maw	99.15	»	»	-1.2	-0.10	Biesbroeck	03.22	355.5	»	-0.4	-0.04
Seabroke	99.18	8.4	»	+0.6	+0.17	Bowyer	04.25	352.3	»	-0.8	-0.03
Aitken	99.18	»	»	-2.7	-0.01	Furner	04.29	352.2	»	+2.8	-0.26
Brown	99.21	8.3	»	-0.7	-0.04	Doolittle	05.09	349.6	1.13	-0.8	+0.05
Doolittle	99.22	»	»	-0.5	+0.31						

In the following table the probable errors of the annual means of each observer's measures are given. The constant error in distance signifies: observation minus calculation.

Observer	Angle P. E.			Distance			Observer	Angle P. E.			Distance		
	Deg. at 1°0	arc.	n	Constant	P. E.	n		Deg. at 1°0	arc.	n	Constant	P. E.	n
W. Struve	±3°04	±0°052	7	+0°052	±0°039	7	Doberck	±2°46	±0°042	9	+0°043	±0°090	6
Dawes	±1.11	±0.019	17	+0.003	±0.035	15	Wilson	±1.14	±0.019	3	0.000	±0.083	3
Smyth	±2.03	±0.035	6	+0.045	±0.095	6	Seabroke	±1.26	±0.021	18	+0.085	±0.083	17
Mädler	±1.66	±0.029	23	+0.031	±0.083	21	Jedrzejewicz	±1.26	±0.021	6	+0.067	±0.040	6
O. Struve	±1.37	±0.024	38	0.000	±0.066	38	Hall	±0.96	±0.017	12	-0.041	±0.047	12
Dembowski	±1.30	±0.022	19	-0.031	±0.068	12	Schiaparelli	±0.74	±0.012	16	+0.063	±0.033	16
Fletcher	±4.17	±0.070	3	+0.043	±0.044	3	Burnham	±1.64	±0.029	4	-0.058	±0.027	4
Jacob	±1.34	±0.023	5	+0.142	±0.115	5	Smith	±2.65	±0.046	4	—	—	—
Winnecke	±2.07	±0.035	3	+0.085	?	2	Highton	±1.50	±0.026	4	-0.075	±0.166	4
Secchi	±0.79	±0.014	5	-0.080	±0.102	5	Comstock	±0.66	±0.012	5	-0.110	±0.030	5
Brünnow	±4.00	±0.070	3	—	—	—	Maw	±1.08	±0.019	13	-0.005	±0.048	13
Engelmann	±1.47	±0.025	6	+0.120	±0.040	6	Bigourdan	±0.79	±0.014	5	+0.067	±0.114	4
Dunér	±1.33	±0.023	6	-0.030	±0.056	6	Lewis	±2.35	±0.040	7	-0.006	±0.121	7
Harvard	±1.73	±0.029	3	+0.040	±0.041	3	Bowyer	±1.04	±0.018	6	-0.035	±0.039	6
Knott	±1.78	±0.030	4	+0.025	±0.054	4	Coleman	±4.85	±0.085	3	-0.127	?	3
Knorre	±0.83	±0.014	3	+0.133	±0.059	3	Aitken	±2.31	±0.039	5	-0.014	±0.030	5
Gledhill	±1.17	±0.020	14	-0.127	±0.070	14	Doolittle	±0.83	±0.014	7	+0.122	±0.072	7

The circumstance that the companion moves at any rate very nearly in the plane of the field of vision renders the calculation of perturbations caused by the distant companion comparatively easy. That there are but very slight

indications of such perturbations indicates that the mass of the distant companion is small or that its orbit is inclined very much. I hope to revert to this question after investigating the orbit of the distant companion.

II. ω Leonis.

t	θ_0	$\theta_0 - \theta_1$	n	$\sqrt{p}$	t	θ_0	$\theta_0 - \theta_1$	n	$\sqrt{p}$	t	θ_0	$\theta_0 - \theta_1$	n	$\sqrt{p}$
1782.86	110°5	+ 0°9	1	$\frac{3}{4}$	1856.0	354°9	+ 0°3	12	$1\frac{7}{10}$	1887.0	94°6	- 1°0	31	$3\frac{1}{2}$
1803.09	130.6	+ 3.2	1	$\frac{3}{4}$	1860.0	9.1	+ 1.3	6	$1\frac{1}{3}$	1892.5	104.0	- 0.1	29	$3\frac{3}{4}$
1831.50	158.3	- 1.1	6	1	1867.0	32.7	- 2.0	8	$1\frac{1}{3}$	1896.5	108.4	- 0.8	20	$3\frac{3}{4}$
1836.50	180.3	- 21.0	3	$\frac{1}{3}$	1872.0	55.9	+ 1.4	10	$1\frac{1}{2}$	1901.0	113.6	- 0.4	25	$4\frac{1}{2}$
1843.00	300.6	- 12.7	5	$\frac{1}{2}$	1877.0	72.2	+ 0.4	19	$2\frac{1}{3}$					
1848.00	333.6	+ 1.8	14	$1\frac{4}{5}$	1881.0	82.0	- 0.8	22	$2\frac{1}{2}$					

The normal equations, where the units $\Delta\Omega$ 5°, $\Delta\lambda$ 4°, $\Delta\gamma$ 4°, Δe 0.04, Δn 0.2, and ΔT 1 year, were as follows:

$$\begin{aligned}
 &+ 2168.7 \Delta\Omega + 2589.8 \Delta\lambda + 1717.4 \Delta\gamma + 745.4 \Delta e + 2007.3 \Delta n - 745.2 \Delta T + 134.6 = 0 \\
 &+ 2589.8 \quad + 3641.4 \quad + 2039.6 \quad + 1262.8 \quad + 2753.9 \quad - 1045.3 \quad + 291.6 = 0 \\
 &+ 1717.4 \quad + 2039.6 \quad + 2221.7 \quad + 182.0 \quad + 1659.9 \quad - 396.0 \quad - 58.9 = 0 \\
 &+ 745.4 \quad + 1262.8 \quad + 182.0 \quad + 793.0 \quad + 950.9 \quad - 348.8 \quad + 150.1 = 0 \\
 &+ 2007.3 \quad + 2753.9 \quad + 1659.9 \quad + 950.9 \quad + 2159.0 \quad - 710.8 \quad + 121.8 = 0 \\
 &- 745.2 \quad - 1045.3 \quad - 396.0 \quad - 348.8 \quad - 710.8 \quad + 509.8 \quad - 293.8 = 0
 \end{aligned}$$

The values of the elements for 1900.0 are as follows:

	I	II
Ω	$= 143^\circ 20'$	$144^\circ 17'$
λ	$= 121 \ 9$	$122 \ 6$
γ	$= 66 \ 35$	$66 \ 12$
e	$= 0.5520$	0.5601
P	$= 1147.05$	1167.74
T	$= 1840.22$	1840.82
a	$= 0.843$	0.844

Elements I have been obtained from the elements determined by construction in the same way as Elements II have been obtained from Elements I. The anomalies are considered negative before and positive after the periastron passage. The hypothetical parallax is 0".035.

The following formulae are calculated from Elements II:

$$\begin{aligned}
 \rho \cos \theta &= - 0.1096 + 0.6006 \sin (E + 19^\circ \ 0') \\
 \rho \sin \theta &= + 0.2779 - 0.5443 \sin (E + 65 \ 44) \\
 \pm z &= - 0.3666 - 0.7374 \sin (E - 62 \ 33)
 \end{aligned}$$

Ephemeris.

t	θ_2	ρ_2	z_2	t	θ_2	ρ_2	z_2	t	θ_2	ρ_2	z_2
1906.2	118°2	0.92	- 0.920	1913.2	123°7	0.99	- 0.783	1920.2	128°8	1.02	- 0.614
1907.2	119.1	0.93	- 0.903	1914.2	124.6	0.99	- 0.761	1921.2	129.5	1.02	- 0.587
1908.2	119.9	0.94	- 0.884	1915.2	125.3	1.00	- 0.738	1922.2	130.2	1.02	- 0.559
1909.2	120.7	0.95	- 0.866	1916.2	125.9	1.00	- 0.715	1923.2	131.0	1.02	- 0.532
1910.2	121.5	0.96	- 0.846	1917.2	126.6	1.01	- 0.690	1924.2	131.7	1.02	- 0.503
1911.2	122.3	0.97	- 0.826	1918.2	127.4	1.01	- 0.665	1925.2	132.3	1.01	- 0.474
1912.2	123.0	0.98	- 0.805	1919.2	128.1	1.02	- 0.639				

The comparison with observations is as follows:

Observer	Epoch	θ_2	ρ_2	$\theta_0 - \theta_2$	$\rho_0 - \rho_2$	Observer	Epoch	θ_2	ρ_2	$\theta_0 - \theta_2$	$\rho_0 - \rho_2$
W. Herschel	1782.86	112°3	0.84	- 1°4	+ 0.16	Dawes	1842.26	306°4	0.31	- 5°8	-
"	1803.09	129.0	1.02	+ 1.9	-	O. Struve	42.31	306.7	"	- 4.4	- 0.01
W. Struve	25.21	147.4	0.76	+ 6.5	+ 0.21	Smyth	43.14	312.2	0.35	- 119.2	- 0.05
J. Herschel	30.24	156.0	0.55	- 9.5	-	Mädler	"	"	"	- 32.0	+ 0.50
Smyth	32.11	161.4	0.46	- 1.4	+ 0.04	Dawes	43.17	312.4	"	- 13.4	-
W. Struve	32.25	161.8	"	+ 1.6	+ 0.06	O. Struve	43.30	313.1	"	+ 3.7	+ 0.02
"	33.29	165.9	0.40	+ 6.9	+ 0.05	"	44.29	318.2	0.40	+ 2.7	+ 0.08
"	35.34	179.4	0.28	- 5.5	-	Mädler	44.32	318.4	"	+ 18.6	- 0.08
"	36.28	190.0	0.23	- 11.3	-	O. Struve	45.31	322.6	0.43	- 1.5	+ 0.01
O. Struve	36.28	"	"	- 10.2	-	Mädler	46.28	326.1	0.46	+ 0.8	- 0.11
Mädler	36.30	190.3	"	- 19.3	-	O. Struve	46.30	326.2	"	- 3.3	- 0.01
W. Struve	38.33	235.6	0.16	- 55.6	-	Mädler	47.28	329.5	0.47	+ 7.5	- 0.10
Smyth	39.33	263.4	0.17	- 88.4	-	O. Struve	47.33	329.6	0.48	- 0.8	+ 0.05
O. Struve	40.29	283.5	0.21	- 36.0	+ 0.09	"	48.32	332.7	0.49	- 0.6	- 0.06
W. Struve	40.31	283.7	0.21	- 33.4	-	Mädler	48.35	332.8	"	+ 14.0	- 0.11
Dawes	41.18	295.9	0.24	+ 58.6	-	O. Struve	49.32	335.8	0.50	- 4.0	- 0.07
Mädler	41.35	298.0	0.26	- 104.0	+ 0.04	"	50.63	339.5	0.51	- 3.7	- 0.02
"	42.21	306.0	0.31	- 56.2	-	Mädler	51.23	341.2	"	+ 1.4	-

Observer	Epoch	δ_2	ϱ_2	$\delta_0 - \delta_2$	$\varrho_0 - \varrho_2$
Mädler	1852.30	344.2	0.51	+ 5.8	- 0.04
O. Struve	52.66	345.4	0.50	- 6.3	- 0.04
Jacob	53.18	346.8	»	- 3.5	- 0.05
Mädler	53.27	347.1	»	- 0.8	- 0.15
Jacob	53.96	349.1	»	+ 0.9	- 0.10
Dawes	54.23	349.9	»	- 3.7	+ 0.05
Mädler	54.28	350.0	»	- 1.7	+ 0.03
»	55.28	353.0	0.49	+ 6.3	-
Secchi	55.29	»	»	+ 7.0	-
O. Struve	55.32	»	»	- 4.3	- 0.02
Winnecke	55.34	353.1	»	+ 13.1	-
Jacob	56.22	355.9	»	+ 6.3	- 0.09
O. Struve	57.28	359.3	0.48	- 1.2	+ 0.04
Morton	57.29	»	»	- 4.3	-
Secchi	57.86	1.1	»	+ 1.2	- 0.13
Jacob	57.98	1.4	»	+ 4.1	+ 0.02
»	58.10	1.8	0.47	+ 2.8	- 0.07
Mädler	59.25	5.8	»	+ 10.9	- 0.12
O. Struve	59.30	5.9	0.46	+ 0.8	+ 0.14
Winnecke	60.28	9.3	»	- 0.1	-
O. Struve	60.28	»	»	+ 0.9	+ 0.16
Mädler	60.33	9.4	»	+ 9.7	- 0.21
O. Struve	61.28	12.8	0.45	- 0.9	+ 0.11
Mädler	62.32	16.7	0.44	+ 1.9	-
O. Struve	64.30	24.1	0.43	+ 5.1	+ 0.09
Dembowski	64.89	26.5	»	- 2.5	-
Engelmann	65.67	29.6	»	- 6.6	+ 0.07
Secchi	66.30	32.1	»	+ 0.8	- 0.13
Winlock	67.08	35.2	»	+ 74.2	-
Searle	67.08	»	»	+ 90.5	-
Winlock	67.32	36.1	»	- 6.8	-
Engelmann	67.34	36.2	»	- 2.5	+ 0.14
Dembowski	68.12	39.3	»	- 13.6	-
Peirce	68.21	39.6	»	- 24.0	-
O. Struve	68.63	41.2	»	+ 3.1	+ 0.12
Peirce	69.13	43.4	»	- 86.2	-
»	69.26	43.8	»	- 7.1	-
Dembowski	70.15	47.3	»	+ 5.1	-
Peirce	70.24	47.6	»	- 3.2	-
O. Struve	70.28	47.8	»	+ 5.8	+ 0.15
Dunér	70.33	47.9	»	- 10.0	- 0.16
Dembowski	71.16	51.1	0.44	+ 1.5	-
O. Struve	71.30	51.6	»	+ 5.1	+ 0.13
Dunér	71.31	51.7	»	- 9.0	- 0.14
W. & S.	72.18	55.0	0.45	+ 11.3	+ 0.03
O. Struve	72.31	55.5	»	+ 3.3	+ 0.07
W. & S.	73.23	58.8	»	- 2.6	-
Gledhill	73.29	59.0	»	- 2.0	- 0.05
Dembowski	73.58	60.0	»	+ 2.0	-
O. Struve	73.96	61.4	0.46	+ 2.2	+ 0.13
Dembowski	75.25	65.7	0.47	- 1.1	- 0.01
Schiaparelli	75.26	»	»	- 3.0	+ 0.02
Dunér	75.31	65.9	»	+ 0.9	- 0.04
O. Struve	75.32	»	»	+ 0.5	+ 0.12
Dembowski	76.16	68.7	0.48	+ 0.8	- 0.04
Doberck	76.24	68.9	»	- 16.2	-

Observer	Epoch	δ_2	ϱ_2	$\delta_0 - \delta_2$	$\varrho_0 - \varrho_2$
W. & S.	1876.27	69.0	0.48	+ 4.5	+ 0.07
O. Struve	76.29	69.1	»	- 3.5	+ 0.09
Copeland	77.21	71.9	0.50	+ 5.3	+ 0.38
Plummer	77.21	»	»	- 0.7	+ 0.04
Doberck	77.21	»	»	+ 1.1	+ 0.01
Schiaparelli	77.28	72.0	»	- 1.3	- 0.03
O. Struve	77.28	»	»	- 0.4	+ 0.04
Dembowski	77.36	72.3	»	+ 4.3	- 0.08
Burnham	78.11	74.5	»	- 4.2	+ 0.13
Doberck	78.26	74.9	0.51	+ 5.4	- 0.01
Seabroke	78.26	»	»	+ 7.8	-
Dembowski	78.28	75.0	»	- 0.3	- 0.07
Hall	78.34	75.1	»	+ 0.8	- 0.05
O. Struve	78.63	76.0	»	+ 1.7	+ 0.09
Seabroke	79.16	77.5	0.52	+ 23.0	-
Hall	79.25	77.7	»	- 4.1	- 0.13
Schiaparelli	79.31	77.9	»	- 1.2	+ 0.03
Seabroke	79.32	»	»	+ 1.7	+ 0.04
Burnham	79.78	79.1	»	+ 0.7	- 0.01
Bigourdan	80.23	80.3	0.54	- 0.6	-
Jedrzejewicz	80.26	80.4	»	+ 14.8	-
Hall	80.26	»	»	+ 0.9	- 0.08
Seabroke	80.40	80.7	»	- 9.4	-
Bigourdan	81.10	82.5	0.55	- 1.5	+ 0.06
Doberck	81.24	82.8	»	+ 0.5	- 0.05
Seabroke	81.26	82.9	»	- 0.8	+ 0.07
Jedrzejewicz	81.26	»	»	+ 15.8	-
O. Struve	81.28	»	»	+ 0.8	+ 0.13
Hall	81.31	83.0	»	+ 1.3	- 0.07
Schiaparelli	81.33	»	»	+ 1.4	+ 0.03
Copeland	82.12	84.9	0.57	- 4.4	-
Engelmann	82.23	85.1	»	- 5.1	- 0.01
Doberck	82.27	85.2	»	- 1.9	+ 0.09
Seabr. & S.	82.28	»	»	- 1.1	+ 0.63
Hall	82.30	85.3	»	- 1.2	- 0.08
O. Struve	82.34	85.4	»	+ 1.3	+ 0.04
Schiaparelli	82.36	»	»	+ 4.6	- 0.02
Engelmann	83.24	87.4	0.58	- 1.6	+ 0.04
Schiaparelli	83.31	87.5	»	+ 3.0	+ 0.07
Hall	83.34	87.6	»	+ 3.3	+ 0.04
Perrotin	84.19	89.4	0.60	+ 1.3	- 0.04
Engelmann	84.23	89.5	»	+ 1.9	+ 0.06
O. Struve	84.26	»	»	- 1.9	+ 0.11
Schiaparelli	84.31	89.6	»	+ 1.7	- 0.02
Hall	84.32	»	»	+ 3.7	- 0.05
Bigourdan	84.34	89.7	»	+ 0.9	-
Seabr. & S.	84.39	89.8	»	- 3.9	+ 0.40
Doberck	85.17	91.4	0.61	+ 1.9	-
Engelmann	85.27	91.6	»	- 1.0	+ 0.11
Tarrant	85.31	91.7	»	+ 2.3	+ 0.08
Schiaparelli	85.31	»	»	+ 2.0	- 0.03
Smith	85.35	»	»	- 2.8	+ 0.39
Perrotin	85.72	92.5	»	- 1.6	+ 0.10
Seabr. & S.	86.25	93.5	0.63	- 3.4	+ 0.56
H. Struve	86.28	»	»	- 2.5	+ 0.10
Engelmann	86.32	93.6	»	- 1.4	+ 0.10

Observer	Epoch	θ_2	ρ_2	$\theta_o - \theta_2$	$\rho_o - \rho_2$	Observer	Epoch	θ_2	ρ_2	$\theta_o - \theta_2$	$\rho_o - \rho_2$
Schiaparelli	1887.26	95°3	0°64	-0°3	-0°02	Schiaparelli	1895.26	107°0	0°77	+1°1	-0°04
Hall	87.31	95.4	»	+0.2	-0.11	See	95.28	»	»	-1.2	+0.09
H. Struve	87.32	»	»	+1.4	+0.15	H. Struve	95.28	»	»	-0.2	+0.04
Smith	87.37	95.5	»	-1.5	-	Hough	95.31	107.1	»	+1.9	-0.17
Leavenworth	88.12	96.8	0.66	-2.2	+0.08	Gledhill	96.14	108.1	0.79	+1.4	+0.01
Tarrant	88.21	97.0	»	+0.4	+0.02	Lewis	96.22	108.2	»	-0.3	-0.23
Smith	88.26	97.1	»	-5.5	-	Dyson	96.24	»	»	-2.4	+0.15
Schiaparelli	88.27	»	»	+1.4	+0.02	Seabroke	96.25	»	»	-1.1	+0.30
Hall	88.29	»	»	+1.2	0.00	Comstock	96.29	108.3	»	-1.0	-0.10
O. Struve	88.33	97.2	»	-2.3	+0.21	Coleman	96.32	»	»	+0.8	-0.09
Leavenworth	89.05	98.4	0.67	-1.6	+0.03	Hussey	97.00	109.1	0.80	+0.7	+0.10
H. Struve	89.06	»	»	+0.9	+0.11	Lewis	97.16	109.3	»	-1.8	+0.04
Highton	89.19	98.6	»	-4.5	+0.03	Seabroke	97.19	»	»	-0.5	+0.25
Hall	89.29	98.7	»	+1.1	0.00	Knorre	97.29	109.4	»	+5.2	-
Schiaparelli	89.33	98.8	»	+1.4	-0.02	Brown	97.30	»	»	+0.1	+0.05
Highton	90.18	100.0	0.69	-7.0	-	Doolittle	97.35	109.5	»	+1.1	+0.10
Gledhill	90.25	100.2	»	+1.9	+0.01	Gledhill	97.36	»	»	-2.5	0.00
Comstock	90.27	»	»	+1.6	-0.01	Hussey	97.47	109.7	0.81	+1.3	+0.07
Schiaparelli	90.31	100.3	»	+0.8	-0.02	Aitken	97.85	110.2	»	-1.6	+0.07
Hall	90.32	»	»	+1.0	-0.05	Bryant	98.29	110.5	0.82	+3.1	-0.17
H. Struve	90.57	100.6	0.70	+1.0	+0.02	Glaserapp	98.33	110.6	»	-0.9	+0.13
Leavenworth	91.05	101.4	0.71	+1.2	-0.07	Lewis	98.34	»	»	+3.1	-0.19
Bigourdan	91.21	101.6	»	+0.6	+0.05	Aitken	98.91	111.2	0.83	+0.5	-0.05
Highton	91.23	»	»	+3.0	-0.11	Solá	99.04	111.3	»	-8.2	+0.02
Gledhill	91.24	»	»	+2.0	-0.11	Gledhill	99.18	111.5	»	-0.4	+0.07
Hall	91.28	101.7	»	-0.5	+0.04	Brown	99.21	»	»	-0.4	-0.01
Schiaparelli	91.32	»	»	+3.2	-0.05	Doolittle	99.25	111.6	»	+0.4	+0.24
Gledhill	92.24	103.0	0.72	+0.5	-0.02	Bryant	1900.27	112.7	0.85	-0.1	-0.20
Maw	92.25	»	»	-0.6	+0.05	Gledhill	00.27	»	»	-1.5	+0.05
Schiaparelli	92.26	103.1	»	+1.8	+0.01	Doolittle	00.30	»	»	+1.0	+0.15
Leavenworth	92.27	»	»	+1.4	+0.15	Seabroke	00.35	»	»	+2.3	+0.47
Glaserapp	93.19	104.4	0.74	+4.0	+0.25	Doolittle	01.09	113.5	0.86	-0.4	-0.07
Highton	93.22	»	»	+0.5	-0.29	Seabroke	01.28	113.7	»	+1.0	+0.07
Comstock	93.25	104.5	»	-3.0	-0.13	Bryant	01.29	»	»	-2.1	-0.22
Lewis	93.27	»	»	+4.8	-0.24	Lewis	01.36	»	»	-1.6	-
Gledhill	93.28	»	»	-0.2	-0.04	Maw	01.40	113.8	»	+2.4	+0.15
Schiaparelli	93.28	»	»	+1.2	-0.04	Bryant	02.21	114.6	0.87	-2.7	-0.19
Gledhill	94.09	105.5	0.76	-1.1	+0.04	Thiele	02.22	»	»	-0.9	+0.24
H. Struve	94.17	105.6	»	-0.4	+0.14	Doberck	03.16	115.4	0.89	+1.0	+0.05
Bigourdan	94.22	105.7	»	-1.2	+0.54	Bryant	03.17	»	»	-4.4	+0.03
Comstock	94.23	»	»	+0.8	-0.06	Bowyer	03.22	115.5	»	+2.1	-0.07
H. C. Wilson	94.25	»	»	-2.4	-0.02	Biesbroeck	03.22	»	»	+1.2	-0.05
Schiaparelli	94.27	105.8	»	+0.9	0.00	Doolittle	03.24	»	»	+1.4	-0.09
Barnard	94.87	106.5	0.77	+0.9	+0.18	Lewis	03.28	»	»	+0.1	-0.09
Lewis	95.19	106.9	»	+1.5	-0.05	Furner	03.29	115.6	»	+1.9	-0.17
Comstock	95.24	107.0	»	-0.9	-0.10						

In the following table the probable errors of the annual means of each observer's measures are given. The constant error in distance signifies: observation minus calculation.

Observer	Angle P. E.			Distance			Observer	Angle P. E.			Distance		
	Deg. at 1°0	arc.	n	Constant	P. E.	n		Deg. at 1°0	arc.	n	Constant	P. E.	n
W. Struve	±2°93	±0°049	3	+0°107	±0°072	3	O. Struve	±1°04	±0°018	29	+0°067	±0°052	29
Dawes	±2.79	±0.046	3	-	-	-	Dembowski	±1.38	±0.023	9	-0.050	±0.024	4
Mädler	±3.19	±0.054	13	-0.040	±0.115	10	Jacob	±1.63	±0.028	5	-0.058	±0.032	5

Observer	Angle P. E.			Distance		
	Deg. at 1"0	arc.	<i>n</i>	Constant	P. E.	<i>n</i>
Secchi	$\pm 1^{\circ}52$	$\pm 0^{\circ}026$	3	$-0^{\circ}130$	—	2
Engelmann	± 1.35	± 0.023	7	$+0.073$	$\pm 0^{\circ}034$	7
Dunér	± 3.00	± 0.051	3	-0.113	± 0.052	3
Gledhill	± 0.86	± 0.015	10	-0.004	± 0.036	10
Doberck	± 1.87	± 0.032	7	$+0.018$	± 0.040	5
W. & S.	± 2.32	± 0.040	15	$+0.263$	± 0.166	11
Hall	± 0.84	± 0.014	12	-0.045	± 0.037	12
H. Struve	± 0.67	± 0.012	6	$+0.093$	± 0.040	6

Observer	Angle P. E.			Distance		
	Deg. at 1"0	arc.	<i>n</i>	Constant	P. E.	<i>n</i>
Schiaparelli	$\pm 0^{\circ}95$	$\pm 0^{\circ}016$	17	$-0^{\circ}006$	$\pm 0^{\circ}023$	17
Highton	± 2.52	± 0.044	4	-0.123	± 0.106	3
Comstock	± 1.02	± 0.017	5	-0.080	± 0.034	5
Bigourdan	± 0.55	± 0.009	5	$+0.217$	± 0.209	3
Lewis	± 1.39	± 0.024	7	-0.127	± 0.086	6
Bryant	± 2.08	± 0.036	5	-0.156	± 0.068	5
Leavenworth	± 1.03	± 0.018	4	$+0.047$	± 0.066	4
Doolittle	± 0.70	± 0.012	5	$+0.066$	± 0.110	5

From 1836 to 1842 the companion remained invisible. In the latter year O. Struve rediscovered it in the 15 inch refractor. In the meantime it had been noted by observers near the place, where they expected it to be, and as they did not realise the speed at which it was revolving at the time the angles were noted far too small.

III. H I 39.

The star H I 39 is usually denominated Σ 3062.

<i>t</i>	θ_0	$\theta_0 - \theta_1$	<i>n</i>	$\sqrt{p}$	<i>t</i>	θ_0	$\theta_0 - \theta_1$	<i>n</i>	$\sqrt{p}$	<i>t</i>	θ_0	$\theta_0 - \theta_1$	<i>n</i>	$\sqrt{p}$
1782.85	319°3	+0°6	2	1	1841.5	194°1	-1°9	5	$\frac{3}{4}$	1875.5	291°7	-0°4	24	$3\frac{1}{2}$
1823.81	36.7	-4.7	1	$\frac{2}{3}$	1846.0	219.9	+1.4	8	$1\frac{1}{2}$	1885.5	313.4	+0.6	24	$3\frac{3}{4}$
1832.50	94.8	+3.0	2	$\frac{1}{2}$	1855.5	246.7	-0.4	23	3	1893.5	328.6	+0.2	32	$4\frac{1}{2}$
1836.50	143.5	-2.2	3	$\frac{1}{3}$	1867.0	273.5	-0.3	25	$3\frac{1}{2}$	1900.0	341.2	+0.6	22	$3\frac{1}{2}$

The normal equations, where the units $\Delta\Omega$ 4°, $\Delta\lambda$ 5°, $\Delta\gamma$ 10°, Δe 0.03, ΔP 4 years, and ΔT 1 year, were as follows:

$$\begin{aligned}
 &+ 1354.9 \Delta\Omega + 2140.2 \Delta\lambda - 360.8 \Delta\gamma + 276.2 \Delta e - 1042.3 \Delta P - 721.0 \Delta T - 35.2 = 0 \\
 &+ 2140.2 \quad + 3496.5 \quad - 424.2 \quad + 337.2 \quad - 1731.7 \quad - 1101.9 \quad - 79.7 = 0 \\
 &- 360.8 \quad - 424.2 \quad + 962.5 \quad - 370.0 \quad + 83.6 \quad + 182.3 \quad - 69.1 = 0 \\
 &+ 276.2 \quad + 337.2 \quad - 370.0 \quad + 216.8 \quad - 122.4 \quad - 167.0 \quad + 19.9 = 0 \\
 &- 1042.3 \quad - 1731.7 \quad + 83.6 \quad - 122.4 \quad + 949.5 \quad + 517.9 \quad + 53.3 = 0 \\
 &- 721.0 \quad - 1101.9 \quad + 182.3 \quad - 167.0 \quad + 517.9 \quad + 448.3 \quad + 14.5 = 0
 \end{aligned}$$

The values of the elements for 1900.0 are as follows:

	I	II
Ω	$= 38^{\circ} 35'$	$37^{\circ} 25'$
λ	$= 97 \ 43$	$98 \ 41$
γ	$= 44 \ 57$	$46 \ 5$
e	$= 0.4612$	0.4664
P	$= 105^{\text{y}}62$	$105^{\text{y}}55$
T	$= 1836.06$	1836.07
a	$=$	$1^{\text{''}}44$

Elements I have been obtained from the elements determined by construction in the same way as Elements II have been obtained from Elements I. The anomalies are considered negative before and positive after the periastron passage. The hypothetical parallax is 0"064.

The following formulae are calculated from Elements II:

$$\begin{aligned}
 \rho \cos \theta &= + 0^{\text{''}}3604 - 1^{\text{''}}2004 \sin (E + 40^{\circ}07) \\
 \rho \sin \theta &= - 0.3042 + 1.0880 \sin (E + 143.17) \\
 \pm z &= - 0.4783 - 1.0348 \sin (E - 82.30)
 \end{aligned}$$

Ephemeris.

<i>t</i>	θ_2	ρ_2	z_2	<i>t</i>	θ_2	ρ_2	z_2	<i>t</i>	θ_2	ρ_2	z_2
1906.5	352°6	1"56	-1"145	1913.5	5°1	1"55	-0"858	1920.5	18°5	1"46	-0"492
1907.5	354.4	"	-1.107	1914.5	6.9	1.54	-0.811	1921.5	20.5	1.44	-0.435
1908.5	356.2	"	-1.070	1915.5	8.8	1.53	-0.762	1922.5	22.6	1.41	-0.374
1909.5	357.9	"	-1.031	1916.5	10.7	1.52	-0.711	1923.5	24.9	1.39	-0.312
1910.5	359.7	"	-0.992	1917.5	12.6	1.51	-0.658	1924.5	27.2	1.36	-0.251
1911.5	1.5	"	-0.948	1918.5	14.5	1.50	-0.605	1925.5	29.6	1.32	-0.189
1912.5	3.3	1.55	-0.903	1919.5	16.5	1.48	-0.552				

The comparison with observations is as follows:

Observer	Epoch	θ_2	ϱ_2	$\theta_o - \theta_2$	$\varrho_o - \varrho_2$	Observer	Epoch	θ_2	ϱ_2	$\theta_o - \theta_2$	$\varrho_o - \varrho_2$
W. Herschel	1782.65	318°6	1"48	+0°8	+0"02	O. Struve	1866.20	271°8	1"39	-1°4	+0"08
»	1783.05	319.4	»	-0.3	—	Talmage	66.64	272.8	»	-2.5	+0.07
W. Struve	1823.81	40.3	1.16	-3.6	+0.09	Harvard	66.72	273.0	»	+2.5	-0.26
»	31.71	82.4	0.68	+5.1	+0.14	Dembowski	66.74	»	»	+0.4	+0.05
»	33.71	105.1	0.57	+3.4	-0.01	Secchi	66.97	273.6	»	-3.6	-0.05
»	35.66	133.6	0.54	-1.0	-0.13	Dembowski	67.74	275.4	1.40	-0.2	+0.01
»	36.61	147.7	0.55	-1.3	-0.08	»	68.67	277.3	»	+0.2	-0.02
»	37.78	163.3	0.59	-5.4	-0.10	Talmage	68.76	277.6	»	-9.3	+0.26
O. Struve	40.32	188.2	0.74	-1.7	-0.09	O. Struve	68.98	278.0	»	-1.5	+0.19
Dawes	40.78	191.6	0.78	-4.7	+0.02	Dembowski	69.75	279.7	»	+0.2	+0.09
Mädler	41.58	196.9	0.82	-3.3	+0.07	O. Struve	70.18	280.7	»	-1.5	+0.08
Dawes	41.86	198.7	0.84	-5.3	+0.11	Gledhill	70.44	281.3	»	-0.3	+0.10
Mädler	42.80	204.1	0.90	+3.2	-0.03	Talmage	70.64	281.7	»	-1.1	+0.23
»	43.58	208.0	0.94	+0.7	-0.02	Dembowski	70.67	»	»	+0.5	+0.03
Dawes	43.80	209.1	0.95	+0.9	-0.01	»	71.57	283.7	1.41	+0.1	-0.02
Mädler	44.49	212.2	0.98	+1.5	-0.13	Gledhill	71.60	»	»	+0.3	+0.19
O. Struve	46.42	220.1	1.08	+0.2	-0.11	Knott	72.60	285.9	»	-3.2	-0.03
Mädler	47.53	224.0	1.12	+1.1	0.00	Dembowski	72.63	286.1	»	-0.4	+0.06
O. Struve	48.22	226.3	1.15	+3.4	-0.01	W. & S.	72.80	286.4	»	-0.1	+0.04
Dawes	48.87	228.4	1.16	+0.4	0.00	Dembowski	73.63	288.1	»	-0.5	+0.04
O. Struve	49.19	229.4	1.18	+3.1	-0.09	Talmage	73.80	288.5	»	+9.3	-0.50
»	50.04	231.9	1.20	+2.0	-0.03	W. & S.	73.82	»	»	-0.7	+0.04
Mädler	50.71	234.0	1.22	-1.7	+0.06	Gledhill	73.84	288.6	»	-0.6	+0.14
Dawes	50.93	234.6	1.23	+0.6	—	Dembowski	74.64	290.4	1.42	-0.6	-0.01
O. Struve	51.16	235.2	1.24	+0.5	+0.11	Talmage	74.72	290.6	»	+8.5	-0.34
Mädler	51.18	235.3	»	+1.7	-0.08	W. & S.	74.86	290.9	»	+0.3	-0.05
»	51.75	236.9	1.25	-2.3	+0.02	Gledhill	74.91	291.0	»	+0.1	-0.07
»	52.21	238.2	1.26	+3.1	-0.24	Dembowski	75.67	292.6	»	-0.4	+0.05
O. Struve	52.49	239.0	»	-0.6	-0.03	Dunér	75.69	292.6	»	+0.3	+0.07
Mädler	52.72	239.6	1.27	-1.6	-0.02	Gledhill	76.41	294.2	»	-1.2	—
O. Struve	54.11	243.3	1.29	+0.2	+0.19	Dembowski	76.67	294.8	»	-0.3	+0.04
Dawes	54.32	243.8	»	+0.5	-0.01	O. Struve	76.74	294.9	»	-1.6	+0.19
Dembowski	54.99	245.5	1.30	+4.4	—	Doberck	76.87	295.2	»	-0.6	+0.18
O. Struve	55.05	245.7	1.31	-3.0	+0.07	W. & S.	76.93	295.3	»	+3.5	+0.02
Dembowski	55.80	247.6	1.32	+1.9	-0.02	Plummer	76.99	295.5	»	-1.0	+0.04
Morton	55.91	247.8	»	+0.1	+0.01	Dembowski	77.61	296.7	1.43	-0.9	+0.03
Winnecke	56.57	249.4	»	-3.9	+0.09	Doberck	77.74	297.0	»	+0.1	+0.06
Dembowski	56.62	249.6	»	+1.0	-0.12	Gledhill	77.95	297.4	»	-1.8	—
O. Struve	56.66	»	»	-1.8	+0.08	Dembowski	78.60	298.8	»	+0.3	+0.08
Mädler	56.81	250.1	1.33	-1.3	+0.10	Gledhill	78.73	299.1	»	-5.6	—
O. Struve	57.37	251.4	»	-1.0	+0.17	Doberck	78.90	299.5	»	+2.8	-0.04
Secchi	57.60	252.0	1.34	+1.4	-0.09	Hall	79.45	300.7	1.44	+1.2	+0.06
Dembowski	57.71	252.3	»	0.0	-0.14	Doberck	79.76	301.3	»	+1.9	-0.11
»	58.54	254.2	1.35	-1.8	-0.15	Burnham	80.60	303.0	»	+1.5	+0.06
O. Struve	59.16	255.7	1.36	-0.4	+0.10	Doberck	80.88	303.6	»	+2.8	+0.11
Mädler	61.79	261.1	1.37	+4.1	-0.16	Jedrzejewicz	81.14	304.2	»	-3.2	0.00
O. Struve	62.18	262.6	»	-0.9	+0.17	Burnham	81.60	305.1	»	+2.7	+0.16
Dembowski	62.79	264.2	1.38	-0.6	+0.08	Bigourdan	81.81	305.6	1.45	+0.9	+0.52
Mädler	62.83	»	»	+1.9	-0.09	Hall	81.83	»	»	0.0	-0.04
Knott	63.52	265.8	»	-0.1	+0.02	Jedrzejewicz	82.11	306.2	»	-1.3	-0.16
Dembowski	63.80	266.4	»	-0.4	+0.04	O. Struve	82.70	307.4	»	+4.9	+0.17
Dawes	63.86	266.6	»	-1.0	+0.02	Doberck	82.82	307.7	»	+0.4	+0.07
Dembowski	64.73	268.6	»	+0.1	+0.03	Engelmann	83.60	309.3	1.46	+0.5	+0.23
»	65.70	270.8	1.39	+0.4	-0.04	Hall	83.94	310.0	»	+2.8	-0.02
Knott	65.71	»	»	-0.9	+0.04	Seabroke	84.48	311.0	»	+0.7	-0.19
Romberg	65.71	»	»	+1.1	-0.25	Hall	85.80	313.7	»	+2.4	0.00

Observer	Epoch	θ_2	ϱ_2	$\theta_0 - \theta_2$	$\varrho_0 - \varrho_2$	Observer	Epoch	θ_2	ϱ_2	$\theta_0 - \theta_2$	$\varrho_0 - \varrho_2$
Seabroke	1886.20	314.6	1.47	+0.6	-0.04	Maunder	1895.11	331.9	1.52	0.0	+0.06
Hall	86.92	316.0	»	-1.4	-0.01	Dyson	95.11	»	»	-1.3	+0.05
Schiaparelli	87.07	316.3	»	-0.8	-0.11	Bigourdan	95.14	»	»	-1.6	+0.09
Tarrant	87.10	»	»	-5.6	+0.03	Hough	95.16	332.0	»	-4.6	-0.36
Schiaparelli	88.09	318.4	1.48	-0.7	-0.08	Comstock	95.18	»	»	-0.1	-0.06
H. Struve	88.68	319.5	»	+0.4	+0.05	Gledhill	95.28	332.2	»	-1.6	-0.22
Hall	88.94	320.0	»	-0.6	-0.12	See	95.73	333.1	»	+1.2	+0.01
Schiaparelli	88.97	»	»	-0.5	-0.02	Moulton	95.74	»	»	+1.4	-0.12
Burnham	89.57	321.3	1.49	-0.2	-0.04	Collins	95.86	333.3	»	-1.3	+0.12
H. Struve	89.80	321.7	»	-0.5	-0.04	Doberck	95.94	333.5	»	-2.2	-
Hall	89.86	321.8	»	+1.2	-0.04	Seabroke	96.07	333.7	1.53	+2.1	-0.02
Highton	89.94	322.0	»	-1.5	-0.11	Schiaparelli	96.09	»	»	+0.1	-0.03
»	90.10	322.3	»	+1.0	-0.05	Hussey	96.75	335.0	»	+0.6	0.00
Bigourdan	90.76	323.5	»	-1.7	+0.12	Morgan	96.77	»	»	-1.7	+0.29
Hall	90.79	323.6	»	+1.6	-0.15	Doolittle	97.17	335.8	»	+0.8	+0.13
Schiaparelli	90.93	323.9	»	-0.5	+0.04	Doberck	97.73	336.8	1.54	+1.2	-0.09
Highton	91.14	324.4	1.50	+0.1	-0.30	Aitken	97.83	337.0	»	-3.0	-0.04
See	91.48	325.0	»	-2.6	0.00	Hussey	97.84	»	»	+0.4	-0.02
Collins	91.64	325.3	»	+0.3	+0.12	Seabroke	97.92	337.2	»	+1.2	-0.12
H. Struve	91.76	325.5	»	+0.5	-0.04	Maw	98.12	337.5	»	-0.8	+0.14
Schiaparelli	91.95	325.9	»	+1.5	-0.03	Gledhill	98.69	338.6	»	+1.0	-0.14
Comstock	92.71	327.4	»	+1.7	-0.03	Bryant	98.98	339.1	»	+0.1	-0.12
Highton	92.82	327.5	»	+0.2	-0.23	»	1900.07	341.1	»	+0.7	-0.04
Collins	92.86	327.6	»	-2.0	+0.02	Solá	00.70	342.2	»	+3.4	-0.22
Jones	92.94	327.8	»	-4.1	+0.12	Doberck	00.79	342.4	»	+2.2	-0.13
Schiaparelli	92.99	327.9	1.51	+0.6	-0.04	Aitken	01.53	343.8	1.55	+1.4	-0.09
Glaserapp	93.04	328.0	»	+3.9	-0.15	Bryant	01.75	344.2	»	+0.8	-0.09
Comstock	93.83	329.5	»	-1.7	+0.07	Doberck	02.00	344.6	»	-2.0	-0.15
Seabroke	93.93	329.7	»	+0.2	-0.12	»	02.90	346.3	1.56	+0.5	+0.05
Schiaparelli	93.96	»	»	+1.2	-0.06	Biesbroeck	04.00	348.2	»	-0.1	-0.08
Bigourdan	94.01	329.8	»	+0.5	+0.17	Doolittle	04.13	348.4	»	-0.1	-0.04
Glaserapp	94.64	331.0	1.52	+1.0	+0.34	Doberck	04.95	349.8	»	-1.7	+0.10
Bigourdan	94.83	331.4	»	-0.1	+0.20	Lau	05.57	350.9	»	+3.1	-0.06
Seabroke	94.91	331.5	»	+0.2	+0.14	Morgan	05.87	351.5	»	+0.2	+0.17

In the following table the probable errors of the annual means of each observer's measures are given. The constant error in distance signifies: observation minus calculation.

Observer	Angle P. E.			Distance			Observer	Angle P. E.			Distance		
	Deg. at 1"0	arc.	n	Constant	P. E.	n		Deg. at 1"0	arc.	n	Constant	P. E.	n
W. Struve	± 2.15	± 0.036	6	-0.015	± 0.081	6	Highton	± 0.90	± 0.015	3	-0.213	± 0.072	3
O. Struve	± 1.84	± 0.031	18	+0.058	± 0.079	18	Doberck	± 2.00	± 0.033	12	+0.004	± 0.088	11
H. Struve	± 0.73	± 0.012	3	-0.010	± 0.041	3	Hall	± 1.85	± 0.031	8	-0.040	± 0.042	8
Dawes	± 1.58	± 0.027	7	+0.022	± 0.027	6	Burnham	± 2.14	± 0.036	3	+0.060	± 0.065	3
Mädler	± 2.14	± 0.036	13	-0.040	± 0.067	13	Comstock	± 1.83	± 0.031	3	-0.007	± 0.059	3
Dembowski	± 0.83	± 0.014	22	+0.005	± 0.047	21	Schiaparelli	± 0.99	± 0.017	8	-0.041	± 0.028	8
Talmage	± 8.08	± 0.137	5	-0.056	± 0.274	5	Bigourdan	± 1.36	± 0.023	5	+0.220	± 0.113	5
Knott	± 2.00	± 0.034	3	+0.010	± 0.028	3	Collins	± 1.90	± 0.032	3	+0.087	± 0.045	3
Gledhill	± 1.80	± 0.030	9	0.000	± 0.129	6	Bryant	± 0.86	± 0.015	3	-0.083	± 0.031	3
W. & S.	± 1.25	± 0.021	10	-0.030	± 0.066	10							

Mr. *J. I. Plummer* assisted me in the calculations and constructed and solved the normal equations. The three systems were investigated simultaneously.

Hongkong Observatory, 1906 Aug. 10.

W. Doberck.