1899 June 9.

Conditions good, seeing 4.

Temperature of dry air 66° F. Barometer 25.87 inches.

Att. Thermometer 68° F.

Following are the position-angle and distance of two stars of 10th magnitude. The approximate coordinates of the stars were:

Star a $\alpha = 15^h 46^m 45^s$ $\delta = +44° 13'$
Star b $= 15\ 46\ 46$ $= +44\ 9$

Mt. H. Sid. T.	Angle	Apparent Distance	Corr. for Refract.	Corrected Distance	Probable Error	Nr. of Settgs.
$17^h\ 3^m$	178°95	—	—	—	—	4
17 8 6^s	—	219″82	+0″05	219″87	±0″05	10
17 22 53	—	220.02	+0.05	220.07	±0.04	10
17 37 6	—	219.98	+0.05	220.03	±0.05	10
17 53 6	—	219.98	+0.05	220.03	±0.04	11
18 50 6	—	220.01	+0.05	220.06	±0.06	10

The position-angle and distance of the comet from star a was:

Mt. Ham. Sid. T.	Angle	Distance
$17^h 13^m 14^s$	99°0	—
17 16 11	—	115″8

Position-angle and distance of the comet from star b:

$18^h 34^m 23^s$	241°2	—
18 37 8	—	284″1

The nucleus of the comet transited a line joining the two stars at $17^h 41^m$ at the following distances from

Star a 130″1
Star b 89.9

A negative taken on the same night by Mr. H. K. Palmer, with an exposure of $2^h 5^m$ shows that the diameter of the head was 8′. The nebulosity about the nucleus was relatively fainter than on May 18th. In the center was a brighter condensation 2′ or 3′ in diameter.

The distance of the comet from the Earth at this time was 62000000 miles. The diameter of the head was therefore 145000 miles. The light from the stars traversed cometary matter as follows:

Star a 122000 miles
Star b 134000 »

At the time of the first set of measures the northern star (a) was slightly immersed in the nebulosity of the comet but in such a way that any effect of refraction would be at right angles to the line joining the stars. At this time star b was immersed in the outer nebulosity to a distance of 1′ and in such a way that refraction would have some slight effect on the apparent distance between the stars.

At the time of the last measures the stars were entirely free from any effect from the comet.

The greatest observed variation in distance of the stars is 0″20. In neither case is there any systematic variation indicating refraction.

The pair of stars, for accurate measurement, should not be too bright. I have found stars of 9th to 11th magnitude most satisfactory for medium and large apertures.

Dr. M. W. Meyer made observations at Geneva of the comet 1881 III by measuring the position-angle and distance of the comet's nucleus from a star before, during, and after its closest approach. From these observations, he considers that he obtains evidences of refraction.*)

In 1891 Professors Burnham and Barnard observed Wolf's comet for this purpose.**) They measured the distance of two stars as the comet passed over one of them. Professor Burnham's measures, made with the 36 inch Refractor, show a slight systematic deviation, but in the opposite direction from what we should expect, upon the most probable assumption as to the physical state of the comet. Professor Barnard's measures made with the 12 inch Equatorial show no such systematic deviations.

Lick Observatory, University of California, 1899 July 31. *C. D. Perrine.*

*) Astr. Nachr. No. 2471. **) Astr. Nachr. No. 3072.

A Correction to Watson's „Theoretical Astronomy" and Oppolzer's „Lehrbuch zur Bahnbestimmung der Cometen und Planeten".

By *C. D. Perrine.*

On page 253 of Watson's »Theoretical Astronomy« is the following:

»The equation

$$\left\{ \eta' = \frac{s'^2 (s' - 1)}{s' + \frac{1}{9}} \right\}$$

is of the third degree, and has therefore, three roots. Since s' is always positive and cannot be less than 1, it follows from this equation that η' is always a positive quantity. The equation may be written thus:

$$s'^3 - s'^2 - \eta' s' - \frac{1}{9}\eta' = 0 ,$$

and there being only one variation of sign, there can be only one positive root, which is the one to be adopted, the negative roots being excluded by the nature of the problem.«

On page 87 of volume I of Oppolzer's »Lehrbuch zur Bahnbestimmung der Cometen und Planeten« occurs the following:

»Wäre ξ bekannt, so würde der Werth von h völlig bestimmt und η durch die cubische Gleichung:

$$\eta^3 - \eta^2 - h\eta - \frac{1}{9}h = 0 ,$$

zu erhalten sein. Diese hat nothwendig nur eine positive Wurzel, weil, h als positiv vorausgesetzt, in der Gleichung nur ein Zeichenwechsel und zwei Zeichenfolgen enthalten sind.«

In computing the preliminary orbit from four places (by Watson's method) for a definitive determination of the elements of comet 1895 IV I found that a negative root of this equation was required, owing to the fact that the arc of true anomaly passed over between the times of the first and second observations exceeded 180°.

The case in which the arc of true anomaly exceeds 180° has not been considered by the above authorities, notwithstanding the treatment of it by Gauss in his »Theoria Motus« § 88.

It is hardly necessary to point out that in cases where a negative value of s is to be used the tables for finding s^2 from η do not apply, and that it must be obtained by a direct solution of the equation. The value of s under these conditions may be less than unity.

Watson's statement on page 243 of his »Theoretical Astronomy« as follows:

> »These ratios s, s', s'' must necessarily be greater than 1, since every part of the orbit is concave toward the sun«

is to be taken in the restricted sense.

Lick Observatory, University of California, 1899 July 31. *C. D. Perrine.*

Ueber die Cometen 1881 IV und 1898 X.

Im ersten Heft der V. J. der A. G. 1899 S. 81 ist auf die Aehnlichkeit der Bahnelemente der Cometen 1898 X und 1881 IV hingewiesen. Die beiden Bahnen besitzen noch eine weitere Eigenschaft, welche vielleicht geeignet ist, auf den gemeinsamen Ursprung hinzuweisen. Zunächst ist die Länge des Knotens nahezu dieselbe wie die der Jupiterbahn. Eine nähere Untersuchung dieser Stelle ergiebt folgendes Resultat:

Helioc. Länge	Comet 1898 X Breite	wahre Anomalie	lg Rad. vect.	Jupiterbahn Breite	lg Rad. vect.	Distanz Com.-Jup.-Bahn
90°	+ 5° 14.′7	−115° 21.′5	0.4224	−12.′8	0.7106	2.51 astr. Einh.
95	+ 1 6.3	−121 49.8	0.5050	− 6.0	0.7124	1.96
100	− 3 2.3	−128 19.2	0.5998	+ 0.8	0.7142	1.23
105	− 7 10.4	−134 45.5	0.7086	+ 7.7	0.7161	0.66
110	−11 4.7	−141 5.2	0.8334	+14.4	0.7179	1.98

Es ist somit in Länge 105° eine Annäherung an die Jupiterbahn vorhanden. Dieselbe erstreckt sich auf mehrere Grade und beträgt für:

Helioc. Länge	Comet 1898 X Breite	log Rad. vect.	Jupiterbahn Breite	log Rad. vect.	Distanz Com.-Jup.-Bahn
102°	−4° 40.′7	0.6415	+3.′6	0.7150	0.898 astr. Einh.
103	−5 29.7	0.6632	+5.0	0.7154	0.755
104	−6 18.5	0.6857	+6.3	0.7157	0.659
105	−7 10.4	0.7086	+7.7	0.7161	0.657
106	−7 55.3	0.7320	+9.0	0.7165	0.769

Rechnet man die Positionen vom Perihel des Cometen auf die drei vorhergehenden Jahre zurück, um die Distanzen von Jupiter selbst vor dieser Erscheinung des Cometen zu bestimmen, so ergiebt sich:

	Comet 1898 X Länge	Breite	log Rad. vect.	Jupiter Länge	Breite	log Rad. vect.	Distanz Com.-Jup.
1895 Nov. 23	112° 48.′8	−13° 13.′7	1.04073	119° 6.′8	+26.′5	0.72127	6.01 astr. Einh.
1896 Nov. 23	108 54.4	−10 13.6	0.91546	148 8.4	+59.1	0.73060	5.42
1897 Nov. 23	100 36.5	− 3 32.1	0.69667	176 6.5	+76.5	0.73600	6.40

Obwohl keine grosse Annäherung an Jupiter stattfand, blieb die Distanz doch durch zwei Jahre nahe constant, so dass wohl die Störungen nicht unbedeutend gewesen sein dürften.

Für den Cometen 1881 IV giebt die Rechnung folgende Abstände von der Jupiterbahn:

Länge	100°	105°	110°	115°
Distanz	2.17	1.45	0.94	2.24 astr. Einh.

Eine ursprünglich elliptische Bahn dürfte wohl bei beiden Cometen vorhanden gewesen sein mit einer bedeutenden Annäherung an die Jupiterbahn in Länge 105°–110°. Es wäre von Interesse speciell für den Cometen 1898 X durch Rückrechnung zu ermitteln, ob die parabolische Bahn eventuell ein Resultat der Störungen ist. Nach obigen Daten dürfte Jupiter 1895–97 eine Beschleunigung der Geschwindigkeit in der Bahn verursacht haben, wodurch die Umwandlung der Ellipse in eine Parabel erklärt werden könnte.

Falkenau-Eger, 1899 Juli 8. Dr. *A. Schobloch.*
