UNIVERSITY OF CALIFORNIA PUBLICATIONS

ASTRONOMY

LICK OBSERVATORY BULLETIN

NUMBER 282

ELEMENTS AND EPHEMERIS OF COMET *b* 1916 (WOLF)

The geocentric distance of this comet at the time of discovery (1916 April 27) was greater than that of any other comet at discovery. It was approximately 4.1 astronomical units, according to the elements given below. On account of this great distance and consequent slow motion there is a large range of possible solutions for an orbit based upon short intervals.

After the announcement of the discovery Professor Barnard of the Yerkes Observatory found that he had an image of the object on plates of April 24. This is the earliest observation available. Using this and observations of May 4 by Van Biesbroeck and May 10 by Barnard an orbit was computed. These observations and also one on May 6 by Barnard were satisfactorily represented by a parabola with perihelion date in 1914 and an inclination of 95° with only one

parabolic solution possible. Just as this orbit was completed Van Biesbroeck's elliptic elements were received. These were so radically different that an erroneous observation was feared and the elements were withheld pending further investigation. In the meantime an observation of May 23 by Van Biesbroeck was kindly sent by Director Frost of the Yerkes Observatory. Comparison of this observation with our parabola showed a residual of $+2' 42''$ in α and $-51''$ in δ . On the basis of these residuals the parabola was corrected differentially so as to give another parabola representing the right ascensions and declinations of May 10 and May 23, and the right ascension of April 24, leaving a residual of only $1''$ in the declination of April 24. These three observations, the elements and ephemeris based upon them are:

1916 Gr.M.T.	Comet's Apparent		Observer
	α	δ	
April 24.6365	12 ^h 41 ^m 42. ^s 4	$+2^\circ 10' 23''$	Barnard, Yerkes.
May 10.6331	12 34 36.0	$+3 24 13$	Barnard.
May 23.7135	12 30 37.2	$+4 08 13$	Van Biesbroeck, Yerkes.

ELEMENTS

$$\begin{aligned}
 T &= 1917 \text{ June } 16.4806 \text{ Gr. M.T.} \\
 \omega &= 120^\circ 37' 07''.9 \\
 \Omega &= 183 \quad 16 \quad 58.8 \\
 i &= 25 \quad 40 \quad 06.4 \\
 \log q &= 0.226855
 \end{aligned}
 \quad \left. \begin{array}{l} \\ \\ \\ \\ \end{array} \right\} 1916.0$$

(O-C)	I	III
$\cos \delta \Delta \alpha$	0"	0"
$\Delta \delta$	+1	0

CONSTANTS FOR THE EQUATOR 1916.0

$$\begin{aligned}
 x &= r [9.999866] \sin (33^\circ 34' 41''.8 + v) \\
 y &= r [9.999682] \sin (303 \quad 37 \quad 57.6 + v) \\
 z &= r [8.657307] \sin (90 \quad 30 \quad 25.9 + v)
 \end{aligned}$$

EPHEMERIS FOR GREENWICH MEAN MIDNIGHT

1916 Gr. M.T.	True α	True δ	$\log \Delta$	Br.
June 2.5	12 ^h 28 ^m 59. ^s 5	$+4^\circ 30' 12''$	0.6201	1.04
4.5	28 48.8	33 29		
6.5	28 41.4	36 22		
8.5	28 37.2	38 51		
10.5	28 36.2	40 56	0.6249	1.05
12.5	28 38.5	42 38		
14.5	28 44.0	43 56		
16.5	28 52.7	44 51		
18.5	29 04.7	45 23	0.6300	1.07
20.5	29 19.9	45 33		
22.5	29 38.2	45 20		
24.5	29 59.8	44 46		
26.5	30 24.5	43 50	0.6352	1.07
28.5	30 52.4	42 33		
June 30.5	12 31 23.5	$+4 40 55$		

EPHEMERIS FOR GREENWICH MEAN MIDNIGHT—(Concluded)

1916 Gr. M.T.	True α	True δ	$\log \Delta$	Br.
July 2.5	12 ^h 31 ^m 57 ^s 7	+4° 38' 56"		
4.5	32 35.0	36 37	0.6403	1.08
6.5	33 15.3	33 58		
8.5	33 58.7	31 01		
10.5	34 45.0	27 45		
12.5	35 34.3	24 11	0.6451	1.09
14.5	36 26.5	20 19		
16.5	37 21.5	16 10		
18.5	38 19.4	11 44		
20.5	39 20.0	07 01	0.6495	1.11
22.5	40 23.4	4 02 02		
24.5	41 29.6	3 56 48		
26.5	42 38.5	51 18		
28.5	43 50.0	45 33	0.6532	1.13
30.5	45 04.2	39 34		
Aug. 1.5	46 21.0	33 21		
3.5	47 40.3	26 54		
5.5	49 02.2	20 15	0.6562	1.16
7.5	50 26.5	13 23		
9.5	51 53.3	3 06 19		
11.5	53 22.5	2 59 04		
13.5	54 54.0	51 37	0.6584	1.19
15.5	56 27.9	44 00		
17.5	58 04.1	36 12		
19.5	12 59 42.6	28 14		
21.5	13 01 23.3	20 07	0.6598	1.23
23.5	03 06.2	11 50		
25.5	04 51.4	2 03 24		
27.5	06 38.8	1 54 50		
Aug. 29.5	13 08 28.4	+1 46 08	0.6602	1.27

Brightness May 10 = 1.00.

With the exception of the element ω this orbit resembles that of Wolf's periodic comet 1884 III, which has a period of approximately seven years. To test the possibility of identity an ellipse of a seven-year period was forced through the same five coordinates used for the parabola leaving all of the residual in the first declination. This residual amounted to +31".

The accuracy of the observations was tested by representing all of the available observations not used

in the computation. As the maximum residual of these is 3" it is seen that all of the observations are of a high degree of accuracy so that the residual of +31" resulting from the seven-year ellipse is too large to be accounted for by accumulated error of observation.

To test the range of period for an ellipse to represent these observations an orbit with a fifty-year period was computed. This leaves a residual of +7" in the first declination. As 7" or 8" is about the limit of accumulated error of observation it is safe to say that, if later computations based upon longer arcs show the orbit to be an ellipse, the period cannot be much less than fifty years and probably will be greater. It may be of interest to add that the three observations used in this computation are completely represented by an orbit that is slightly hyperbolic. Therefore the complete range of solution from the available observations extends from an ellipse with a period of about fifty years to an hyperbola, with a lower limit of eccentricity of about 0.86.

This investigation shows, therefore, that this comet is not Wolf's periodic comet of 1884 III, since the perturbations computed by Kamensky (*cf.* A. N. 4460) cannot account for a large change in the period.

For the sake of comparison the elements of Wolf's periodic comet and those of the seven-year and fifty-year ellipses mentioned above are here tabulated:

	1884 III	Ellipse Seven-year Period	Ellipse Fifty-year Period
$\omega = 172^\circ 49'$		170° 54'	126° 10'
$\Omega = 206 38$		187 22	184 07
$i = 25 16$		40 34	27 49
$\log q = 0.2022$		0.1824	0.2290
$e = 0.557$		0.5842	0.8752
		$\Delta\delta_1 = +31''$	+7"

The observations available and not used in this computation, together with their representation by our parabolic orbit are:

1916 Gr. M.T.	Comet's Apparent α	δ	(O-C)	$\cos \delta \Delta\alpha$	$\Delta\delta$	Observer
May 4.8565	12 ^h 36 ^m 55 ^s 6	+2° 59' 51"	+0.1	0"	0"	Van Biesbroeck, Yerkes.
6.6559	12 36 10.3	3 07 46	+0.2	+1	+1	Barnard, Yerkes.
6.6846	12 36 09.5	3 07 53	+0.1	+2	+2	Burton, U. S. Naval Observatory.
8.6889	12 35 20.9	3 16 21	0.0	+1	+1	Hubble, Yerkes.
18.6680	12 31 55.7	3 53 09	+0.1	—1	—1	Van Biesbroeck.
22.6721	12 30 51.9	4 05 19	0.0	0	0	Barnard.
27.6893	12 29 48.6	4 18 17	—0.1	0	0	Barnard.
27.7933	12 29 47.4	4 18 30	—0.1	—2	—2	Aitken.
28.6536	12 29 38.8	4 20 28	+0.1	—2	—2	Van Biesbroeck.
May 30.7009	12 29 19.9	+4 24 22	+0.1	(—30)	(—30)	Van Biesbroeck.

There is probably an error of 30" in the transmission of the declination of the observation of May 30. The last four of these observations were received after

the orbit was completed. With the exception of the declination of the last one it is seen that they are represented with great accuracy.

BERKELEY ASTRONOMICAL DEPARTMENT,

June 2, 1916.

Issued June 5, 1916.

R. T. CRAWFORD,
DINSMORE ALTER.