LICK OBSERVATORY BULLETIN

NUMBER 69

ELLIPTIC ELEMENTS AND EPHEMERIS OF COMET *e* 1904 (BORRELLY)

The telegram announcing the discovery of a faint comet by M. Borrelly, at Marseilles, was received at the Lick Observatory on the night of December 30, 1904; but, owing to clouds, the comet could not be observed until the following night. From my observations of December 31, 1904, January 1 and January 2, 1905, I computed a set of parabolic elements and an ephemeris extending to January 17, that were transmitted by telegram to Harvard College Observatory at 9:00 A.M., January 3.

An observation secured on the last date of the ephemeris (January 17) showed that this orbit did not represent the comet's motion satisfactorily. I therefore computed another set of parabolic elements, using the observations of December 31, 1904, January 17 and 27, 1905. The best parabola that could be passed through the places observed on these dates left a residual of $+1' 55''$ (O — C) in longitude for the middle date. A comparison with the other available observations—including one secured on February 3, 1905,—indicated that the observations used in the computation were not seriously in error. The same data were accordingly used in computing another orbit without assumption as to the eccentricity.

The resulting elements, printed below, indicate that the comet is travelling in an elliptic orbit, in a period of 7.3 years. I have computed the residuals resulting from these elements for my observations of January 7 and February 7, as well as for those on which the calculation was based. The results in the sense (O — C) are:

		$\Delta\alpha$	$\Delta\delta$
1904	December 31	+0.08	+ 1.1
1905	January 7	+0.04	+ 3.0
	17	+0.23	+ 1.4
	27	+0.21	+ 3.3
	February 7	+0.69	+10.0

In view of the fact that all of the observations were made under very poor atmospheric conditions, these residuals are satisfactory.

ELEMENTS.

Epoch = 1905 January 0.0

$$M = -2^{\circ} 13' 51''.7$$

$$\omega = 352 \ 08 \ 34.0$$

$$\Omega = 76 \ 35 \ 10.1$$

$$i = 30 \ 35 \ 48.6$$

$$\phi = 38 \ 55 \ 00.0$$

$$\log a = 0.575636$$

$$\log e = 9.798092$$

$$\mu = 485''.9067$$

CONSTANTS FOR THE EQUATOR 1905.0

$$x = r [9.938934] \sin (156^{\circ} 39' 23''.6 + v)$$

$$y = r [9.950647] \sin (83 \ 23 \ 11.9 + v)$$

$$z = r [9.825848] \sin (27 \ 27 \ 32.2 + v)$$

EPHEMERIS FOR GREENWICH MEAN MIDNIGHT.

	1905	True α	True δ	$\log r$	$\log \Delta$	Br.
February	11.5	2 ^h 34 ^m 39 ^s .8	+22° 29' 45"	0.1556	0.0810	0.46
	13.5	39 31.8	23 40 46			
	15.5	44 29.7	24 49 55	0.1587	0.0935	0.43
	17.5	49 33.7	25 57 12			
	19.5	2 54 43.9	27 02 36	0.1622	0.1061	0.40
	21.5	3 00 00.3	28 06 08			
	23.5	05 22.8	29 07 46	0.1660	0.1187	0.37
	25.5	10 51.4	30 07 29			
	27.5	16 26.1	31 05 17	0.1701	0.1314	0.34
March	1.5	22 07.0	32 01 10			
	3.5	27 54.0	32 55 08	0.1745	0.1440	0.31
	5.5	33 47.1	33 47 11			
	7.5	39 46.1	34 37 18	0.1792	0.1567	0.29
	9.5	45 51.0	35 25 30			
	11.5	52 01.7	36 11 46	0.1842	0.1692	0.27
	13.5	3 58 18.1	36 56 06			
	15.5	4 04 39.9	37 38 30	0.1894	0.1817	0.25
	17.5	11 06.9	38 18 58			
	19.5	17 39.0	38 57 31	0.1948	0.1940	0.23
	21.5	24 16.0	39 34 08			
	23.5	30 57.7	40 08 49	0.2004	0.2063	0.21
	25.5	37 43.8	40 41 35			
	27.5	44 34.0	41 12 26	0.2061	0.2184	0.19
	29.5	51 28.0	41 41 23			
	March 31.5	4 58 25.9	+42 08 25	0.2119	0.2303	0.18

Brightness December 31, 1904 = 1.0.

R. G. AITKEN.

February 10, 1905.

EPHEMERIS OF COMET *d* 1904 (GIACOBINI)

An observation secured on the night of January 28, 1905, indicates that Comet *d* 1904 (Giacobini) is following very closely the orbit given in Bulletin Number 67. I have therefore extended the ephemeris to April 3, 1905, as below. Judging from the comet's appearance on January 28, it will soon pass beyond the reach of all but the most powerful telescopes.

EPHEMERIS FOR GREENWICH MEAN MIDNIGHT.

1905	True α	True δ	$\log r$	$\log \Delta$	Br.
March	6.5	21 ^h 29 ^m 40 ^s +62° 33' 1	0.3824	0.4067	0.56
	8.5	40 07 62 54.8			
	10.5	21 50 31 63 14.4	0.3877	0.4159	0.52
	12.5	22 00 50 32.1			
	14.5	11 02 63 47.9	0.3930	0.4253	0.49
	16.5	21 07 64 01.9			
	18.5	31 04 14.3	0.3983	0.4347	0.46
	20.5	40 52 25.1			
	22.5	50 30 34.4	0.4037	0.4442	0.43
	24.5	22 59 57 42.5			
	26.5	23 09 13 49.3	0.4090	0.4536	0.40
	28.5	18 18 55.0			
	30.5	27 11 64 59.7	0.4143	0.4629	0.37
April	1.5	35 52 65 03.5			
	3.5	23 44 21 +65 06.5	0.4196	0.4720	0.34

Brightness December 20, 1904 = 1.0.

R. G. AITKEN.

February 10, 1905.

OBSERVATIONS OF COMET *e* 1904 (BORRELLY)

Mt. Hamilton M.T.	Star	No. of Comparisons	Comet-Star $\Delta\alpha$	$\Delta\delta$	Comet's Apparent α	δ	$\log p$	Δ
1904 December 31	8 ^h 04 ^m 36 ^s	2	10, 10	+10 ^h 92	+1' 17'' 9	1 ^h 16 ^m 32 ^s 58	— 8° 07' 02'' 1	9.251 0.791
1905 January 1	7 05 19	3	10, 8	—23.35	+0 51.6	1 17 47.82	— 7 19 55.5	8.809 0.789
	2 6 32 17	5	10, 10	—25.89	—2 16.9	1 19 06.81	— 6 32 02.2	7.299 0.783
	7 7 25 52	7	12, 6	+ 9.62	+1 31.8	1 26 19.56	— 2 26 40.6	9.133 0.747
	17 8 07 30	9	10, 6	+14.86	+2 44.7	1 42 46.87	+ 5 26 37.1	9.464 0.678
	27 8 41 39	11	10, 8	— 9.16	—5 26.2	2 01 49.91	+12 49 10.4	9.542 0.614
February 3	7 50 16	12	12, 6	+25.55	+3 32.4	2 16 34.9	+17 34 06.	9.476 0.528
	7 8 33 31	14	10, 8	—34.95	—4 33.2	2 25 40.98	+20 09 33.9	9.578 0.534

MEAN PLACES OF COMPARISON STARS FOR 1904.0 AND 1905.0.

Star	α 1904.0	Red. to app. place	δ 1904.0	Red. to app. place	Authority
1	1 ^h 14 ^m 07 ^s 15	+2 ^h 85	— 8° 12' 37'' 8	+ 9'' 8	BD.—8°227. Two observ. in Vienna A.G. Zones.
2	1 16 18.81	+2.85	— 8 08 29.8	+ 9.8	Micrometer comparison with (1).
	α 1905.0		δ 1905.0		
3	1 18 11.31	—0.14	— 7 20 38.0	— 9.1	Micrometer comparison with (4).
4	1 19 03.07	—0.14	— 7 20 19.2	— 9.1	BD.—7°222. Two observ. in Vienna A.G. Zones.
5	1 19 32.83	—0.13	— 6 29 36.4	— 8.9	Micrometer comparison with (6).
6	1 19 57.66	—0.13	— 6 28 41.0	— 8.9	BD.—6°268. Two observ. in Vienna A.G. Zones.
7	1 26 10.04	—0.10	— 2 28 04.4	— 8.0	München Neue Annalen II:419.
8	1 41 32.98	—0.08	+ 5 28 41.4	— 6.5	A.G. Leipzig II. 668.
9	1 42 32.09	—0.08	+ 5 23 58.9	— 6.5	Micrometer comparison with (8).
10	2 01 21.95	—0.05	+13 00 31.4	— 5.2	A.G. Leipzig I. 625.
11	2 01 59.12	—0.05	+12 54 41.8	— 5.2	Micrometer comparison with (10).
12	2 16 09.4	+0.02	+17 30 38.	— 4.6	BD.+ 17°349, micrometer comparison with (13).*
13	2 19 22.29	+0.01	+17 28 06.9	— 4.4	A.G. Berlin A. 666.
14	2 26 15.91	+0.02	+20 14 11.1	— 4.0	" " 689.

February 10, 1905.

R. G. AITKEN.

* The micrometer comparison is weak.

FURTHER MEASURES OF COMET *a* 1904 (BROOKS)*

The following measures, obtained with the 12-inch refractor, continue* the series published in Lick Observatory Bulletin Number 56. The $\Delta\alpha$ comparisons were all made directly with the micrometer except

those of June 21, made by transits. The observations of July 8, August 26 and September 4 were made by Dr. R. G. Aitken.

Mt. Hamilton M.T.			Star	No. of Comparisons	Comet—Star		Comet's Apparent				$\log p \Delta$	
					$\Delta\alpha$	$\Delta\delta$	α		δ		α	δ
1904	June	21	10 ^h 23 ^m 13 ^s	1	14 <i>t</i> , 8	—1 ^m 39.93	—9' 38".2	12 ^h 53 ^m 49.80	+55° 02' 14".2		9.810	<i>n</i> 9.667
	July	8	8 41 10	2	8 <i>d</i> , 8	+ 20.85	—2 27.4	12 29 20.24	+51 43 58.8		9.760	<i>n</i> 9.436
		9	11 25 26	3	12 <i>d</i> , 8	— 19.49	—7 19.9	12 28 16.80	+51 31 05.7		9.875	0.544
		13	9 04 01	4	10 <i>d</i> , 8	+ 38.71	—4 00.8	12 25 01.37	+50 46 46.3		9.812	9.880
		19	8 45 10	5	10 <i>d</i> , 8	+ 49.52	+ 48.7	12 21 09.94	+49 41 20.5		9.810	0.023
		25	8 47 54	6	12 <i>d</i> , 8	+ 8.00	—6 12.2	12 18 30.07	+48 39 32.3		9.825	0.250
		31	8 48 17	7	10 <i>d</i> , 8	— 24.26	—1 04.3	12 16 49.65	+47 41 56.3		9.831	0.385
	August	11	9 37 01	9 <i>a</i>	12 <i>d</i> , 8	— 32.21	+4 52.4	12 15 46.78	+46 07 48.2		9.821	0.663
		12	8 15 37	9 <i>b</i>	10 <i>d</i> , 8	— 31.36	—2 26.9	12 15 47.61	+46 00 28.8		8.822	0.464
		26	8 09 43	10	10 <i>d</i> , 6	— 43.40	+5 57.1	12 17 21.94	+44 26 25.0		9.815	0.608
	September 4	7	33 30	11	14 <i>d</i> , 14	— 15.01	+3 22.6	12 19 25.87	+43 40 34.0		9.810	0.606

MEAN PLACES OF COMPARISON STARS FOR 1904.0.

Star	α	Red. to App. place	δ	Red. to App. place	Authority.
1	12 ^h 55 ^m 28.96	+0.77	+55° 11' 42".0	+10".4	A. G. Helsingfors-Gotha 7397. 2 obs.
2	12 28 59.13	+0.26	+51 46 17.2	+ 9.0	A. G. Harvard 4097. 5 obs.
3	12 28 36.07	+0.22	+51 38 16.8	+ 8.8	A. G. Harvard 4095. 5 obs.
4	12 24 22.50	+0.16	+50 50 38.9	+ 8.2	A. G. Harvard 4085. 2 obs.
5	12 20 20.37	+0.05	+49 40 24.4	+ 7.4	½ (A. G. Harvard 4069 + A. G. Bonn 8492).
6	12 18 22.10	—0.03	+48 45 38.0	+ 6.5	A. G. Bonn 8476. 3 obs.
7	12 17 14.00	—0.09	+47 42 55.0	+ 5.6	A. G. Bonn 8469. 2 obs.
8	12 17 01.53	—0.17	+45 59 48.1	+ 3.8	A. G. Bonn 8466. 2 obs.
9 <i>a</i>	12 16 19.16	—0.17	+46 02 52.1	+ 3.7	½ (A. G. Bonn 8460 + position by micrometer connection† with (8)).
9 <i>b</i>	12 16 19.16	—0.19	+46 02 52.1	+ 3.6	
10	12 18 05.60	—0.26	+44 20 26.8	+ 1.1	A. G. Bonn 8475. 2 obs.
11	12 19 41.18	—0.30	+43 37 12.4	— 1.0	A. G. Bonn 8488. 4 obs.

J. D. MADDRILL.

January 17, 1905.

*The comet is still visible in the 12-inch telescope. An observation secured on January 26th shows that Nijland's ephemeris (Ephemeriden-Zirkular der Astron. Nach., 1904, Nr. 115) is very nearly exact.—R. G. AITKEN.

†Star 9-star 8: $\Delta\alpha$ —42.34; $\Delta\delta$ +3' 03".7.