

Orbits of comets 1892 VI and 1911 V

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Computations of definitive orbits for Brooks' comets 1892 VI and 1911 V, begun by the late G. Van Biesbroeck, have been completed. The "original" values of the reciprocal semimajor axes are found to be -0.000027 ± 0.000011 and $+0.006285 \pm 0.000004 \text{ AU}^{-1}$, respectively, although the original hyperbolic nature of the orbit of the former comet is not regarded as proven.

INTRODUCTION

COMETS 1892 VI (= 1892d) and 1911 V (= 1911c) were among the four or five brightest of the 27 comets discovered by W. R. Brooks. They were discovered at the Smith Observatory in Geneva, New York, evidently with a 26-cm refractor. As in the case of the orbit determination for comet 1911 VI (Van Biesbroeck *et al.* 1974), the observations of these comets were collected and initial solutions for the orbits made by the late G. Van Biesbroeck. The work has been completed by the other two authors of this paper.

I. COMET 1892 VI

Comet 1892 VI was discovered on the morning of 28 (or possibly 29) August 1892 as an 11th-mag object in Auriga, moving slightly south of eastward. The discoverer observed the comet again on 30 August. The first micrometric observations of the comet's position were made on the morning of 1 September by E. Lamp at Kiel, G. Witt at Berlin, O. Knopff at Jena, and H. C. Wilson at Carleton College. The early orbits (Berberich 1892; Searle 1892; Hill 1892; Ristenpart 1892) showed that the comet was then 2.1 AU from the Sun and slightly farther from the Earth, and that it would brighten considerably as it came to its minimum distance of 0.87 AU from the Earth in early December, some three or four weeks before perihelion passage. The comet became faintly visible to the naked eye, and according to observations by Holetschek (1893) at Vienna, the total magnitude reached 5.5 on 23 November (UT). Although the comet was expected to become a little brighter during December and into January 1893, it seems in fact to have faded slightly.

A spectroscopic observation on 10 November (Campbell 1892) yielded some continuum and the usual three C_2 bands in the visible region, and photographs by Archenhold (1892) on 27 November showed a tail 5° long. When the comet was last observed at Vienna, low in the morning twilight on 20 December, it was at a declination of -32° , and for the following four months—the declination reached -42° in late January—the only observers of the comet were W. H. Finlay at the

Cape Observatory, R. H. Tucker at Córdoba, and especially J. Tebbutt at Windsor, New South Wales. On its moving northward again, the comet was picked up on 19 April by L. Fabry at Marseilles; and in May and June, as it approached opposition, the comet was also under observation by H. Kobold at Strasbourg (the magnitude being given as about 12 on 10 June), J. G. Porter at Cincinnati, E. O. Lovett at Charlottesville, and Wilson at Carleton College. The last astrometric measurements of the comet were made (at declination -21°) on 10 July (Cincinnati) and 11 and 13 July (Charlottesville), although the comet could still be faintly seen at Carleton College on 19 July, at which time it was at a heliocentric distance of 3.1 AU.

Although comet 1892 VI was a bright object under frequent and continuous observation for more than ten months, there seems to have been no attempt hitherto to determine a definitive orbit. The most extensive previous computation, by Oppenheim (1892), was based on no more than seven observations made between 2 September and 13 November. After eliminating more than half of the observational material as unsatisfactory, we derived the following result from 123 observations made between 1 September 1892 and 10 July 1893:

Epoch = 1893 Jan. 17.0 ET;

$T = 1892 \text{ Dec. } 28.58635 \pm 0.00015 \text{ (m.e.) ET};$

$\omega = 252^\circ 66858 \pm 0^\circ 00017$

$\Omega = 265.32194 \pm 0.00016$ } 1950.0;

$i = 24.80114 \pm 0.00012$

$q = 0.9759894 \pm 0.0000013 \text{ AU};$

$e = 1.0004410 \pm 0.0000107.$

Perturbations by all nine planets were taken into account, and the mean residual, $2''.40$, reflects the fact that several of the observations included still have random errors in excess of 4 arcsec. The corresponding value of the reciprocal of the semimajor axis is $1/a = -0.000452 \pm 0.000011 \text{ AU}^{-1}$. Allowing for the perturbations between the osculation epoch and the perihelion time T , and then applying the u_b quantity tabulated

for this comet by Everhart and Raghavan (1970), we obtain the "original" value (referred to the center of mass of the solar system) as $(1/a)_{\text{orig}} = -0.000027 \text{ AU}^{-1}$. Because of the poor quality of many of the observations, as well as the likelihood that the motion of the comet was affected by unknown nongravitational forces (Marsden and Sekanina 1973), we do not consider this to be a proven case of an interstellar comet but suggest that it was rather probably a "new" comet in the Oort (1950) sense. Application of the Everhart-Raghavan u_a quantity gives the "future" value $(1/a)_{\text{fut}} = -0.000539 \text{ AU}^{-1}$, so it seems certain that the comet will never return.

II. COMET 1911 V

Comet 1911 V, the last of the comets discovered by Brooks, also became his most spectacular one. Discovered on the late evening of 20 July 1911 (21 July UT), the comet was a well-condensed object of magnitude about 10, moving northwestward in Pegasus. The first accurate observations of this comet were made the following evening by E. E. Barnard at the Yerkes Observatory, by S. Albrecht at Córdoba, and by R. G. Aitken at the Lick Observatory, and on the night of 22–23 July positions were measured at no fewer than 13 European observatories. About 2.0 AU from the Sun at discovery, the comet brightened very rapidly as it approached both the Sun and the Earth, and during the second half of August it became visible to the naked eye. It reached its maximum northern declination of $+57^\circ$ on 12 September and a week later was at its minimum geocentric distance of 0.51 AU. By the end of that month the comet had a tail more than 20° long. The comet remained a conveniently placed object of second or third magnitude during the whole of October, and a few days before perihelion passage on 28 October its tail attained a length of 30° . Although then close to its minimum elongation of 29° from the Sun (in the morning sky) the comet was still being widely observed for astrometric purposes. Not until 11 November (UT) did a day pass without any micrometric observations of the comet, and on several days a dozen or more measurements were made. In November, however, the tail shrank considerably, and the comet faded as it moved rapidly away from the Earth. The comet also moved southward, although it could be followed by F. Gonnessiat at Algiers until 30 December, when its declination was -42° . Subsequently, it was observed only by R. Prager, R. Castro, F. Ristenpart, and R. Grandón at Santiago and by E. Chaudet at Córdoba. This last observer gave the magnitude as 11 when he last measured the comet on 28 February 1912; the heliocentric distance was then 2.3 AU. Extensive spectroscopic observations were made of this

comet, and these have been discussed at length by Baldet (1926).

Numerous preliminary orbits were calculated for comet 1911 V, the most satisfactory of the very early ones being that by Thiele (1911) from a three-day arc. As in the case of comet 1911 VI (Van Biesbroeck *et al.* 1974), the determination of the definitive orbit of comet 1911 V was undertaken by E. Kühne, although his only published result (Kühne 1913) is incomplete. That computation, based on 31 observations in eight normal places, evidently included the effects of perturbations, but the epoch of osculation was not specified; it indicates that the orbital eccentricity was about 0.997.

Of the 1104 observations collected and punched on to cards, we have eliminated almost 50% with large residuals. The following result satisfies 619 observations made between 22 July 1911 and 28 February 1912 with a mean residual of $1''.85$:

Epoch = 1911 Oct. 11.0 ET;

$T = 1911 \text{ Oct. } 28.23676 \pm 0.00004 \text{ (m.e.) ET};$

$\omega = 153^\circ.01480 \pm 0^\circ.00011$
 $\Omega = 293.49999 \pm 0.00012$
 $i = 33.80634 \pm 0.00009$ } 1950.0;

$q = 0.4894293 \pm 0.0000005 \text{ AU};$

$e = 0.9970055 \pm 0.0000019.$

Perturbations by all nine planets were included, and the general correctness of Kühne's result is confirmed. The reciprocal of the semimajor axis is $1/a = +0.006118 \pm 0.000004 \text{ AU}^{-1}$. Application of the Everhart-Raghavan u_b and u_a quantities (with allowance for the difference between epoch and T) gives $(1/a)_{\text{orig}} = +0.006285 \text{ AU}^{-1}$ and $(1/a)_{\text{fut}} = +0.006353 \text{ AU}^{-1}$. The comet's revolution period is about 2000 yr.

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