

GARY W. KRONK

COMETOGRAPHY

A CATALOG OF COMETS

VOLUME 4: 1933-1959



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Cometography

A Catalog of Comets

Volume 4: 1933–1959

Cometography is a multi-volume catalog of every comet observed throughout history. It uses the most reliable orbits known to determine the distances from the Earth and Sun at the time a comet was discovered and last observed, as well as the largest and smallest angular distance to the Sun, most northerly and southerly declination, closest distance to the Earth, and other details to enable the reader to understand the physical appearance of each well-observed comet. Volume 4 provides a complete discussion of each comet seen from 1933 to 1959. It includes physical descriptions made throughout each comet's apparition. The comets are listed in chronological order, and each listing includes complete references to publications relating to the comet. This book is the most complete and comprehensive collection of comet data available, and provides amateur and professional astronomers, and historians of science, with a definitive reference on comets through the ages.

GARY KRONK has held a life-long passion for astronomy, and has been researching historical information on comets ever since sighting Comet Kohoutek in 1973/74. His work has been published in numerous magazines, and in two previous books – *Comets: A Descriptive Catalog* (1984) and *Meteor Showers: A Descriptive Catalog* (1988). Kronk holds positions in various astronomical societies, including Coordinator of the Comet Section of the Association of Lunar and Planetary Observers, and Consultant for the American Meteor Society. The International Astronomical Union (IAU) named minor planet 48300 Kronk, in honor of the extensive research Gary Kronk has done in cometography.

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VOLUME 4: 1933–1959

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Introduction

The period of 1933–59 brought forth several improvements in the study of comets, which led to more discoveries and longer periods of visibility. The greatest advances came in the area of telescopes and photography.

Comet discoveries

The USA continued its dominance in discovering comets during this period, with amateur and professional astronomers being given official credit for 60 discoveries. Following the USA were South Africa (24 discoveries), Slovakia (19 discoveries), Japan (9 discoveries), Russia (8 discoveries), and Finland (7 discoveries).

The most prolific comet discoverer of this period was A. Mrkos (Slovakia), who found 11 new comets. Next in line were M. Honda (Japan) and L. C. Peltier (USA), who each found 7 new comets, M. J. Bester (South Africa), who found 6, and R. Burnham Jr. (USA) and D. du Toit (South Africa), who each found 5. Honda and Peltier were both amateur astronomers, while Burnham discovered comets as both an amateur and a professional astronomer.

Another important point concerning comets discovered during this period was that many were found during surveys. The most successful were the National Geographic–Palomar Observatory Sky Survey, which found 11 comets during the period of 1949–55, and the Skalnaté Pleso binocular comet search program, which found 19 comets during the period of 1948–59.

Comet observations

Several very active comet observers mentioned in *Cometography* volume 3 continued to observe during most, if not all, of the period covered by this volume. The most notable include G. van Biesbroeck, H. M. Jeffers, and M. Beyer. The most notable observers to make their first observations during these years were H. L. Giclas, A. F. A. L. Jones, and E. Roemer.

The most common type of observation remained those that are visual. Visual observers usually provided estimates of the total magnitude, coma diameter, and tail length, all of which are important when studying a comet's development. Although a few photographic observers obtained exposures that were long enough to reveal these same parameters, most obtained short exposures that enabled a comet's position to be precisely measured. This is why the reader will notice photographic observers frequently providing fainter magnitudes, smaller coma diameters, and shorter tail lengths for the brighter comets than the visual observers.

Although the "Bobrovnikoff method" of estimating comet magnitudes was still being used, a new method was gaining in popularity. S.K.

Vsekhsvyatskij (Russia) and W.H. Steavenson (England) had independently come up with a new technique. Where the “Bobrovnikoff method” had the observer defocus both the comet and the star until they were about the same size, the Vsekhsvyatskij–Steavenson method had the observer memorize the brightness and diameter of the comet and then defocus stars until they matched the memorized parameters. In other words, the new method compared the focused comet with defocused stars. The method was popularized by J. B. Sidgwick in his 1955 book *Observational Astronomy for Amateurs* (Faber and Faber, London) and the technique became officially known as the “Sidgwick method.”

As with previous volumes of *Cometography*, some observers provided magnitude estimates of the “nucleus.” These magnitude estimates can vary widely from one observer to the next, because the true nucleus is not really being observed. Instead, the observers were seeing a compact condensation, with the compactness varying according to the telescope type, telescope size, and magnification being used.

The reflector was making a bigger impression during this period primarily because of the invention of the Schmidt camera. Bernhard Schmidt built the first Schmidt camera in 1930 and it was used at Hamburg Observatory (Germany). Schmidt’s camera was a mirror system, similar to the usual reflector; however, it used a correcting lens and allowed very fast focal ratios. The result was a telescope that could take wide-field photographs, which would reveal faint objects during rather short exposures. Observatories around the world began installing Schmidt cameras, with some of the largest being the 122-cm Samuel Oschin Schmidt Telescope (Palomar Observatory, California, USA) in 1948, the 61-cm Curtis Schmidt Telescope (University of Michigan’s Portage Lake Observatory, USA) in 1950, and the 80-cm Hamburg Schmidt Telescope (Hamburg Observatory) in 1954.

Of course, the Schmidt cameras would not have performed as well as they did without good photographic plates. The films of choice at many observatories became Kodak’s 103aO and 103aE during the 1940s, which were sensitive to blue and red, respectively. When used in conjunction with the 122-cm Samuel Oschin Schmidt Telescope at Palomar Observatory, these photographic plates allowed astronomers to obtain images of stars down to about magnitude 19–20. Several comets were found using this telescope during the National Geographic–Palomar Observatory Sky Survey of the early 1950s. In fact, astronomers are still finding comet images on these old survey plates at the present time!

Astronomical periodicals

The most dominant astronomical periodicals during the period covered by this volume were the *Astronomische Nachrichten*, the *Monthly Notices of the Royal Astronomical Society*, and the *Astronomical Journal*. Each published articles and papers concerning comets in nearly every issue.

The dissemination of news concerning comet discoveries was mostly handled by the *Bureau Central Astronomique Circulaire*, which was published in Copenhagen (Denmark); however, two other publications played smaller roles. These were the *British Astronomical Association Circulars* (England) and the *Astronomicheskij Tsirkulyar* (Russia). Most of what the *British Astronomical Association Circulars* published came from the *Bureau Central Astronomique Circulaire*, however, much of what the *Astronomicheskij Tsirkulyar* published rarely made it to other, more accessible, publications.

The most interesting comets from 1933 to 1959

Although this period enjoyed several naked-eye comets, exceptionally bright comets did not appear until the 1940s. So, during the 1930s, observers had to be content with C/1936 K1 (Peltier), C/1937 N1 (Finsler), and C/1939 H1 (Jurlof–Achmarof–Hassel), all of which peaked at magnitude 3.0–3.5.

C/1940 R2 (Cunningham) raised the hopes of observers when early calculations revealed the comet might attain a maximum magnitude of -2.6 ; however, the comet's rate of brightening began slowing about a month before perihelion and it peaked at only magnitude 3.5, or about 6 magnitudes fainter than predicted!

Comet C/1941 B2 (de Kock–Paraskevopoulos) became the brightest comet since 1931. It was discovered about 2 weeks prior to passing closest to the sun and Earth. Several observers reported magnitudes around 2.5 during late January, while the maximum tail length attained $5-6^\circ$.

The dearth of spectacular comets finally ended in the late 1940s and during the next decade no less than four comets appeared that attained a maximum brightness of 1 or possibly brighter.

Comet C/1947 X1 (Southern Comet) was independently discovered by many people in the Southern Hemisphere during 1947 December 7 and 8. It was then in evening twilight, about 14° from the sun. Magnitude estimates ranged from -5 to $+2$, with most around 1, while the tail length eventually reached $25-30^\circ$.

During the total solar eclipse of 1948 November 1, people located in Africa saw a comet 2° from the sun with a tail pointing toward the horizon. Following the few minutes of totality, the comet remained hidden in the sun's glare for the next three days before it finally emerged in the morning sky. The magnitude estimates at this time ranged from -4 to 2 and after a few more days the tail attained a length of $15-20^\circ$.

The most spectacular comet discussed in this volume has to be C/1956 R1 (Arend–Roland). The comet was discovered 5 months prior to passing perihelion. Following the comet's passing just 5° from the sun on 1957 April 16, it passed closest to Earth on April 20. During the next couple of days, observers reported the magnitude was near 1, while the main tail extended at least 15° . Most interesting was the appearance of a sunward-pointing tail, or anti-tail, that was about $10-15^\circ$ long. Photographs revealed an even more

impressive display with the main tail 25–30° long and the anti-tail about 15° long.

The last really bright naked-eye comet of the 1950s was C/1957 P1 (Mrkos). Appearing barely 3 months after the spectacular appearance of C/1956 R1 (Arend–Roland), there were numerous independent discoveries around the time the comet was passing perihelion. The maximum brightness was then generally estimated as between magnitude 1 and 2. Maximum visual tail lengths were around 2–5°, while photographs revealed a tail at least 16° long.

Periodic comet 7P/Pons–Winnecke deserves attention, not because of a bright naked-eye appearance, but because of an especially close approach to Earth of 0.11 AU on 1939 July 1. Most visual observers reported a maximum magnitude around 8 and a coma diameter of 3–4' during late June and early July, using binoculars and telescopes; however, M. Beyer (Germany) used a wide-field telescope to determine a maximum magnitude of 7 and a maximum coma diameter of 10', while F. de Roy (Belgium) saw the comet with the naked-eye at magnitude 6 and noted a coma 21–24' across.

Cometography

The format of this volume of *Cometography* is essentially the same as with volume 3, except for one alteration. As mentioned in volume 3, a change was going to be made in terms of how the full moon dates would be handled for the annual comets. Although I had stated that a limit would be placed on these dates, I opted to just not calculate them at all for these comets because it really served no point. The comets affected included 29P/Schwassmann–Wachmann 1 and 39P/Oterma. As a couple of amateur and professional astronomers pointed out, these two comets generally remained faint so that observations were generally never made when the moon was in the sky.

Something that I have neglected to explain in previous volumes was how I chose the orbits to display for each comet. The selection was simple, as I tended to use either the most recent orbit or the one with the smallest residuals. I converted all of the orbits to equinox 2000.0 myself. In looking through B. G. Marsden's various editions of his *Catalogue of Cometary Orbits*, I noticed that, in a few cases, he adjusted the orbit calculated by another astronomer to a standard epoch. Since I was not interested in competing with Marsden's excellent work, I decided not to include the epoch dates in *Cometography*. Consequently, all of the orbits presented are as originally published, with the exception of the conversion to equinox 2000.0.

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Catalog of Comets

C/1933 D1 *Discovered:* 1933 February 16.1 ($\Delta = 0.60$ AU, $r = 1.01$ AU, Elong. = 75°)
(Peltier) *Last seen:* 1933 April 14.21 ($\Delta = 1.52$ AU, $r = 1.49$ AU, Elong. = 68°)

Closest to the Earth: 1933 February 23 (0.5575 AU)

1933 I = 1933a *Calculated path:* CEP (Disc), CAS (Feb. 17), PER (Feb. 23), TAU (Mar. 8), ORI (Mar. 18)

L. C. Peltier (Delphos, Ohio, USA) was involved in a routine comet-sweeping session on 1933 February 16.1, when he came across an object of magnitude 8.6 at $\alpha = 22^{\text{h}} 48^{\text{m}}$, $\delta = +62^\circ$. He immediately wired G. van Biesbroeck (Yerkes Observatory, Wisconsin, USA) for confirmation, but cloudy skies were prevalent. Peltier sent a telegram to Harvard College Observatory (Massachusetts, USA) the next morning announcing his discovery. Confirmation came on February 17.05, when van Biesbroeck detected the comet in hazy skies. He described it as 9th magnitude, with a round centrally condensed coma 5' across. H. M. Jeffers (Lick Observatory, California, USA) independently confirmed the comet with the 30-cm refractor on February 17.23. He estimated the magnitude as 9, and said the centrally condensed coma was 2' across, but contained no stellar nucleus. Additional confirmation came on February 17.81, when R. Carrasco (Madrid Observatory, Spain) estimated the photographic magnitude as 8. The comet attained its most northerly declination of $+62^\circ$ on February 17. The comet was discovered a few days after it had passed perihelion, but was approaching Earth.

On February 18, the magnitude was given as 8.6 by Peltier, 8.7 by van Biesbroeck, 9 by P. Chofardet (Besançon, France), and 9.0 by M. Müндler (Königstuhl Observatory, Heidelberg, Germany). Van Biesbroeck added that the coma was 6' in diameter and extended mostly to PA 10° . Chofardet said the centrally condensed coma was 1.5' across. On the 19th, the magnitude was given as 8.1 by Peltier, 9 by C. D. Boyd and L. E. Cunningham (Harvard College Observatory, Massachusetts, USA) and Jeffers, 9.4 by van Biesbroeck, 10 by H. E. Burton (US Naval Observatory, Washington, DC, USA), and 10.0 by F. C. A. Schwassmann (Hamburg Observatory, Bergedorf, Germany) and F. Kaiser (Wiesbaden, Germany). Jeffers said the centrally condensed coma was 2' across, but contained no stellar nucleus. Burton described the comet as diffuse. Kaiser noted a coma about 30'' across. On the 20th, the magnitude was given as 10.5 by R. R. E. Schorr (Hamburg

Observatory) and 11 by Müндler. Schorr noted the coma was 3' across, while Müндler estimated the nuclear magnitude as about 13. On the 21st, the magnitude was given as 8.8 by Peltier and 10.5 by van Biesbroeck. Van Biesbroeck said the coma was 30'' across. On the 22nd, the magnitude was given as 8.8 by Peltier and 9.4 by van Biesbroeck. Van Biesbroeck added that the coma was 4' across and contained a well-condensed starlike nucleus of magnitude 13. On February 23, the magnitude was given as 10 by B. Meyer-mann (Göttingen, Germany) and 10.5 by H. Krumpholz (Vienna University Observatory, Austria). Jeffers observed with the 30-cm refractor and noted that the brightness was only slightly less than on the 19th. Krumpholz said the coma was 2' across, with a distinct condensation. Jeffers added that the centrally condensed coma was 2' across, but contained no stellar nucleus.

The comet was moving away from both the sun and Earth for the remainder of its apparition. On February 24, the magnitude was given as 8.4 by van Biesbroeck, 8.7 by Peltier, 9–10 by Chofardet, and 11.0 by E. J. Delporte (Uccle, Belgium). Burton said the comet was diffuse and barely visible in a 13-cm finder. Chofardet said the coma was 1.5' across, with a central condensation. Van Biesbroeck noted that the coma had expanded to 6', while a stellar nucleus shone at magnitude 13. On the 25th, the magnitude was given as 10 by Chofardet and 10.5 by Kaiser. Chofardet said the nucleus was poorly defined. Kaiser said the coma was 3' across, with a central condensation. On the 27th, M. Beyer (Hamburg, Germany) determined the magnitude as 8.73. He said the coma was about 2' across. On February 28, the magnitude was given as 8.80 by Beyer, 9.2 by van Biesbroeck, 9.5 by Peltier and Schwassmann, brighter than 10 by E. Warmbier (Poznan, Poland), and 11 by Krumpholz. Jeffers observed with the 30-cm refractor and noted that the brightness was only slightly fainter than on the 19th. Beyer said the nuclear magnitude was 11.8 and the coma diameter was 2.2'. Krumpholz said the coma diameter was 1.5'. Warmbier noted a coma 3' across. He saw no nucleus, but did see a faint central condensation. Jeffers added that the centrally condensed coma was 2' across, but contained no stellar nucleus.

Moonlight interfered with observations during the first half of March. On March 1, the magnitude was given as 8.98 by Beyer, 9.5 by Peltier, and 10 by van Biesbroeck. Beyer noted the coma was about 2' across and exhibited a nuclear magnitude of 12.3. Van Biesbroeck simply described the comet as a well-condensed coma. The comet attained a maximum solar elongation of 82° on March 7. On the 13th, the magnitude was given as 9.97 by Beyer, 11 by Krumpholz, and 12 by Schwassmann. Beyer said the nuclear magnitude was 12.7 and the coma was about 2' across. Krumpholz said the coma was 2' across, with little condensation. On March 15, the magnitude was given as 10.5 by van Biesbroeck and 12 by Chofardet. Biesbroeck said the round coma was 2' across and contained a nearly stellar nucleus of magnitude 13. Chofardet said the nucleus was uncertain.

The comet seemed to fade more quickly during the last half of March. On March 17, the magnitude was given as 10.2 by Peltier and 10.5 by van

Biesbroeck. On the 20th, Beyer determined the total magnitude as 10.54 and the nuclear magnitude as 13.0. On the 21st, Beyer gave the magnitude as 10.35 and Chofardet gave it as 12. Beyer said the nuclear magnitude was 13.0 and the coma diameter was about 3'. On the 22nd, the magnitude was given as 10.48 by Beyer, while photographic magnitudes of 13 and 14.5 were provided by Jeffers and Schorr, respectively. Beyer said the coma diameter was 2.5'. Jeffers said the comet was "round and somewhat condensed in the middle." On the 24th, the magnitude was given as 10.78 by Beyer, 12 by van Biesbroeck, and 13.0 by Kaiser. Krumpholz was no longer able to see the comet in the 30-cm refractor. Beyer said the coma diameter was 1.8'. Van Biesbroeck said the coma was 1' across and contained a sharp nucleus. Kaiser noted the "halo" was about 30" across. On the 25th, Beyer gave the magnitude as 11.06 and noted a coma 1.6' across. On the 26th, Beyer gave the magnitude as 11.00. He said the nuclear magnitude was brighter than 13.2, while the coma was 1.7' across. On the 27th, Beyer gave the visual magnitude as 11.48, while Schorr provided a photographic magnitude of 14. Beyer said the coma was 1.4' across. On March 28, van Biesbroeck estimated the magnitude as 13.5. He said the round coma was 50" across and contained a well-defined nucleus.

The last two detections of the comet came on April 14.18 and April 14.21, when Jeffers obtained 30-minute exposures with the 91-cm Crossley reflector at Lick Observatory. He gave the position on the latter date as $\alpha = 5^{\text{h}} 59.6^{\text{m}}$, $\delta = -1^{\circ} 28'$. Jeffers estimated the magnitude as 16.

The first orbits were published on February 20. C. M. Anderson Jr. and A. B. Wyse used precise positions obtained on February 17 and 18, and found a perihelion date of 1933 February 7.63. At the same time F. L. Whipple and L. E. Cunningham used three precise positions obtained between February 17 and 19, and revealed a perihelion date of February 9.19. C. Bergen used the same positions as the Harvard astronomers and found a perihelion date of February 9.22. M. Davidson and A. C. D. Crommelin independently took positions from February 17, 18, and 19, and determined perihelion dates of February 6.98 and February 6.96, respectively. Among all of these, the orbit by Davidson and Crommelin was closest. J. Lindgren calculated three orbits that gave perihelion dates ranging from February 6.49 to February 6.77.

The only astronomers to use positions spanning the entire period of visibility were Anderson and Wyse. They took seven positions, reduced them to three Normal places, and determined the perihelion date as February 6.70. This orbit is given below.

T	ω	Ω (2000.0)	i	q	e
1933 Feb. 6.6990 (UT)	135.9874	312.4663	86.6786	1.000691	1.0

ABSOLUTE MAGNITUDE: $H_0 = 9.9$, $n = 3.39$ (Beyer, 1933); $H_{10} = 10.2$ (V1964)

FULL MOON: Feb. 10, Mar. 12, Apr. 10, May 9

SOURCES: H. M. Jeffers, C. M. Anderson Jr., and A. B. Wyse, *LOB*, **16** (1933), p. 114, 117–18; L. C. Peltier and G. van Biesbroeck, *HAC*, No. 257 (1933 Feb. 17); C. M. Anderson Jr., A. B. Wyse, F. L. Whipple, and L. E. Cunningham, *HAC*, No. 258 (1933 Feb. 20); R. Carrasco, G. van Biesbroeck, C. D. Boyd, L. E. Cunningham, and C. Bergen, *HAC*, No. 259 (1933 Feb. 20); L. C. Peltier, R. Carrasco, M. Müндler, F. C. A. Schwassmann, C. M. Anderson Jr., and A. B. Wyse, *BZAN*, **15** (1933 Feb. 21), p. 12; C. Bergen and G. van Biesbroeck, *HAC*, No. 260 (1933 Feb. 23); C. M. Anderson Jr. and A. B. Wyse, *AN*, **248** (1933 Feb. 24), p. 77; M. Müндler, F. Kaiser, R. R. E. Schorr, B. Meyermann, and H. Krumpholz, *BZAN*, **15** (1933 Feb. 27), p. 13; C. M. Anderson Jr. and A. B. Wyse, *HAC*, No. 261 (1933 Feb. 27); L. C. Peltier, G. van Biesbroeck, C. M. Anderson Jr., and A. B. Wyse, *PA*, **41** (1933 Mar.), pp. 165–6; L. C. Peltier, M. Davidson, A. C. D. Crommelin, C. M. Anderson Jr., and A. B. Wyse, *The Observatory*, **56** (1933 Mar.), p. 101; E. J. Delporte, F. Kaiser, M. Beyer, F. C. A. Schwassmann, and E. Warmbier, *BZAN*, **15** (1933 Mar. 8), p. 15; M. Beyer and F. C. A. Schwassmann, *BZAN*, **15** (1933 Mar. 20), p. 17; M. Beyer and F. Kaiser, *BZAN*, **15** (1933 Mar. 30), p. 22; L. C. Peltier and G. Van Biesbroeck, *PA*, **41** (1933 Apr.), p. 217; H. M. Jeffers, *HAC*, No. 266 (1933 Apr. 3); R. R. E. Schorr, *BZAN*, **15** (1933 Apr. 5), p. 24; G. van Biesbroeck, *AJ*, **43** (1933 Jun. 22), pp. 18, 21, 24; J. Lindgren, *AN*, **249** (1933 Aug. 12), p. 307; M. Beyer, *AN*, **250** (1933 Nov. 4), pp. 233–46; P. Chofardet, *JO*, **17** (1934 Mar.), pp. 49, 51; H. Krumpholz, *AN*, **251** (1934 Mar. 3), pp. 199–202; R. R. E. Schorr, *AN*, **251** (1934 Mar. 5), p. 212; H. E. Burton, *AJ*, **50** (1942 Aug. 13), p. 26; V1964, p. 72.

7P/Pons–Winnecke *Prerecovery*: 1933 February 18.33 ($\Delta = 1.12$ AU, $r = 1.58$ AU, Elong. = 97°)
Recovered: 1933 March 24.12 ($\Delta = 0.76$ AU, $r = 1.32$ AU, Elong. = 97°)

Last seen: 1933 September 22.92 ($\Delta = 1.01$ AU, $r = 1.90$ AU, Elong. = 140°)

1933 II = 1933b *Closest to the Earth*: 1933 May 14 (0.5416 AU)

Calculated path: SER (Pre), HER (Feb. 25), OPH (Mar. 9), AQL (Apr. 6), DEL (Apr. 27), AQR (May 2), CET (Jun. 12), SCL (Jul. 26), FOR (Aug. 5), SCL (Aug. 16)

Using an orbit computed for the 1927 apparition, A. C. D. Crommelin applied perturbations by Jupiter and integrated the comet's motion forward. He predicted the comet would next arrive at perihelion on 1933 May 18.21. He noted an approach to within 0.5 AU of Jupiter. V. Guth also started with the 1927 orbit and predicted the comet would arrive at perihelion on May 19.00. Using Guth's ephemeris, R. R. E. Schorr (Hamburg Observatory, Bergedorf, Germany) photographed the comet's predicted position on March 2, but found nothing near it.

A. A. Wachmann (Hamburg Observatory, Bergedorf, Germany) recovered this comet on 1933 March 24.12. He gave the position as $\alpha = 17^{\text{h}} 44.0^{\text{m}}$, $\delta = +9^\circ 27'$, and estimated the magnitude as 14. The recovery was confirmed on March 25.09, when F. C. A. Schwassmann and D. Werner-Starke (Hamburg Observatory) photographed the comet at magnitude 14.5. Shortly after the announcement, G. van Biesbroeck (Yerkes Observatory, Wisconsin, USA) rechecked his photographic plates exposed in his search for this comet and identified an image far from the center of a plate exposed on

March 24.45. The magnitude was 14.5. In addition, he found images near the corner of plates exposed on February 18.33 and February 18.35. The magnitude was then 15. The comet was found a little less than 2 months from perihelion and its closest approach to Earth.

Van Biesbroeck photographed the comet using the 61-cm reflector on March 28. He gave the magnitude as 14.5 and noted a round coma about 15'' across. On April 26, the magnitude was given as 13.0 by G. Adamopoulos (National Observatory, Athens, Greece) and 14.5 by R. R. E. Schorr (Hamburg Observatory, Bergedorf, Germany). Schorr also gave the magnitude as 14.5 on the 27th and 14 on the 28th. On April 29, van Biesbroeck estimated the photographic magnitude as 13 using the reflector. He said the coma was described as well condensed and round.

The comet passed closest to both the sun and Earth during May. On May 4, van Biesbroeck obtained a photographic magnitude of 12 using the reflector. He said the coma was round with a central condensation. On May 22, the comet reached a minimum elongation of 85°. On the 23rd, van Biesbroeck estimated the photographic magnitude as 11. He said the coma was diffuse and 2' across, while the nucleus was well defined and exhibited a jet extending 1' in PA 40°. On May 27, E. L. Johnson (Union Observatory, Johannesburg, South Africa) photographed the comet using the 25-cm Franklin–Adams Star Camera and estimated the magnitude as 10.0.

The comet was moving away from both the sun and Earth as June began. On June 2, van Biesbroeck gave the visual magnitude as 11 using the 102-cm refractor. The coma was very diffuse and contained a nucleus measuring more than 10'' in diameter. On the 21st, van Biesbroeck found the comet diffuse with a photographic magnitude of 10. On the 23rd, Johnson gave the photographic magnitude as 9.5. He wrote that the comet was "large, round, diffuse with no stellar nucleus." On June 27, van Biesbroeck estimated the photographic magnitude as 11.5, and said the coma was diffuse with hardly any condensation.

The comet steadily faded during the remainder of its apparition. On July 3, van Biesbroeck photographed it using the 61-cm reflector and gave the magnitude as 12. He also noted that the coma was faintly visible to a diameter of 2', while the nucleus was "very poorly defined" and about 20'' across. On the 3rd and 17th, Johnson gave the photographic magnitude as 10.0. On July 22, van Biesbroeck gave the photographic magnitude as 13. He said the coma was very poorly defined and about 20'' across. Johnson gave the photographic magnitude as 11.0 on August 2 and 13.0 on August 21. On August 25, Adamopoulos estimated the magnitude as 13.0. He said the comet was 30'' across and exhibited ill-defined edges. On September 16, Johnson gave the photographic magnitude as 13.5.

The comet was last detected on September 22.92, when Johnson estimated the magnitude as 13.5. He gave the position as $\alpha = 0^{\text{h}} 59.8^{\text{m}}$, $\delta = -37^{\circ} 15'$.

Both Crommelin and Guth used the early positions to correct their predicted orbits. Crommelin gave the perihelion date as May 18.68 and the

period as 6.09 years. Guth gave the perihelion date as May 18.27. During October and November, Crommelin deduced orbits based exclusively on positions obtained during this apparition. These gave perihelion dates between May 18.78 and May 18.81, and periods between 6.10 and 6.16 years.

Multiple apparition orbits have been calculated by B. G. Marsden (1968), L. Y. Anan'eva and E. A. Reznikov (1974), and Reznikov (1978). These included perturbations by all nine planets. They gave the perihelion date as May 18.78–18.79 and the period as 6.09 years. Marsden's orbit is given below. The nongravitational terms were given as $A_1 = +0.01$ and $A_2 = +0.0024$ by B. G. Marsden, Z. Sekanina, and D. K. Yeomans (1973).

T	ω	Ω (2000.0)	i	q	e
1933 May 18.7803 (TT)	169.2593	97.5377	20.1146	1.101818	0.669664

ABSOLUTE MAGNITUDE: $H_{10} = 10.4$ (V1964)

FULL MOON: Feb. 10, Mar. 12, Apr. 10, May 9, Jun. 8, Jul. 7, Aug. 5, Sep. 4, Oct. 3
 SOURCES: A. C. D. Crommelin, *BAA Handbook for 1933* (1932), p. 26; V. Guth, *AN*, **247** (1933 Feb. 8), p. 443; V. Guth, *IAUC*, No. 422 (1933 Feb. 14); V. Guth, *The Observatory*, **56** (1933 Mar.), p. 102; R. R. E. Schorr, *BZAN*, **15** (1933 Mar. 8), p. 15; A. A. Wachmann, F. C. A. Schwassmann, and D. Werner-Starke, *BZAN*, **15** (1933 Mar. 27), p. 21; A. A. Wachmann, *HAC*, No. 265 (1933 Mar. 27); A. A. Wachmann, *The Observatory*, **56** (1933 Apr.), p. 136; G. van Biesbroeck, *HAC*, No. 266 (1933 Apr. 3); A. C. D. Crommelin and V. Guth, *IAUC*, No. 434 (1933 Apr. 8); R. R. E. Schorr, *BZAN*, **15** (1933 Apr. 27), p. 27; R. R. E. Schorr, *BZAN*, **15** (1933 May 10), p. 32; *The Observatory*, **56** (1933 Jul.), pp. 242–3; G. van Biesbroeck, *PA*, **41** (1933 Aug.–Sep.), p. 405; G. Adamopoulos, *IAUC*, No. 450 (1933 Sep. 10); A. C. D. Crommelin, *The Observatory*, **56** (1933 Oct.), p. 319; E. L. Johnson, *BZAN*, **15** (1933 Oct. 27), p. 68; A. C. D. Crommelin, *JBA*, **44** (1933 Nov.), p. 39; E. L. Johnson, *UOC*, No. 91 (1934 Jan. 29), p. 10; A. A. Wachmann, G. van Biesbroeck, and A. C. D. Crommelin, *MNRAS*, **94** (1934 Feb.), pp. 326–7; G. Adamopoulos, *JO*, **17** (1934 Mar.), pp. 51–2; R. R. E. Schorr, *AN*, **251** (1934 Mar. 5), p. 212; G. van Biesbroeck, *AJ*, **44** (1934 Aug. 31), pp. 1, 3, 5; V1964, p. 72; B. G. Marsden, *AJ*, **73** (1968 Jun.), pp. 370–1; B. G. Marsden, *QJRAS*, **9** (1968 Sep.), pp. 314–15; B. G. Marsden, Z. Sekanina, and D. K. Yeomans, *AJ*, **78** (1973 Mar.), p. 214; L. Ya. Anan'eva and E. A. Reznikov, *QJRAS*, **15** (1974 Dec.), pp. 452–3, 459; E. A. Reznikov, *QJRAS*, **19** (1978 Mar.), pp. 82–3, 88.

21P/Giacobini–Zinner *Recovered:* 1933 April 23.08 ($\Delta = 1.64$ AU, $r = 1.51$ AU, Elong. = 65°)
Last seen: 1933 October 18.44 ($\Delta = 1.59$ AU, $r = 1.63$ AU, Elong. = 74°)
Closest to the Earth: 1933 June 30 (1.2365 AU)

1933 III = 1933c *Calculated path:* PEG (Rec), AND (May 31), PSC (Jun. 8), TRI (Jun. 19), ARI (Jun. 28), TAU (Jul. 9), ORI (Aug. 6), TAU (Aug. 9), ORI (Aug. 11), MON (Aug. 20), CMi (Sep. 4), MON (Sep. 13), HYA (Oct. 3), PUP (Oct. 14), HYA (Oct. 15)

The comet's recovery during this apparition began with a prediction by F. R. Cripps (1932). He applied perturbations by Jupiter to a previously

published orbit and predicted the comet would next reach perihelion on 1933 July 16.33. R. R. E. Schorr (Hamburg Observatory, Bergedorf, Germany) recovered the comet on 1933 April 23.08. He gave the position as $\alpha = 21^{\text{h}} 34.1^{\text{m}}$, $\delta = +15^{\circ} 18'$, and estimated the magnitude as 15.5. Schorr confirmed the recovery on April 26.06, when he again estimated the magnitude as 15.5. Calculations showed the comet was 1 day earlier than predicted by Cripps. The comet was 2 months from its closest approach to Earth and nearly 3 months from perihelion.

On April 29, G. van Biesbroeck (Yerkes Observatory, Wisconsin, USA) obtained a 5-minute exposure with the 61-cm reflector and simply described the comet as "quite vague." On May 21, Schorr gave the magnitude as 15. On the 23rd, van Biesbroeck estimated the magnitude as 13.5. He described the coma as round and noted a faint tail extending 3' in PA 255° . On the 25th, van Biesbroeck estimated the magnitude as 13.5 and saw a slender tail extending 4' in PA 260° . On May 28, van Biesbroeck estimated the magnitude as 13.

On June 1, van Biesbroeck estimated the magnitude as 13.5. He noted a small, ill-defined nucleus and a narrow tail extending over 5' in PA 262° . The comet attained its most northerly declination of $+28^{\circ}$ on June 17. On the 21st, van Biesbroeck gave the magnitude as 12.5. He said the coma was 25" in diameter and contained a fairly well-condensed nucleus. A faint tail extended over 5' in PA 265° . On the 27th, van Biesbroeck gave the magnitude as 12 and observed a well-defined nucleus. On June 28 and 30, H. M. Jeffers (Lick Observatory, California, USA) visually observed the comet using the 91-cm refractor and gave the magnitude as 12.5. He said the coma was 0.3' across and well condensed, but with no stellar nucleus. Jeffers added that the coma extended about 2' toward the west.

On July 3, van Biesbroeck gave the magnitude as 11.5. He added that there was a sharp nucleus and the very faint tail extended toward PA 265° . On the 22nd, Jeffers observed with the 91-cm refractor and said the comet was slightly brighter than in June. He noted the coma was 0.3' across and well condensed, but with no stellar nucleus. Jeffers added that the coma extended about 2' toward the west. The comet attained a minimum elongation of 51° on July 24. On July 25 and 26, P. Finsler (Zürich, Switzerland) visually estimated the magnitude as 12.

On September 18, van Biesbroeck estimated the magnitude as 16.5. The coma was "quite diffuse," and the tail extended 1' in PA 270° . On the 21st, Jeffers photographed the comet using the 91-cm Crossley reflector and gave the magnitude as 15.5. He said the well-condensed coma was about 0.3' across, with a small extension toward the west. On September 21 and 23, van Biesbroeck gave the magnitude as 17. He said the coma was round and 15" across, while the tail was hardly visible.

The comet was last detected on October 18.44, when van Biesbroeck photographed it with the 61-cm reflector at Yerkes Observatory. The comet appeared as a tiny round coma of about magnitude 18. Van Biesbroeck initially said that identity with this comet was "somewhat doubtful,"

but orbital calculations proved this was definitely an observation of P/Giacobini–Zinner. The position was determined as $\alpha = 8^{\text{h}} 29.2^{\text{m}}$, $\delta = -12^{\circ} 36'$.

Using positions from April and July, A. C. D. Crommelin calculated an “approximate” elliptical orbit which gave the perihelion date as July 15.15 and the period as 6.60 years.

Calculations using multiple apparitions and planetary perturbations were published by Y. V. Evdokimov (1956, 1958, 1972) and Yeomans (1972, 1986). These revealed a perihelion date of July 15.15 and a period of 6.60 years. Yeomans’ orbit is given below. Yeomans (1972) gave the nongravitational terms as $A_1 = +0.06584$ and $A_2 = +0.010911$. In the 1986 book *ESA Proceedings of the 20th ESLAB Symposium on the Exploration of Halley’s Comet*, Yeomans gave the nongravitational terms as $A_1 = +0.4090$ and $A_2 = +0.0324$.

T	ω	Ω (2000.0)	i	q	e
1933 Jul. 15.1475 (TT)	171.7655	196.9463	30.6777	0.999529	0.715984

ABSOLUTE MAGNITUDE: $H_{10} = 12.1$ (V1964)

FULL MOON: Apr. 10, May 9, Jun. 8, Jul. 7, Aug. 5, Sep. 4, Oct. 3, Nov. 2

SOURCES: F. R. Cripps, *BAA Handbook for 1933* (1932), p. 28; R. R. E. Schorr, *HAC*, No. 269 (1933 Apr. 26); R. R. E. Schorr, *BZAN*, **15** (1933 Apr. 27), p. 27; R. R. E. Schorr, *IAUC*, No. 435 (1933 Apr. 27); R. R. E. Schorr, *The Observatory*, **56** (1933 May), p. 169; *The Observatory*, **56** (1933 Jun.), p. 204; R. R. E. Schorr and G. van Biesbroeck, *PA*, **41** (1933 Jun.–Jul.), p. 323; P. Finsler, *BZAN*, **15** (1933 Jul. 27), p. 47; P. Finsler, *BZAN*, **15** (1933 Aug. 18), p. 52; H. M. Jeffers, *LOB*, **17** (1934), p. 5; R. R. E. Schorr, F. R. Cripps, and A. C. D. Crommelin, *MNRAS*, **94** (1934 Feb.), pp. 326–7; R. R. E. Schorr, *AN*, **251** (1934 Mar. 5), p. 212; G. van Biesbroeck, *AJ*, **44** (1934 Aug. 31), pp. 1, 3, 5–6; Y. V. Evdokimov, *MNRAS*, **116** (1956), pp. 226–7; Y. V. Evdokimov, *MNRAS*, **118** (1958), pp. 396–7; V1964, p. 72; Y. V. Evdokimov and D. K. Yeomans, *IAUS*, No. 45 (1972), pp. 173, 185; D. K. Yeomans, *ESA Proceedings of the 20th ESLAB Symposium on the Exploration of Halley’s Comet*. Volume 2: *Dust and Nucleus* (1986), p. 424; D. K. Yeomans, *QJRAS*, **27** (1986 Mar.), p. 116.

14P/Wolf *Recovered*: 1933 July 25.27 ($\Delta = 2.00$ AU, $r = 2.85$ AU, Elong. = 140°)

Last seen: 1934 December 11.36 ($\Delta = 2.21$ AU, $r = 3.09$ AU, Elong. = 148°)

1934 I = 1933e *Closest to the Earth*: 1933 August 17 (1.9497 AU)

Calculated path: SGE (Rec), AQL (Sep. 1), DEL (Oct. 31), EQU (Nov. 24), AQR (Nov. 29), PEG (Jan. 19), PSC (Jan. 28), ARI (Apr. 29), TAU (Jun. 21), ORI (Aug. 11), ERI (Dec. 7)

Using an orbit computed by G. Merton and A. C. D. Crommelin for the 1925 apparition, W. P. Henderson and J. D. McNeile applied perturbations by Jupiter and Saturn and predicted the comet would next arrive at perihelion on 1934 February 28.63. They wrote that the comet would be too close to the sun for observations after January 1934. M. Kamienski’s extensive

investigations in the orbital motion of this comet predicted a perihelion date of February 27.86.

Using an ephemeris calculated by Kamienski, H. M. Jeffers (Lick Observatory, California, USA) recovered this comet with the 91-cm Crossley reflector on 1933 July 25.27, at $\alpha = 20^{\text{h}} 07.9^{\text{m}}$, $\delta = +20^{\circ} 40'$. He described the comet as not quite stellar with a magnitude of about 18.5. Additional exposures on July 25.36 and July 25.43, confirmed the recovery. Jeffers obtained another photographic observation on July 29.35, and again noted a magnitude of about 18.5. The indicated correction to Kamienski's prediction was -0.1 day.

On August 25, Jeffers successfully photographed the comet with the 91-cm Crossley reflector, and N. U. Mayall determined the magnitude as 18.4 ± 0.2 , based upon a comparison with the polar sequence. Jeffers obtained additional photographs of the comet on September 16, November 10, and November 11, before it moved into the glare of the sun. The comet attained a southerly declination of $+2^{\circ}$ on December 23, before turning northward.

The comet passed slightly over 2° from the sun on 1934 April 9 and attained a northerly declination of $+13^{\circ}$ on June 21, before once again beginning its trek southward. Following its conjunction with the sun, the comet was recovered on September 7 and confirmed on September 10, when Jeffers obtained exposures ranging from 65 to 70 minutes using the 91-cm Crossley reflector. Jeffers obtained another photograph on September 14, from which Mayall was able to determine the magnitude as 19.1, using the polar sequence. A 60-minute exposure by Jeffers on October 15 also showed the comet.

The last two detections of the comet were on December 11.30 and December 11.36, when Jeffers obtained 80-minute exposures with the 91-cm Crossley reflector. He gave the comet's position as $\alpha = 5^{\text{h}} 05.0^{\text{m}}$, $\delta = -8^{\circ} 49'$. Jeffers noted that conditions were unusually favorable and described the comet as round and about $3''$ across.

Kamienski and M. Bielicki (1934) calculated a revised orbit for this comet based on Jeffers' observations and found the perihelion date to be February 27.77. They added that the fact that the comet was 2 magnitudes fainter than expected suggested it was undergoing "dissipation" and would possibly not be observed at many more returns.

Multiple apparition orbits have been calculated by Kamienski (1959), D. K. Yeomans (1975, 1978), and E. I. Kazimirchak-Polonskaya (1977, 1978, 1982) and these revealed a perihelion date of February 27.76 and a period of 8.33 years. Yeomans (1975) and Kazimirchak-Polonskaya (1977) said non-gravitational effects were apparently no longer active. Yeomans' orbit is given below.

T	ω	Ω (2000.0)	i	q	e
1934 Feb. 27.7593 (TT)	160.8108	205.1150	27.2575	2.450275	0.403654

ABSOLUTE MAGNITUDE: $H_{10} = 12.4$ (V1964)

FULL MOON: Jul. 7, Aug. 5, Sep. 4, Oct. 3, Nov. 2, Dec. 2, Dec. 31, 1934 Jan. 30, Mar. 1, Mar. 31, Apr. 29, May 28, Jun. 27, Jul. 26, Aug. 24, Sep. 23, Oct. 22, Nov. 21, Dec. 20

SOURCES: G. Merton and A. C. D. Crommelin, *MNRAS*, **86** (1926 Feb.), p. 226; W. P. Henderson and J. D. McNeile, *BAA Handbook for 1933* (1932), p. 29; H. M. Jeffers, *HAC*, No. 272 (1933 Jul. 26); H. M. Jeffers, *BZAN*, **15** (1933 Jul. 27), p. 47; M. Kamienski, *BZAN*, **15** (1933 Aug. 1), p. 48; H. M. Jeffers, *HAC*, No. 273 (1933 Aug. 7); M. Kamienski, *AN*, **249** (1933 Sep. 11), p. 419; H. M. Jeffers, *PA*, **41** (1933 Oct.), p. 440; H. M. Jeffers and N. U. Mayall, *PASP*, **45** (1933 Oct.), pp. 260–1; H. M. Jeffers, *LOB*, **17** (1934), p. 6; H. M. Jeffers and M. Kamienski, *The Observatory*, **57** (1934 Jan.), p. 38; M. Kamienski and M. Bielicki, *BZAN*, **16** (1934 Jan. 5), p. 1; M. Kamienski and M. Bielicki, *MNRAS*, **94** (1934 Feb.), pp. 326–7; H. M. Jeffers, *PASP*, **46** (1934 Apr.), pp. 110–11; M. Kamienski, *The Observatory*, **57** (1934 Apr.), pp. 139–40; H. M. Jeffers and N. U. Mayall, *HAC*, No. 310 (1934 Sep. 24); H. M. Jeffers, *BZAN*, **16** (1934 Oct. 11), p. 61; H. M. Jeffers, *PA*, **42** (1934 Nov.), p. 508; H. M. Jeffers, *The Observatory*, **57** (1934 Nov.), p. 351; H. M. Jeffers, *LOB*, **17** (1935), p. 123; M. Kamienski, *MNRAS*, **95** (1935 Feb.), pp. 386–7; M. Kamienski, *AcA*, **9** (1959), pp. 66–72; V1964, p. 73; D. K. Yeomans, *PASP*, **87** (1975 Aug.), pp. 635–6; E. I. Kazimirchak-Polonskaya, *SvA*, **21** (1977 Jan.–Feb.), pp. 107–12; D. K. Yeomans and E. I. Kazimirchak-Polonskaya, *QJRAS*, **19** (1978 Mar.), pp. 52–3, 57; E. I. Kazimirchak-Polonskaya, *CCO*, 4th ed. (1982), pp. 20, 52.

36P/1933 U1 *Discovered:* 1933 October 15.27 ($\Delta = 1.64$ AU, $r = 2.54$ AU, Elong. = 149°)
(Whipple) *Last seen:* 1935 March 28.30 ($\Delta = 3.47$ AU, $r = 4.04$ AU, Elong. = 119°)

Closest to the Earth: 1933 November 3 (1.5913 AU)

1933 IV = 1933f *Calculated path:* TAU (Disc), CET (Oct. 26), TAU (1934 Feb. 11), ORI (Apr. 14), TAU (May 22), ORI (May 29), GEM (Jun. 19), CMi (Aug. 12), CNC (Aug. 20), HYA (Nov. 3), CNC (1935 Feb. 10)

F. L. Whipple (Harvard College Observatory's Oak Ridge Station, Massachusetts, USA) discovered this comet on the edge of a photograph exposed with the 41-cm Metcalf telescope on 1933 October 15.27, at a position of $\alpha = 3^{\text{h}} 25.3^{\text{m}}$, $\delta = +10^\circ 02'$. The magnitude was estimated as 13, while a tail was 3' long. He confirmed the comet on October 21.12 and October 21.40. Whipple estimated the magnitude as 13 and noted a tail 3' long on all of these photographs. At the time of the discovery, the comet was over 2 months past perihelion, but was nearing its closest approach to Earth.

On October 22, G. van Biesbroeck (Yerkes Observatory, Wisconsin, USA) described the comet as a small, round coma of magnitude 14, with a faint tail extending over 3' in PA 280° . F. C. A. Schwassmann and A. A. Wachmann (Hamburg Observatory, Bergedorf, Germany) estimated the magnitude as 13.0. On the 24th, E. J. Delporte (Uccle, Belgium) noted a nucleus of magnitude 15.0. On the 25th, P. C. Keenan (Yerkes Observatory) gave the magnitude as 14.2. On October 31, Whipple and L. E. Cunningham gave the magnitude as 13.5.

As November began, the comet was passing closest to Earth and, thereafter, moved away from both the sun and Earth. On November 9, F. Kaiser (Wiesbaden, Germany) gave the magnitude as 13.0. On November 10, the comet attained a maximum elongation of 170° . On the 11th and 13th, L. S. Barnes and C. H. Barthelman (Harvard College Observatory's Oak Ridge Station) gave the magnitude as 13.5. On the 15th and 16th, van Biesbroeck gave the magnitude as 13.5 and noted the coma was round, while a tail was still faintly visible on the preceding side. On the 18th, van Biesbroeck and Keenan gave the magnitude as 14.5. On November 19, Kaiser estimated the magnitude as 13.0.

The comet's southward motion took it to a declination of $+5^\circ$ on December 16 and then it began moving northward again. On the 16th, R. R. E. Schorr (Hamburg Observatory) gave the magnitude as 14. On the 18th, van Biesbroeck described the comet as a round coma with a magnitude of 15. On December 22, van Biesbroeck estimated the magnitude as 14.5 and said the coma was $20''$ across, with a fairly sharp nucleus.

Only a few observatories maintained observations during 1934. On January 11, 16, and 17, van Biesbroeck estimated the magnitude as 15. The coma was well defined, but the tail was no longer visible. On January 18, Barnes and Barthelman estimated the magnitude as 15.0. On January 19, Barnes and Barthelman estimated the magnitude as 15.0. On February 10 and 13, van Biesbroeck estimated the magnitude as 16. The coma was more diffuse than in January and exhibited a "broad extension in the fourth quadrant." On March 5, H. M. Jeffers (Lick Observatory, California, USA) estimated the magnitude as 16.5, using the 91-cm Crossley reflector. On March 10 and 11, van Biesbroeck estimated the magnitude as 16.5, while the coma was ill defined and $10''$ across. On March 16, van Biesbroeck estimated the magnitude as 17, and described the coma as round and $8''$ across. On March 19, van Biesbroeck estimated the magnitude as 17. The coma was simply described as tiny, containing a central condensation. The comet attained its most northerly declination of $+16^\circ$ on June 7 before turning southward. It passed 8° from the sun on July 3. Jeffers obtained observations on October 10 and 12 and gave the magnitude as 18 on each date. On November 5 and 7, Jeffers estimated the magnitude as about 18. The comet's southerly motion again took it to a declination of $+5^\circ$ by December 23.

As Earth swung around its orbit, the distance between it and the comet decreased to 2.897 AU on 1935 January 24. The comet's elongation was also increasing and it attained a maximum of 169° on February 2.

The comet was last detected on March 28.30, when Jeffers obtained a 120-minute exposure with the 91-cm Crossley reflector which showed a weak object of magnitude 19. C. D. Swanson gave the position as $\alpha = 8^{\text{h}} 22.9^{\text{m}}$, $\delta = +9^\circ 55'$. Jeffers obtained a 90-minute exposure of the comet's position with the reflector on April 25, but the comet was not detected.

The first orbit calculated for this comet was an elliptical one by Whipple and Cunningham. They took three positions from October 15, 21, and 22,

and determined the perihelion date as 1933 July 8.43 and the period as 8.23 years. A few days later, A. D. Maxwell used the same positions to determine a perihelion date of July 2.99 and a period of 8.53 years. Using positions from October 15, 22, and 31, Whipple and Cunningham calculated a revised orbit with a perihelion date of August 2.59 and a period of 7.49 years. They added that the comet had apparently passed about 0.3 AU from Jupiter in May of 1922. Their orbit proved a very good representation of the true orbit, as shown by the orbits of M. Davidson (1934), Maxwell (1934, 1936), and C. M. Anderson Jr. and P. S. Riggs (1934).

Multiple apparition orbits were calculated by B. G. Marsden (1968, 1969, 1986), S. Nakano (2000), and P. Rocher (2005). All of these included planetary perturbations, while those published from 1969 onwards also solved for nongravitational forces. The result was a perihelion date of August 1.44 and a period of 7.50 years. Marsden (1968) noted a "very slight secular acceleration." Marsden (1969) gave the nongravitational terms as $A_1 = +0.60516$ and $A_2 = -0.062093$. Nakano (2000) gave the nongravitational terms as $A_1 = +0.332$ and $A_2 = -0.05283$. Rocher (2005) gave the nongravitational terms as $A_1 = +0.49054$ and $A_2 = -0.04709$. Nakano's orbit is given below.

The comet's close approach to Jupiter was examined by R. N. Thomas (1948) and K. Kinoshita (2005). Thomas said the comet passed 0.26 AU from Jupiter on 1922 June 14, while Kinoshita said it passed 0.2519 AU from the planet on June 20. Thomas said the comet's pre-encounter orbit had a perihelion distance of 3.9 AU and a period of 10.3 years. Kinoshita said the pre-encounter orbit had a perihelion distance of 4.23 AU and a period of 11.01 years.

T	ω	Ω (2000.0)	i	q	e
1933 Aug. 1.4370 (TT)	190.5471	189.5088	10.2064	2.496923	0.348190

ABSOLUTE MAGNITUDE: $H_{10} = 8.0$ (V1964)

FULL MOON: Oct. 3, Nov. 2, Dec. 2, Dec. 31, 1934 Jan. 30, Mar. 1, Mar. 31, Apr. 29, May 28, Jun. 27, Jul. 26, Aug. 24, Sep. 23, Oct. 22, Nov. 21, Dec. 20, 1935 Jan. 19, Feb. 18, Mar. 20, Apr. 18

SOURCES: F. L. Whipple, *HAC*, No. 283 (1933 Oct. 21); F. L. Whipple, L. E. Cunningham, and G. van Biesbroeck, *HAC*, No. 284 (1933 Oct. 23); F. L. Whipple, F. C. A. Schwassmann, A. A. Wachmann, and L. E. Cunningham, *BZAN*, **15** (1933 Oct. 27), p. 68; A. D. Maxwell, *HAC*, No. 286 (1933 Oct. 30); F. L. Whipple and L. E. Cunningham, *The Observatory*, **56** (1933 Nov.), p. 350; F. L. Whipple and L. E. Cunningham, *HAC*, No. 287 (1933 Nov. 3); F. L. Whipple and L. E. Cunningham, *The Observatory*, **56** (1933 Nov.), p. 350; E. J. Delporte, *BZAN*, **15** (1933 Nov. 1), p. 70; F. Kaiser, *BZAN*, **15** (1933 Nov. 17), p. 76; F. Kaiser, *BZAN*, **15** (1933 Nov. 25), p. 78; F. L. Whipple and L. E. Cunningham, *The Observatory*, **56** (1933 Dec.), p. 378; F. L. Whipple and L. E. Cunningham, *AN*, **250** (1933 Dec. 4), p. 363; H. M. Jeffers, C. M. Anderson, Jr., and P. S. Riggs, *LOB*, **17** (1934), pp. 6, 33–5; G. van Biesbroeck, *PA*, **42** (1934 Jan.), p. 49; G. van Biesbroeck, *PA*, **42** (1934 Feb.), p. 86; M. Davidson, *The Observatory*, **57** (1934 Feb.), p. 75; G. van Biesbroeck, *The Observatory*,

57 (1934 Mar.), p. 106; R. R. E. Schorr, *AN*, **251** (1934 Mar. 5), p. 212; L. S. Barnes, C. H. Barthelman, and H. M. Jeffers, *HAC*, No. 297 (1934 Apr. 3); H. M. Jeffers, *The Observatory*, **57** (1934 May), p. 170; M. Davidson and A. D. Maxwell, *The Observatory*, **57** (1934 Jun.), p. 202; G. van Biesbroeck, *AJ*, **44**, (1934 Aug. 31), pp. 1, 4, 6; H. M. Jeffers, *HAC*, No. 316 (1934 Nov. 26); H. M. Jeffers, *BZAN*, **16** (1934 Dec. 18), p. 76; H. M. Jeffers, *LOB*, **17** (1935), p. 124; H. M. Jeffers, *The Observatory*, **59** (1936 Jan.), p. 27; H. M. Jeffers, *MNRAS*, **96** (1936 Feb.), p. 345; A. D. Maxwell, *MNRAS*, **97** (1937 Feb.), pp. 334–5; A. D. Maxwell, *MNRAS*, **98** (1938 Feb.), pp. 348–9; R. N. Thomas, *AJ*, **53** (1948 May), pp. 188–91; V1964, p. 73; B. G. Marsden, *AJ*, **73** (1968 Jun.), pp. 370, 374; B. G. Marsden, *AJ*, **74** (1969 Jun.), pp. 725–6; B. G. Marsden, *CCO*, 5th ed. (1986), pp. 20, 54; B. G. Marsden, *QJRAS*, **27** (1986 Mar.), p. 116; S. Nakano, *Nakano Note*, No. 711 (2000 May 12); personal correspondence from P. Rocher (2005).

2P/Encke *Recovered*: 1934 July 6.45 ($\Delta = 1.93$ AU, $r = 1.43$ AU, Elong. = 46°)

Last seen: 1934 September 3.19 ($\Delta = 1.26$ AU, $r = 0.46$ AU, Elong. = 20°)

1934 III = 1934a *Closest to the Earth*: 1934 August 28 (1.2481 AU)

Calculated path: TAU (Rec), AUR (Jul. 22), GEM (Aug. 11), CNC (Aug. 21), LEO (Aug. 31)

A. C. D. Crommelin (1933) prepared an assumed set of elements for the upcoming 1934 apparition. He predicted perihelion would occur between 1934 September 15 and 17. During the first half of 1934, L. Matkiewicz and N. I. Idelson independently computed orbits for this comet and predicted perihelion would occur on September 15.20 and September 15.23, respectively.

H. M. Jeffers (Lick Observatory, California, USA) tried to recover this comet during the first half of July 1934. On 1934 July 6.45, the photographic plate exposed with the 91-cm Crossley reflector had been fogged by moonlight and dawn, but a suspicious object was found at $\alpha = 3^{\text{h}} 34.6^{\text{m}}$, $\delta = +26^\circ 50'$. This object was just visible as an uncondensed diffuse object of magnitude 16 and measured 0.2' in diameter. A plate exposed on July 9 was centered just east of the ephemeris position and failed to show the object; however, on July 10.44, Jeffers definitely found the comet at a position of $\alpha = 3^{\text{h}} 48.8^{\text{m}}$, $\delta = +27^\circ 44'$. The magnitude was estimated as 15, while the coma was diffuse and measured 0.2' in diameter. Some condensation was noted on this latter date. Another photograph was obtained by Jeffers on July 11.44, and showed the comet at magnitude 15, with a coma 0.2' across and containing a "not very sharp nucleus." Upon receiving Jeffers' announcement, G. van Biesbroeck (Yerkes Observatory, Wisconsin, USA) re-examined a pair of photographic plates exposed with a 61-cm reflector on July 8.35, and found the comet as a round diffuse coma about 15'' across. The magnitude was estimated as 15.5, while only a slight trace of condensation was noted.

Comet Encke remained at an elongation of $40\text{--}47^\circ$ during June 12–August 13 (maximum elongation came on July 17) and it is obvious that it was

detected almost as soon as its steadily increasing brightness permitted. On July 15, van Biesbroeck estimated the magnitude as 15. He said the very diffuse coma was about 25'' in diameter. On the 18th, van Biesbroeck gave the magnitude as 14.5. The coma was described as better defined (though without a nucleus) and 20'' across. On July 21, Jeffers gave the magnitude as 13 (91-cm Crossley reflector). He said the coma was 0.7' across and contained a nonstellar nucleus eccentrically situated in the southwest portion.

The occurrence of a full moon on July 26 put a damper on observations during the last week of July and during the first two weeks of August, but observations resumed shortly before mid-August. The comet had attained its most northerly declination of +31° on August 5. On August 9, D. Kotsakis (National Observatory, Athens, Greece) described the comet as very diffuse and irregular, with a total magnitude of 13. G. Adamopoulos (National Observatory) observed using the 40-cm refractor and said the coma was irregular, without a nucleus. He noted the condensation was elongated toward the west-southwest. On the 10th, Adamopoulos gave the magnitude as 12 and noted a coma 80'' across. On the 11th, Adamopoulos gave the magnitude as 11.5 and noted it was visible in the 8-cm finder. Kotsakis gave the magnitude as 11 on the 12th, 10.5 on the 13th, and 10 on the 14th. He noted a distinct condensation on the 13th. On the 15th, Kotsakis said the round coma contained a very distinct condensation. He added that from time to time a weak nucleus was visible in the center of the condensation.

The comet continued to brighten during the last half of August. On August 17, the magnitude was independently given as 9.5 by Adamopoulos and van Biesbroeck. Adamopoulos said the coma was 80'' across, while a stellar nucleus was occasionally seen that was eccentric toward the west-northwest. Van Biesbroeck described the comet as exhibiting a coma 20'' in diameter, with a diffuse central condensation of magnitude 10.5, and a broad tail extending about 3' in PA 80°. On the 18th, van Biesbroeck noted the coma was "quite bright in central part," with a magnitude of 9.0, a nucleus of magnitude 10, and a tail extending to PA 75°. On the 20th, Kotsakis gave the magnitude as 9.5. On the 21st, the magnitude was given as 8.5 by van Biesbroeck and 9.2 by Adamopoulos. Van Biesbroeck determined the coma diameter as 20'' and said, "The axis of the broad tail is in 75 degrees." The nuclear magnitude was given as 9. Adamopoulos said the stellar nucleus was magnitude 11.5 and eccentric toward the west-northwest. On the 22nd, Adamopoulos gave the magnitude as 9.0 and said the coma was 70'' across. On the 28th and 29th, Adamopoulos gave the magnitude as 9.0. On the former date, he noted a nucleus of magnitude 10.0–10.5. On the 30th, van Biesbroeck found twilight too bright to allow photography, but visually saw the comet and noted a well-defined nucleus and a magnitude that equalled the star 79 Cancri (magnitude about 6.3). On August 31, Adamopoulos observed using the 40-cm refractor and gave the magnitude as 8.5.

The comet was last detected on September 3.19, when R. Carrasco (Madrid Observatory, Spain) photographed it in morning twilight. He gave the

position as $\alpha = 9^{\text{h}} 37.6^{\text{m}}$, $\delta = +18^{\circ} 26'$. The comet was at a minimum elongation of 1° on September 17.

M. G. Sumner (1934) took positions from August 17, 23, and 29, and calculated an orbit with a perihelion date of September 15.26 and a period of 3.41 years.

Multiple apparition orbits have been calculated by S. Y. Luchich (1958), B. G. Marsden (1969, 1970), N. A. Bokhan and Y. A. Chernetenko (1974), and Marsden and Z. Sekanina (1974). All of these orbits included planetary perturbations, while those from 1969 and later also included the effects of nongravitational terms. The result was a perihelion date of September 15.28 and a period of 3.28 years. Marsden and Sekanina (1974) gave the nongravitational terms as $A_1 = -0.09$ and $A_2 = -0.01144$.

T	ω	Ω (2000.0)	i	q	e
1934 Sep. 15.2835 (TT)	184.9229	335.6024	12.5678	0.331865	0.849813

ABSOLUTE MAGNITUDE: $H_{10} = 11.6$ (V1964)

FULL MOON: Jun. 27, Jul. 26, Aug. 24, Sep. 23

SOURCES: A. C. D. Crommelin, *BAA Handbook for 1934* (1933), p. 20; *The Observatory*, **56** (1933 Dec.), p. 379; H. M. Jeffers, *HAC*, No. 304 (1934 Jul. 11); H. M. Jeffers, *BZAN*, **16** (1934 Jul. 13), p. 40; H. M. Jeffers and G. van Biesbroeck, *HAC*, No. 305 (1934 Jul. 16); H. M. Jeffers, *AN*, **252** (1934 Jul. 31), p. 387; H. M. Jeffers, *PASP*, **46** (1934 Aug.), pp. 234–5; H. M. Jeffers, G. van Biesbroeck, L. Matkiewicz, and N. I. Idelson, *The Observatory*, **57** (1934 Aug.), p. 260; H. M. Jeffers and G. van Biesbroeck, *PA*, **42** (1934 Aug.–Sep.), p. 391; G. van Biesbroeck, *PA*, **42** (1934 Oct.), p. 464; H. M. Jeffers, *PASP*, **46** (1934 Oct.), pp. 283–4; G. Adamopoulos, *The Observatory*, **57** (1934 Oct.), p. 314; M. G. Sumner, *JBA*, **45** (1934 Nov.), p. 49; G. van Biesbroeck, *The Observatory*, **57** (1934 Nov.), pp. 350–1; G. Adamopoulos, *JO*, **17** (1934 Dec.), pp. 195–6; D. Kotsakis, *AN*, **254** (1934 Dec. 21), pp. 63–4; R. Carrasco, *Boletín Astronómico del Observatorio de Madrid*, **2** (1935), p. 1; H. M. Jeffers, *LOB*, **17** (1935), p. 124; L. Matkiewicz and N. I. Idelson, *MNRAS*, **95** (1935 Feb.), pp. 386–7; G. van Biesbroeck, *AJ*, **45** (1935 Dec. 4), pp. 17–19; [Madrid Observatory], *VJS*, **71** (1936), p. 46; S. Y. Luchich, *MNRAS*, **119** (1959), pp. 442–3; V1964, p. 73; B. G. Marsden, *AJ*, **74** (1969 Jun.), pp. 725–6, 728–30; B. G. Marsden, *QJRAS*, **11** (1970 Sep.), pp. 232–3; N. A. Bokhan and Y. A. Chernetenko, *QJRAS*, **15** (1974 Dec.), pp. 452–3, 459; B. G. Marsden and Z. Sekanina, *AJ*, **79** (1974 Mar.), pp. 413–19.

30P/1934 V1 (Reinmuth 1) *Recovered*: 1934 November 5.41 ($\Delta = 1.52$ AU, $r = 2.38$ AU, Elong. = 142°)
Last seen: 1935 April 7.10 ($\Delta = 1.85$ AU, $r = 1.87$ AU, Elong. = 75°)

Closest to the Earth: 1934 December 24 (1.2243 AU)

1935 II = 1934b *Calculated path*: ORI (Rec), TAU (Dec. 21), ORI (Mar. 28), GEM (Apr. 2)

The recovery of this comet began when J. T. Foxell and A. E. Levin (1934) took the orbit for the 1928 apparition, applied perturbations by Jupiter and Saturn, and predicted the next perihelion date would occur on 1935 May

1.42. H. M. Jeffers (Lick Observatory, California, USA) recovered this comet on 60-minute exposures obtained with the 91-cm Crossley reflector on 1934 November 5.41 and November 5.45. The position on the former date was given as $\alpha = 5^{\text{h}} 11.8^{\text{m}}$, $\delta = +11^{\circ} 47'$. He initially estimated the magnitude as 16, but later revised it to 15, and noted "a small extension of the coma towards the west." The recovery was confirmed by Jeffers on November 7.35. The comet was described as fairly well condensed and $6''$ across. The magnitude was also initially estimated as 16, but was later revised to 15. Foxell and Levin's predicted perihelion date proved to have been 0.36 days too early.

On November 12, G. van Biesbroeck (Yerkes Observatory, Wisconsin, USA) obtained the first of several photographs of this comet using the 61-cm reflector. He estimated the magnitude as 16.5. The coma diameter was $12''$, while there was "a little indication of an extension towards the west." On November 15, van Biesbroeck estimated the magnitude as 16. On December 2, the comet attained its most southerly declination of $+11^{\circ}$. Jeffers then obtained two 40-minute exposures using the 91-cm Crossley reflector, which revealed a magnitude of 13.5. He noted that the comet was larger and rounder than in November. A 20-minute exposure was obtained by van Biesbroeck, using the 61-cm reflector on December 11. He estimated the magnitude as 15.5. Van Biesbroeck added that the coma was $15''$ across and fanned out toward PA 260° where a tail extended $20''$.

On 1935 January 3 and 4, van Biesbroeck said the comet was very diffuse, with a coma diameter of $20''$ and a magnitude of 15. On January 24, van Biesbroeck said the coma was round with a magnitude of 15.5. On January 24 and 31, Jeffers examined 20-minute exposures obtained by C. D. Swanson, while using the 91-cm Crossley reflector. Jeffers estimated the magnitude as 13.5 and noted the comet was larger and rounder than in November. On February 6, R. R. E. Schorr (Hamburg Observatory, Bergedorf, Germany) estimated the photographic magnitude as 16. On February 26, van Biesbroeck estimated the photographic magnitude as 15, while a faint indication of a tail was noted to PA 100° . On February 27, van Biesbroeck estimated the photographic magnitude as 15. The coma was round, $20''$ across, and a faint broad tail extended $1.5'$ in PA 110° . On March 5, Schorr estimated the photographic magnitude as 16. On March 29, van Biesbroeck estimated the photographic magnitude as 16.

The comet was last detected on April 7.10, when van Biesbroeck obtained a 20-minute exposure with the 61-cm reflector. He described it as $12''$ in diameter, with a "little indication of tail in the following side." The magnitude was 16.5. The position was determined as $\alpha = 6^{\text{h}} 07.3^{\text{m}}$, $\delta = +23^{\circ} 09'$. The moon was full on April 18.

Multiple apparition orbits have been calculated by S. Kanda and H. Hirose (1936), F. R. Cripps (1949), G. Merton (1949), and B. G. Marsden (1979). The perihelion date was given as April 29.77 by Kanda and Hirose, April 29.87 by Cripps, April 29.91 by Merton, and April 29.90 by Marsden. Marsden's orbit

was the first to use more than five positions from the first two apparitions, as well as perturbations by all nine planets. His orbit is given below.

T	ω	Ω (2000.0)	i	q	e
1935 Apr. 29.8992 (TT)	8.8400	125.8266	8.0615	1.855917	0.503541

ABSOLUTE MAGNITUDE: $H_{10} = 11.5$ (V1964)

FULL MOON: Oct. 22, Nov. 21, Dec. 20, 1935 Jan. 19, Feb. 18, Mar. 20, Apr. 18

SOURCES: J. T. Foxell and A. E. Levin, *BAA Handbook for 1935* (1934), p. 23; H. M. Jeffers, *HAC*, No. 313 (1934 Nov. 6); H. M. Jeffers, *BZAN*, **16** (1934 Nov. 9), p. 68; H. M. Jeffers, *HAC*, No. 316 (1934 Nov. 26); H. M. Jeffers, *PA*, **42** (1934 Dec.), p. 593; H. M. Jeffers, J. T. Foxell, and A. E. Levin, *The Observatory*, **57** (1934 Dec.), p. 391; H. M. Jeffers, *BZAN*, **16** (1934 Dec. 18), p. 76; H. M. Jeffers, *LOB*, **17** (1935), p. 124; H. M. Jeffers, *The Observatory*, **58** (1935 Jan.), pp. 30–1; J. T. Foxell and A. E. Levin, *MNRAS*, **95** (1935 Feb.), pp. 386–7; R. R. E. Schorr, *AN*, **254** (1935 Feb. 14), p. 247; R. R. E. Schorr, *BZAN*, **17** (1935 Feb. 17), p. 11; R. R. E. Schorr, *The Observatory*, **58** (1935 Mar.), p. 99; R. R. E. Schorr, *IAUC*, No. 524 (1935 Mar. 9); R. R. E. Schorr, *BZAN*, **17** (1935 Mar. 11), p. 17; G. van Biesbroeck, *PA*, **43** (1935 Apr.), p. 256; G. van Biesbroeck, *PA*, **43** (1935 May), p. 306; G. van Biesbroeck, *AJ*, **45** (1935 Dec. 4), pp. 17, 19; R. R. E. Schorr, *AN*, **262** (1937 Mar. 8), p. 33; S. Kanda and H. Hirose, *MNRAS*, **107** (1947), pp. 108–9, 112; F. R. Cripps and G. Merton, *MNRAS*, **109** (1949), pp. 254–5; V1964, p. 73; B. G. Marsden, *CCO*, 3rd ed. (1979), pp. 24, 51; B. G. Marsden, *QJRAS*, **26** (1985 Mar.), p. 79.

- 31P/1934 XI** *Recovered*: 1934 December 11.11 ($\Delta = 2.05$ AU, $r = 2.76$ AU, Elong. = 126°)
(Schwassmann–Wachmann 2) *Last seen*: 1936 June 10.29 ($\Delta = 2.31$ AU, $r = 2.87$ AU, Elong. = 113°)
Closest to the Earth: 1936 March 24 (1.5938 AU)
Calculated path: PSC (Rec), CET (Jan. 29), ARI (Feb. 11), TAU (Mar. 26), ORI (Jun. 5), GEM (Jun. 10), CNC (Jul. 30), LEO (Sep. 3), VIR (Nov. 8)
1935 III = 1934c

F. K. Zweck (1934) computed the perturbations for the period of 1929–35. He determined the likely perihelion date as 1935 August 17.9. During 1934 November, H. Q. Rasmusen took the 1929 orbit computed by S. Kanda and applied perturbations by Jupiter and Saturn. He predicted the next perihelion would occur on 1935 August 31.39. P. J. Harris and J. D. McNeile (1934) applied perturbations by Jupiter and Saturn to an orbit computed for the 1929 apparition and predicted the comet would next arrive at perihelion on August 24.1.

Using a search ephemeris published by Zweck, A. A. Wachmann found an object within $2'$ of the predicted position on 1934 August 15.03. It was described as stellar and, with a magnitude of 12, it was 2 magnitudes brighter than expected. The object was confirmed by L. E. Cunningham on August 16.32 and 17.25, who described it as perfectly stellar, with a magnitude of 11. Cunningham was at once suspicious of the object and calculated a circular orbit based on his two positions and found a very close agreement with the asteroid Nysa (44). A comparison with the predicted position and

motion of that asteroid immediately confirmed this finding and the search for P/Schwassmann–Wachmann 2 continued.

Using an ephemeris computed by Rasmusen, G. van Biesbroeck (Yerkes Observatory, Wisconsin, USA) recovered this comet on 1934 December 11.11, at $\alpha = 1^{\text{h}} 43.4^{\text{m}}$, $\delta = +5^{\circ} 22'$. It was photographed with the 61-cm reflector and was described as “fuzzy,” with a magnitude of 16. Van Biesbroeck confirmed the observation on December 12.11, and described the comet as round and diffuse, with a magnitude 16.5. The coma was $8''$ across. On December 13.24, van Biesbroeck estimated the magnitude as 16. A well-defined, broad tail extended over $1'$ in PA 35° . The comet’s perihelion date ended up being 2.6 days earlier than predicted.

This was not a particularly favorable apparition for the comet as perihelion occurred on the opposite side of the sun from Earth, meaning that the comet was lost in the sun’s glare when at its brightest. It therefore remained a faint object during this apparition and was only visible to the larger telescopes in the world. Photographs by van Biesbroeck on 1935 January 3 and 4 revealed a round coma about $20''$ across, with a magnitude of 15.4. There was also a faint tail extending toward PA 50° . On the 24th, van Biesbroeck obtained another image which revealed the comet was fairly well defined and magnitude 15.5. The short tail extended toward PA 70° . On January 31, H. M. Jeffers (Lick Observatory, California, USA) photographed the comet using the 91-cm Crossley reflector and gave the magnitude as 14. He noted that 20- and 30-minute exposures showed “a trace of a tail extending $0.2'$ towards the east.”

On February 6, R. R. E. Schorr (Hamburg Observatory, Bergedorf, Germany) photographed the comet using the 100-cm reflector and estimated the magnitude as 15. On February 27, van Biesbroeck gave the magnitude as 15.5. He said the round coma was about $15''$ across, while the tail extended about $2'$ in PA 80° . Van Biesbroeck considered the tail “a rather unexpected feature for so faint an object.”

The comet was last observed before entering twilight on March 5.84, when Schorr estimated the magnitude as 16.5. The comet was in conjunction with the sun throughout the spring and summer months. It attained its most northerly declination of $+22^{\circ}$ on June 17 and passed about 1° from the sun on July 7. The comet finally emerged from the sun’s glare in November, when van Biesbroeck photographed it on the 23rd. He said the coma was round and magnitude 15, while the tail extended $3'$ in PA 300° . It was photographed by Jeffers on November 28, at which time the magnitude was given as 15 and the tail extended 2 – $3'$ toward the west. Van Biesbroeck again photographed the comet on December 2. He estimated the magnitude as 15.5, and noted a short tail extending toward PA 305° .

On 1936 January 24, Jeffers gave the photographic magnitude as 16 and said a 20-minute exposure hardly revealed the tail. On January 28, van Biesbroeck gave the photographic magnitude as 16 and noted a faint indication of a tail extending to PA 310° . Van Biesbroeck photographed the comet

on February 1 and gave the magnitude as 16. He said the coma was well defined and the tail extended 2' in PA 305°. The comet attained its most southerly declination of -5° on February 7. Van Biesbroeck photographed it on March 18 and gave the magnitude as 15. He said the round coma was about 20'' across. On April 12, van Biesbroeck gave the photographic magnitude as 14.5. He said the coma was 25'' in diameter and extended to PA 170°. There was also a well-defined nucleus. On April 15, van Biesbroeck gave the photographic magnitude as 14, while the coma was described as over 40'' across under "very transparent" skies. Jeffers photographed the comet on April 16 and gave the magnitude as 16. He said a 20-minute exposure hardly revealed the tail. Van Biesbroeck photographed the comet on April 17 and 18 and gave the magnitude as 14.5. On the first date, van Biesbroeck said the coma was centrally condensed, while, on the second date, he noted the round coma was about 30'' across. On April 22, van Biesbroeck gave the photographic magnitude as 15 and the coma diameter as 20'' across. Van Biesbroeck photographed the comet on May 14 and 17 and gave the magnitude as 16.5. On May 20, van Biesbroeck gave the photographic magnitude as 17.5 and the "hardly measurable diffuse coma" as about 30'' across.

The last two observations of the comet came on June 10.26 and June 10.29, when Jeffers obtained 30- and 40-minute exposures with the 91-cm Crossley reflector. For the latter date, he gave the position as $\alpha = 12^{\text{h}} 52.4^{\text{m}}$, $\delta = -0^{\circ} 37'$. Jeffers estimated the magnitude as 17.5, and described the comet as diffuse, with a diameter of "a few seconds of arc." Jeffers obtained a 1-hour exposure with the 91-cm Crossley reflector on July 17, but the comet was not found.

Very similar orbits have been computed by a number of astronomers during the last few decades. While the comet was still in the sky, Rasmusen (1935) did an elaborate investigation of the comet's motion back to 1920. He noted the comet passed only 0.179 AU from Jupiter on 1926 March 26, but even more remarkable was the fact that the comet stayed within 2 AU of Jupiter from 1921 March until 1928 March. Prior to this encounter the comet's orbit had a perihelion distance of 3.55 AU and an orbital period of 9.31 years. Multiple apparition orbits were computed by Rasmusen (1953), B. G. Marsden (1968, 1969, and 1973), and G. Forti (1983), which gave the perihelion date as August 28.63 and the period as 6.42 years. The 1973 orbit of Marsden and that of Forti included the effects of nongravitational forces, with Forti's terms being $A_1 = +0.76$ and $A_2 = -0.1863$.

T	ω	Ω (2000.0)	i	q	e
1935 Aug. 28.6272 (TT)	358.0700	126.9131	3.7241	2.094649	0.393889

ABSOLUTE MAGNITUDE: $H_{10} = 9.9$ (V1964)

FULL MOON: Dec. 20, 1935 Jan. 19, Feb. 18, Mar. 20, Apr. 18, May 18, Jun. 16, Jul. 16, Aug. 14, Sep. 12, Oct. 12, Nov. 10, Dec. 10, 1936 Jan. 8, Feb. 7, Mar. 8, Apr. 6, May 6, Jun. 5

SOURCES: P. J. Harris and J. D. McNeile, *BAA Handbook for 1935* (1934), p. 25; A. A. Wachmann, *BZAN*, **16** (1934 Aug. 15), p. 46; A. A. Wachmann, *HAC*, No. 306 (1934 Aug. 15); L. E. Cunningham, *HAC*, No. 307 (1934 Aug. 20); F. K. Zweck and A. A. Wachmann, *The Observatory*, **57** (1934 Sep.), pp. 286–7; L. E. Cunningham, *BZAN*, **16** (1934 Sep. 6), p. 52; A. A. Wachmann and L. E. Cunningham, *The Observatory*, **57** (1934 Oct.), p. 313; A. A. Wachmann, *PA*, **42** (1934 Oct.), pp. 464–5; H. Q. Rasmusen, *AN*, **253** (1934 Nov. 13), pp. 427–30; G. van Biesbroeck, *HAC*, No. 317 (1934 Dec. 12); G. van Biesbroeck, *BZAN*, **16** (1934 Dec. 18), p. 76; H. M. Jeffers, *LOB*, **17** (1935), p. 124; G. van Biesbroeck, *PA*, **43** (1935 Jan.), pp. 60–1; G. van Biesbroeck, *The Observatory*, **58** (1935 Jan.), p. 30; G. van Biesbroeck, *BZAN*, **17** (1935 Jan. 7), p. 1; L. E. Cunningham, G. van Biesbroeck, H. Q. Rasmusen, P. J. Harris, and J. D. McNeile, *MNRAS*, **95** (1935 Feb.), pp. 386–7; R. R. E. Schorr, *AN*, **254** (1935 Feb. 14), p. 247; R. R. E. Schorr, *BZAN*, **17** (1935 Feb. 17), p. 11; R. R. E. Schorr, *The Observatory*, **58** (1935 Mar.), p. 99; R. R. E. Schorr, *IAUC*, No. 524 (1935 Mar. 9); R. R. E. Schorr, *BZAN*, **17** (1935 Mar. 11), p. 17; G. van Biesbroeck, *PA*, **43** (1935 Apr.), p. 256; G. van Biesbroeck, *HAC*, No. 355 (1935 Nov. 27); G. van Biesbroeck, *PA*, **43** (1935 Dec.), p. 654; G. van Biesbroeck, *AJ*, **45** (1935 Dec. 4), pp. 18–19; G. van Biesbroeck, *BZAN*, **17** (1935 Dec. 23), p. 74; H. M. Jeffers, *LOB*, **17** (1936), p. 193; G. van Biesbroeck, *The Observatory*, **59** (1936 Jan.), p. 27; G. van Biesbroeck, *BZAN*, **18** (1936 Jan. 6), p. 1; H. Q. Rasmusen, *MNRAS*, **96** (1936 Feb.), pp. 345–7; G. van Biesbroeck, *The Observatory*, **59** (1936 May), p. 175; H. M. Jeffers, *LOB*, **18** (1937), pp. 85; G. van Biesbroeck, *AJ*, **46** (1937 Jan. 2), pp. 1, 3–5; R. R. E. Schorr, *AN*, **262** (1937 Mar. 8), p. 33; H. Q. Rasmusen, *MNRAS*, **113** (1953), pp. 390–1; H. Q. Rasmusen, *MNRAS*, **116** (1956), pp. 226–7; H. Q. Rasmusen, *QJRAS*, **1** (1960 Dec.), pp. 232–3; V1964, p. 73; B. G. Marsden, *AJ*, **73** (1968 Jun.), pp. 373, 375; B. G. Marsden, *QJRAS*, **9** (1968 Sep.), pp. 314–15; B. G. Marsden, *QJRAS*, **10** (1969 Sep.), pp. 252–3; B. G. Marsden, *AJ*, **74** (1969 Jun.), pp. 721–4; B. G. Marsden, *QJRAS*, **14** (1973 Dec.), pp. 404–5; G. Forti, *AAP*, **126** (1983), pp. 307–10.

C/1935 A1 *Discovered:* 1935 January 7.78 ($\Delta = 1.11$ AU, $r = 1.22$ AU, Elong. = 70°)

(Johnson) *Last seen:* 1935 May 24.27 ($\Delta = 1.48$ AU, $r = 1.71$ AU, Elong. = 84°)

Closest to the Earth: 1935 February 11 (0.8530 AU)

1935 I = 1935a *Calculated path:* PHE (Disc), SCL (Jan. 18), CET (Jan. 28), PSC (Feb. 13), AND (Mar. 5), CAS (Mar. 17), CEP (Apr. 9), DRA (May 4), UMi (May 16)

E. L. Johnson (Union Observatory, Johannesburg, South Africa) was using the 25-cm Franklin–Adams Star Camera for the purpose of filling some of the remaining gaps in a series of star charts of the Southern Hemisphere. On the evening of 1935 January 7, he exposed two photographs, one centered at $\alpha = 0^{\text{h}} 45^{\text{m}}$, $\delta = -52^\circ$, and the other centered at $\alpha = 1^{\text{h}} 15^{\text{m}}$, $\delta = -52^\circ$. The first plate was exposed for 30 minutes, while the second, being interrupted by clouds, was exposed for 22.5 minutes. The following morning the plates were developed and examined. Johnson discovered a short, diffuse trail on the first photograph exposed on 1935 January 7.78. The position was given $\alpha = 0^{\text{h}} 59.6^{\text{m}}$, $\delta = -52^\circ 05'$, and the comet's image appeared large and faint, without a nucleus, and with a magnitude of 10.0. Due to some overlap

between the two plates, the comet also appeared on the second plate, so that the possibility of a "false object" was immediately ruled out. Johnson confirmed the comet on January 8.77. It was described as diffuse, with a magnitude of 10. He then announced the discovery to the Central Bureau in Copenhagen (Denmark). At the time of discovery, the comet was heading toward both the sun and Earth.

On January 9 and 12, H. E. Wood (Union Observatory) gave the magnitude as 10. He described the comet as large, rather faint, and without a nucleus. Johnson visually saw the comet through a 23-cm telescope on January 24 and gave the magnitude as 9. He said the comet was large, diffuse, without a stellar nucleus. On the 30th, G. van Biesbroeck (Yerkes Observatory, Wisconsin, USA) gave the magnitude as 9.7. He added that the coma was constructed of a bright inner portion about 20'' across surrounded by a much fainter outer portion measuring 3–4' across. There was no nucleus or tail. On January 31, K. Graff (Arenal, Spain) gave the magnitude as 9.2. He said the comet appeared washed out, with no nucleus. He added that the coma was 2' across.

The comet was closest to Earth near mid-February. On February 1, Johnson visually observed with the 15-cm telescope and estimated the magnitude as 9. He said the comet was large and diffuse, with no nucleus. Van Biesbroeck gave the magnitude as 9.8 on the 4th and noted the brighter portion of the coma had increased to 30'', but there was still no nucleus. On February 6, Graff gave the magnitude as 9.1, while R. R. E. Schorr (Hamburg Observatory, Bergedorf, Germany) said the coma was 1.5' across and contained no nucleus. On February 7, the magnitude was given as 8.5 by van Biesbroeck and 9.0 by F. Kaiser (Wiesbaden, Germany). Van Biesbroeck said the comet seemed more condensed. H. Krumpholz (Vienna, Austria) said the round coma was 3' across and contained a small condensation, but no nucleus. Kaiser said the coma was diffuse and 2' across, but exhibited no tail. A. A. Wachmann (Hamburg Observatory) described the comet as diffuse, 2–3' across, without a nucleus. Johnson saw the comet on February 8, using a 15-cm refractor. He estimated the magnitude as 8.5 and described the comet as large and diffuse, with no nucleus. On February 9 and 11, S. I. Beljowsky (Simeis Observatory, Crimea, Ukraine) estimated the magnitude as 9.0. Also on the 11th, H. M. Jeffers (Lick Observatory, California, USA) observed the comet in moonlight with the 30-cm refractor and gave the magnitude as 10.5. He said the comet was faint, diffuse, and about 0.8' across. On the 12th, Johnson gave the magnitude as 8.5. He said the coma was round and more condensed, but still contained no nucleus. On February 14, A. Schmitt (Alger, now al-Jazâ'ir, Algeria) said the comet was diffuse, without a nucleus, and 45'' across. Schmitt gave the coma diameter as 1' on the 15th and 17th.

The comet passed perihelion near the end of February. On February 19, Krumpholz gave the magnitude as 9.5. He noted a distinct condensation, but no nucleus. Schmitt said the round coma was 1' across, but contained

no nucleus. On the 20th, G. Adamopoulos (National Observatory, Athens, Greece) gave the magnitude as 8.7. He said the coma was round and 1' across, while there was a central condensation, and a possible stellar nucleus. P. Chofardet (Besançon, France) said the round coma was 2' across. J. Franz (Bautzen, Germany) said the comet was easily visible in the 13-cm comet seeker as a condensed nebulosity. On the 21st, the magnitude was given as 8.8 by van Biesbroeck and 9.3 by N. Rudsky (Kiev, Ukraine). Van Biesbroeck said the coma seemed smaller and more condensed, but there was still no nucleus. Schmitt said the round coma was 1' across, but contained no nucleus. On the 22nd, the magnitude was given as 8.5–9.0 by Adamopoulos and 9.0 by Rudsky. Adamopoulos said the coma was 1.5' across, with a condensation 20'' across. There was also a stellar nucleus of magnitude 12.0–12.5, which was eccentrically situated towards the east-northeast. Jeffers said the comet appeared diffuse in the 30-cm refractor. On the 24th, the magnitude was given as 8.6 by Rudsky, 9.0 by C. Fedtke (Königsberg, now Kaliningrad, Russia), and 9.2 by A. D. Dubiago (University Observatory, Kazan, Russia). The coma was described as round and 1.5' across by Schmitt and condensed and 3' across by Fedtke. Fedtke saw no nucleus. On February 25 and 28, Adamopoulos gave the magnitude as 8.8. He said the coma was 2' across, while the condensation was 25'' across. The stellar nucleus was situated just east of the condensation's center and was magnitude 11.0–11.5. On the 26th, the magnitude was given as 8.4 by van Biesbroeck, 8.55 by Graff, and 8.78 by M. Beyer (Hamburg, Germany). Beyer said the coma was round and 3' across. On the 27th, the magnitude was given as 8.6 by van Biesbroeck, 9.2 by Krumpholz, and 9.5 by Dubiago. Schmitt said the round coma was 1.5' across. Van Biesbroeck said a 20-minute exposure showed a diffuse outer coma 2.8' across, while the central, brighter part was about 1' across. A "minute stellar nucleus" was occasionally suspected. A threadlike filament extended from the nucleus to PA 60°. It widened at 10' from the nucleus and was about 35' long. On February 28, van Biesbroeck gave the magnitude as 9.0. He said the coma diameter was 2.1', while the tail noted on the previous night had become fainter. The nucleus was more sharply defined to PA 60°, or at the root of the tail, while it was more diffuse in the opposite direction. He noted that this gave the nucleus "a slightly pear-shaped appearance."

The comet was moving away from both the sun and Earth as March began. On March 2, the visual magnitude was given as 8.7 by van Biesbroeck, while the photographic magnitude was estimated as 10.5 by P. Vocca. Van Biesbroeck said the coma diameter was 1.5'. The threadlike tail extended 4' in PA 51°, but instead of gradually widening or diffusing to invisibility, it just abruptly stopped. On the 3rd, Beyer and Fedtke independently gave the magnitude as 8.8 and the coma diameter as 3'. Beyer said the coma was round, while Fedtke noted a strong central condensation. On the 4th, the magnitude was given as 8.8 by Fedtke and 8.85 by Beyer. Beyer said the coma was round and 3' across. On the 5th, the magnitude was given as 8.6

by Fedtke, 8.77 by Beyer, and 9.0 by Dubiago. Beyer said the coma was 3' in diameter. On the 7th, the magnitude was given as 8.5 by Fedtke and 9.0 by Kaiser. Schmitt said the coma was 45'' across, while Kaiser and Fedtke noted it was 3' across. Kaiser and Fedtke both reported a strong central condensation. On the 8th, the magnitude was given as 8.6 by Fedtke and 8.9 by Beyer. Fedtke noted the coma was 3' across, with a strong central condensation. On the 9th, the magnitude was given as 8.6 by Fedtke, 8.79 by Beyer, 8.8 by Rudsky, and 8.9 by van Biesbroeck. The coma diameter was given as 1.5' by van Biesbroeck and 3' by Beyer. The coma was described as round by S. D. Tscherny (Kiev), Beyer, and Chofardet. Wachmann noted a faint nucleus. During the period of March 9–20, H. Fischer (Innsbruck, Austria) photographed the comet and estimated the magnitude as 9. He also noted the round coma was about 1' across and exhibited no nucleus. On the 10th, Fedtke gave the magnitude as 8.6 and noted the coma was 3' across, with a strong central condensation. On the 11th, Beyer gave the magnitude as 8.83. Jeffers observed with the 30-cm refractor and said the comet was diffuse with a magnitude of 10.5–11. On the 12th, van Biesbroeck gave the magnitude as 8.8. Jeffers estimated it as 10.5–11, while R. M. Aller (Pontevedra, Spain) gave it as 11. Van Biesbroeck said the coma diameter was 1.4'. Jeffers described the comet as diffuse. On the 13th, Beyer gave the magnitude as 8.93. He said the coma was round, with a diameter of 3'. On the 14th, Beyer gave the magnitude as 9.02 and the nuclear magnitude as fainter than 11.5. On March 15, van Biesbroeck gave the magnitude as 9.3.

The comet faded more rapidly during the last half of March. On March 18, van Biesbroeck observed in moonlight and gave the magnitude as 9.2. On the 21st, Adamopoulos and Dubiago independently gave the magnitude as 11.0 in moonlight. Adamopoulos said it was feeble, with the condensation situated east-northeast of the coma's center. On the 23rd, Dubiago gave the magnitude as 11.0 in moonlight. On the 24th, van Biesbroeck gave the magnitude as 9.7 and noted the very diffuse coma was 2.5' across. On the 25th, the magnitude was given as 11 by Krumpholz and Chofardet, while Schmitt said it was 12, but these probably represented the condensation. Krumpholz said there was a small condensation, but no nucleus. Chofardet said the round coma was 1' across. On the 26th, Chofardet gave the magnitude as 11 and the coma diameter as 2'. On the 27th, Beyer gave the magnitude as 9.70. He said the coma was round, with a diameter of 2' and a nucleus of magnitude 11.8. On the 29th, van Biesbroeck gave the magnitude as 10. He added that the coma was less condensed, very diffuse, and about 3' across. There was no longer a trace of a tail. Adamopoulos said the coma was 1.8' across, with an almost central condensation. On March 30, Beyer gave the magnitude as 9.81. He said the coma was 2' in diameter, with a nucleus of magnitude 12.0.

The comet faded rapidly during April. On April 2 and 3, Adamopoulos gave the magnitude as 11.0. He said the coma was 1.8' across, with an almost central condensation. On the 6th, the magnitude was given as 10.23 by

Beyer and 10.5 by Wachmann. Beyer said the coma was 2' in diameter with a nucleus fainter than magnitude 12. Van Biesbroeck gave the magnitude as about 11 on the 7th and described the comet as extremely diffuse and about 3' in diameter. On the 11th, Schmitt gave the magnitude as 13 and said the coma was 0.5' across. On the 13th, van Biesbroeck said the comet was poorly condensed, with a diameter of 4' and a magnitude near 12. Van Biesbroeck described the comet as "much fainter" on the 21st and gave the magnitude as 14.5. He noted the coma was diffuse and 1' across. On the 22nd, van Biesbroeck gave the magnitude as 15. He described the comet as very diffuse, with a round coma 45'' across. On April 30, van Biesbroeck gave the magnitude as 15. A faint central condensation was about 30'' across, while the round coma was about 1' across.

On May 4, van Biesbroeck described the comet as a "hardly measurable hazy coma," with a magnitude near 16.5. On the 6th, Kaiser gave the magnitude as 12.0 and noted a coma 2' across. He noted that the position was over 11' from what was predicted. On May 8, the comet attained its most northerly declination of +81°. On May 11, van Biesbroeck photographed the comet as a vague, diffuse coma of about magnitude 17.

The comet was last detected on May 24.27, when van Biesbroeck obtained a 20-minute exposure with the 61-cm reflector. The comet appeared as a small round coma with a magnitude near 17.5. The position was given as $\alpha = 16^{\text{h}} 14.2^{\text{m}}$, $\delta = +74^{\circ} 58'$. Schorr reported that J. Larink obtained photographic positions on May 27.96 and May 28.98. The comet was described as weak and diffuse, with a magnitude of 15.

S. K. Vsekhsvyatskij (Sternberg Astronomical Institute, Moscow, Russia) photographed the spectrum of this comet on March 6 and 14 using a 15-cm prismatic camera. He noted strong bands of cyanogen and diatomic carbon, as well as a weak band of triatomic carbon.

The first published orbit was calculated by J. P. Möller and H. Q. Rasmussen. They took three positions from January 7, 9, and 12, and determined the perihelion date of the resulting parabolic orbit as 1935 March 1.08. Shortly thereafter, H. E. Wood took positions from January 8, 12, and 16, and determined the perihelion date as February 25.61. M. Davidson calculated a very similar orbit to Wood's using positions from January 7, 16, and 30. He gave the perihelion date as February 26.34.

The first elliptical orbit was calculated by A. D. Maxwell. Published on February 21, the orbit revealed a perihelion date of February 26.51 and a period near 750 years. Around mid-March, Maxwell revised this orbit, giving the perihelion date as February 26.5 and the period as 896 years. This last orbit proved an excellent representation, according to the later calculations of Davidson (1935) and Maxwell (1936). Maxwell's orbit is given below.

T	ω	Ω (2000.0)	i	q	e
1935 Feb. 26.4688 (UT)	18.3970	92.4469	65.4250	0.811148	0.991301

ABSOLUTE MAGNITUDE: $H_0 = 9.50$, $n = 3.04$ (Beyer, 1937); $H_{10} = 10.0$ (V1964)
 FULL MOON: Dec. 20, 1935 Jan. 19, Feb. 18, Mar. 20, Apr. 18, May 18, Jun. 16
 SOURCES: H. M. Jeffers, *LOB*, **17** (1935), p. 125; E. L. Johnson, *HAC*, No. 322 (1935 Jan. 9); E. L. Johnson, *BZAN*, **17** (1935 Jan. 14), p. 3; J. P. Möller, H. Q. Rasmusen, and H. E. Wood, *BZAN*, **17** (1935 Jan. 30), p. 7; G. van Biesbroeck, *HAC*, No. 326 (1935 Jan. 30); E. L. Johnson, *The Observatory*, **58** (1935 Feb.), p. 62; H. E. Wood, *BZAN*, **17** (1935 Feb. 6), p. 8; H. Krumpholz and F. Kaiser, *BZAN*, **17** (1935 Feb. 11), p. 10; R. R. E. Schorr, *AN*, **254** (1935 Feb. 14), p. 247; R. R. E. Schorr, *BZAN*, **17** (1935 Feb. 17), p. 11; A. A. Wachmann, *BZAN*, **17** (1935 Feb. 21), p. 12; A. D. Maxwell, *HAC*, No. 329 (1935 Feb. 21); K. Graff and M. Davidson, *AN*, **254** (1935 Feb. 27), p. 311; S. I. Beljawsky, J. Franz, and C. Fedtke, *BZAN*, **17** (1935 Feb. 28), p. 13; H. E. Wood, J. P. Möller, H. Q. Rasmusen, A. D. Maxwell, and G. van Biesbroeck, *PA*, **43** (1935 Mar.), p. 188; M. Davidson and F. Kaiser, *The Observatory*, **58** (1935 Mar.), pp. 98–9; K. Graff, *BZAN*, **17** (1935 Mar. 6), p. 15; P. Vocca, *IAUC*, No. 524 (1935 Mar. 9); S. D. Tscherny and F. Kaiser, *BZAN*, **17** (1935 Mar. 11), p. 17; M. Davidson, *IAUC*, No. 525 (1935 Mar. 15); S. K. Vsekhsvyatskij, *IAUC*, No. 526 (1935 Mar. 19); A. A. Wachmann and M. Beyer, *BZAN*, **17** (1935 Mar. 20), p. 19; E. L. Johnson, *AN*, **255** (1935 Mar. 21), pp. 13–16; G. van Biesbroeck and A. D. Maxwell, *PA*, **43** (1935 Apr.), pp. 254–6; S. D. Tscherny, N. Rudsky, and C. Fedtke, *BZAN*, **17** (1935 Apr. 5), p. 23; M. Beyer, *BZAN*, **17** (1935 Apr. 10), p. 25; R. M. Aller, *AN*, **255** (1935 Apr. 20), p. 187; A. A. Wachmann, *BZAN*, **17** (1935 Apr. 24), p. 26; G. van Biesbroeck, *PA*, **43** (1935 May), p. 306; F. Kaiser, *BZAN*, **17** (1935 May 11), p. 29; H. Fischer, *AN*, **255** (1935 May 17), p. 379; G. van Biesbroeck, *PA*, **43** (1935 Jun.–Jul.), p. 356; P. Chofardet, *JO*, **18** (1935 Jul.), pp. 123–4; G. Adamopoulos, *AN*, **257** (1935 Oct. 9), p. 63; E. L. Johnson and M. Davidson, *JASSA*, **4** (1935 Nov.), pp. 31–4, 40; G. van Biesbroeck, *AJ*, **45** (1935 Dec. 5), pp. 18–20; E. L. Johnson, *UOC*, No. 95 (1936 Jan. 25), pp. 197–8; A. D. Maxwell, *AJ*, **45** (1936 Jan. 31), pp. 49–54; A. D. Maxwell, *MNRAS*, **96** (1936 Feb.), pp. 344, 346–7; H. Krumpholz, *AN*, **259** (1936 Jun. 25), p. 331; J. Larink, *AN*, **262** (1937 Mar. 8), p. 33; A. D. Dubiago, *AN*, **262** (1937 Mar. 16), p. 67; M. Beyer, *AN*, **262** (1937 Apr. 22), pp. 217–28; A. D. Maxwell, *MNRAS*, **98** (1938 Feb.), pp. 348–9; A. Schmitt, *JO*, **21** (1938 Apr.), pp. 58, 60; V1964, p. 73.

C/1935 M1 *Discovered:* 1935 June 3.97 ($\Delta = 3.25$ AU, $r = 4.26$ AU, Elong. = 172°)

(Jackson) *Last seen:* 1935 August 5.1 ($\Delta = 4.19$ AU, $r = 4.59$ AU, Elong. = 107°)

Closest to the Earth: 1934 August 6 (2.7077 AU)

1934 II = 1935b *Calculated path:* OPH (Disc), SCO (Jul. 4), LIB (Aug. 6)

C. V. Jackson (Union Observatory, Johannesburg, South Africa) discovered this comet during his regular systematic search for minor planets. He obtained two plates of the same area of the sky on the evening of 1935 June 3 and, upon examining the plates the next day with the Zeiss Stereocomparator, he immediately noted an object moving faster than a minor planet and nebulous in appearance. The first plate had been exposed on 1935 June 3.97, at which time the comet was at $\alpha = 17^{\text{h}} 14.0^{\text{m}}$, $\delta = -18^\circ 42'$. He estimated the magnitude as 13. Due to the comet's faintness, Jackson needed additional confirmation before announcing his discovery. The comet was

again photographed by him on June 8.06, June 11.03, and June 19.73, before being announced as a new comet. The magnitude was estimated as 13 on each date. The comet had passed perihelion about 9 months earlier and had made its closest approach to Earth 10 months earlier.

Although fading, the large perihelion distance allowed the comet to be followed for a few more months. On June 21, A. W. Recht and P. C. Keenan (Yerkes Observatory, Wisconsin, USA) estimated the magnitude as 14. On the 24th, F. L. Whipple and L. E. Cunningham (Harvard College Observatory, Massachusetts, USA) photographed the comet and described it as diffuse, with a magnitude “not brighter than 15.0.” On June 26, Cunningham and W. A. Johnson estimated the comet’s magnitude as 15. A total lunar eclipse was visible across a large part of North America on July 16. G. van Biesbroeck (Yerkes Observatory) then estimated the comet’s magnitude as 16, while the round diffuse coma was not more than 10'' across. The comet was virtually unchanged when van Biesbroeck observed the comet on July 21.

The comet was last observed on August 5.1, when van Biesbroeck observed it low in the southwestern sky, not long after the end of evening twilight. He described it as a small coma with a magnitude of 16. As the comet continued moving away from the sun, it passed within 0.84 AU of Jupiter on 1935 October 27. Around that time, S. Kanda and Simidu calculated an ephemeris for this comet covering the 2 years prior to its discovery. They remarked that the comet would have been brighter during the summer of 1934 than at any time during 1935 – possibly as bright as 11.7. Unfortunately, no prediscovery observations were revealed.

The first orbit was calculated by Whipple. He took three positions spanning the period of June 21–26 and determined a perihelion date of 1934 September 8.38. As it turned out, this date was only about 1.5 days later than the actual date, which is quite an accomplishment considering the short arc and the large perihelion distance of about 3.5 AU! Additional parabolic orbits were calculated by A. D. Maxwell and H. E. Wood. A hyperbolic orbit was calculated by M. Davidson, which gave a perihelion date of September 8.29 and an eccentricity of 1.01046. Wood’s orbit is given below.

T	ω	Ω (2000.0)	i	q	e
1934 Sep. 6.9205 (UT)	124.3132	74.2111	141.9494	3.485700	1.0

ABSOLUTE MAGNITUDE: $H_{10} = 4.4$ (V1964)

FULL MOON: May 18, Jun. 16, Jul. 16, Aug. 14

SOURCES: C. V. Jackson, *HAC*, No. 335 (1935 Jun. 20); C. V. Jackson, *IAUC*, No. 541 (1935 Jun. 20); A. W. Recht, P. C. Keenan, F. L. Whipple, and L. E. Cunningham, *HAC*, No. 336 (1935 Jun. 25); L. E. Cunningham, W. A. Johnson, and F. L. Whipple, *HAC*, No. 337 (1935 Jun. 27); A. D. Maxwell, *HAC*, No. 338 (1935 Jun. 28); C. V. Jackson, F. L. Whipple, and L. E. Cunningham, *BZAN*, 17 (1935 Jun. 29), p. 39; C. V. Jackson, *AN*, 256 (1935 Jul. 12), p. 187; L. E. Cunningham and W. A. Johnson,

BZAN, 17 (1935 Jul. 19), p. 43; H. E. Wood, *AN*, 256 (1935 Aug. 22), p. 331; C. V. Jackson, G. Van Biesbroeck, F. L. Whipple, L. E. Cunningham, and A. D. Maxwell, *PA*, 43 (1935 Aug.–Sep.), p. 454; C. V. Jackson and H. E. Wood, *The Observatory*, 58 (1935 Sep.), p. 279–80; G. van Biesbroeck, *PA*, 43 (1935 Oct.), p. 541; C. V. Jackson and M. Davidson, *JASSA*, 4 (1935 Nov.), pp. 33–4; S. S. Kanda and Simidu, *PA*, 43 (1935 Nov.), p. 608; C. V. Jackson, *UOC*, No. 95 (1936 Jan. 25), pp. 198–9; H. E. Wood, *MNRAS*, 96 (1936 Feb.), pp. 344–7; V1964, p. 73.

- 32P/1935 P1** *Prerecovery*: 1935 August 9.38 ($\Delta = 2.51$ AU, $r = 1.86$ AU, Elong. = 40°)
(Comas Solá) *Recovered*: 1935 August 12.48 ($\Delta = 2.49$ AU, $r = 1.86$ AU, Elong. = 42°)
Last seen: 1936 July 16.23 ($\Delta = 3.21$ AU, $r = 3.04$ AU, Elong. = 71°)
1935 IV = 1935c *Closest to the Earth*: 1936 February 21 (1.3163 AU)
Calculated path: GEM (Pre), CNC (Sep. 10), LEO (Oct. 9), COM (Dec. 17), LEO (Apr. 7), COM (Jun. 1), VIR (Jun. 4)

The recovery of this comet began with the calculations of J. M. Vinter Hansen (1934, 1936). She calculated a definitive orbit for the 1927 apparition, applied perturbations spanning the period of 1927–35, and predicted the comet would next arrive at perihelion on 1935 October 8.38. G. van Biesbroeck (Yerkes Observatory, Wisconsin, USA) exposed search photographs using the 61-cm reflector on 1935 August 9.38 and August 11.40. The comet was then at a low altitude and nothing was found. H. M. Jeffers (Lick Observatory, California, USA) exposed a search photograph using the 91-cm Crossley reflector on August 10 and also failed to locate the comet. Jeffers exposed his next photograph on August 12.48 and located the comet at a position of $\alpha = 6^{\text{h}} 32.2^{\text{m}}$, $\delta = +25^\circ 09'$. He described the comet as diffuse, with a magnitude of 14 and a coma 0.3' across. A faint tail extended 1.5' towards the west. Jeffers confirmed the recovery on August 13.49. L. E. Cunningham compared the comet's position with that predicted by Vinter Hansen in the 1935 *Handbook of the British Astronomical Association* and found the actual perihelion date to be about 1.8 days earlier than predicted. Following the announcement, van Biesbroeck re-examined his search photographs from the 9th and 11th and located the comet on both. On the first date, the comet appeared as a very diffuse coma, with a magnitude of 15. The image was better defined on the second date and exhibited a diffuse coma, with a magnitude of 14.5.

The comet remained a rather faint object through the rest of 1935. On August 24, van Biesbroeck described the comet as a round diffuse coma 25'' across, with a magnitude of 14. On September 5 and 6, van Biesbroeck gave the magnitude as 13.5. The round, diffuse coma exhibited a faint, broad tail extending about 2' in PA 290° . On the 24th, van Biesbroeck gave the magnitude as 13.5. The coma was round and small, while the tail was slender and extended to PA 300° . On September 28, A. Schmitt (Alger, now al-Jazâ'ir, Algeria) gave the magnitude as 13. Schmitt described the comet as diffuse. The comet was moving away from the sun after October 6. On October 7,

van Biesbroeck gave the magnitude as 13. The round coma was 12'' across, while the tail was narrow and extended 10' in PA 290°. On October 24, A. A. Wachmann (Hamburg Observatory, Bergedorf, Germany) gave the magnitude as 13.0. On November 21, Jeffers gave the magnitude as 13. He said a 30-minute exposure using the 91-cm Crossley reflector showed a sharp condensation and a tail extending 7' in PA 300°. On November 22, van Biesbroeck estimated the magnitude as not more than 13.5. There was still a "well marked tail pointing away from the sun." On December 21, van Biesbroeck gave the magnitude as about 13.5, while a faint tail continued to point away from the sun. On December 27, van Biesbroeck gave the magnitude as 13. The coma was diffuse and the tail extended 10' in PA 300°. After moving southward since its recovery, the comet reached a declination of +18° on December 28 and then began moving northward.

The comet was moving away from the sun as 1936 began, but it was still approaching Earth. On 1936 January 20, van Biesbroeck described the comet as a diffuse nebulosity with a magnitude of 14. A short tail extended towards the north-preceding direction. On the 23rd, S. Kanda (Tokyo, Japan) gave the magnitude as 12.5. On the 24th, van Biesbroeck gave the magnitude as 13.5. He said a fairly well-defined nucleus shone at magnitude 14. Jeffers photographed the comet with the 91-cm Crossley reflector on that same date and said the coma was 8'' across and exhibited a tail extending 3' in PA 300°. On the 25th, van Biesbroeck gave the magnitude as 14. The coma was about 20'' across and the tail was fainter. On January 28, van Biesbroeck gave the magnitude as 14 and said the tail extended to PA 300°.

On February 18, van Biesbroeck gave the magnitude as 15, while a short faint tail extended in the direction opposite to the sun. On the 22nd, van Biesbroeck gave the magnitude as 14.5. There was a sharp, eccentric nucleus and the tail extended to PA 275°. On February 28, van Biesbroeck gave the magnitude as 14.5 and noted a sharp nucleus and a tail extending 1' in PA 275°.

The comet was moving away from both the sun and Earth as March began. On March 13, F. Kaiser (Wiesbaden, Germany) gave the magnitude as 13. On the 16th, R. R. E. Schorr (Hamburg Observatory, Bergedorf, Germany) gave the magnitude as 13.0. On March 16 and 18, van Biesbroeck gave the magnitude as 14. The coma diameter was nearly 1' across, but it extended "slightly eccentrically from the nucleus" to PA 260°, "suggesting a fore-shortened tail in that direction." On the 17th, Kaiser gave the magnitude as 12.8. After generally moving northward since late December, the comet attained a declination of +23° on March 19 and then began moving southward again. On March 20, the magnitude was given as 12.5 by Schorr, as well as Wachmann and K. Müller (Hamburg Observatory). On March 25, Kaiser gave the magnitude as 13.0 and noted a coma 1' across.

The comet steadily faded in the following months. On April 9, J. O. Stobbe (Kiel, Germany) gave the magnitude as 12.5. He described the comet as diffuse and 1' across, with a stellar nucleus of magnitude 14.5. On the 12th, van

Biesbroeck said the coma was 20'' in diameter, while the tail extended about 30'' in PA 150°. On the 14th, the magnitude was given as 13 by Wachmann, Müller, and Schorr. On the 15th, van Biesbroeck gave the magnitude as 14.5. The tail extended to PA 160°. On the 16th, Jeffers photographed the comet with the 91-cm Crossley reflector and said the coma was 5'' across and had become more diffuse. On April 17, van Biesbroeck gave the magnitude as 14.5. On May 14, van Biesbroeck gave the magnitude as 15.5 and said the diffuse coma was 40'' in diameter. On the 18th, Schorr gave the magnitude as 15–16. On the 19th, Schorr gave the magnitude as 15.5–16. On May 20, van Biesbroeck gave the magnitude as 16. He said the coma was “extremely diffuse.” On June 10, Jeffers gave the magnitude as 17.

The comet was last detected on July 16.23, when Jeffers found it on a 60-minute exposure obtained with the 91-cm Crossley reflector. He gave the position as $\alpha = 12^{\text{h}} 30.4^{\text{m}}$, $\delta = +6^{\circ} 21'$. He estimated the magnitude as 18.

Multiple apparition orbits have been calculated by B. G. Marsden (1968, 1972) and G. Forti (1983). They included perturbations by all nine planets, as well as nongravitational effects. The result was a perihelion date of October 6.58 and a period of 8.53 years. Marsden (1968) noted a “very slight secular deceleration.” Marsden, Z. Sekinina, and D. K. Yeomans (1973) gave the nongravitational terms as $A_1 = +1.04$ and $A_2 = +0.0015$. Forti gave the nongravitational terms as $A_1 = +1.12$ and $A_2 = +0.0106$. Forti’s orbit is given below.

T	ω	Ω (2000.0)	i	q	e
1935 Oct. 6.5759 (TT)	38.8135	66.3790	13.7246	1.777142	0.574447

ABSOLUTE MAGNITUDE: $H_{10} = 9.6$ (V1964)

FULL MOON: Jul. 16, Aug. 14, Sep. 12, Oct. 12, Nov. 10, Dec. 10, 1936 Jan. 8, Feb. 7, Mar. 8, Apr. 6, May 6, Jun. 5, Jul. 4, Aug. 3

SOURCES: J. M. Vinter Hansen, *The Observatory*, **56** (1933 Jul.), p. 243; J. M. Vinter Hansen, *BAA Handbook for 1935* (1934), p. 27; H. M. Jeffers, L. E. Cunningham, J. M. Vinter Hansen, *HAC*, No. 341 (1935 Aug. 14); H. M. Jeffers, *BZAN*, **17** (1935 Aug. 16), p. 49; G. van Biesbroeck, *HAC*, No. 342 (1935 Aug. 19); H. M. Jeffers, *The Observatory*, **58** (1935 Sep.), p. 280; *PASP*, **47** (1935 Oct.), p. 286; H. M. Jeffers and G. van Biesbroeck, *PA*, **43** (1935 Oct.), p. 541; G. van Biesbroeck, *PA*, **43** (1935 Nov.), p. 608; A. A. Wachmann, *BZAN*, **17** (1935 Nov. 5), p. 64; G. van Biesbroeck, *PA*, **43** (1935 Dec.), p. 654; H. M. Jeffers, *LOB*, **17** (1936), pp. 193–4; H. M. Jeffers and J. M. Vinter Hansen, *MNRAS*, **96** (1936 Feb.), pp. 345–7; G. van Biesbroeck, *PA*, **44** (1936 Feb.), p. 102; G. van Biesbroeck, *The Observatory*, **59** (1936 Feb.), p. 66; S. Kanda, *BZAN*, **18** (1936 Feb. 24), p. 15; G. van Biesbroeck, *PA*, **44** (1936 Mar.), p. 151; G. van Biesbroeck, *The Observatory*, **59** (1936 Mar.), p. 102; F. Kaiser, *BZAN*, **18** (1936 Mar. 18), p. 20; F. Kaiser, A. A. Wachmann, and K. Müller, *BZAN*, **18** (1936 Mar. 30), p. 21; G. van Biesbroeck, *PA*, **44** (1936 Apr.), p. 211; G. van Biesbroeck, *The Observatory*, **59** (1936 Apr.), p. 142; J. O. Stobbe, *BZAN*, **18** (1936 Apr. 15), p. 25; A. A. Wachmann and K. Müller, *BZAN*, **18** (1936 Apr. 24), p. 27; G. van Biesbroeck, *PA*, **44** (1936 May), p. 268; R. R. E. Schorr and

J. O. Stobbe, *The Observatory*, **59** (1936 May), p. 175; R. R. E. Schorr, *AN*, **259** (1936 Jul. 7), p. 361; R. R. E. Schorr and J. O. Stobbe, *AN*, **260** (1936 Aug. 11), p. 157; H. M. Jeffers, *LOB*, **18** (1937), p. 85; G. van Biesbroeck, *AJ*, **46** (1937 Jan. 2), pp. 1, 3–4; J. O. Stobbe and G. van Biesbroeck, *MNRAS*, **97** (1937 Feb.), p. 334; R. R. E. Schorr, *AN*, **262** (1937 Mar. 8), p. 33; A. Schmitt, *JO*, **21** (1938 Apr.), pp. 58, 60; V1964, p. 73; B. G. Marsden, *AJ*, **73** (1968 Jun.), pp. 369–70; B. G. Marsden, *QJRAS*, **9** (1968 Sep.), pp. 314–15; B. G. Marsden, *QJRAS*, **13** (1972 Sep.), pp. 430–1; B. G. Marsden, Z. Sekinina, and D. K. Yeomans, *AJ*, **78** (1973 Mar.), pp. 213, 215–16; G. Forti, *AAP*, **126** (1983), pp. 307–10.

- C/1935 Q1** *Prediscovery*: 1935 July 3.90 ($\Delta = 3.87$ AU, $r = 4.83$ AU, Elong. = 157°)
(van Biesbroeck) *Discovered*: 1935 August 21.14 ($\Delta = 3.74$ AU, $r = 4.62$ AU, Elong. = 146°)
Last seen: 1938 January 26.2 ($\Delta = 6.09$ AU, $r = 6.49$ AU, Elong. = 110°)
1936 I = 1935d *Closest to the Earth*: 1935 August 4 (3.6988 AU), 1936 August 6 (3.6236 AU)
Calculated path: CAP (Pre), SGR (Jul. 27), AQL (Oct. 11), DEL (1936 Jan. 30), EQU (Feb. 25), PEG (Mar. 20), CYG (May 13), CEP (1937 Feb. 15), LAC (Feb. 21), CEP (Feb. 24), LAC (Feb. 27), CEP (Mar. 4), CAS (Mar. 18), CEP (Mar. 23), CAS (Mar. 28), CEP (May 1), CAS (May 2), CAM (Jul. 14), CEP (Jul. 15), CAM (Jul. 16), CEP (Oct. 23)

The discovery of this comet is quite interesting and begins in July 1935, when G. van Biesbroeck (Yerkes Observatory, Wisconsin, USA) was exposing plates with the 61-cm reflector in order to detect the Trojan asteroid Odysseus (1143). These photographs showed the presence of a faint new asteroid. He continued to follow this object in order to secure enough positions to establish its orbit. On 1935 August 21.14, photographs continued to show the asteroid, but they also showed a diffuse, 14th-magnitude object $8'$ away. This proved to be a new comet and its position was given as $\alpha = 19^{\text{h}} 41.6^{\text{m}}$, $\delta = -17^\circ 23'$. The comet was confirmed on August 22.10, when van Biesbroeck visually observed it in the 102-cm refractor. The magnitude was estimated as 14, while a stellar nucleus shone at magnitude 15. The coma measured about $20''$ in diameter.

H. E. Wood (Union Observatory, South Africa) announced that prediscovery images were found on photographic plates exposed by E. L. Johnson (Union Observatory) on July 3.90, July 22.83, July 29.83, August 5.78, and August 5.81. On the first date the magnitude was estimated as 13.0. On the last date, the comet had been recognized, but its magnitude of 13.5, as well as the small scale of the photographs, caused the nebulosity to be overlooked and it was thought to be a minor planet. The comet had attained a maximum solar elongation of 180° on July 23.

Although the comet was found about 9 months prior to passing perihelion, it changed little in appearance during the remainder of 1935 because of the large perihelion distance of 4.04 AU. On August 23, H. M. Jeffers (Lick Observatory, California, USA) visually observed the comet using the 91-cm refractor and gave the magnitude as 14.5. He said the comet was “small

and round, with a central nucleus." On the 24th, the magnitude was given as 14 by van Biesbroeck and 14.5 by Jeffers. Van Biesbroeck said the round coma was 25" across. Jeffers said the comet was "small and round, with a central nucleus." On the 27th, van Biesbroeck gave the magnitude as 14. On August 29, the magnitude was given as 14 by van Biesbroeck and 14.5 by Jeffers. Van Biesbroeck said the coma was 30" in diameter. Jeffers said the comet was "small and round, with a central nucleus." On September 1 and 7, van Biesbroeck gave the magnitude as 14.5. He said the coma was 25" across on the 1st and exhibited a central condensation on the 7th. On September 24, van Biesbroeck gave the magnitude as 15. He added that the comet was "well condensed centrally." On October 20, van Biesbroeck gave the magnitude as 14.5. The coma was round, 20" across, and contained a slight central condensation. On October 25, van Biesbroeck gave the magnitude as 15. The central condensation shone at magnitude 15.5, while the coma was 18" in diameter. On November 14, Jeffers photographed the comet with the 91-cm Crossley reflector and said the comet was 7" across and more diffuse. On November 23, van Biesbroeck gave the magnitude as 15, while the coma was 20" across. On December 20, van Biesbroeck gave the magnitude as 15, while the diffuse round coma was about 20" across. On December 21, van Biesbroeck obtained two 14-minute exposures of the comet at low altitude and estimated the magnitude as 14. The comet was then situated 36° from the sun.

The comet was lost in the sun's glare as 1936 began and it passed 20° from the sun on January 29. Van Biesbroeck recovered it on February 28, when 30° from the sun. He then gave the magnitude as 14.5 and noted a diffuse coma, 15" in diameter. Interestingly, although the comet was approaching both the sun and Earth, it experienced a slight fading. Van Biesbroeck photographed the predicted position of the comet on March 18, using the 61-cm reflector, but found nothing. Longer exposures using the same telescope on March 25 revealed the comet was fainter than magnitude 16, which was 3 magnitudes fainter than predicted. On April 16, van Biesbroeck gave the magnitude as 16 and noted a round coma 15" across. On April 18, van Biesbroeck gave the magnitude as 16.5.

The comet passed perihelion on May 11, but was still approaching Earth. On May 14, van Biesbroeck gave the magnitude as 17 and said the coma was hardly 10" across. On the 17th, van Biesbroeck gave the magnitude as 16.5 and noted the coma was 15" across. On May 27 and 28, van Biesbroeck gave the magnitude as 16. On June 15, 24, and 28, van Biesbroeck gave the magnitude as 16 and said the coma was 20" across. On July 24 and 26, van Biesbroeck gave the magnitude as 16.

The comet's distances from the sun and Earth were increasing shortly after August began. On August 17 and 22, van Biesbroeck gave the magnitude as 15.5. The round coma was 15" across and contained a little condensation. The comet attained a maximum solar elongation of 113° on August 19. On August 25, van Biesbroeck gave the magnitude as 16 and said the coma

was 10'' across. After steadily moving in a northerly direction since its discovery, the comet attained a declination of $+53^\circ$ on September 3 and then began moving southward. On September 17, Jeffers gave the magnitude as 16. His photograph using the 91-cm Crossley reflector revealed a tail extending about 0.5' toward the southeast. On September 19, van Biesbroeck gave the magnitude as 16.5. The slightly condensed coma was 15'' in diameter. On October 7, Jeffers photographed the comet with the reflector and noted a tail extending about 0.5' toward the southeast. On December 3, Jeffers gave the magnitude as 17.5. He noted a coma "a few seconds of arc in diameter," with a trace of tail. After generally moving southward since September, the comet attained a declination of $+49^\circ$ on December 6 and then began moving northward again. On December 14, van Biesbroeck gave the magnitude as 16.5 and noted the round coma was fairly well defined.

On 1937 January 13, van Biesbroeck gave the magnitude as 17. The coma was round and was 8'' across. On March 17, van Biesbroeck photographed the comet as a quite vague image of magnitude 17. The comet attained a minimum solar elongation of 55° on May 17. On July 17, Jeffers obtained 50- and 90-minute exposures with the 91-cm Crossley reflector and described the comet as very faint and diffuse. On August 6, 11, and 31, W. Dieckvoss and H.-U. Sandig (Hamburg Observatory, Bergedorf, Germany) gave the magnitude as 16. On September 10, Jeffers obtained 38- and 80-minute exposures with the reflector and described the comet as very faint and diffuse. On October 7 and 10, Sandig gave the magnitude as 16. On October 9, Jeffers obtained a 110-minute exposure with the reflector and described the comet as very faint and diffuse. Dieckvoss and Sandig gave the magnitude as 16.5 on November 2 and 17 on November 3. The comet was in opposition on November 9, with the distance from Earth then being 5.64 AU. On November 9, 10, and 12, van Biesbroeck gave the magnitude as 17 and said the round coma was 10'' across. The comet attained its most northerly declination of $+86^\circ$ on November 18.

The final two observations of this comet were obtained by Jeffers on 1937 December 6.2 and 1938 January 26.2. In both instances, the comet was photographed with the 91-cm Crossley reflector, but the comet was "so faint that measures are scarcely worth while." The comet attained a maximum elongation of 118° on 1937 December 19.

As the first orbits were computed it became obvious this comet had a large perihelion distance. This made the perihelion date very difficult to pinpoint with so few observations. Using the three precise positions obtained between August 21 and 23, van Biesbroeck computed a parabolic orbit which gave the perihelion date as 1935 December 9.13. From the same positions, Swanson and Popper computed a parabolic orbit showing the perihelion date as November 25.07. L. E. Cunningham published his computations on August 28, which were based on three positions obtained between August 23 and 27. The perihelion date was 1935 June 10.21.

A better representation of the orbit came to light on September 16, when Swanson and Popper published a hyperbolic orbit using three observations obtained between August 23 and September 4. The perihelion date was given as 1936 May 26.78 and the eccentricity was 1.03101. Van Biesbroeck published an orbit on September 18, which generally confirmed the orbit given by Swanson and Popper. He used three observations obtained between August 21 and September 7, and found the perihelion date to be May 12.90. Although this was a parabolic orbit, he commented that a general orbit calculation produced an eccentricity of 1.025. During the next few months, additional orbits were calculated by H. E. Wood and van Biesbroeck, with the latter astronomer finding an eccentricity of 1.003525.

G. van Biesbroeck (1940) used 125 positions obtained between 1935 July 3 and 1937 October 10, applied perturbations by Venus to Neptune, and computed a hyperbolic orbit with a perihelion date of May 11.63 and an eccentricity of 1.00197. He also applied perturbations by Venus to Neptune and moved the orbit backwards to 1916. He found the orbit was then elliptical with a period of about 341 thousand years.

B. G. Marsden and Z. Sekanina (1973) used 107 positions obtained between 1935 July 3 and 1937 November 10, as well as perturbations by all nine planets, and computed a hyperbolic orbit with a perihelion date of May 11.64 and an eccentricity of 1.002045. This orbit is given below. The original orbit was elliptical with a period of about 12 million years and the future orbit is hyperbolic with an eccentricity of about 1.001136.

T	ω	Ω (2000.0)	i	q	e
1936 May 11.6361 (TT)	44.8957	300.5614	66.1122	4.043409	1.002045

ABSOLUTE MAGNITUDE: $H_{10} = 5.4$ (V1964)

FULL MOON: Jun. 16, Jul. 16, Aug. 14, Sep. 12, Oct. 12, Nov. 10, Dec. 10, 1936 Jan. 8, Feb. 7, Mar. 8, Apr. 6, May 6, Jun. 5, Jul. 4, Aug. 3, Sep. 1, Sep. 30, Oct. 30, Nov. 28, Dec. 28, 1937 Jan. 26, Feb. 25, Mar. 26, Apr. 25, May 25, Jun. 23, Jul. 23, Aug. 22, Sep. 20, Oct. 19, Nov. 18, Dec. 17, 1938 Jan. 16, Feb. 14

SOURCES: G. van Biesbroeck, *HAC*, No. 343 (1935 Aug. 22); G. van Biesbroeck, *HAC*, No. 344 (1935 Aug. 23); Swanson and Popper, *HAC*, No. 345 (1935 Aug. 26); L. E. Cunningham, *HAC*, No. 346 (1935 Aug. 28); G. van Biesbroeck, *BZAN*, 17 (1935 Sep. 2), p. 51; Swanson and Popper, *HAC*, No. 349 (1935 Sep. 16); G. van Biesbroeck, *HAC*, No. 350 (1935 Sep. 18); G. van Biesbroeck, Swanson, and Popper, *PA*, 43 (1935 Oct.), pp. 541–3; G. van Biesbroeck and A. D. Maxwell, *PA*, 43 (1935 Nov.), p. 606; G. van Biesbroeck and H. E. Wood, *The Observatory*, 58 (1935 Nov.), p. 341; G. van Biesbroeck, *PA*, 43 (1935 Dec.), p. 653; H. M. Jeffers, *LOB*, 17 (1936), p. 194; G. van Biesbroeck, *PA*, 44 (1936 Jan.), p. 51; E. L. Johnson, *UOC*, No. 95 (1936 Jan. 25), pp. 199–200; G. van Biesbroeck and H. E. Wood, *MNRAS*, 96 (1936 Feb.), pp. 345–7; G. van Biesbroeck, *PA*, 44 (1936 Mar.), p. 151; G. van Biesbroeck, *HAC*, No. 367 (1936 Mar. 9); G. van Biesbroeck, *BZAN*, 18 (1936 Mar. 30), p. 21; G. van Biesbroeck, *PA*, 44 (1936 Apr.), p. 212; G. van Biesbroeck, *The Observatory*, 59 (1936 Apr.), p. 142; G. van Biesbroeck, *PA*, 44 (1936 May),

pp. 268–9; G. van Biesbroeck, *BZAN*, **18** (1936 May 6), p. 29; G. van Biesbroeck, *The Observatory*, **59** (1936 Jun.), pp. 201–2; G. van Biesbroeck, *The Observatory*, **59** (1936 Nov.), p. 356; H. M. Jeffers, *LOB*, **18** (1937), p. 85; H. M. Jeffers, *PASP*, **49** (1937 Feb.), p. 36; W. Dieckvoss and H.-U. Sandig, *BZAN*, **19** (1937 Aug. 30), p. 52; W. Dieckvoss and H.-U. Sandig, *AN*, **263** (1937 Sep. 6), p. 367; G. van Biesbroeck, *AJ*, **46** (1937 Sep. 14), pp. 141–5; H. M. Jeffers, *LOB*, **18** (1938), p. 163; W. Dieckvoss and H.-U. Sandig, *AN*, **265** (1938 Feb. 2), p. 1; G. van Biesbroeck, *AJ*, **47** (1938 Nov. 21), pp. 161, 163; G. van Biesbroeck, *PYO*, **8**, Pt. IV (1940 Jul.), pp. 113–21; G. van Biesbroeck, *MNRAS*, **107** (1947), pp. 108–9, 112; V1964, p. 73; B. G. Marsden and Z. Sekanina, *AJ*, **78** (1973 Dec.), pp. 1119–20; B. G. Marsden and Z. Sekanina, *QJRAS*, **15** (1974 Dec.), pp. 452–3, 459.

C/1936 K1 *Discovered:* 1936 May 15.2 ($\Delta = 1.55$ AU, $r = 1.40$ AU, Elong. = 62°)

(Peltier) *Last seen:* 1936 October 22.02 ($\Delta = 1.88$ AU, $r = 1.95$ AU, Elong. = 78°)

Closest to the Earth: 1936 August 4 (0.1720 AU)

1936 II = 1936a *Calculated path:* CEP (Disc), CAS (Jul. 5), CEP (Jul. 11), CAS (Jul. 12), AND (Jul. 22), LAC (Jul. 23), PEG (Jul. 29), AQR (Aug. 3), CAP (Aug. 4), MIC (Aug. 7), IND (Aug. 10), TEL-PAV (Aug. 13), OCT (Oct. 10), PAV (Oct. 19)

L. C. Peltier (Delphos, Ohio, USA) was routinely sweeping the sky for new comets with his 15-cm telescope when he found this object on 1936 May 15.2, at $\alpha = 23^{\text{h}} 59^{\text{m}}$, $\delta = +74^\circ$. In a telegram immediately sent to G. van Biesbroeck (Yerkes Observatory, Wisconsin, USA) he described the comet as 9th magnitude, with an extremely slow motion. Van Biesbroeck confirmed the discovery on May 16.17 and estimated the magnitude as 9.8. He added that the coma contained a well-condensed nucleus and exhibited a tail extending $5'$ toward PA 310° . Van Biesbroeck immediately telegraphed the news of the discovery to Harvard College Observatory (Massachusetts, USA), where the comet was photographed by F. L. Whipple and L. E. Cunningham on May 16.34. The comet had attained its most northerly declination of $+79^\circ$ on March 28. The comet was heading toward both the sun and Earth when discovered.

On May 17, the magnitude was given as 8.9 by F. Kaiser (Wiesbaden, Germany), 9 by van Biesbroeck and A. A. Wachmann (Hamburg Observatory, Bergedorf, Germany), and 10 by R. R. E. Schorr (Hamburg Observatory) and H. M. Jeffers (Lick Observatory, California, USA). Kaiser said a 40-minute exposure revealed a coma $1'$ across and a tail extending $2'$ toward PA 335° . Van Biesbroeck said a 2-minute exposure using the 61-cm reflector “shows the sharp nucleus surrounded by a diffuse coma streaming out into a tail some $10'$ long in a direction nearly opposite to that of the Sun.” E. Przybyllok (Königsberg, now Kaliningrad, Russia) said the coma was about $3'$ across, with a stellar nucleus of magnitude 11–12, and a tail towards the southeast. Jeffers said the comet was moderately condensed, with a short tail. On May 17 and 18, P. Bourgeois and E. Vandekerkhove (Royal Observatory, Uccle, Belgium) photographed the comet and noted a nebulous nucleus of magnitude 12–13. G. B. Lacchini (Triest, Italy) estimated the magnitude as 11.0.

He noted the nucleus was elongated toward the sun. On May 18, the magnitude was given as 9.5 by S. Plakidis (National Observatory, Athens, Greece), 10 by M. Campa (Milan, Italy) and Przybyllok, and 10.5 by J. O. Stobbe (University Observatory, Kiel, Germany). Plakidis said the coma was 1' across, with a distinct condensation and a stellar nucleus. P. S. Riggs (Lick Observatory) obtained a 30-minute exposure and noted a faint, broad tail extending 2.5–3' in PA 320°. On May 18 and 19, Wachmann gave the magnitude as 9.5. On May 19, the magnitude was given as 10 by H. L. Giclas (Lowell Observatory, Arizona, USA), A. Schmitt (Alger, now al-Jazâ'ir, Algeria), and D. Kotsakis (National Observatory). Stobbe said the coma was 2.5' across and exhibited an elongated nucleus. He noted the tail extended 3' toward the northwest. Kotsakis said a tail extended towards the southeast, while the nucleus was eccentrically situated towards the northwest portion of the coma. Schmitt said the comet appeared diffuse, with a central condensation. J. Dick (Berlin-Babelsberg Observatory, Germany) said the tail extended 2' toward PA 305°.

On May 20, the magnitude was given as 9.53 by M. Beyer (Hamburg, Germany) and 10 by Kotsakis. Beyer said the nuclear magnitude was 11.0, the coma diameter was 3', and the tail was about 1' long. Kotsakis said a tail extended towards the southeast, while the nucleus was eccentrically situated towards the northwest portion of the coma. On May 21, the magnitude was given as 9 by G. N. Neujmin (Simeis Observatory, Crimea, Ukraine), 9.5 by H. Krumpholz (Vienna University Observatory, Austria) and van Biesbroeck, and 10 by Przybyllok. Van Biesbroeck said the coma diameter was 1.3', while the nucleus was elongated in the direction of the tail and measured 0.8'' by 2''. The tail extended over 6' in PA 305°. W. K. Green (Amherst, Massachusetts, USA) obtained a 3-hour exposure with an 11-cm Ross lens and found the tail to extend 5' in PA 335°. He added that the tail was 4' across at its end. Przybyllok said there was a nucleus of magnitude 10.8. Krumpholz said the condensation was distinctly elongated and a broad tail extended to PA 310°. On May 22, the magnitude was given as 9.4 by van Biesbroeck, 9.62 by Beyer, and 10 by Giclas and Stobbe. Beyer said the nuclear magnitude was 11.5, the coma diameter was 2.5', and the tail extended about 1'. Van Biesbroeck said the tail extended over 8' in PA 310°. On May 23, N. Rudski (Kiev, Ukraine) gave the magnitude as 9.2, while Kotsakis estimated it as 10.5. Kotsakis said there was a distinct tail.

On May 24, K. Graff (Vienna, Austria) gave the magnitude as 8.62 and Campa estimated it as 9.5. On May 24 and 25, F. Schembor (Vienna University Observatory, Austria) said the coma measured 4' × 2', with the longest axis directed to PA 320°. The comet attained a minimum solar elongation of 62° on May 25. That same night, the magnitude was given as 9.35 by Beyer and 10 by J. Stein (Vatican Observatory, Castel Gandolfo, Italy). On the 26th, the magnitude was given as 9.4 by van Biesbroeck, 9.5 by P. Chofardet (Besançon, France), 10 by Plakidis, and 11.2 by P. P. Parenago (Moscow, Russia). Van Biesbroeck said the tail was fan-shaped and covered

PA 291–335°. The brightest portion extended 10' in PA 303°. Chofardet said the nucleus was elongated and the tail extended 2' towards the northwest. Plakidis said the coma was spindle-shaped. On the 27th, Beyer gave the magnitude as 9.13. He said the coma diameter was 2', and the tail extended 3' in PA 315°. Schmitt said the comet was round, with a central condensation. On the 28th, Graff gave the magnitude as 8.46 and Stobbe estimated it as 9.5. On the 29th, van Biesbroeck gave the magnitude as 9.3 in moonlight. He said the tail extended to PA 297°. On the 30th, Parenago gave the magnitude as 10.4. On May 31, Beyer gave the magnitude as 8.61. He said the coma diameter was 2', and the tail extended 5' in PA 331°.

On June 1, the magnitude was given as 8.53 by Beyer and 9.0 by Stobbe. Beyer said the nuclear magnitude was 11.0, the coma diameter was 1.5', and the tail extended 4' in 319°. G. R. Miczaika (Berlin-Neutempelhof, Germany) observed using a 5-cm refractor and said the tail extended 2' toward PA 315°. On the 4th, van Biesbroeck gave the magnitude as 8.8. The coma contained a stellar nucleus and the tail extended to PA 290°. On the 5th, the magnitude was given as 8.46 by Beyer and 8.5 by Stobbe. Schmitt said the coma was slightly elongated, with a central condensation. On June 6, Beyer gave the magnitude as 8.47. Kotsakis said the stellar nucleus was eccentrically placed in the northwest portion of the coma. Beyer said the nuclear magnitude was 11.0, the coma diameter was 1.0', and the tail extended 2.5' in 304°.

On June 8, the magnitude was given as 8.38 by Beyer, 8.8 by Stobbe and van Biesbroeck, and 9.0 by Campa. Beyer said the nuclear magnitude was 11.05, the coma diameter was 1', and the tail extended 4' in 311°. Van Biesbroeck said, "From the stellar nucleus emanates a vase-shaped bright streamer in angle 103°; it extends to about 50'' where it bends back into the broad tail some 15'. . . ." The tail extended to PA 283°. On the 9th, J. Franz and F. Knappe (Bautzen, Germany) gave the magnitude as 8.6 using a 13-cm comet seeker. They noted a short tail extending toward about PA 315°. On the 11th, the magnitude was given as 8 by van Biesbroeck and Giclas, 8.5 by S. D. Tscherny (Kiev, Ukraine), and 8.8 by G. Loreta (Bologna, Italy). Tscherny noted a nucleus and tail. On the 12th, the magnitude was given as 7.8 by van Biesbroeck, 8 by Giclas, 8.17 by Beyer, and 8.7 by Loreta. Beyer said the nuclear magnitude was 10.7, the coma diameter was 1.5', and the tail extended 4' in 302°. On the 13th, the magnitude was given as 8.16 by Beyer, 8.5 by Loreta, and 8.97 by K. Himpel (Wiesbaden, Germany). Beyer said the nuclear magnitude was 10.5, the coma diameter was 1.5', and the tail extended towards 295°. On June 14, the magnitude was given as 8.2 by Rudski and 8.5 by Loreta.

On June 15, the magnitude was given as 8.0 by Kaiser, and 8.5 by Loreta, Kotsakis, and Tscherny. Kaiser observed with an 8-cm telescope and noted the centrally condensed coma was 3' across, while the tail extended 4' toward PA 300°. Van Biesbroeck obtained a 20-minute exposure which showed a narrow streamer extending over 20' in PA 270°. The brighter part of the tail was shorter and extended to PA 279°. On the 16th, the magnitude was

within the range of 7.7–8.5, according to van Biesbroeck, Stobbe, Himpel, Beyer, Rudski, Loreta, and Tscherny. Beyer said the nuclear magnitude was 10.71, the coma diameter was 1.5', and the tail extended 8' in 288°. Van Biesbroeck said the tail extended to PA 277°. On the 17th, the magnitude was within the range of 7.6–8.5, according to G. Archenhold (Berlin-Treptow), P. Ahnert (Wittgendorf, Germany), Tscherny, Himpel, Rudski, Beyer, and Loreta. Ahnert said the tail extended 5'. Beyer said the nuclear magnitude was 10.4, the coma diameter was 1.5', and the tail extended 11' in 285°. On the 18th, the magnitude was within the range of 7.6–8.0, according to C. Fedtke (Königsberg, now Kaliningrad, Russia), Loreta, Campa, and Beyer. Beyer said the nuclear magnitude was 10.3, the coma diameter was 2', and the tail extended 10' in 291°. Fedtke noted a very diffuse elongated coma which exhibited a tail extending 4' toward PA 305°. On the 19th, the magnitude was within the range of 7.4–8.5, according to Loreta, Beyer, Chofardet, Schmitt, and Himpel. Beyer said the nuclear magnitude was 10.0, the coma diameter was 2', and the tail extended 8' in 284°. Chofardet said the coma was round and 3' across. Schmitt said the coma was slightly elongated. M. Schürer (Berlin-Babelsberg Observatory, Germany) observed with the 65-cm refractor and said a weak tail extended 2' toward PA 266°. On the 20th, the magnitude was within the range of 7.4–8.5, according to Stobbe, Himpel, Beyer, Loreta, Miczaika, and Franz. Beyer said the coma diameter was 2', and the tail extended 8' in 281°. On June 21, the magnitude was within the range of 7.4–8.4, according to Loreta, Himpel, Beyer, and Fedtke. Beyer said the nuclear magnitude was 9.8, and the coma was 2' across.

On June 22, the magnitude given as 7.5 by Loreta and Fedtke, 7.7 by Rudski, and 7.9 by Franz. Fedtke noted a very diffuse elongated coma which exhibited a tail extending 4' toward PA 305°. On the 23rd, Tscherny gave the magnitude as 8.0. On the 24th, the magnitude was within the range of 7.2–8.0, according to Tscherny, van Biesbroeck, Beyer, Chofardet, Franz, and Loreta. Van Biesbroeck estimated the nucleus as less than 0.3'' across. He added, "A broad fan-shaped ejection extends from the nucleus between position-angle 45° and 125° to a distance of 1', where it melts away in the head which has a diameter of 6'." The tail extends at least 30', with the brightest portion in PA 265°. Chofardet said the round coma was 3' across, with a well-defined central nucleus, and a tail extending 15' towards the west-northwest. On the 25th, the magnitude was given as 7.5 by Schmitt and Rudski, 7.6 by Franz, and 8 by Tscherny. Schmitt said the tail extended 10' in PA 270°. On the 26th, the magnitude was within the range of 7–8, according to Stobbe, Loreta, Beyer, Krumpholz, Rudski, Schmitt, Fedtke, and Tscherny. Beyer said the nuclear magnitude was 10.30, the coma was 2' across, and the tail extended 10' in 273°. Schmitt said the tail extended 10' in PA 270°. On the 27th, the magnitude was given as 7.17 by Beyer and 8 by Tscherny. Tscherny noted a nucleus and a tail. Beyer said the nuclear magnitude was 10.0, the coma diameter was 2.5', and the tail extended 8' in 275°. On the 28th, the magnitude was within the range of 7–8, according to

Tscherny, Rudski, Chofardet, Fedtke, and Loreta. Rudski gave the nuclear magnitude as 9.2. Chofardet said the round coma was 3' across, with a central nucleus, and a straight tail pointing to the west. Van Biesbroeck obtained a 30-minute exposure which showed the tail extending 90' in PA 252°. The brightest portion of the tail extended to PA 265°. On the 29th, the magnitude was within the range of 6.8–8.0, according to Krumpholz, Rudski, Beyer, Himpel, Campa, Graff, Fedtke, and Loreta. Graff noted a distinct nucleus and a short tail. Rudski gave the nuclear magnitude as 9.1. Krumpholz said the coma was 2–3' across, with a very distinct, nearly stellar nucleus. The tail extended 20' in PA 265°. Beyer said the nuclear magnitude was 10.0, the coma diameter was 2.5', and the tail extended 10' in 265°. On June 30, the magnitude was given as 7.0 by Loreta, 7.3 by Fedtke, and 7.89 by Himpel. Van Biesbroeck observed under hazy skies and estimated the nuclear magnitude as 9.

On July 1, the magnitude was given as 6.8 by Loreta, 6.87 by Graff, and 7.3 by Fedtke. Przybyllok said the coma was elliptical. On the 2nd, the magnitude was given as 6.7 by van Biesbroeck, 7.2 by Fedtke, and 7.6 by Rudski in moonlight. Rudski said the nuclear magnitude was about 9.0. On the 3rd, the magnitude was given as 6.51 by Beyer, and 6.6 by van Biesbroeck and Loreta. Van Biesbroeck said the tail extended to PA 254°. Beyer said the nuclear magnitude was 9.5, the coma diameter was 2.5', and the tail extended 10' in 264°. On the 4th, the magnitude was given as 6.78 by Graff, 7.6 by Rudski, and 7.8 by A. D. Dubiago (University Observatory, Kazan, Russia). Rudski said the nuclear magnitude was 8.1 in moonlight. On the 5th, the magnitude was given as 6.57 by Beyer, 6.7 by Fedtke, and 6.73 by Graff. Beyer said the nuclear magnitude was 9.68, the coma diameter was 3.0', and the tail extended 14' in 255°. On the 6th, the magnitude was within the range of 6.4–6.6, according to van Biesbroeck, Beyer, Fedtke, and Graff. Van Biesbroeck said the stellar nucleus shone at magnitude 8. The tail extended to PA 245°. Beyer said the coma diameter was 3.5', and the tail extended 13' in 254°. On July 7, the magnitude was within the range of 6.4–6.8, according to van Biesbroeck, Rudski, Fedtke, and Graff.

The comet passed closest to the sun on July 8, but, although it moved away thereafter, it was still approaching Earth and continued to brighten. The magnitude was then placed within the range of 6.2–6.7, according to D. N. Davis (Lick Observatory), Rudski, Beyer, Loreta, and van Biesbroeck. Van Biesbroeck said the tail extended to PA 244°. Rudski said the nuclear magnitude was 7.2. Beyer said the tail extended 20' in 255°. On the 9th, the magnitude was given as 6.2 by van Biesbroeck and Loreta, 6.6 by Fedtke, and 7 by Chofardet and Ahnert. Ahnert said the tail was 15' long. Chofardet said the round coma was 4' across, with a central nucleus, and a tail extending 15–20' towards the southwest. On the 10th, the magnitude was given as 6.1 by van Biesbroeck, 6.31 by Beyer, and 6.5 by Campa and Tscherny. Van Biesbroeck said the tail extended to PA 244°. On the 11th, the magnitude was given as 5.8 by van Biesbroeck, 5.90 by Beyer, 6.5 by Tscherny, and 6.6

by Rudski. Van Biesbroeck said the tail extended to PA 243° . Rudski said the nuclear magnitude was 7.2. Beyer said the tail extended $35'$ in 250° . On the 12th, Beyer gave the magnitude as 5.84 and said the tail extended $30'$ in PA 249° . Van Biesbroeck said the coma diameter was $4'$ across, while the tail was over 2° long. The tail covered an angle of 20° when first leaving the coma, but it was reduced to a narrow streamer at a distance of $20'$ from the nucleus. It became more diffuse further out in PA 243° . On the 13th, Beyer gave the magnitude as 5.79 and said the tail extended $35'$ in PA 248° . Van Biesbroeck said the tail was broad and diffuse near the coma, with a bright, threadlike streamer traveling up the middle for 1° in PA 236° . This streamer broadened and diffused further out from the nucleus. The coma was $5'$ across. On July 14, the magnitude was within the range of 5.3–6.0, according to van Biesbroeck, Graff, Beyer, and Loreta. Van Biesbroeck said the tail extended to PA 240° . Beyer reported the nuclear magnitude was 8.74, the coma was $5'$ across, and the tail extended $35'$ in PA 244° .

On July 15, the magnitude was given as 5.2 by van Biesbroeck, 5.5 by Loreta, and 5.78 by Graff. Graff said the tail was $20'$ long. Ahnert said the tail extended about $40'$. L. Dezsö (Budapest-Svábhegy) obtained a 95-minute exposure using the 7-cm astrocamera and noted a tail extending $30'$ toward PA 235° . On the 16th, the magnitude was within the range of 4.9–5.6, according to Loreta, Graff, Krumpholz, van Biesbroeck, Beyer, and Chofardet. Rudski said the tail extended less than $45'$, while the nucleus was 2 – $3'$ across and shone at magnitude 7.5. Van Biesbroeck said the tail extended to PA 238.5° . Beyer said the coma diameter was $6'$, and the tail extended $40'$ in PA 235° . Krumpholz said the tail extended 1.5° in PA 230° . Chofardet said the round coma was $5'$ across, with a tail 25 – $30'$ long. On the 17th, the magnitude was within the range of 4.9–5.7, according to J. Witkowski (Poznan, Poland), Graff, Beyer, Krumpholz, Fedtke, and Loreta. Graff said the tail was $30'$ long. Rudski said the nuclear magnitude was 7.5. Beyer said the nuclear magnitude was 8.53, and the tail extended $50'$ in PA 239° . On the 18th, the magnitude was within the range of 5.1–5.8, according to J. Gadowski (Warszawa, Poland), E. Buchar (Prague, Czech Republic), W. T. Gayfer (England), Witkowski, Tscherny, Loreta, Campa, and Fedtke. Rudski said the nuclear magnitude was 7.3. On the 19th, the magnitude was within the range of 4.9–5.4, according to Gadowski, Krumpholz, Buchar, Beyer, Tscherny, and Loreta. Rudski said the nuclear magnitude was 6.7. Beyer said the tail extended $45'$ in PA 237° . On the 20th, the magnitude was within the range of 4.9–5.3, according to Loreta, van Biesbroeck, Buchar, Beyer, and Gadowski. Beyer said the tail extended $65'$ in PA 235° . Van Biesbroeck said the tail extended to PA 222° . He added, "The fan-shaped emanation from the stellar nucleus extends from position-angle 2° to 86° and has sharply defined edges." On July 21, the magnitude was within the range of 4.7–5.1, according to T. Kumon (Kwasan Observatory, Kyoto, Japan), Witkowski, Beyer, Tscherny, and Loreta. Rudski said the nuclear magnitude was 7.0. Beyer said the tail extended $45'$ in PA 238° .

On July 22, the magnitude was within the range of 4.6–5.5, according to T. Takagi (Kwasan Observatory, Kyoto, Japan), Graff, Chofardet, Fedtke, and Loreta. Chofardet said the round coma was 6' across, with a central stellar nucleus, and a tail pointing to the southwest. On the 23rd, the magnitude was within the range of 4.3–4.9, according to Loreta, Beyer, Tscherny, Przybyllok, Fedtke, and Rudski. Rudski said the nuclear magnitude was 7.6. Beyer said the tail extended 65' in PA 221°. On the 24th, the magnitude was within the range of 4.3–5.0, according to Witkowski, Przybyllok, Graff, Krumpholz, Gadomski, Fedtke, and Loreta. Van Biesbroeck said the tail was broad and diffuse, and extended only about 1° in PA 224°. The coma was 8' in diameter. G. Peisino (Trieste, Italy) observed a distinct nucleus and a tail about 30' long. Graff said the tail was 1.5° long. On the 25th, the magnitude was within the range of 4.1–5.0, according to B. H. Dawson (La Plata Observatory, Argentina), van Biesbroeck, Krumpholz, Beyer, Buchar, Gadomski, and Loreta. Rudski said the tail was greater than 1° long and the nuclear magnitude was 6.9. Beyer said the nuclear magnitude was 7.11, the coma diameter was 10', and the tail extended 75' in PA 231°. On the 26th, the magnitude was within the range of 3.9–4.5, according to Kamesima (Kwasan Observatory, Kyoto), Dawson, Beyer, Rudski, Krumpholz, Graff, Witkowski, Tscherny, Loreta, Buchar, and van Biesbroeck. Dawson said the tail extended 45' in PA 220°. Van Biesbroeck said the coma was 9' across and the broad tail extended about 50' in PA 229°. Beyer said the coma was 11' across, and the tail extended 80' in PA 225°. Krumpholz said the tail extended 1°. Chofardet said the round coma was 10' across, with a tail extending towards the southwest. He added that the well-defined nucleus was situated at the apex of a V-shaped formation within the coma, which extended towards the northeast. On July 27, the magnitude was within the range 3.7–4.2, according to van Biesbroeck, Loreta, Beyer, Tscherny, Fedtke, and Buchar. Beyer said the nuclear magnitude was 7.30, the coma diameter was 11', and the tail extended 80' in 225°.

On July 28, the magnitude was within the range of 3.2–4.2, according to A. A. Wachmann (Hamburg Observatory, Bergedorf, Germany), van Biesbroeck, Witkowski, Graff, Tscherny, Buchar, Loreta, Parenago, and Fedtke. Van Biesbroeck said the tail extended to PA 250°. He added, "The emanation from the nucleus covers the angle between 350° and 92° but it is dissymmetrical in intensity, being brightest between 0° and 40°." Chofardet said the coma was 10–15' across, with a tail 3–4° long.

On July 29, the magnitude was within the range of 3.3–4.1, according to Dawson, Gadomski, Tscherny, Himpel, Parenago, Fedtke, and Buchar.

On July 30, the magnitude was within the range 3.1–4.0, according to van Biesbroeck, Loreta, Kumon, Witkowski, Fedtke, and Beyer. Van Biesbroeck said the broad, structureless tail extended about 45' in PA 221°. The coma was measured as 22' in diameter on a 20-minute exposure, while the emanation from the nucleus had widened and covered the angle from 351° to 100°. M. Schürer (Berlin-Babelsberg Observatory) estimated the nuclear

magnitude as 5. Przybyllok obtained a photograph which showed a sharp nucleus and coma extensions to PA 342° , 51° , and 106° . Beyer said the nuclear magnitude was 7.34, the coma diameter was 12', and the tail extended 80' in 226° .

The comet was observed in moonlight on July 31. The magnitude was within the range 3.0–4.0, according to van Biesbroeck, Przybyllok, Tscherny, Loreta, Fedtke, and Himpel. H. E. Houghton and G. E. Ensor (Pretoria, South Africa) said the comet was barely visible to the naked eye.

The comet was probably at its brightest as August began, as it passed closest to Earth on the 4th, although moonlight was still a factor that hampered observations. On August 1, the magnitude was within the range 2.9–4.1, according to Loreta, van Biesbroeck, Ahnert, and Tscherny. Ahnert said the nuclear magnitude was 6.9. On the 3rd, the magnitude was given as 3.0 by Tscherny, 3.7 by Rudski, and 3.9 by Buchar. On the 4th, the magnitude was given as 3.0 by Tscherny, 3.1 by Dawson, and 3.5 by Himpel. Chofardet said the nucleus still exhibited the V-shaped formation. On the 5th, the magnitude was given as 2.9 by Dawson, 3.5 by Buchar, 3.7 by Loreta, and 3.8 by Fedtke. A. F. I. Forbes (Cape Town, South Africa) observed with a 20-cm reflector and said the nucleus was very small, sharp, and bright, and seemed to be surrounded by a narrow border of light "which appeared to be caused by the light of the nucleus lighting up the misty coma." He noted that the coma was round "and was of an almost uniform degree of mistiness though at times one seemed to get a slight suggestion of lamination on the side next to the Sun." Forbes estimated the tail length as 6° . On August 6, the comet attained a maximum solar elongation of 174° . Beyer gave the magnitude as 3.46. Dawson said the tail extended to PA 326° and was 6° long in binoculars and 4.5° long with the naked eye. J. W. Hutchings (Wellington, New Zealand) said a photograph showed an elliptical coma, with a sharp stellar center, measuring 21' by 15'. The broad, straight tail extended about 3.5° in PA 320° .

On August 7, the magnitude was given as 3.5 by Houghton and Ensor, 3.6 by Buchar, and 4.0 by Campa. Dawson observed with the naked eye and said the tail extended 3° in PA 339° . A. W. Long (South Africa) observed with an 11-cm refractor and reported a very large coma, with a very bright, clear-cut nucleus, and a faint tail extending at least 5° . Houghton and Ensor said binoculars showed a broad, diffuse tail extending about $3\text{--}4^\circ$. On the 9th, Houghton and Ensor gave the magnitude as 4. Dawson said the tail extended 5° in PA 354° in binoculars, while it extended only 1.5° with the naked eye. On the 10th and 11th, Dawson gave the magnitudes as 4.0 and 3.8, respectively. On the 12th, Houghton and Ensor gave the magnitude as 5. Hutchings obtained a 2-hour exposure which showed a faint secondary tail, in addition to the primary one. On the 13th, Houghton and Ensor gave the magnitude as 5.5 and noted the comet was "hard to see with the naked eye." On the 15th, Hutchings said the comet's tail was barely 1° long, while the coma was about 8' across. On August 16 and 17, Dawson gave the

magnitude as 5.1. On the 17th, Houghton and Ensor gave the magnitude as 6. Long said the comet was still visible to the naked eye. On the 18th, R. Watson (Somerset West, South Africa) said the nucleus was bright, but not quite stellar. Forbes saw the comet on the 19th with the naked eye, but noted it was a difficult observation. On the 21st, Houghton and Ensor gave the magnitude as 7. Forbes said the comet was still visible with the naked eye, but only after first finding its position in binoculars. On the 22nd, Dawson gave the magnitude as 5.9. On August 24, Hutchings estimated the magnitude as 7.

On September 4, Houghton and Ensor estimated the magnitude as about 9. On September 6, Watson said the tail extended 20' and possibly even 40'. Watson noted the tail was 17' long on the 10th. On September 19, Watson gave the magnitude as 10–11, while Houghton and Ensor estimated it as about 11. Watson said the tail was 5' long, and about 2.5' wide.

Dawson obtained seven photographs of the comet during the period spanning October 1–11. He described it as a fairly compact, faint nebulosity, with no nucleus. On October 19, the comet was photographed for the final time by astronomers at Union Observatory (Johannesburg, South Africa) using the 25-cm Franklin-Adams Star Camera.

The comet was last detected on October 22.02, when J. Tretter (Córdoba) found it on a 45-minute exposure made with a 75-cm reflector. The position was given as $\alpha = 19^{\text{h}} 30.4^{\text{m}}$, $\delta = -74^{\circ} 50'$.

Several spectra of this comet were obtained. A. B. Wyse (Lick Observatory) obtained a 2.75-hour exposure on May 21, using the low-disperser spectrograph and the 91-cm refractor. A weak spectrum was visible, in which the only recognizable feature was a bright band of cyanogen. D. M. Popper obtained a denser spectrogram on June 18, using a spectrograph attached to the 91-cm Crossley reflector and an exposure of 1 hour. The most conspicuous molecule was cyanogen, while fainter bands of diatomic carbon and triatomic carbon were also visible. D. Belorizky (Marseille Observatory, France) photographed the spectrum of the comet on July 23, 25, 26, and 30. He detected cyanogen and diatomic carbon.

The first parabolic orbits were calculated using positions from May 16, 17, and 18. Whipple and Cunningham used Harvard photographic positions and determined the perihelion date as 1936 July 4.85. F. Koebeke took a different set of positions and determined the perihelion date as April 14.52. Whipple and Cunningham added that the comet would pass close to Earth at the end of July, so that it "may be expected to attain naked eye brilliancy." Using positions from May 16, 18, and 19, A. D. Maxwell and H. R. J. Grosch determined the perihelion date as July 7.28. As May progressed, calculations by M. Davidson, J. P. Möller, P. Herget, and Whipple and Cunningham eventually established the perihelion date as July 8.9. Later parabolic orbits were calculated by Möller and Maxwell during early June.

The first elliptical orbit was calculated by J. Bobone. Using positions from May 16, June 19, and July 29, he gave the perihelion date as July 8.97 and

the period as about 2018 years. Shortly thereafter, Davidson determined the perihelion date as July 8.96 and the period as about 1769 years.

A definitive orbit was calculated by Bobone (1947). He took 636 positions spanning the entire period of visibility and determined the perihelion date as July 8.96 and the period as about 1542 years. This orbit is given below.

T	ω	Ω (2000.0)	i	q	e
1936 Jul. 8.9551 (UT)	148.4754	134.9408	78.5447	1.099870	0.991760

ABSOLUTE MAGNITUDE: $H_0 = 6.13$, $n = 7.87$ (Beyer, 1937); $H_{10} = 6.9$ (V1964)

FULL MOON: May 6, Jun. 5, Jul. 4, Aug. 3, Sep. 1, Sep. 30, Oct. 30

SOURCES: P. S. Riggs, *LOB*, **17** (1936), p. 196; L. C. Peltier and G. van Biesbroeck, *HAC*, No. 373 (1936 May 16); L. C. Peltier, G. van Biesbroeck, and R. R. E. Schorr, *BZAN*, **18** (1936 May 18), p. 33; F. L. Whipple and L. E. Cunningham, *HAC*, No. 374 (1936 May 18); F. L. Whipple, L. E. Cunningham, A. A. Wachmann, R. R. E. Schorr, and E. Przybyllok, *BZAN*, **18** (1936 May 19), p. 34; F. L. Whipple and L. E. Cunningham, *HAC*, No. 375 (1936 May 19); G. van Biesbroeck, A. D. Maxwell, and H. R. J. Grosch, *HAC*, No. 376 (1936 May 21); G. B. Lacchini, F. Kaiser, A. A. Wachmann, J. O. Stobbe, and J. Dick, *BZAN*, **18** (1936 May 25), p. 35; G. N. Neujmin, K. Graff, and J. O. Stobbe, *BZAN*, **18** (1936 May 29), p. 36; L. C. Peltier, F. L. Whipple, L. E. Cunningham, F. Koebecke, and M. Davidson, *The Observatory*, **59** (1936 Jun.), p. 201; L. C. Peltier, *Time*, **27** (1936 Jun. 1); J. O. Stobbe, K. Graff, and G. R. Miczaika, *BZAN*, **18** (1936 Jun. 2), p. 38; W. K. Green, *HAC*, No. 377 (1936 Jun. 3); P. Herget, *HAC*, No. 378 (1936 Jun. 3); F. L. Whipple and L. E. Cunningham, *HAC*, No. 379 (1936 Jun. 4); L. C. Peltier, G. van Biesbroeck, J. P. Möller, P. Bourgeois, and E. Vandekerkhove, *AN*, **259** (1936 Jun. 9), p. 267; J. Franz, F. Knappe, and M. Beyer, *BZAN*, **18** (1936 Jun. 16), p. 39; A. D. Maxwell, *HAC*, No. 382 (1936 Jun. 25); F. Kaiser, G. Archenhold, G. R. Miczaika, and C. Fedtke, *BZAN*, **18** (1936 Jun. 26), p. 42; F. Schembor, J. Stein, M. Schürer, and S. D. Tscherny, *AN*, **259** (1936 Jun. 30), p. 347; L. C. Peltier, G. van Biesbroeck, F. L. Whipple, and L. E. Cunningham, *PA*, **44** (1936 Jun.–Jul.), pp. 324–5; J. P. Möller and G. van Biesbroeck, *The Observatory*, **59** (1936 Jul.), pp. 234–5; M. Beyer, K. Graff, J. Franz, C. Fedtke, and S. D. Tscherny, *BZAN*, **18** (1936 Jul. 8), p. 44; K. Graff, *BZAN*, **18** (1936 Jul. 19), p. 48; L. Dezsö and C. Fedtke, *BZAN*, **18** (1936 Jul. 22), p. 49; L. C. Peltier, D. N. Davis, A. D. Maxwell, A. B. Wyse, and D. M. Popper, *PASP*, **48** (1936 Aug.), pp. 222–5; W. T. Gayfer, *The Observatory*, **59** (1936 Aug.), p. 261; C. Fedtke, *BZAN*, **18** (1936 Aug. 7), p. 53; C. Fedtke, *BZAN*, **18** (1936 Sep. 8), p. 60; J. O. Stobbe, S. D. Tscherny, R. R. E. Schorr, A. A. Wachmann, M. Schürer, and G. Peisino, *AN*, **260** (1936 Aug. 11), p. 159; G. van Biesbroeck and A. D. Maxwell, *PA*, **44** (1936 Aug.–Sep.), pp. 389–92; S. Plakidis, D. Kotsakis, and J. Bobone, *AN*, **260** (1936 Sep. 17), pp. 321–4; T. Kumon, T. Takagi, and Kamesima, *AN*, **260** (1936 Sep. 30), p. 391; J. W. Hutchings, *PASP*, **48** (1936 Oct.), pp. 270–1; G. Loreta, P. Ahnert, K. Himpel, J. Witkowski, J. Gadowski, and E. Buchar, *AN*, **260** (1936 Oct. 12), pp. 425–8; S. D. Tscherny, *AN*, **260** (1936 Oct. 19), pp. 429–34; D. Belorizky and P. Chofardet, *JO*, **19** (1936 Dec.), pp. 201–4; E. Przybyllok and M. Campa, *AN*, **261** (1936 Dec. 17), pp. 219, 225; H. M. Jeffers, *LOB*, **18** (1937), pp. 85–6; G. van Biesbroeck, *AJ*, **46** (1937 Jan. 2), pp. 1–2, 4–6; [Union Observatory], *UOC*,

No. 97 (1937 Jan. 27), pp. 306–7; M. Davidson and L. C. Peltier, *MNRAS*, **97** (1937 Feb.), pp. 334–5; H. E. Houghton, G. E. Ensor, A. W. Long, A. F. I. Forbes, and R. Watson, *JASSA*, **4** (1937 Mar.), pp. 79–81; K. Graff, *AN*, **262** (1937 Mar. 1), p. 13; R. R. E. Schorr, *AN*, **262** (1937 Mar. 8), p. 33; *Zeitschrift für Astrophysik*, **13** (1937 Mar. 9), pp. 186–95; A. D. Dubiago, *AN*, **262** (1937 Mar. 16), p. 69; N. Rudski, *AN*, **262** (1937 Mar. 19), pp. 89–92; M. Beyer, *AN*, **262** (1937 Apr. 22), pp. 217–28; B. H. Dawson, *AJ*, **46** (1937 May 10), pp. 57–9; J. Tretter, *AN*, **263** (1937 Jul. 13), pp. 163–6; H. Krumpholz, *AN*, **264** (1937 Oct. 12), pp. 21–4; P. P. Parenago, *AJSU*, **15** (1938), pp. 173–4; A. Schmitt, *JO*, **21** (1938 Apr.), pp. 58, 60; H. L. Giclas, *AJ*, **51** (1944 Aug.), p. 62; J. Bobone, *MNRAS*, **107** (1947), pp. 108–9, 112; V1964, p. 73.

- C/1936 O1** *Discovered:* 1936 July 17.49 ($\Delta = 0.98$ AU, $r = 0.52$ AU, Elong. = 30°)
(Kaho–Kozik–Lis) *Last seen:* 1936 November 24.51 ($\Delta = 1.62$ AU, $r = 2.42$ AU, Elong. = 136°)
Closest to the Earth: 1936 June 25 (0.3708 AU)
1936 III = 1936b *Calculated path:* LMi (Disc), LYN (Sep. 19), GEM (Nov. 13)

S. Kaho (Sappora, Japan) discovered this comet on 1936 July 17.49, at $\alpha = 10^h 03.6^m$, $\delta = +34^\circ 26'$. He described it as magnitude 6, with a nucleus and a short tail. S. Kozik (Ashkhabad Geophysical Observatory, Turkmanian Republic, Soviet Union) independently found the comet nearly 7 hours later on July 17.73, and described it as magnitude 6, with a very faint, straight, and narrow tail extending about 1.5° . W. Lis (Astronomical Station of Cracow Observatory, Mount Lubomir, Poland) independently discovered the comet on July 17.86, and gave the nuclear magnitude as 8.0. The comet had been situated at a minimum elongation of about 18° from the sun on June 29 and moved out to a maximum elongation of 31° by July 14. The comet was moving away from both the sun and Earth at the time of discovery.

On July 18, the magnitude was given as 4–5 by F. Quénisset (Juvisy Observatory, France), 6 by G. N. Neujmin (Simeis Observatory, Crimea, Ukraine), and 6.0 by S. Herrick and D. N. Davis (Lick Observatory, California, USA). T. Banachiewicz (Cracow) said the comet and tail were faintly visible to the naked eye in twilight. The tail length was given as 1° by Banachiewicz and over 2° by Quénisset. Banachiewicz also reported an oval “nucleus” of magnitude 8 was visible in a 12-cm refractor.

On July 19, the magnitude was given as 5 by Davis and H. M. Jeffers (Lick Observatory), 5.0 by Kozik, 5.9 by G. Loreta (Bologna, Italy), and 6 by Neujmin. Neujmin noted a nucleus and tail. Davis and Jeffers obtained a 3-minute exposure using the 91-cm Crossley reflector and said the tail extended 0.5° toward the east.

The comet faded slightly during the remainder of July. On the 20th, the magnitude was given as 5 by G. van Biesbroeck (Yerkes Observatory, Wisconsin, USA) and 6 by L. E. Cunningham (Harvard College Observatory, Massachusetts, USA). Van Biesbroeck said the tail extended over 1° . On the 21st, the magnitude was given as 5.5 by van Biesbroeck and 6.0 by Loreta. On the 22nd, the magnitude was given as 5.0 by M. Campa (Milan, Italy), 5.5

by E. J. Delporte (Uccle, Belgium), and 6.0 by Loreta. Delporte said the tail was less than 1° long, while there was a central condensation. On the 23rd, Loreta gave the magnitude as 6.3. On the 24th, the magnitude was given as 5 by H. L. Giclas (Lowell Observatory) and van Biesbroeck, 6.0 by Campa, and 6.4 by Loreta. On the 25th, Jeffers said an 8-minute exposure with the 91-cm Crossley reflector showed a tail extending over 0.5° "with structure suggesting a bright central filament inside a less conspicuous envelope." On the 26th, van Biesbroeck gave the magnitude as 5.5. On the 28th, the magnitude was given as 5.5 by van Biesbroeck, 6.5 by A. Bohrmann (Königstuhl Observatory, Heidelberg, Germany), and 7.0 by Campa. Van Biesbroeck said the coma was $50''$ across and contained a sharp nucleus. The tail was "much fainter" and extended to PA 51° . The comet attained its most northerly declination of $+37^\circ$ on July 30, at which time van Biesbroeck gave the magnitude as 5.8. On July 31, van Biesbroeck gave the magnitude as 6.5, and said the tail was no longer visible in evening twilight.

The last observation before the comet's conjunction with the sun was made by Bohrmann on August 6.85, when he gave the magnitude as 8.7. The elongation was then 22° . On August 10, the comet reached a minimum solar elongation of 21° .

The first observation of this comet following its conjunction with the sun came on August 29.40, when van Biesbroeck found it in morning twilight and described it as a round, centrally condensed coma, with a magnitude of 12. The elongation was then 29° .

On September 18, Jeffers gave the magnitude as 12.5, using the 30-cm refractor. He said "the comet seemed quite diffuse." The comet attained its most southerly declination of $+33^\circ$ on October 6. On October 24, van Biesbroeck described the comet as a diffuse coma $40''$ in diameter, with a magnitude of 15.5. On October 26, Jeffers photographed the comet using the 91-cm Crossley reflector and gave the magnitude as 17.5. He said a 60-minute exposure revealed the coma was moderately condensed, with a diameter of $5''$, and contained a "far from stellar nucleus." After moving very slowly northward for about a month, the comet attained a declination of $+34^\circ$ on November 14 and then began moving southward again.

The last two detections of this comet came on November 24.45 and November 24.51, when Jeffers obtained two 1-hour exposures with the 91-cm Crossley reflector at Lick Observatory. B. P. Riggs gave the comet's position on the latter date as $\alpha = 7^{\text{h}} 11.9^{\text{m}}$, $\delta = +33^\circ 52'$. Jeffers described the comet as "a mere fleck of nebulosity" with a magnitude of 18. The moon was full on November 28.

The first orbital calculation was made by F. L. Whipple and Cunningham and was published on July 21. Using positions obtained on July 18, 19, and 20, they found a perihelion date of 1936 July 13.70. Large residuals for the first date led them to state that the orbit was uncertain due to "observational inconsistency."

Cunningham revised his orbital calculations using observations made up through July 27, and published them on August 6. He found the perihelion date was July 15.83. J. P. Möller used a similar set of positions and determined the perihelion date as July 15.80. A. D. Maxwell and H. R. J. Grosch published a parabolic orbit on August 28, which was based on four precise positions obtained between July 19 and 30. The perihelion date was July 15.84. Using three observations obtained between July 18 and 30, H. Hirose computed a parabolic orbit. The perihelion date was determined as July 15.84.

I. Nikoloff (1952) used 65 positions obtained between July 18 and November 24, and computed an elliptical orbit with a perihelion date of July 15.82 and a period of about 887 years. This orbit is given below.

T	ω	Ω (2000.0)	i	q	e
1936 Jul. 15.8203 (UT)	45.8496	265.0062	121.9417	0.518403	0.994389

ABSOLUTE MAGNITUDE: $H_{10} = 8.4$ (V1964)

FULL MOON: Jul. 4, Aug. 3, Sep. 1, Sep. 30, Oct. 30, Nov. 28

SOURCES: S. Kaho, S. Kozik, and G. N. Neujmin, *BZAN*, **18** (1936 Jul. 19), p. 48; S. Kaho, S. Herrick, D. N. Davis, H. M. Jeffers, S. Kozik, L. E. Cunningham, and G. van Biesbroeck, *HAC*, No. 383 (1936 Jul. 20); F. L. Whipple and L. E. Cunningham, *HAC*, No. 384 (1936 Jul. 21); W. Lis, S. Kozik, G. N. Neujmin, G. Loreta, F. L. Whipple, and L. E. Cunningham, *BZAN*, **18** (1936 Jul. 22), p. 49; S. Kaho, F. L. Whipple, and L. E. Cunningham, *The Observatory*, **59** (1936 Aug.), p. 261; G. van Biesbroeck, *HAC*, No. 385 (1936 Aug. 3); L. E. Cunningham, *HAC*, No. 386 (1936 Aug. 6); S. Kaho, S. Kozik, W. Lis, and J. P. Möller, *AN*, **260** (1936 Aug. 17), p. 171; A. Bohrmann, *BZAN*, **18** (1936 Aug. 19), p. 56; A. D. Maxwell and H. R. J. Grosch, *HAC*, No. 387 (1936 Aug. 28); S. Kaho, S. Kozik, F. L. Whipple, and L. E. Cunningham, *PA*, **44** (1936 Aug.–Sep.), p. 393; L. E. Cunningham and J. P. Möller, *The Observatory*, **59** (1936 Sep.), p. 296; W. Lis and T. Banachiewicz, *AN*, **260** (1936 Sep. 1), p. 271; A. Bohrmann, *AN*, **260** (1936 Sep. 7), p. 287; A. Bohrmann, *AN*, **260** (1936 Sep. 17), p. 323; G. Loreta, A. Bohrmann, and E. J. Delporte, *AN*, **260** (1936 Sep. 30), p. 389; W. Lis, A. D. Maxwell, H. R. J. Grosch, and G. van Biesbroeck, *PA*, **44** (1936 Oct.), p. 451; G. van Biesbroeck, *The Observatory*, **59** (1936 Nov.), p. 356; S. Kaho, S. Kozik, and W. Lis, *PASP*, **48** (1936 Dec.), p. 316; S. Kaho, S. Kozik, W. Lis, A. D. Maxwell, and H. R. J. Grosch, *PASP*, **48** (1936 Dec.), p. 339; M. Campa, *AN*, **261** (1936 Dec. 17), p. 225; H. M. Jeffers, *LOB*, **18** (1937), pp. 86, 88; S. Kaho, S. Kozik, W. Lis, F. Quénisset, A. D. Maxwell, and H. R. J. Grosch, *MNRAS*, **97** (1937 Feb.), pp. 334–5; *PASP*, **49** (1937 Feb.), p. 36; G. van Biesbroeck, *The Observatory*, **60** (1937 Feb.), p. 55; G. van Biesbroeck, *AJ*, **46** (1937 Sep. 14), pp. 141, 143–5; H. Hirose, *JJAG*, **15** (1938), p. 24; H. L. Giclas, *AJ*, **51** (1944 Aug.), p. 62; I. Nikoloff, *MNRAS*, **112** (1952), pp. 342–3; V1964, p. 73.

58P/1936 S1 *Prediscovery:* 1936 September 9.92 ($\Delta = 0.48$ AU, $r = 1.49$ AU, Elong. =
(Jackson–Neujmin) 173°)
Discovered: 1936 September 15.86 ($\Delta = 0.48$ AU, $r = 1.48$ AU,
1936 IV = 1936c Elong. = 167°)

Last seen: 1936 November 5.27 ($\Delta = 0.68$ AU, $r = 1.51$ AU, Elong. = 128°)

Closest to the Earth: 1936 September 16 (0.4788 AU)

Calculated path: AQR (Pre), CET (Oct. 27)

This comet was independently discovered on plates taken in the course of routine minor planet surveys. The initial discovery was made by C. V. Jackson (Union Observatory, Johannesburg, South Africa) on 1936 September 20, while examining one of the plates exposed using the Franklin–Adams Star Camera on September 15.86. The position was then given as $\alpha = 22^{\text{h}} 54.4^{\text{m}}$, $\delta = -10^\circ 41'$. Jackson rephotographed the region on September 20.84 to confirm the discovery. A visual observation with the 66-cm telescope showed a diffuse, 12th-magnitude object, without a central condensation or nucleus. The daily motion was determined as $+1^{\text{m}} 05^{\text{s}}$ in α and $-25'$ in δ . An independent discovery of this comet was made by G. N. Neujmin (Simeis Observatory, Crimea, Ukraine) on September 21.82. He also estimated the magnitude as 12. Near the end of November, F. Rigaux (Royal Observatory, Uccle, Belgium) announced the finding of a predisccovery image on a photographic plate exposed on September 9.92. The comet was near its closest distance to Earth when discovered, but was still approaching the sun.

On September 22, the magnitude was given as 12 by Neujmin, 12.5 by H. M. Jeffers (Lick Observatory, California, USA), and 13 by G. van Biesbroeck (Yerkes Observatory, Wisconsin, USA). Van Biesbroeck described the comet as a round, centrally condensed coma, with a diameter of $30''$. On the 23rd, the photographic magnitude was given as 11 by H. L. Giclas (Lowell Observatory, Arizona, USA), 12 by J. Bobone (National Observatory, Córdoba, Argentina) and Neujmin, 12.5 by A. A. Wachmann (Hamburg Observatory, Bergedorf, Germany), and 13 by van Biesbroeck. On the 24th and 25th, Bobone gave the magnitude as 12. On September 25, van Biesbroeck gave the magnitude as 13. He added that the coma was round, centrally condensed, and measured $25''$ across.

The comet was closest to the sun at the beginning of October and was moving away from both the sun and Earth thereafter. On October 8, van Biesbroeck gave the magnitude as 13.5. The coma was extremely diffuse and $35''$ across. On the 12th, van Biesbroeck gave the magnitude as 14. He added that the coma was “diffuse with hardly any condensation,” and measured $30''$ across. On the 14th, Jeffers visually observed the comet using the 91-cm refractor and gave the magnitude as 15.5. He simply described it as “a small fleck of nebulosity.” On the 16th, van Biesbroeck simply described the comet as extremely diffuse with a magnitude of 15. On the 21st, Jeffers obtained a photograph with the 91-cm Crossley reflector and noted a coma 10–15'' across, with a moderately condensed nucleus. The comet attained its most southerly declination of -20° on October 27.

The last two detections of the comet came on November 5.23 and November 5.27, when Jeffers obtained photographs with the 91-cm Crossley reflector. B. P. Riggs gave the comet’s position on the latter date as $\alpha = 0^{\text{h}} 09.4^{\text{m}}$,

$\delta = -20^\circ 07'$. Jeffers said the comet was a small, well-defined object of magnitude 17.5.

The first orbit was computed by L. E. Cunningham and published on September 26. Using van Biesbroeck's precise positions from September 22, 23, and 25, he found an elliptical orbit with a perihelion date of 1936 October 4.79 and a period of 6.83 years. This orbit indicated the comet had passed about 0.5 AU from Jupiter in the spring of 1934. Jackson took positions from September 15, 20, and 26, and determined the perihelion date as October 2.50 and the period as 9.52 years. Despite these elliptical orbits, two teams of astronomers independently calculated parabolic orbits a few days after Jackson and using the same positions. S. Herrick, G. E. Kron, and "Miss Hill" determined the perihelion date as September 30.81, while A. D. Maxwell and H. R. J. Grosch determined it as October 5.58.

The comet's orbit was virtually pinpointed about mid-October. Cunningham used three positions determined by van Biesbroeck during the period September 22–October 8. He gave the perihelion date as October 3.67 and the period as 8.53 years. Herrick, Kron, and Hill computed an elliptical orbit using eight precise positions spanning the period September 22–October 7, and found a perihelion date of October 3.39 and a period of 8.54 years. Using positions from September 15, October 4, and 19, Jackson determined the perihelion date as October 3.24 and the period as 8.06 years. Following the announcement of the predisccovery position of September 9, Cunningham used it, plus positions from September 23 and October 21, to determine a perihelion date of October 3.45 and a period of 8.53 years.

The comet was not found at its next three apparitions. B. G. Marsden (1960, 1961, 1969) subsequently published orbits which indicated the period was slightly longer: 8.57 years. These orbits led to the comet's recovery in 1970. Thereafter, Marsden (1975) and G. Forti (1989) computed multiple apparition orbits using both gravitational and nongravitational effects. Forti's orbit is given below. It used 41 positions obtained during the observed apparitions of 1936–1978, as well as perturbations by all nine planets and nongravitational terms of $A_1 = +0.00$ and $A_2 = -0.2595$, and determined the perihelion date as October 3.37.

The suggestion was made on several occasions during the discovery apparition that this comet might be comet Swift of 1895 (D/1895 Q1), which was shown to have an orbit of 7.2 years, but was not seen again after its discovery apparition. Later computations have shown the link is not possible.

T	ω	Ω (2000.0)	i	q	e
1936 Oct. 3.3680 (TT)	197.2803	165.1350	13.2898	1.462680	0.650596

ABSOLUTE MAGNITUDE: $H_{10} = 13.3$ (V1964)

FULL MOON: Sep. 1, Sep. 30, Oct. 30, Nov. 28

SOURCES: C. V. Jackson, *BZAN*, **18** (1936 Sep. 22), p. 67; G. van Biesbroeck, *HAC*, No. 389 (1936 Sep. 23); G. van Biesbroeck and L. E. Cunningham, *HAC*, No. 390 (1936 Sep. 26); S. Herrick, G. E. Kron, "Miss Hill", A. D. Maxwell, and H. R. J. Grosch, *HAC*, No. 391 (1936 Sep. 29); G. N. Neujmin and A. A. Wachmann, *BZAN*, **18** (1936 Sep. 30), p. 68; C. V. Jackson, *The Observatory*, **59** (1936 Oct.), p. 322; G. N. Neujmin, *BZAN*, **18** (1936 Oct. 7), p. 71; L. E. Cunningham and G. van Biesbroeck, *HAC*, No. 394 (1936 Oct. 13); S. Herrick, G. E. Kron, "Miss Hill", and G. van Biesbroeck, *HAC*, No. 395 (1936 Oct. 14); C. V. Jackson, *BZAN*, **18** (1936 Oct. 19), p. 73; L. E. Cunningham, S. Herrick, G. E. Kron, "Miss Hill", *IAUC*, No. 627 (1936 Oct. 29); C. V. Jackson, L. E. Cunningham, S. Herrick, G. E. Kron, "Miss Hill", and G. van Biesbroeck, *PA*, **44** (1936 Nov.), p. 494; C. V. Jackson, *The Observatory*, **59** (1936 Nov.), pp. 355–6; F. Rigaux and G. N. Neujmin, *IAUC*, No. 628 (1936 Nov. 3); H. A. Kobold, *AN*, **261** (1936 Nov. 10), p. 85; C. V. Jackson, *IAUC*, No. 629 (1936 Nov. 10); C. V. Jackson, *AN*, **261** (1936 Nov. 17), p. 101; L. E. Cunningham, *HAC*, No. 401 (1936 Dec. 2); J. Bobone, *AN*, **261** (1936 Dec. 17), p. 225; G. N. Neujmin, *PA*, **44** (1936 Dec.), p. 573; H. M. Jeffers and L. E. Cunningham, *PASP*, **48** (1936 Dec.), pp. 339–40; C. V. Jackson and G. van Biesbroeck, *The Observatory*, **59** (1936 Dec.), p. 383; C. V. Jackson, *UOC*, No. 97 (1937 Jan. 27), pp. 307–8; H. M. Jeffers, *LOB*, **18** (1937), p. 86; L. E. Cunningham, *The Observatory*, **60** (1937 Jan.), p. 28; C. V. Jackson, G. N. Neujmin, F. Rigaux, and L. E. Cunningham, *MNRAS*, **97** (1937 Feb.), p. 336; G. van Biesbroeck, *AJ*, **46** (1937 Sep. 14), pp. 141, 144–5; L. E. Cunningham, *VJS*, **73** (1938), pp. 60–1; H. L. Giclas, *AJ*, **51** (1944 Aug.), p. 62; B. G. Marsden, *QJRAS*, **1** (1960 Dec.), pp. 232–3; B. G. Marsden, *QJRAS*, **2** (1961 Oct.), pp. 157–9; V1964, p. 73; B. G. Marsden, *QJRAS*, **10** (1969 Sep.), pp. 252–3; B. G. Marsden, *CCO*, 2nd ed. (1975), pp. 24, 50; B. G. Marsden, *QJRAS*, **19** (1978 Mar.), pp. 52–3, 57; G. Forti, *AAP*, **215** (1989), pp. 381–2, 384.

33P/1937 B1 *Recovered*: 1937 January 31.43 ($\Delta = 1.23$ AU, $r = 1.54$ AU, Elong. = 87°)

(Daniel) *Last seen*: 1937 April 1.85 ($\Delta = 1.77$ AU, $r = 1.67$ AU, Elong. = 68°)

Closest to the Earth: 1936 November 12 (0.8836 AU)

1937 I = 1937a *Calculated path*: ARI (Rec), TAU (Feb. 27), PER (Mar. 8), AUR (Mar. 22)

Following this comet's discovery in 1909, it was missed at its next three apparitions. For the 1916 apparition, a prediction of May 23.92 was provided by S. Einarsson and M. Harwood (1916), while J. Krassowski (1916) determined it as May 22.26. Although these indicated the comet was unfavorably placed for observation, Einarsson and Harwood noted that the predicted "positions may be considerably in error due to the fairly close approach to Jupiter." They found that the comet was within 0.7 AU from Jupiter during the period spanning 1911 December and 1912 March. A prediction for the next apparition came from C. H. Hall Jr. and E. L. Kinsey (1922). They began with the orbit determined for the 1909 apparition and found that the comet would next arrive at perihelion on 1922 October 18. A. D. Dubiago (1923, 1924) predicted the comet would pass perihelion around the middle of 1923. F. R. Cripps (1929, 1930) provided a prediction