Cometography

A Catalog of Comets
Volume 5: 1960–1982

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 5 provides a complete discussion of the observations and pertinent calculations for every comet seen between 1960 and 1982. The comets are listed in chronological order, with complete references to publications relating to each comet and physical descriptions of each comet's development throughout its apparition. *Cometography* will be valuable to historians of science as well as providing amateur and professional astronomers 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 1973–4. His work has been published in numerous magazines, and in two previous books *Comets: A Descriptive Catalog* (1984), *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.

MAIK MEYER has observed comets since 1987. Besides comet observing, he is researching cometary orbits in order to link and identify historic comet apparitions. His speciality area is the history of comet hunting. In 2002, he discovered the Meyer group of sunskirting comets. Meyer was leader of the Comet Section of the German Vereinigung der Sternfreunde and serves as Assistant Editor of the *International Comet Quarterly* (*ICQ*). The International Astronomical Union (IAU) named minor planet 52005 Maik, in honor of his research work in comets.

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Introduction

The period 1960–1982 did not see a lot of improvements in the equipment that professional astronomers were using. What does stand out during this period is the remarkable increase in the number of observations from amateur astronomers.

Comet discoveries

The discovery of comets during this period was dominated by two countries, with the USA barely surpassing Japan with 45 discoveries to Japan's 44. Following Japan were Australia with 27 discoveries and Chile with 11 discoveries.

The most prolific comet discoverer of this period was W. A. Bradfield (Australia), who found 11 new comets. Next in line were T. Seki (Japan), who found 6 new comets, K. Ikeya (Japan), M. Honda (Japan), P. Wild (Switzerland), L. Kohoutek (Germany), and T. Gehrels (United States), with 5 discoveries, and then Y. Sato (Japan), S. Fujikawa (Japan), and M. Lovas, who each found 4 comets. Of these observers, only Wild, Kohoutek, and Lovas were professional astronomers. Another discoverer of comets was the satellite P78–1, which found 5 using its SOLWIND coronograph, making it the first satellite to discover a comet.

Comet observations

Several very active comet observers mentioned in *Cometography*, volume 4 continued to observe during most, if not all, of the period covered by this volume. The most notable include G. van Biesbroeck, E. Roemer, and A. F. A. L. Jones. The most notable observers to make an impression during these years were J. E. Bortle, T. Seki, and C. S. Morris.

Roemer and Bortle particularly stand out. Roemer's work continued to be aimed at precisely measuring the positions of comets, but she was frequently the first person to recover periodic comets, and she made the final observation of numerous comets. Many of these recoveries occurred before the comet began showing any activity and Roemer was able to determine the upper limits for the diameter of the nucleus. Bortle made more observations than anyone during the period covered by this volume. His consistent magnitude estimates enabled the lightcurves of many comets to be examined. Bortle found that several periodic comets have asymmetric lightcurves, meaning they are not at their brightest when at perihelion. Most notable was comet 6P/d'Arrest, which Bortle found experiences a brightness surge that typically occurs about 20 days after perihelion.

Visual observations remained the most abundant type of observation, with most observers continuing to provide estimates of the total magnitude, coma diameter, and tail length. 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 provide fainter magnitudes, smaller coma diameters, and shorter tail lengths for the brighter comets than the visual observers. The reader will also notice the first observations made using electronic camera systems. These cameras use a chip called a charge coupled device (CCD), which literally creates an electronic image from the light focused on it. These cameras rose to great prominence in the 1980s and 1990s and changed the way comet images were obtained.

The "Bobrovnikoff method" and the "Sidgwick method" were still the most preferred methods for determining the magnitude of a comet; however, Morris and S. J. O'Meara came up with a method in the late 1970s that basically combined the two techniques. Referred to as the "Modified Out" method, it required that the comet was defocused until the nuclear condensation became invisible or smeared out, leaving a coma of uniform brightness. The observer then memorized the appearance and defocused comparison stars until they were the same size as the defocused comet. Although a more difficult technique to master, the results ultimately produced lightcurves that gave more accurate predictions of later comet returns.

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.

Astronomical periodicals

The most dominant astronomical periodicals during the period covered by this volume were the *Monthly Notices of the Royal Astronomical Society* and the *Astronomical Journal*. Each published articles and papers concerning comets in nearly every issue. During the mid-1970s, a new publication arose called *The Comet*. It continued evolving to finally become the *International Comet Quarterly*, providing comet observations and analysis.

The Central Bureau for Astronomical Telegrams moved from Copenhagen (Denmark) to Cambridge (Massachusetts, USA) during 1965, but remained the official clearing house for comet discoveries and recoveries. Throughout the book it is simply referred to as the "Central Bureau." It continued to disseminate information through the *International Astronomical Union Circular*, whenever necessary.

The *British Astronomical Association Circulars* (England) and the *Astronomicheskij Tsirkulyar* (Russia) also continued to publish comet observations. As noted in volume 4, the *British Astronomical Association Circulars* mostly republished material found in the *International Astronomical Union Circulars*, while the material in the *Astronomicheskij Tsirkulyar* rarely made it to other, more accessible publications.

The most interesting comets from 1960 to 1982

There were several bright comets that were widely observed during this period.

Comet C/1961 O1 (Wilson–Hubbard) was discovered by no less than seven observers, of which five were flying aboard airplanes. All of the discoveries were made with the naked-eye between 1961 July 23 and 24. The comet displayed a naked-eye tail at least 15° long, while photographs revealed it extending 25–30°.

Comet C/1962 C1 (Seki–Lines) was discovered in early February 1962. It became visible to the naked eye during early March and was at its brightest during early April, when some observers estimated the magnitude as –1.5 to –2 in twilight. The tail reached a maximum length of 15° around April 8–10.

Comet C/1965 S1 (Ikeya–Seki) was independently discovered by two amateur astronomers. It became visible to the naked eye in broad daylight during October 20–22, when the magnitude apparently reached –10. The tail reached a maximum length of 25–26° around the first week in November. The comet definitely split into two pieces, although a third was also noted by a few observers early in November.

Comet C/1969 Y1 (Bennett) brightened rapidly after its late December 1969 discovery and became a naked-eye object in late February 1970. As it continued to brighten, the tail increased to a length of 10° by early April. It reached a maximum magnitude of about 0 shortly after mid-March and finally dropped below naked-eye visibility in mid-May.

Comet C/1973 E1 (Kohoutek) was discovered while still relatively far from the sun and a quick prediction was made that it could be a bright naked-eye object near the end of 1973. The media picked up on this and began touting the comet as the "Comet of the Century." Although the comet became a naked-eye comet, it was at its brightest when too close to the sun to be observed by anyone but the astronauts aboard the *Skylab* space station. The brightest magnitude seen by Earth-based observers came on 1974 January 1, when it was reported to be 0. The comet faded quickly, although a tail extending 15° or more was reported around mid-January.

Comet C/1975 V1 (West) was another comet discovered when still relatively far from the sun, but it was virtually ignored by the media after the public's disappointment in comet Kohoutek. The comet attained a maximum magnitude of –3 during late February 1976 and could briefly be seen with the naked eye in broad daylight. As March began, the comet was moving out of morning twilight and was an easy naked-eye object displaying a tail more than 30° long. The comet remained a naked-eye object until mid-April. The nucleus split into four pieces.

The brightest periodic comet during this period was the long-awaited return of 1P/Halley. It was recovered on 1982 October 16 and was first spotted with the naked eye during November 1985. The comet was brightest during March and April 1986, when the magnitude reached 2.0 and was then best seen by observers in the Southern Hemisphere. The tail seems to have been longest during early May 1986 when it reached a length of 19°. The comet was last detected with the naked eye around mid-May 1986.

Cometography

The biggest change in volume 5 is the condensing of many comets. It became obvious while writing volume 4 that it was becoming tedious to deal with the number of observations. With volume 5, it was decided to concentrate on the observations of experienced observers – particularly when dealing with bright comets. This should be an improvement for the reader, as he/she will not have to wade through as many observations and this will make brightness trends more obvious. The authors point out this change because some reviewers have compared the page count for write-ups of bright comets in past volumes. For the record, the 1982 write-up for 1P/Halley was close to 150 pages prior to the condensing, because we had included nearly 5000 observations!

It should also be noted that the positions given in this volume are representative of those initially reported by the people making the discoveries/recoveries and final observations. They are given for equinox 1950.0.

Throughout the volumes of *Cometography* are representative values of each comet's absolute magnitude, which is the brightness a comet would have if located 1 astronomical unit (AU) from both the sun and Earth. The absolute magnitude gives astronomers the tool to compare the brightness behavior of comets. Comets follow the standard power law equation $m_1 = H_0 + 5 \log \Delta + 2.5\, n \log r$, where m_1 is the apparent total visual magnitude, H_0 is the absolute magnitude, Δ is the geocentric distance in AU, and r is the heliocentric distance in AU. The value of n is the so-called slope or activity factor, which indicates how fast the comet's magnitude changes as it moves toward or away from the sun. When only a few observations are available, or if the variation in the heliocentric distance is small, the absolute magnitude is designated by H_{10} and indicates the slope factor is assumed to be $n = 4$, which is an average value for many comets. There are a few cases where additional parameters are given, since the comet exhibited a different behavior during certain parts of its apparition. These regions are defined either by a range in the heliocentric distance r or by the temporal distance t from the perihelion date T in days.

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