Cometography

A Catalog of Comets
Volume 2: 1800–1899

Cometography is a four-volume catalog of every comet observed throughout history. It is the most complete and comprehensive collection of data on comets available. Volume 2 provides a complete discussion of the comets seen during the nineteenth century. *Cometography* 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 from the Earth, and other details to enable the reader to understand the physical appearance of each well-observed comet. The book also provides non-technical details to help the reader appreciate better how the comet may have influenced various cultures at the time of its appearance. *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 1973/74. His work has been published in numerous magazines and journals, 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 those of Coordinator of the Comet Section of the Association of Lunar and Planetary Observers, and Consultant for the American Meteor Society.

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Frontmatter
More information

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Contents

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Introduction

As would be expected, the nineteenth century was a period of change with respect to the study of comets. Although visual observations were still the primary method of acquiring data, bigger telescopes and new methods of observing greatly added to our understanding of these objects. The field of celestial mechanics also saw improvements, as astronomers were able to provide more accurate ephemerides to allow comets to be followed longer, and new techniques were applied to the orbits of periodic comets which enabled their perihelion dates to be predicted to within just a few hours.

Comet discoveries

Continuing with the tradition of the late eighteenth century, the two French rivals, C. Messier and P. F. A. Méchain, independently found the first comet of the nineteenth century, but they were beaten by a new kid on the block. A Frenchman named J. L. Pons found the comet before anyone. The discovery marked a changing of the guard among comet hunters. Messier and Méchain would never get credit for a comet discovery again, while Pons would go on to surpass everyone and become the greatest visual comet discoverer of all time.

Marseille Observatory ranked as the dominant observatory for comet discoveries during the century. A total of 48 comets held the names of Marseille observers at one time, although comets later identified as periodic by J. F. Encke, W. von Biela, A. C. D. Crommelin, and others would drop the current official total to 42. In addition, another 13 comets were independently discovered at Marseille before word arrived of their previous discovery elsewhere. Marseille astronomers are credited with at least one comet discovery in every decade of the nineteenth century except the 1840s.

Despite the dominance of the Marseille observers, the French were not the most prolific comet discoverers during this century. That honor went to astronomers within the USA, whose names are on more than 70 comets found during the nineteenth century. The earliest US discovery of the century was by M. Mitchell, who found a comet in 1847. The period of 1862–99 was quite incredible as 59 comets were found by L. Swift, E. E. Barnard, W. R. Brooks, and C. D. Perrine in the USA.

Comet observations

The visual observations of comets changed little from the eighteenth century through the first half of the nineteenth century. Observers continued to provide measurements of the coma diameter and the tail length, while estimates were made of the brightness of the nucleus. The only estimates of the comet's total magnitude were made at times when naked-eye observations were possible. The astronomers providing the longest series of such data during this century were J. F. J. Schmidt, J. Holetschek, and T. W. Backhouse. The latter two astronomers were among the first to provide extensive series of total magnitude estimates of comets fainter than naked-eye visibility. No special technique was used to obtain these estimates, as they basically made observations with the smallest instrument possible. Beginning in the early 1880s, many other astronomers began using the same technique.

There were many attempts to try to obtain a better indication of the comet's brightness and/or appearance throughout the century. One of the earliest techniques was to compare a comet to the objects in William Herschel's catalog of deep sky objects. Herschel's catalog categorized 2514 objects into eight classes. These were as follows:

Class I: Bright nebulae
Class II: Faint nebulae
Class III: Very faint nebulae
Class IV: Planetary nebulae
Class V: Very large nebulae
Class VI: Very compressed and rich clusters of stars
Class VII: Compressed clusters of small and large stars
Class VIII: Coarsely scattered clusters of stars

This method of classification was not widely used, but does occasionally come up in the literature throughout the century. It has since been shown that comparing the appearance of a comet with a deep sky object is generally not accurate because of the potentially varying intensity of the central condensations.

A more interesting technique was the attempt to accurately determine a comet's brightness by comparing it to stars. The technique, now known as the Bobrovnikoff method, appears to have first been utilized during the last decades of the nineteenth century. The English amateur astronomer G. Knott specifically noted that while he was observing comet C/1882 F1 (Wells) on 1882 May 11, he threw a telescope out of focus and compared the head of the comet to a nearby star. Before the end of the century, the same technique was also being utilized by Backhouse, as well as the American astronomers E. F. Sawyer and L. Boss. This technique increased in popularity early in the twentieth century and modifications were later made which improved the accuracy.

Astronomical periodicals

The dissemination of comet discovery announcements, observations, and research underwent a notable change during the first couple of decades of the nineteenth century. The French journal *Memoirs of the Academie des Sciences* was no longer a major monthly source of comet information as the century began, but the *Connaissance des Temps* and *Berliner Astronomische*

Jahrbuch continued to carry such information. The better of these two journals was the *Berliner Astronomische Jahrbuch*, but, as it was an astronomical almanac, it was only published once a year, so that the included astronomical papers were not published in a timely fashion. This was remedied for a short time by monthly periodicals such as the *Monatliche Correspondence*, the *Correspondance Astronomique, Geographique, Hydrographique et Statistique du Baron de Zach* and others, but it was not until the 1820s that significant long-term changes took place.

The 1820s saw the beginning of two of astronomy's oldest periodicals: the German periodical *Astronomische Nachrichten* and the British periodical *Monthly Notices of the Royal Astronomical Society*. These would be joined by the French periodical *Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences* during the 1830s. Although all were fine journals, the *Astronomische Nachrichten* grew in popularity as the years passed. Most important was its conversion from a monthly periodical to more of a weekly, with a publication date that floated to enable a rather quick distribution of information. For most of the nineteenth century, the *Astronomische Nachrichten* was the clearing house of comet news and research.

Another important journal came on the scene in 1849. Named the *Astronomical Journal*, it became an important periodical for publishing observations made by observatories in the USA. Financial problems forced a temporary end to the journal early in 1861, but it resumed late in 1886 and continues to the present time.

Observations

Visual observers still dominated the field, with the greatest advances being the building of larger telescopes. Refractors dominated the century, with those between 15 cm and 20 cm being most prominent; however, during the last couple of decades, refractors quickly increased in size and culminated with the 102-cm refractor of Yerkes Observatory around the middle of the 1890s. The result was that early in the century comets were usually lost after having faded to magnitude 11 or 12, while at the end of the century comets were being followed until near magnitude 16.

Two new tools came into use during the nineteenth century that greatly increased our knowledge of comets. The first was the spectroscope. The Italian astronomer G. B. Donati first applied a spectroscope to a comet on 1864 August 5 and 6. The comet was C/1864 N1 (Tempel) and Donati reported the appearance of three bright bands, which are now known as the Swan bands of carbon. Although many astronomers began observing bright comets with this new instrument, it was the English astronomer W. Huggins who quickly advanced this field and identified some of the molecules astronomers were detecting within the comets. Spectroscopic observations of C/1882 R1 (Great September Comet) ultimately revealed the presence of carbon, sodium, iron, and nickel.

The first photograph was a 7-second exposure of C/1858 L1 (Donati) made by the English photographer W. Usherwood on 1858 September 27. Being made with a portrait lens, the photograph succeeded in revealing part of the comet's bright tail. The next night, Harvard astronomer G. P. Bond became the first astronomer to photograph a comet through a telescope. His 6-minute exposure revealed only the bright region surrounding the nucleus of comet Donati. Interestingly, photographs would not again be taken of a comet until the appearance of C/1881 K1 (Great Comet). At that time, W. Huggins became the first person to photograph the spectrum of a comet, while the French astronomer P. J. C. Janssen revealed how valuable photography could be when his long exposures revealed details in the comet's tail which could not be seen with the naked eye or with a telescope. The US astronomer E. E. Barnard made the first photographic discovery of a comet in 1892 and the Germany astronomer M. F. J. C. Wolf was conducting a regular photographic survey of the sky before the century ended.

The most interesting comets of the nineteenth century

The nineteenth century was noted for some very interesting comets. The Great Comet of 1811 was visible to the naked eye for nine months, setting a record that would not be broken until comet Hale–Bopp moved through our skies in 1996 and 1997. The Great Comet of 1843 was the first well-studied sungrazer and exhibited one of the longest tails in history. This comet and its brighter, sungrazer cousin, the Great September Comet of 1882, both became easy objects to see with the naked eye in broad daylight.

One of the most interesting of the nineteenth century comets was not among the brightest. Back in January of 1846 the well-known periodic comet Biela was suddenly found to have split into two pieces. Both pieces returned in 1852, but neither was seen in the years that followed. Interestingly, huge meteor storms occurred at the end of November of 1872, 1885, and 1892. Astronomers realized the storms were caused by the debris of comet Biela, thus indicating the comet had probably broken up entirely

Celestial mechanics

The art of calculating the motions of comets underwent some improvements during the nineteenth century. Progress during the eighteenth century had enabled astronomers to calculate orbits based on three positions, where the middle position was perfectly represented and the first and third were represented by residuals. During the first year of the nineteenth century, the Germany astronomer C. F. Gauss developed a technique to calculate an orbit from three positions, which precisely fits the first and third position, while determining residuals for only the middle position.

The next improvement came during 1819, when J. F. Encke investigated the orbit of a comet discovered by Pons on 1818 November 26. He noted the similarity to the orbit of another comet found by Pons on 1805 October 20. Curiosity in a possible identity between these two comets prompted Encke to calculate an elliptical orbit for the 1818 comet, followed by an elliptical orbit for the 1805 comet. He was convinced the two were identical. During the next few months Encke looked further back in time and found comets seen in 1795 and then 1786, which he successfully linked to the two nineteenth century comets. Encke's ultimate paper on the subject applied planetary perturbations to his calculations, which enabled the four apparitions to be very accurately linked.

Encke predicted the comet would return on 1822 May 24. The comet was recovered in Australia on 1822 June 2, just a short distance from his predicted position. Encke suggested in 1823 that the apparent decrease in the comet's calculated orbital period was due to a resisting medium. Because of Encke's success in predicting the return of this comet, the comet that had been seen in 1786, 1795, 1805, 1818, and 1822 was later named after him.

The resisting medium theory was first applied to the investigation of the motion of comet Encke by F. E. von Asten in 1877. He used positions obtained between 1818 and 1868, determined the perturbations by six planets, and added rough nongravitational terms based on Encke's theory. Although the early nongravitational terms determined by Encke and von Asten were an interesting first attempt to explain the variation in the motion of a comet that cannot be explained by the gravitational influences of the planets, the cause was not a resisting medium. F. W. Bessel (1836) introduced a new idea that came about as a result of his observations of 1P/Halley in 1835. Bessel had noticed material apparently exiting the nucleus on the sunward side and wondered whether it could be responsible for slowing the comet. Unfortunately, von Asten favored Encke's resisting medium and it was not until the mid-twentieth century that Bessel's idea was refined by F. L. Whipple (1950) and B. G. Marsden (1968).

Cometography

Overall, this volume of *Cometography* follows the same basic format as did the first volume, but there are two significant changes. First, I have altered the style in which the "Sources" are given for each comet. As is normally the case with books and papers, the author's name is given at the beginning of each reference, but, to keep the main text readable, I have put the names of astronomers whose observations were discussed at the beginning of each reference, so if you wish to look for a particular astronomer's observations you will generally only have to check a couple of sources. The second change followed a suggestion by Marsden, I have reduced the precision of the positions, as there was no real benefit to keeping them as precise as given for the last few comets discussed in volume 1.

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