NOVA NOTES

HALLEY'S COMET SPECIAL ISSUE

Halifax Centre

May~June 1985
Volume 16
Number 3

1985 Halifax Centre Executive

President	– Norman Scrimger 12 Lynwood Drive HALIFAX, N.S. B3M 1Y9
Vice-President	– Cathy McLeod 4 Mott Street DARTMOUTH, N.S. B3A 2W4
Secretary	– Ralph Fraser 40 Murray Hill Drive DARTMOUTH, N.S. B2Y 3A8
Treasurer	– Randall Brooks 71 Woodlawn Road DARTMOUTH, N.S. B2W 2S2
NOVA NOTES Editor	– Patrick Kelly 2 Arvida Avenue HALIFAX, N.S. B3R 1K6
National Rep.	– Darrin Parker Room 7-1-2 High Rise 2 Saint Mary's University HALIFAX, N.S. B3H 3C3
Librarian	– David Chapman 8 Lakeview Avenue DARTMOUTH N.S.
Observing Chairman	– Gordon Hawkins 327 Arklow Drive DARTMOUTH, N.S. B2W 4S1
Mailing Address	– Halifax Centre, R.A.S.C. c/o 1747 Summer Street HALIFAX, N.S. B3H 3A6

NOTICE OF MEETINGS

Date: Friday, May 10th :
** NOTE THIS IS THE 2nd FRIDAY **

Place: TO BE ANNOUNCED

Topic: ANNUAL BANQUET: Our guest speaker will be our new Honorary President (whose identity will be revealed at the banquet. Please see the enclosed sheet for further details

****

Date: Saturday, May 18th : 7:00 P.M.

Place: Desbrisay Museum, Bridgewater

Speaker: Come see the meteorite exhibit and listen to a brief talk (7:30) on meteors. Later there will be an observing session for the Eta Aquarids meteor shower with a new moon.

****

Date: Friday, June 21st: 8:00 P.M.

Place: Nova Scotia Museum (Lower Theatre)

Speaker: To be announced

****

About the cover: The cover this issue is of a 16th century woodcut depicting the Great Comet of 249 A.D.

FROM THE EDITOR'S DESK

This special issue is something new for NOVA NOTES and I think it worthwhile to make a few comments for the benefit of the readers. More than anything else I would like to thank those of you who took the time to contribute articles for this issue. The consistently high quality of the articles that I have received in the past has been continued in the submissions for this issue. As well the number of contributions is the main reason that this issue has 44 pages rather than the usual 24!

As this issue is being sent out to regular members and also being made available to members of the general public, the articles were written with that in mind and thus may appear slightly less technical then usual. However there are bound to be places in which terms familiar to astronomers have been used which may be incomprehensible to those not as familiar with astronomy. I can only hope that if you find some terms sufficiently puzzling you will make the effort to find out more about them. You may also find while reading this issue that there is a bit of overlap between some of the articles. This is inevitable, but I feel it helps to relate the different topics covered as well as provide a sense of continuity. Another new feature for this special issue is the number of illustrations used. If this proves to be favorable, I hope to try to include more visual aids in the future.

I should add that although the article on the lecture at Saint Mary's does not concern Halley's Comet, I decided to include it because it ties in quite well with the talk that Dr. Welch gave on CCD's at our March meeting and that it would be quite out of date if I waited until the next issue. Lastly I should mention that despite my reservations when I started looking, I was even able to find a cartoon for this issue that also fits in with the theme of comets.

— Pat Kelly

This amateur photograph of Halley's Comet was taken during its 1910 apparition.

UNIQUE SLIDES SHOWN AT LECTURE

High-tech astronomy and some of its recent discoveries were the topics of a lecture held March 6th at Saint Mary's University. The talk, entitled "New Wave Galaxies" was part of the Harlow Shapley Visiting Lecture Series which is sponsored by the American Astronomical Society. The lecturer, Dr. Rudy Schild of the Harvard-Smithsonian Center for Astrophysics has recently been using a charge coupled device (CCD) to obtain color images of galaxies which had been impossible before the advent of CCD technology. A CCD is a semi-conductor device which converts incoming photons into electrical charges. These charges are stored on a grid, which consists of a rectangular array of 320 by 512 individual detectors. These charges accumulate until the end of the exposure at which time the charge at each detector is read into a computer. Since a CCD cannot produce a color image directly, three exposures of each object are taken, through blue, red and green filters. The computer then manipulates this data to produce an image on a color monitor.

Dr. Schild began by showing images of the basic types of galaxies: spiral, barred and elliptical; as well as showing how galaxies group together to form clusters. This was used as an introduction to the idea of galactic cannibalism, in which a large elliptical galaxy is formed in a large cluster by the gradual merging together of many separate smaller galaxies. A slide was shown of a large elliptical galaxy whose image had been computer processed to reveal what appeared to be a massive nucleus, accompanied by two smaller nuclei which presumably all that is left of two other galaxies which have been "absorbed" by the larger one. It is thought that these small nuclei are spiralling in to the more massive nucleus and will eventually merge with it.

From this point he went on to show how the stars in a galaxy are formed from the clouds of gas and dust which are present in most galaxies. Once again, the CCD was used to illustrate this by showing images of nebulae in various stages of star formation, including an as yet unpublished image of a gas and dust cloud which is still condensing, and has not reached the point where stars are visible at all. The cloud is seen only by the light reflected from all of the other stars in the galaxy. The color of the cloud was white towards the middle but red on the edges which agreed with this type of object's predicted appearance. Another image of a reflection nebula showed that the filaments of it were red or blue depending on their placement relative to the illuminating star and the line of sight. Until this image was taken, it had been though that only white light would show up.

The next subject to be discussed was stellar evolution and the end product of massive stars, namely supernovas. These he attributed to the fact that at one time God had been drafted by the Army Corps of Engineers, who told him that whenever you are through with something, you blow it up! The images of planetary nebulas and the Crab nebula graphically displayed the type of energy involved in these types of events. Dr. Schild concluded his talk by showing a few slides of the Multiple Mirror Telescope. One of the interesting engineering features of the MMT is that since it was designed to use an altazimuth mounting, it was decided that instead of turning the telescope from east to west, that the entire building should turn instead. Dr. Schild related that one unlucky person made the mistake of parking their truck too closely to the square building. He stated that he would have been curious to see what the driver put down on his insurance claim! After his talk, Dr. Schild entertained questions from the audience, and it was obvious from the questions that those in attendence had both enjoyed the lecture and been well-informed on the aspects of galaxies which are being uncovered by CCD's

- Pat Kelly

COMET ORBITS AND ORIGINS--HALLEY'S

In 1972 Marsden cataloged 924 comets observed since 87 BC and by now that list must contain over 1000 comets. The observations represent more than 620 individual comets of which only 16% are short period comets (periods less that 200 years). Halley's comet is one of those. Comets are classified according to the period (P) and eccentricity (e) of their orbits. Of those cataloged, the distribution is as follows:

Short Period Comets (P<200 yrs)	16%
Long Period Comets (P>200 yrs)	24%
Parabolic Comets (e=1)	48%
Hyperbolic Comets (e>1)	12%

Near the Earth long period period comet orbits differ very little from parabolic orbits and both types have been observed only once (periods > 200 years). These make up 72% of all the comets. Hyperbolic comets are those whose orbits allow them to escape the solar system. In most cases, the hyperbolic orbits are only slightly different from parabolic and these comets most likely were originally long period comets that have been perturbed into their present orbits by gravitational interaction with the planets.

About half of the short period comets have aphelions (distance of greatest distance from the sun) between 5 and 6 astronomical units (A). All those with aphelion less than 7 A are classified as part of the "Jupiter Family" because they are influenced by Jupiter's gravitational attraction (Jupiter's mean distance from the sun is 5.2 A). Halley's comet is among the small group of short period comets that have aphelions between 10 and 60 A and can not be conveniently associated with the perturbations of a major planet. Another different aspect of Halley's comet is its large inclination (162 degrees) and hence retrograde motion. Most of the short period comets have small inclinations to the ecliptic plane.

By contrast the long period comets have inclinations of all possible values and do not interact with the planets to any significant amount. Analysis of the aphelion distances of these comets lead to the conclusion by Oort that all comets originate at a distant of about 5Ø ØØØ A from the sun. Recently, more refined calculations has been able to include some other comets in the group and support the concept of an "Oort Cloud" of comets beyond the orbits of the planets. The theory is that the gravitational perturbations of a passing nearby stars cause the comets to drop from their larger orbits to ones that come near the sun. Comet Kohoutek is a famous comet in this group; its estimated period is 8Ø ØØØ years and its aphelion distance is 24ØØ A. The small period comets originate from the "Oort Cloud" also but have been captured by passing near Jupiter and having their orbits changed even more.

Some of the orbit parameters Halley's comet are:

period	76.2 years
eccentricity	Ø.967
aphelion	35.4 A
perihelion	Ø.59 A
inclination	18 degrees retrograde

The comet crosses the plane of the ecliptic much nearer the Earth than Jupiter. At Jupiter's orbit the comet is about 1.3 A below the Ecliptic while the comet is only about .15 A from the Earth upon crossing the Ecliptic. It seems unlikely that Jupiter could have perturbed the comet orbit at that distance.

Each planet has around it a "sphere of influence" that delineates the region of space where the gravitational effects of the planet will be greater than those of the Sun. The table below gives the radii of the spheres for several planets.

Planet	Sphere of Influence Radius (A)
Jupiter	Ø.32
Saturn	Ø.36
Uranus	Ø.35
Neptune	Ø.58
Earth	Ø.ØØ6

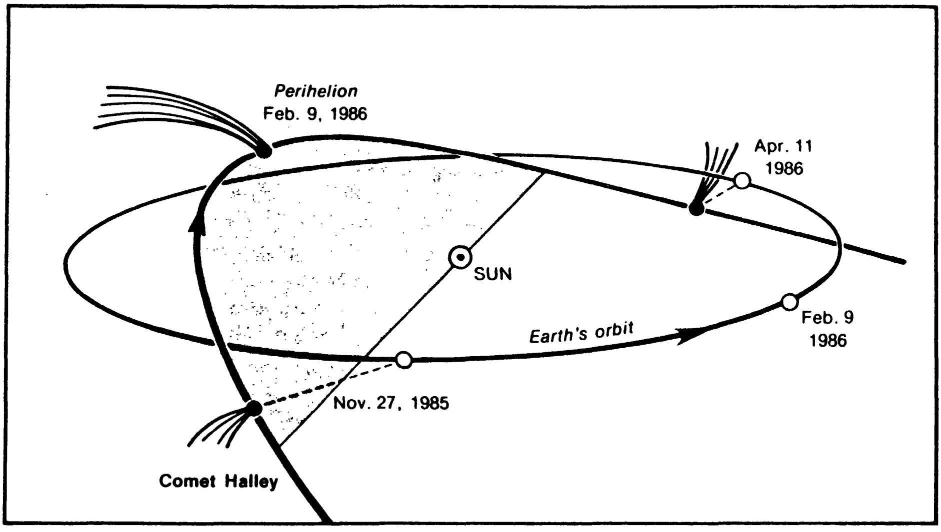
Two factors determine the size of the sphere: first the mass of the planet and second the distance from the sun. The major planets have a much bigger spheres of influence because they are more massive and because they are farther from the sun. If Halley's comet came as close as .14 A to Jupiter, well inside its sphere of influence, it would be deflected by 2 degrees and have its energy changed by Ø.7%. This is far from enough to switch a parabolic orbit into the present Halley's comet orbit.

Either the comet came very close to a planet at one time or its orbit has been slowly changed by many small planetary perturbations. Calculations have shown that the Jupiter group of comets were put in their orbits by many small rather than one large interaction with Jupiter. Halley's comet, however, does not have an orbit near enough to Jupiter to allow this to happen.

I calculated the interaction between Halley's Comet and the Earth necessary to switch its orbit from a parabola to its present one. The results showed that such an event is impossible because it requires that the comet pass within 1ØØØ km of the Earth's center (the Earth's radius is 637Ø km). Small planets such as the Earth can not be effective in capturing comets because their masses are too small but also the velocities of the comets in the inner Solar System are larger and that make them harder to "deflect". It is a mystery how Halley's was captured into its present orbit.

The 1985-86 encounter with the Earth is a unique one in that it comes near the Earth both before and after perihelion. Unfortunately, because of its retrograde motion, it will be on the opposite side of the sun from us at perihelion and hence it will not be easily seen when it is at its brightest. The diagram shows the situation; at post-perihelion it will have moved south of the eclipic before closest approach and make it difficult to observe for northern latitudes. Because it is a once in a life-time occurance, it might be worth visiting more southern latitudes during that period.

Larry Bogan



The rather unfavorable 1985-86 apparition of Halley's comet is summarized here. The comet reaches perihelion on February 9, 1986, when it will be on the far side of the Sun from us. Nearly two months will pass before the comet, receding from the Sun but approaching Earth, makes its best showing for observers. Minimum separations from the Earth occur on November 27, 1985 (0.62 astronomical unit), and April 11, 1986 (0.42 a.u.), when the comet will be 1.55 a.u. and 1.33 a.u. from the Sun, respectively. The shaded area indicates where the comet is north of the plane of the Earth's orbit.

THE SIGNIFICANCE OF HALLEY'S DISCOVERY

The significance of Edmund Halley's discovery, ie. that the comet of 1682 orbited the Sun in an eliptical orbit, is not limited to our understanding of comets but had implications in the revision of philosophical views of nature. Halley's calculations were not, contrary to popular belief, particularly revolutionary as will be shown but were based on the scientific discoveries, work and observations of his predecessors. The fact that he was able to prove at least one example of a comet was bound to the Solar System and that its return could be predicted was one of the final steps in eliminating the superstitious aura that surrounded the infrequent and often spectacular appearances of comets. It is desireable to begin by reviewing earlier beliefs concerning comets and then to review some of the discoveries in astronomy which lead to Halley's discovery.

Consider for a moment what people, including astronomers, would have observed at the appearance of a comet. Bright comets would unpredictably appear in any part of the sky (unlike the planets which are restricted in their motions to the region of the ecliptic), move in apparently airatic paths, brightening then fading as quickly as they had appeared. The brightest comets would have spectacular tails sometimes stretching across the sky and would be far more brilliant and totally different in appearance from any other observable body in the night sky. Even supernova were still similar to stars dispite all their brilliance. It is little wonder that comets held such mystery and awe for their early observers and that their nature remained unknown.

The region of the sky traversed by comets was of great concern to the ancients. The Chaldeans placed them among the planets but this concept was not based on specific observations. The Greeks had several views with Aristotle's finally gaining priority. Early Greek ideas envisioned comets as small and invisible being able, after a time, to transmit light. In another theory comets were believed to be small planets moving about the celestial sphere under no determinate law while other Greek philosophers believed them to be optical illusions like rainbows, an idea still being considered as late as Galileo's time. The great Greek observational astronomer, Hipparcus, enlikened comets to Mercury and Venus because of the similarities in their motions. Aristotle first envisioned these bodies as exhaltations from the Milky Way which he also viewed as a large comet and which was being constantly renewed through some mechanism. However, the theory which held priority for a millenia and a half was Aristotle's concept which produced comets by exhaltations from the Earth's lower atmosphere. Aristotle viewed the atmosphere as having three layers with the lowest being the air we breath. In his concept, comets were formed in the air rising through the warm upper atmosphere where they caught fire due to the Sun's heat and burned to exhaustion. This theory long maintained priority because it complied with the Aristotealian philosophy of the immutability of the celestial sphere. Under this philosophy everything in the sky was considered to be perfect and unchanging and thus any observed changes in the sky must be in the vacinity of the Earth.

Aristotealian ideas were, of course, considered as truth even after the time of Galileo and you will recall that Galileo's troubles arose from his attempts to teach Copernicism and to prove incorrect Aristotle's view of Earth as centre of the Universe. The 16th century scientist Leonard Digges (1510-c1571) reflected long held supestitions surrounding comets by saying "They signifie the corruption of the Ayre; they are signes of earthquake, warres, chaunging of Kyngdomes, great dearth of corne, yea a common death of man and beast." Digges' contemporary, Claud Comirs, thought that comets were issued from the Sun floating upwards through planetary regions like soap bubbles. However, Regiomontanus

(1436-76) with his student Bernard Walther (1430-1504), began the first systematic observations of planets and comets as a first step in the development of a new theory of the Universe. Although Regiomontanus died before fully formulating his theory, Walther continued the observations for thirty years. These observations mark the beginning of the end for Aristotealian doctrines on the celestial sphere.

Peter Apian (1495-1572) and Jerome Fracaster (1483-1543) were the first to observe that cometary tails pointed away from the Sun thus establishing a link between these celestial bodies. Tycho Brahe (1546-1601) measured the daily parallax (ie. he measured the small angle or shift in position that would be caused by the Earth's daily rotation) but found none. Knowing the accuracy of his instruments, Tycho was able to conclude that the comet of 1577 was more than three times the distance of the Moon and thereby proved that they were not atmospheric phenonema as Aristotle would have had them. Tycho also believed that comets moved in circular orbits like planets.

Old ideas die hard, however, and even Galileo wrote--although somewhat ingenuously--in **Saggiotore** (published 1623) that comets were atmospheric phenonena like halos or rainbows. The fact that the great Galileo stated such a belief undoubtedly had an effect in prolonging adherance to Aristotealian ideas. However, this apparent support for Aristotealian philosophy was probably not sincere but a result of the Pope's 1616 warning to Galileo not to teach Copernicism. It will be recalled that the Dominican monk, Giodano Bruno (1548-1600) was burned at the stake for his support of the Copernican theory. Among Bruno's beliefs was that which considered comets to be a species of planet moving about the Sun. Many of his ideas on celestial bodies were later proven correct but were never based on anything but intuition.

Interestingly though, Johannes Kepler (1571-1630) who discovered the three laws of motion governing the motion of the planets about the Sun, maintained that comets moved in straight lines and that once passed the Sun continued into infinte space. Kepler never attempted to test his laws of planetary motion on comets although he allowed that it might "not be impossible for some (comets) to move in parabolic orbits but there was no good reason to suppose any ever existed". He agreed with Apian and Fracastor on the orientation of comet tails and further explained the tail as being formed by rays of the Sun which penetrated the comet body carrying away a portion of its substance--allowances being made, not far from the truth! In a book published at the appearance of a comet (Halley's) in 1607 Kepler stated that comets reminded us of our mortality and stated his belief that contact with the tail might cause pestilence. As late as 1910 great panic arose when it was learned that the Earth would pass through the tail of Halley's comet. The fact that the Earth had twice passed through comet tails in the 19th century without ill effects had no bearing on quelling the hysteria.

The true place of comets began to appear in the 17th century when Johannes Hevelius (1611-87) observed that comet orbits were partly straight and partly circular. He concluded, c1680, that comets had parabolic orbits with the Sun in the same plane and Doerfeld of Saxony went further and proposed the Sun was at the focus of the paraboloid. It may have been fortuitous that a very bright comet appeared in 1680 (known as Newton's Comet) because Isaac Newton (1642-1727) was at that time writing the **Principia** (published 1687). He computed the orbit of the comet and found it to be parabolic and in the **Principia** he was able to explain, for the first time, the celestial nature of comets based on observations. This makes the chapter on comets in the **Principia** one of the most significant in a landmark work of science. It is perhaps also fortuitous that a second bright comet appeared shortly after in

1682. Reminded of Newton's suggestion in the Principia that it might be possible for a comet to have an elliptical orbit, Halley solved the orbit for the comet of 1682 on that assumption. Having success, he went on to calculàte the orbits of 23 other comets which had appeared between 1337-1698 and published the results in the 1705 Philosophical Transactions under the title "Synopses of Cometary Astronomy". In this paper Halley noted the similarity of the orbits of the comets of 1531, 1607 and 1682 concluding they were one and the same object. For the first time it had been proven that a comet was a permanent member of the Solar System and further it gave very strong confirmation of Newton's theory of universal gravitation on which the orbital calculations were based! But Halley went further calculating and predicting the comet's appearance in 1758 and suggesting that the orbit was affected by the gravitational attraction of the planets. In 1758 before the reappearance, Alexis Clairaut (1713-65) calculated the orbital path of Haley's comet and found that it came close enough to Jupiter and Saturn to cause perturbations, or changes in its orbit, ammounting to a retardation of 518 and 100 days respectively. On this basis, Clairaut predicted perihelian passage on 13 April 1759 (+/- 1 month).

When Halley's comet reached perihelian on 12 March 1759 an important era was marked in our study of these hitherto troublesome and eratic bodies. Once the physical relation of a comet's path to other celestial bodies could be determined, astronomers were then in a position to enter a new phase of investigation and to theorize on the constitition of these bodies. Thus with Halley's discovery any lagging support for Aristotealian philosophy on the basis of comets was irrevocably overturned opening new and unrestricted opportunities for the study of the Universe.

R.C. Brooks

The 1066 apparition of Halley's Comet was depicted in the famous Bayeux Tapestry as its coming was seen as one of the key events leading to the Norman invasion of England. One can see people staring at the comet and King Harold, who was to die later that year at the Battle of Hastings can be seen to be in a most perturbed state. The inscription reads: "They wonder at the star".

Edmund Halley

1656 · 1742

EDMUND HALLEY: THE MAN BEHIND THE COMET

Mention the name of Edmund Halley to most people and the only thing that will come to their mind (usually only on recognizing the last name) is a non-descript ball of dirty ice that makes its way about the sun every 76 years. That is most unfortunate, as Halley was a genius by anyone's standards even when compared with his most notable contemporary, Sir Isaac Newton.

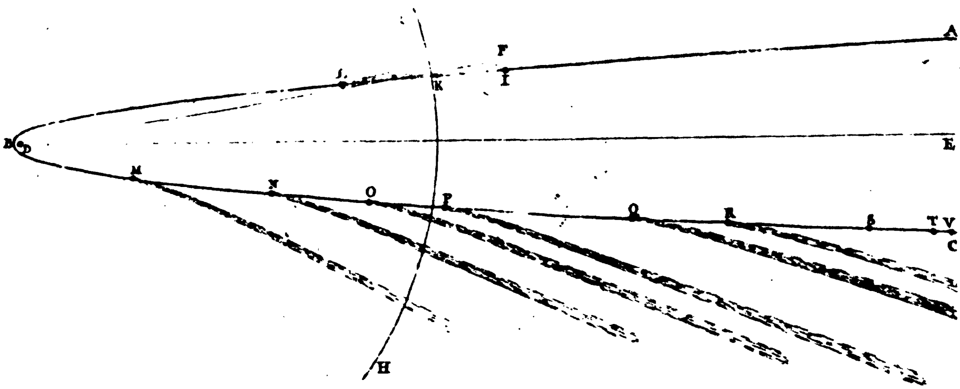
Consider for a moment some of his other achievements. While still quite young, he commanded a small navy ship on two trips to the South Atlantic Ocean. The data he collected on these trips allowed him to make the first accurate star charts for the southern hemisphere, chart the global variation in the Earth's magnetic field and map the world winds including the trade winds and the monsoons. He conducted the first thorough survey of the tidal currents in the English Channel, climbed a mountain to see how barometric pressure decreased with height and drew up the first accurate tables of life expectancy. His creativity was obvious in his solution to the problem of determining the areas of English counties; he simply cut the counties out of the map and weighed the pieces of paper. He was also well skilled as a machinist and invented and tested his own diving bell. He was imaginative as he thought that there were people living inside the Earth and he also had the capability to be both accurate and profound together, as when he determined that the universe could not be infinite or the night sky would be as bright as the Sun in all directions.

Like most of the scientists of his time, he made blunders which make us laugh today, such as when he performed a series of experiments to determine if plants grew better in complete darkness. And he also missed further claims to fame by coming close to an important discovery but not realizing it. An example is that he determined from the texts of Ptolmey and

Hipparcus that the bright stars Sirius and Procyon had both moved southwards by about 0.5 degrees over the last 1800 years. Although he stated that this was due to their proper motion through space, he did not try to compare their angular speed with a linear velocity and thus obtain their distances. If he had used a linear speed of 30 km/s (the orbital speed of the Earth) he would have found both stars to be 6 parsecs distant. In fact, their current values place them at 3.5 and 2.7 parsec respectively. Thus Halley could have gone down in history as the first person to accurately determine the distances of the stars.

However, as this issue is devoted to Halley's Comet, one should get on with the task of explaining how it came to be that Halley is most remembered for a piece of ice that orbits the sun. Halley was 24 years old and in Paris at the time of the Great Comet of 1680. He obtained records of its movement through the sky from the Paris Observatory and tried to ascertain the comets true motion through space. This was quite impossible as he tried to use Kepler's belief that comets travelled in straight lines through space. It was then that Halley decided to see if he could figure out how comets moved and what their place was in the solar system. He was back in England two years later where he observed the comet that would eventually become irreversibly linked with his name. The next year at a meeting of the Royal Society of London, he and Robert Hooke, another distinguished scientist, discussed the idea of a law that would govern the motions of all objects in the solar system. A prize had even been offered to the person who could come up with such a theory, but neither man could fight his way through the formidable mathematics. It was in August of 1684 that Halley decided to contact Isaac Newton who was at Cambridge and had acquired a reputation as a first-rate mathematician. You can imagine both his surprise and frustration to find that Newton had already solved the problem but had mislaid his calculations! Newton was a shy and secretive person and did not want to release his works too quickly. Halley realized that he could get no further without Newton's work and spent the next three years hounding him to publish his results. It is interesting to note that although Halley could ill afford it and Newton was fairly well off, it was Halley who finally paid the publisher in order that to have Newton's "Principia" printed.

Newton had already determined that the orbit of the Great Comet of 1680 was roughly parabolic (see figure below) and left Halley to do the arithmetic. Newton held the opinion that it could not be determined for sure whether comets followed elliptical orbits and returned or whether their orbits were either parabolic or hyperbolic and thus could not come back. Nevertheless, he did write: "I am out of my judgement, if they are not planets of a sort, revolving in orbits that return into themselves with a continual motion"



A sketch of the orbit of the Great Comet of 1680 by Isaac Newton. The sun is at D while the arc centered on it is the Earth's orbit with H and K representing positions of the earth during the comet's apparition

Halley picked up on this idea and began to study historical records of great comets. He published what he felt to be correlations of at least three comets which he felt had been viewed on several different apparitions in the past, and he predicted their returns. One correlation was between the Great Comet of 1680 which he had observed from Paris and which he thought had been seen before in 1106, 531 and 44 B.C. Both this supposition and another relating the comets of 1532 and 1661 were way off track. However, by 1695 he became convinced that the comet he had observed in 1682 corresponded to those 1607, 1531 and 1456. They all went around the sun in the same direction and as the observations of them were fairly recent, and thus Halley hoped, fairly accurate. The slight differences between the consecutive periods of return he attributed to the gravitational influence of Jupiter.

In 1705 Halley wrote: Whence I would venture confidently to predict its return, namely in 1758. By now Halley had been appointed Astronomer Royal and went on to hold that position until his death in 1742. It was an anxious world that waited in 1758 to see if his prediction would come true, and finally on Christmas Day of that year, Halley's Comet was seen again. Thus for the first time, comets were dropped from their pedestal as mysterious and frightening objects which were sent to Earth at the whim of the gods and simply became another part of the solar system in which we live. It is perhaps fitting that although Halley is not famous for his many other personal achievements, we can at least be sure that every 76 years a new generation will find reason to look back on this man and recognize him for the genius he was.

— Pat Kelly

DATES ASSOCIATED WITH HALLEY'S COMET

March 12, 1759 - Halley's Comet reached its first perihelion after calculation of its orbit.

April 6, 218 - Halley's Comet was associated with the death of Emperor Macrinus in Rome.

May 4 - Maximum concentration of Northern Aquarids, debris from Halley's Comet

May 18, 1910 - The tail of Halley's Comet reached 105° in length; 30° were below the horizon. Earth passed through the tail.

July 3, 451 - Halley's Comet was associated with the death of Attila.

July 10, 1910 - Death of Johann G. Galle, the only astronomer to see Halley's Comet twice. He discovered three comets.

Sept. 11, 1909 - Max Wolf of Heidelberg made the first photographic recovery of Halley's Comet.

Oct. 14, 1066 - Battle of Hastings. Halley's Comet was taken as a good omen for William the Conqueror's cause against King Harold. It proved true and the Comet appeared in the Bayeux Tapestry which was worked by William's wife.

Oct. 29, 1656 - Birth in London of Edmund Halley, who began the study of comets and their orbits.

Oct. 16, 1982 - Edward Danielson, a staff astronomer and David Jewitt, a graduate student, imaged Halley's comet with a CCD camera on the 5 meter Hale telescope at Mount Palomar. It was the first detection of the comet on this apparition.

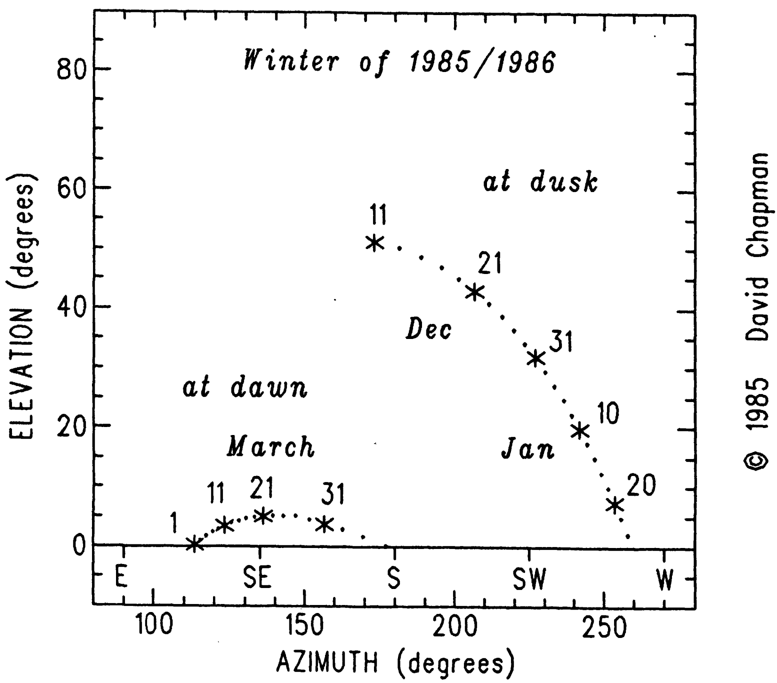
Jan. 23/4, 1985 - Steve O'Meara, an assistant editor with Sky Publishing, was the first person to see Halley's comet visually. He was using a 61 cm telescope of the Univ. of Hawaii on Mauna Kea.

- Diane Brooks

Map of Comet Halley's Position in Sky

The map is for the latitude of Halifax/Dartmouth. The positions of the comet are shown at two day intervals at the time of dusk (end of twilight in the evening) and dawn (beginning of twilight in the morning). At these times, the Sun is 18 degrees below the horizon. The following table gives the time of dawn or dusk, the visual magnitude of the comet and the phase of the Moon for selected dates.

Date	Dawn/Dusk	Magnitude	Phase of Moon
Dec 11	6:06 PM	6.2	New Moon
16	6:07 PM	6.2	Waxing Crescent
21	6:09 PM	6.1	First Quarter
26	6:12 PM	6.0	Full Moon
Dec 31	6:16 PM	5.9	Waning Gibbous
Jan 5	6:20 PM	5.6	Waning Crescent
10	6:25 PM	5.4	New Moon
15	6:30 PM	5.1	Waxing Crescent
20	6:35 PM	4.9	Waxing Gibbous
Jan 25	6:41 PM	4.6	Full Moon
Mar 1	5:05 AM	4.4	Waning Gibbous
6	4:57 AM	4.4	Waning Crescent
11	4:47 AM	4.5	New Moon
16	4:38 AM	4.5	Waxing Crescent
21	4:28 AM	4.4	Waxing Gibbous
26	4:17 AM	4.3	Full Moon
Mar 31	4:07 AM	4.1	Last Quarter
Apr 5	3:56 AM	3.9	Waning Crescent



Observing tips for Comet Halley

Many people hoping to view Comet Halley in 1985/86 have never seen a comet of any description before, except perhaps in photographs. This article will describe when the comet will be visible, roughly where it should appear in the sky and what we might expect to see. As the comet approaches Earth and the Sun throughout this year, there will be many articles in newspapers and magazines and many broadcasts on radio and television that will provide more detailed information than we can supply here in a short article. Nevertheless, the basic information below should be useful for planning purposes, especially for the novice.

o Two misconceptions regarding comets: Comets do not streak across the sky like rockets, as do meteors (i.e. shooting stars). From night to night, comets move steadily across the sky on a smooth, predictable curve relative to the stars, travelling at most several degrees per day. If you miss the comet one night due to cloudy weather, it will be there the next night! Also, a comet does not necessarily move in the direction suggested by its tail, that is, the tail is not propellant pushing the comet on its trajectory. The tail is made up of gases and small solid particles boiled out of the comet's nucleus by the sun's heat and pushed away from the head by the solar wind of charged particles and by radiation pressure from the sun. Consequently, the tail generally points away from the sun, regardless of the actual direction of motion of the comet. The word 'comet' derives from the Latin word 'coma', meaning 'hair'; imagine the comet's 'hair' being blown in the direction away from the sun by the solar wind.

o Comet Halley travels on an elliptical orbit which brings it past Earth on its inbound journey to the Sun on 27 Nov 85; the comet passes around the opposite side of the Sun on 9 Feb 86; on its outbound journey, it passes Earth again on 11 Apr 86. Although predictions of the comet's brightness vary, it should be observable in binoculars and small telescopes from late November to late March, except for a period in February when it will be lost in the Sun's glare. In a dark sky, we should be able to see the comet with the unaided eye in late December and in January, March and April.

o The visibility of Comet Halley will depend upon the observer's location on Earth. From the latitude of Halifax/ Dartmouth, which is 45 degrees North, the comet will be easiest to observe on its inbound journey in December and January. (See the map accompanying this article.) It will appear high in the southern sky during mid-December evenings. As the weeks pass, it will move westward and down as it closes with the Sun. In late January, the comet sets soon after the Sun and will be seen only in twilight low in the western sky. After it passes around the Sun in February, it will appear in March very low in the southeastern sky during morning twilight. As the weeks pass, it will move southwards at dawn, remaining low in the sky, and will eventually disappear below the horizon in early April. This is unfortunate for us, since it will be at its brightest on 11 Apr 86 but will only be seen at more southern latitudes. (For example, at its best, the comet will be 25 degrees above the horizon in Jamaica and almost overhead in New Zealand.) It actually will reappear in our southwestern evening sky later in April, but it will have dimmed considerably.

o The view of a comet is improved through binoculars or a large-aperture, low-magnification telescope having a wide field of view. High magnification does not improve the appearance of diffuse objects such as a comet's head and tail, but the their apparent brightness can be increased by using the aids mentioned. At its best, the Comet Halley's head will appear half as large as the Full Moon, while the tail may span 10 degrees (the breadth of a clenched fist held at arm's length).

o A comet's visibility will depend upon the darkness of the background sky. In twilight, in the Moon's glare, or in urban light-polluted skies, a comet will be more difficult to observe. We can't do much about the first two, but the third problem can be overcome by finding a rural dark-sky observing location.

o Assuming we have found a dark observing site on a date with no Moon and we know where to look for Comet Halley amongst the stars, what should we look for? As mentioned, a comet's head is diffuse, brighter near the centre than at the edges, and looks somewhat like a cotton ball amongst the point-like stars. In binoculars and small telescopes, it might be easy to confuse a comet with a globular star cluster or a gaseous nebula. For this reason, it would be a good idea to have a reasonably good star atlas which indicates the position of these known objects. If the fuzzy-looking thing is a comet, it will move with respect to the background stars over a period of several hours, whereas the clusters and nebula are fixed in position. Once you have located the comet for the first time, it shoud be easy to track its position from night to night. Early on, when Comet Halley is too far from the Sun to have formed a tail, only the head will be visible. As the comet approaches the Sun, it will begin to form a tail, which will grow longer with time. The tail should be more spectacular after perihelion, since a lot of material will have been evaporated from the comet's head by the fierce heat of the Sun during the period of closest approach.

o A useful pastime with which to occupy yourself this summer is to begin to learn the location of the principal constellations and brighter stars. When the time comes, it will be easier to locate Comet Halley amongst the stars if you already know your way around the sky. Also, you can become familiar with the appearance of the brighter star clusters and nebulae in your binoculars or telescope. Most bookshops carry elementary astronomy books which contain simple star charts suitable for the beginner.

We hope these few tips will assist those of you hoping to view Comet Halley next winter and spring. If you find that you are interested in learning more, why not contact the local centre of the RASC or another astronomy club?

— Dave Chapman —

COMETS: EVIDENCE FROM METEORS

Even if you aren't 75 years old it is quite possible that you have seen Halley's Comet (or more precisely a small piece of Halley's Comet)! This is because one of the prominent annual meteor showers, the Orionids, which peaks about October 21 each year, is believed to be derived from Halley's comet.

Orbital and physical evidence suggest that most small meteoroids (the term meteoroid refers to the solid grain of dust, while meteor refers to the light and other effects of the atmospheric interaction) originate in comets. The large meteoroids which survive atmospheric flight to end up as meteorites have a different origin - the asteroid belt.

The cometary nucleus (the solid "dirty snowball" part of the comet) is the source of these small meteoroids. When the comet nucleus heats in the inner solar system, the ices evaporate and the remaining porous matrix breaks off, probably aided by gas pressure. In this way the comet leaves a trail of debris in its wake. Biela's comet provided a graphic demonstration of this process. It was officially "discovered" in 1826 (although a search of historical records indicated appearances at least as far back as 1772), and made a normal appearance in 1832. However in 1846 and 1852 it was observed to be split into two separated segments. It was never again observed as a comet, but in 1872, when the Earth passed through the region where the comet would have been expected, a very active meteor shower was observed.

In interplanetary space the stream of debris released from a cometary nucleus gradually disperses from an oribiting cloud to fill a "doughnut" shaped region along the comet's orbit.

When the Earth's orbit intersects this "doughnut" a meteor shower is observed. The parallel orbits of the members of the meteor stream, and a perspective effect, cause shower meteors to appear to radiate from a single point, and showers are named according to the constellation containing this radiant point. The Orionid shower radiates from a point in the top left of Orion (where the hunter's arm grasps the raised sword).

The Earth's orbit intersects most meteor streams in only a single point because the orbit of the Earth and that of the original comet are in different planes. However it has been suggested that a second meteor shower is also associated with Halley's comet - the Eta Aquarid shower which peaks about May 4. This shower is a daytime shower, and can only be observed by meteor radars (the passage of the meteor through the atmosphere results in the production of a cylinder of electrons and ionized atoms which reflects radio waves).

While both the Orionids and Eta Aquarids are widely believed to be derived from Halley, it should be pointed out that effects such as planetary perturbations alter the orbits of both comets and meteor streams, and definite associations are difficult. As time goes on the meteor stream is further dispersed by radiation and collisional effects, and gradually the stream meteors become part of the sporadic meteor background.

Until we have the data from the Halley spacecraft missions, meteors serve as our only direct sample of cometary material. It is therefore reasonable to ask what this evidence suggests about the nature of the comet itself. The most important contribution has probably been support for the "dirty snowball" theory of cometary structure. One would expect that meteoroids derived from such a structure would be porous, and relatively loosely bound together. Observations with sensitive meteor cameras have suggested just such a structure. For example, flares are frequently found on the light curves of meteors. These can be explained by the meteoroid fragmenting during atmospheric flight. This fragmentation exposes a larger surface area, and hence more rapid evaporation resulting in more intense luminosty (you might consider it to be similar to splitting wood into kindling to make it burn faster). One can calculate the atmospheric pressure at which meteoroids begin to fragment. As predicted by the model, most meteoroids appear to be loosely bound together (if you held one between your fingers you could easily crumble it). The porous structure suggests that average densities should be low. This is confirmed by observations which find average meteoroid densities of the order of one-sixth that of typical stony material.

Extremely small meteoroids (with dimensions of the order of a few thousandths of a centimeter) are decelerated sufficiently to float to Earth without evaporating. These are called micrometeorites, and over the last decade a large number have been collected by various methods, and studied by scanning electron microscopes. The results suggest that even these tiny meteoroids are irregular and porous in nature.

As you gaze out on a clear night in late October, and catch a glimpse of a meteor streaking away from Orion, you are probably watching the death of a collection of grains which were once part of the nucleus of Halley's comet. Just as astronomers look back into time as they observe objects many light years distant, you are witnessing Halley as it was long ago, since the meteors you observe were probably released from the cometary nucleus hundreds or thousands of years ago.

Robert Hawkes

HOW DO COMETS GET THEIR NAMES

To most people, the appearance of a comet is a rare event, as spectacular comets have been quite scarce over the past few decades. When pressed to name comets, everyone invariably gets Halley's Comet; some will remember the great fiasco of 1973, Comet Kohoutek; and there are a few who can recall Comet West or Comet Bennett. Thus it does not seem as if there should be amy great problem with naming comets. However, unknown to most people, for every spectacular comet that is seen, there can be virtually dozens of comets that never become visible to the unaided eye. Since may of these are comets that return regularly, it is important to keep track of them all, especially as there are at least 700 comets known to date.

Comets fall into two broad categories, those that have very long periods (from 100 years and up) and periodic comets which have short periods (less than 100 years) and return frequently. The orbits of period comets are well known and thus their returns can be predicted quite accurately. Most, however, are quite faint as they have lost most of their material after many trips past the sun. These comets are given the prefix "P" and have a permanent name. The name may be of the discoverer (e.g. P/Holmes and P/Schuster), co-discoverers (e.g. P/Temple-Swift and P/Pons-Brooks) or less often, the name of the person who first determines their orbit (e.g. P/Halley, P/Encke and P/Crommelin).

In cases where several people independently discover a comet, the comet's name is limited to the first three discoverers, given in order of discovery (e.g. P/Honda-Mrkos-Pajdusakova). With the advent of astronomical satellites, several comets now include the names of these orbiting devices (e.g. Comet Hartley-IRAS and Comet IRAS-Araki-Alcock). It is not uncommon for one person to have their name associated with more than one comet. The French astronomer Jean Louis Pons still holds the record, having discovered 37 comets between 1801 and 1827, 12 of which bear his name alone. In March of 1973, Lubos Kohoutek discovered two comets, both of which bore his name. A comet may be discovered in several ways. The vast majority are found by amateur astronomers who spend evening and mornings, sweeping the sky with binoculars or telescopes, hoping to be the first to detect the faint smear of light that heralds an approaching comet. Others are found quite accidentally by either amateur or professional astronomers, who while photographing various celestial objects, find to their surprise, the image of a new comet on their developed film. Also, as already mentioned, this accidental discovery can now occur using an astronomical satellite.

Once a comet has been discovered (or in the case of a period comet, recovered) it is given a provisional designation consisting of the year followed by a letter which indicates the order in which it was discovered. Thus the more famous of the two Comet Kohouteks was the sixth to be discovered in 1973 and was provisionally known as 1973f. Once the orbit has been well determined, the provisional designation is replaced by a year and a Roman numeral. The numeral corresponds to the order in the year in which the comet makes perihelion passage (closest approach to the sun). Thus at the end of 1974, Comet 1973f was given the permanent designation 1973 XII. It is interesting to note that although Halley's Comet will not be visible to the unaided eye until late 1985, its orbit it sufficiently well known that it was first spotted several years ago and thus already carries the provisional designation 1982i. There is one exception to this rule. As Comet P/Encke returns every 3.3 years, its recovery is simply noted without giving it either a provisional or final designation!

— Pat Kelly

DISCOVERY OF A COMET

Hunting for new comets, a process by which I slowly sweep across the sky with a telescope is not a confrontation. It is more a cajoling, hour after hour, to move ever deeper into strange cosmic territory. What will the next field bring? An interesting double star I have not seen before? A pencil-thin spiral galaxy seen edge-on toward us? The field of one of my favorite variable stars? Or perhaps a comet?

I began hunting on December 17, 1965, after being absolutely amazed by the sight of the great sungrazing comet of that year, Ikeya-Seki. A few months later I read the freshly published Starlight Nights by Leslie C. Peltier, and my urge to hunt for comets grew. In retrospect, I was impressed more by the hunt than by the possibility of discovery, anxious to look through a telescope to learn the sky, field by field, star by star, nebula by nebula. I remember thinking how nice it would be to find a new comet, but I knew the competition was stiff and the sky that was needed would have to be better than what was available for me.

During the summer of 1966, I took my first paid position in astronomy, at the Adirondack Science camp. I hunted through the dark Adirondack sky through Hercules, and only learned later that my telescope must have passed right over Comet Kilston, bright enough to be found, but obviously needing someone who knew what he was looking for!

Beginning with an 8-inch f/7 reflector, I switched in 1967 to a wide field 6-inch f/4 reflector. But shortly after that I also switched to a greater interest in English Literature and though my interest was strong through the 1970's, my comet hunting hours were reduced. In 1983, in Tuscon with a new 16-inch f/5 reflector, a telescope I had saved for for a long time, and planned to use it for comet sweeping, I independently discovered Comet Hartley-IRAS just after it had brightened sufficiently to be observed visually.

Early in the evening of November 13, 1984, I had just completed my 917th hour with eye at the eyepiece hunting for comets, a process that now has taken me nineteen years, when I saw a patch of haze in my telescope's field of view. I knew that part of the sky well enough to get suspicious, but I had been fooled before. It was not a resolvable cluster of stars; it did not look like a galaxy; and it did not have the appearance of a gas cloud in space. Within ten minutes, through its perceptible motion through a rich field of background stars, the new comet gave its identity away. I called Brian Skiff, a friend at Lowell Observatory, who confirmed that the object was not already known, and then, armed with position, direction and speed of motion, and a magnitude estimate that was a bit too approximate, I notified the International Astronomical Union's Central Telegram Bureau of the discovery.

A few statistics: I found Comet 1984t on Tuesday, November 13, 1984. I was using a 16-inch f/5 reflector whose mirror is commercial, tube assembly and mount made by a friend, and sliding roof observatory made mostly by me. The discovery took place after 917 hours 28 minutes of comet hunting, spread out over 19 years and approximately 850 hunting sessions. I discovered the comet during observing session 6684E (in my observing log), which started an interest in astronomy late in the 1950's. I am especially happy that this discovery took place 59 years to the day that after that of Peltier's first comet, and that Venus and Jupiter were close together in the evening sky on both nights.

I am thrilled to share the credit for this comet with another amateur hunter, Michael Rudenko of Massachusetts, who independently found Comet 1984t the following evening. Also a comet seeker, he has spent almost 250 hours in his program. I don't feel a sense of competition with other people who share the same tranquil hours with a telescope. The competition for comets is not with other seekers, but with the sky itself. I do not share the idea that has been suggested in some books that comet seekers mistrust each other. How can we? The nocturnal activity we share is far more important than some mythical race to be first. It is only during the minutes and hours after a discovery that a feeling of competition sets in. I like to think that most comet hunters agree with Leslie Peltier's words from <u>Starlight Nights</u>:

"Time has not lessened the age-old allure of the comets. In some ways, their mystery has only deepened with the years. At each return a comet brings with it questions which were asked when it was here before, and as it rounds the sun and backs away toward the long, slow night of its aphelion, it leaves behind us those questions, still unanswered.

To hunt a speck of moving haze may seem a strange pursuit, but even though we fail, the search is still rewarding, for in no better way can we come face to face, night after night, with such a wealth as Croesus never dreamed of."

- David Levy
reprinted from "Regulus"
Kingston Centre

COMETS IN HISTORY

The word comet is derived from the Greek "komets" meaning "the hairy one". Since man first began observing the night sky, he was puzzled over the sudden appearance of bright comets. The ancient Chinese, who were excellent observers, compared comets to brooms in the sky when they wrote their chronicles. In the Bible, there are only vague references to early comets, and probably the most prominent one is in 1 Chron 21:16 :

> " and David lifted up his eyes, and saw the angel of the Lord stand between the earth and the Heaven, having drawn a sword in his hand stretched out over Jerusalem..."

Comets were certainly influential objects in the Greco-Roman world. The writers of the day described comets as precursors of fatal events. The births and deaths of emperors were allegedly accompanied by brilliant comet apparitions, although there are no carefully recorded events. Democritus, whose name is certainly familiar with early atomic theory, strongly believed that all comets were the souls of famous people who, at death, were transported into the heavens as brilliant lights. The bright comet which appeared in 43 B.C. was supposed to be the soul of Julius Caesar transported to the heavens.

Even during this period in history, more sensible solutions to the comet mystery were proposed. Aristotle pronounced that, although comets were not true astronomical bodies, they inhabited the upper region of the three regions of the air. Diogenes, Hippocrates, and several others of the Pythagorean School believed instead that comets were in common with the planets, which for them, wandered among the stars. On the other hand, Pliny, who lived in the first century A.D., wrote several passages about comets and terrible significance of their appearances.

In the 4th and 5th centuries, in fact, this type of belief was so widespread that chronicles recorded comets which were actually never seen to mark the passing on of some powerful figure of those times. The imagination of some people, as in this account of the comet of 1528 is highly representative of the ideas of the time. Writes the famous French surgeon Ambroise Pare:

> "This comet was so horrible and so frightful and it produced such great terror ... that some died of their fear and others fell sick."

When Halley's Comet appeared in 1456, the Pope, Calixtus III, himself struck with general terror, ordered public prayers to be offered up for the deliverance from this comet and the enemies of Christianity.

Fortunately, the Renaissance eventually began to influence scientific method. Peter Apian in 1531 observed that comet tails always appear to be turned in a direction away from the sun, but the Chinese had recorded this fact about the late 8th century. When Halley's Comet appeared in 837, the Europeans were flocking to church while the more civilized Chinese were observing it with cool scientific detachment. Needless to say, the Chinese were far ahead in the understanding of comets as celestial objects just as are the planets and the rest of the celestial sphere.

The turning point in the history of cometary astronomy occurred in 1577 when Tycho Brahe applied himself to observing the bright comet of that year. His numerous observations proved beyond all reasonable doubt that comets were bodies which moved in the region beyond the moon. A climax of scientific interest occurred in 1618 when three bright ones appeared in rapid succession. The debate concerning their true nature sparked off a great controversy between Horatio Gassi (a Jesuit priest), Galileo, Mario Guiducci (a pupil of Galileo) and later Kepler.

In Kepler's work on the paths of the planets, which led to his three laws of planetary motions, he omitted including cometary motion, since a comet could not be continuously observed to make a complete orbit around the sun as could planets in their more circular motions. With Newton's formulation of his ideas of gravity, the problems of cometary orbits was near to being solved. It was the work of Edmond Halley that finally solved one of the longest lived mysteries of mankind.

- Dave Fedosiewich
reprinted from "Astro Notes"
Ottawa Centre

BOOKWATCH

In keeping with the theme of this issue I have chosen to review one of the more popular of several books which have come out concerning the current apparition of Halley's Comet and also one of the latest acquisitions of our centre's library. "The Comet is Coming" is written by Nigel Calder, who is a noted popularizer of astronomy and physics, both in print and through the BBC. In this book, he attempts to cover mankind's perception and understanding of comets from earliest times up to the present date, with an understandable emphasis on Halley's Comets. He sticks pretty well to a chronological order in doing this and also gives the thoughts not only of the leading thinkers of the day, but from the 'person on the street' as well. As our thoughts have progressed, Calder allows us to emphasize with the frustrations and triumphs of those who devoted their time to determining the rightful place of comets in the scheme of things: from Brahe who could not convince others that his parallax measurements proved that comets lay far beyond the moon, to Kepler who tried to fit their movements to a straight line through space, to Newton first worked out the proper orbits of comets, to Halley who first predicted correctly the return of that comet which is now his namesake.

This book although it is not very technical or full of numbers, does an excellent job of illustrating just what a comet is and how little material is really contained in one of these objects, despite their large size as viewed from the Earth. (The quote that "a comet is the closest that something can come to being nothing and still be something" is most appropriate. A good job is also done of following the various theories of the formation, composition, orbits ,etc. of comets throughout history. Two theories even get special treatment in their own chapters. "An Interplanetary 'flu Machine" looks at Hoyle's theory that comets are the source of many of the epidemics that plague mankind, while "Coffin of the Dinosaurs" explores the link between comets and the massive extinctions which occurred at the end of the Cretacious period. Although Calder thinks that the former theory is absurd and the second one already a fact, he does allow equal treatment for arguments on both sides of these issues. In another chapter he even examines the practicality of using nuclear weapons to deflect meteor/comets which are on a collision course with the Earth to prevent the same thing from happening to us that happened to Brontosaurus and his kin.

However, probably the most appealing aspect of this book is not the fact that it is full of interesting tidbits of information about comets or the profusion of photographs which are used to accompany the text, but rather the author's style of writing. It is concise while also being both informative and humorous to the point that one literally flies through the book and is sorry to have reached the end. His style of humour is in his own words "less than reverent". A few examples from the book will best illustrate what he means:

- "Öort ... reworked Öpik's idea... Thus was the fabulous Opik-Öort Cloud conceived... I abridge the name to Öoo Cloud and defend this coinage on the grounds of sight and sound. It looks like a collection of roughly round objects of various sizes, and it is pronounced "Er,Oh!" - just what a neophyte comet lover is liable to utter when he is first told that there are many billions of the things out there"

- "As a result some comets acquire tongue-twisting names like De Kock-Paraskevopoulos and Schwassmann-Wachmann 3... These cosmic visitors are usually as forgettable as their names, but I regret to say that Schwassmann- Wachmann 1 never goes away."

- "... at half past six in the morning of 22 November 1682, when a newly married man might have been better occupied, Halley observed the comet that became his Doppelganger.

If one can find any flaw with this book is despite its concern with HAlley's Comet, there is no information at all on where to see it in the night sky. A series of charts for several different latitudes showing where to look for the comet at dawn or at dusk would have been a welcome addition. Despite this overlook, the book is a good introduction to comets for the average person while still entertaining enough for someone who is already familiar with the topic of comets. "The Comet is Coming" is published by:

Penguin Books Canada Ltd.
2801 John Street
Markham, Ontario
L3R 1B4

ISBN: 0 14 00.6069 3

-Patrick Kelly

****

INFORMATION SOUGHT

In late August or early September, a large brass telescope was stolen from a home in Chester. The telescope has a tube about 6 ft. long and mounts on a tall wooden tripod. Should anuone come across this instrument in their travels, it would be appreciated if you would contact Randall Brooks at 429-9780 (local 184) or 434-7274 (evenings)

R.A.S.C MEMBERSHIP

If you are reading this newsletter, chances are you have an interest in astronomy. If you have not already done so, why not become a member of the Halifax Centre of the Royal Astronomical Society of Canada. Your membership fee brings you the following each year:

- The Observer's Handbook
- 6 issues of the R.A.S.C. Journal
- 6 issues of the National Newsletter
- 6 issues of NOVA NOTES
- R.A.S.C. Annual Report

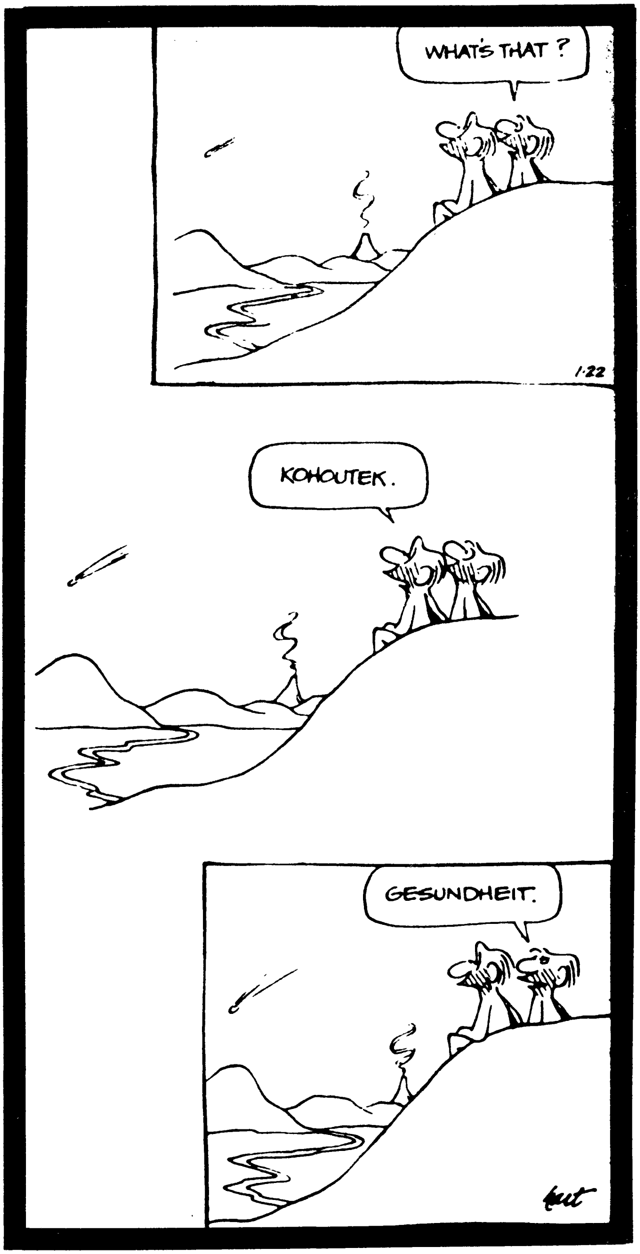
You also get borrowing privileges at the Halifax Centre's library, which contains a vast quantity of books covering all astronomical subjects. Meet new people who share your interest and learn more about this rewarding passtime from other members. Even if you don't have a telescope, you are welcome to our observings sessions. Learn the night sky as never before.

Memebership fees are:

$300.00 life membership
$20.00 adult membership
$12.50 youth membership (under 18)

If you would like to join, please contact anyone on the executive or send your membership fee (payable to the Halifax Centre, R.A.S.C.) directly to the Halifax Centre. (see inside front cover for list of executive men=mbers and mailing address)

HALIFAX CENTRE



reprinted from
"B.C. The Sun Comes Up, The Sun Goes Down"

NOVA NOTES INDEX

May-June 1985 Volume 16/Number 3

NOVA NOTES is published bi-monthly by the Halifax Centre of the Royal Astronomical Society of Canada in January, March, May, July, September and November. Articles for the next issue should reach the editor by JUNE 21st 1985. Articles on any aspect of astronomy will be considered for publication. The editor is:

Patrick Kelly
2 Arvida Avenue
Halifax, Nova Scotia
B3R 1K6
477-8720

NOVA NOTES is printed courtesy of the
Nova Scotia Museum

R. A. S. C. - HALIFAX CENTRE 1985 CALENDAR OF EVENTS

Key to calendars:

Meetings: outlined

Special days: shadowed

Observing sessions:
bold and underlined

Observing session alternates:
italics and underlined

February 1985

S	M	T	W	Th	F	S
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	**16**
17	18	19	20	21	22	*23*
24	25	26	27	28		

March 1985

S	M	T	W	Th	F	S
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	**16**
17	18	19	20	21	22	*23*
24	25	26	27	28	29	30
31						

April 1985

S	M	T	W	Th	F	S
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	*20*
21	22	23	24	25	26	27
28	29	30				

May 1985

S	M	T	W	Th	F	S
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	**18**
19	20	21	22	23	24	25
26	27	28	29	30	31	

June 1985

S	M	T	W	Th	F	S
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	**15**
16	17	18	19	20	21	*22*
23	24	25	26	27	28	29
30						

July 1985

S	M	T	W	Th	F	S
	1	2	3	4	5	6
7	8	9	10	11	12	**13**
14	15	16	17	18	19	*20*
21	22	23	24	25	26	27
28	29	30	31			

August 1985

S	M	T	W	Th	F	S
				1	2	3
4	5	6	7	8	**9**	**10**
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

September 1985

S	M	T	W	Th	F	S
1	2	3	4	5	6	**7**
8	9	10	11	12	13	*14*
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30					

October 1985

S	M	T	W	Th	F	S
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	*19*
20	21	22	23	24	25	26
27	28	29	30	31		

November 1985

S	M	T	W	Th	F	S
					1	2
3	4	5	6	7	8	**9**
10	11	12	13	14	15	*16*
17	18	19	20	21	22	23
24	25	26	27	28	29	30

December 1985

S	M	T	W	Th	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	**14**
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

Observing sessions:

- February 16 observing is in Bridgewater
- March 16 observing of galaxies
- April 14 is an occultation at 10:10 p.m. AST
- May 18 observing is in Bridgewater
- August 9,10,11 camping observing weekend
  Perseid meteor shower (24-day old moon)
- November 16 is the Leonids (5-day old moon)
- December 14 is the Geminids (2-day old moon)

Meetings:

The 3rd Friday of each month at the N.S. Museum.

Special events:

- March 6 Shapley lecture in Astronomy at St. Mary's University.
- April 27 is International Astronomy Day.
- May 18 in Bridgewater - a display of meteorites and a speaker.
- June 28 - July 1 is the General Assembly.
- Banquet will be on a Friday in May - yet to be announced - watch for it!
- October 1 - 1986 Memberships due.
- October 18 is Nova Scotia Astronomy Day - meeting and observing at the museum.

Halifax Centre
Royal Astronomical Society of Canada
c/o 1747 Summer Street
HALIFAX, Nova Scotia
Canada
B3H 3A6

ROYAL ASTRONOMICAL SOC OF CAN,
136 DUPONT ST,
TORONTO ONT,
M5R 1V2

E N