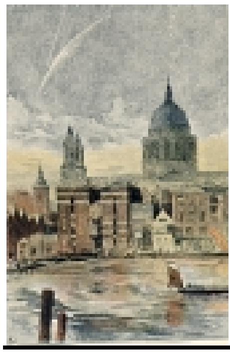

THE COMET'S TALE

Newsletter of the Comet Section of the British Astronomical Association

Volume 6, No 2 (Issue 12), 1999 October

THE SECOND INTERNATIONAL WORKSHOP ON COMETARY ASTRONOMY

New Hall, Cambridge, 1999 August 14 - 16

After months of planning and much hard work the participants for the second International Workshop on Cometary Astronomy began to assemble at New Hall, Cambridge on the afternoon and evening of Friday, August 13th. New Hall is one of the more recent Cambridge colleges and includes a centre built for Japanese students as well as accommodation for the graduate and undergraduate students. It is a women's college and a few participants were later disturbed by the night porter doing his rounds and making sure that all ground floor windows were closed. A hearty dinner was provided, but afterwards I had to leave to continue last minute preparations for the morning.

On Saturday morning, Dan Green and Jon Shanklin made a few opening announcements. We had nine comet discoverers present and five continents were represented. The next meeting would take place in 4 – 5 years time, possibly in America. For most of the day the British Astronomical Association had a sales desk in the entrance foyer to New Hall, with a range of eclipse memorabilia on offer, as well as copies of cometary publications.

Don Machholz gave the opening talk about comet hunting. He used to live in a light polluted site and drove out to Lomo Prieta for comet searching. In 1990 he moved 180 miles to the small town of Colfax (pop 1000) and has since discovered five comets.

He had searched 1000 hours since 1994 without a discovery. If the Edgar Wilson award had been in operation he would have netted an average of $4000 a year, though some years would be more rewarding and others less. His search technique is to scan east/west and move down in the morning sky. There are three conditions for success – you must look, the comet must be bright enough and you must find it first. His first three comets were closer to the sun than those previously discovered by amateurs in the previous 25 years. Type 1 comets are 30 – 60 deg from the Sun in the morning sky, bright, few in number and have small q. Type 2 lie in the evening sky 60 – 120 deg from the Sun, are dim, common and have large q.

Most discoveries were from Japan, USA and Australia. Southern Hemisphere observers only discover southern declination comets, however northern hemisphere observers find them in both hemispheres. There is no significant trend in discovery declination.

Continued on page 11

Contents

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Subscription to the Section newsletter costs £5 for two years, extended to three years for members who contribute to the work of the Section in any way. Renewals should be sent to the Director and cheques made payable to the BAA. Those due to renew should receive a reminder with this mailing.

Section news from the Director

Dear Section member,

As you will read elsewhere in this issue the IWCA was very successful and an enjoyable time was had by all participants. I was pleased to see a good representation from British amateurs and hope that the next workshop, likely to be held in the USA in five years time will see an equally large British contingent.

On September 17 I became the proud discoverer of a comet myself. As with many discoveries there was an element of luck to it, in that I just happened to be the first person to scan the real time images from the SOHO LASCO coronagraph and recognise that there was an intruder present. The discovery does however follow Don Machholz's tenets of comet discovery: you have to look, the comet must be bright enough and you have to find it first.

I have agreed to take on the Directorship of the Comet Section of the Society for Popular Astronomy. I've actually been a member of this society longer than I have been a member of the BAA. SPA members will be able to subscribe to The Comet's Tale and their observations will be included in the Section archives. I look forward to close co-operation between the two groups.

Since the last newsletter observations or contributions have been received from the following BAA members: Sally Beaumont, Denis Buczynski, John Fletcher, James Fraser, Maurice Gavin, Werner Hasubick, Guy Hurst, Nick James, Martin Mobberley, Bob Neville, Gabriel Oksa, Roy Panther, Jonathan Shanklin, David Storey, David Strange, John Vetterlein and Alex Vincent

and also from: Jose Aguiar, Alexandr Baransky, John Bortle, Reinder Bouma, Jose Carvajal, Tim Cooper, Stephen Getliffe, Guus Gilein, Bjorn Granslo, Roberto Haver, Andreas Kammerer, Heinz Kerner, Atilla Kosa-Kiss, Martin Lehky, Rolando Ligustri, Andrew Pearce and Seiichi Yoshida (apologies for any errors or omissions).

Comets under observation were: 10P/Tempel 2, 29P/Schwassmann-Wachmann 1, 37P/Forbes, 52P/Harrington-Abell, 95P/Chiron, 134P/Kowal-Vavrova, 140P/Bowell-Skiff, 1995 O1 (Hale-Bopp), 1997 BA6 (Spacewatch), 1998 M5 (LINEAR), 1998 P1 (Williams), 1998 T1 (LINEAR), 1998 U3 (P/Jager), 1998 U5 (LINEAR), 1999 F2 (Dalcanton), 1999 H1 (Lee), 1999 H3 (LINEAR), 1999 J2 (Skiff), 1999 J3 (LINEAR), 1999 K2 (Ferris), 1999 K3 (LINEAR), 1999 K5 (LINEAR), 1999 K6 (LINEAR), 1999 K8 (LINEAR), 1999 L2 (LINEAR), 1999 N2 (Lynn), 1999 S3 (LINEAR), 1999 S4 (LINEAR).

Many of the fainter comets were observed by Seiichi Yoshida who is using a CCD camera on an 18 cm reflector to very good effect. It is pleasing to have received a few CCD observations from UK observers over the summer and I hope the winter will bring many more.

The observing supplement accompanying this issue of *The Comet's Tale* is thinner than usual to compensate for the thicker main section. I have only given ephemerides for comets brighter than 10th magnitude. Ephemerides for fainter comets are available on the Section web page and observers can generate their own charts using the elements given in the supplement. In future I will only give ephemerides for fainter comets if they are particularly in need of observation.

Jonathan Shanklin

Tales from the Past

This section gives a few excerpts from past RAS Monthly Notices, BAA Journals and Sky & Telescope.

150 Years Ago: The editor noted that, given the discovery circumstances, he would prefer to call Schweizer's comet (1849 G1) that of Schweizer-Bond, however he followed the authority of Professor Schumacher. Computations by Hind showed that the 'first Comet of Brorsen, 1846' (5D/Brorsen) had passed very close to Jupiter in May 1842. He further suggested that there might be a link with the comets of 1532 & 1661, which could be investigated further.

100 Years Ago: A paper read at the June meeting discussed 'Who First suggested the Periodical Return of Comets' and suggested that Hooke had the idea that comets could return as early as 1665, following the appearance of the comet of 1664, which Hooke thought could be a return of the comet of 1618 [it wasn't]. At this time Halley was only 9 and didn't voice his famous utterance until shortly before his death in 1742. At the same meeting a paper by Mr John Grigg described a graphic method of computing a search ephemeris for a periodic comet. The annual report of the Section in the October Journal records that two conspicuous comets had been under observation and that Tempel's comet (10P) had been observed by Mr Denning with a 10" (25 cm) telescope.

50 Years Ago: The July Journal has a note about an article on comet Families by C H Schwette which appeared in Popular Astronomy in April. He thought that a group of comets with aphelia one and a half times that of Pluto implied a tenth planet. The annual report notes observations by George Alcock and Albert Jones, both still active observers.

Professional Tales

Many of the scientific magazines have articles about comets in them and this regular feature is intended to help you find the ones you've missed. If you find others let me know and I'll put them in the next issue so that everyone can look them up.

Andreas Kammerer has pointed out an interesting article by Ichiro Hasegawa and Syuichi Nakano on **Periodic Comets Found in Historical Records** in the Publications of the Astronomical Society of Japan (**47**, pp 699-710, 1995). The authors have studied observations of comets reported in oriental manuscripts and have made three linkages. They suggest that comet 1110 K1 was a return of comet Pons-Gambart (see also The Comet's Tale No 8). Their linkage implies that it returned unseen in 1956 and will return again in 2022. They also link 1500 H1 with 1861 J1, which would give a return in 2265 or thereabouts. The final linkage is for 1337 M1 and 1468 S1, with a period of just over 130 years, and if this is correct the comet would have returned in 1984. The comet is always well placed, so the failure to see it suggests an error in the period and that perhaps the comet has not yet returned. It might be worth searching along a track given by the approximate elements, which are given in the observing supplement.

Jonathan Shanklin

The following abstracts (some shortened further for publication) are taken from the Cambridge Conference Network (CCNet), which is a scholarly electronic network devoted to catastrophism, but which includes much information on comets. To subscribe, contact the moderator Benny J Peiser at <b.j.peiser@livjm.ac.uk>. Information circulated on this network is for scholarly and educational use only. The abstracts, taken from daily bulletins, may not be copied or reproduced for any other purposes without prior permission of the copyright holders. The electronic archive of the CCNet can be found at http://abob.libs.uga.edu/bobk/cccmenu.html

A. Lewis Licht: **The rate of naked-eye comets from 101 BC to 1970 AD.** *Icarus*, **137 (2)**, pp 355-356 February 99

The number of comets that are bright enough and that come close enough to Earth to be seen with the unaided eye fluctuates randomly from century to century. The mean number seen per century, R, is a parameter determined by the distribution of short-period comets and by the escape of new, near parabolic comets into the inner Solar System from the Oort Cloud (J. H. Oort, 1963, The Solar System, Univ, of Chicago Press, Chicago, London) and the Kuiper Belt (H. F. Levison and M. J. Duncan, 1997, Icarus 127, 13-32). A measurement of R provides a constraint on possible escape mechanisms. In the following it is shown that R can be determined by a comparison of the number of comets reported from the east and west with those reported from both regions. An analysis of the reports compiled by I. Hasegawa (1980, Vistas in Astronomy, Pergamon, Great Britain) shows that R = 86.0 +/- 6.7 comets/century and moreover R has been remarkably constant over the past two millennia. One could conclude from this that the mean rate at which all comets, visible and invisible, enter the inner Solar System has also been constant over this period. *© 1999 Academic Press*

E. Desvoivres, J. Klinger, A.C. LevasseurRegourd, J. Lecacheux, L. Jorda, A. Enzian, F. Colas, E. Frappa, P. Laques: **Comet C/1996 B2 Hyakutake: observations, interpretation and modelling of the dynamics of fragments of cometary nuclei.** MONTHLY NOTICES OF THE ROYAL ASTRONOMICAL SOCIETY, 1999, Vol.303, No.4, pp.826-834

Comet C/1996 B2 Hyakutake was extensively observed at the Pic du Midi observatory during late March of 1996, Bright condensations were observed in the near-nucleus coma. We have performed a detailed data analysis in order to derive the position of these features with respect to the nucleus. We make the hypothesis that they are induced by fragments of the nucleus. Despite the frequency of fragmentation of cometary nuclei, the dynamics of the fragments is not yet well understood. We propose a general approach in order to study the motion of the fragments in the orbital plane of the comet. An estimate of the non-gravitational forces is used to describe the motion of the fragment and of the nucleus with respect to their centre of mass. Then the equations of the theory of perturbed Keplerian motion are solved in order to study the motion of the centre of mass, This approach is applied to Comet C/1996 B2 Hyakutake, The results are in good agreement with the observations, An excellent fit is obtained for a fragment size of 20 m, assuming a density of 300 kg m(-3).

S.H. Pravdo, D.L. Rabinowitz, E.F. Helin, K.J. Lawrence, R.J. Bambery, C.C. Clark, S.L. Groom, S. Levin, J. Lorre, S.B. Shaklan, P. Kervin, J.A. Africano, P. Sydney, V. Soohoo: **The Near-Earth Asteroid Tracking (NEAT) Program: An automated system for telescope control, wide-field imaging, and object detection.** ASTRONOMICAL JOURNAL, 1999, Vol.117, No.3, pp.1616-1633

The Near-Earth Asteroid Tracking (NEAT) system operates autonomously at the Maul Space Surveillance Site on the summit of the extinct Haleakala Volcano Crater, Hawaii. The program began in 1995 December and continues with an observing run every month. Its astrometric observations result in discoveries of near-Earth objects (NEOs), both asteroids (NEAs) and comets, and other unusual minor planets. Each six-night run NEAT covers about 10% of the accessible sky, detects thousands of asteroids, and detects two to five NEAs. NEAT has also contributed more than 1500 preliminary designations of minor planets and 26,000 detections of main-belt asteroids. This paper presents a description of the NEAT system and discusses its capabilities, including sky coverage, limiting magnitude, and detection efficiency. NEAT is an effective discoverer of NEAs larger than 1 km and is a major contributor to NASA's goal of identifying all NEAs of this size. An expansion of NEAT into a network of three similar systems would be capable of discovering 90% of the 1 km and larger NEAs within the next 10-40 yr, while serving the additional role of satellite detection and tracking for the US Air Force. Daily updates of NEAT results during operational periods can be found at JPL's Web site (http://huey.jpl.nasa.gov/ similar to spravdo/neat.html). The images and information about the detected objects, including times of observation, positions, and magnitudes are made available via NASA's SkyMorph program.

NASA SELECTS MISSIONS TO A COMET'S INTERIOR AS NEXT DISCOVERY FLIGHT

The Deep Impact mission will send a 1,100-pound (500-kilogram) copper projectile into comet P/Tempel 1, creating a crater as big as a football field and as deep as a seven-story building. A camera and infrared spectrometer on the spacecraft, along with ground-based observatories, will study the resulting icy debris and pristine interior material. Dr. Michael A'Hearn will lead Deep Impact from the University of Maryland in College Park.

Deep Impact will be launched in January 2004 toward an explosive July 4, 2005, encounter with P/Tempel 1. It will use a copper projectile because that material can be identified easily within the spectral observations of the material blasted off the comet by the impact, which will occur at an approximate speed of 22,300 mph (10 kilometers per second.). The total cost of Deep Impact to NASA is $240 million. Deep Impact will be managed by NASA's Jet Propulsion Laboratory in Pasadena, CA, and built by Ball Aerospace in Boulder, CO.

Other comet missions include the Stardust mission to gather samples of comet dust and return them to Earth, which was launched in February 1999. The Genesis mission to gather samples of the solar wind and return them to Earth and the Comet Nucleus Tour (CONTOUR) mission to fly closely by three comets are being prepared for launch in January 2001 and June 2002, respectively.

Y.R. Fernandez, D.D. Wellnitz, M.W. Buie, E.W. Dunham, R.L. Millis, R.A. Nye, J.A. Stansberry, L.H. Wasserman, M.F. AHearn, C.M. Lisse, M.E. Golden, M.J. Person, R.R. Howell, R.L. Marcialis, J.N. Spitale: **The inner coma and nucleus of Comet Hale-Bopp: Results from a stellar occultation.** ICARUS, 1999, Vol.140, No.1, pp.205-220

We discuss the properties of the nucleus and inner coma of Comet Hale-Bopp (C/1995 O1) as derived from observations of its occultation of Star PPM 200723 on 5 October 1996, while the comet was 2.83 AU from the Sun. Compared to previous occultations by active comets, this is possibly the closest to the nucleus one has ever observed. Three chords (lightcurves) through the comet's inner coma were measured, though only one chord has a strong indication of measuring the occultation, and that was through thin cirrus. We have constrained the radius of the nucleus and properties of the coma using a simple model; there is a large valid section of parameter space. Our data show the optical depth of the coma was greater than or equal to 1 within 20 to 70 km of the center of the (assumed spherical) nucleus, depending on the coma's structure and the nucleus' size. The dependence of the dust coma's opacity on cometocentric distance, rho, was steeper than expected for force-free, radial how being probably as steep as or steeper than 1/rho(1.4) within 100 km of the nucleus (though it is marginally possible to fit one coma hemisphere with a 1/rho law), Assuming the dust coma flowed radially from a spot at the center of the nucleus and that the coma's profile was not any steeper than rho(-2) the upper limit to the radius of the nucleus is about 30 km, though relaxing these assumptions limits the radius to 48 km, The chord through the coma does not show the same coma structure within 100 km of the nucleus as that which is apparent in larger-scale (similar to 700 km/pixel) imaging taken just before the event, suggesting that (a) the star's path sampled the acceleration region of the dust, and/or (b) azimuthal variation in the inner coma is different than that seen in the outer coma.

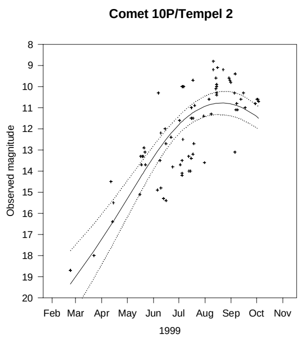
Review of comet observations for 1999 April - 1999 September

The information in this report is a synopsis of material gleaned from IAU circulars 7139 – 7280 and The Astronomer (1999 April – 1999 September). Note that the figures quoted here are rounded off from their original published accuracy. Lightcurves for the brighter comets are from observations submitted to The Astronomer and the Director. A full report of the comets seen during the year will be published in the Journal in due course.

Comet 10P/Tempel 2, made its 20th observed return since its discovery by William Tempel (Milan, Italy) as a 9^m object in 1873.

David Strange obtained an image of the comet on July 10. It brightened rapidly. Jose Carvajal estimated it at 10.6 in his 32-cm L on August 5.9, but I was unable to see it with the 20-cm Thorrowgood refractor on the same night. On Aug 10.9 Andrew Pearce and I observed it with 14x100B from just outside Penzance, Cornwall, my estimate was 8.7 and Andrew made it a little fainter. In Cambridge it was a very difficult object in the 20-cm refractor, though it was observed during the IWCA. Back in Australia Andrew Pearce reported that the comet had faded to near 10^m at the end of August.

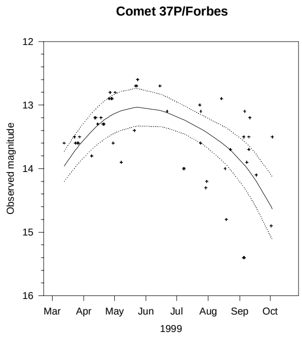
77 observations give an uncorrected preliminary light curve of 5.8 + 5 log d + 32.2 log r



A few further observations of **Comet 21P/Giacobini-Zinner** were received after the last issue appeared, though they don't change the overall shape of the light curve very much.

223 observations give an uncorrected preliminary light curve of 8.9 + 5 log d + 13.6 log r

Comet 29P/Schwassmann-Wachmann 1. Reports suggest another outburst to around 13^m in early June. Jose Aguiar reported it in outburst once again at the beginning of July.

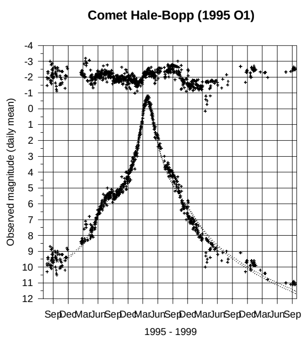


Comet 37P/Forbes is currently 14^m, but is fading rapidly. 49 observations give an uncorrected preliminary light curve of 10.6 + 5 log d + 11.8 log r

A few further observations of **Comet 52P/Harrington-Abell** were received**,** which give an uncorrected preliminary light curve following the second outburst of m = 10.2 + 5 log d + 0.0416abs(t-T+23.1).

Comet/Asteroid 95P/Chiron was around 16m when at opposition in late May in Libra. Maurice Gavin obtained images of the comet on July 10 and 11.

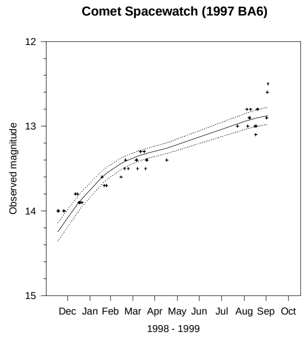
Comet 114P/Wiseman-Skiff will be brightening from 14^m in November and may be observed with large aperture telescopes or CCDs.



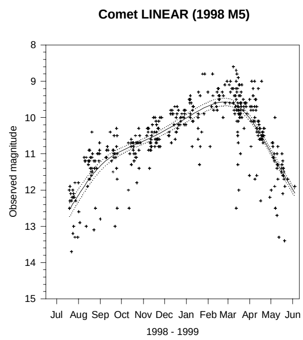
The residuals on the fitted curve are shown above.

Comet 1995 O1 Hale-Bopp , the great comet of 1997, is fading slowly but is only observable from Southern Hemisphere locations as it loops round the Large Magellanic Cloud. An observation by Andrew Pearce in late August 1999 made it 12.5.

Over the entire apparition (750 days with observations, spread over 1532 days) the comet has the corrected lightcurve of: -0.66 + 5 log d + 7.59 log r There are significant variations from this, and the comet is currently a little brighter than indicated by this equation.

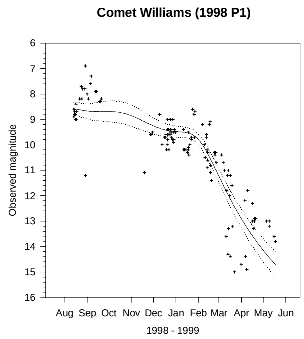


1997 BA6 Spacewatch Details of the orbit of an unusual asteroid, 1997 BA6 were given on MPEC 1997 C-13. The orbit is very eccentric, with a period near 4500 years and a semi-major axis of several hundred AU. Currently it is near 13^m and will be at high southern dec when near perihelion which is at 3.4 AU in 1999 December when it may be around 12^m. 40 observations give an uncorrected preliminary light curve of 5.5 + 5 log d + 8.2 log r

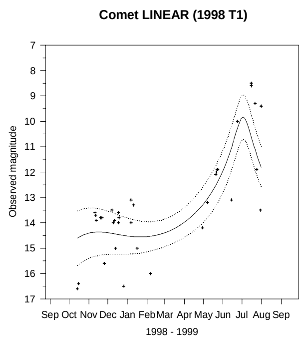


1998 M5 LINEAR was at perihelion in January and passed very close to the pole in mid March. Heading south it passed through Camelopardalus and Lynx, reaching Cancer in mid year. 397 observations give an uncorrected preliminary light curve of 6.1 + 5 log d + 10.0 log r

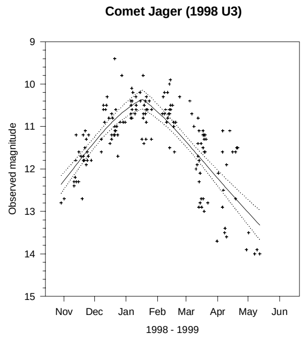
1998 P1 Williams was widely observed from the UK after perihelion. 126 observations give an uncorrected preliminary light curve of 6.7 + 5 log d + 9.9 log r



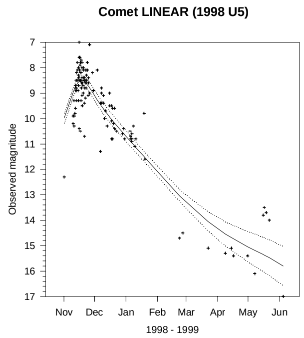
1998 T1 LINEAR. Seiichi Yoshida recovered the comet in late April after conjunction but its magnitude was fainter than expected in his CCD images. It brightened and reached 9^m in late June, but is now fading. 35 observations give an uncorrected preliminary light curve of 10.2 + 5 log d + 4.5 log r



1998 U3 P/Jager Observations with the Northumberland in March put the comet at 12^m - 13^m. Observing on April 9/10 I could barely see the comet in the Northumberland, estimating it 13.6. 157 observations give an uncorrected preliminary light curve of 9.8 + 5 log d + 0.0151 abs(t-T-46.0). This is a linear type of light curve and the comet began fading before perihelion.



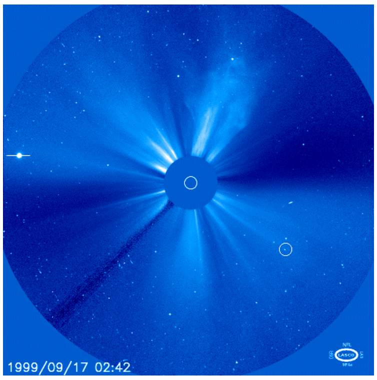
Only a few further observations of **1998 U5 LINEAR** were received. The 130 observations give an uncorrected preliminary light curve of 8.4 + 5 log d + 14.7 log r



1999 G2 SOHO (IAUC 7142, 1999 April 14), **1999 H2 SOHO** (IAUC 7147, 1999 April 19), **1999 H4 SOHO** (IAUC 7157, 1999 May 3), **1999 J1 SOHO** (IAUC 7162, 1999 May 10), **1999 K1 SOHO** (IAUC 7173, 1999 May 20), **1999 K9 SOHO** (IAUC 7204, 1999 June 18), **1999 K10 SOHO** (IAUC 7204, 1999 June 18), **1999 L1 SOHO** (IAUC 7197, 1999 June 11), **1999 L4 SOHO** (IAUC 7204, 1999 June 18), **1999 L5 SOHO** (IAUC 7208, 1999 June 25), **1999 M1 SOHO** (IAUC 7208, 1999 June 25), **1999 M2 SOHO** (IAUC 7212, 1999 June 30), **1999 N1 SOHO** (IAUC 7213, 1999 July 1), **1999 N3 SOHO** (IAUC 7222, 1999 July 14), **1999 P2 SOHO** (IAUC 7234, 1999 August 9), **1999 S1 SOHO** (IAUC 7256, 1999 September 17) were sungrazing comets discovered with the SOHO LASCO coronographs and have not been observed elsewhere. Several others have yet to receive designations. SOHO has now discovered 89 comets, of which 84 are members of the Kreutz group of sungrazing comets.

1999 K1 was one of the brighter objects. On May 20.47 UT, the comet was about 11 solar radii from the sun and showed a tail; on May 20.51 it was 6.8^m. A standard magnitude prediction suggested it could reach -4 magnitude, however as with most of the Kreutz group fragments it faded as it got closer to the sun. Some of the comets show no tail at all and it is possible that some supposed observations of Vulcan were actually tiny Kreutz group comets.

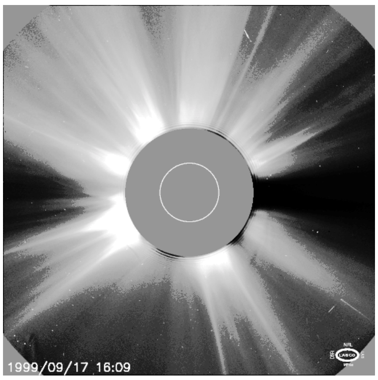
I discovered SOHO-86=1999 S1 on the morning of September 17 and the discovery has a story behind it.



A discovery frame of comet 1999 S1. The comet is shown circled.

The University of Cambridge Cavendish Laboratory hosts a 'Physics at Work' Exhibition in mid September, which is designed to get prospective GCSE students enthusiastic about following a career in physics. I usually run an exhibit about work at the British Antarctic Survey (BAS), which shows the students the physics behind measuring ozone in the atmosphere. This year we were asked to put on two exhibits and for a variety of reasons I ended up teaching the students about 'geospace'. I had been looking at the real-time movies of the LASCO C3 camera for several months on an occasional basis and was impressed by how well they show the dynamic activity of the Sun. I thought it would be educational to show the students live images of the Sun, so I downloaded the images every morning and showed the current movie loop. There were no comets during the exhibition, but the planet Mercury was visible heading out from superior conjunction. I also showed an archival image, which did show a comet, to illustrate that comet tails always point away from the sun, thus demonstrating the existence of the solar wind.

Having packed everything up on Friday morning (September 17th), I cycled back to BAS and decided to have a look at the latest sequence from the wide field C3 camera. A quick scrutiny showed a star-like object heading towards the Sun and brightening, but without a tail. The object became visible at about 15:18 UT on September 16 and was brightest on the most recent frame to be downloaded, which was taken at 05:18. I guessed that it was a probable Kreutz group fragment, though expected someone else to have picked it up already. At 09:41 UT, I e-mailed Doug Biesecker of the SOHO-LASCO consortium to inform him of the object, with a copy to Dan Green at the CBAT. Doug responded at 12:32, and confirmed that it was a probable Kreutz group fragment and that I was the first to report it. He measured the images and quickly passed the details on to the CBAT. Brian Marsden was able to compute a preliminary orbit whilst the object was still visible in the coronagraphs. The positions and orbit appeared on MPEC 1999-S04, issued at 15:26 and a note recording the discovery appeared on IAUC 7256 at 17:08. The orbit shows that it is another member of group I of the Kreutz family of sungrazing comets. The fragment grew a short tail, visible on the C2 frames, but then faded as it dived towards the sun. The last available image to show it that day was taken at 16:54, though archival images record it a little longer.



The comet is the radial streak in the bottom right corner.

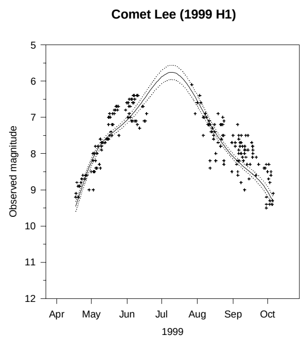
1999 DN3 P/Korlevic-Juric The 19^m, apparently asteroidal object 1999 DN3, observed by K. Korlevic and M. Juric at Visnjan (0.41-m f/4.3 reflector + CCD) on February 18.97 and 24.0 UT (MPC 33833, MPS 4018), was linked by G. V. Williams, Minor Planet Center, to observations on April 6 and 14 in routine asteroidal astrometry from LINEAR. Owing to the unusual nature of the orbit, computed on May 13, the object was added to The NEO Confirmation Page. In response to this, further observations were reported on May 14.2 by D. A. Klinglesmith, III, and R. Huber (Etscorn Observatory) and by G. Hug (Farpoint Observatory). Williams also identified LONEOS observations of the object on Apr. 10. In addition, C. W. Hergenrother, Lunar and Planetary Laboratory, reported that observations made on May 14 with the 1.5-m Catalina reflector showed the object to be cometary, with a compact, well-condensed 10" coma and a strongly curved 30" tail, starting in p.a. 45 deg and curving to p.a. 335 deg. [IAUC 7167, 1999 May 14]. The comet is distant and fading.

1999 F1 CATALINA On Apr. 17, T. B. Spahr, Lunar and Planetary Laboratory, reported the automatic discovery of an 18^m object of unusual motion and stellar appearance in the course of the Catalina Sky Survey (0.41-m Schmidt + CCD) on March 23.32. Spahr obtained follow-up data on Apr. 16 and 17. Computations by B. G. Marsden suggested that the object was a long-period comet in a highly-inclined orbit, yielding an identification in Mar. 13 Spacewatch data. CCD images (660 s total exposure) obtained with the Catalina 1.5-m reflector by J. Bialozynski, D. Dietrich, C. Greenberg, E. Hooper, D. McBee, D. McCarthy, J. Pici, G. Rudnick, and C. Vedeler, and co-added by C. W. Hergenrother, show a faint coma of diameter 8"-10" [IAUC 7148, 1999 April 20]. The comet is currently very distant (over 8 AU) and not due to reach perihelion until 2002, but even then it will be 5.8 AU from the Sun.

1999 F2 Dalcanton Julianne Dalcanton, University of Washington; S. Kent, Fermi National Accelerator Laboratory; and S. Okamura, University of Tokyo, on behalf of the Sloan Digital Sky Survey (SDSS), reported the discovery by Dalcanton of a comet on several SDSS images taken on March 20 through different filters. An r'-band filter shows a tail about 2' long and a sharp nucleus inside a coma of diameter about 20". Upon receipt at the Central Bureau on June 7 of the astrometry, spanning only 72 s of time, G. V. Williams found a possible link with a single-night apparently asteroidal LINEAR object in archival data for March 24; this permitted Williams to find further apparently asteroidal LINEAR observations, first on Feb. 23, then on May 12, and finally on 1998 June 18. At this point, the object was placed on the NEO Confirmation Page in expectation that additional observations would confirm the cometary nature. In response, confirming CCD observations showing cometary appearance were received from M. Tichy and Z. Moravec at Klet on June 7.9 UT (coma diameter 15", tail 50" in p.a. 230 deg) and from R. A. Koff at Thornton, CO, on June 8.2 (15" coma, 35" tail in p.a. 195 deg). Dalcanton subsequently forwarded single-night LONEOS observations obtained on March 28 and found by G. Magnier. [IAUC 7194, 1999 June 8]. The comet is distant, but intrinsically quite bright. It will fade from its current 15^m.

1999 G1 LINEAR another object discovered by LINEAR has been identified as a comet [IAUC 7140, 1999 April 10]. The 17^m object is in a distant parabolic orbit and will fade.

1999 H1 Lee Steven Lee (a night assistant at the Anglo-Australian Telescope in New South Wales) discovered this 9^m comet on April 16.5 with a 0.41-m f/6 Newtonian reflector (about x75) at a star party near Mudgee, New South Wales [IAUC 7144, 1999 April 16].

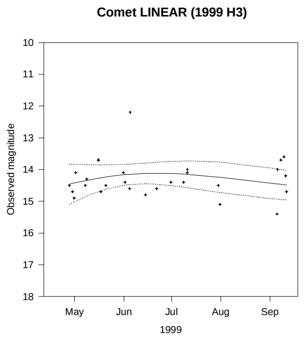


I picked it up in 14x100B on July 27.09 at mag 6.1, though it was a difficult object in a bright twilight sky. It has faded and become more diffuse. Several observers imaged an anti-tail in September.

213 observations give an uncorrected preliminary light curve of 6.6 + 5 log d + 11.5 log r

1999 H3 LINEAR An apparently asteroidal 17th mag object discovered by LINEAR on April 22.31, and noted on The NEO Confirmation Page, was reported as cometary by Klet and Ondrejov observers [IAUC 7151, 1999 April 23]. The comet is in a distant parabolic orbit and didn't become much brighter than 13^m.

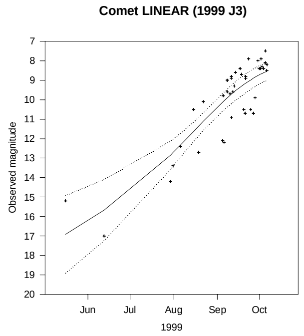
38 observations give a somewhat indeterminate uncorrected preliminary light curve of 8.7 + 5 log d + [5] log r



1999 J2 Skiff Brian Skiff of the Lowell Observatory Near-Earth Object Search (LONEOS) team discovered a 16^m comet on May 13.40 [IAUC 7165, 1999 May 13]. The comet is at high northern declination, and is very distant at over 7 AU, with perihelion in October 1999. It will remain near 15^m for some time.

1999 J3 LINEAR An apparently asteroidal 19^m object discovered by LINEAR on May 12.28, and noted on The NEO Confirmation Page, was reported as cometary by Klet observers [IAUC 7166, 1999 May 13]. Estimates in mid July put it at 12^m. By early September it had reached 10^m. It was 9.6 in 20x80B from a dark sky site on September 12.1, rather smaller than comet Lee. It peaked in brightness at around 7^m in mid October. It is currently small and well condensed.

50 observations give an uncorrected preliminary light curve of 9.3 + 5 log d + 17.4 log r



1999 J4 LINEAR Another asteroidal object reported by LINEAR on May 15.32 UT (mag 18.2-18.8) with unusual motion was noted on The NEO Confirmation Page, and it was subsequently reported to be cometary in appearance by several observers, including M. Elowitz and F. Shelly from May 17 LINEAR observations. P. Pravec, U. Babiakova, and P. Kusnirak (Ondrejov, 0.65-m f/3.6 reflector + V filter) reported a coma diameter of 0'.2 and a tail 0'.6 long in p.a. 160 deg, and J. Ticha and M. Tichy (Klet, 0.57-m f/5.2 reflector) noted the object to be slightly diffuse (coma diameter about 7"), on May 16.9 [IAUC 7170, 1999 May 17]. The comet is in a distant parabolic orbit.

1999 J5 P/LINEAR An apparently asteroidal 19^m object reported by LINEAR on May 12.36 and 17, and linked by G. V. Williams to LINEAR observations on June 8 and 10 by way of a comet-like orbit, was posted on The NEO Confirmation Page for additional observations. P. Pravec and P. Kusnirak, Ondrejov, reported that their June 12 CCD images showed a faint coma and a tail marginally visible to the southwest. Also, A. Sugie, Dynic Astronomical Observatory, reported strong condensation and a coma diameter of 12" on June 14 [IAUC 7201, 1999 June 14]. The comet will fade.

1999 K2 Ferris William D. Ferris discovered an 18th mag comet on CCD frames taken with the 0.59-m LONEOS Schmidt telescope on May 19.37. Measurer B. Koehn noted that the comet showed a well-condensed nucleus, a coma of diameter about 15", and a faint tail about 20" long in p.a. 225 deg on May 19. Additional astrometry appeared on MPEC 1999-K22. May 22 observations by J. Ticha and M. Tichy (Klet) showed the comet as diffuse with a 12" coma; observations on the same night by L. Kornos and P. Koleny (Modra) also showed a coma. C. W. Hergenrother and A. E. Gleason (Catalina 1.5-m reflector) reported a 20" coma and a 20" tail in p.a. 230 deg. [IAUC 7175, 1999 May 22]. The comet is in a distant parabolic orbit and won't brighten much from its present visual magnitude of around 16.

1999 K3 LINEAR M. Elowitz, Lincoln Laboratory, Massachusetts Institute of Technology, reported the discovery of 19^m, apparently cometary object in LINEAR data on May 20.27. Following posting of this object on The NEO Confirmation Page, numerous observers confirmed the cometary appearance, and additional astrometry and orbit were given on MPEC 1999-K23. Around May 22.0 UT, L. Sarounova (Ondrejov) reported coma diameters about 20" and 15"; Ticha and Tichy report a 10" coma and a wide tail in p.a. 245 deg; and coma was also noted by Kornos and Koleny. [IAUC 7175, 1999 May 22]. The comet is past perihelion and is fading from visual magnitude 16.

1999 K4 LINEAR Another apparently asteroidal object of 19^m found by LINEAR on May 17.33, and posted on The NEO Confirmation Page, was reported as cometary by M. Hicks (Table Mountain; faint coma of diameter about 5" on May 21) and by C. W. Hergenrother and A. E. Gleason (Catalina 1.5-m reflector; highly condensed coma with a faint 10"-15" tail in p.a. 170 deg on May 22) [IAUC 7176, 1999 May 22]. The comet is intrinsically faint and will fade.

1999 K5 LINEAR Another apparently asteroidal, 17^m object discovered by LINEAR on May 20.32 and posted on The NEO Confirmation Page, was reported as cometary by several observers. CCD frames taken by D. D. Balam (Victoria) on May 23 show a condensed coma with a 16" fan-shaped tail in p.a. 303 deg. On May 24, L. Kornos and P. Koleny (Modra) report a coma diameter of about 15" and a short tail in p.a. 330 deg, and G. Hug (Farpoint Observatory) indicated a hint of coma in p.a. about 300 deg. [IAUC 7178, 1999 May 24]. This is LINEARs 23rd discovery in around 14 months. The comet is currently around 16^m visually, and does not reach perihelion until 2000 July, by which time it may have brightened to around 13^m. It will however be at high southern declination.

1999 K6 LINEAR Yet another apparently asteroidal object, of 18^m, discovered by LINEAR on May 20.23, and posted on The NEO Confirmation Page, was reported as cometary, on May 24 by L. Sarounova (Ondrejov; faint coma with condensed nucleus) and by M. Tichy and Z. Moravec (Klet; diffuse with coma diameter /= 10") [IAUC 7180, 1999 May 25]. The comet will brighten a little, but is unlikely to do better than 15^m.

1999 K7 LINEAR A 19^m object discovered by LINEAR on May 24.34 was reported as possibly cometary by M. Elowitz, Lincoln Laboratory, with an apparent tail in p.a. about 220 deg. Confirmation of cometary activity was made by D. D. Balam (Victoria), who noted no tail but measured a 7" diffuse coma. [IAUC 7181, 1999 May 26] The comet will fade from its present magnitude.

1999 K8 LINEAR Another apparently asteroidal 19^m object discovered by LINEAR on May 26.38 and posted on The NEO Confirmation Page, was reported as cometary on May 27 by L. Sarounova (Ondrejov; coma diameter at least 30" with condensed nucleus), by M. Tichy and Z. Moravec (Klet; 10" coma), and by R. A. Koff (Thornton, CO; diffuse coma of diameter about 8") [IAUC 7182, 1999 May 27]. The comet is a distant one and will remain near 14^m until 2000.

12 observations give an uncorrected preliminary light curve of 1.8 + 5 log d + [15] log r

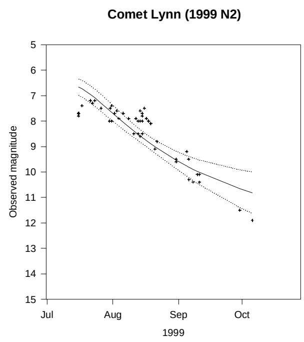
1999 L2 LINEAR M. Elowitz and F. Shelly reported the discovery of a 18^m comet with a coma but no distinct tail in LINEAR data on June 11.24. In response to posting on The NEO Confirmation Page, G. R. Viscome (Lake Placid, NY) reported that the object showed a 16" coma and moderately strong condensation, but again no discernible tail [IAUC 7199, 1999 June 12]. The comet is around 16^m visually and reached perihelion in August.

1999 L3 LINEAR An 18th mag apparently asteroidal fast-moving LINEAR object found on June 9.17 and posted on The NEO Confirmation Page, was noted by F. B. Zoltowski, Woomera, S. Australia, as having a tail about 30" long in p.a. 100 deg and a rather dense coma on June 13 and 14 CCD images. P. R. Holvorcem, Valinhos, Brazil, reports a about 10" coma on his June 12 images. [IAUC 7200, 1999 June 14]

A/1999 LD31 and **A/1999 LE31** MPEC 1999-M28 and 1999-M29 provided detailed information about two apparently asteroidal objects, 1999 LD31 and LE31, discovered by LINEAR on June 8 and 12, respectively (with prediscovery observations of the latter on May 17), and followed extensively by observers using The NEO Confirmation Page. In each case the orbit was found to be retrograde: 1999 LD31 has a = 21.9 AU, e = 0.89, i = 160 deg, P=103 years, H = 13.9; 1999 LE31 has a = 8.0 AU, e = 0.46, i = 152 deg, P=23 years, H = 12.3. All observers consistently reported 1999 LD31 to be asteroidal, and only one observer suggested that 1999 LE31 may have cometary appearance (although this is unconfirmed). In particular, A. Fitzsimmons, Queen's University, Belfast, reported that 250-s exposures in 1" seeing by S. Collander-Brown and S. Lowry with the 1-m Kapteyn telescope at La Palma on June 15 show both objects clearly to be point sources. [IAUC 7208, 1999 June 25]

1999 N2 Lynn Daniel W. Lynn, Kinglake West, Victoria, Australia, visually discovered an 8^m comet using handheld 10x50 binoculars on July 13.45 [IAUC 7222, 1999 July 14]. I glimpsed it in 20x80B on August 5.9 at 7.7, and Jose Carvahal also estimated it at 7.7. I made a further observation in company with Andrew Pearce on August 10.9 and estimated the comet at about 7.6 in 20x80B. The comet will continue to fade slowly and will become a morning object.

54 observations give an uncorrected preliminary light curve of 8.4 + 5 log d + 5.8 log r



1999 N4 LINEAR (L-30) Yet another LINEAR discovery with unusual motion, which was placed in The NEO Confirmation Page and found to have a retrograde orbit. At the request of the Central Bureau, some of the observers making astrometric observations examined their images carefully and concluded that the object was a comet. M. Tichy (Klet, 0.6-m reflector) noted comae of diameter about 6" on July 14.9 and about 7" on July 15.9 UT. L. Sarounova (Ondrejov, 0.6-m reflector) indicated a small coma, some lack of condensation but no tail on July 16.9. F. B. Zoltowski (Woomera, 0.3-m reflector) remarked on a compact, diffuse image with an asymmetrical distribution that may indicate a small, faint tail at p.a. around 90 deg on July 17.6 [IAUC 7226, 1999 July 17]. The comet has m2 around 18^m and is a distant object, reaching perihelion next year.

Robert H. McNaught recovered **Comet 1999 P1 141P/Machholz 2** on CCD images obtained with the 1.0-m f/8 reflector at Siding Spring on August 3.55. The object was of stellar appearance. The indicated correction to the prediction by B. G. Marsden on MPC 27082 (for component A) is Delta T = +0.8 day. Seeing was good on Aug. 4, and there was no sign of any other components within Delta T = +/- 1.5 days. Further orbital computations by Brian Marsden confirmed that if the observations were of the same object that was observed at Siding Spring on 1995 Mar. 29 and 30 (MPC 25097), this is indeed component A. However, attempts to link all the observations (back to 1994 Aug. 15), even using the nongravitational parameters A1 and A2, were not satisfactory. A gravitational solution gives an acceptable fit to 67 observations back to 1994 Oct. 2 (mean residual 0".9; earlier residuals increasing to 20") [IAUC 7231, 1999 August 04] Z. Sekanina (1999, A & Ap 342, 285; Table 7) tabulates the expected offsets of components B and D from component A. In terms of Delta T, these amount to +0.21 and +0.82 day, respectively. [IAUC 7232, 1999 August 04] The expected magnitude this autumn is still a little uncertain.

1999 R1 SOHO =SOHO 85 Doug A. Biesecker, SM&A Corporation and Goddard Space Flight Center, reported observations of what was presumably a comet, not a Kreutz sungrazer, discovered by T. Lovejoy in SOHO/LASCO C3 data and later also recognized in earlier C2 data. It was observed from September 4.90 to September 6.26, reaching 6th mag at best and no tail was detected. [IAUC 7251, 1999 September 9]

1999 R2 142P/Ge-Wang Jim Scotti, Lunar and Planetary Laboratory, recovered comet P/1988 V1 (= 1988o = 1988 VIII) with the Spacewatch 0.9-m telescope at Kitt Peak on September 15.44. The nuclear magnitude m2 was 22.1. On September 15 there was a coma 12" across and a tail extending 0'.53 in p.a. 266 deg. On September 16 the coma diameter was 11", and the tail extended 0'.47 in p.a. 267 deg. The indicated correction to the prediction by S. Nakano on MPC 27081 was Delta T = -5.5 days. The comet is unlikely to become brighter than 19th mag. [IAUC 7255, 1999 September 17].

1999 RO28 P/LONEOS C. Hergenrother, Lunar and Planetary Laboratory, reported that a co-added 600-s CCD exposure with the Steward Observatory 2.3-m reflector on Sept. 13 of 1999 RO_28 (discovered by LONEOS on September 7.33, with details given on MPEC 1999-R23) showed a stellar condensation with a faint 20" tail in p.a. 310 deg. M. Tichy and J. Ticha, Klet, later reported a faint coma of diameter 8" and 7" on images taken on Sept. 8.93 and 10.02 UT, respectively. Observations by J. V. Scotti with the Spacewatch telescope at Kitt Peak on Sept. 15.4 showed a coma diameter of 9" (m_1 = 18.6-18.7, m_2 = 20.6-21.0) and a 0'.72 tail in p.a. 308 deg. [IAUC 7253, 1999 September 15]. The comet has a 6.5 year period and will fade as it recedes from the Earth.

1999 S2 McNaught-Watson Rob H. McNaught, Australian National University, reported his discovery of a comet on an R survey film taken with the U.K. Schmidt Telescope by F. G. Watson on September 19.72. The comet showed a very strong central condensation, a weak circular coma of diameter 20", and a diffuse tail 3'.5 long in p.a. 210 deg. Confirming CCD images by McNaught with the 1.0-m f/8 reflector at Siding Spring taken on September 21.6 yielded m_2 = 20.1-20.2 [IAUC 7260, 1999 September 21]. The orbit shows that the comet is intrinsically bright, but very distant and perihelion was a couple of years ago.

1999 S3 LINEAR (L-31) M. Bezpalko reported the discovery by LINEAR of a 16^m comet on September 24.34. Following posting on the NEO Confirmation Page, additional observations were reported, giving m1 near 13^m [IAUC 7264, 1999 September 24]. The comet has a period of around 80 years and reaches perihelion in early November. It will brighten a little before fading. It was surprisingly easy in the Northumberland refractor on October 2.90, although the BAA VS sequence for RX And put it at 13.6. Transparency was very good and I could see star S of the sequence, which is magnitude 15.6.

1999 S4 LINEAR (L-32) Another unusual-moving object of 17^m discovered by LINEAR on September 27.40, reported as asteroidal and subsequently posted on the NEO Confirmation Page, was noted to be cometary in appearance by D. Durig (Sewanee, TN, 0.3-m f/7 reflector + CCD; coma diameter about 10"; tail about 20"-25" long in p.a. 200-220 deg) and by J. Ticha and M. Tichy (Klet, 0.57-m f/5.2 reflector + CCD; comet diffuse with 8" coma and tail 10" long in p.a. 245 deg). The preliminary parabolic orbital elements suggest that this comet might become a naked-eye object next July [IAUC 7267, 1999 October 1]. The comet will brighten to within reach of visual observers early next year before solar conjunction. After conjunction it will brighten rapidly to become a naked eye object in the northern sky. Full details will appear in the next issue.

Stop press. 1999 T1 (McNaught-Hartley) may be a binocular object in December 2000 and **1999 T2 (LINEAR)** may reach 13^m in late summer of 2000. More details in the next issue.

For the latest information on discoveries and the brightness of comets see the Section www page:
http://www.ast.cam.ac.uk/~jds
or the CBAT headlines page at
http://cfa-www.harvard.edu/cfa/ps/Headlines.html

Comet Hunting Notes

Don Machholz

MAY 1999: Of the 79 comets visually discovered since 1975, 36 were found in the southern sky. These southern discoveries were not evenly spaced throughout the year. Exactly half (18) of them took place in about three months-between Nov. 23 and Feb. 25. (During that same time only eight Northern Hemisphere finds occurred.) Good summer weather in the Southern Hemisphere does not account for all the finds; eight of those 18 discoveries were made by Northern Hemisphere comet hunters searching the southern skies. So when did Northern Hemisphere finds prevail? Between mid-March and mid-June, 11 of the 12 finds occurred in the northern sky.

JUNE 1999: Comet Lee is one of four comets found by amateurs at star parties during the past 25 years. In 1975 Doug Berger found Comet Kobayashi-Berger-Milon while looking for M 2 at a San Jose Astronomical Association event. In 1985 I found Comet Machholz (1985e) at the Riverside Telescope Makers' Conference. In 1995, at a star party in Arizona, Thomas Bopp found a comet near M 70. Three of these four finds were accidental finds, and those three comets reached magnitude seven or brighter.

JULY 1999: Steve Lee's comet discovery in April was the third accidental find of the past six Southern Hemisphere visual comet discoveries. That is a high percentage considering that there are only two other accidental finds among the 80 discoveries visually found since 1975. What does this mean? Are comet hunters getting lazy? If the comets were outside typical comet hunting areas, then comet hunters would tend to miss them. For two of the comets this may be true, as the discovery elongations of all three were 72, 103, and 120 degrees from the sun. And if the comets brighten rapidly before discovery, then the usual comet hunting methods may miss them. A third reason for more accidental finds is an increase of activity among non-comet hunters. With the Internet making it easier to report suspicious objects, and the Wilson award motivating the reporting of new comets, it is likely that accidental comet discoveries by amateurs will continue at a brisk rate in the Southern Hemisphere, which is not covered well by the automated search programs.

AUGUST 1999: Fifty-two of the 80 comets discovered by amateurs over the past 24 years have perihelion distances of less than 1.0 Astronomical Unit (AU). At the extremes we have a minimum distance of 0.11 AU for a comet found by me in 1985, and a maximum distance of 3.32 AU for a comet found by K. Cernis in 1983. Now contrast that to the SOHO satellite whose discoveries have perihelion distances of under .01 AU and to LINEAR, which is finding many comets with perihelion distances of greater than 3.0 AU.

SEPTEMBER 1999: Lynn's discovery is the fourth consecutive comet to be visually discovered from Australia, and all four have been found in the past 12 months. Of the last nine comets found visually, seven have been discovered by Australians.

OCTOBER 1999: Comet LINEAR (1999 J3) discovered on May 12, has left the polar region and entered our morning sky, brightening rapidly. Imagine my surprise when I recently swept it up while comet hunting, not knowing it would be so bright. The tilt of the comet's orbit is called the inclination, and it is measured in degrees. A comet going in earth's orbit has a 0 degree inclination, while one going in the opposite direction has a 180 degree inclination. An object travelling perpendicular to earth's orbit (as does Comet Hale-Bopp) has an inclination of 90 degrees. The average inclination for the last 81 visually found comets is 84 degrees. There is a slight grouping of comets in the 40-50 degree range and a dearth of comets near 100 degrees. I suspect this is a true picture of comet orbit distribution, since comet hunter sweeping patterns would not seem to favour (and unfavour) these particular inclinations.

<u>**Don's Comet Hunting Hours**</u>

Comet Hunting Hours 1975-1998: **6468.00**
Additional hours in 1999: **117.00**
Total hours at last discovery (10-8-94): **5589.00** (nearly 1,000 hours ago)
Least hours in any month since he began comet hunting on 1/1/75: **4.00** (02/98), **4.50** (01/86), **5.50** (02/80)
Most hours in any month since he began comet hunting: **69.25** (05/76), **63.00** (05/78)

These notes are taken from Comet Comments by Don Machholz, which is published on the Internet.

The Edgar Wilson award for 1999 was announced on IAUC 7223 on July 14 and was divided among the following six individuals or groups: Peter Williams, Heathcote, N.S.W., Australia, for C/1998 P1; Roy A. Tucker, Tucson, AZ, U.S.A., for P/1998 QP54; Michael Jager, Weissenkirchen i.d. Wachau, Austria, for P/1998 U3; Justin Tilbrook, Clare, S.A., Australia, for C/1999 A1; Korado Korlevic and Mario Juric, Visnjan, Croatia, for P/1999 DN3; and Steven Lee, Coonabarabran, N.S.W., Australia, for C/1999 H1.

International Workshop on Cometary Astronomy

Continued from page 1

The average elongation is 70 deg. Most are 20 to 60 altitude and average 9.4 mag. They are slightly brighter closer to the sun, but not much. Some bright comets (6th mag) have been found far from the Sun. Amateurs average 3.3 per year, with an average of 368 hours per comet and a median of 177 [NH 433/228, SH 165/113]. Average q is 0.9.

Kesao Takimizawa addressed the meeting on Japanese comet discoverers. He had become interested in astronomy in 1966 aged 14, and had observed Ikeya-Seki. He had searched for 33 years and discovered 5 comets. The first Japanese comet discovery occurred in 1928. Honda had been very successful with 12 comets, followed by Ikeya and Seki. Several Japanese discoveries were made simultaneously by three or more observers. 57 visual Japanese discoverers have found comets, with 72 in total (14 photographic and one CCD). Most used reflectors or binoculars, and 113 different instruments had been used. He has used large binoculars for 15 years. A plot of discoveries showed that they were mostly morning, followed by evening and opposition, with gaps between opposition and quadrature, particularly in the evening sky. He showed prints of Japanese discoverers and mentioned a medal for Japanese discoverers.

Alan Hale and Kesao Takamizawa.

After a break for refreshments came a panel discussion on hunting for comets, however I missed most of these whilst carrying out administrative duties. LINEAR doesn’t search within 90 deg of the sun, and there is no move to set up a Southern

Hemisphere equivalent. The Edgar Wilson award was discussed, most panellists didn't think it would make much difference, but it was nice to have the money. One negative aspect is the feeling of financial loss when someone else discovers a comet.

Michael Jager had made accidental discoveries as a result of photographing other comets. He had found a fragment of Machholz 2 (what should this be called if it turned out to be the main fragment?) and P/1998 U3 whilst photographing Harrington-Abel. He uses Schmidt cameras, the smaller reaching 14m and the larger 15m and has photographed over 150 comets. He thanked the discoverers for providing him with opportunities for photographing new comets. He began photographic work in 1982 and had failed to see comet Kohoutek.

We broke for a buffet lunch, which turned out to be another filling meal, with more than just bites on offer. After lunch Charles Morris spoke to the title "Why you don't get your papers published in the ICQ and other rants". He began by defining a rant as a heated one sided discussion. His topic was on amateur research. Many amateurs observe at a professional level. The ICQ would like to publish amateur papers, but their quality is often below the acceptable standard.

To demonstrate the problem that occurs with some amateur publications, he cited a situation at the last IWCA where informal exchange about his use of averted vision was then used as the basis of a paper to (incorrectly) discredit the Morris magnitude estimation method. This paper was published in an amateur comet publication and neither the author nor editor bothered to check the validity of the reference to the informal conversation. The ICQ tries to avoid such problems by using a referee review system.

As a side note, he pointed out that the Morris method actually integrates the Sidgwick and Bobrovnikoff methods. That is, when properly used these two methods are actually subsets of the Morris method. Morris then asserted (Charles Morris personal communication!) that using the Sidgwick technique for DC3+ or Bobrovnikoff method for DC7- will give biases brighter and fainter, respectively. In discussion Nick James pointed out that this assertion about the Morris method was not proven; Charles was not allowed to forget it for the rest of the meeting, though he commented that the underestimate of the Bobrovnikoff method was well documented. Joe Marcus later commented that the extensive work by the Dutch comet section did demonstrate the delta effect.

Morris noted that several groups want additional observational information to be published in the ICQ tabulations. However, prior to adding parameters, it must be shown that the information would be useful. This is the responsibility of the person/group proposing the parameters, not the ICQ staff. Adding additional parameters to the database, particularly for past observations, is non-trivial. It will be done (for instance, the changes made in the DC parameter after the last IWCA) when the change clearly improves the database.

Most amateur research requires statistics. Statistics are very important and you can't just assert a correlation. There is a difference between precision and accuracy and you need to quote errors. The delta effect may exist, but as r and delta are correlated, any delta effect study must not blindly use multiple regression analyses. (Morris has yet to be convinced that the delta effect has been proven.) Extrapolation also presents problems when observations only cover a limited magnitude range. Adding extra parameters, eg coma diameter, doesn't necessarily improve estimates or analyses of M1, particularly if the parameter is poorly defined. Morris' advice was to listen to reviewers comments, they should help to improve the paper, though reasoned argument can convince an editor that the reviewer is incorrect.

The next item was a panel discussion between Charles Morris, Jonathan Shanklin, Guy Hurst, Dan Green and Andreas Kammerer on the World Wide Web, the Internet and the influence on comet observing. Although there had been some feeling that the new media acted to bias observers, there was little demonstrable evidence. Guy Hurst made the point that the scatter in variable star estimates was typically no more than ±0.8 whilst the scatter in comet observations was often 2 magnitudes. When the extreme observations were queried the observers sometimes admitted that they were guestimates rather than actual observations. There might be a case for always including the actual magnitude estimate in reported observations, as is done with variable stars. Magnitude estimates of comet Hyakutake were quite discordant, with experienced and inexperienced observers making systematically different estimates. It was pointed out that the telephone had existed before the Internet and that it had always been possible to exchange information. Charles Morris said that he regarded the Internet as an educational tool, and the beginner observers would eventually become experienced.

Andreas Kammerer commented that the long tails reported for comet Hyakutake were physically impossible. The waxing moon coincided with the publication of IAUC 6360, which first cast doubts on these estimates, thus preventing further observations, which might have settled the question of influence on observers. The tail had shrunk significantly by the time the moon waned after closest approach. In his poster Andreas showed results of his investigations on this matter: the contentious observations can only be explained by the somewhat dubious assumption of a tail that must have deviated in step with the changing position of the earth.

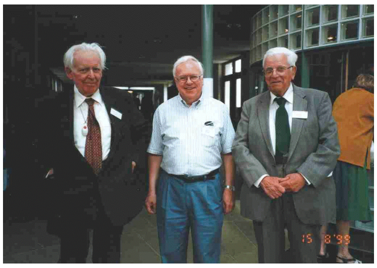
After the discussion, tea was a little delayed and we took the opportunity for the first group photograph. Following the break Herman Mikuz explained his careful procedures for CCD photometry [I missed this talk whilst finding new supplies of poster pins and mains adaptors.] Nicolas Biver spoke on his work on the outgassing of carbon monoxide from distant comets. He concluded that there was a good correlation between visual magnitude and CO outgassing. He suggested that any comet brighter than 14^{th} magnitude should be observable if CO drives the activity, even out to 30 AU.

A panel discussion between Charles Morris, Dan Green, Herman Mikuz, Nicolas Biver and for the last few minutes Jonathan

Shanklin followed. One conclusion was that a group should be set up to discuss the issues of CCD photometry and set up standard procedures. Jon Shanklin commented that current ICQ coding didn't include a code for the type of CCD chip being used in the photometry.

As the weather looked a bit threatening (we had heard thunder rolling around and a gust front had thrown up dust outside the college), a fleet of taxis took the participants the short drive to the Cambridge University Press bookshop in the centre of Cambridge. It should have been a short drive, but at least one taxi was sufficiently unfamiliar with Cambridge that they went to the Press Building on the other side of town. Here we were treated to a generous reception from the Press, and were able to purchase books at 20% of list price. Most participants managed to walk back to New Hall for dinner. By the end of dinner the storm clouds were retreating and Jon Shanklin took all those that were interested over to the University Observatory, a 20 minute walk from New Hall. Here we were able to use 20x80 binoculars to observe comet Lynn, the Thorrowgood refractor to observe comet 10P/Tempel 2 and the Northumberland refractor for a variety of deep sky objects. The two refractors are historic instruments, with the Northumberland first being used to observe comets over 150 years ago. Skies were very transparent and most observers spotted fragments of 109P/Swift-Tuttle blazing through our atmosphere. Observing finished around midnight, though we managed to loose at least a couple of observers on the walk back to New Hall. They were eventually retrieved and I stayed up till dawn at a dark sky site observing Perseid meteors and the other two comets visible in the morning sky.

On Sunday morning the participants were free to explore Cambridge and discussions resumed after lunch. Kay Williams introduced the legendary British observer, George Alcock. By way of background she revealed that her son Gareth had wanted to be an astronomer from the age of seven and had eventually gone to Cambridge, MA to work with Brian Marsden. At a dinner party Nancy Marsden had suggested that her next work should be a biography of George Alcock. She was a bit daunted by this as all her previous subjects had been dead! George's work speaks for itself and includes history, architecture, ornithology, meteorology and astronomy as well as a lifetime in teaching. George is perhaps most famous for his comet and novae discoveries, but some of his comet drawings were also on display. George said a few words in response and sat down to a standing ovation.



George Alcock, Brian Marsden and John Alcock.

George was followed by another comet discoverer, Kesao Takamizawa, who had been observing comets, variable stars, novae, supernovae etc since the 1960s. He now uses a 10-cm f4 astrograph, with limiting magnitude 15.5 (B) on T-Max 400 and a 25-cm f2.8 Baker-Schmidt with limiting magnitude 17. He sometimes visits a 1500-m altitude site in the mountains. He searches in 720 areas and checks for variable stars and minor planets using a PC. Over 5 years he has observed on 367 occasions, taken 16530 shots and discovered two comets, two novae, one supernova and 502 new variables. He changed from visual to photographic search techniques in 1994.

Jean-Claude Merlin spoke about his work at Le Creusot, IAU station 504, which has a 40-cm f5 reflector and CCD, with more than 120 clear nights a year. He averages 6 runs per month, taking two hours per run while observing two - five comets, with up to 30 second exposures. He has measured 900 positions since 1997, with an average accuracy of about 0.5". As a guide he suggested that Exposure time = pixel size/object speed. As an example if pixel size was 2" and the object was moving 30" per hour it would require a total of 4 minutes exposure. Looking at combined observations he had found systematic trends in the position residuals, for example 104P/Kowal 2 showed about a 160 day period. 73P/Schwassmann-Wachmann 3 showed larger residuals than average and he thought there might be a 75 day period to them. Questions suggested that these might be related to poor orbital determinations, or that the non-gravitational parameters didn't quite match reality. However the possibility of a true physical phenomenon is not completely ruled out (for example precession effect on a small nucleus, such as in the case of comet 104P/Kowal 2).

Bob Neville gave a very enthusiastic talk about the need to use CCD equipment to make positional measurements. His own set-up at 967 Greens Norton was entirely homemade. He used a 30-cm guide scope to a 22-cm reflector with a Starlight Xpress SX CCD. The system allowed for offset guidance to about 1 degree. The telescope had a roller drive in RA, which was very smooth and gave symmetrical star images. For reduction he used Astrometrica and the USNO catalogue which gives dense coverage, with Guide 6 or Megastar for finder charts. ACLOCK (share/freeware) provided LST. Observers need to use short exposures to avoid saturation. Sometimes poor seeing can actually help as it fuzzes out images; it is possible to make worthwhile observations even in poor environments. Nicolas Biver commented that speedy astrometry to provide good orbits is essential to help professionals target radio telescopes.

During the break for tea we had a group photograph and managed to capture 11 discoverers on film, namely: George Alcock, Doug Biesecker (SOHO), Kazimieris Cernis, Alan Hale, Michael Jager, Bill Liller, Don Machholz, David Seargent, Patrick Stonehouse, Kesao Takamizawa and Keith Tritton who between them had discovered 28 comets and many SOHO comets. Research in Sky & Tel showed that seven discoverers who at that time had discovered 15 comets had been present at an RTM meeting in 1990 [David Levy (6), Jean Mueller (1), Don Machholz (4), Clyde Tombaugh (1?), William

Sorrels (1), Doug Berger (1) and Jeff Phinney (1)].

Before we resumed the formal sessions Charles Morris took centre stage and confessed that it was time to honour his bet with Alan Hale that his comet wouldn't become brighter than 0 mag. It did, so Alan received 10 one dollar bills. Our first speaker after tea was Doug Biesecker, a member of the SOHO LASCO team, which has discovered a large number of sungrazing comet fragments. They are all remains of a single progenitor, which had a period of around 800 years, with a highly inclined orbit (and therefore not affected much by Jupiter). The date of the original progenitor is not known and multiple fragmentation has occurred. The most famous member of the familly is Ikeya-Seki.

SOHO orbits at the L1 Lagrangian point between the earth and sun. The LASCO C2 camera has an orange filter with a bandwith of 100nm and views the region from 2.5 to 6 solar radii with a resolution of 13". The C3 camera has an orange/clear filter with a bandwith of 300nm and views from 4 to 30 solar radii with a resolution of 56". They offer 360 deg coverage round the sun, with C3 taking about 1 frame an hour and C2 2 frames an hour. The camera support pylon hides the track of typical sungrazers between March and April. Before LASCO about 10 sungrazers had been discovered from the ground between –371 and 1970. Six were discovered by Solwind between 1979 and 1984 and 10 by SMM between 1980 and 1989. SOHO has now discovered 78 comets (updated to 79 that evening); it finds about 1.9 comets a month, when corrected for the duty cycle. Of a subset of 53 Kreutz group comets, 33 were seen in C2 and 52 in C3. It has not been possible to compute an orbit for SOHO-45, though an mpeg loop shown later clearly showed the object. There was some speculation as to whether the object was a sungrazer or earth approacher. The team are getting better at visual detection, but are still running the automated search program. This will only detect potential Kreutz group members, so there could be other faint comets being missed. The comets show fairly slow motion, and 'disc' like ones are difficult to spot, and may only be seen in a few frames.

Most of the comets brighten as 10 log r, but after a certain point fade quickly. Magnitude scales are not well calibrated on SOHO, partly because solar physicists require less accuracy than comet observers do. There is a problem with vignetting and this makes reduction of the C2 and C3 magnitudes uncertain. At T-20 hours the median magnitude is around 8, with the brightest 1st magnitude and the faintest 10th. Most stop brightening 6 – 12 hours before perihelion, which implies a fairly narrow range of sizes. No comets have shown tail features, and none have been observed closer than 3 solar radii.

The SOHO spectrometer had observed two comets. Lyman alpha emissions give an upper limit to the solar wind velocity of 640 km/sec. The comets suffer a 20 kg/sec mass loss. A body 6.7-m in diameter would weigh 120,000 kg and evaporate in about 5 hours.

Brian G. Marsden, (Harvard-Smithonian Center for Astrophysics) provided a synopsis of his talk on 'Discoveries, astrometry, catalogues and awards'.

This month we are celebrating the fortieth anniversary of George Alcock's discovery of what were announced on the IAU Circulars at the time as "Comet Alcock (1959e)" and "Comet Alcock (1959f)". Following the tradition, the year/letter designations supplied in order of discovery announcement were later changed to 1959 IV and 1959 VI, showing the order of passage of the year's comets through perihelion. In terms of the new system introduced in 1994 the announcements would have involved the single appellations "Comet C/1959 Q1 (Alcock)" and "Comet C/1959 Q2 (Alcock)", the 1 and 2 indicating the order of announcement of discoveries in half-month "Q" of the year, i.e., the second half of August. Although we intended no disrespect, some astronomers have been condemning the IAU Circulars for this "new" procedure of placing the name of the discoverer, rather than the designation, in parentheses. As it happens, this procedure is not new at all--early IAU Circulars speak of "Comet 1922c (Baade)", for example--and since "Comet Alcock" is not by itself a unique form of address, it is surely more logical to state the unique designator for the comet first, backing it up with the additional information identifying the discoverer. The parenthetical use of the discoverer's name was for many decades also standard use in the Astronomische Nachrichten, the principal international source for information about discoveries, astrometry and orbits of comets prior to the first IAU Circular. The discoverer's name, and sometimes also the date of discovery, were specified in this way, even in cases when the year/letter designations were not used and the Roman numeral designations had not yet been supplied. "Comet 1889 ... (Barnard 1888 Sept. 2)", already recognizing the year in which the object would pass perihelion, uniquely defined the comet that later became 1889 I, that was from the start defined in some publications as 1888e, and that we now know as C/1888 R1 (Barnard).

Since two earlier speakers have provided admirable accounts of their astrometric activities, there is little I need add, except perhaps to point out that it was not always this way. Modern CCD astrometry has turned out to be a much more automatic, accurate, reliable, rapid and straightforward process than the older astrometric processes involving photography and micrometry.

Although I am happy to announce that the thirteenth edition of the Central Bureau for Astronomical Telegrams/Minor Planet Center "Catalogue of Cometary Orbits" has just now become available, I again want to stress that by far the best and most detailed such catalogue ever published is that by Galle of 1894, which has the sole disadvantage that it is just very much out of date! One feature of the 1894 catalogue is that it defined the 15 multiple-apparition comets as (H) = Halley, (E) = Encke, ..., (Wo) = Wolf, (Fi) = Finlay. Actually, these periodic comets are the only named objects in the catalogue. Since there are now 140 such comets, it might have been preferable if Galle had instead given them consecutive numbers. The 1994 designation system has taken care of this by calling them 1P, 2P, etc. As many as 55 comets were discovered during the twelve months preceding the end of July 1999. Although 22 and 14 of these were discovered by the very automated LINEAR and SOHO projects, respectively, even the remaining activity was prodigious in comparison with a year as recent as 1971, which yielded only a single discovery. Cataloguing new discoveries has been complicated by the fact that, more often than not, LINEAR does not recognize its discoveries as cometary. The same is also true of other CCD discovery programs, which often involve exposures sufficient only to detect moving objects. Cometary status is often established only by careful scrutiny of objects that have orbits suggesting cometary nature. Although some of these objects, like P/1999 DN3 (Korlevic-Juric), had already received designations as minor planets, the beauty of the new system is that such designations can be retained and combined with genuine cometary designations in a transparent manner. Again to complicate matters, June 1999 saw for the first time the discovery of an object (two objects, in fact) having a retrograde orbit but no trace of cometary activity!

While monetary prizes and other awards specifically for the discoveries of comets date back to the year 1831, there was no such international award between the 1950s and this past year. The Edgar Wilson Award, made possible by a bequest from a businessman in Kentucky, has recently been instituted for cometary discoveries by amateur astronomers (or individuals acting in an amateur capacity) for whom those comets are named and who are using for the discoveries amateur, privately-owned equipment. The amount available each year, roughly $20 000, is shared according to the number of comets with eligible discoveries during the year, which for this purpose is taken as beginning at 0 hours UT on June 11. The first year of operation has just ended, and there were six eligible comets, including the aforementioned P/1999 DN3 (with the two Croatian CCD discoverers having an equal share), a CCD discovery in Arizona, a photographic discovery in Austria and three visual discoveries in Australia.

My notes show a few further asides, which Brian mentioned in passing. The D/ designation for some periodic comets implies defunct or comets which JPL shouldn't send a mission to as they might not find it. He would like to see the numeric sequence disappearing from the named periodic comets (eg S-L 1 to 9). Orbital computations are now not quite good enough to fit all the available observations, even with the inclusion of non-gravitational forces, and an improved model is clearly needed. July and August is the rainy season in New Mexico, so there are not many LINEAR observations at this time of year. LINEAR doesn't follow objects from night to night, which gives the amateur the chance to do two night linkages. By definition tailed asteroids are comets (eg 133P/Elst-Pizzarro). The Edgar Wilson award begins on June 11th because his brother died on June 10th. The original bequest included recoveries, however this was thought to be unfair for recoveries with well-known orbits, though accidental recoveries might count towards future awards.

Responding to a question, Brian said that comets are not allocated a provisional designation until positions were available. Several recent SOHO comets have yet to have their positions measured and so do not yet have designations, and one has positions but no derivable orbit, despite clearly existing. Brian's talk continued into a panel discussion also including Doug Biesecker, Bill Liller and Alan Hale. Kuiper belt objects are cometary objects. There might be some bright Kreutz group comets to come, but he wasn't sure about different sub-groups. The IAU could decline to name a comet if this might cause aggravation. The first Solwind object had been named, and the team's intention had been to name each subsequent object with the next three team-member's names, however they were instead named after the instrument. New spacecraft missions planned for the future include stereo solar imaging and all sky imaging down to 12th magnitude every 90 minutes. The first named comet is 1760 A1 as this was the year the Messier first began deliberate comet hunting.

Guiseppe Canonaco commented that useful positional data had been found in the logbook of a Dutch ship, enabling an orbit to be computed for a comet for the first time. Jon Shanklin noted that he had been forwarded recent meteorological logbook entries relating to comets Hyakutake and Hale-Bopp, which showed that mariners were generally unaware of the comets despite widespread information being available and that they only spotted them when they reached 2nd or 3rd magnitude.

The skies again cleared after dinner, giving another very transparent night (for Cambridge), with the Milky Way clearly visible from the University Observatory. It was possible to observe comets Lynn and 10P/Tempel 2 and more fragments of 109P/Swift-Tuttle were seen.

Monday began with the final session, which was devoted to short presentations and posters. Philippe Morel of the Societe Astronomique de France described the history of the comet section of the SAF. L'Astronmie, the Journal of the SAF had published observations of comets since 1887 when it was founded by Camille Flammarion. Charles Bertaud formed the comet section in 1970. Annie Chantal Levasseur Regourd, who organised several training camps for the International Halley Watch, followed him. Serge Thebault took over in 1989 and he organised further camps to observe comet Austin in Provence in 1990 and Hale-Bopp in Normandy in 1997. There are about 120 members distributed through France and other countries, of which around 15 regularly submit observations, including drawings and photographs. The Internet is very important for communication between members. Two members have been successful in discovering comets: Alain Maury (1998 X1) and Michel Meunier (1997 J2). Future projects include transcribing old observations from L'Astronomie. The SAF web pages (http://www.iap.fr/saf) include a section on comets. Visitors to Paris can be assured of a welcome at 3 Rue Beethoven, across the Seine from the Tour Eiffel.

Stephane Garro went on to elaborate about the SAF comet database. They had decided to use database software and set up a form input so that those not familiar with the ICQ codes could enter observations correctly. The first observations were from 1882, but there are few in the ICQ database prior to 1980 and they were concentrating on entering these observations. There were 713 observations between 1939 and 1959. Many of the early observations are rough, lacking supporting data. Sometimes the date is imprecise, for example only quoting October 1901, others gave no instrument and often only the date and magnitude were quoted.

Gyula Szabo described his observations at Konkoly in northern Hungary. The 0.60-m Schmidt is now equipped with a CCD camera which has a 29'x18' field of view, compared to the original plates which gave a 5°x5° field, however the CCD reaches 22 magnitude compared to 19 magnitude on film. He showed images of 1998 K5, which revealed a bright tail, but little coma. Several comets showed features in the coma. A short period light curve of P/1998 U3 over 2 hours showed variation in the nuclear brightness. They had carried out surface photometry using varying apertures, calculating the magnitude in various rings. Theoretically (d ln B)/(d ln P) = -1 where P is the radius of the annulus and B its width. Some LINEAR comets, eg 1998 K5, show much greater slopes than this. Solar activity, diffusivity in the coma or activity in the comet may explain the variation. Some of the data may show a trend, with minimum values occurring some 20 days after perihelion.

Bill Liller had followed comet Hale-Bopp with his 0.20-m f1.5 Schmidt with an ST5 CCD at the Newtonian focus on 338 nights. This gave a 27'x36' field at a scale of 7" per pixel. He could get a photometric accuracy of ±0.04 magnitude using a broadband V filter (effectively minus IR). Looking at the inner coma only, there was a 20±5 day periodicity when the comet was inbound. After perihelion there were ongoing recurrent outbursts about 100 days apart, which showed an outflow of 40 - 55 ms^{-1}.

After the tea break Bill Liller presented Jonathan Shanklin with a bottle of Chilean wine and thanked him for making all the local arrangements for what had been a very successful meeting. Bernd Brinkmann gave a short talk on his CCD observations with an SX camera on a C8 and with the Askania 0.34/0.50-m Schmidt camera and ST6 camera, which also has several smaller telescopes which are under used. He processes the images, which are mostly 60-second exposures, with bias, dark and flat field frames and uses co-added frames for fainter objects. He showed high quality images of several recent comets, which had been used for astrometry. He concluded with some spectacular slides of Hale-Bopp.

Bill Liller and Michael Jager.

The final speaker was Simona Nikolova who spoke about the endurance lifetime of meter sized cometary fragments. Meter sized fragments were common in meteor streams [though the audience was a little sceptical that photographs had showed such objects prior to atmospheric entry] and fragmentation in comets was common. She had developed a sublimation model, in collaboration with Martin Beech, using the interaction of solar radiation with water ice and several variable parameters. She concluded that 2P/Encke looses 0.65-m per revolution and a 10-meter sized fragment would last around 50 years; 55P/Tempel-Tuttle looses 0.18-m and a fragment would last 1900 years.

During the meeting several posters were on display, though I'm afraid I didn't have time to make detailed notes. The BAA Comet Section and TA had light curves of recent comets on display, a selection of superb comet drawings by George Alcock and the discovery observations of comet 1980 Y2 by Roy Panther. Comets Hyakutake and Hale-Bopp featured prominently in several posters. Nicolas Biver presented work on the estimation of the rotation period of Hale-Bopp using visual drawings. Philippe Morel discussed possible irregularities in Hale-Bopp's rotation, illustrating his poster with 15 drawings made through his 0.41-m Newtonian. Bill Liller had illustrations from his talk on Hale-Bopp and the Belgian VVS showed many photographs. Andreas Kammerer displayed a comprehensive analysis of observations of the two comets and this will also be displayed at the Meteor Section meeting at the end of October. Simona Nikolova showed a synopsis of her talk on cometary fragment lifetimes.

After lunch we boarded an air-conditioned coach for the trip to Avebury and Stonehenge. It is quite a long journey to Avebury and I kept everyone entertained with descriptions of the passing scenery and was persuaded to recount some tales from my other hobbies, which include church bell-ringing, ice hockey, natural history and cricket. Although there was rain en route, it had stopped by the time we reached Avebury and there was time to look round the large complex and discover its history in the local museum. After a light tea we continued on to Stonehenge, where we waited until the public had left before being ushered into the stone circle. We had an hour to ourselves and the lighting conditions provided a spectacular backdrop to the ancient monument, which is Britain's earliest astronomical observatory. The trip back was much quicker than the outward journey and we arrived back before midnight.

Final goodbyes were said on Tuesday morning and the remaining participants departed from New Hall for further touring round the UK and their journeys home. During the three days of the Workshop 65 astronomers and friends participated in what was a very rewarding meeting. My thanks to all those that contributed to making it such a success and I look forward to the next one in a few years time.

Jonathan Shanklin

Thanks to Martin Mobberley for providing the illustrations. Colour versions can be seen on his web page at http://ourworld.compuserve.com/homepages/MartinMobberley

Observations of Comet 2P/Encke

Alex Vincent

During its 1994 apparition, I made an extensive number of observations of Comet Encke during the early evenings of January of that year. The comet went through the Water Jar asterism of Aquarius and passed very close to the star Pi Aquarii on January 15.

I observed the comet through Dave Storey's 0.30-m telescope on 1993 December 31 when it appeared as a faint ball shaped object at 9.5 magnitude and also on 1994 January 16th near Pi Aquarii shining at magnitude 8.5. It appeared slightly elongated as shown in the sketch. I took several photographs of it at prime focus.

My other observations were done through 10x50 binoculars and an 8x21 monocular on January 7th, 13th, 14th, 16th, 17th, 19th, 23rd and 28th. It appeared as a small smudge of light as it traversed Aquarius

I took a number of photographs of Comet Encke with my camera piggyback on the Worthing Astronomical Society's 0.30-m telescope and also down at the beach with a camera platform, using 50-mm, 135-mm and 270-mm lenses. As the moon was around on some of the days, the sky appears blue.

Comet Encke has the shortest known period of any comet, which is only 3.3 years, and its last return was in 1997, but it was not favourable placed. It will however be well placed for observation in the year 2000.

C/1807 R1 (Great Comet)

Gary W. Kronk

(Abridged from Cometography, to be published this winter by Cambridge University Press)

This comet was first seen on 1807 September 9 by Castro Giovanni (Sicily). It passed perihelion on September 19 and then emerged out of evening twilight, at which point it became widely observed. Independent discoveries were then reported by Jean Louis Pons (Marseille, France) on September 21 and Edward Pigott (Bath) on September 28. The comet passed closest to Earth (0.1533 AU) on September 26.

The comet was well observed as October began. William Dunbar saw the comet on the 3rd. He was then situated about 5 miles southeast of Natchez, Mississippi. He said it seemed similar in brightness to a star of magnitude 2 or 3, though "considerably larger." With a reflecting telescope (128x) he said the nucleus and coma were shown "with tolerable distinctness; the idea produced in the mind of the observer, was that of a round body in combustion, which had produced so much smoke as to obscure the nucleus; the smoke seemed to be emitted in every direction; but, as if it met on one side with a gentle current of air, the smoke seemed to be repelled and bent around the nucleus, escaping on the opposite side, in the direction of the tail." Dunbar added that the telescope showed about 63' of tail, while the nucleus was considered one-third, or possibly one-half, the brightness of Mars. William Herschel saw the comet with the naked eye on October 4. He said a reflector of 10-foot focal length showed an apparently round nucleus which was evenly illuminated across its surface. Although he initially estimated its diameter as 5" in the reflector of 7-foot focal length, later in the observing session he said it was more like 3" across. He made several comparable nuclear diameter estimates during the next few days, and also estimated the tail length as 3.75 degrees on October 18. On the 19th Herschel said the coma diameter was 6 arcmin. About mid October the Gentleman's Magazine reported, "The Comet became visible immediately after twilight, at a considerable elevation in the heavens, nearly due West, and set about one degree half past eight o'clock, within a few degrees of N.W. The nucleus, or star, when viewed through a small telescope, appeared about the size of a star of the first magnitude, but less vivid, and of a pale dusky colour. The atmosphere of the Comet, owing to the limited power of the telescope, was barely perceptible. The tail...appeared sometimes extremely brilliant, seeming to be a vibration of luminous particles, somewhat resembling the Aurora Borealis, and at other times almost to disappear." H. W. M. Olbers saw the comet on October 20 and said the comet exhibited two tails separated by about 1.5 degrees. The northern tail was very slender, faint, and straight, with a length of about 10 degrees, while the southern tail was short, wide, and brighter, with a length of about 4.5 degrees. The southern tail was also more intense on the southern side, while the concave side of the tail was very poorly defined. Olbers measured the very distinct nucleus as 8" or 9" across, which he said equalled about 900 miles. On October 24, Dunbar indicated the tail was about 2.7 degrees long. On October 26, Herschel said the tail was "considerably longer on the south-preceding, than on the north-following side." On October 28, Herschel said the tail's south-preceding side was well defined, while the north-following side is shorter and "hazy." On October 31, Herschel said, "The tail continues to be better defined on the south-preceding than on the north-following side."

Moonlight interfered for about a week before mid-November. By the 18th Dunbar said the comet had visibly diminished since earlier observations, and noted the nucleus was about one-half its observed magnitude of October 3. On November 20, Herschel said the nucleus was distinctly visible, but only "a mere point" in the 7-foot focal length reflector. On December 6, Herschel observed with the 24-inch reflector and described the coma as "a very large, brilliant, round nebula, suddenly much brighter in the middle." It was about 4.75 arcmin across, with a tail 23 arcmin long. On December 7, Dunbar said, "I directed the reflecting telescope to the comet; the nucleus is now much diminished in apparent magnitude; I compared it with a star of the sixth magnitude in the Swan, which was within the field of view at the same time, their apparent diameters were nearly equal, but the comet is become so dim, as to be seen with the naked eye only in a pure atmosphere, with favourable circumstances...the coma is yet considerable, but the tail is no longer visible...." On December 16, Herschel said the comet resembled "a very bright, large, irregular, round nebula, very gradually much brighter in the middle, with a faint nebulosity on the south preceding side."

On 1808 January 1 Herschel described the comet as "very bright, very large, very gradually much brighter in the middle." He added that the 7-foot focal length telescope showed the center consisting of very small stars, but the 24-inch reflector showed "several small stars shining through the nebulosity of the coma." On January 6, Dunbar said the comet was no longer visible to the naked eye. His reflecting telescope showed the nucleus "as small as a star of the seventh magnitude." He added, "the coma seems diminished more than half of its appearance, on the 6th of December [December 7th UT], and the nucleus is equally surrounded by it on all sides, without any trace of tail, and so faint as very much to resemble some of the nebulae." On January 14, Herschel described the comet as "bright, pretty large, irregular round, brighter in the middle." On January 16, Dunbar said, "In the great telescope, the coma is yet sufficiently conspicuous; the nucleus visible like a star of the eighth magnitude, in our purest atmosphere, and the coma little changed since the 5th instant [January 6th UT]."

On February 2, Herschel observed with the 24-inch reflector and described the comet as "very bright, large, irregular round, very gradually much brighter in the middle." He added that a faint, diffused nebulosity was seen on the north-preceding side, and he surmised this might have been "the vanishing remains of the comet's tail." On February 19, Herschel indicated the comet was about 3.4 arcmin across and "gradually brighter in the middle." He added, "The faint nebulosity in the place where the tail used to be, still projects a little farther from the center than in other directions." On February 21, Herschel noted the comet was fainter than on the 19th, but still about the same size. It was gradually brighter towards the middle, and some nebulosity still extended on the side where the tail once existed. On February 24, Bessel observed the comet with a 7-foot focal length reflector and described it as very faint. On February 26, Dunbar "searched with great diligence and some anxiety, and at length found an object which I had no doubt was the comet, situated between Chi Cassiopeiae and Omicron Cassiopeiae...." This observation was made with the 6-foot Gregorian reflector, but the comet was not detected in its finder.

The comet was last detected on March 27.87, when Vincent Wisniewski (St. Petersburg, now Leningrad, Soviet Union) estimated the position as RA=1h 43m 13.83s, DEC=+48d 54m 38.6s.

Bessel ultimately used positions reported from September 22 to March 27 and found the comet was moving in a long-period orbit of nearly 2000 years.

Comet Prospects for 2000

The year 2000 is not a particularly good one for predicted returns of periodic comets. The comet predicted to be brightest is a new discovery by LINEAR, 1999 S4. There is a good chance that it could become a naked eye object in the northern sky next summer. A couple of long period comets discovered in previous years are still faintly visible and there are some poor returns of short period comets. Recent theories on the structure of comets suggest that any comet could fragment at any time, so it is worth keeping an eye on some of the fainter periodic comets, which are often ignored. Ephemerides for new and currently observable comets are published in the *Circulars*, Comet Section Newsletters and on the Section, CBAT and Seiichi Yoshida's web pages. Complete ephemerides and magnitude parameters for all comets predicted to be brighter than about 18^m are given in the International Comet Quarterly Handbook[1]; details of subscription to the ICQ are available from the comet section Director. The section booklet on comet observing[2] is available from the BAA office or the Director; a new edition is likely to be printed in 2000.

First some comets, which were at perihelion in previous years. Comet **Hale-Bopp (1995 O1)**, the great comet of 1997, is still fading slowly and could be 13^m at the beginning of the year, though this is likely to be the last year with visual observations. It is only observable from Southern Hemisphere locations as it loops round Mensa.

1999 S4 (LINEAR) offers the prospect of a naked eye comet next July. The comet should become visible to large aperture telescopes in the New Year, possibly earlier if the comet is brighter visually than with CCD. It brightens slowly, but also closes with the Sun and reaches conjunction in March. We should pick it up again as a binocular object in the northern sky in June, becoming naked eye in July. It doesn't stray far from the Sun and then begins to head south and back towards conjunction. UK observers will loose it by August, but Southern Hemisphere observers may follow it into September and will pick it up again as a telescopic object in November.

Stop Press: Another new comet **1999 T1 (McNaught-Hartley)** may reach binocular brightness in December 2000. More details in the next issue.

141P/Machholz 2 (1999 P1) was recovered by Rob McNaught in early August, not far from its predicted track. Its likely brightness is still uncertain, but it could be fading from 8th magnitude at the end of 1999.

29P/Schwassmann-Wachmann 1 is an annual comet which has frequent outbursts and seems to be more often active than not at the moment, though it rarely gets brighter than 12^m. In the first half of 1999 it was in outburst on several occasions. The randomly spaced outbursts may be due to a thermal heat wave propagating into the nucleus and triggering sublimation of CO inside the comet. It begins the year in Scorpius and reaches opposition in the same constellation in June. It passes through Ophiuchus and into Sagittarius and is in solar conjunction in December. This comet is an ideal target for those equipped with CCDs and it should be observed at every opportunity. Unfortunately opportunities for UK observers may be limited, as its altitude does not exceed 11° from this country.

This year sees comet **2P/Encke's** 58th observed return to perihelion since its discovery by Mechain in 1786. The orbit is quite stable, and with a period of 3.3 years apparitions repeat on a 10 year cycle. This year the comet is not particular well seen, but there are short observing windows from the Northern Hemisphere prior to perihelion, which is in September, and in the Southern Hemisphere after the comet reaches perihelion. There is some evidence for a secular fading and any observations will help confirm this. Another suggestion is that Encke has two active regions, an old one with declining activity, which operates prior to perihelion and a recently activated one present after perihelion. The comet is the progenitor of the Taurid meteor complex and may be associated with several Apollo asteroids.

9P/Tempel 1 was first observed in 1867, but was lost between 1879 and 1967 following an encounter with Jupiter in 1881 which increased the perihelion distance from 1.8 to 2.1 AU. Further encounters in 1941 and 1953 put q back to 1.5 AU and calculations by Brian Marsden allowed Elizabeth Roemer to recover it in 1967. Alternate returns are favourable, but pertubations will once again increase the perihelion distance in the middle of the next century. This return is an unfavourable one, but Southern Hemisphere observers will be able to follow it as it fades after perihelion. It is an important comet to observe as it is a potential spacecraft target, so all observations will be welcome.

A few comets not due to return until 2001 may become visible towards the end of the year. Horace Tuttle was the first discoverer of **41P/Tuttle-Giacobini-Kresak** in 1858, when he found a faint comet in Leo Minor. Nearly 50 years later, Professor M Giacobini discovered a 13^{th} magnitude object whilst comet hunting, which was observed for a fortnight. A C D Crommelin linked the apparitions in 1928 and made predictions for future returns, but the comet wasn't recovered and it was given up as lost. In 1951, Lubor Kresak discovered a 10^{th} magnitude comet in 25x100 binoculars whilst participating in the Skalnate Pleso Observatory's program of routine searches for comets. After further observations the comet was identified with the lost comet and a better orbit computed. At the 1973 return, which was similar to the 1907 return, it underwent a major outburst and reached 4^{th} magnitude, before fading and then undergoing a second outburst. Alternate returns are unfavourable and this is one of them, but the comet has been observed at a few of them and it should be possible to observe it from equatorial regions in December. If it undergoes a further outburst, more widespread observation may be possible.

47P/Ashbrook-Jackson was discovered in 1948 following an approach to Jupiter in 1945, which reduced the perihelion distance from 3.8 to 2.3 AU. Although intrinsically relatively bright, the large perihelion distance keeps it faint. Alternate returns are favourable, but this is not one of them, although the comet will be reasonably well placed for Southern Hemisphere observers at 13^{th} magnitude.

Professor A Schwassmann and A A Wachmann of Hamburg Observatory discovered their 3rd periodic comet, on minor planet patrol plates taken on 1930 May 2. Initially of magnitude 9.5 it brightened to nearly 6^m, thanks to a very close approach to Earth (0.062 AU) on June 1. The initial orbit was a little uncertain and the comet wasn't found at this or succeeding apparitions until 1979. The comet passed within 0.9 AU of Jupiter in 1953, and 0.25 AU in 1965. In August 1979, Michael Candy reported the discovery of a comet on a plate taken by J Johnston and M Buhagiar while searching for minor planets; this had the motion expected for **73P/Schwassmann-Wachmann 3**, but with perihelion 34 days later than in a prediction by Brian Marsden. Missed again at the next return, it has been seen at the last three returns. The 1930 approach to Earth is 9th on the list of well determined cometary approaches to our planet. In May 2006 it will make another close approach (0.082 AU), when it could again reach 7^m or brighter. This small miss distance makes it a convenient spacecraft target, and the Contour mission is scheduled to intercept it, as well as comets 2P/Encke and 6P/d'Arrest and possibly a new discovery. Following its outburst in 1995, 73P/Schwassmann-Wachmann 3 is expected to show fresh cometary surfaces, whilst 2P/Encke is an old comet and 6P/d'Arrest an average one. With the orbit approaching so closely to the Earth, an associated meteor shower might be expected, and the comet has been linked to the Tau Herculid shower, though the radiant now lies in the Bootes - Serpens region. Strong activity was reported in 1930 by a lone Japanese observer, but little has been seen since then. It is likely that any future activity would be in the form of a short-lived outburst, confined to years when the comet is at perihelion.

The comet underwent several outbursts at its last return, reaching naked eye brightness and the expected magnitude at this return is uncertain. The comet will be brightening towards the end of the year on its way to perihelion in late January 2001. If it maintains the level of activity seen at the last return it might be glimpsed in the morning sky around the beginning of December and may reach 7^{th} magnitude at the end of the year, although the solar elongation is not good.

A number of fainter comets may be of interest to CCD observers or those with large aperture telescopes. These include: Spacewatch (1997 BA6) (slowly fading from 13^{tm} in January), LINEAR (1999 H3) (fading from 13^m in January), LINEAR (1999 L3) (fading from 13^m in January), LINEAR (1999 K5) (14^{tm} between May and September), LINEAR (1999 T2) (13^m in late Summer) and 95P/Chiron (16^m at opposition in late May in Libra). Ephemerides for these can be found on the CBAT WWW pages. CCD V magnitudes of Chiron would be of particular interest as observations show that its absolute magnitude varies erratically.

Several other comets return to perihelion during 2000, however they are unlikely to become bright enough to observe or are poorly placed. 71P/Clark, 76P/West-Kohoutek-Ikemura, 64P/Swift-Gehrels, 108P/Ciffreo, 112P/Urata-Niijima, 137P/Shoemaker-Levy 2 and P/Lovas 2 (1986 W1) have unfavorable returns. 14P/Wolf, 17P/Holmes, 33P/Daniel, 70P/Kojima, 87P/Bus, 114P/Wiseman-Skiff, D/Kowal-Mrkos (1984 H1), D/Shoemaker 2 (1984 W1), P/Shoemaker-Levy 5 (1991 T1), Skiff (1999 J2), LINEAR (1999 K5), LINEAR (1999 K8) and LINEAR (1999 N4) are intrinsically faint or distant comets. 5D/Brorsen has not been seen for over a century and is unlikely to be recovered, however if it still exists and resumes activity it could be a binocular object in the dawn sky between late August and early October, however it could be virtually anywhere along its orbital track.

Looking ahead, 2001 sees favourable returns of comets 19P/Borelly, which may reach 9th magnitude and 24P/Schaumasse, which may reach 10th magnitude.

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Comets reaching perihelion in 2000

Comet	T	q	P	N	H1	K1
9P/Tempel 1	Jan 02.6	1.50	5.51	9	5.2	23.4
C/LINEAR (1999 L3)	Jan 04.8	1.99			10.0	10.0
114P/Wiseman-Skiff	Jan 11.7	1.57	6.66	2	11.5	15.0
137P/Shoemaker-Levy 2	Feb 05.8	1.87	9.37	1	14.5	10.0
112P/Urata-Niijima	Mar 04.4	1.46	6.65	2	14.0	15.0
P/Lovas 2 (1986 W1)	Mar 11.7	1.45	6.75	1	10.0	10.0
C/Skiff (1999 J2)	Apr 05.9	7.11			6.4	5.0
108P/Ciffreo	Apr 18.4	1.71	7.24	2	9.2	15.0
64P/Swift-Gehrels	Apr 21.9	1.34	9.18	4	9.0	20.0
C/LINEAR (1999 K8)	Apr 24.4	4.20			1.9	15.0
C/LINEAR (1999 N4)	May 25.5	5.50			6.0	10.0
17P/Holmes	May 11.8	2.17	7.07	8	10.0	15.0
76P/West-Kohoutek-Ikemura	Jun 01.3	1.60	6.45	4	11.0	15.0
D/Shoemaker 2 (1984 W1)	Jun 15.5	1.32	7.84	1	13.0	10.0
33P/Daniel	Jun 23.5	2.16	8.07	8	10.5	20.0
C/LINEAR (1999 K5)	Jul 04.6	3.25			6.0	10.0
C/LINEAR (1999 S4)	Jul 24.4	0.75			7.0	10.0
P/Shoemaker-Levy 5 (1991 T1)	Aug 18.6	1.99	8.68	1	13.0	10.0
2P/Encke	Sep 09.7	0.34	3.30	57	10.0	8.8
70P/Kojima	Sep 14.8	2.00	7.05	4	11.0	15.0
5D/Brorsen	Oct 05±	0.54	5.5±	5	9.5	10.0
D/Kowal-Mrkos (1984 H1)	Oct 26.8	2.68	9.31	1	12.0	15.0
14P/Wolf	Nov 21.1	2.41	8.21	14	5.3	30.0
C/LINEAR (1999 T2)	Nov 24.7	3.02			6.0	10.0
71P/Clark	Dec 01.9	1.56	5.51	5	8.6	15.0
C/McNaught-Hartley (1999 T1)	Dec 09.6	1.15			5.0	10.0
87P/Bus	Dec 29.8	2.18	6.51	3	10.0	15.0

The date of perihelion (T), perihelion distance (q), period (P), the number of previously observed returns (N) and the magnitude parameters H1 and K1 are given for each comet. Note: $m_1 = H1 + 5.0 * \log(d) + K1 * \log(r)$