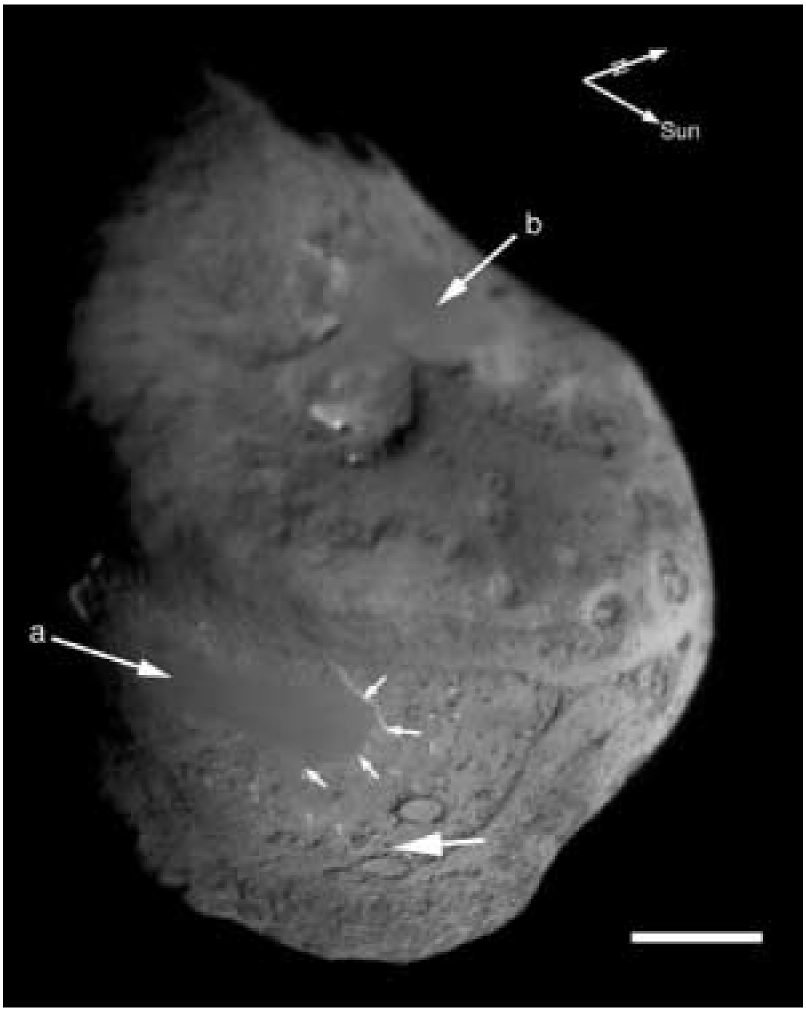
THE COMET’S TALE

Newsletter of the Comet Section of the British Astronomical Association

Volume 12, No 2 (Issue 24), 2005 October

Deep Impact hit by 9P/Tempel



The Deep Impact (DI) mission has returned spectacular images of 9P/Tempel, although visually it was not the event of the year. Mike A’Hearn gave us details of the latest scientific results from this and the Stardust missions at the BAA out of London meeting in Cambridge, which was held just before the American Astronomical Society Division for Planetary Sciences Meeting.

Both spacecraft are part of the Discovery programme – small, cheap missions costing less than 300 M$. Stardust is the first sample return mission since Apollo 17, whilst Deep Impact was the first impact mission since Apollo. Both are to Jupiter Family Comets, but 81P/Wild (the Stardust target) has had its perihelion changed recently. Comets may have brought water and organics to Earth. The KT event that finished the dinosaurs was possibly a comet or carbonaceous chondrite, but there is probably a gradation between these bodies anyway. The outer Oort Cloud goes half way to alpha Centauri in all directions, but the inner cloud is more in the plane of the solar system. Dynamics move objects both inwards and outwards.

Stardust used an aerogel to capture material; this is a glass with a density of only 3 $mgcm^{-3}$. The material returned by Stardust will loose its ices. The DI impactor was made from copper, as this was cheaper than gold or silver. The impactor was actually hollowed out to reduce the bulk density so as to increase impact efficiency. The duration of the Stardust mission is much longer than DI – 6 years compared to 6 months. The July 4 impact date was fixed by a combination of the perihelion date and ecliptic crossing both of which occurred a few days later, and the publicity requirements. Comet 19P/Borrelly (imaged by Deep Space 1) was an odd shape, but 9P was quite different. 81P had huge features with near vertical walls.

Contents

Comet Section contacts

Director:	Jonathan Shanklin, 11 City Road, CAMBRIDGE. CB1 1DP, England. Phone: (+44) (0)1223 571250 (H) or (+44) (0)1223 221482 (W) Fax: (+44) (0)1223 221279 (W) or (+44) (0) 1223 571250 (H) E-Mail: JDS@AST.CAM.AC.UK or J.SHANKLIN@BAS.AC.UK WWW page : http://www.ast.cam.ac.uk/~jds/
Assistant Director (Observations): (and also Editor of *The Astronomer* magazine)	Guy Hurst, 16 Westminster Close, Kempshott Rise, BASINGSTOKE, Hampshire. RG22 4PP, England. Phone & Fax: (+44) (0)1256 471074 E-Mail: GUY@TAHQ.DEMON.CO.UK *or* GMH@AST.STAR.RL.AC.UK
Assistant Director (CCD):	Nick James, 11 Tavistock Road, CHELMSFORD, Essex. CM1 5JL, England. Phone: (+44) (0)1245 354366 E-mail: NDJ@BLUEYONDER.CO.UK
Photographic Advisor:	Michael Hendrie, Overbury, 33 Lexden Road, West Bergholt, COLCHESTER, Essex, CO6 3BX, England Phone: (+44) (0)1206 240021

The Section newsletter is now free to all BAA Members who make contributions to the work of the Section. The cost for other postal subscribers is £5 for two years, extended to three years for those who contribute to the work of the Section in any way, for example by submitting observations or articles. **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. You can also download the newsletter (in colour) from the Section web page.

Section News from the Director

Dear Section member,

Yet again it has been a busy six months for me, particularly at work, where I have been involved in the design of the science quarters on the new Antarctic station that we are planning at Halley. Facilities include an optical caboose, which is primarily for atmospheric observation of the aurora and skyglow, but has in the process imaged comets and meteors. We don't have any research programmes in astronomy, but do have a Meade ETX125 for leisure use. It has proved difficult to use on our present science platform, as it sways too much (only minutes of arc) for steady viewing. My other leisure interests include natural history, particularly botany, but with the advance of autumn and the change of clocks there is less suitable time for these. It is perhaps fortunate that it has been a quiet autumn so far for comet observing, so I have at last had time to start putting this issue of the newsletter together, albeit over a month later than the normal schedule.

You will notice that I've bound the observing supplement with the main issue. This is largely to make life easier for me when I have to put the issue in the envelope, and unless there are strong objections, I plan to go further next time, and include the ephemerides, finder charts and visibility diagrams with the review of observations.

Deep impact had a very successful collision with comet 9P/Tempel. New results from the studies continue to trickle in and are regularly published in the astronomical journals. One concern that I have is the conservatism of many groups of astronomers. One example is the large number of professionals who use the incorrect nomenclature and append 1 after Tempel. Elsewhere they use CG as an abbreviation for the Rosetta target, when 67P would suffice. I try and use the CBAT nomenclature throughout the Comet Section reports. Another example is those who try and maintain that Pluto is still a major planet, when clearly it is just a Kuiper Belt Object. In this issue there are reports of the talk given by Mike A'Hearn at the BAA Out of London meeting, which was held in Cambridge prior to the DPS meeting, and some highlights from the DPS meeting itself.

You can now pay subscriptions to the ICQ, IAUC, MPEC etc by credit card via the cfa secure web site at http://cfa-www.harvard.edu/iau/services/OnLineOrders.html. The new printed *Catalogue of Cometary Orbits 2005* costs $40 via surface mail and the printed *ICQ* is $50 per year by airmail. It is also possible to subscribe to the BAA and purchase BAA sales items via the internet from the BAA web page at http://www.britastro.org

I would like to thank BAA members: James Abbott, Peter Birtwhistle, Roger Dymock, John Fletcher, Massimo Giuntoli, Werner Hasubick, Guy Hurst, Nick James, Geoffrey Johnstone, Albert Jones, Richard Miles, Martin Mobberley, Gabriel Oksa, Roy Panther, Jonathan Shanklin, Jeremy Shears, Giovanni Sostero, David Strange, Cliff Turk, Alex Vincent, and also: Jose Aguiar, Alexandre Amorim, Alexander Baransky, Nicolas Biver, Reinder Bouma, Jose Carvajal, Edwin van

Dijk, Stephen Getliffe, Vergil Gonano, JJ Gonzalez, Bjorn Granslo, Ernesto Guido, Michael Jager, Andreas Kammerer, Heinz Kerner, Mark Kidger, Carlos Labordena, Martin Lehky, A Lepardo, Rolando Ligustri, Michael Mattiazzo, Sensi Pastor, Maciej Reszelski, Jose Reyes, Juan San Juan, Pepe Manteca, Jose Martinez, Andrew Pearce, Stuart Rae, Walter Robledo, V Santini, Tony Scarmato, Tony Ward and Seiichi Yoshida (apologies for any errors or omissions) for submitting observations or contributions since the last newsletter. Without these contributions it would be impossible to produce the comprehensive light curves that appear in each issue of *The Comet's Tale*. Observations from groups that currently do not send observations to the BAA would be much appreciated as they make a valuable addition to the analyses.

Comets under observation included: 9P/Tempel, 21P/Giacobini-Zinner, 29P/Schwassmann-Wachmann, 37P/Forbes, 62P/Tsuchinshan, 117P/Helin-Roman-Alu, 161P/Hartley-IRAS, 169P/NEAT, 2003 T4 (LINEAR), 2005 A1 (LINEAR), 2005 E2 (McNaught), 2005 JQ5 (P/Catalina), 2005 K1 (Skiff), 2005 K2 (LINEAR), 2005 N1 (Juels-Holvorcem), 2005 P3 (SWAN), 2005 R2 (P/Van Ness) and 2005 T4 (SWAN).

I hope to produce the April issue on schedule, although I will be visiting the Antarctic again, from roughly mid February until towards the end of March. In theory I should be in e-mail contact during this period, as a new permanent satellite link is being installed at the station that I'm visiting. I'm not expecting too much in the way of clear skies, as the station is at the west end of South Georgia, and is notoriously cloudy.

Jonathan Shanklin

Tales from the Past

This section gives a few excerpts from past RAS Monthly Notices and BAA Journals.

150 Years Ago: Nothing of interest!

100 Years Ago: At the April meeting Mr Lynn gave a paper on "Dorfel and the Comet of 1680". Dorfel was born in Plauen in 1643, and was a pupil of Hevelius. He computed a parabolic orbit for the comet and published the details "some years before the appearance of the *Principia*". Although Lynn suggested that the comet might be allied with Kreutz group comet 1882 R1, the inclination is prograde, ruling this out. Surprisingly Kronk makes no reference to Dorfel's observations or his orbit computation. A note from AN No 4025 notes measurements of what was clearly a disconnection event in the tail of comet 1903 M1. The comet section report for the year to September 30 notes "The comets of the last twelve months have not presented physical features of interest, and in consequence little has been done in the Section".

1955 L1 drawn by George Alcock

50 Years Ago: The July Journal had a pair of papers by D Justin Schove, one on "Halley's Comet 1930 BC to AD 1986" and the other entitled "The Comet of David and Halley's Comet". He attempts to reconcile a return in 1005.34 BC with the construction of the Temple of Jerusalem in 989 BC. Comet Notes records the discovery of 1955 L1 by Antonin Mrkos who "had built his own little observatory at the top of Mt Lomnica (2630m), the 2nd highest peak in the Tatra mountains, where he was in charge of the meteorological station". He found it during a routine search with 25x100 Somet-Binar binoculars, although it was a naked eye object with tail. George Alcock observed it at 4.4 three nights later, and drawings by George were displayed at the June meeting, and published in the October Journal. It was noted that southern hemisphere observers should have made an easy discovery in May. The annual report notes that George had spent 66.5 hours comet searching on 50 nights. Four members of the Section who contributed observations that year are still active in astronomy: Michael Hendrie, Albert Jones, Roy Panther and Gordon Taylor. Comet Notes points out that Rev C J Renner of Ohio had reported a second comet; however the reality of neither was ever independently confirmed. [*A problem that still seems to exist today*] Photographs of 5th magnitude comet 1955 O1 needed an hour long exposure to reveal a few degrees of tail – a far cry from today's digital cameras.

Deep Impact results

Continued from Page 1.

The impact was at roughly 35°, ie at an oblique angle. The first impact ejecta from 9P was blasted out at 5 kms^{-1}, but later material came out at $100ms^{-1}$ reducing to cms^{-1}. There was no trace of large chunks coming off. The jumps in the imagery prior to impact were due to four dust impacts on the spacecraft. One particle was 1g, three were 1 – 10 mg. The flyby spacecraft was not affected by impacts at all.

9P had features like impact craters, whilst 81P has round features that don't appear to be impact craters. The bigger 'craters' are 300m across and follow a power law. The bright areas are bluish, but generally the comet has a pretty constant colour. The brightest areas have an albedo of 8%, whilst the average albedo is 4%. A smooth area overlies a rougher area with a 20m scarp. 81P had spires, whilst none have so far been identified in images of 9P. The bulk of 9P ejecta was around 10 micron in size. There was no evidence for a dust crust, with fine material to 20m.

There was very good photometry for a week prior to the impact, until the coma became too big for the field of view. There were some 'outbursts' in the light curve. These had very sharp pointed minima, resulting from the shape of the comet and shadowing. The outbursts were directional and probably tied to surface features. The space craft impact light curve is rather different to the ground based one as it shows a fast peak, followed by steady output. The peak temperature of the nucleus was 326 K.

The observed crater was gravity controlled and maybe 80m in diameter. The first ejecta had a temperature of 3000 K and was self luminous. The impact plume was still tied to the surface after 45 minutes. The comet is 3km across. The mass of the comet was 7 x 10^{13} kg, with a density of 0.6 gcm^{-3}. The spectra show H_2O, CO_2, CH_x, HCN etc. The nucleus is more than 50% porous with lots of organics. The rotation period is around 40 hours. There is a plan to continue on to 46P/Wirtanen – the spacecraft motors have fired to allow an Earth Gravity Assist , however the extended mission is not yet approved by NASA.

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.

Mike A'Hearn gave a presentation on the Deep Impact mission (details above) at the BAA Out of London meeting, which was held in Cambridge just before the American Astronomical Society Division of Planetary Sciences meeting. I went to the comet session at the DPS meeting and also the following poster session. Unfortunately due to a BAA Council meeting I was unable to go to the Deep Impact sessions. Talks were very brief, with speakers only allowed 10 minutes, and the poster session was crowded and in addition the posters were only up for one day. My notes reflect what I heard the speakers say, so may not be a completely accurate account of what they intended to say. The numbers given are the session numbers.

Carolyn Porco in her talk to the BAA noted that clumps of material exist in the F ring of Saturn, which are perhaps areas of ring material trying to coalesce into a solid body. [*This perhaps resurrects the flying sandbank model of comets, as such constructs are exactly what is expected on the basis of this theory.*].

11.1 **Hawaii trails project** – H Hsieh and Dave Jewitt, University of Hawaii
Comet 133P is dynamically asteroidal, but observationally a comet. It shows a tail which consists mostly of large (20 micron) particles. It could be a 'lost' comet, but this is unlikely. If it is an icy asteroid that has suffered a recent impact there should be other similar objects. Ice accretion in the asteroid belt is possible. Aqueous alteration is seen in meteorites. Ceres may have ice. Activity is probably weak and transient, which is why not many objects have been seen. The ejection velocity must exceed the escape velocity, and therefore there is a limited range of possible asteroidal sizes. The search is focusing on the Themis family. So far 200 objects have been imaged, but no comets have been found.

11.2 **Meteor and comet orbits** – T J Jopek et al
By studying the distribution of meteroid orbits in a stream it is possible to estimate ejection velocities from the parent comet. Ejection velocities between 40 and 900 ms^{-1} are implied from present methods. The new technique gives a better estimation and suggests velocities are generally a few hundred ms^{-1}.

11.3 **Light curves of Kreutz comets** – M Knight et al
Eight ground based, 20 SMM/Solwind and around 800 SOHO Kreutz comets have been discovered. They reach peak brightness at 10 – 13 solar radii, then fade, although if the geometry is favourable a second peak may occur inside 6 solar radii. The secondary peak may be due to disintegration, extinction of volatiles, sublimation of silicates etc. There is probably a unimodal distribution for the first peak. The slope of brightening and fading varies with peak magnitude. The team have attempted a search for Kreutz objects at large r. None have been detected, although 12 should have been within the fields of view. This implies that they brighten faster than $r^{-3.5}$ (ie 9 log r). Southern Hemisphere observations would increase the chances of discovery, particularly with bigger telescopes. There is no evidence for change with time or between the two sub-groups.

11.4 **The dust trail of 67P/Churyumov-Gerasimenko** – J Agarwal et al
The group had modelled the trail and found that there were more

mm sized particles than expected. Magnetite gives a good spatial profile, but olivine fits the absolute brightness better. The length of the trail was 35' in April 2004 when the comet was 4.7 AU from the Sun and was noted to split into two near the end, showing dust emission from the previous return.

11.5 **Dust in comets** – L Kolokolova et al
Polarimetry versus phase angle shows two classes of comets, which correspond to dusty and gassy comets. The degree of polarisation in gassy comets decreases from the nucleus, which implies that dust is concentrated near the nucleus. It is also possible to divide comets into two classes on the basis of silicate features in the infra-red. Again the difference reflects gassy and dusty comets. They suggest that a strong feature represents porous aggregates. Gassy comets tend to have smaller perihelion distance [*though I suspect this is a selection effect*].

11.6 **Thermal evolution of 67P** – M C De Sanctis et al
At the last return in 2002 – 2003 it was a typical Jupiter family comet, with perihelion distance at 1.29 AU and a period of 6.6 years. It was poorly observed [*It may reach 11^{th} magnitude in 2009*]. They have developed a thermal evolution model which reflects physical processes known to operate, together with the dynamical properties of the comet (eg rotation, orbit evolution etc). The orbit had a relatively constant perihelion distance at 2.75 AU until a Jupiter encounter in 1959. They assume that a dust crust was removed just after the encounter. The model gives a strong pre/post perihelion asymmetry for water, but less so for carbon monoxide, carbon dioxide etc as these are more deeply buried. The model implies a high obliquity for the rotation axis and discrete active areas. [*Visual observations show a linear type of light curve, peaking some 50 days after perihelion*].

11.7 **Carbon monoxide in Hale-Bopp** – Dominique Bockelee-Morvan et al
An extended source of carbon monoxide in the coma of Hale-Bopp is suggested from infra-red data, but radio data only requires a nuclear source. The cause of the discrepancy may be opacity effects at solar distances of less than 1.5 AU. In March 1997 the results suggested a thermal temperature of 100 K. They still need to run the model with jets.

11.8 **Spectroscopic observations of recent bright comets** – G L Villanueva et al
They carried out spectroscopic observations of 2001 Q4 (NEAT), 2002 T7 (LINEAR) and 2004 Q2 (Machholz) with the 10m SMT on Mt Graham. The $H^{12}CN$ to $H^{13}CN$ ratio is 72, similar to the terrestrial. The ratio of isomers HNC and HCN is about 0.06. They estimate expansion velocities at 700 – 900 ms^{-1}. The two new comets (Q4 & T7) show a high isomeric ratio of about 9%, perhaps implying incorporation of interstellar material.

11.9 **Deep Impact spectroscopy** – M A DiSanti et al
Observations were made with the Keck telescope. They observed water, ethane, HCN and acetylene, showing a thermal temperature of 40 K. The observations show peak activity some 20 minutes after the impact. Ethane was enriched in the ejecta, but HCN and methanol were unchanged.

15.18 **Arecibo radar observations** – Michael C Nolan et al.
Arecibo made radar observations of 2005 JQ5 which passed 0.1 AU from the Earth at the end of June. This was the first ever radar imaging of a comet, and the images show that the comet was spheroidal, with a diameter of 1km and a rotation rate of less than 6.5 hours. Visually the comet only had a weak coma, however it was surprisingly detected in the radio data.

16.2 **Surface characteristics of comet – asteroid transition objects** – H Campins et al
162P/Siding Spring has a radius of 6km and an albedo of 0.045. The spectrum is remarkably similar to (944) Hidalgo, suggesting that this asteroid may be a comet.

16.6 **Chemical diversity of comets at radio wavelengths** – Nicolas Biver et al
Between 2003 and 2005 seven comets have been observed at radio wavelengths, with 12 different molecules being detected.

16.15 **Narrow band imaging of 9P/Tempel** – L M Woodney et al
This poster showed an interesting way of enhancing post impact coma features, by subtracting a pre-impact image from later ones, thus revealing the ejecta plume. This may provide better results than Larsen-Sekanina transforms etc.

16.17 Nearly isotropic comets (as defined by Levison) are redder than ecliptic comets. Red nuclei have V-R which varies linearly with perihelion distance.

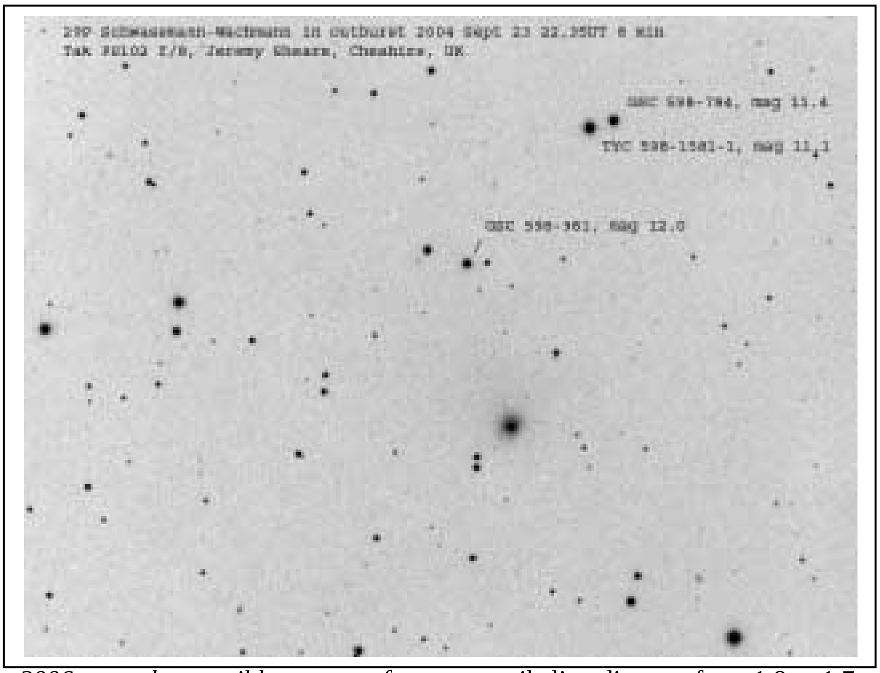
16.18 **USNO Flagstaff astrometry**
They are currently using an 8" astrograph and 61" reflector, but are developing a 52" (1.3m), which will have 5 chips giving a 18x37' field and a 22^m limit. The central chip is operated in scan mode to track the comet, whilst the whole camera can be rotated to the pa of the comet's motion. They fit a 2D gaussian profile to a 3x3 pixel box centred on the brightest pixel. UCAC2 is best for astrometry. To get good results they use at least 30 seconds exposure (ie not the minimum possible) to minimise seeing effects. They track on the comet, but try to keep the exposure short enough to keep round stars. They also use a long enough exposure to get a good signal to noise and show enough stars.

Jonathan Shanklin

THE CAMBRIDGE-CONFERENCE NETWORK (CCNet)

CCNet was an electronic network devoted to catastrophism, but which included occasional information on comets. Over the last year or so it has become increasingly devoted to greenhouse warming scepticism. To subscribe, contact the moderator Benny J Peiser at <b.j.peiser@livjm.ac.uk>. The electronic archive of the CCNet can be found at http://abob.libs.uga.edu/bobk/cccmenu.html

Comet Prospects for 2006



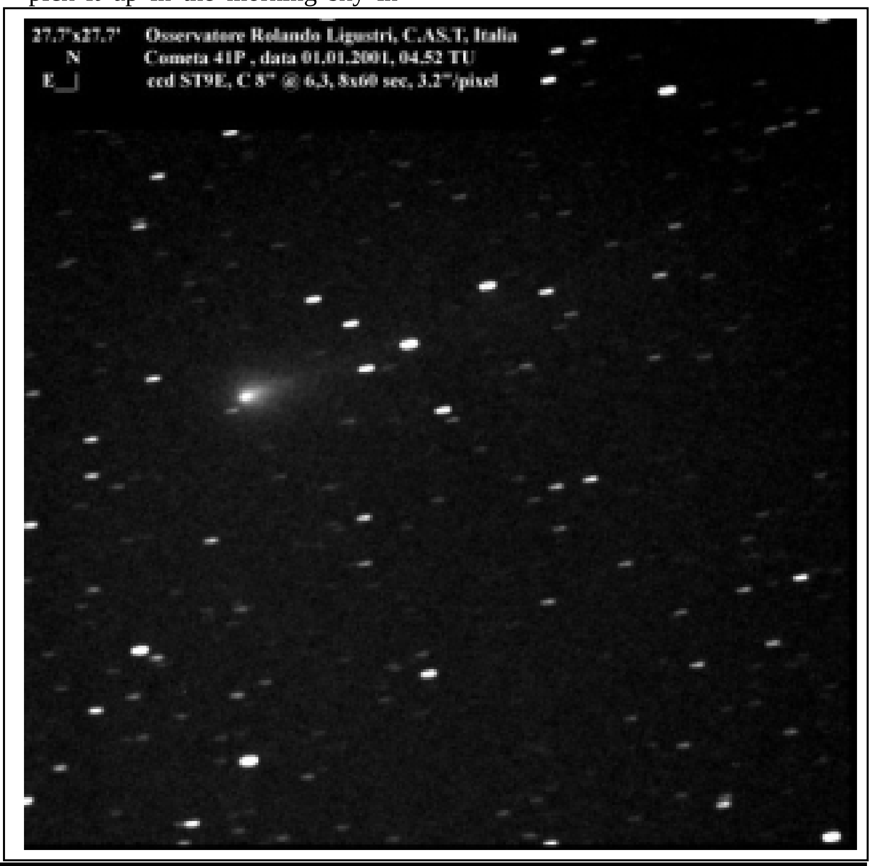
2006 sees the possible return of 28 periodic comets and several of these are likely to come within range of visual observation with moderate apertures. Potentially, the most exciting is the close passage of 73P/Schwassmann-Wachmann in May.

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. This would make a useful project for CCD observers. As an example 51P/Harrington was observed to fragment in 2001. 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 21^m are given in the International Comet Quarterly Handbook; details of subscription to the ICQ are available from the comet section Director. The updated section booklet on comet observing is available from the BAA office or the Director.

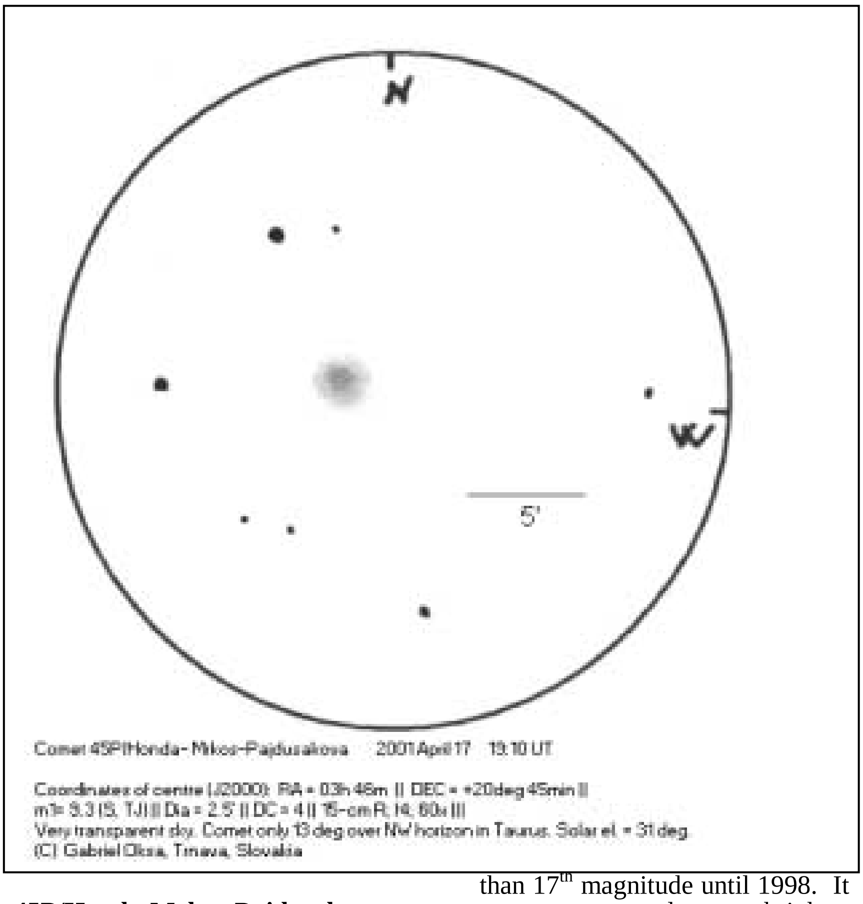
Hervé A Faye discovered **4P/Faye** in 1843 during a visual search with a small telescope at the Paris Observatory. It reached 5^m, though this has never been reached at subsequent returns. It is possible that this was a one off caused by a slight reduction in perihelion distance from 1.8 to 1.7 AU following a close encounter with Jupiter in 1841. Several authors have suggested that the absolute magnitude of the comet is declining rapidly, but it reaches a similar magnitude at all favourable apparitions. This return is very similar to the 1991 return, when it reached 10^{th} magnitude. We should be able to pick it up in the morning sky in July, and it reaches opposition on the border of Cetus and Pisces in late October. It is at its brightest in early November and slowly fades.

29P/Schwassmann-Wachmann is an annual comet that has outbursts, which in recent years seem to have become more frequent and were more or less continuous in 2004. At many recent outbursts it has reached 12^m. It spends the first half of the year in Aries, reaching opposition in late November as it retrogrades on the borders of Taurus and Perseus. The comet is an ideal target for those equipped with CCDs and it should be observed at every opportunity. It is well placed this year and UK based observers should be able to follow it until the end of March, and it should be possible to recover it again in July.

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 Michael Giacobini discovered a 13^m object whilst comet hunting, which was observed for a fortnight. Andrew



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^m 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^m, before fading and then undergoing a second outburst. Alternate returns are favourable and this, its 10^{th}, is one of them. At the last two returns the comet has reached around 8^{th} magnitude and it could do a little better this time. The comet could be visible from the UK from the beginning of the year until August. It begins the year retrograding in Orion, then swings northward and through Taurus, Gemini, Cancer, Leo and Virgo. It should be at its best in June, when it is in Leo, but could be a binocular object from April.



45P/Honda-Mrkos-Pajdusakova makes its 11th observed return since discovery in 1948 (it was missed in 1959). It has had several close encounters with Jupiter, the most recent in 1983 which made dramatic changes to ω and Ω. The perihelion distance has steadily decreased and is now the smallest it has been for the last 200 years. It can approach quite closely to the Earth and will do so in 2011 (0.06 AU) and 2017 (0.09 AU). At present the MPC only lists eight approaches closer than 0.06 AU out of 20 passes closer than 0.102 AU, and five of these are by periodic comets. It can also pass close to Venus and does so on June 4^{th}, when it passes at 0.083 AU. It was well observed in 1995/96, when it reached 7^{th} magnitude, but in 2001 it was fading from 9^{th} magnitude. This is not a favourable return for UK observers, but it may be seen from further south during May and June when it is a morning object on its way in to perihelion.

52P/Harrington-Abell was discovered on a plate taken for the Palomar Sky Survey by Robert G Harrington and George O Abell. This is the eighth observed return of the comet since its discovery in 1955 and it never became brighter than 17^{th} magnitude until 1998. It was not expected to get brighter than 15^{th} magnitude at that return, however it was found in outburst at 12^{th} magnitude in 1998 July, which was seven magnitudes brighter than expected. After the outburst it faded, and it is unclear how bright it will get this time around. In any case, it is not a favourable return and is poorly placed for observation from the UK.

71P/Clark Michael Clark of Mount John Observatory, New Zealand discovered this comet on a variable star patrol plate in June 1973. At discovery the magnitude reached 13, but alternate returns are unfavourable and it is then 5 magnitudes fainter, though it hasn't been missed. An encounter with Jupiter in 1954 put it into its present orbit, which is such that it can approach quite closely to Mars, passing within 0.09 AU in 1978. This is the comet's 7^{th} return since discovery and it could reach 10^{th} magnitude. As might be expected from the discovery, it is best seen from the Southern Hemisphere and will not be visible from the UK.

Professor Arnold Schwassmann and Artur A Wachmann of Hamburg Observatory discovered their third 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 the next 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**, 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. At the 1995 return the comet underwent a major outburst near perihelion, reaching 5^m when it was only expected to be 12^m. Subsequently four components were observed, though calculations by Sekanina suggested that the fragmentation occurred after the outburst. Three fragments were recovered in 2001, but only a few visual observations were reported as the comet was poorly placed and the absolute magnitude had clearly faded a little from the previous return. The components have now separated in the date of perihelion by roughly a day.

The comet's 1930 approach to Earth is currently ninth on the list of well-determined cometary approaches to our planet. In May the fragments will make another close approach, when the brightest one could again reach 7^m or brighter, possibly even becoming visible to the naked eye. The encounter circumstances are favourable for the UK. At closest approach the fragments will be racing across the sky at around 4.5° a day, though they are separated by around ten degrees from each other. Their exact paths across the sky will only be determined after recovery due to uncertainties in the non-gravitational parameters for each fragment and the extremely close approach. The main fragment (C) has been recovered and is predicted to pass at 0.079 AU on May 12.38 when it is in Vulpecula. The other fragments (B and E) have not yet been recovered, but will follow it, approaching closer and will be further north in the sky (provisionally May 14.60, 0.065 AU; May 17.32, 0.052 AU); the pass of fragment E will replace the 1930 pass as the 9th closest cometary encounter and the other two will be 12th and 14th closest. After the encounter they rapidly head south and will be difficult to observe a week later.

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.

There are several close cometary approaches in the 2nd decade of the 21st century. Three feature comets at perihelion this year, with 41P/ approaching to 0.135 AU in 2017, in addition to the approaches of 45P/ already mentioned. There are five others, with 2000 G1 passing at only 0.032 AU in 2016 (4th closest) and 2004 CB passing at 0.051 AU in 2014 (9th closest). The brightest pass is that of 46P/Wirtanen, which may be a circumpolar object of 3rd magnitude over Christmas 2018, when it passes 0.076 AU at mid month.

76P/West-Kohoutek-Ikemura was discovered in 1975 following a very close encounter with Jupiter in 1972 which produced one of the largest reductions of perihelion distance on record, reducing q from 5.0 to 1.4 AU. Lubos Kohoutek was actually taking a confirmation plate for a second comet (75P/Kohoutek) discovered 18 days earlier and then lost. Although 12^m at the discovery apparition, it is another comet that has not done so well on subsequent returns and it may not trouble visual observers this time round.

80P/Peters-Hartley. This will be the fifth observed return of the comet, which was discovered in 1846, then lost until it was accidentally recovered in 1982. At its first apparition the comet was quite bright, $8\text{-}9^m$, which suggests that its absolute magnitude may have faded over the past 150 years. No visual observations were reported at the last return when it was expected to reach 13th magnitude, though it was observed in 1990.

102P/Shoemaker. The comet was discovered at the very favourable return in 1984, following a close approach to Jupiter in 1980 which reduced the perihelion distance from 3.8 to 2.0 AU. In 1984 it reached 11^m however no further visual observations have been reported to the Section. This apparition is a little better than the last one, but it will probably not be until the next apparition, which is similar to that of the discovery, that we will visually observe it again.

1991 V1 (P/Shoemaker-Levy) was discovered by the Shoemaker-Levy team with the Palomar Schmidt on 1991 November 7 at photographic magnitude 13. Prior to discovery it was at high southern declinations and could potentially have been discovered by amateur comet seekers. It wasn't seen last time round, but the circumstances this time are similar to that of discovery. It will initially be a Southern Hemisphere object, but moves north after perihelion, so that UK observers may pick it up in late November. It could be 11th magnitude, but many one-apparition comets disappoint the next time they are recovered.

Comet **2005 E2 (McNaught)** was discovered by BAA Member Rob McNaught on March 12.75 with the 0.5m Uppsala Schmidt, during the course of the Siding Spring Survey. It reaches perihelion at 1.52 AU in late February 2006, when it could reach 9th magnitude. It should become visible to UK observers in December and will remain visible at 9 - 10 magnitude until April, when it enters solar conjunction. Next best of recently discovered objects is comet **2004 B1 (LINEAR)**, which may get to 13th magnitude. Sebastian Hoenig has predicted that **2002 R5 (SOHO)** may return in August. If his prediction holds, the object could become visible to Southern Hemisphere observers prior to perihelion, but is unlikely to be brighter than 12th magnitude.

Several other periodic and parabolic comets are at perihelion during 2006, however they are unlikely to become brighter than 13th magnitude or are poorly placed. Ephemerides for these can be found on the CBAT WWW pages. 3D/Biela, and 5D/Brorsen have not been seen since the 19th century, whilst D/Skiff-Kosai and D/Lovas were only seen once, and for all four the likely perihelion dates and magnitudes are extremely uncertain.

Looking ahead to 2007, the two brightest comets are 2P/Encke and 96P/Machholz and there may be more than two dozen fainter ones. 2P/Encke puts on a brief showing in the evening sky just before perihelion, when it may be a binocular object. After perihelion it may be visible in the SOHO LASCO field or that of its successor. 96P/Machholz is also best seen in the coronagraph field, when it reaches 2nd magnitude. UK observers may pick it up after perihelion, but it will be a fading telescopic object. 8P/Tuttle is really a comet for 2008, however it could be a binocular or even naked eye object at the close of 2007 as it makes a close pass of the Earth at 0.25 AU at the beginning of the New Year.

Jonathan Shanklin

Comets reaching perihelion in 2006

Comet	T	q	P	N	H_1	K_1	Peak r
P/Read (2005 S3)	Jan 10.6	2.84	10.9	0	12.0	10.0	18
3D/Biela	Jan 23	0.8	6.7	6	8.1?	10.0	?
P/Read (2005 T3)	Jan 23.6	6.21	20.5	0	9.0	10.0	21
170P/Christensen (2005 M1)	Jan 26.8	2.93	8.63	1	12.0	10.0	18
LINEAR (2002 VQ94)	Feb 6.7	6.80	3000	0	9.5	5.0	18
LINEAR (2004 B1)	Feb 7.9	1.60			10.5	5.0	13
NEAT (2004 D1)	Feb 10.8	4.97			11.5	5.0	18
132P/Helin-Roman-Alu	Feb 15.0	1.92	8.28	2	10.1	10.0	15
P/Catalina (2005 JY126)	Feb 21.3	2.13	7.27	0	11.5	10.0	17
McNaught (2005 E2)	Feb 23.5	1.52			5.5	10.0	9
Christensen (2005 B1)	Feb 23.6	3.20			6.5	10.0	14
LINEAR (2005 G1)	Feb 27.3	4.96			8.0	10.0	18
98P/Takamizawa	Mar 6.5	1.66	7.40	3	11.5	15.0	16
LINEAR (2005 R4)	Mar 9.4	5.19			7.0	10.0	17
83P/Russell	Apr 7.7	2.17	7.62	2	12.0	10.0	16
LINEAR (2003 WT42)	Apr 10.8	5.19			9.2	5.0	16
P/LONEOS (1999 RO28)	May 11.8	1.23	6.61	1	18.0	5.0	20
Christensen (2005 W2)	May 29.7	3.08			9.5	10.0	17
73P/Schwassmann-Wachmann (C)	June 6.9	0.94	5.36	5	5.5?	7.0	?
71P/Clark	June 7.2	1.56	5.52	6	8.6	15.0	10
102P/Shoemaker	June 7.3	1.97	7.23	3	8.0	15.0	14
73P/Schwassmann-Wachmann (B)	June 8.2?	0.94	5.36	1	5.5?	7.0	?
73P/Schwassmann-Wachmann (E)	June 9.6?	0.94	5.36	1	5.5?	7.0	?
41P/Tuttle-Giacobini-Kresak	June 11.3	1.05	5.42	9	7.0	15.0	7
45P/Honda-Mrkos-Pajdusakova	June 29.8	0.53	5.25	10	11.0	11.1	9
P/Skiff (2005 S2)	June 30.7	6.40	22.5	0	7.5	10.0	19
5D/Brorsen	July 6	0.6	5.7	5	9.3?	10.0	?
P/Hug-Bell (1999 X1)	July 6.7	1.95	7.06	1	13.5	10.0	18
84P/Giclas	Aug 7.5	1.85	6.97	5	9.5	20.0	16
SOHO	Aug 8	0.05	3.93	1	14?	5.0	7 ?
52P/Harrington-Abell	Aug 14.8	1.76	7.54	7	6.8	15.0	13
D/Skiff-Kosai (1977 C1)	Aug 31	2.80	7.47	1	8.5	15.0	?
114P/Wiseman-Skiff	Sep 13.2	1.58	6.68	3	11.5	15.0	16
80P/Peters-Hartley	Sep 25.8	1.63	8.14	4	8.5	15.0	13
112P/Urata-Niijima	Oct 29.6	1.46	6.67	3	14.0	15.0	15
P/Hergenrother (2000 C1)	Nov 6.9	2.09	6.62	1	14.0	10.0	19
D/Lovas (1986 W1)	Nov 23	1.40	6.61	1	10.0	10.0	?
P/LONEOS-Christensen (2005 RV2)	Nov 11.3	3.60	9.00	0	9.5	10.0	17
4P/Faye	Nov 15.5	1.67	7.55	19	6.0	20.4	10
P/Shoemaker-Levy (1991 V1)	Nov 17.0	1.13	7.53	1	10.5	10.0	11
76P/West-Kohoutek-Ikemura	Nov 19.6	1.60	6.48	4	8.0	30.0	14
P/LINEAR (2000 R2)	Dec 15.1	1.46	6.13	1	18.0	10.0	21

The date of perihelion (T), perihelion distance (q), period (P), the number of previously observed returns (N), the magnitude parameters H_1 and K_1 and the brightest magnitude are given for each comet. The date of return of 3D/Biela and 5D/Brorsen must be regarded as highly uncertain, whilst both D/Skiff-Kosai and D/Lovas have only been seen once and missed at several returns.

Note: $m_1 = H_1 + 5.0 * \log(d) + K_1 * \log(r)$

The date of perihelion (T), perihelion distance (q), period (P), the number of previously observed returns (N), the magnitude parameters H_1 and K_1 and the brightest magnitude are given for each comet. The brightest magnitude given for 29P is that typical of an outburst. Comet 141P/Machholz has experienced a number of fragmentations and the magnitude of the components is uncertain.
Note: $m_1 = H_1 + 5.0 * \log(d) + K_1 * \log(r)$

References and sources

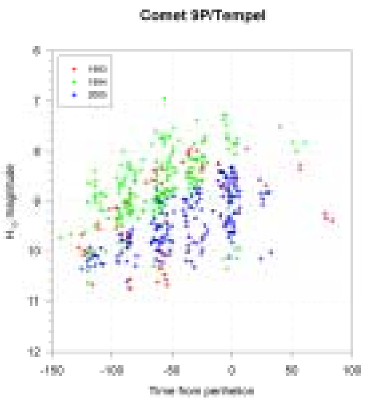
Belyaev, N. A., Kresak, L., Pittich, E. M. and Pushkarev, A. N., *Catalogue of short Period Comets*, Bratislava (1986).

Hoenig, S. F., *Identification of a new short-period comet near the Sun*, A&A (in press).
Kozlov, E. A., Medvedev, Y. D., Pittichova, J., and Pittich, E. M. *Catalogue of short Period Comets, 2nd edition*, (http://astro.savba.sk/cat/) (2003).
Kronk, G. W., *Cometographia*, Cambridge University Press, (1999, 2004) and http://www.cometography.com.
Marsden, B. G. *Catalogue of Cometary Orbits*, 15th edition, IAU CBAT, (2003).
Nakano Notes at http://www.oaa.gr.jp/~oaacs/nk/
Nakano, S. and Green D. W. E., Eds, *International Comet Quarterly 2005 Comet Handbook*, (2004).
Shanklin, J. D., *Observing Guide to Comets*, 2nd edition (2002)

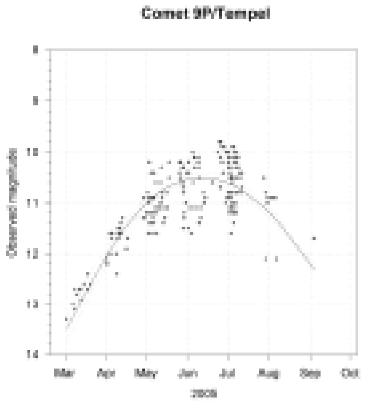
Review of comet observations for 2005 April - 2005 October

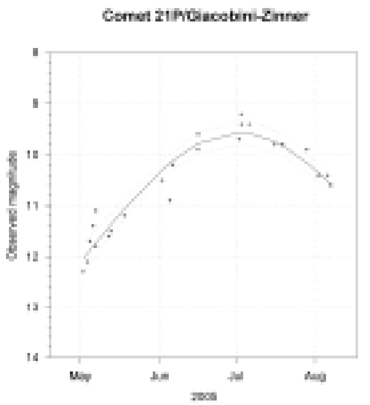
The information in this report is a synopsis of material gleaned from IAU circulars 8522 – 8635, The Astronomer (2005 April – 2005 October) and the Internet. Note that the figures quoted here are rounded off from their original published accuracy. Lightcurves for the brighter comets are from observations 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. I have used the convention of designating interesting asteroids by A/Designation [Discoverer] to clearly differentiate them from comets, though this is not the IAU convention.

Observations of comet **9P/Tempel** in late May were putting it at around 10.5 - 11th magnitude. Observations from the HST and the onboard Deep Impact camera show what appear to be minor outbursts of the comet during June. These were promoted as major events by the NASA Deep Impact site, although they were of short duration (dissipating in less than 12 hours) and were of small size (about 2000 km). Interestingly stars passing through the field appeared to brighten during the event shown by the DI camera. Following the impact, there was no obvious increase in visual magnitude, however the coma did become more condensed. More details of the Deep Impact results are given elsewhere in this issue.



193 observations give a preliminary, aperture corrected, light curve of m = 6.7 + 5 log d + 19.7 log r. The H10 magnitude is 9.4. The light curve this year is very similar to those in 1983 and 1994 and taking all together gives an aperture corrected equation of m = 5.7 + 5 log d + 21.9 log r





Comet **21P/Giacobini-Zinner** wasn’t visible to UK observers, as it was too low in the twilight. 25 observations give a preliminary, aperture corrected, light curve of m = 7.8 + 5 log d + 17.7 log r. The absolute magnitude is similar to that found for the 1998 return, however the comet brightened more rapidly this time round.

Comet **29P/Schwassmann-Wachmann** appears to be continuing its frequent outbursts, with observations suggesting one took place in mid September and another in early November. The comet is well placed for observation and is one of the few objects currently at moderate brightness.

Comet **37P/Forbes** appears to have reached 11th magnitude in August, but was another one that was too far south for observation from the UK.

Several observers reported comet **62P/Tsuchinshan** fading from 13th magnitude during June and July.

Seven more **Meyer Group** SOHO comets (**2005 H2, 2005 H9, 2005 K4, 2005 K9, 2005 O5, 2005 Q2 and 2005 Q8**) have been discovered with the SOHO LASCO coronographs but were not observed elsewhere. They were sungrazing comets of the Meyer group.

No further **Marsden Group** SOHO comets have been discovered, and the fragments predicted to reappear have not been seen.

Three SOLWIND **Kreutz Group** comets (**1981 W1, 1983 N2 and 1984 Q1**) were discovered by Rainer Kracht on archival images taken with the SOLWIND coronograph and have not been observed elsewhere. They were all from sub-group I.

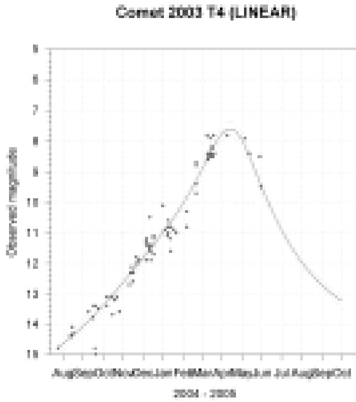
SOHO **Kreutz Group** comets **2000 S6, 2001 Q9, 2001 S3, 2005 F3, 2005 F4, 2005 F5, 2005 G3, 2005 G4, 2005 G5, 2005 G6, 2005 G7, 2005 H3, 2005 H4, 2005 H5, 2005 H6, 2005 H8, 2005 J3, 2005 J4, 2005 J5, 2005 J6, 2005 J7, 2005 J8, 2005 J9, 2005 J10, 2005 J11, 2005 J12, 2005 K5, 2005 K6, 2005 K7, 2005 K8, 2005 K10, 2005 L6, 2005 L7, 2005 L8, 2005 L9, 2005 L10, 2005 L11, 2005 L12, 2005 L13, 2005 L14, 2005 L15, 2005 M2, 2005 M4, 2005 M5, 2005 M6, 2005 M7, 2005 M8, 2005 M9, 2005 M10, 2005 N6, 2005 N7, 2005 N8, 2005 N9, 2005 N10, 2005 O3, 2005 O4, 2005 O6, 2005 P1, 2005 P2, 2005 Q7, 2005 Q9, 2005 Q10, 2005 R5, 2005 R6, 2005 R7, 2005 S1, 2005 S5, 2005 S6, 2005 S7, 2005 S8, 2005 S9, 2005 S10 and 2005 S11** were discovered with the SOHO LASCO coronographs and have not been observed elsewhere. They were sungrazing comets of the Kreutz group and were not expected to survive perihelion. There are now 1040 SOHO comets, of which around 850 are of the Kreutz group.

1984 R1 (SOLWIND) This was a non-group comet that was discovered by Rainer Kracht in archival SOLWIND images in August 2005. Orbital elements are on IAUC 8583 [2005 August 13].

2000 QJ46 (P/LINEAR) A 19th magnitude asteroid was found by LINEAR on 2000 August 24.27. In October 2005 it was found to show a coma and tail on archival Sloan Digital Sky Survey images taken just over a week after discovery. The comet has a 14.4 year period, with perihelion at 1.93 AU in 2000 December.

2002 EX12 (169P/NEAT) An object discovered by NEAT on 2002 March 15.27, was found to show a tail in late July 2005 by two independent groups of observers. It had not shown a tail when observed two months earlier. It reaches perihelion at 0.6 AU in mid September and has a period of 4.2 years. The orbit is secure, the object having been linked to observations made by Spacewatch in 1998 and the DSS in 1989, and it has been numbered 169. A couple of visual observations in the early autumn suggest that it may have reached 11th magnitude.

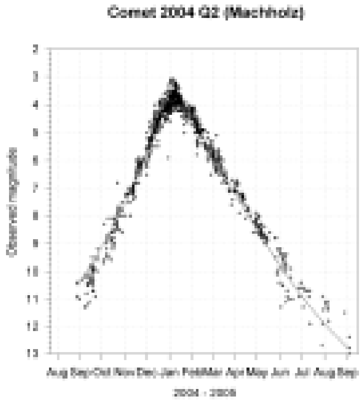
A few more observations of **2003 T4 (LINEAR)** were made during May, but it seems to have faded and rapidly became more diffuse. No visual observations have been reported since May, however there are astrometric observations which put the comet at 17th magnitude in mid October. 68 observations suggest a preliminary, aperture corrected, light curve of m = 7.1 + 5 log d + 5.5 log r up to the point where it disappeared from view.



2004 FY140 (P/LINEAR) An asteroidal object found by LINEAR on 2004 March 27.33 was noted to be non stellar on images taken by Carl Hergenrother on 2004 May 19 and 20. The object was not recorded to 22nd magnitude on 2005 July 5 and 6, when it should have been around 19th magnitude.

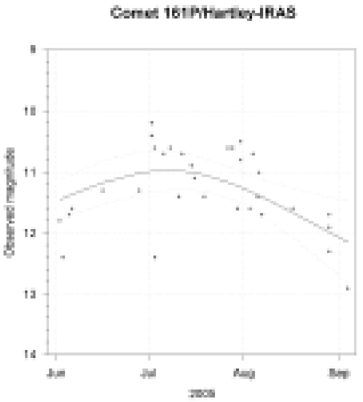
2004 PY42 (P/CINEOS) The Campo Imperatore-CINEOS discovered a 20th mag unusual asteroid on August 10.87. It is in an indeterminate orbit, which is distant, but the orbit may be parabolic [MPEC 2004-P48, 2004 August 12] Observations in early June 2005 revealed a faint coma to the object, which had been classified as a Centaur type asteroid, with a period of 65 years and perihelion at 11.8 AU.

2004 Q2 (Machholz) continued to behave according to the light curve and steadily faded. The final observations put it at around 13th magnitude in early September. 1090 observations suggest a preliminary, aperture corrected, light curve of m = 5.2 + 5 log d + 7.2 log r

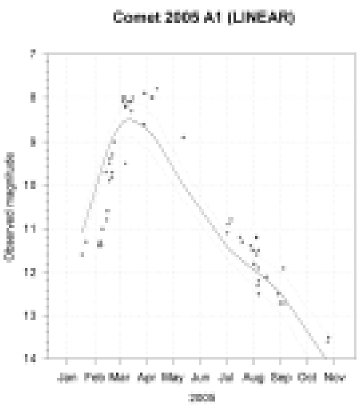


In October 2005 a faint secondary component of **2004 U1 (LINEAR)** was reported.

2004 V2 (161P/Hartley-IRAS) 32 observations suggest a preliminary, aperture corrected, H10 value of m = 7.9. The r magnitude parameter is not well defined. Although the comet reached 11th magnitude, surprisingly few observations have come in so far, perhaps reflecting the difficulty of observing objects in the northern sky for those with equatorially mounted telescopes.

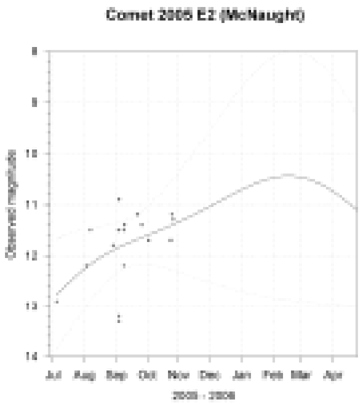


2005 A1 (LINEAR) R. Kracke reports the LINEAR discovery of a comet. After posting on the `NEO Confirmation Page', other observers have confirmed the cometary nature on CCD images, including C. Jacques and E. Pimentel (Belo Horizonte, Brazil; 0.30-m reflector, Jan. 14.3 UT; coma diameter about 15" and a noticeable 75"-long tail in p.a. 313 deg) and J. Young (Table Mountain 0.6-m reflector, Jan. 14.5, moderate cirrus clouds; slightly elongated 12" coma of mag 15.0 and a 1'-long broad tail in p.a. 295 deg). [IAUC 8463, 2005 January 14]



There have been suggestions of an outburst, but this isn't entirely clear from the light curve. If one did occur, it was towards the end of March. Observations by Spanish amateurs in July show that the comets nucleus has split, with Sekanina calculated separation having occurred around April 23. Jeremy Shears has reported the detection of the secondary condensation in the tail of the comet in images taken in early September. Visual observations suggest a total magnitude around 12. 59 observations suggest a preliminary light curve of m = 8.2 + 5 log d + 4.7 log r

2005 E2 (McNaught) Observations by Juan José González Suárez" with a 20cm SCT show that the comet was around 11.5 in early September, though other observers have made it up to a couple of magnitudes fainter. Clear, transparent skies are essential to see the comet as it is still at a very low altitude for European observers. Although it may soon become visible to UK observers, the initial indications are that it will be a bit fainter than expected, although it may still reach 9th magnitude in January. 17 observations suggest a preliminary light curve of m = 5.8 + 5 log d + 10.1 log r without any aperture correction.



Brian Marsden notes on MPEC 2005-K27 [2005 May 23] that the "original" and "future" barycentric values of 1/a are +0.000152 and -0.002367 (+/- 0.000031) AU^{-1}, respectively. The "original" value suggests that this is not a "new" comet.

2005 EL173 (LONEOS) Somewhat as expected from the orbit this object finally showed cometary characteristics. Alan Fitzsimmons using the 3.6-m NTT at ESO found that the object had a coma on 2005 May 10.0.

2005 H7 (SOHO) This was a non-group comet discovered by Rainer Kracht in C2 images on April 26. Orbital elements on MPEC 2005-K44 [2005 May 26] give perihelion at 0.0127 AU on April 25.60, however Brian Marsden notes that the orbit is indeterminate.

2005 J1 (P/McNaught) Rob McNaught discovered a periodic comet of 18th magnitude during the Siding Spring Survey on May 3.72. The comet was at perihelion at 1.5 AU in mid April and has a period of 6.7 years. It will fade.

2005 J2 (Catalina) An apparently asteroidal object of 19th magnitude found by the Catalina Sky Survey on May 12.16 and placed on the NEOCP has been found to show cometary features. It was at perihelion at 4.3 AU in March 2005.

2005 JN (P/Spacewatch) An apparently asteroidal object of 20th magnitude found by Spacewatch on May 3.20 has been found to show cometary features. It reaches perihelion at 2.3 AU in June 2005 and has a period of 6.5 years.

2005 JQ5 (P/Catalina) An apparently asteroidal object of 17th magnitude found by the Catalina Sky Survey on May 6.28 has been found to show cometary features. It reached perihelion at 0.83 AU in late July 2005 and has a period of 4.4 years. The comet reached 10th magnitude in June and passed 0.10 AU from the Earth at the end of the month. It makes regular close approaches, but this was the closest it will make over the next century.

2005 JD108 (P/Catalina-NEAT) An 18th magnitude comet found by NEAT on June 28.40 has been linked to an asteroid detected by the Catalina Sky Survey on May 12.43 and with observations by LONEOS on May 13. It reaches perihelion in early August at 4.03 AU and has a period of 16.4 years.

2005 JY126 (P/Catalina) An 18th magnitude comet found during the Catalina Sky Survey on June 7.32 has been linked to an asteroid detected at the Steward Observatory on May 3.37, and with earlier observations by the Catalina Sky Survey on April

17.40. It reaches perihelion in February 2006 at 2.13 AU and has a period of 7.3 years.

A/2005 JM3 [Catalina] This ususual asteroid, of 19th magnitude, was discovered during the Catalina Sky Survey with the 0.68m Schmidt on May 3.31. It has a period of 5.9 years and perihelion is at 1.31 AU in mid June 2005. [MPEC 2005-K13, 2005 May 17, 13-day orbit]. The orbit approaches within 0.1 AU of Jupiter, but there have been no close approaches to the planet over the past few hundred years.

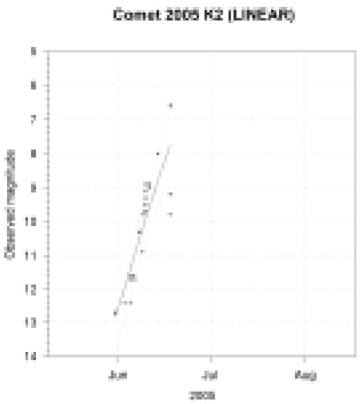
2005 K1 (Skiff) Brian Skiff discovered 17th magnitude comet during the LONEOS sky survey on May 16.34. It reaches perihelion in late November at 3.7 AU.

Brian Marsden notes on MPEC 2005-O05 [2005 July 18] that the "original" and "future" barycentric values of 1/a are -0.000011 and -0.000097 (+/- 0.000044) AU^{-1}, respectively. The small "original" value suggests that this is a "new" comet from the Oort cloud.

2005 K2 (LINEAR) LINEAR has discovered an 18th magnitude comet, which reaches perihelion at 0.54 AU on July 5. It was found at high northern declination and there were indications that it was large and diffuse, perhaps putting it within visual range.

Several observers, including Giovanni Sostero and José González reported visual observations, putting at around 12 - 12.5 in early June. On June 8/9 Nicolas Biver and José González reported that it had brightened further to around 10th magnitude and had become more condensed. Two days later I estimated it at 9th magnitude. On June 13.98 it was 8th magnitude in 20x80B, although summer twilight was making the northern sky quite bright. Observations over June 15 - 19 are scattered, but suggest that the comet faded rapidly.

Images by David Strange, Michael Jager & Gerald Rhemann and Giovanni Sostero & Ernesto Guido over June 12 - 14 suggest the presence of a secondary condensation, implying that the comet had split. Calculations by Zdenek Sekanina suggest that the split took place around April 22. Whilst this may have facilitated the rapid brightening seen in June, it was clearly not the primary cause. An image to 16th magnitude taken by Michael Mattiazzo on August 1st does not show 2005 K2, suggesting it has disintegrated.



22 observations give a preliminary light curve of 12.8 + 5 log d + 26.9 log r up to the point when it disappeared from view.

2005 K3 (P/McNaught) Rob McNaught has discovered another comet with the 0.5-m Uppsala Schmidt during the Siding Spring Survey. This one was found on May 20.79 and was 17th magnitude at discovery. It is in a short period orbit of 4.3 years with perihelion at 1.44 AU in late August. It is predicted to reach 15th magnitude at brightest.
An improved orbit by Hirohisa Sato has increased the period to 10.0 years with perihelion at 1.54 AU in August. Further observations have decreased the period to 7.1 years with perihelion at 1.51 AU in mid August.

2005 L1 (P/McNaught) Rob McNaught has discovered another comet with the 0.5-m Uppsala Schmidt during the Siding Spring Survey. This one was found on June 2.66 and was 17th magnitude at discovery. It is in a short period orbit of 7.9 years with perihelion at 3.1 AU in mid December.

2005 L2 (McNaught) Rob McNaught has discovered another comet with the 0.5-m Uppsala Schmidt during the Siding Spring Survey. This one was found on June 2.56 and was 19th magnitude at discovery. It reaches perihelion at 3.2 AU in mid July.

2005 L3 (McNaught) Rob McNaught has discovered another comet with the 0.5-m Uppsala Schmidt during the Siding Spring Survey. This one was found on June 3.68 and was 18th magnitude at discovery. It reaches perihelion at 5.6 AU in January 2008.

Brian Marsden notes on MPEC 2005-P57 [2005 August 15] that the "original" and "future" barycentric values of 1/a are +0.000049 and +0.000279 (+/- 0.000010) AU^{-1}, respectively. The small "original" value suggests that this is a "new" comet from the Oort cloud.

2005 L4 (P/Christensen) Eric Christensen discovered an 18th magnitude comet in the course of the Mt Lemon survey on June 13.35. It is in a periodic orbit of 8.3 years with perihelion at 2.37 AU in late August.

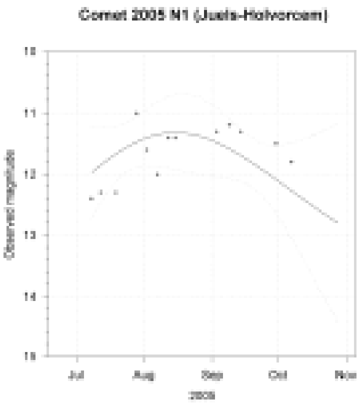
2005 M1 (170P/Christensen) Eric Christensen discovered a 20th magnitude comet in the course of the Mt Lemon survey on June 17.41. Further observations show that it is a periodic comet with period of 8.6 years and will reach perihelion at 2.93 AU in late January 2006. It has been identified in observations made by NEAT in 1997, so the orbit is now secure and the comet has received a numeric designation.

2005 M3 (SOHO) This was a non-group comet discovered by Hua Su in C2 images on June 19.

A/2005 MW1 [Siding Spring] This ususual asteroid, of 19th magnitude, was discovered during the Siding Spring Survey with the 0.5m Uppsala Schmidt on June 17.71. It has a period of 4.9 years and perihelion is at 1.26 AU in mid July 2005. [MPEC 2005-M35, 2005 June 21, 4-day orbit]. Maik Meyer comments that there is some resemblance to the elements for comet 1884 O1 (D/Barnard).

A/2005 MW9 [Mt Lemon] This ususual Apollo asteroid, of 20th magnitude, was discovered during the Mt Lemon Survey with the 1.5m reflector on June 18.39. It has a period of 6.8 years and perihelion was at 0.40 AU in April 2005. [MPEC 2005-M66, 2005 June 30, 12-day orbit]. It has made no recent close approaches to Jupiter.

2005 N1 (Juels-Holvorcem) C Juels and Paolo Holvorcem discovered a diffuse, 14th mag, comet on CCD images taken with their 7cm f3 refractor at Fountain Hills Observatory on July 2.45, with prediscovery images on June 30 and July 1. The comet reached perihelion in late August at 1.13 AU. The observations suggest that it brightened to 11th magnitude, but it was not well placed for observation. 13 observations give a preliminary, and very poorly defined, light curve of 8.9 + 5 log d + 8.1 log r



Brian Marsden notes on MPEC 2005-S06 [2005 September 17] that the "original" and "future" barycentric values of 1/a are +0.001289 and +0.001814 (+/- 0.000038) AU^{-1}, respectively. The "original" value suggests that this is not a "new" comet from the Oort cloud.

2005 N2 (168P/Hergenrother) David Herald has recovered comet 1998 W2 (P/Hergenrother) on images taken with his 0.36m f4 SC reflector on July 4 & 5. The comet is 0.27 days ahead of the prediction on MPC 45658. The comet may reach 16th magnitude in the autumn. Following recovery it has been numbered 168.

2005 N3 (P/Larson) Steve Larson discovered a 20th magnitude comet during the course of the Mt Lemon Survey on July 5.38. Further observations showed that it is a short period comet with perihelion at 2.2 AU in mid December. The period is 6.8 years. It is unlikely to become brighter than 18th magnitude.

2005 N4 (Catalina) The Catalina Sky Survey discovered an apparently asteroidal 19th magnitude object on July 6.28, which, following posting on the NEOCP, has been found to show a coma. The comet reached perihelion at 2.3 AU in early July. It is in a long period elliptical orbit.

2005 N5 (Catalina) The Catalina Sky Survey discovered another apparently asteroidal 17th magnitude object on July 12.44, which, following posting on the NEOCP, has been found to show a coma and tail. The comet reached perihelion at 1.63 AU in late August. It may brighten to 16th magnitude. The latest orbit by Hirohisa Sato shows that it has a period of around 150 years.

A/2005 NA56 [Mt Lemon] This ususual asteroid, of 21st magnitude, was discovered during the Mt Lemon Survey with the 1.5m reflector on July 5.39. It has a period of 5.4 years and perihelion was at 1.37 AU in late October 2004. [MPEC 2005-N78, 2005 July 15, 10-day orbit]. In the current orbit it can approach to around 0.6 AU of Jupiter. Sebastian Hoenig has suggested that it may be linked to comet 41P/Tuttle-Giacobini-Kresak on the basis of similar orbital elements. This may be possible, but any separation would have taken place over 500 years ago. Comet 41P underwent a series of encounters with Jupiter in the sixteenth century, which reduced the perihelion distance from around 1.5 AU to 1.0 AU.

A/2005 NP82 [Siding Spring] This very ususual asteroid, of 19th magnitude, was discovered during the Siding Spring Survey with the 0.5m Uppsala Schmidt on July 6.66. It has a retrograde orbit with a period of 14.9 years and is at perihelion at 3.08 AU in June 2006. [MPEC 2005-O03, 2005 July 17, 11-day orbit]. It can pass within 0.1 AU of Jupiter, with the most recent close approach being in 1872 in an encounter that reduced the inclination from 140 degrees to 130 degrees. An encounter in 1646 reduced the perihelion distance from 3.3 to 3.0 AU. A more distant encounter took place in 1978.

2005 O1 (NEAT) An asteroidal object of 19th magnitude, discovered by NEAT on July 27.40, has been found to show a coma by Alan Fitzsimmons. It was at perihelion at 3.59 AU in mid May 2005 and is now fading. The latest elements show that it is in a long period eliptical orbit, with a period around 360 years.

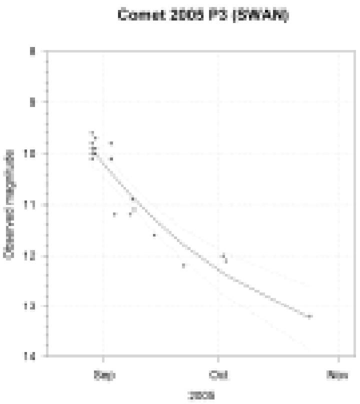
2005 O2 (Christensen) Eric Christensen discovered an 18th magnitude comet with the 0.5-m Uppsala Schmidt in the course of the Siding Spring Survey on July 31.75. It reached perihelion at 3.33 AU in early September 2005. Further observations show that it is in an elliptical orbit with a period of about 115 years.

A/2005 OE [Catalina] This ususual asteroid, of 19th magnitude, was discovered during the Catalina Sky Survey with the 0.68m Schmidt on July 16.35. It has a period of 259 years and perihelion was at 2.80 AU in January 2005. [MPEC 2005-O16,

Image of 2005 P3 (SWAN) by Michael Jager on 2005 August 28

2005 July 19, 3-day orbit]. There have been no recent close approaches to Jupiter.

2005 P3 (SWAN) SWAN images released on August 24 showed an obvious comet candidate, that was noted by many observers, including Michael Mattiazzo. Following visual confirmation by Alan Hale and posting on the NEOCP a preliminary orbit showed that it was at perihelion on August 9 at 0.5 AU. It moved northwards, from below the Plough, and faded. I was able to observe it on August 28.9 from a site outside Cambridge, with 0.20m SCT and 25x100B, estimating it at 10^{th} magnitude, with a 2' diameter, diffuse coma. 19 observations indicated a preliminary, aperture corrected light curve of 10.0 + 5 log d + 6.7 log r



Orbit calculations by Hirohisa Sato suggested the possibility of an elliptical orbit, and as observations accumulated they showed that it moves in a long period ellipse, with a period around 270 years.

2005 Q1 (LINEAR) LINEAR discovered another comet, of 19^{th} magnitude, on August 27.42. The latest MPEC orbit shows that it was at perihelion at 6.4 AU in late August 2005, and Hirohisa Sato has computed a similar orbit.

2005 Q3 (SOHO) This was a non-group comet discovered by Tony Hoffman in C2 images on August 30. There was initially some speculation that it might belong to the Marsden group, however the orbit does not confirm this.

2005 Q4 (P/LINEAR) A 19^{th} magnitude, asteroidal object discovered by LINEAR on August 31.40 and posted on the NEOCP was shown to have a tail by J Lacruz (Madrid) and J Young (Table Mountain, USA). The comet reaches perihelion at 1.75 AU at the end of September. It is in an eliptical orbit with a period of 9.4 years. It will brighten a little, reaching 18^{th} magnitude in October.

2005 Q6 (SOHO) This was a non-group comet discovered by Hua Su, Tony Hoffman and Maik Meyer in C2 images on August 19.

2005 R1 (P/NEAT) NEAT discovered a cometary object of 18^{th} magnitude on images taken on September 2.43. The comet reached perihelion at 2.0 AU in early October. It is in an eliptical orbit with a period of 13 years. It will brighten a little, reaching 17^{th} magnitude in October.

2005 R2 (P/Van Ness) M E Van Ness noted a 17^{th} magnitude cometary object on LONEOS images taken on September 10.41. It is in a short period orbit of 6.3 years and was at perihelion at 2.13 AU in 2005 February.

2005 R3 (171P/Spahr) Comet 1998 W1 (P/Spahr) has been recovered by F. Fratev and E. Mihaylova of Zvezdno Obshtestvo Obsevatory, Plana, with a 0.25-m f/4.7 reflector and by E. J. Christensen with the Catalina 0.68-m Schmidt telescope. The prediction in the 2005 Handbook requires a correction of delta T = -0.2 day. Following recovery the comet was numbered 171.

2005 R4 (LINEAR) A 19^{th} mag asteroid discovered by LINEAR on September 13.41 was shown to have a coma and tail. It will reach perihelion at 5.2 AU in 2006 March.

2005 RV25 (P/LONEOS-Christensen) Eric Christensen discovered an 18^{th} magnitude comet with the 0.5-m Uppsala Schmidt in the course of the Siding Spring Survey on October 22.25, which has been confirmed by Peter Birtwhistle, Richard Miles and Rob McNaught. It has been linked to an asteroid discovered by LONEOS on September 11. It reaches perihelion at 3.60 AU in November next year and has a period of 9.0 years.

2005 S2 (P/Skiff) Brian Skiff discovered 19^{th} magnitude comet during the LONEOS sky survey on September 29.28. The initial orbit was currently very indeterminate, and suggested that the comet might reach perihelion in 2010 February at 3.3 AU. Other solutions suggested a very small perihelion distance. However as observations accumulated the orbit changed, and they now show that the comet is periodic, with a 22 year orbit and perihelion at 6.4 AU in 2006 June.

2005 S3 (P/Read) Michael Read has discovered a 19^{th} mag comet on Spacewatch images taken on September 30.41. Further observations suggest a period of 11 years, with the comet at perihelion in 2006 January at 2.8 AU.

2005 S4 (McNaught) Rob McNaught has discovered another comet with the 0.5-m Uppsala Schmidt during the Siding Spring Survey. This one was found on September 30.56, although pre-discovery images were subsequently found back to July 27, and was 19^{th} magnitude at discovery. It reaches perihelion at 5.9 AU in July 2007.

2005 SD (P/LINEAR) A 17^{th} mag asteroid discovered by LINEAR on September 16.30 was found to have a coma and tail by Spanish amateur astronomers. It will reach perihelion at 1.58 AU in mid November and has a period of 5.5 years. Further observations by other observers however show no cometary features at all, so the cometary designation is likely to be withdrawn.

A/2005 SB223 [Siding Spring] This ususual asteroid, of 19^{th} magnitude, was discovered during the Siding Spring Survey with the 0.5m Uppsala Schmidt on September 30.74. It has a period of around 150 years in a retrograde (just) orbit and perihelion was at 2.77 AU is in November 2005. Aphelion is at 54 AU. [MPEC 2005-T41, 2005 October 6, 6-day orbit].

2005 T1 (P/Mueller) Comet 1993 W1 (P/Mueller) has been recovered by E. J. Christensen with the Catalina 0.68-m Schmidt telescope and confirmed by astrometry from LONEOS and independently by F. Fratev of Zvezdno Obshtestvo Obsevatory, Plana, with a 0.25-m f/4.7 reflector. The prediction on MPC 54168 requires a correction of delta T = -0.8 day.

2005 T2 (P/Christensen) Eric Christensen discovered a 20th magnitude comet in the course of the Mt Lemon survey on October 7.21. It is in a periodic orbit of 7.5 years and perihelion was at 2.21 AU in early April.

2005 T3 (P/Read) Michael Read has discovered a 20th mag comet on Spacewatch images taken on October 7.33. It is past perihelion, which was at 5.9 AU last November, and has a period of around 23 years.

2005 T4 (SWAN) Rob Matson and Michael Mattiazzo reported a possible comet in SWAN images between October 6 and 13, which was confirmed by ground based observations by Rob McNaught and Eric Christensen. At around 10th magnitude it was at perihelion at 0.6 AU in early October and will fade quickly. An improved orbit by Hirohisa Sato allowed Terry Lovejoy to find pre-discovery images taken on October 9 and October 18. Calculations by Hirohisa Sato show that it is a periodic comet, with period around 28 years.

2005 T5 (P/Broughton) Amateur astronomer John Broughton, of Reedy Creek, Queensland, Australia, has discovered an 18th magnitude comet in images taken with his 51cm f2.7 reflector on October 9.57. Prediscovery observations back to August 26 have been found. It is a periodic comet, with perihelion at 3.25 AU in early November, and a period of 19 years. It will fade.

A/2005 TC [Mt Lemon] This Amor asteroid, of 20th magnitude, was discovered during the Mt Lemon Survey with the 1.5m reflector on October 1.24. It has a period of 7.0 years and perihelion was at 1.04 AU in late August 2005. [MPEC 2005-T17, 2005 October 3, 2-day orbit]. In the current orbit it can approach to around 0.4 AU of Jupiter and was within 0.1 AU of Earth on September 20. This type of orbit is typical of Jupiter family comets. The object is estimated at around 100m in diameter.

A/2005 TF50 [Steward] This unusual asteroid, of 21st magnitude, was discovered at the Steward Observatory on Kitt Peak with the 0.9m reflector on October 10.24. It has a period of 3.3 years and reaches perihelion at 0.27 AU in 2006 January. [MPEC 2005-T90, 2005 October 12, 2-day orbit]. Katsuhito Ohtsuka has pointed out that it may be a member of Taurid complex. Seiichi Yoshida gives more details in his call for observations. It is classed as an Apollo asteroid, and can pass within 0.25 AU of Jupiter, most recently in 1962.

A/2005 TJ50 [Steward] This unusual asteroid, of 21st magnitude, was discovered at the Steward Observatory on Kitt Peak with the 0.9m reflector on October 5.41. It has a retrograde orbit with a period of around 45 years and reaches perihelion at 3.8 AU in mid April next year. [MPEC 2005-T86, 2005 October 12, 9-day orbit].

2005 U1 (P/Read) Michael Read has discovered a 20th mag comet on Spacewatch images taken on October 24.33. It has a period of 5.9 years, with the comet at perihelion in early July at 2.3 AU.

A/2005 UJ159 [NEAT] This unusual asteroid, of 19th magnitude, was discovered by NEAT at Palomar with the 1.2-m Schmidt on October 30.52. It has a period of around 70 years and reaches perihelion at 0.6 AU in late December. [MPEC 2005-V55, 2005 November 7, 8-day orbit].

2005 V1 (P/Bernardi) Fabrizio Bernardi has discovered a 20th magnitude comet on CFH telescope images taken on November 1.62. It has a period of 16 years, with perihelion at 2.4 AU in early September.

A/2005 VD [Mt Lemon] This distant asteroid, of 21st magnitude, was discovered during the Mt Lemon Survey with the 1.5-m reflector on November 1.21. It is in a retrograde orbit and has a period of around 10 years. Perihelion is at 3.70 AU in April 2007. [MPEC 2005-W45, 2005 November n, 10-day orbit]. The orbit is significantly influenced by Jupiter, and it can approach to around 0.3 AU of the planet. The object is estimated at around 8km in diameter.

A/2005 VH1 [Steward] This unusual asteroid, of 20th magnitude, was discovered at the Steward Observatory on Kitt Peak with the 0.9-m reflector on November 3.19. It reaches perihelion at 1.1 AU in mid December. [MPEC 2005-V43, 2005 November 5, 2-day orbit]. In the current orbit it can approach to around 0.5 AU of Jupiter.

A/2005 VX3 [Mt Lemon] This distant asteroid, of 20th magnitude, was discovered during the Mt Lemon Survey with the 1.5-m reflector on November 1.49. It is in a retrograde orbit and has a period of around 30 years. Perihelion is at 3.98 AU in mid November 2005. [MPEC 2005-V58, 2005 November 8, 5-day orbit].

P/2005 W1 (SOHO) is probably identical with the SOHO Marsden group comet 2000 C4. If so, it has a period of 5.78 years.

2005 W2 (Christensen) Eric Christensen discovered a 17th magnitude comet in the course of the Catalina Sky Survey on November 22.28. The orbit is still uncertain, but it is predicted to reach perihelion at 3.3 AU in March 2006, and has a period of around 80 years.

2005 W3 (Kowalski) Richard Kowalski discovered a 19th magnitude comet in the course of the Catalina Sky Survey on November 25.32. The comet is a periodic one, with a period of 16 years, and it was at perihelion at 3.0 AU in late August 2005. It will fade.

A/2005 WY3 [Spacewatch] This unusual asteroid, of 21st magnitude, was discovered Spacewatch with the 1.8-m reflector on November 21.07. It reaches perihelion at 1.8 AU in December 2007. [MPEC 2005-W71, 2005 November 26, 25-day orbit]. In the current orbit it can approach to within 0.5 AU of Jupiter and can also approach within 0.9 AU of Saturn.

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 Section CCD meeting

2005 May 14

Jonathan Shanklin welcomed everyone to the meeting and thanked the IoA for providing the excellent facilities free of charge. He went on to mention the recently unveiled plaque in Peterborough Cathedral commemorating the life of George Alcock. At least 100 people came along to the unveiling and a pamphlet produced by the BAA is available from the office. Jonathan then presented the final Keedy award to Jeremy Shears. Jeremy has been producing wonderful CCD images and his images of faint comets have inspired others to go out and observe these objects.

At this point Nick James took the chair and outlined the main objectives of the meeting. The intention was to cover the use of modern CCD techniques on comets particularly with regard to obtaining photometry. Nick noted that both Mark Kidger and Giovanni Sostero would be talking about their respective approaches to this difficult subject and that a lively discussion was expected. Before lunch however there would be three talks on other observational techniques with Guy Hurst discussing visual observations, Martin Mobberley talking on the prospects for amateur comet discoveries and Peter Birtwhistle outlining the methods he uses to image 20th magnitude objects from the UK using a relatively small telescope.

Guy Hurst started by saying that, in the context of today's meeting, visual comet observing was the rather ancient art of looking through the eyepiece. This was unusual these days and only 20 people had contributed visual observations to the section this year. Ten of those were from abroad. This was a worrying trend since visual observations of comets were still important and observing comets can still be exciting since unexpected things can happen.

Guy described how he started out in cometary observation on 1974 January 6 when he observed C/1973 E1 Kohoutek. These first observations were made using 10x50 binoculars and he made drawings of the comet since, at

the time, he didn't know how to make magnitude estimates. One of the problems for newcomers is finding the comet in the first place. A good star atlas is important but it should not go too faint or it could be confusing for the beginner. Guy recommended Storm Dunlop's new atlas which goes to magnitude 7.5. Ephemerides were published in Comet's Tail or could be obtained from the MPC website. Observers should beware that the position is usually given for 0hr UT on the date in question and so the comet will be nearer the following day's position if the observation takes place in the evening. Magnitudes given in the ephemeris are notoriously unreliable and they should only be used as a guide to visibility.

For magnitude estimates Guy recommended the Sidgwick method to new observers. Basically this requires the observer to remember the appearance of the comet and then defocus the comparison stars until they look the same. A methodical technique is required for consistent estimates but with practice good accuracy can be achieved. Coma and tail sizes can be estimated by using stars of known separation although it is often very difficult to estimate the length of tail since it merges with the sky background. For visual observers the Degree of Condensation (DC) is something of a nightmare. There is no direct relation between DC and magnitude but observers tend to make this connection and so report brighter comets as more condensed.

Guy's next major comet after Kohoutek was C/1975 V1. He recalled that he persuaded his wife to come out observing at 5am and she was quite impressed so it must have been particularly spectacular comet! It was one of those occasions to put down all forms of optical aid and just look with naked eye. He made a magnitude estimate of -0.7 but for comets that bright there are very few comparison stars to use and it helps to have a conveniently placed planet to act as a guide. Comet West led to some of the best visual observations of a cometary breakup as the nucleus split into at least 5 parts. Bortle's observations between 1975 March 8-23 showed that it was worth using a telescope even on a comet as large and bright as West.

The reporting of observations was critical. There is little point making estimates if they are not reported. At present there are three similar reporting formats. Both the BAA and the TA formats are derived from the ICQ format but they are subtly different. Guy said that he can accept ICQ format observations and convert these to the TA or BAA format. For any magnitude estimates it was essential to include the magnitude source since your magnitude estimate may not be used otherwise. It is also important to include instrumentation details. Guy noted that there were often aspects that could not be conveyed numerically and a textual description of the comet is often useful and helps to make the reports more interesting.

To conclude, Guy emphasised the value of visual observations but also asked observers to be careful when they submit data. Some errors can be corrected, although this involves the coordinator in considerable work, but other errors mean that the effort put into the observation is wasted. A particularly common error is to get the date wrong and there is really no excuse for this.

Following applause Mark Kidger commented that visual observing is still very important since CCD observers are recording completely different things. Since CCDs are relatively new the only connection with much historical data is through continued visual observation. Denis Buczynski recalled that Harold Ridley had told him that the weather was very bad around the time of Comet West and Guy was lucky to have seen it. Jonathan Shanklin added that the weather was not particularly bad but West was a morning object and this discouraged many potential observers.

Martin Mobberley then gave his talk entitled "prospects for amateur comet discovery in the days of professional automatic surveys". The large professional sky surveys were making life more difficult for potential discoverers but there has never been an easy way to discover a comet. It was a sad fact that 22 years, 11 days had passed since Alcock discovered the last comet from UK soil (C/1983 H1 Iras-Araki-Alcock). Alcock discovered his comets with nothing more than binoculars and a great deal of dedication. The only living British comet discoverer was Roy Panther, and he is still searching. There have, of course, been 144 UK SOHO comets but these were discoveries of a different nature and so they were not really relevant to the subject of this talk.

Martin noted that he had been asked to comment on the potential for CCD, rather than visual, discoveries but there were very few amateur CCD comet discoverers. The CCD discoverers had to deal with the same problems as visual discoverers, particularly the very high level of competition from automated surveys. In the Good Old Days comets usually had interesting names since they were discovered by human beings, not machines. These days most comets are called LINEAR or NEAT but Martin showed that these machines did have their weaknesses. The two most important factors were that the surveys did not look south of declination -35 or, normally, within 90 degrees of the Sun. As an example P/2001 Q2 Petriew escaped the surveys since it was very faint when well elongated and it only brightened when the elongation fell below 90 degrees.

Despite the surveys the level of amateur discoveries back to 1990 has remained fairly healthy. In 2002 there were 7 amateur discoveries of which 5 were visual. Last year (2004) there were 3 amateur discoveries of which 2 were visual. As far as Martin could see there were only four amateur comet CCD discoverers: Tabur, Tucker, Juels/Holvorcem and Yeung.

Vello Tabur has discovered comets visually and with a CCD. His first CCD discovery was C/2003 T3. He uses a 140mm Nikon lens and an ST-8 CCD piggybacked on a Losmandy mounting and has written his own software to drive the mount and patrol the twilight sky. In addition to his CCD comet he has two visual comet discoveries, a nova, a nova like variable and 200 other variables to his credit.

Roy Tucker has a very clever system using three 14-inch reflectors in drift scan mode. In this mode the telescope is undriven and CCD lines are read out at the sky drift rate. His integration time is 3 minutes since the CCD is 45 arcmin on a side. the drift scan produces images of long, thin strips of the sky and Tucker uses Robert Denny's "Pinpoint" package for moving object detection. He has made an impressive number of discoveries with this system including several NEOs and two comets.

Charles Juels and Paulo Holvorcem use a 5-inc refractor on a Paramount located in Arizona. This is equipped with a 1Kx1K CCD giving 8.25 arcsec/pixel or a 2.35 deg field. Juels takes the images and Holvorcem, who lives in Brazil, checks them using his own software. As with many discoveries they discovered C/2002 Y1 on the first night of patrolling. Their other success was the recovery of 157P/Tritton.

The final CCD discoverer is Bill Yeung. He has a wheeled 18-inch, f/2.8 telescope which reaches to magnitude 22 and which has very large sky coverage. Yeung is a Canadian who commutes to Arizona to observe and he is mainly interested in NEOs. His comet, 172P, was originally thought to be asteroidal.

Martin noted that, while it isn't an amateur system, the All Sky Automated Survey (ASAS) could be. This is a system at the Las Campanas Observatory which surveys the whole sky to 14^{m} each night. It is a 200mm Minolta f/2.8 lens coupled to an Apogee CCD giving a 9x9 deg field. ASAS discovered C/2004 R2 last year.

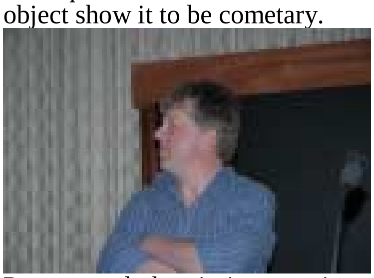
Martin then compared the five CCD discovery systems. Tucker went to magnitude 20 and imaged at a rate of 12 square degrees per hour. Yeung reached magnitude 22 and covered hundreds of square degrees each night. Juels/Holvorcem reached magnitude 15 and covered around a hundred square degrees each night. Tabur reached magnitude 13 with coverage of the entire twilight zone. ASAS covers the entire southern hemisphere sky to magnitude 14 each night. The individual images ranged from fields of 2.35 deg square to mag 15 (Juels/Holvorcem) to 9 degrees square to mag 14 (ASAS). Martin noted that a Canon 300D setup could do something similar but it would need to be operated by a manically dedicated observer.

In conclusion Martin summarised the strategies available. We could give up. Alternatively we could concentrate on twilight scans or scans of circumpolar areas to faint magnitudes where LINEAR doesn't go.

Following applause Mark Kidger commented that he had the impression that in the 1960s there were hundreds of searchers but this was no longer the case. Martin replied that the surveys can go so faint that they have years to find a comet before it comes into amateur range. Many experienced discoverers were still going despite this. Any serious discoverer had to be prepared to patrol for months on end without a discovery. To Alcock observing was a ritual and when it got dark he went outside to observe. There were no excuses and he needed to do this for year after year before he had a success.

Another questioner asked Who got the discovery credit if the cometary nature was detected by others? As present it was the original discoverer but Mark Kidger noted that this was under discussion at the MPC.

The next speaker was Peter Birtwhistle. Peter makes very effective use of the LINEAR discoveries. His main interest is in NEOs but sometimes these turn out to be comets. Peter explained that his talk would cover what the amateur can do to image very faint objects. He said that LINEAR currently takes four images of an area every 15 minutes. Software then looks for moving objects and this is a very effective strategy however they generate so much data that nobody actually looks at the images to see what they are like. Quite often the IAUC reports an "apparently asteroidal object" which subsequently turns out to be a comet. All of these discoveries get posted on the NEO confirmation page (http://cfa-www.harvard.edu/iau/NEO/ToConfirm.html) and at this early stage astrometry is required. There is usually a flurry of observing early on but things then go very quiet as the object fades or goes into twilight. There is plenty of work to be done following these objects. In around one in 30 cases subsequent observations of the object show it to be cometary.



Peter noted that it is sometimes difficult to decide whether an object appears cometary or not. For example P/2003 O3 was posted as an asteroid and his image on the first night (2003 July 31) didn't look unusual. A further image on August 2 looked slightly elongated as if there was a short tail. Further imaging through the following week showed that there was generally more "haze" on one side of the object and the cometary nature was confirmed by bigger telescope that showed a clear coma and a short tail.

To get faint it helps to have a large telescope and a very sensitive CCD however this is not an option for many amateurs and there is a large amount your can do with the equipment you have. The key to this work is that CCD images have to be properly calibrated with flats and darks. Focussing is critical to getting faint and it is particularly important if you are trying to determine whether an otherwise point source object has a cometary nature. A motorised focusser makes life much easier and special software such as FocusMax saves a huge amount of time. This software learns the characteristics of your system. In operation it then takes a number of images out of focus and then goes straight to focus. The whole process takes seconds or a couple of minutes and this can be critical when you are trying to get early observations of an object.

Since comets are moving there is little benefit in taking long exposures since their image will be trailed. Take many short exposures and stack them using suitable software. It may take an hour's worth of imaging to get to LINEAR’s survey limit when they only needed 30 seconds but LINEAR has a much larger telescope than you do! In most cases the object is not visible in the individual frames but it can be detected after suitable stacking. You should expect to get around one magnitude fainter for each factor of 6 so 60 images goes around 2.5 magnitudes fainter than the individual image. Since the reported magnitude is often wrong it is worth stacking in real-time so that you can decide how to continue. Peter pointed out that he has to be in the observatory during the exposure in any case and so he could change his strategy as the observation developed.

The first thing to do with the images is to check for motion. To do this divide the images into three sets and stack these so that you can see the object moving between the sets. To check if the object has a coma/tail stack all images rather than just looking at the three sets. To confirm a suspect comet it is worth looking for differences in the FWHM (Full-Width Half-Maximum) between the object and the stars. Point sources in field should have same FWHM independent of magnitude although there will be some variation with seeing. Cometary objects generally have a flatter profile.

Following applause Mark Armstrong asked what equipment was being used. Peter replied that it was a standard 12-inch Meade GPS with an Apogee AP-47. The limit is around magnitude 21 with many stacked frames but images are very weak at this level and they are generally not suitable for astrometry.

Geoffrey Johnstone asked how it was possible to stack on an object if it was not possible to see it in the individual images? Peter replied that you use the predicted motion from the ephemeris. There may be some uncertainty in position but motion is normally well known. The Astrometrica program from Herbert Raab is ideal for this.

Giovanni Sostero asked whether the observing location was very dark. Peter replied that the skies were reasonably good but there are nearby towns which cause glows on the horizon and a streetlight around 40 ft from the observatory.

Denis Bucksynski asked about the minimum pixel scale that could be used. Peter replied that he normally worked in 2x2 bin mode which gave 3 arcsec/pixel. Most of these cometary objects were of the order of 10 arcsec in diameter and so scales of 5 arcsec/pix would risk missing these objects.

The lunch break was then taken. Nick James introduced the session after lunch noting that it would concentrate on the thorny issue of cometary photometry. A number of approaches were being used and the proponents of two distinct methods were here today. We would first hear from Mark Kidger who would outline the "Spanish Method". Giovanni Sostero would then tell us about the Italian approach.

Mark Kidger started by pointing out that the MPC database on comets contains 272,376 astrometric observations, almost all of which have associated "photometry". One of Mark's students had tried to use this database to do science but, for any given comet, the photometry had a scatter of 4 magnitudes or more. The reason for this scatter was that the photometry was not standardised in any way. Observations were made with any filter or none, there was no indication of aperture and no description of the reduction method. The conclusion is that the photometry in the MPC database is of little use. It was this that prompted the development of the Spanish Method.

By 1995 Mark was starting to receive CCD photometry amateur observers in Majorca and by 1998 he was getting substantial amounts of photometry from observers all over Spain. Unfortunately, as with the MPC database, there was no comparison between observers' data since they were all using different methods. It was time to introduce some standardisation however this had to take into account the practical limitations inherent in amateur observations using relatively small telescopes from light polluted sites. In order to maximise uptake the method also had to be straightforward and enjoyable.

The approach was that everybody should measure with a standard photometric aperture and should use the same reduction software and same reference star catalogue. The CCDs are used unfiltered and we assume that this corresponds approximately to R. The choice of aperture was driven by the reality that most amateurs have seeing of around 4 arcsec and considerable light pollution. Professional observatories have sky brightness levels fainter than 20 mags/square arcsec but some amateurs have to deal with a sky 6 magnitudes brighter than this. A typical professional aperture of 30 arcsec is far too large in this case since there are so many photons coming from the sky. At the other end of the scale the aperture cannot be too small since the seeing disk is so large. A compromise of 10 arcsec is used and this reduces the sky background to manageable levels. More recently we have been measuring in multiple apertures of 10, 20, 30, 40, 60 arcsec to provide additional data.

The Spanish Group decided to use Astrometrica as our reduction software. This is by far the best program available and one of the things it does very well is photometry. It is robust and correct and Herbert Raab has adapted the program to change some of the options to automate some of the reduction tasks. One critical aspect of the reduction method is to do sky subtraction using the median of the whole image rather than using the standard Astrometrica option of small annulus around the object. This is performed using the additional program FOCAS available for download from the author's website at http://www.astrosurf.com/cometas-obs/_Articulos/Focas/Focas.htm.

The reduction consists of measuring relative photometry against field stars. After a considerable amount of investigation we have decided to use R magnitudes from the USNO-A2.0 catalogue. This is a controversial decision but, whilst the Tycho 2 catalogue is very high quality it only contains B & V magnitudes whereas we want R. In addition Tycho 2 has 2.5 million stars which is only 60 per sq deg so a typical amateur CCD frame may not have many reference stars. USNO-A2.0 has moderate quality photometry and 500 million stars in R so there are hundreds of stars in the field. The magnitude errors in USNO-A2.0 are surprisingly small. Well over 1/3 of all stars are less than 0.1 magnitudes away from corresponding Landolt photometry. It is true that around 6% are more than 0.5 magnitudes in error but these outliers can be rejected from the reduction. The catalogue median magnitude error is 0.15 and the standard deviation is 0.26 mags (i.e. 67% of stars will be within 0.26 mags).

The magnitudes are converted to a parameter called Af(rho). This is a number originally proposed by Mike Ahern which groups three unknowns: A is the dust grain albedo, f is the filling factor (i.e. How much of line of sight filled up with dust grains) and rho is the density of the dust grains. Effectively Af(rho) is the equivalent column of dust in our line of sight. It is a useful parameter for describing the comet and it can be translated to the dust production rate.

We were able to check how well our observations corresponded to professional results by using the results obtained for 46P/Wirtanen. Since this was going to be target for the Rosetta spacecraft it received a lot of attention from the professionals during 1998. They obtained narrowband photometry using big telescopes. We compared this with a set of Spanish amateur observations obtained in 2002 and there is a pretty good agreement.

Recently the Spanish group has been monitoring 9P/Tempel. As of last Friday morning we had 960 photometric observations of this comet in a 10 arcsec aperture obtained on 98 nights with 22 observers. The typical dispersion on any night is around 0.15 mags, which is very good. The dispersion is much worse with larger photometric apertures and below magnitude 14.5 most of the data in larger apertures than 10 arcsec is useless.

Whilst the use of unfiltered CCDs is simple things can go wrong if you are not careful. If a comet is very gassy (the recent C/2004 Q2 Machholz is a good example) then large errors are introduced. Close in to the Sun active comets show very strong Swan band emissions and this contaminates unfiltered photometry leading to Af(rho) values that are too large. To a large degree we could cure this by imaging bright comets using an R filter but for 95% of the comets we are observing the Swan emission is not a problem since it is not strong enough to affect our photometry.

In conclusion the Spanish Method is simple but not perfect. It is easy to use so that many people can use it. We are developing it to some of the outstanding problems but our aim is not to overcomplicate the method.

Part 2, which will appear in the next issue, will conclude the report of this meeting.

Nick James

The Comet's Tale is produced by Jonathan Shanklin, with thanks to the British Antarctic Survey and the Institute of Astronomy, Cambridge for the use of computing facilities. E&OE.