THE COMET'S TALE

Newsletter of the Comet Section of the British Astronomical Association

Number 29, 2010 January

The Central Bureau for Astronomical Telegrams (CBAT)

The Central Bureau for Astronomical Telegrams (CBAT) has recently celebrated the 125th anniversary since its founding by the editors of *Astronomische Nachrichten* at Kiel, Germany, in late 1882. The immediate cause was the sudden appearance of the great September sungrazing comet, for which a coordinated worldwide center was seen to be much needed, due to problems in getting proper information circulated quickly to the astronomical community. The CBAT moved to Copenhagen Observatory out of necessity during World War I, where it took on IAU acceptance in 1922 (after an initial 2-year stint of an IAU Central Bureau floundered in Brussels); the IAU's Central Bureau remained at Copenhagen until its transfer to Cambridge at the start of 1965 (where Harvard College Observatory had maintained the western hemisphere's central bureau for astronomical telegrams since 1883). The Smithsonian Astrophysical Observatory (SAO), located on the grounds of HCO, has overseen the Central Bureau – on behalf of the IAU – since 1965.

The Kiel Bureau and its IAU continuance has long been recognized as the source of official designations for many astronomical objects, providing a trusted source for early information regarding such discoveries. While wide public access to the Internet in the past 1.5 decades has naturally encouraged many different additional sources – both professional and amateur – to produce alerts on various new astronomical discoveries, there is often a lack of oversight to prevent errors from being propagated. The CBAT publications are refereed, and the long history and reputation of the CBAT – together with its efforts to remain fair and non-political, while simultaneously maintaining constructive dialogue with all interested astronomers – will ensure that it remains an important part of the astronomical community. Indeed, at a meeting held recently between organizers of the Virtual Observatory and the CBAT/SAO staff, it was acknowledged by the VO members that there will continue to be a strong need for the Central Bureau to highlight the important astronomical discoveries, as automated surveys produce an ever-greater flood of data. The CBAT is working with the astronomical community to aid astronomers with this rapid rise in new data.

The primary subjects of CBAT publications continue to be supernovae, comets, novae and other unusual variable stars, and satellites of minor planets and major planets – both discovery information and follow-up information. Contributors also send information to the CBAT regarding novae in other galaxies, and while publication is generally made of novae in galaxies other than M31, the CBAT webpage devoted to M31 novae now appears satisfactorily to provide a venue for designating and announcing new novae in that nearby galaxy, with suitable follow-up observations also provided there. Following discussion with IAU Commission 22 in Prague in 2006, reports on new meteor showers also are now routinely published by the CBAT.

The years 2006-2008 continued the marked transition toward the increased issuance of *Central Bureau Electronic Telegrams* (CBETs) as part of the plan to issue many reports more quickly and to help alleviate the cost of printing the *IAU Circulars* (IAUCs). For example, a policy was begun to issue *all* supernova discoveries on CBETs; initially, short summaries of the designations issued and some limited follow-up supernova information were also put on the IAUCs, but even the summaries have ceased on the IAUCs in the last couple of years due to the effort and cost of printing (combined with declining interest in paying line charges for publication of supplemental information). The IAUCs are still used to note the formal issuance of official IAU designations and names of celestial objects other than supernovae. The natural continued evolution worldwide from print to electronic publication is borne out in the Central Bureau's activity as well, although many astronomers still desire that the CBAT continue to maintain its printing of the IAUCs (which are both printed and electronic).

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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 three years, extended to four 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 and in future this will be the only option for non BAA subscribers.

Section News from the Director

Dear Section member,

I must apologise for the late arrival of this edition of the Comet's Tale, which wasn't quite ready for printing before I left for another visit to the Southern Hemisphere. I will spend most of February at King Edward Point, near the old whaling station of Grytviken on South Georgia. I have another visit to the Southern Hemisphere in the autumn, though this is a shorter one to Hobart, Tasmania for a World Meteorological Organisation meeting. I seem to get ever busier, so that I haven't achieved my objective of completing the report on the comets of 2001, although at least the report on the comets of 1999 has been published in the BAA Journal and that for 2000 is in press.

Italian comet discoverer/observer Mauro Vittorio Zanotta died on Sunday, May 24. He was only 46 and in addition to cometary astronomy he had a passion for skiing. It was in conjunction with this pursuit that Mauro lost his life on the slopes of Mont Blanc. I and Dan Green stayed with him and his wife after the IWC held in Italy and went skiing with him at Santa Catarina.

The BAA is holding an observers workshop on September 25th at Burlington House in London. This will focus on observing comets and meteors and will be designed to take observers into the next steps of making scientific observations, both visual and CCD. MACE 2010 will be held at Visnjan/Tican, Croatia from May 21 to 23; there is a url to the event on the Section web page.

Best wishes for the New Year,

Jonathan Shanklin

Tales from the Past

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

150 Years Ago: Observations of Donati's comet continued to appear. William Lassell observed it from Liverpool on September 30, when it was about the same altitude as Arcturus and the tail could be traced to "the nearest bright star (η) of the Great Bear". Rev W R Dawes observed it from Haddenham, Bucks during daylight on October 8 with his 7.25" equatorial, noting that the nucleus had a crescent shape, the convexity being towards the sun. He continued "...it certainly gave me a strong impression of its solidity and opacity, as presenting a true phase; thus satisfactorily accounting for the dark line extending from it in the direction of the exis of the tail." Both observers commented on the dark spot seen in early October. A letter from Mr Maclear at the Cape of Good Hope remarked that he remembered the comet of 1811 and considered that neither it nor Donati's comet was comparable in splendour to the great comet of 1843. Mr De La Rue had attempted to photograph the comet, but did not obtain any trace of an image in 60 seconds. A severe domestic calamity prevented a repetition of the experiment under more favourable circumstances. Mr Usherwood, an artist residing on Walton Common, succeeded in obtaining, in 7 seconds, a good negative with a portrait lens of short focus. So far as the Council of the RAS had been informed, this is the only instance of a photograph of Donati's comet having been obtained. A letter from Mr

Bond at Harvard however noted that it had been photographed there on September 28th, and also drew attention to an additional comet discovered there by Mr H P Tuttle on September 5, which had been omitted from the RAS report.

A lengthy report (9 pages) on the comet begins "Equally interesting to the professional astronomer and to the unlearned gazer in the heavens, it has been the object which has attracted to itself during the preceding autumn the undivided attention of the civilised world, and been the subject of intelligent study and speculation to the philosopher, and the reviver of astronomical tastes to the other classes of the community." The report also chides "The results of the observations made at Cambridge (England) have not yet been made public." Later in the report "...few persons who were fortunate enough to observe the transit of the comet over Arcturus will ever forget the impression made on them by that sublime spectacle."

Several reports from ships were presented in the December 1859 MN. These included Charles in the Southern Ocean, the Hudson Bay Company's steamer Labouchere, the Arctic discovery yacht Fox, and Marco Polo at 53°S 57°W, [just east of the Falkland Islands and on my route to South Georgia].

A report taken from Comptes Rendus detailed M. Faye's objections to Professor Encke's theory of a resisting medium to explain the acceleration in motion of comet 2P/, with responses from M. le Verrier. One objection involved a calculated very low density for the nucleus (0.009, cf air=1), with the density of the tail being less than that of the vacuum produced in our best air-pumps. Faye's theory was based on a particle nature for light from the sun (well before wave particle duality was understood). Le Verrier supported Encke's theory, but then Faye suggested a further variation of a force directed from the Sun. The report of the RAS notes the debate and notes "....it may be reasonably expected that a result of such importance will in due time lead to conclusions of high interest in astronomical physics".

Rev T W Webb suggests an explanation for "the dark space so frequently included in the tails of great comets". He speculates the existence of a hollow interior, combined with a radiated structure, "in consequence of which the luminous particles, drawn out into a lengthened form, would in the apparent centre of the tail present their ends only, but on each side of it their full extent, to the observer's eye."

A paper by O G Downes Esq. "On the Physical Constitution of Comets" suggests that comets have similar atmospheres to the Earth. He remarks that "comets belong to the same family as planets, and that with continuously contracting orbits they will, in the fullness of time, take their place with the other planets in the solar system."

100 Years Ago: A report on a paper "The comet of 1556 : Its possible breaking up by an unknown planet into three parts, seen in 1843, 1880 and 1882" by George Forbes which had appeared in MN notes "So as to thoroughly grasp this paper it must be read in its entirety." The author proposes an ultra-Neptunian planet, which could only be observed from the Southern Hemisphere.

Mr Burns read a paper on "The Physical Nature of Comets" at the February meeting. In it he proposed that all comets were accompanied by a train of meteors. Mr G F Chambers asked on what evidence this was based? Mr Burns replied that it seemed reasonable given that three or four comets had such trains. Mr Chambers disagreed with the generalisation. The paper also attracted considerable debate about the nature of comet tails. Professor Sampson had submitted a paper on Halley's Comet and Pope Callixtus, which was read by Mr Crommelin. He suggested that Laplace was the most likely culprit who made embroidery on the original statement. Mr Chambers said that "knowing as they did the religious opinions of Laplace and of those associated with him, one could understand there might be a disposition on his part to make mischief as to anything which might have a religious connection."

Mr Ross had been observing comet Morehouse from Melbourne, Australia, and had sent in a newspaper cutting, which included a quote from a member of the Melbourne Observatory staff "It is certainly the most bizarre comet that we have to deal with since photography began to register the freaks of the tails of comets". Mr H Wright had observed the comet from Sydney and commented "My wide made a sketch in crayons. Whilst drawing, she said the tail appeared to be blown about slightly. Some well-known observers have seen light pulsate in the tail. I think both appearances are easily explained by a light wind causing a gentle tremor in the telescope." Sydney Manning noted seeing it in daylight with binoculars on February 2,

The Royal Academy of Sciences of Denmark gave as the subject for their gold medal "Examiner les conditions dans lesquelles il est possible de determiner la masse d'une comete, et rechercher si ces conditions se retrouvent pour des cometes qui, comme celle de Svedstrup, n'ont pas concorde avec des orbites calculees suivant le procede ordinaire". A definitive orbit for such a comet must be calculated, and the result compared with observations. Papers may be written in Danish, Danish-Norwegian, Swedish, English, German, French or Latin.

A talk on Chinese Astronomy from Mr E B Knobel, which included mention of Chinese records of comets, drew the interest of Mr Crommelin, who asked about as yet untranslated manuscripts that might contain records of comets and other phenomena. Mr Knobel said that the British Museum had an immense number of volumes which seemed to be entirely unexplored.

Further observations of Encke's comet had necessitated the abandonment of the theory of a resistive medium and Herr Hackenberg of Vienna suggested that the changing motion might be due to the action of meteoric streams in the orbit of the comet. Another note comments that the brightness of the comet diminished enormously between 1904 and 1908, having an absolute magnitude of 8 in 1904, but 12 in 1908. Yet another note links the brightness of the comet with sunspot number, suggesting that it is brightest near periods of maxima of Sun-spots.

At the July meeting Mr Burns read a paper on "The Connection between Comets and Meteorites". He described any small object, even 100m diameter as dust. He would say that a comet, just as the rings of Saturn, consisted of a cloud of brickbats. He also noted that both Halley's and Encke's comets seemed to be fading away, and that this was a consequence of their steady dissolution. Comets brightened as they approached the Sun because the gaseous content of the solid particles were emitted and formed a gaseous envelope around them under the effect of the Sun's heat. He suggested that comets constituted an aggregation of meteorites, and would in the process of time shed a number of them, which would spread out and form a ring all round their orbits.

The comet Section report in October, notes that only comet Morehouse had been observed during the course of the year. It had only been faintly visible to the naked eye, but was better adapted for photographic observation as its spectrum was strongest in the ultra-violet. The tail had been complex and changed rapidly, indicating the action of powerful forces. The first item after the annual report of the Association is of congratulations to Messrs Cowell and Crommelin who computed an orbit for Halley's comet under the motto "Isti mirantur stellam" which required a correction of only +3.4d. The comet had been recovered at Heidelberg, but following this, plates taken at Greenwich on September 9 with 25 and 30 minute exposures were discovered to show the comet.

The October Journal has a book review of G F Chambers' "The Story of Comets simply told for General Readers". It finds no fault, though does slightly lament that Halley's comet was recovered at Heidelberg, even though the first photograph was secured at Halley's old observatory.

At the November meeting, Rev Theodore E R Philips read a paper on his recent visual observations of Halley's comet. The President (H P Hollis) noted that Mr Philips had sent him a card the previous week saying that he had seen it, so he had a look himself with the 10" guider of the Astrographic Equatorial and was surprised at how bright it was - about the same as a star of magnitude 9.5 - 10. Mr Crommelin then gave some predictions for the light curve and tail length, along with details of the orbit. He also noted that there would be a transit of the Sun on May 19 at 2am. Another comment was that he had been unable to find any drawings showing the appearance of the comet in 1759. Mr Willis had also observed the comet from Norwich with an 18" reflector, but did not give a magnitude as "I have no accurate means of determining the same, and also because I consider it hardly correct to refer to the "magnitude" of a body which exhibits to the observer a very appreciable angular diameter." He goes on to discuss the issue "I am quite convinced that large telescopes have not the same advantage over small ones in respect of the visibility of a small comet as they have in respect of the visibility of a faint star. Surely the visibility [of an extended object] must depend partly on the brightness of the surface presented, and not solely on the total light emitted by it. If this be agreed, it must also be agreed that to speak without qualification or explanation about the magnitude of a comet is to make a statement liable to misinterpretation."

A book review on a booklet about Halley's comet noted "The return of Halley's comet will doubtless lead to the production of several works; some of which have already appeared."

The RAS noted that thanks to Cowell and Crommelin's corrected ephemeris, images of comet Halley had been found on a plate taken at Helwan with the Reynolds reflector on August 24. Mr Brent spoke of the appearance of the comet, which he well remembered at its return in 1835. The 67th award of the Donohoe Comet Medal was made to Mr Zaccheus Daniel, of Princeton, New Jersey for his discover on June 15, 1909 and to M A Borrelly of Marseilles, for his discovery of the same comet the day before. Mr Daniels discovery was the first notified. [33P/Daniel]. A note from another magazine contains an item from Miss Irene E Toye Warner who calls attention to the coincidence of many of the returns of Halley's Comet with events favourable to England's advancement. Mr Ross was the first person to observe the comet from Australia.

At the December meeting Mr Burns returned to the fray with his theory of solar activity influencing the brightness of comet Encke and pointed out that three revolutions of the comet was roughly the same as one solar cycle. There was considerable debate about the graphs he presented. Later Mr Crommelin exhibited a slide of the 1066 return of Halley's comet as shown in the Bayeux tapestry and drew attention to a feature in the tail that resembled something seen in Morehouse's comet, viz luminous masses projected outwards from the head. He had also now found a diagrammatic representation of the comet in 1759. He showed a new way of representing the motions of a comet, first presented in the Journal of the Royal Astronomical Society of Canada. This shows the Earth and Sun as fixed points and the correct angular elongation shown throughout. He concluded by saying a few words about the sensational article which appeared in Pearson's Magazine for December. It was a revival of the worst type of comet panic.

50 Years Ago: The annual report noted work on comet orbits carried out by Brian Marsden. Only Burnham-Slaughter (1958 R1) had become bright enough (12m) for visual observation and had been photographed by Michael Hendrie and R L Waterfield. George Alcock had carried out 67 hours of comet searching, and Stan Milbourn and Roy Panther had also carried out searches.

At the AGM the President noted that circulars had been issued about two great events of the year - the comets recently discovered by Mr G E D Alcock. Since he joined the Association in 1936 Mr Alcock had been a most assiduous observer of comets and meteors and was the first BAA observer to see comet Mrkos in 1955 June. His two comets were designated 1959 Q1 and 1959 Q2. The President concluded by saying that the discovery "may even cause a change in mind amongst those who declare that the amateur can no longer do useful work in astronomy!" Later Mr Alcock spoke about his observing, including his Quadrantid watch on 1952 January 3, which began at 5:30 in the evening and finished at 6:50 the next morning. He said that he couldn't carry out such long comet sweeps as the strain on the eyes was too great, but he had done one of six hours. His first comet had been discovered after 560 nights and 646 hours of observation, using 105x25 binoculars that he had purchased in April. His second discovery had a tail, so he had rung Herstmonceux to ask them to take a photograph. He had anticipated some difficulty, as it was a Sunday morning, but the photograph had been taken, although they didn't tell him.

The Central Bureau for Astronomical Telegrams (CBAT)

Daniel W. E. Green, Director of the Bureau, 1 May 2009
IAU Information Bulletin 104, June 2009

(Cont from page 1) While a total of 137 IAUCs were issued in 2006 – up from the 130 published in 2005 (see IAU *Information Bulletin* No. 98, p. 31) – this number declined to 117 in 2007 and to 102 in 2008, due to the transferral of most supernova material to CBETs, which saw 446 CBETs issued in 2006, 398 in 2007, and 451 in 2008 (well up from the 243 CBETs that were issued in 2005). As the CBAT announced that there are no line charges levied for items on the electronic-only CBETs, many other follow-up items on unusual variable stars, meteor showers, comets, and supernovae also are submitted specifically for publication therein. In 2006, two notable astronomical objects were the source of a larger-than-usual number of textual items contributed to the Central Bureau: the recurrent nova RS Oph, which experience an outburst to visual mag 4.5 in February; and comet 73P/Schwassmann-Wachmann, which was making its long-awaited close approach to the earth, reaching total visual mag 5 and observed to split into scores of individual pieces. In 2007, again two astronomical objects produced a larger-than-usual number of CBAT-published items: comet C/2006 P1 (McNaught), the brightest comet since 1965, which was visible to the naked eye in broad daylight in January when near perihelion; and comet 17P/Holmes, which experienced an outburst of some 13 magnitudes over two days in October, to total visual mag 2.5. V1280 Sco (Nova Sco 2007) also produced numerous CBAT-published reports, as it became one of the brighter novae in recent years, at peak visual mag ~4 in February (curiously, the nova V598 Pup – announced in November 2007 – was found on archival images also to have peaked near visual mag ~4 in June, but it wasn't detected in real time).

The IAUCs continue to have multiple titles (regarding multiple objects) on most issued Circulars, whereas the CBETs contain only one title (one object/subject) per issue. During 2006-2008, the number of IAUC titles regarding supernova discoveries decreased from 74 in 2006 to 20 in 2007, and to only two in 2008 – reflecting the move of supernova items to CBETs; the last IAU Circular with supernova designations summarized was No. 8875 in late September 2007. Meanwhile, the number of items on IAU Circulars pertaining to discoveries of novae (~10 items/yr), other variables including follow-up text on novae (~35/yr), natural solar-system satellites and rings (~15/yr), major and minor planets (several per year), comet discovery (~90/yr), and cometary follow-up text (~50/yr) remained rather steady over the past triennium. Some 1017 CBETs were devoted to supernovae during 2006-2008, with another 162 pertaining to other variable objects outside the solar system, while 53 CBETs concerned minor planets (including satellites), 33 CBETs were issued regarding comets, 26 regarding meteor showers, and two dealt with major planetary satellites and rings.

Milky-Way novae (and occasional other unusual variable stars announced by the Central Bureau) have formal IAU/GCVS designations announced in CBAT publications, after they have been assigned by the GCVS staff in Moscow (via an on-going collaboration between the Central Bureau and the GCVS staff). The Central Bureau has initiated a designation scheme for novae in other nearby galaxies, beginning with M31 (and extended now also to M33 and M81), which is now widely used in the astronomical community; these lists are maintained at the CBAT website, along with lists of novae, supernovae, comets, and solar system satellites announced by the Bureau. The Central Bureau issued 1380 new designations for supernova discoveries announced during 2006-2008, including nine designations for belated discovery reports for objects found in images from 1985, 1996, 2004, and 2005. The type-II supernova 2007it, which peaked at red mag ~12, appears to have been the brightest supernova detected in the past three years. The Central Bureau has continued to report occasional supernova linkages with observed γ-ray outbursts, as with objects that were given the supernova designations 2008D and 2008hw. The CBAT also began a new designation scheme (labelled 'PSN') for (generally fainter) possible supernovae that are unconfirmed spectroscopically, and it maintains a website list with these objects.

The Central Bureau issues designations and names of comets, and during 2006- 2008 it announced 176 designations of new and recovered comets observed from the ground, plus 469 designations for presumed comets found by solar imaging spacecraft (six by *STEREO*, the rest by *SOHO* – none of which were observed from the ground). Presumed comets discovered via *SOHO* spacecraft images are found primarily by amateur astronomers looking at images at the *SOHO* website, and the *SOHO* comets reported in the past three years include many objects found from the mid-1990s through 2005 (though the majority were from 2006 onwards). The last three years also saw a large increase (by ~50-60 percent) over the previous five years in the number of satellites of minor planets reported – continuing the trend that started around 2000; a large portion of this increase involves transneptunian objects, which has naturally created much excitement and investigation in recent years. The Central Bureau also announced the annual recipients of the Edgar Wilson Award for the discoveries of comets by amateur astronomers (three recipients each in 2006 and 2007, and two in 2008).

The continuing close collaboration of the CBAT with the Minor Planet Center resulted in near-simultaneous announcements on IAU Circulars and Minor Planet Electronic Circulars of most of the professional-survey comets, many of which are initially reported as asteroidal but found to show cometary appearance elsewhere by follow-up observers (many of whom again are amateurs) who monitor the MPC's 'Near-Earth-Object Confirmation' webpage. Some initial information on comet discoveries and recoveries appears also on CBETs, which can be prepared and issued more rapidly than the IAUCS.

The Central Bureau is working hard to get all its older IAUCs available online. Plain-ASCII-text versions of Circulars from about No. 1600 onwards should be available at the CBAT website by the end of 2010, and most of the earlier Circulars should also be available at the CBAT website in jpeg image form (from scans) by year's end; they are being added to nearly every week. We thank Sally Bosken (U.S. Naval Observatory

Librarian), her assistants, and Lone Gross (Astronomical Observatory Library, University of Copenhagen), for their time and effort in helping to augment the HCO/SAO collection of older IAUCs (which suffered from damage).

Assistant Director G. V. Williams has continued to serve as joint MPC/CBAT webmaster (and has been responsible for the Web CS dissemination of the IAUCs). All of the year's Circulars were prepared by the undersigned, with very helpful editorial backup by Director Emeritus B.G. Marsden, who prepared some CBETs during the Director's absence from Cambridge during the year (and helped to proofread and referee many IAUCs prior to issuance and to discuss many CBAT matters from his decades of experience as CBAT Director). Numerous referees worldwide, especially some who are Commission 6 members, are also to be thanked for their great help with many items published on Circulars in the past triennium. Correspondence with scientists, the general public, and the news media occupies much of the Director's time, with thousands of e-mails and many phone calls relating to CBAT science arriving each year. At SAO, Muazzez Lohmiller has continued to handle the accounts, addressing of envelopes, and other administrative matters. Dan Wooldridge continues, as he has for years, with the fine printing of the IAUC cards. The CBAT has continued its notable presence on the World Wide Web, with those Circulars and CBETs older than about one year being posted freely. The number of paid subscribers to the printed edition of the IAU Circulars continued to fall, from 146 at the end of 2005 to 103 at the end of 2008.

However, the subscriptions to the printed IAUCs do pay for the cost of printing and mailing, and there clearly is a continued interest in printing the IAUCs – both from the subscribers and from contributors who perceive a certain prestige for a publication with a very long history in print, despite the simultaneous online presence. In addition, there were 14 free (complimentary or exchange) subscriptions to the printed IAUCs at the end of 2005. The printed IAUCs go to 43 addresses within North America and 74 outside of North America. The number of subscribers to the Computer Service (shared by the CBAT with the MPC, and which includes web access to all CBAT publications plus eligibility for e-mail delivery) remained very stable, at around 460.

Until 2000, the Director's salary was paid by SAO, with two additional CBAT employees paid entirely by subscriptions to the Bureau's publications. The tremendous growth of the World Wide Web has eaten into the subscription revenues of the CBAT, just as it has with magazines and newspapers worldwide: people have come to expect information to be freely available on the Web, expecting that 'somebody else will pay for whatever professional expertise is necessary to make that information available. Thus, the total number of recipients of CBAT publications (both printed and electronic) is down by roughly 50 percent from the pre-Web era.

The Central Bureau is grateful to the U.S. National Science Foundation for funding half of the Director's salary during 2008 - 2010, and to the IAU for its small-but-helpful annual subvention that helps to pay for supplying CBAT publications to astronomers in countries with poor financial support. As noted in recent reports, the subscription and line-charge income is no longer sufficient to sustain fully the salary of the current CBAT Director, as it had done for decades, together with secretarial help. While there are likely sufficient funds through the existing sources to pay the Director's and secretary's salaries into 2010, additional funding is needed for the long-term health of the CBAT. The Director continues actively to seek alternate sources of income to maintain the CBAT. It is hoped that individual countries may help with small contributions to ensure that the important work of the Bureau in serving the astronomical community can continue.

History of the Minor Planet Center (MPC)

Brian G. Marsden, Harvard Smithsonian CfA, 27 March 2009
IAU Information Bulletin 104, June 2009

Until World War II, the recording of observations and the computation of orbits of the minor planets was principally organized in Germany. This arrangement then broke down, obviously in part due to the war, but also because the ever-increasing number of observations made possible by improving photographic emulsions taxed the ability of astronomers using logarithms and mechanical calculators to utilize them in orbit computations. After World War II, the organizational work was largely divided between the U.S.A. and the U.S.S.R., with the observations being collected at the Cincinnati Observatory and the publication of the annual ephemeris volumes at the Institute for Theoretical Astronomy in Leningrad, both of these activities being overseen by IAU Commission 20. The Cincinnati operation, given the name *Minor Planet Center* in 1947 by its first director, Paul Herget, became feasible because of the availability of at least some automated computing. Further, continuity with pre-war work became possible because some of the earlier 68 practitioners continued to be associated with the West German branch of the Astronomisches Rechen-Institut in Heidelberg, and one Rechen-Institut staff member, Eugene Rabe, moved to Cincinnati. Peter Musen also joined the MPC staff and contributed in particular to the development of automated procedures for the computation of planetary perturbations. Indeed, throughout the 1950s the strength of the MPC lay in that area, with the perturbative effects on many hundreds of minor planets being developed on computers at the Gas Company and at Procter and Gamble in Cincinnati, and eventually on the university's IBM 650. Herget also arranged for orbital computations to be carried out on the Naval Ordnance Research Calculator in Dahlgren, Virginia, a capability he recognized by giving to minor planet (1625) the name 'The NORC'. The actual fitting of the perturbed orbits to the observations was largely done by hand, by many astronomers around the world, including some at the Astronomisches Rechen-Institut, which in fact continued to assign all the provisional designations of newly discovered minor planets until well into the 1960s.

The early efforts of the MPC were devoted to cleaning up the situation with regard to the numbered minor planets, of which there were 1564 when the MPC was established. To secure the necessary new observations

Herget enlisted the assistance of Frank Edmondson and others at Indiana University. Initially, well over 10% of the orbit computations were in bad shape, with many observations attributed to the wrong objects. Concentration on this work meant that relatively little attention was paid to augmenting the set with new objects, although a handful of astronomers around the world did take an interest in trying to identify new discoveries with objects observed so weakly in the past that they had not yet been numbered. Conrad Bardwell joined the MPC staff in 1958 and a few years later was developing and using automated procedures for making identifications of this type. Around that same time Herget developed new procedures for the automated computation of preliminary orbits, applying these in particular to the 2000 new discoveries made in the course of the pioneering work of Tom Gehrels, Kees van Houten and Ingrid van Houten-Groeneveld in the Palomar-Leiden Survey. Nevertheless, despite the steady increase in computing capability, and the success of a comprehensive new observing program at the Crimean Astrophysical Observatory in the late-1960s and throughout the 1970s, when Herget retired as MPC director in 1978 the set of numbered minor planets had increased only to 2060, and 1% of the pre-war numberings were still lost. Herget's retirement as director also meant the closure of the historic Cincinnati Observatory as a research organization. My appointment to succeed Herget as director meant that the MPC would be moving to the Smithsonian Astrophysical Observatory in Cambridge. The continuing operation of the MPC benefited greatly from Bardwell's appointment as MPC assistant director and later as associate director, a position he held until his retirement in 1989. There was also a magnetic tape containing the Cincinnati collection of 190,000 positional observations of minor planets, a compilation intended to be complete back to 1939. As director of the Central Bureau for Astronomical Telegrams I had made a similar collection of 25,000 observations of comets, and it therefore seemed appropriate at least partially to combine the two IAU functions. Although the CBAT was, and still is responsible for announcing the discoveries of comets, it was more efficient to use the MPC resources to publish and file subsequent observations of these bodies. The relationship between the organizations was further cemented by the fact that the CBAT was announcing the discoveries of what were then generally termed 'earth-crossing asteroids'. Thanks largely to the work of Eugene Shoemaker and Eleanor Helin, the 1970s had seen a renaissance of interest in these objects, the observations and orbits of which were obviously being incorporated into the MPC files anyway. Beginning intermittently in 1978, then continuously since 1980, Dan Green joined the staffs of both the MPC and the CBAT, succeeding me as director of the latter in 2000.

The arrival of the MPC at SAO also coincided with a resurgence of observing programs, notable amongst them being those of Ted Bowell at the Lowell Observatory and Antonín Mrkos at Klet. An effort was made to incorporate pre-1939 observations in the MPC files, at least to the extent that every object with a 'new-style' (i.e., post-1925 style) provisional designation would be properly documented there. It was therefore inevitable that the inventory of numbered minor planets with high-quality orbits would soon start to increase, and during the 1980s there was a doubling to 4295 (way ahead of my 1978 estimate we should reach 4000 around the end of the century!), with only two of the early numberings still lost. The MPC and the CBAT had started 'to go electronic' already in 1984, with a dial-up facility that would allow the exchange of messages and a computer program that allowed the user to identify numbered minor planets, a feature that was particularly useful for observers who suspected they had discovered a nova. Gareth Williams joined the MPC staff on Bardwell's retirement; in 1991 he identified the missing (878) Mildred and was soon afterward appointed MPC associate director. By this time CCDs were starting to replace photography for the acquisition of observations, and the idea of discovering 90% of the kilometre-sized 'near-earth asteroids' (as they came to be called) within a matter of decades was becoming a serious aim. Searches for objects in the outer solar system also became a worthy endeavour, with the year 1992 seeing the discovery, not only of the second transneptunian object (after Pluto), but also of the second 'centaur', a body confined generally to the Saturn-Uranus-Neptune region – this coming after the 1977 discovery of (2060) Chiron, the last object to be numbered while the MPC was located in Cincinnati.

Herget initiated the series of *Minor Planet Circulars*. This was the publication, generally in batches two or three times a year, of observations, orbits, ephemerides and the assignment of new minor-planet names, and 4390 pages had been issued when he retired. After the move to Cambridge these batches of MPCs were issued monthly. In 1993 we introduced the *Minor Planet Electronic Circulars*, principally to document the discoveries of NEAs with the greater immediacy they require, although they also proved useful for announcing new TNOs, in the hope of inspiring adequate follow-up at their discovery oppositions. It was to be understood that these electronic announcements were a temporary publication, the permanent documentation subsequently being in the MPCs. In 1996 we introduced the even more temporary 'NEO Confirmation Page', an internet site on which new discoveries of candidate NEOs would be announced within a matter of hours of their first observation and prior to the assignment of an MPC provisional designation for them. After enough follow-up observations had been received, the objects were removed from the NEOCP, given an MPC designation, and the detailed information was issued on one of the *MPEC*s.

We added the millionth minor-planet observation to our files in 1996, and the ever-increasing size of the monthly batches of *MPC*s made it desirable, a year or so later, to transfer the publication of the observations to a supplement series, available only electronically. By 2001 we were frequently also issuing a 'midmonth' supplement batch, and since 2003 this supplement has generally been appearing weekly. Minor-planet numberings reached 10,000 in 1999, and this led us, again a year of so later, to introduce a second supplement series for the publication of orbital elements, including a tabulation of the residuals. The *MPC*s themselves have continued to include summaries of the observations made by the contributing observatories and summaries of the orbital information. This has meant that, as of March 2009, the published *MPC*s still amount to only 65,554 pages (a doubling in little over 10 years), although the orbit supplement amounts to 154,270 pages and the observation supplement to 281,184. The publication of the *MPC*s themselves can still sometimes amount to 500 pages per month, so since the end of 2005 the version that is actually printed and mailed to subscribers has been restricted to the pages with citations for new namings and a summary of the new numberings, which reached 100,000 around that same time. The last remaining lost numbered object, (719) Albert, was identified by Williams in 2000.

Also in 2000, Tim Spahr joined the MPC staff, principally to attend to the burgeoning interest in NEAs. Kyle Smalley (a.k.a. Sonia Keys) also joined the staff, initially as a contractor but since 2005 as an employee, also mainly to work on NEAs. When Spahr was appointed the aim with regard to NEAs had been refined to the idea of finding 90% of the km-sized objects with perihelion distance under 1.3 AU by the end of 2008. The number found so far is around 800 and is estimated to be more than 80% of the likely total. From the point of view of the danger NEAs may represent for the earth, it is more meaningful to speak in terms of 'potentially hazardous asteroids', which have the possibility of passing within 0.05 AU of the earth. Early in the new century Spahr participated in national deliberations in the U.S.A. specifying the need to discover 90% of the PHAs down to a size limit of 140 meters, if possible by 2020. The number of such objects so far found is already more than 1000. Smaller objects are not ignored, and in October 2008, for the first time, a 5-meter natural object was discovered out in space that subsequently hit the earth. The lead time was only 20 hours, but enough information was garnered that allowed a number of tiny fragments to be recovered from northern Sudan.

The search for NEAs and PHAs has provided the principal impetus for increased automation in the MPC operations. For already more than a decade, a 'Daily Orbit Update' *MPEC* has been automatically prepared (around 2 a.m. local time) with all the orbits computed at the MPC during the previous 24 hours; this DOU *MPEC* also includes the observations of NEAs received during that time. Another longstanding automated feature is that e-mails addressed to the MPC that contain observations are partially processed by the time a staff member actually sees them: minor formatting errors are corrected, and the observations are filed separately, according as to whether they are of comets, TNOs, NEAs or main-belt objects, as well as whether they are numbered objects, other multiple-opposition objects or just discovered recently.

A more recent automated feature allows for verifying observations of numbered objects, say, to the point that they are filed for publication in the weekly observation supplement. Some particularly ingenious MPC software allows NEA candidates to be placed on the NEOCP automatically, essentially as soon as they arrive. As further observations arrive the predicted NEA ephemerides are automatically updated. Although there is also automation for the extraction of the names of the observers and their instrumentation directly from the e-mail messages, we have drawn the line – for obvious reasons – at having this go through to publication. Nevertheless, when observers are actually credited on the MPECs and MPCs, this is usually done with rather minimal human editing. I retired as MPC director in 2006, and after an interim period, Spahr moved into the position of director. Despite its tiny staff (including myself in an emeritus position), the MPC continues to flourish, and our files now include 62 million observations (455,000 of them being of comets), 210,454 numbered minor planets, 155,183 other multiple-opposition objects, some 6100 NEAs and more than 1300 transneptunians and centaurs. To someone such as myself, who first visited the MPC in Cincinnati some 49 years ago; and to Bardwell, who by then had already been on the staff for two years and still takes a significant interest in what the MPC does, the enormous increase in activity is quite remarkable. One thing that has not changed, however, is the MPC's detailed attention to accuracy and to giving credit where it is due. As we move now toward the era of Pan- STARRS and the Large Synoptic Survey Telescope, we obviously expect to see yet more of the same. Whether anybody will actually care about minor planets (the vast majority of them in the main belt, at any rate) half a century from now remains to be seen.

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.

Comet impacts may have triggered ancient famine
New Scientist

It has been proposed that multiple comet impacts around 1500 years ago may have triggered a 'dry fog' that plunged half the world into famine. Historical records tell us that from the beginning of 536 March a fog of dust blanketed the atmosphere for 18 months. During that time, the Sun (it was said) gave no more light than the Moon, global temperatures plummeted and crops failed. The cause has been unknown, but theories have included a great volcanic eruption or an impact from space. Now scientists have found the first, indirect, evidence that multiple impacts caused the haze. They found tiny balls of condensed rock vapour or 'spherules' in debris inside Greenland ice cores dating back to early 536 AD. Though the spherules' chemistry suggests that they did not belong to an impactor, they do point to terrestrial debris ejected into the atmosphere by an impact event. That represents the first actual geological evidence for an impact in 536.

The fallout material was laid down over several years, and some layers were particularly densely deposited. That suggests that more than one impactor was involved -- probably comets, which do tend to fragment. Two possible submarine craters whose age ranges fit the global dimming event have been identified -- one is in the Gulf of Carpentaria in Australia, and the other in the North Sea near Norway. Marine micro-fossils found with the impact spherules are consistent with an ocean impact.

The Active Centaurs *David Jewitt* The Astronomical Journal

The Centaurs are recent escapees from the Kuiper belt that are destined either to meet fiery oblivion in the hot inner regions of the Solar system or to be ejected to the interstellar medium by gravitational scattering from the giant planets. Dynamically evolved Centaurs, when captured by Jupiter and close enough to the Sun for near-surface water ice to sublimate, are conventionally labelled as ``short-period'' (specifically, Jupiter-family) comets. Remarkably, some Centaurs show comet-like activity even when far beyond the orbit of Jupiter, suggesting mass-loss driven by a process other than the sublimation of water ice. We observed a sample of 23 Centaurs and found nine to be active, with mass-loss rates measured from several kg s-1 to several tonnes s-1. Considered as a group, we find that the ``active Centaurs" in our sample have perihelia smaller than the inactive Centaurs (median 5.9 AU vs. 8.7 AU), and smaller than the median perihelion distance computed for all known Centaurs (12.4 AU). This suggests that their activity is thermally driven. We consider several possibilities for the origin of the mass-loss from the active Centaurs. Most are too cold for activity at the observed levels to originate via the sublimation of crystalline water ice. Solid carbon monoxide and carbon dioxide have the opposite problem: they are so volatile that they should drive activity in Centaurs at much larger distances than observed. We consider the possibility that activity in the Centaurs is triggered by the conversion of amorphous ice into the crystalline form accompanied by the release of trapped gases, including carbon monoxide. By imposing the condition that crystallization should occur when the crystallization time is shorter than the orbital period we find a qualitative match to the perihelion distribution of the active Centaurs and conclude that the data are consistent with the hypothesis that the Centaurs contain amorphous ice.

Jupiter - Friend or Foe? II: The Centaurs *J. Horner and B.W. Jones* International Journal of Astrobiology

It has long been assumed that the planet Jupiter acts as a giant shield, significantly lowering the impact rate of minor bodies upon the Earth, and thus enabling the development and evolution of life in a collisional environment which is not overly hostile. In other words, it is thought that thanks to Jupiter, mass extinctions have been sufficiently infrequent that the biosphere has been able to diversify and prosper. However, in the past, little work has been carried out to examine the validity of this idea. In the second of a series of papers, we examine the degree to which the impact risk resulting from objects on Centaur-like orbits is affected by the presence of a giant planet, in an attempt to fully understand the impact regime under which life on Earth has developed. The Centaurs are a population of ice-rich bodies which move on dynamically unstable orbits in the outer Solar system. The largest Centaurs known are several hundred kilometres in diameter, and it is certain that a great number of kilometre or sub-kilometre sized Centaurs still await discovery. These objects move on orbits which bring them closer to the Sun than Neptune, although they remain beyond the orbit of Jupiter at all times, and have their origins in the vast reservoir of debris known as the Edgeworth-Kuiper belt that extends beyond Neptune. Over time, the giant planets perturb the Centaurs, sending a significant fraction into the inner Solar System where they become visible as short-period comets. In this work, we obtain results which show that the presence of a giant planet can act to significantly change the impact rate of short-period comets on the Earth, and that such planets often actually increase the impact flux greatly over that which would be expected were a giant planet not present.

Jupiter – friend or foe? III: the Oort cloud comets *J. Horner, B. W. Jones & J. Chambers*

Abstract It has long been assumed that the planet Jupiter acts as a giant shield, significantly lowering the impact rate of minor bodies on the Earth. However, until recently, very little work had been carried out examining the role played by Jupiter in determining the frequency of such collisions. In this work, the third of a series of papers, we examine the degree to which the impact rate on Earth resulting from the Oort cloud comets is enhanced or lessened by the presence of a giant planet in a Jupiter-like orbit, in an attempt to more fully understand the impact regime under which life on Earth has developed. Our results show that the presence of a giant planet in a Jupiter-like orbit significantly alters the impact rate of Oort cloud comets on the Earth, decreasing the rate as the mass of the giant planet increases. The greatest bombardment flux is observed when no giant planet is present. For the full paper see http://jontihorner.com/papers/FoF-LPCs.pdf

The Colors of Cometary Nuclei - Comparison with Other Primitive Bodies of the Solar System and Implications for their Origin *P. Lamy and I. Toth* Icarus

We present new colour results of cometary nuclei obtained with the Hubble Space Telescope (HST) whose superior resolution enables us to accurately isolate the nucleus signals from the surrounding comae. By combining with scrutinized available data obtained with ground-based telescopes, we accumulated a sample of 51 cometary nuclei, 44 ecliptic comets (ECs) and 7 nearly-isotropic comets (NICs) using the nomenclature of Levison (1996). We analyze colour distributions and colour-colour correlations as well as correlations with other physical parameters. We present our compilation of colours of 232 outer solar system objects - separately considering the different dynamical populations, classical KBOs in low and high-inclination orbits (respectively CKBO-LI and CKBO-HI), resonant KBOs (practically Plutinos), scattered-disk objects (SDOs) and Centaurs - of 12 candidate dead comets, and of 85 Trojans. We perform a systematic analysis of all colour distributions, and conclude by synthesizing the implications of the dynamical evolution and of the colours for the origin of the minor bodies of the solar system. We find that the colour distributions are remarkably consistent with the scenarios of the formation of TNOs by Gomes (2003) generalized by the "Nice" model (Levison et al., 2008), and of the Trojans by Morbidelli et al. (2005). The colour distributions of the Centaurs are globally similar to those of the CKBO-HI, the Plutinos and the SDOs. However the potential bimodality of their distributions allows the possibility to distinguish two groups based on their (B-R) index: Centaurs I with (B-R) > 1.7 and Centaurs II with (B-R) < 1.4. Centaurs I could be composed of TNOs (prominently CKBO-LI) and ultra red objects from a yet unstudied family. Centaurs II could consist in a population of evolved objects which have already visited the inner solar system, and which has been scattered back beyond Jupiter. The diversity of colours of the ECs, in particular the existence of very red objects, is consistent with an origin in the Kuiper belt. Candidate dead comets represent an ultimate state of evolution as they conspicuously appear more evolved than the Trojans and Centaurs II.

Glycine discovered in comet Goddard Space Flight Center

NASA scientists have discovered traces of the amino acid glycine in samples of Comet Wild 2 returned by the Stardust spacecraft. Stardust passed through dense gas and dust surrounding the icy nucleus of Wild 2 on

2004 January 2. As the spacecraft shot past, a special collection grid filled with aerogel -- a novel sponge-like material that is more than 99% empty space -- 'gently' captured samples of the comet's gas and dust. The grid was stowed in a capsule that detached itself from the spacecraft and parachuted to Earth on 2006 January 15. Since then, scientists have been analyzing the samples to learn a bit about comet formation and our Solar System's history.

Preliminary analysis detected glycine in the aluminium foil from the sides of tiny chambers that held the aerogel in the collection grid and also in a sample of the aerogel. However, since terrestrial life uses glycine, at first the team was unable to rule out contamination from sources on Earth. It was possible that the glycine originated from handling or manufacture of the Stardust spacecraft itself. The new research used isotopic analysis to adjudicate on that possibility.
A glycine molecule from space will tend to have more carbon-13 atoms in it than glycine from Earth. The team found that the Stardust glycine has an extra-terrestrial carbon-isotope signature, indicating that it originated in the comet.

147P/Kushida-Muramatsu. European Planetary Science Congress 2009

Comet 147P/Kushida-Muramatsu was captured as a temporary moon of Jupiter in the mid-20th century and remained trapped in an irregular orbit for about twelve years.

There are only a handful of known comets where this phenomenon of temporary satellite capture has occurred and the capture duration in the case of Kushida-Muramatsu, which orbited Jupiter between 1949 and 1961, is the third longest. The discovery was presented at the European Planetary Science Congress in Potsdam by Dr David Asher on Monday 14 September.

An international team led by Dr Katsuhito Ohtsuka modelled the trajectories of 18 “quasi-Hilda comets”, objects with the potential to go through a temporary satellite capture by Jupiter that results in them either leaving or joining the “Hilda” group of objects in the asteroid belt. Most of the cases of temporary capture were flybys, where the comets did not complete a full orbit. However, Dr Ohtsuka’s team used recent observations tracking Kushida-Muramatsu over nine years to calculate hundreds of possible orbital paths for the comet over the previous century. In all scenarios, Kushida-Muramatsu completed two full revolutions of Jupiter, making it only the fifth captured orbiter to be identified.

Dr Asher said, “Our results demonstrate some of the routes taken by cometary bodies through interplanetary space that can allow them either to enter or to escape situations where they are in orbit around the planet Jupiter.”

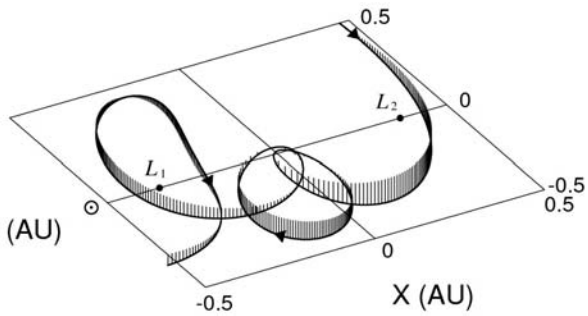
Asteroids and comets can sometimes be distorted or fragmented by tidal effects induced by the gravitational field of a capturing planet, or may even impact with the planet. The most famous victim of both these effects was comet D/1993 F2 (Shoemaker-Levy), which was torn apart on passing close to Jupiter and whose fragments then collided with that planet in 1994. Previous computational studies have shown that D/1993 F2 may well have been a quasi-Hilda comet before its capture by Jupiter.

“Fortunately for us Jupiter, as the most massive planet with the greatest gravity, sucks objects towards it more readily than other planets and we expect to observe large impacts there more often than on Earth. Comet Kushida-Muramatsu has escaped from the giant planet and will avoid the fate of D/1993 F2 for the foreseeable future”, said Dr Asher.

The object that impacted with Jupiter this July, causing the new dark spot discovered by Australian amateur astronomer Anthony Wesley, may also have been a member of this class, even if it did not suffer tidal disruption like D/1993 F2.

“Our work has become very topical again with the discovery this July of an expanding debris plume, created by the dust from the colliding object, which is the evident signature of an impact. The results of our study suggest that impacts on Jupiter and temporary satellite capture events may happen more frequently than we previously expected,” said Dr Asher.

The team has also confirmed a future moon of Jupiter. Comet 111P/Helin-Roman-Crockett, which has already orbited Jupiter three times between 1967 and 1985, is due to complete six laps of the giant planet between 2068 and 2086.



147/Kushida-Muramatsu’s orbital path around Jupiter (Ohtsuka/Asher)

"Atlas of Secular Light Curves of Comets" *Ignacio Ferrin* arXiv:0909.3498v1 [astro-ph.EP]

Abstract: In this work we have compiled 37,692 observations of 27 periodic and non-periodic comets to create the secular light curves (SLCs), using 2 plots per comet. The data has been reduced homogeneously. Our overriding goal is to learn the properties of the ensemble of comets. More than 30 parameters are listed, of which over ~20 are new and measured from the plots. We define two ages for a comet using activity as a proxy, the photometric age P-AGE, and the time-age, T-AGE. It is shown that these two parameters are robust, implying that the input data can have significant errors but P-AGE and T-AGE come out with small errors. This is due to their mathematical definition. It is shown that P-AGE classifies comets by shape of their light curve. The value of this Atlas is twofold: The SLCs not only show what we know, but also show what we do not know, thus pointing the way to meaningful observations. Besides their scientific value, these plots are useful for planning observations. The SLCs have not been modelled, and there is no cometary light curve standard model as there is for some variable stars (i.e. eclipsing binaries). Comets are classified by age and size. In this way it is found that 29P/Schwassmann-Wachmann 1 is a baby goliath comet, while C/1983 J1

Sugano-Saigusa-Fujikawa is a middle age dwarf. There are new classes of comets based on their photometric properties. The secular light curves presented in this Atlas exhibit complexity beyond current understanding.

Earth's atmosphere came from space? National Geographic News

A new study proposes that the gases that make up Earth's atmosphere came from a swarm of comets, not from volcanoes as has been thought. The new theory came about after scientists discovered that pristine samples of the elements krypton and xenon, recently collected from deep within the Earth, have the same chemical make-up as ancient meteorites.

Most of the gases in the air we breathe originated in the solar nebula, the cloud of gas and dust that formed the Sun and planets. The gases became gravitationally bound to the young Earth and were then transported into the Earth's interior -- leaking out over the aeons through vulcanism and cracks in the Earth's crust. It is true that volcanoes emitted some gases, but now it is being suggested that that contribution was insignificant. Scientists studied krypton and xenon because they are 'noble' gases, so called because they do not associate chemically with most other elements. As a result, most of the Earth's krypton has remained unchanged since its arrival on our planet. The team claims that our atmosphere formed when gas- and water-rich comets bombarded the Earth shortly after its formation.

The Tunguska impact event and beyond. *Bill Napier and David Asher.* A&G, February 2009

In this paper Bill Napier and David Asher consider possible contributions to cosmic impacts on our planet. They conclude that over the last 250 My, comets have been the major contributor to global impacts. Not enough active comets are seen to account for this, so the majority must be dark, dormant objects. In addition periods of enhanced flux follow the fragmentation of comets in appropriate orbits, and the Taurid complex could be an example. They suggest that the three major airbursts of the twentieth century were from this source, and that we should expect more to come this century.

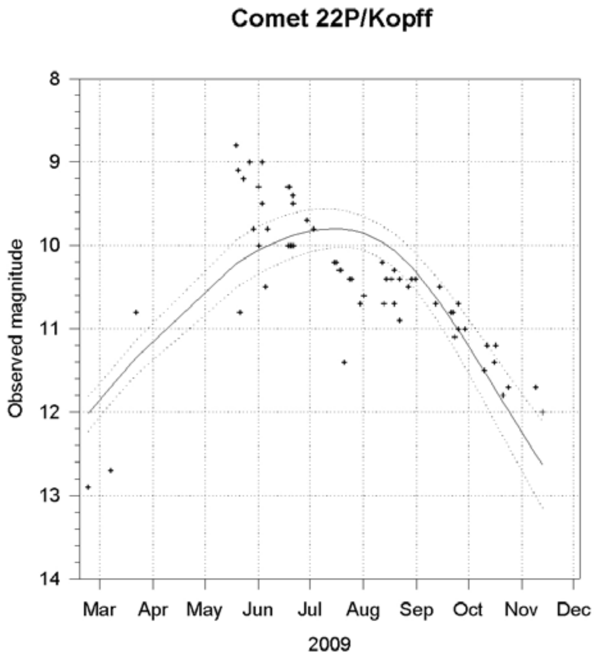
Review of comet observations for 2009 January - 2009 December

The information in this report is a synopsis of material gleaned from IAU circulars 9008 – 9107, The Astronomer (2009 January – 2009 December) and the Internet. Note that the figures quoted here are rounded off from their original published accuracy. Lightcurves for the brighter comets are mostly from observations submitted to the Director. A full report of the comets seen during the year, including observations published in The Astronomer will be produced for 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.

Information that used to be published in the Observing Supplement can be found on the Section web pages and in the BAA Guide to Observing Comets. Reminders of the observing circumstances of forthcoming comets will however continue to appear in the predictions for the year.

22P/Kopff imaged by Alexander Baransky on May 12.

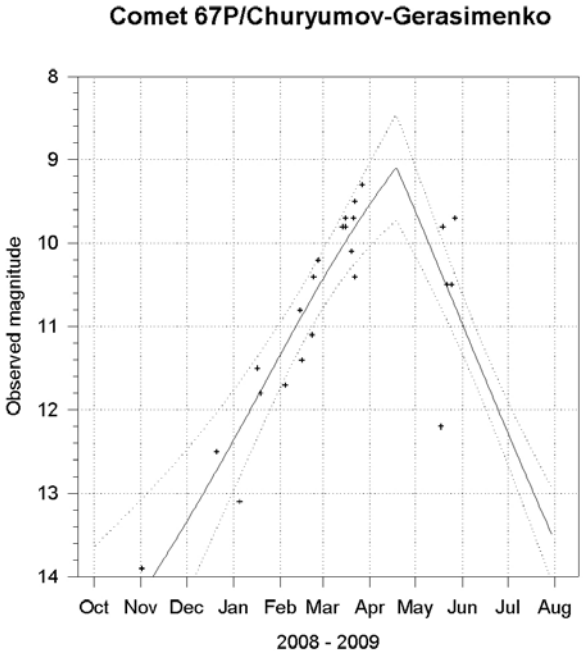
As predicted, **22P/Kopff** was at its brightest in June, though neither a standard light curve nor a linear light curve is a good fit the observations. The comet remained weakly condensed throughout, and few visual observers reported a tail. It was not well placed for observation from the UK, and in addition it was a morning object until well past its brightest.



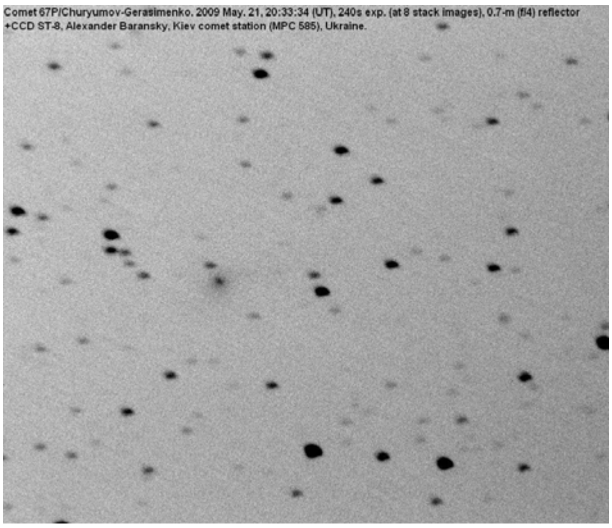
29P/Schwassmann-Wachmann continued to show enhanced activity, with positive observations through most of January, February and March, and again after conjunction in September to November. On several occasions in the spring it became brighter than 11th magnitude.

A few observations of **33P/Daniel** were made in February, when the comet was around 14th magnitude.

Comet **65P/Gunn** slowly brightened in the first half of the year. At around 13th magnitude it is brighter than expected, so may reach 11th magnitude in June. Unfortunately its southern declination will make it next to impossible for UK observers.

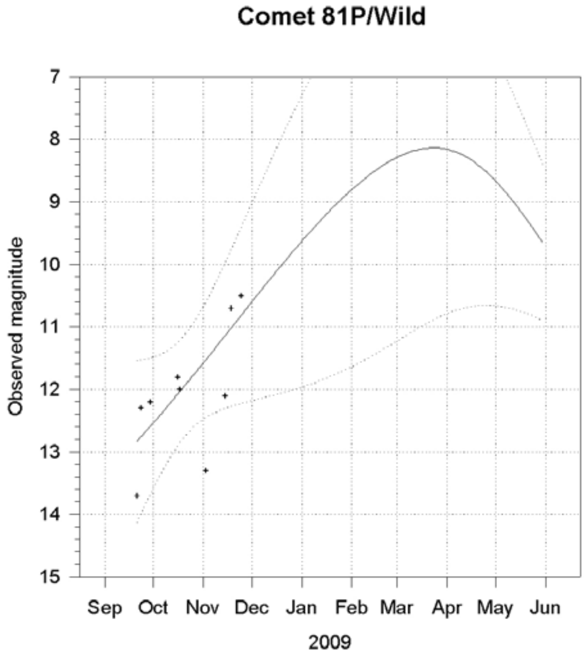


67P/Churyumov-Gerasimenko peaked at around 9th magnitude in April, significantly brighter than expected, and a linear light curve is a best fit to the available observations. These differences from expectation will be of interest to the ESA team controlling the Rosetta spacecraft, which is due to rendezvous with the comet at its coming aphelion in 2012 and follow the comet to perihelion in 2015 August. It won't come into position for visual observation from the UK until after perihelion, but this could be when it is at its brightest, based on the light curve from this return.



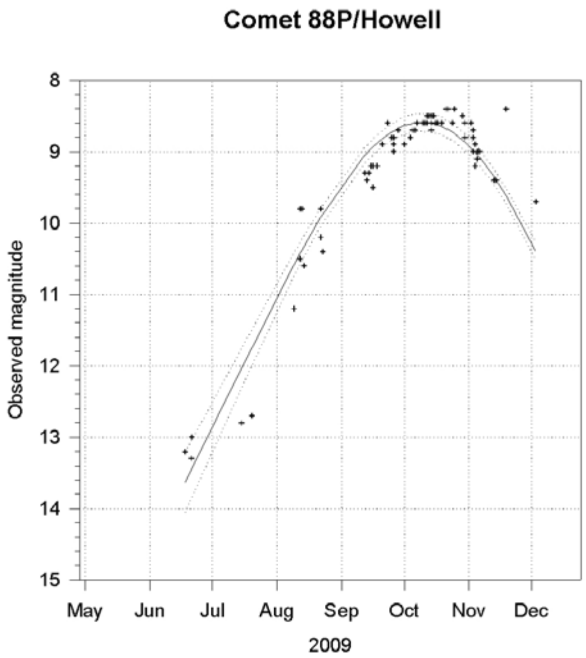
67P/Churyumov-Gerasimenko by Alexander Baransky on May 21.

Observations of **81P/Wild** began in September when it had already brightened to around 13th magnitude and it was approaching 10th magnitude by the end of the year. Further details are given in the predictions for 2010, though indications are that it could do slightly better than described there.

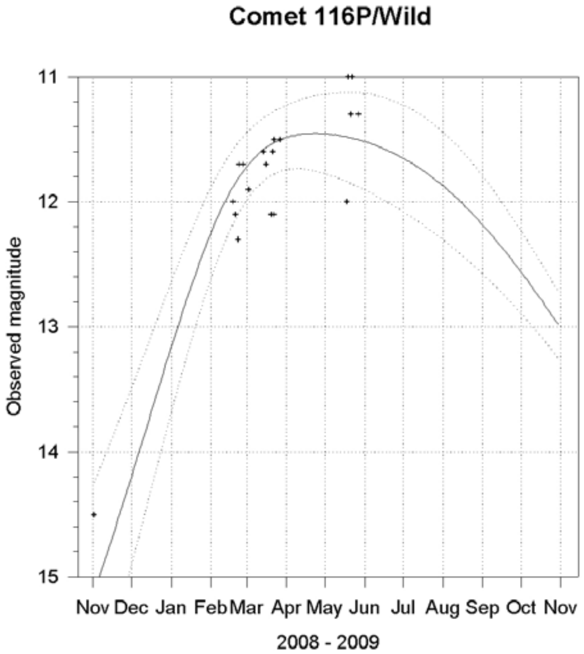


81P/Wild imaged by Rolando Ligustri on December 25

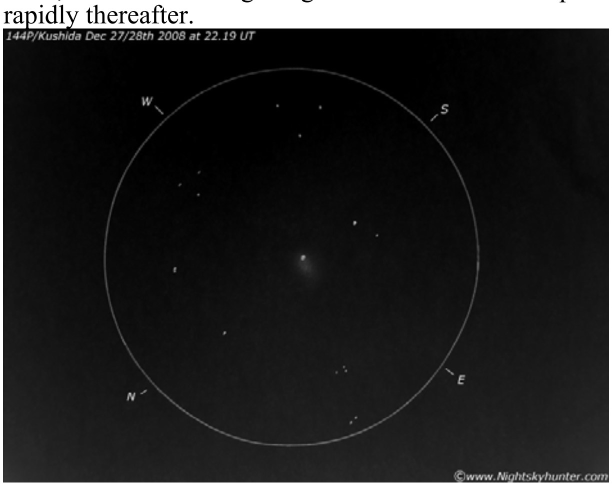
88P/Howell did rather better than expected, but was not so well observed from the UK on account of its southern declination.



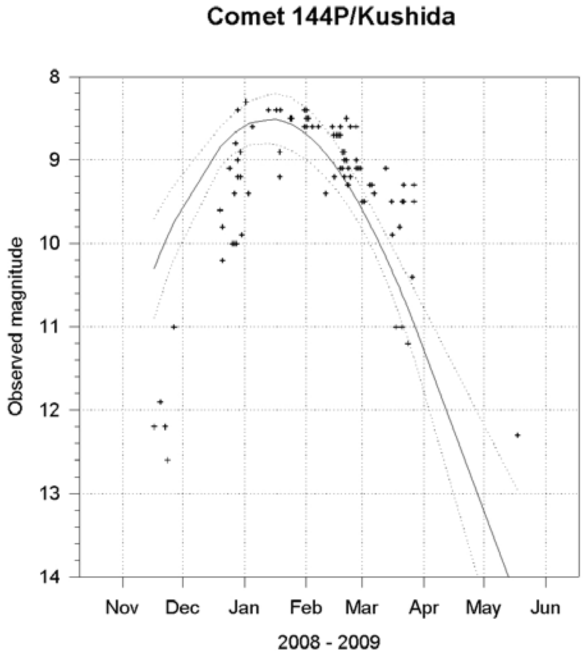
116P/Wild performed much as expected. Although reasonably well placed it was not widely observed from the UK.



144P/Kushida continued to brighten until mid January 2009, but with a large log r coefficient faded quite rapidly thereafter.



144P/Kushida drawn by Martin McKenna on 2008 December 27

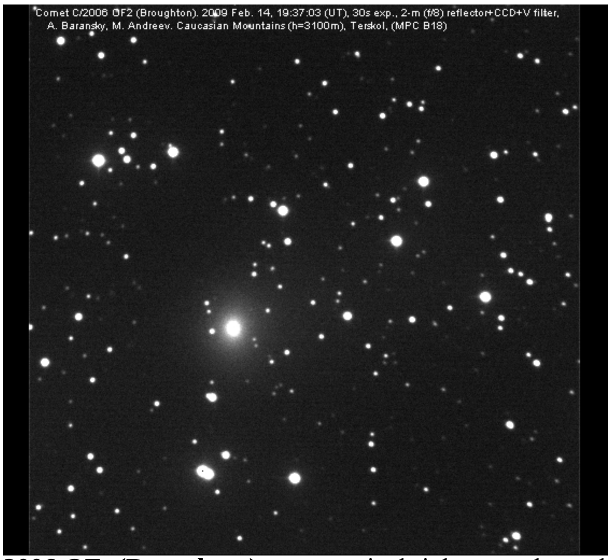


210P/Christensen was recovered visually in early January, when it was still around 10th magnitude. Few observers managed to follow it, but it seems to have faded to around 12th magnitude by the end of the month, with a final observation in late March at 13.7.

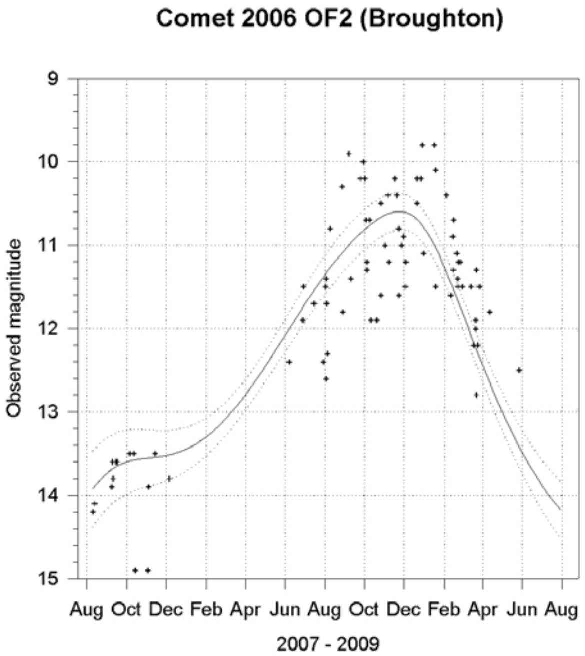
1997 J6 (P/SOHO) Following the linkage between 2001 D1, 2004 X7 and 2008 S2, Rainer Kracht revisited the archival SOHO C2 images from 1997 and was able to secure a positive identification of the comet.

Brian Marsden published a linked orbit on MPEC 2009-H56 [2009 April 26] and noted: The above computation, using nongravitational parameters A1 = +0.0002, A2 = -0.0002, is based on work by R. Kracht. Despite the poor quality of the SOHO observations, a purely gravitational computation from the four apparitions appears to leave significantly systematic residuals.

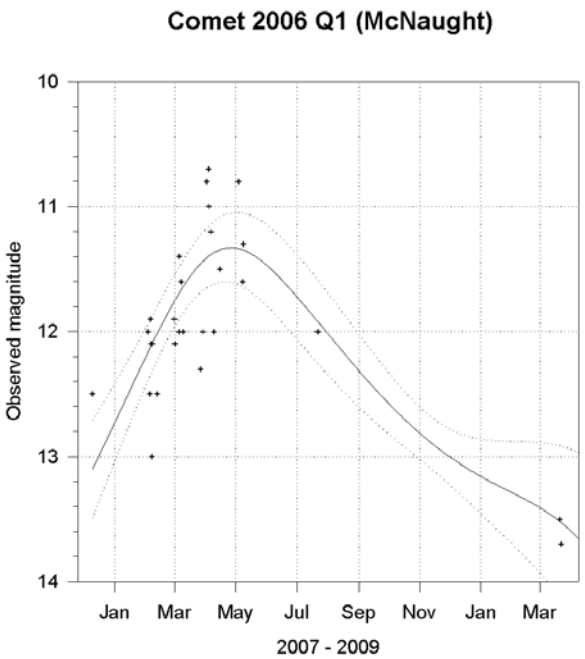
This suggests that the object really is a comet, and should therefore be numbered as such.



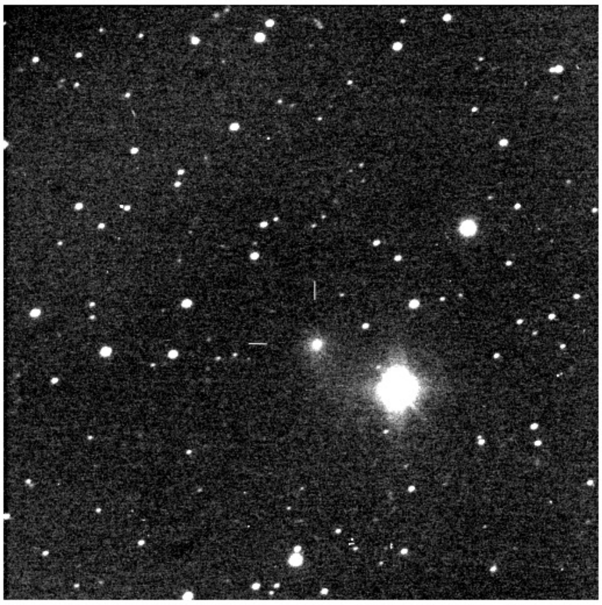
2006 OF_2 (Broughton).was near its brightest at the end of 2008, and faded rapidly in 2009. Section observers followed it well until March, but thereafter only a few observations were made.



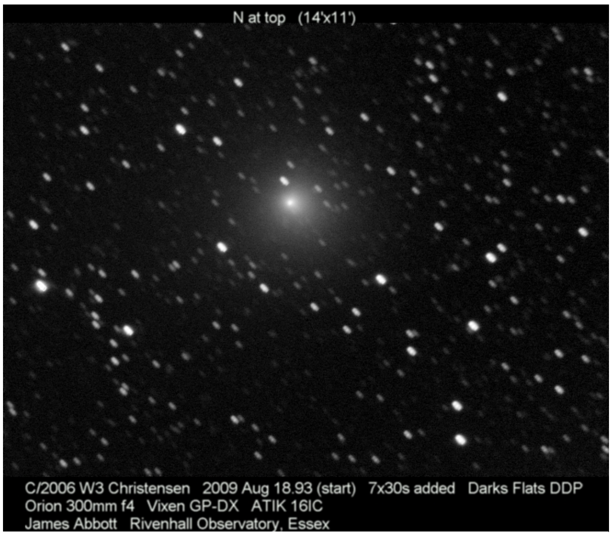
2006 Q1 (McNaught) had a long period of observation, running from 2007December to 2009 March. The comet was in solar conjunction for most of the second half of 2008, explaining the lack of observations for this period.

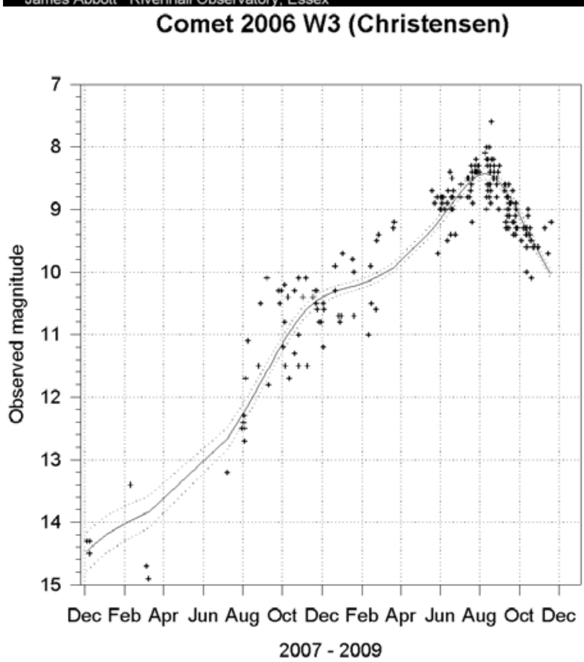


2006 W3 (Christensen) is another comet with a long period of observation, from 2007 December to 2009 November, with every prospect of further observations from the Southern Hemisphere when it emerges from solar conjunction in February. It is intrinsically quite a bright object, with an absolute magnitude of -0.7, suggesting that it is either very large or very active. The former is more likely as it is a relatively distant object with perihelion at 3.1 AU.



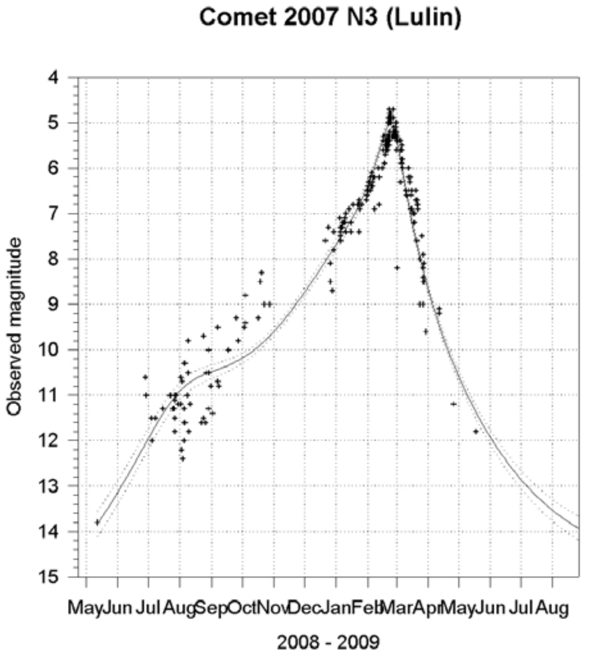
C/2006 Q1 (McNaught). 2009-05-29, 21:49:44. 18 x 20s unfiltered. ST9XE + C11. FOV 12'.4 x 12'.4 N up. Nick James. IAU 970.
CK06Q010 C2009 05 29.90954 16 24 18.08 +37 03 22.1 16.25N 970





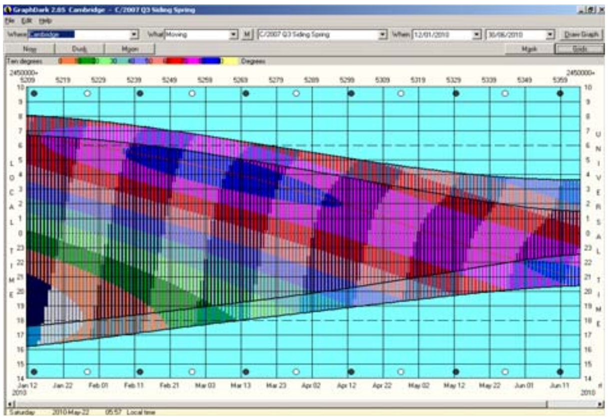
203 observations received so far suggest an uncorrected preliminary light curve of m = -0.7 + 5 log d + 14.8 log r. The comet is likely to remain visible to Southern Hemisphere observers until 2010 September.

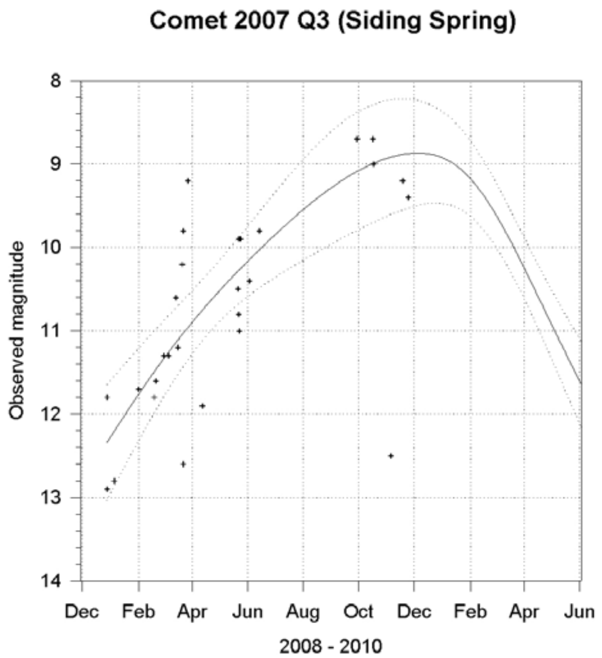
2007 N3 (Lulin) was the brightest comet of the year, reaching 5th magnitude in February when several observers saw it with the naked eye. Visual observations showed a tail one or two degrees long. The light curve is very normal, with 239 observations giving an uncorrected preliminary light curve of m = 5.5 + 5 log d + 10.5 log r.



2007 N3 imaged by John Vetterlein on February 25

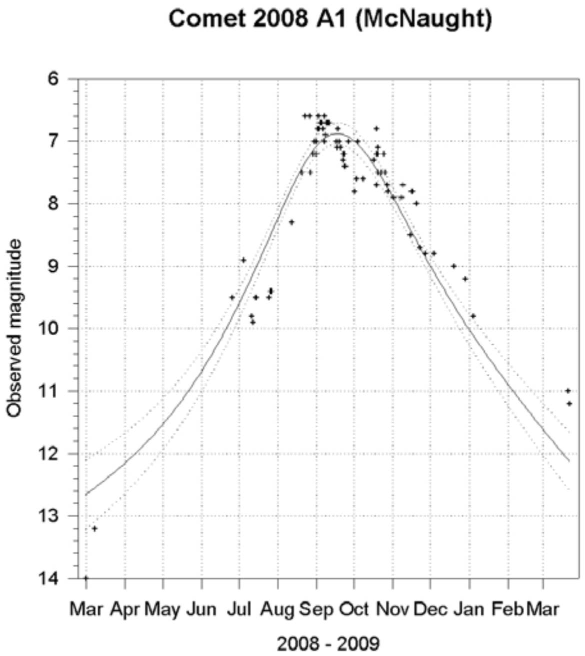
Observations of **2007 Q3 (Siding Spring)** began at the end of 2008 for Southern Hemisphere observers, and their observations show that the comet brightened steadily. Observers in the Northern Hemisphere picked it up after solar conjunction, however it was a morning object and despite its relative brightness few observers have braved the winter weather. As is often the case, there is something of a discord between CCD magnitudes and the visual observations. The comet becomes better placed as it fades and hopefully more observers will follow it.



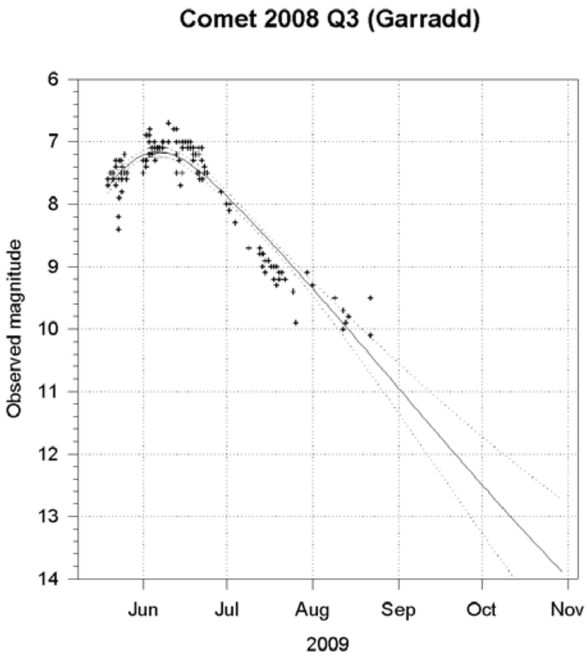


2007 Q3 near NGC 5466 on 2010 January 10 – Rolando Ligustri

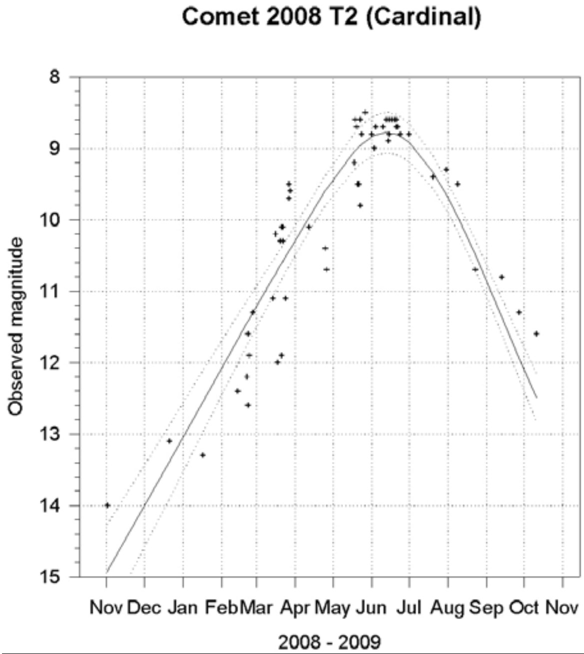
Observations of **2008 A1 (McNaught)** continued into 2009, but only for a few favourably placed observers.

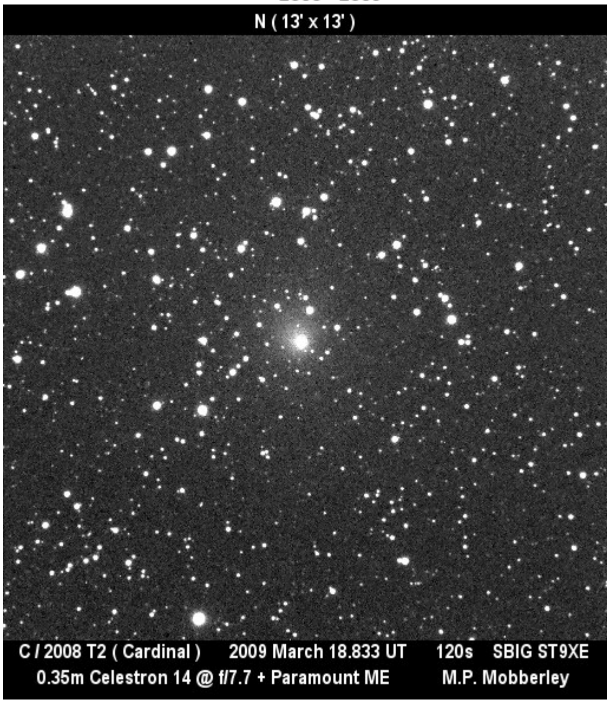


2008 Q3 (Garradd) reached perihelion at 1.8 AU in June 2009. It was only expected to reach 13th magnitude, but observers picked it up at nearly 7th magnitude in May. This shows the value of checking up on all comets during their apparition, particularly ones that have been discovered by professional astronomers a long time prior to perihelion. The light curve is quite a steep one, with 132 observations giving an uncorrected preliminary light curve of m = -1.1 + 5 log d + 32.5 log r.



2008 T2 (Cardinal) reached perihelion at 1.20 AU in mid June 2009, when it was a little brighter than 9th magnitude. Northern hemisphere observers were able to follow it into May, but it was best seen from the Southern Hemisphere when at its brightest.





SOHO Comets. Altogether 183 SOHO comets and 15 STEREO comets were discovered during the year. Some still await orbits. A further 4 SOHO and 1 STEREO comets have so far been discovered in 2010.

Meyer Group SOHO comets 2009 B10, D6, D8, E3 were discovered with the SOHO LASCO coronagraphs and were not observed from the ground.

Kracht Group SOHO comets 2009, L8, L13 were discovered with the SOHO LASCO coronagraphs and were not observed from the ground.

Brian Marsden noted on MPEC 2009-O22 [2009 July 21]: It seems rather likely that the two Kracht group comets C/2009 L8 and C/2009 L13 were previously observed as one (or maybe two) of the Kracht members of May 2004 (C/2004 J4, 2004 J12, 2004 J13, 2004 J15, 2004 J16, 2004 J17, 2004 J18 and 2004 J20; see MPEC 2004-M71, 2004-N04, 2004-N05 and 2007-K65).

Identity with comets C/2004 A3 or C/2004 B3 (suggested by K. Battams) or with C/2004 L10 (which itself was perhaps a return of comet C/1999 M3) seems a less likely prospect. Given the poor quality of the observations, the computation of a definite linkage is further complicated by the fact that there would have been an approach to within some 1.2 AU of Jupiter in 2008.

Marsden Group SOHO comet 2009 J12 was discovered with the SOHO LASCO coronagraphs and was not observed from the ground.

Kreutz group comets SOHO 2009 A2, A3, A4, A5, A7, B8, B9, B11, C3, C4, C5, D2, D3, D4, D5, D7, E2, E4, E5, F8, F9, F10, G2, G3, G4, G5, G6, G7, H3, H4, H6, H7, H8, J1, J2, J3, J4, J5, J6, J7, J8, J9, J10, J11, K6, K7, K8, K9, K10, K11, K12, K13, K14, L3, L4, L5, L6, L7, L9, L10, L11, L12, L14, L15, L16, L17, M1, M2, M3, M4, M5, M6, M7, O5, P3, P4, P5, Q6, Q7, Q8 were discovered with the SOHO LASCO coronagraphs and **STEREO 2009 A6, A8, A9, A10, B6, B7, C1, C2, O1** with the STEREO coronagraphs and have not been observed elsewhere. They were sungrazing comets of the Kreutz group and were not expected to survive perihelion. Some of these comets show no tail at all and it is possible that some supposed observations of Vulcan were actually tiny Kreutz group comets. 1451 SOHO and STEREO members of the group have now been discovered. SOHO has discovered 1780 confirmed comets with STEREO having another 23, though some more await orbit determination. At the moment there are no resources to measure the SOHO comets, though it is hoped that the position may change.

2009 A1 (STEREO) This was a non-group comet discovered in HI1A images by Alan Watson on 2009 January 13. Dimitry Chestnov and Rainer Kracht computed preliminary orbits, and Karl Battams was then able to get additional measurements from HI1B. There was a chance that ground based southern hemisphere observers might be able to image it when it emerged from solar conjunction in late January, but it was not seen.

A/2009 AU_1 [Tozzi] This unusual asteroid was discovered by Italian amateur astronomer Fabrizio Tozzi, working remotely with the Sierra Stars 0.6m reflector on January 3.29. It was initially confirmed by himself using other remote observatories. Follow-up observations show a stellar appearance to the 18th magnitude object. It has a period of 9.7 years and perihelion was at 2.3 AU in late July 2008. [MPEC 2009-A48, 2009 January 8, 9-day orbit]. There have been no recent close encounters with Jupiter or the Earth. The Tisserand criterion with respect to Jupiter is 2.77 This type of orbit is typical of Jupiter family comets.

A/2009 AU_{16} [Siding Spring] This unusual object was discovered during the Siding Spring Survey with the 0.5m Uppsala Schmidt on January 6.55. It has a period of 260 years and it was discovered near the time of perihelion, which was at 1.9 AU. [MPEC 2009-B21, 2009 January 20, 13-day orbit]. With a Tisserand parameter of 1.84 and an absolute magnitude of 16, it is clearly a candidate for an extinct comet nucleus.

2009 B1 (P/Boattini) Andrea Boattini discovered an 18th magnitude comet during the Catalina Sky Survey with the 0.68m Schmidt on January 21.07. Several observers confirmed the cometary nature. Further observations allowed the comet to be found on CSS images from November 2008. The comet has a period of around 17 years and perihelion is at 2.4 AU in early February.

2009 B2 (LINEAR) An apparently asteroidal 19th magnitude object discovered by LINEAR on January 29.47 was found to show cometary characteristics by other astrometrists. The comet reached perihelion at 2.3 AU in early March. It is in a periodic orbit of around 270 years.

Brian Marsden noted on MPEC 2009-G11 [2009 April 4] that: The "original" and "future" barycentric values of 1/a are +0.024104 and +0.024593 (+/- 0.000001) AU^-1, respectively. The large "original" value shows that this comet has made a previous visit to the inner solar system.

2009 B3 (213P/Van Ness) Comet 2005 R2 (P/Van Ness) was recovered by Gary Hug with his 0.56-m reflector at Sandlot Observatory on January 31.36. The indicated correction to the prediction on MPC 62889 is Delta(T) = -0.1 day.

2009 B4 (214P/LINEAR) Comet 2002 CW134 (P/LINEAR) was also recovered by Gary Hug with his 0.56-m reflector at Sandlot Observatory, on January 31.49. The indicated correction to the prediction on MPC 56802 is Delta(T) = -0.32 day.

2009 B5 (215P/NEAT) Comet 2002 O8 (P/NEAT) was also recovered by Gary Hug with his 0.56-m reflector at Sandlot Observatory, on January 22.49. The comet was 20th magnitude. The indicated correction to the prediction on MPC 59599 is Delta(T) = -0.34 day.

In September, Maik Meyer detected the comet on two SERC-J plates taken in September and October 1994. The two trails appeared slightly diffuse.

A/2009 BL_{80} [LINEAR] This unusual object was discovered by LINEAR with the 1.0-m reflector on January 31. It has a period of 15 years, perihelion at 2.2 AU and a Tisserand criterion value of 2.51. [MPEC 2009-C77, 2009 February 11, 103-day orbit]. It has made no recent close approaches to Jupiter.

A/2009 CS [Catalina] This unusual asteroid was discovered by the Catalina Sky Survey with the 0.68m Schmidt on February 2.41. 18th magnitude at discovery it has a period of around 5.3 years and perihelion was at 0.79 AU in early December 2008 [MPEC 2009-C24, 2009 February 3, 1-day orbit]. The object can pass within 0.3 AU of Jupiter and 0.04 AU of the earth. This type of orbit is typical of Jupiter family comets.

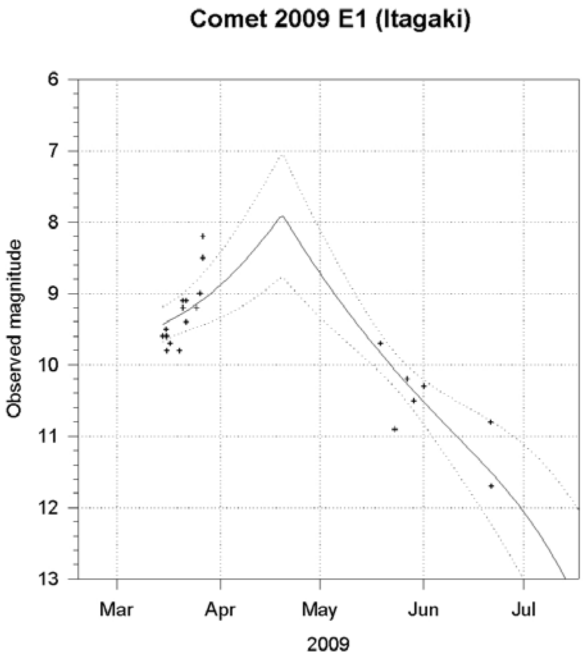
A/2009 CR_2 [Catalina] This unusual asteroid was discovered by the Catalina Sky Survey with the 0.68m Schmidt on February 3.30. 19th magnitude at discovery it has a period of around 5.1 years and perihelion is at 1.10 AU in early June [MPEC 2009-C45, 2009 February 4, 1-day orbit]. The object can pass within 0.3 AU of Jupiter and 0.10 AU of the earth. This type of orbit is typical of Jupiter family comets and it has a Tisserand criterion value of 2.93.

2009 D1 (216P/LINEAR) Comet 2001 CV8 (P/LINEAR) was recovered by Jim Scotti with the

Spacewatch 1.8-m reflector on February 19.53. The indicated correction to the prediction on MPC 54170 is Delta(T) = -0.37 day.

A/2009 DD_{47} [LINEAR] This unusual object was discovered by LINEAR with the 1.0-m reflector on February 27.34. It has a retrograde orbit with a period of around 65 years, perihelion at 2.1 AU, aphelion at over 30 AU and a Tisserand criterion value of 2.08. Perihelion was in 2008 October. [MPEC 2009-E12, 2009 March 2, 3-day orbit]. It has made no recent close approaches to Jupiter or Saturn.

Numerous attempts were made to detect cometary appearance in March, but none succeeded [IAUC 9035, 2009 April 7]



2009 E1 (Itagaki) Koichi Itagaki of Yamagata, Japan, discovered a 13th magnitude comet on March 14.41 on images taken with a 21-cm f/3 reflector (diameter of field 2.2 deg) located at Takanezawa, Tochigi using software by H. Kaneda (Sapporo, Japan) to detect moving objects automatically. Michal Kusiak, Astronomical Observatory, Jagiellonian University, reports that comet C/2009 E1 is visible in SOHO SWAN ultraviolet images. Initial visual estimates put the comet at around 10th magnitude. An early orbit by Hirohisa Sato suggested an ellipse with a period of around 200 years and the latest orbit gives 250 years.

The comet was at perihelion in early April at 0.6 AU. At discovery it was visible in the early evening sky, but was too close to the Sun for observation by the end of March. After conjunction it was recovered in May, but steadily become more diffuse and was last reported in June.

Brian Marsden noted on MPEC 2009-L10 [2009 June 3] that: The "original" and "future" barycentric values of 1/a are +0.025613 and +0.025159 (+/- 0.000007) AU^-1, respectively. The large "original" value shows that this comet has made a previous visit to the inner solar system.

2009 F1 (Larson) Steve Larson discovered a 19th magnitude comet on survey images taken with the Mt Lemmon 1.5-m reflector on March 16.43. It was confirmed by several CCD imagers, including Peter Birtwhistle. The preliminary orbit is retrograde with perihelion at 1.8 AU in late June. It moves in a long period elipse with a period of around 1000 years. The comet will only brighten a little.

2009 F2 (McNaught) Rob McNaught discovered an 18th magnitude comet on images taken during the Siding Spring Survey with the 0.5-m Uppsala Schmidt on March 19.58. It is a distant comet with perihelion at 5.9 AU in November. It has a period of around 7000 years.

Brian Marsden noted on MPEC 2009-L11 [2009 June 3] that: The "original" and "future" barycentric values of 1/a are +0.002783 and +0.003054 (+/- 0.000032) AU^-1, respectively. The large "original" value shows that this comet has made a previous visit to the inner solar system.

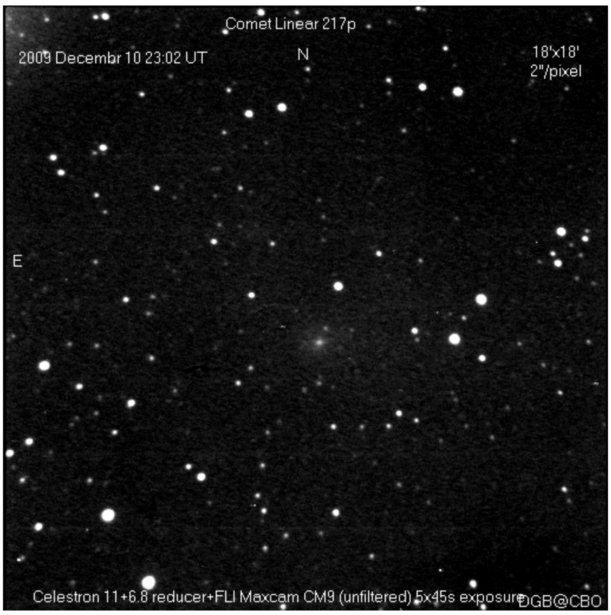
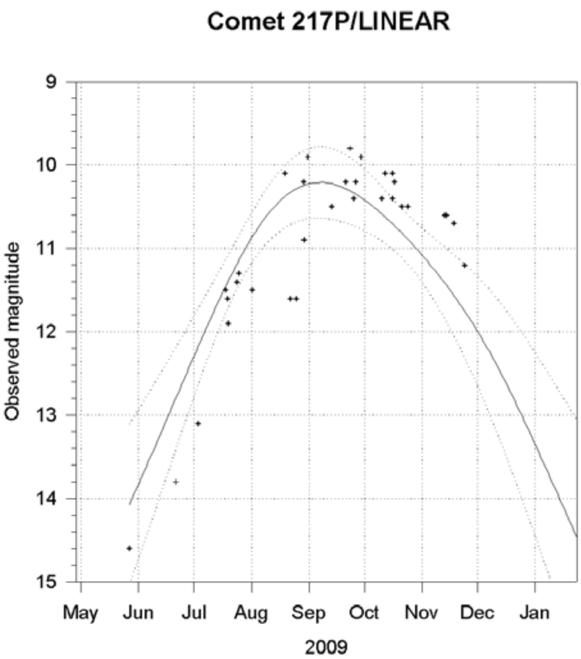


Image by Denis Buczynski

2009 F3 (217P/LINEAR) Comet 2001 MD_7 (P/LINEAR) was recovered by Ernesto Guido, Giovanni Sostero and Paul Cammileri on March 17.50 using remote telescopes in the USA (the RAS Observatory 0.25-m reflector near Mayhill, NM) and in Australia (the 0.35-m reflector at Grove Creek Observatory, Trunkey, N.S.W.). The comet was 18th magnitude. The indicated correction to the predictions on MPC 56804 is Delta(T) = +0.01 day. It was a reasonably favourable return and the comet did better than expected, reaching 10th magnitude near the time of perihelion. When at its best it was visible in the morning sky, which despite the relative brightness put off many observers.



2009 F4 (McNaught) Rob McNaught discovered another 18th magnitude comet on images taken during the Siding Spring Survey with the 0.5-m Uppsala Schmidt on March 19.68. It is also a distant comet, with perihelion at 5.5 AU in 2011 December.

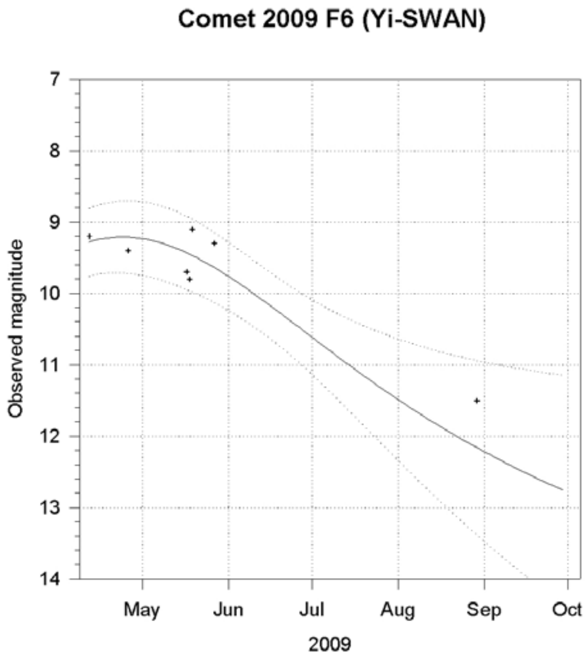
Brian Marsden noted on MPEC 2009-L12 [2009 June 3] that The "original" and "future" barycentric values of 1/a are -0.000078 and -0.000016 (+/- 0.000101) AU^-1, respectively. The small "original" value shows that this comet is on its first visit to the inner solar system.

2009 F5 (McNaught) Rob McNaught discovered a 16th magnitude comet on images taken during the Siding Spring Survey with the 0.5-m Uppsala Schmidt on March 20.66. It was at perihelion at 2.2 AU in 2008 November. It is in a long period orbit of around 700 years.

Brian Marsden noted on MPEC 2009-L13 [2009 June 3] that The "original" and "future" barycentric values of 1/a are +0.012472 and +0.012849 (+/- 0.000041) AU^-1, respectively. The large "original" value shows that this comet has made a previous visit to the inner solar system.

2009 F6 (Yi-SWAN) On April 4 Rob Matson reported a possible 9th magnitude comet seen in SOHO-SWAN images between March 29 and April 4. This was soon confirmed as a comet by ground based astrometrists. Following the initial IAUC, the CBAT received a message that a comet had been discovered by Dae-am Yi of Korea on DSLR images that he had taken on March 26. Orbital calculation showed that the two objects were identical.

The comet was a difficult object in April and most of my searches for it were negative, though I did see it on the 11th and 25th. The comet was at perihelion in early May at 1.3 AU. It became a diffuse object and only one visual observation was reported after late May. CCD observations in late August and early September gave the total magnitude as around 16.5, much fainter than expected from the visual light curve.



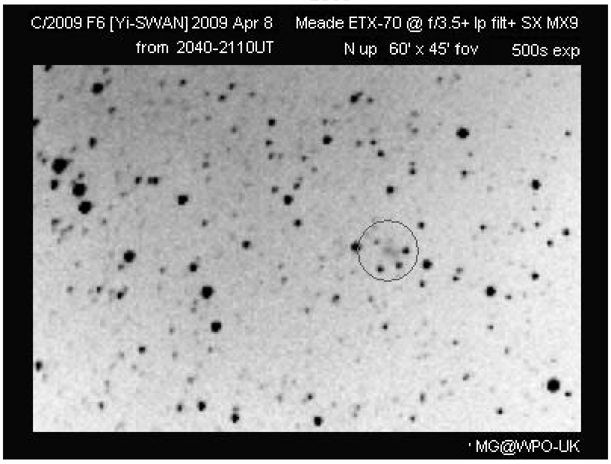


Image by Maurice Gavin

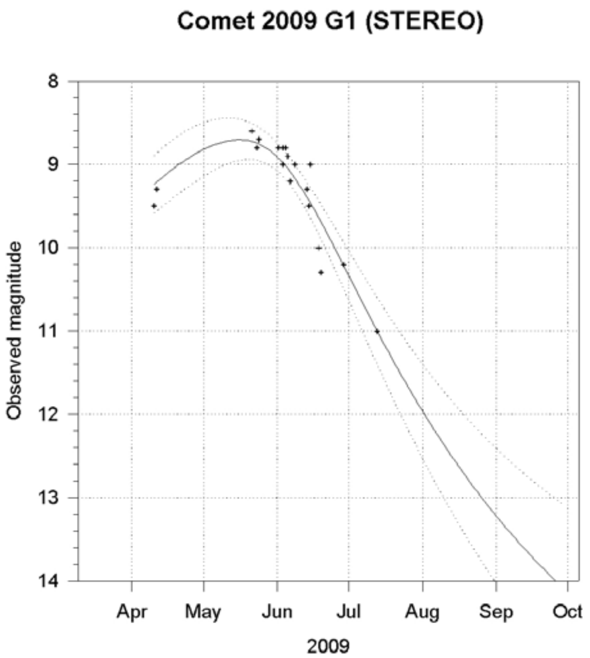
With such a bright object it is surprising that patrol images did not pick it up earlier. One reason is its location in the Milky Way, which is often avoided by the professional search programmes and its orbit is almost exactly along the plane of our galaxy. At least one amateur imager did locate the comet:

Stanislav Korotkiy (Ka-Dar obs., Moscow, Russia) reports that during the patrol photographic survey of the Milky Way he photographed a comet C/2009 F6 on 2009 March 25, 01:26 UT (one day before discovery). He used Canon EOS 20D digital camera + 50-mm f/4 lens. Limiting magnitude was about 13m. During first processing of images no new objects were detected. After a publication of MPEC 2009-G21 that announced an orbit for a new comet C/2009 F6, the images was processed again and a comet was found near the calculated position.

Brian Marsden noted on MPEC 2009-S14 [2009 September 17] that The "original" and "future" barycentric values of 1/a are +0.001440 and +0.002210 (+/- 0.000016) AU^-1, respectively. The large "original" value suggests that this comet has made a previous visit to the inner solar system.

2009 F7 (218P/LINEAR) On March 31 the LINEAR team reported a possible recovery of comet 2003 H4 (P/LINEAR) and this was confirmed by Giovanni Sostero, E Propsperi, Ernesto Guido and Paul Cammileri on April 15 using a remote telescope in Australia (the 0.35-m reflector at Grove Creek Observatory, Trunkey, N.S.W.). The comet was 20th magnitude. The indicated correction to the predictions on MPC 56804 is Delta(T) = -0.13 day.

A/2009 FW_{23} [Siding Spring] This unusual object was discovered during the Siding Spring Survey with the 0.5m Uppsala Schmidt on March 19.52. It has a period of about 35 years, with a near perpendicular inclination. It was discovered about a month after perihelion, which was at 1.7 AU. It has an absolute magnitude of 15. [MPEC 2009-F72, 2009 March 24, 5-day orbit]. With a Tisserand parameter of 2.01, on the boundary between a Jupiter family comet and an intermediate period comet, it may be a candidate for an extinct comet nucleus. It has however made no recent approaches to either Jupiter or Saturn.



2009 G1 (STEREO) Jiangao Ruan discovered a non-group comet in HI1B images from April 5 on April 8. It was at perihelion at 1.1 AU in mid April. Its elongation from the Sun was increasing, and ground based observers were able to image it, allowing a good orbit to be computed. It was around 9th magnitude and nearing its brightest at discovery but faded rapidly in June. Although it was exclusively a Southern Hemisphere object it could have been discovered from the UK in January or February when according to the light curve it was 11th magnitude.

Hirohisa Sato noted that the best fit orbit is slightly elliptical and the latest orbit has a period of over 10,000 years.

Brian Marsden noted on MPEC 2009-N14 [2009 July 6] that The "original" and "future" barycentric values of 1/a are +0.002337 and +0.002432 (+/- 0.000057) AU^-1, respectively. The moderate "original" value shows that this comet has probably made a previous visit to the inner solar system.

2009 G8 (SOHO) This was a non-group comet discovered in C2 images by Bo Zhou on 2009 April 13.

2009 H1 (219P/LINEAR) Ernesto Guido, Giovanni Sostero, Paul Cammileri and E Propsperi recovered comet 2002 LZ11 (P/LINEAR) on April 17.45 using a remote telescope in the USA (a 0.25-m reflector near Mayhill, New Mexico). The comet was 19th magnitude. The indicated correction to the predictions on MPC 59599 is Delta(T) = -0.4 day.

2009 H2 (220P/McNaught) Automatic analysis of data from April 28 provided to the Minor Planet Centre by Spacewatch identified comet P/2004 K2 (McNaught). The comet was also independently recovered by Gustavo Muler, J. M. Ruiz and Ramon Naves with the 0.30-m Schmidt-Cassegrain at the Observatorio Nazaret (Lanzarate, Spain) on May 1 and 3. The indicated correction to the prediction on MPC 56805 is Delta(T) = -0.08 day.

A/2009 HC_{82} [Catalina] This unusual asteroid was discovered by the Catalina Sky Survey with the 0.68m Schmidt on April 29.37. 20th magnitude at discovery it has a retrograde orbit with a period of around 3.4 years and perihelion was at 0.40 AU on 2008 November 7 [MPEC 2009-J04, 2009 May 1, 2-day orbit]. The object can pass within 0.0235 AU of the earth, but does not pass particularly close to Jupiter. It has a Tisserand criterion value of 3.06.

2009 K1 (P/Gibbs) Alex Gibbs discovered a 19th magnitude comet on survey images taken with the Mt Lemmon 1.5-m reflector on May 16.15. The preliminary orbit gave perihelion at 1.5 AU in mid June, but it had a small inclination and was likely to be periodic. Further observations confirmed the short period orbit, and both the CBAT and Hirohiso Sato computed orbits. Perihelion was at 1.3 AU in late June and the period around 7.1 years.

2009 K2 (Catalina) A 19th magnitude object discovered by the Catalina Sky Survey with the 0.68m Schmidt on May 18.33 was found to show cometary features by other observers, including Peter Birtwhistle. The comet reaches perihelion at 3.2 AU in 2010 February. It may reach 16th magnitude.

Brian Marsden noted on MPEC 2009-P11 [2009 August 3] that The "original" and "future" barycentric values of 1/a are +0.001106 and +0.001305 (+/- 0.000020) AU^-1, respectively. The moderate "original" value shows that this comet has probably made a previous visit to the inner solar system.

2009 K3 (Beshore) Ed Beshore discovered a 20th magnitude comet on survey images taken with the Mt

Lemmon 1.5-m reflector on May 26.16. The preliminary orbit gives perihelion at 3.9 AU in 2011 January.

2009 K4 (Gibbs) Alex Gibbs discovered a 17th magnitude comet on Catalina Sky Survey images taken with the 0.68m Schmidt on May 27.15. The comet was at perihelion at 1.5 AU in mid June.

Computations by Hirohisa Sato suggest that a long period orbit is also possible and this was confirmed by later orbits.

Brian Marsden noted on MPEC 2009-P12 [2009 August 3] that The "original" and "future" barycentric values of 1/a are +0.023510 and +0.023929 (+/- 0.000000) AU^-1, respectively. The large "original" value shows that this comet has made a previous visit to the inner solar system.

2009 K5 (McNaught) Rob McNaught discovered an 18th magnitude comet on images taken during the Siding Spring Survey with the 0.5-m Uppsala Schmidt on May 27.61. The comet reaches perihelion at 1.4 AU in late April 2010. It will come into visual observation in 2010 February, and may reach 9th magnitude in 2010 April, becoming well placed in the northern sky. Hirohisa Sato has also calculated a hypberbolic orbit, which has a similar perihelion.

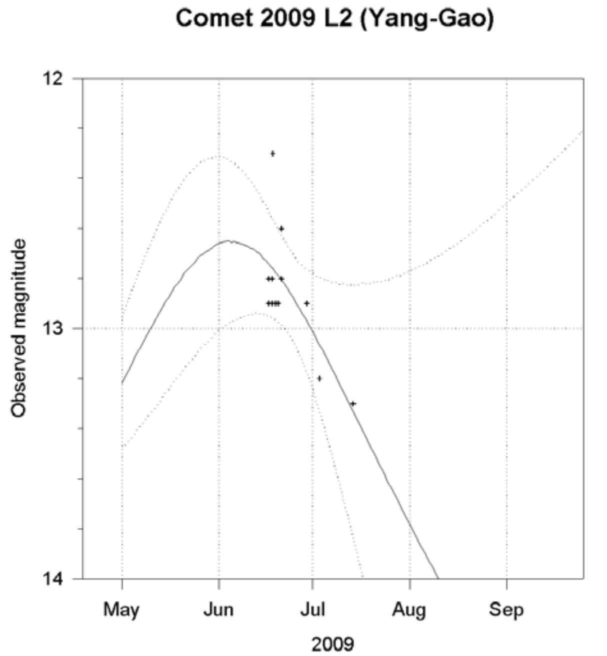
Brian Marsden noted on MPEC 2009-P13 [2009 August 3] that The "original" and "future" barycentric values of 1/a are +0.000020 and +0.000485 (+/- 0.000039) AU^-1, respectively. The small "original" value shows that this comet is on its first visit to the inner solar system.

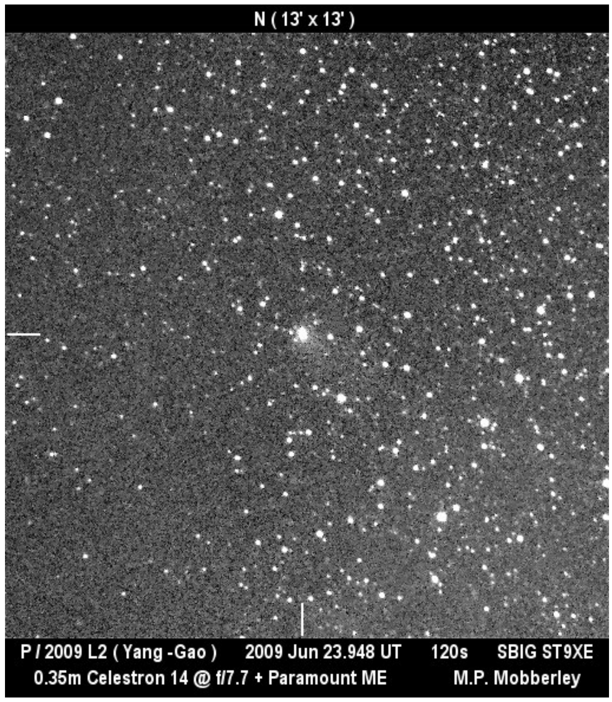
A/2009 KC_3 [Siding Spring] This object was discovered during the Siding Spring Survey with the 0.5m Uppsala Schmidt on May 23.65 at around 19th magnitude. It has a period of about 5.7 years, with perihelion at 1.0 AU in August. It will brighten to around 16th magnitude in late August when it passes 0.05 AU from the Earth. [MPEC 2009-K39, 2009 May 24, 20-day orbit]. It has a Tisserand parameter of 2.75 and may be a candidate for an extinct comet nucleus. It can approach Jupiter to within 0.2 AU, most recently around 1956, and has an Earth MOID of 0.0098 AU.

2009 L1 (221P/LINEAR) Leonid Elenin, Lyubertsy, Moscow region, Russia, has recovered comet P/2002 JN16 as part of the ROCOT project. On June 1.40, he detected a diffuse object (~20.2m) with a small tail on 16 images obtained on 0.36-m f/3.8 Maksutov-Newtonian + ST-10XME (Tzec Maun observatory, Mayhill, NM, USA). The next day he requested confirmation of the recovery, and Michael Schwartz at Tenagra observatory imaged the comet on June 3 with 0.81-m f/7 Ritchey-Chretien + SITe. These images clearly show a tail at PA 248 degrees and length about 35". The correction to the predictions on MPC 56802 is Delta(T) = -0.2 day.

2009 L2 (P/Yang-Gao) Rui Yang, Hangzhou, Zhejiang, China and Xing Gao, Urumqi, Xinjiang, China discovered a new comet on several survey images (limiting mag about 15) taken by Gao in the course of the Xingming Comet Survey using a Canon 350D camera (+ 10.7-cm f/2.8 camera lens) at Mt. Nanshan on June 15.81. The object, of 14th magnitude, but perhaps brighter visually, was identified as cometary by Yang. It was confirmed by several amateur CCD observers. [IAUC 9052, 2009 June 16]. The comet was around a month past perihelion at 1.3 AU at a very favourable opposition and has a period of 6.3 years. This is the second discovery by the Xingming Survey, the first being 2008 C1 (Chen-Gao).

A few visual observations were made in June and July as the comet faded.





2009 L18 (223P/Skiff) G. Sostero, E. Guido, P. Camilleri and E. Prosperi recovered P/Skiff (2002 S1) on June 15.61 from the co-addition of forty unfiltered 60-s CCD exposures obtained remotely on June 15.6 UT with the 0.35-m f/7 reflector at the Skylive-Grove Creek Observatory (near Trunkey, NSW, Australia). The recovery was confirmed by them on August 18.58. The comet was 20th magnitude and of stellar appearance. The indicated correction to the predictions on MPC 59600 is Delta(T) = -0.16 day.

2009 M8 (SOHO) This was a non-group comet discovered in C2 images by Rainer Kracht on 2009 June 30.

2009 MB_9 (222P/LINEAR) Rob McNaught discovered an 18th magnitude asteroid on images taken during the Siding Spring Survey with the 0.5-m Uppsala Schmidt on June 29.47. On a subsequent observing run on August 2.38 he noted that the object appeared cometary. Hirohiso Sato pointed out that the object appeared to be comet P/LINEAR (2004 X1); the indicated correction to the prediction on MPC 56804 being Delta_T = -2.2 days. The comet has a period of 4.83 years and reached perihelion at 0.78 AU on September 1.1. Two visual observations suggest that the comet was then around 13^{th} magnitude.

2009 N1 (SOHO) This was a non-group comet discovered in C2 images by Bo Zhou on 2009 July 3.

2009 N3 (SOHO) This was a non-group comet discovered in C2 images by Bo Zhou on 2009 July 5.

A/2009 NE [LINEAR] This somewhat unusual object was discovered by LINEAR with the 1.0-m reflector on July 2.28. It has a period of 4.4 years, with perihelion at 0.36 AU, and a Tisserand criterion value of 2.67. Perihelion is in 2009 October. [MPEC 2009-N13, 2009 July 6]. It has made no recent close approaches to Jupiter and can pass 0.44 AU from Earth.

2009 O2 (Catalina) A 19th magnitude object discovered by the Catalina Sky Survey with the 0.68m Schmidt on July 27.30 was found to show cometary features by other observers. Peter Birtwhistle also contributed initial astrometric observations. The comet will reach perihelion at 0.7 AU in 2010 March and has a very long period orbit of about 4000 years. It may reach 9th magnitude, or brighter if activity switches on, and will be well placed for observation from the UK when at its brightest.

2009 O3 (P/Hill) An 18th magnitude comet was discovered by Rik Hill during the Catalina Sky Survey with the 0.68m Schmidt on July 29.43. Peter Birtwhistle contributed initial astrometric observations. The comet has a period of 22 years and was at perihelion at 2.4 AU in 2009 May.

2009 O4 (Hill) Rik Hill discovered a 16th magnitude comet the following night on July 30.37, again during the Catalina Sky Survey with the 0.68m Schmidt. The comet will reach perihelion at 2.6 AU in early January 2010. It was at opposition in September and is unlikely to become brighter than 15th magnitude. Calculations by Hirohisa Sato suggested that a hyperbolic orbit was also possible, with similar T and q. This was confirmed by MPEC 2009-S146.

Brian Marsden noted on MPEC 2009-S146 [2009 September 30] that The "original" and "future" barycentric values of 1/a are +0.000080 and -0.000037 (+/- 0.000030) AU^-1, respectively. The small "original" value shows that this comet is on its first visit to the inner solar system.

2009 P1 (Garradd) Gordon Garradd discovered a 17th magnitude comet on images taken during the Siding Spring Survey with the 0.5-m Uppsala Schmidt on August 13.77. The preliminary orbit suggests that the comet reaches perihelion at 1.6 AU in December 2011. It will come into visual range in 2011 May, and may reach 7th magnitude in 2012 February. UK observers may pick it up from 2011 June, when it will be around 10th magnitude.

Brian Marsden noted on MPEC 2009-S147 [2009 September 30] that The "original" and "future" barycentric values of 1/a are +0.000446 and +0.000192 (+/- 0.000389) AU^-1, respectively. The moderate "original" value shows that this comet may have made a previous visit to the inner solar system.

2009 P2 (Boattini) Andrea Boattini discovered a 19th magnitude comet during the Catalina Sky Survey with the 0.68m Schmidt on August 15.44. Several amateur observers confirmed the cometary nature. It was later linked to the same object as asteroids 2008 TQ_{137} and 2008 VP_{28}. The comet will reach perihelion at 6.5 AU in 2010 February.

Brian Marsden noted on MPEC 2009-R29 [2009 September 9] that The "original" and "future" barycentric values of 1/a are +0.000021 and +0.000048 (+/- 0.000006) AU^-1, respectively. The small "original" value shows that this comet is on its first visit to the inner solar system.

2009 Q1 (P/Hill) Rik Hill discovered an 18th magnitude comet on August 27.40, during the Catalina Sky Survey with the 0.68m Schmidt. The comet was at perihelion at 2.8 AU in July and has a period of 13 years. This is the 100th comet found by the Catalina and Mt Lemmon team.

Rob Matson found images of the comet on three Heleakala-NEAT images from 1996, which in turn allowed him to find it in two more nights from 1998. It was very bright in the 1996 images showing obvious coma, but barely detectable in 1998.

2009 Q2 (P/LINEAR-NEAT) Jim Scotti recovered 2003 XD_{10} (P/LINEAR-NEAT) with the Spacewatch 1.8-m f/2.7 reflector at Kitt Peak on August 27.39. The comet was 21st magnitude and of stellar appearance. The indicated correction to the prediction on MPC 59598 is Delta(T) = -0.10 day.

2009 Q3 (P/LINEAR) Jim Scotti recovered 2002 T1 (P/LINEAR) with the Spacewatch 1.8-m f/2.7 reflector at Kitt Peak on August 28.49. The comet was 21st magnitude and of near-stellar ("soft") appearance. The indicated correction to the prediction on MPC 56804 is Delta(T) = +0.04 day.

2009 Q4 (P/Boattini) Andrea Boattini discovered a 19th magnitude comet during the Catalina Sky Survey with the 0.68m Schmidt on August 26.47. Several amateur observers confirmed the cometary nature. The comet will reach perihelion at 1.3 AU in mid November and has a period of 5.6 years.

2009 Q5 (P/McNaught) Rob McNaught discovered an 17th magnitude comet on images taken during the Siding Spring Survey with the 0.5-m Uppsala Schmidt on August 31.63. The comet was near perihelion at 2.9 AU. This is Rob McNaught's 50th comet discovery. The comet has a period around 20 years.

2009 QG_{31} (P/La Sagra) An apparently asteroidal object of 18th magnitude discovered on CCD images taken remotely in the course of the "La Sagra Sky

Survey" (LSSS), with a 0.45-m f/2.8 reflector located at Sagra mountain in southeastern Spain, was found to show cometary appearance by CCD astrometrists elsewhere. The observation on August 19.05 was assigned "discovery" status after the Minor Planet Center linked "one-night" LSSS observations made on August 19 with others made on August 25 (though earlier LSSS observations were made on August 16), and later LSSS and Catalina observations linked by the MPC allowed the issuance a comet-like orbit on September 8, in the daily aggregate of new orbits (MPEC 2009-R26). [IAUC 9078, 2009 September 29] The comet was at perihelion in mid October at 2.1 AU and has a period of 6.8 years.

Reiner Stoss notes the following discovery story on behalf of the LSSS team :

Exactly one year ago fellow asteroid hunter Patrick Wiggins posted on MPML his joy about his latest asteroid discovery. You can find the thread in the MPML archive (subject: "It's still possible"). His conclusion was that it is still possible for amateurs to find "bright" asteroids, despite the huge sky coverage by the NASA NEO surveys.

In an attempt to underline this and to motivate other fellow observers I had then posted some experiences made in the first few months of our own sky survey. After just three months of permanently scanning the skies we had received around one thousand designations from MPC and the sky seemed to be full of unidentified asteroids, some of them as bright as magnitude 17.

Now, exactly one year later, the situation has not changed significantly. At J75 we keep scanning with the 45-cm and we find lots of new stuff ranging from magnitude 18 to 20. Sometimes as many as a few hundred possibly new objects per night. It shows that finding new asteroids is not a matter of luck, just a function of search area and limiting magnitude... and more or less the same applies to comets I guess.

We have missed a few of them in the past, either because they were just outside the search area. Or because of some other "constraints" (see below). Now we finally scored one and this one would have gone unnoticed too if MPC wouldn't have linked it to other survey observations so that it showed a cometary orbit and drew special attention therefore. Finding one is way more difficult than finding an asteroid, even a NEO. But I guess it comes too more or less guaranteed after a lot of searching, like with asteroids.

Definitely the times are much harder now compared to the age when Dennis di Cicco wrote his famous "Hunting Asteroids From Your Backyard" article 15 years ago. At that time nearly every mover on the sky was a new one, even at magnitude 16. The big surveys are now in operation since more than 10 years and the number of objects that have been discovered and have received orbits has virtually exploded, from around 29,000 in early January 1996 to more than 460,000 objects now (out of these were 6,800 numbered then vs. 220,000 numbered objects now).

I am not into visual comet hunting, but I think to remember that these folks invested on average hundreds of hours per discovery. Clearly their work was very difficult, learning all those faint galaxies to distinguish them from possible comets without using star maps and a light to not destroy the adaptation of the eyes. Today's work is rather different. Being outside with the telescope under the sky was replaced by endless sessions on the computer screen watching CCD images scroll by. Judge yourself what is easier and more pleasurable :o)

I am therefore not able to tell how many hours it took us to score the first one, but here are a few numbers that might help evaluate how much "asteroid work" was done (=sky was scanned) until the first new comet showed up. They are from more or less one year of LSSS operations.

Earlier this month I did extract some numbers for J75 LSSS from the MPC observations database and I noticed that we had meanwhile published more than 500,000 observations for a total of 75,000 individual objects. Thirty percent of all numbered asteroids to date were observed by J75. And the number of designations received from the MPC is now at 3300.

And still, compared to the numbers delivered by Catalina, LINEAR and Spacewatch ours are rather humble. We know that we can't compete with them and it isn't our goal at all. LSSS is working different than the big surveys. It is an amateur survey done entirely remotely. Only one operator is permanently at the observatory, while all others are up to several thousand kilometres away. As all of us have day jobs, it is only possible to run this survey by using every free minute, being connected remotely no matter where we currently are.

My LSSS colleague Jaime Nomen is sometimes working via laptop and 3G card while he is travelling in a high-speed train (AVE) between Barcelona and Madrid. If you ever happen to use that train and you see someone getting anxious when the 3G signal is getting weak in one of the tunnels, you know who it is and what some people do at over 300km/h :o)
Anyway, no matter if you are after asteroids or comets, I think that the closing sentence of Dennis di Cicco's 1996 article is still true:

"There's a lot of stuff out there waiting to be discovered, and it doesn't take long to find it!"

... except with some comets :o)

P.S.: As mentioned above, here is one sure way to lose a comet discovery: Travel to a remote island without taking a 3G card with you! Some of us were on the island of Lastovo in the Adriatic Sea around New Year's Eve 2008/2009, unfortunately without Internet. When we returned on Jan. 2, I checked my email inbox to see the detections made of possibly new asteroids by our telescopes in the past days. I ran them through MPChecker just to find this: ----- The following objects, brighter than V = 23, were found in the 5.0-arcminute region around the following observation:

```
     8CTB133   C2008 12 30.16450 10 03 12.59
+20 00 29.2          18.3 V      J75
    P/2008 Y2 (Gibbs)    10 03 12.6 +20 00 30
0.0W   0.0N    0.6 128.6
cmt  (r =   1.65 AU)
```

----- We had a comet in the inbox waiting to be reported, right when we were out of town for a couple

of days without Internet. And then of course comes what must come... Catalina picks it up, reports it and gets the credit in IAUC 9008 from Jan. 1 Sometimes you lose, sometimes you win :o)

A/2009 QN_5 [Catalina] This unusual asteroid was discovered by the Catalina Sky Survey with the 0.68m Schmidt on August 18.36. 20th magnitude at discovery it has a period of around 5.9 years and perihelion is at 0.38 AU on 2009 October 21 [MPEC 2009-Q25, 2009 August 19, 1-day orbit]. The object can pass within 0.1216 AU of the earth, and 0.7 AU of Jupiter. It has a Tisserand criterion value of 2.35. Aphelion is at 6.1 AU.

A/2009 QY_6 [LINEAR] This unusual object was discovered by LINEAR with the 1.0-m reflector on August 17.38. It has a retrograde orbit with period of 18 years, with perihelion at 2.1 AU, aphelion at 11.6 AU and a Tisserand criterion value of 2.4. Perihelion is in 2009 September. [MPEC 2009-Q32, 2009 August 20]. It does not pass particularly close to any of the major planets - 3.9 AU from Saturn, 2.8 AU from Jupiter and 1.1 AU from Earth.

A/2009 QB_{36} [LINEAR] This unusual object was discovered by LINEAR with the 1.0-m reflector on August 29.34. 20th magnitude at discovery it has a period of around 4.5 years and perihelion is at 0.42 AU on 2009 November 20 [MPEC 2009-Q81, 2009 August 30, 1-day orbit]. The object can pass within 0.26 AU of the earth, and 0.1 AU of Jupiter. It has a Tisserand criterion value of 2.68.

2009 R1 (McNaught) Rob McNaught discovered a 17th magnitude comet on images taken during the Siding Spring Survey with the 0.5-m Uppsala Schmidt on September 9.62. The comet reaches perihelion at 0.4 AU in early July 2010. Based on this orbit, it will be an easy binocular object in 2010 June, perhaps reaching 5th magnitude, though for UK observers it will have dropped into the twilight by the end of the month.

Brian Marsden noted on MPEC 2009-S152 [2009 September 30] that The "original" and "future" barycentric values of 1/a are +0.000064 and -0.000569 (+/- 0.000035) AU^-1, respectively. The small "original" value shows that this comet is on its first visit to the inner solar system.

2009 R2 (226P/Pigott-LINEAR-Kowalski) Rich Kowalski discovered a very diffuse comet during the Catalina Sky Survey with the 0.68m Schmidt on September 10.4, which was confirmed by several observers including Peter Birtwhistle following posting on the NEOCP as 9R1E5E6. Dimitry Chestnov linked the object to comet 2003 A1, although the linked orbit had considerably different orbital elements (notably T and q) to those predicted for 2003 A1. Brian Marsden notes on IAUC 9072: "it is meaningless to indicate a Delta(T) value because the prediction is strongly influenced by a very close approach to Jupiter (nominally 0.0605 AU on 2006 Sept. 10.4 TT)." He then computed a linked orbit that satisfactorily included observations of comet Pigott, seen in 1783. The comet was at perihelion in May.

Following publication of the new orbit, Maik Meyer was able to locate images of the comet on Siding Spring images taken on 1995 October 29.

A/2009 RN [OAM] This unusual asteroid was discovered from the OAM Observatory with a 0.40-m reflector by S. Sanchez, J. Nomen, R. Stoss, W. K. Y. Yeung, J. Rodriguez, M. Hurtado on September 11.00. 18th magnitude at discovery it has a period of around 5.9 years and perihelion is at 1.0 AU on 2009 November 8 [MPEC 2009-R38, 2009 September 11, 0.4-day orbit]. The object can pass within 0.0096 AU of the earth, and 0.05 AU of Jupiter. It has a Tisserand criterion value of 2.73. It may be a candidate for an extinct Jupiter family comet. It made a close approach to Jupiter during its most recent orbit.

A/2009 RO [Catalina] This unusual asteroid was discovered by the Catalina Sky Survey with the 0.68m Schmidt on September 11.18. 18th magnitude at discovery it has a period of around 6.6 years and perihelion is at 1.37 AU on 2009 September 24 [MPEC 2009-R37, 2009 September 11, 15-day orbit]. The object can pass within 0.4 AU of Jupiter. It has a Tisserand criterion value of 2.78.

2009 S1 (229P/Gibbs) Alex Gibbs discovered a 19th magnitude comet on September 20.38, during the Catalina Sky Survey with the 0.68m Schmidt. The comet was at perihelion at 2.4 AU in early August and has a period of 7.8 years. Richard Miles used the 2.0-m "Faulkes Telescope North" at Haleakala to provide confirming astrometry and images. When an improved orbit became available, Rob Matson was able to identify images of the comet in NEAT imagery from 2001, and it was given the identifier 2001 Q10 for this return.

2009 S2 (P/McNaught) Rob McNaught discovered a 19th magnitude comet on images taken during the Siding Spring Survey with the 0.5-m Uppsala Schmidt on September 20.68. The preliminary orbit allowed pre-discovery observations from August 3 to be located. The comet was at perihelion at 2.2 AU in June and has a period of around 8.5 years.

2009 S3 (Lemmon) A 21st magnitude object found during the Mt Lemmon survey with the 1.5-m reflector on September 24.16, was posted on the NEOCP and found to be diffuse during follow up observations. The comet is a distant one, and reaches perihelion at 6.5 AU at the end of 2011.

2009 S4 (227P/Catalina-LINEAR) Jim Scotti recovered P/2004 EW_{38} with the 1.8-m Spacewatch telescope at Kitt Peak on September 21.37, noting only stellar appearance. The indicated correction to the orbit prediction on MPC 59600 is Delta(T) = +0.02 day.

Following publication of the new orbit, Maik Meyer was able to locate images of the comet on Haleakala-NEAT images taken on 1997 January 15. Due to the mediocre quality of the images a decision on whether the object showed cometary activity was not possible. The magnitude was around 19.

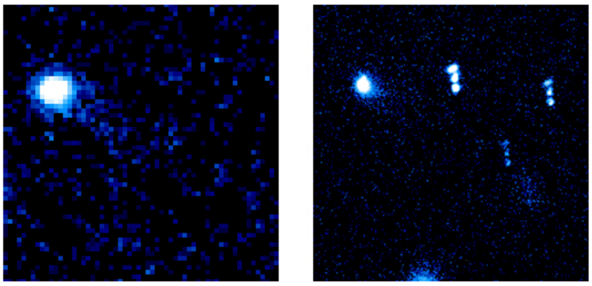
2009 SK_{280} (P/Spacewatch-Hill) Rik Hill discovered a 20th magnitude comet on October 15.36, during the Mt Lemmon Survey with the 1.5-m reflector. The Minor Planet Centre then identified it with earlier asteroidal images that had been taken on September 17, 25.29 and 29 by Spacewatch, with the later two linked under the designation 2009 SK280. The comet was at perihelion at 4.2 AU in late May and has a period of around 10 years.

A/2009 SK_{104} [Mt Lemmon] This unusual object was discovered during the Mt Lemmon Survey with the 1.5-m reflector on September 25.36. 22nd magnitude at discovery it has a period of around 5.7 years and perihelion was at 1.01 AU on 2009 April 13 [MPEC 2009-S111, 2009 September 27, 2-day orbit]. The object can pass within 0.07 AU of the earth, and 0.4 AU of Jupiter. It has a Tisserand criterion value of 2.78. It is a likely candidate for an extinct comet nucleus.

2009 T1 (McNaught) Rob McNaught discovered an 18th magnitude comet on images taken during the Siding Spring Survey with the 0.5-m Uppsala Schmidt on October 9.75. The comet was at perihelion at 6.2 AU in October 2009.

Brian Marsden noted on MPEC 2009-Y10 [2009 December 16] that The "original" and "future" barycentric values of 1/a are +0.000878 and +0.000942 (+/- 0.000038) AU^-1, respectively. The moderate "original" value shows that this comet may have made a previous visit to the inner solar system.

2009 T2 (P/La Sagra) The "La Sagra Sky Survey" (LSSS) team discovered a second comet with the 0.45-m f/2.8 reflector located at Sagra mountain in southeastern Spain on October 12.87. This object was 17th magnitude. The comet is at perihelion in mid January 2010 at 1.8 AU and has a period of 21 years. Richard Miles (Stourton Caundle, Dorset, England, 0.28-m f/9.4 Schmidt-Cassegrain reflector) writes that 127 stacked 30-s CCD frames taken on October 13.0 show weak cometary appearance with a narrow tail 25" long in p.a. 230 deg.



2009 Oct 13 00:40 UT
100 x 30 sec 0.28-m SCT
60 x 60 arcsec
unfiltered confirmatory image from J77

2009 Oct 13 11:14 UT
3 x 90 sec 2.0-m RC
60 x 60 arcsec
R filter image from Faulkes North, F65

Comet P/2009 T2 (LA SAGRA)

R. Miles

Reiner Stoss provides the following discovery information

The big surveys didn't miss it. As can be seen in the discovery MPEC and IAUC, Catalina did detect it several times before we did, but it went unnoticed into the huge batch of asteroid ONS data.

*MPC then did not link the individual nights because they were not too close together *and* because you can't link them if you assume any realistic "asteroid orbit".*

The question could be rather why Catalina missed the cometary nature. I can not answer this question, but I know that it is very easy to miss it. It almost happened to us too this time and for sure many times in the past.

First of all surveys (including us) do not make dozens of images per field to stack them, to see if any object could show a faint coma/tail. They make just relatively short exposures, to maximize sky coverage and to minimize trailing losses for fast-movers. P/2009 T2 did not show a coma or a tail on our survey images from the 45-cm despite the "fast" optics of f/2.8 . It was the pure brightness of this apparently new "asteroid" that made me suspicious, so we quickly scheduled follow-up on our 40-cm tracking telescope. Only those images then showed the tail (already on 90s exposures) and it became more obvious after some stacking.

We pick up sometimes hundreds of new V 19.x movers in one night. We pick up a dozen new V 18.x movers per night and some on the faint end of V 17 too. But it is highly unusual to find a new V 17.0 main-belt asteroid. The NEOR score was low for what became P/2009 T2 later and its brightness was the only hint that the object could be unusual.

*Contrary to what other surveys do (I think most of them check only high NEOR objects visually before posting them to the NEOCP) at LSSS we *do* check each and every new mover visually. "New" means it can't be IDed with the MPCORB. But depending on the quality of the night and several other factors, it is often impossible to tell from survey images if an object is cometary or not, except it shows a big coma and/or a long tail or you are Rob McNaught :o)*

I am therefore sure we missed a few comets at LSSS in the past two years or so. They were reported together with thousands of other unidentified asteroidal movers as ONS to the MPC and will get linked eventually as precovery observations to future comets.

2009 T3 (LINEAR) An apparently asteroidal object of 19th magnitude discovered by LINEAR with the 1.0-m reflector on October 14.43 was found to show a cometary appearance by other astrometrists, including Giovanni Sostero and Richard Miles. The comet will reach perihelion at 2.3 AU in mid January 2010.

Brian Marsden noted on MPEC 2009-Y11 [2009 December 16] that The "original" and "future" barycentric values of 1/a are +0.000611 and +0.000375 (+/- 0.000076) AU^-1, respectively. The moderate "original" value shows that this comet may have made a previous visit to the inner solar system.

2009 U1 (Garradd) Gordon Garradd discovered a 20th magnitude comet on images taken during the Siding Spring Survey with the 0.5-m Uppsala Schmidt on October 17.71. The preliminary orbit suggests that the comet reaches perihelion at 3.0 AU in July 2010.

2009 U2 (228P/LINEAR) Jim Scotti recovered P/2001 YX127 with the 1.8-m Spacewatch telescope at Kitt Peak on October 18.45, noting that it was very faintly diffuse with a short tail. The indicated correction to the orbit prediction on MPC 62881 is Delta T = -0.36 day.

2009 U3 (Hill) Rik Hill discovered an 18th magnitude comet on October 21.32 during the Catalina Sky Survey with the 0.68m Schmidt. The comet will reach perihelion at 1.4 AU in March 2010, when it is predicted to reach around 15th magnitude.

Brian Marsden noted on MPEC 2009-Y12 [2009 December 16] that The "original" and "future" barycentric values of 1/a are +0.006289 and +0.005921 (+/- 0.000065) AU^-1, respectively. The large "original" value shows that this comet has made a previous visit to the inner solar system.

2009 U4 (P/McNaught) Rob McNaught discovered a 17th magnitude comet on images taken during the Siding Spring Survey with the 0.5-m Uppsala Schmidt on October 23.49. Following this he was able to locate prediscovery observations from October 22 and then October 11. The comet was at perihelion at 1.6 AU in early September and has a period of around 11 years.

2009 U5 (Grauer) Al D Grauer discovered a 19th magnitude comet on survey images taken with the Mt Lemmon 1.5-m reflector on October 23.46. The preliminary orbit gave perihelion at 0.6 AU in 2010 August, however it proved to be a more distant object. The comet is at perihelion at 6.1 AU in 2010 June.

Brian Marsden noted on MPEC 2009-Y42 [2009 December 22] that The "original" and "future" barycentric values of 1/a are +0.000042 and -0.000228 (+/- 0.000039) AU^-1, respectively. The small "original" value shows that this comet is on its first visit to the inner solar system.

2009 U6 (230P/LINEAR) An apparently asteroidal object of 18th magnitude discovered by LINEAR with the 1.0-m reflector on October 27.43 was found to show a cometary appearance by other astrometrists, The comet was at perihelion at 1.5 AU in early August and has a period of around 6.3 years.
Following improved astrometry S. Nakano identified observations of the comet among single-night data from NEAT at the two preceding apparitions in 1997 and 2002, with it being assigned the identifications 1997 A2 and 2002 Q15. Rob Matson independently located the images corresponding to these observations, together with some additional ones and provided measurements. The comet's approach to a distance of 0.88 AU from Jupiter in September 2007 means that the orbital period, currently 6.27 years, was previously 6.48-6.49 years, with the comet's previous two perihelion passages occurring on 2003 Mar. 3 and 1996 Sept. 4.

A/2009 UV_{18} [LINEAR] This unusual object was discovered by LINEAR with the 1.0-m reflector on October 22.40 and subsequently linked to an object found in NEAT images and designated 2004 CN97. 19th magnitude at discovery it has a period of 5.7 years and perihelion is at 1.2 AU on 2010 January 18 [MPEC 2009-U127, 2009 October 29]. The object can pass within 0.22 AU of the earth, and 0.5 AU of Jupiter. It has a Tisserand criterion value of 2.85 and is classed as an Amor asteroid.

A/2009 UG_{89} [Mt Lemmon] This unusual object was discovered during the Mt Lemmon Survey with the 1.5-m reflector on October 22.10. 20th magnitude at discovery it is in a retrograde orbit and has a period of around 600 years with perihelion at 4.3 AU on 2010 November [MPEC 2009-U123, 2009 October 27, 3-day orbit]. Aphelion is at 144 AU. The object passed 0.5 AU from Jupiter in September. It has a Tisserand criterion value of 2.62. It is a likely candidate for an extinct comet nucleus.

2009 W1 (232P/Hill) Rik Hill discovered an 18th magnitude comet on November 18.51 during the Catalina Sky Survey with the 0.68m Schmidt. The comet was at perihelion at 3.0 AU in October and has a period of around 9.5 years.

F. Manca, Bosisio Parini (LC), Italy, has suggested that the comet was observed at its previous perihelion passage as 1999 XO_{188}, the observations of which, all by LINEAR, were given on MPS 9249 and 82876. An orbit was published on MPO 50446. [CBET 2083, 2009 December 17]

2009 W2 (Boattini) Andrea Boattini discovered a 19th magnitude comet on November 23.48 during the Catalina Sky Survey with the 0.68m Schmidt. The comet will reach perihelion in 2010 May and has a perihelion distance of 6.9 AU.

2009 X1 (231P/LINEAR-NEAT) Comet 2003 CP7 (P/LINEAR-NEAT) was recovered by Gary Hug with his 0.56-m reflector at Sandlot Observatory on December 11.32. The indicated correction to the prediction on MPC 62880 is Delta(T) = -0.5 day.

2009 Y1 (Catalina) A 19th magnitude object discovered by the Catalina Sky Survey with the 0.68m Schmidt on December 17.51 and reported by Rik Hill was found to show cometary features by other observers. Peter Birtwhistle also contributed initial astrometric observations. The comet will reach perihelion at 2.6 AU in 2011 January.

Calculations by Hirohisa Sato suggest that it may be in a long period retrograde orbit of over 400 years, with slightly different perihelion circumstances.

2009 Y2 (P/Kowalski) Richard Kowalski discovered a 19th magnitude comet on December 20.12 during the Catalina Sky Survey with the 0.68m Schmidt. The comet will reach perihelion in 2010 March and has a perihelion distance of 2.3 AU. It has a period of about 16 years.

A/2009 YS_6 [Mt Lemmon] This unusual object was discovered during the Mt Lemmon Survey with the 1.5-m reflector on December 17.39. 21st magnitude at discovery it is in a retrograde orbit and has a period of around 12 years with perihelion at 1.3 AU in 2011 February [MPEC 2009-Y35, 2009 December 21, 4-day orbit]. Aphelion is at 9.3 AU. The object can pass within 0.5 AU of Jupiter and 0.41 AU from the Earth. It has a Tisserand criterion value of 2.29. It is a likely candidate for an extinct comet nucleus.

2010 A1 (P/Hill) Rik Hill discovered an 18th magnitude comet on January 6.46 during the Catalina Sky Survey with the 0.68m Schmidt. Confirming images were taken by Peter Birtwhistle amongst others. The comet has a period of around 9 years, and was at perihelion at 1.9 AU in 2009 August.

2010 A2 (P/LINEAR) An apparently asteroidal object of 20th magnitude discovered by LINEAR with the 1.0-m reflector on January 6.27 was found to show a cometary appearance by other astrometrists, notably Peter Birtwhistle, but whilst it has a tail, there is no distinctive central condensation. The comet has an exceedingly short period of around 3.4 years and was at perihelion at 2.0 AU in 2009 November. The orbit is typical of a main belt asteroid and it may be a small (less than 500 metres) carbonaceous type object.

2010 A3 (Hill) Rik Hill discovered a 17th magnitude comet on January 8.10 during the Catalina Sky Survey with the 0.68m Schmidt. The comet will reach perihelion at 1.7 AU in March 2010.

2010 A4 (Siding Spring) was discovered during the Siding Spring Survey with the 0.5-m Uppsala Schmidt telescope on January 12.72, and was initially reported as asteroidal by Gordon Garradd. After posting on the NEOCP he noted a possibly cometary appearance, as did several other astrometrists. The comet reaches perihelion at 2.7 AU in October.

A/2010 AJ [Steward] This unusual asteroid was discovered at the Steward Observatory, Kitt Peak with the 0.9m reflector on January 6.29. It has a period of 5.5 years and perihelion was at 1.14 AU in October 2009. [MPEC 2010-A27, 2010 January 7, 1-day orbit]. In the current orbit it can approach to around 0.3 AU of Jupiter and 0.15 AU of the Earth. It has a Tisserand criterion value of 2.87. This type of orbit is typical of Jupiter family comets.

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

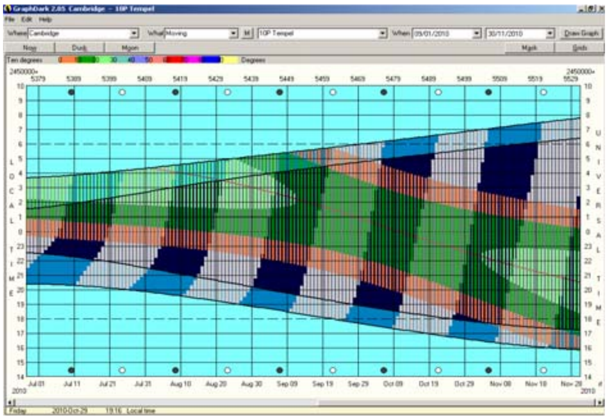
Comet Prospects for 2010

2010 sees a very favourable return of 103P/Hartley, which should reach naked eye visibility during a close pass to the earth in the autumn. Newly discovered comet 2009 R1 (McNaught) could reach 5th magnitude in June, but will be low in the summer twilight. Comet 2P/Encke will be a bright object at perihelion, but is then too close to the Sun for observation from the ground. 81P/Wild should be a binocular object in the spring.

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. Perhaps the most spectacular example of such fragmentation is 73P/Schwassmann-Wachmann, which exhibited a debris string of over 60 components as it passed close to the Earth in May 2006. 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 on the Internet. A section booklet on comet observing is available from the BAA Office.

This is comet **2P/Encke's** 61st observed return to perihelion since its discovery by Mechain in 1786. The orbit is quite stable, and with a period of 3.3 years apparitions repeat on a 10-year cycle. This year it has a poor elongation prior to perihelion, but it will be visible passing through the SOHO LASCO field and that of its successors, the twin STEREO satellites in late July and early August. After perihelion the comet becomes visible from the Southern Hemisphere in mid August as a fading binocular object, and can be followed throughout September. BAA Members have been observing the comet for over 50 years and there is little evidence for a secular fading, although the comet is often brighter post perihelion than it is before. The comet is the progenitor of the Taurid meteor complex and may be associated with several Apollo asteroids.

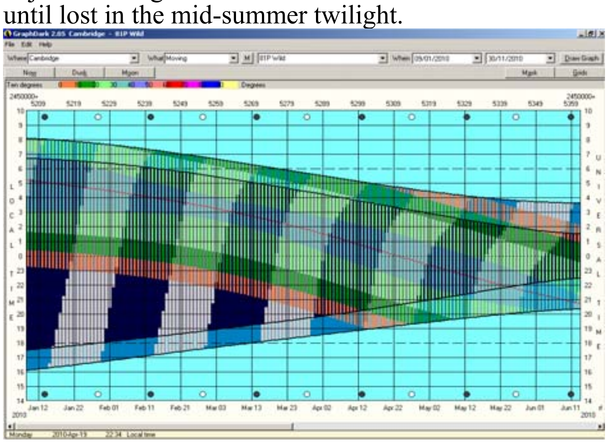
10P/Tempel makes its 23rd observed return since its discovery by William Tempel (Milan, Italy) as a 9th magnitude object in 1873. Several unfavourable returns were missed in the earlier years. The orbit is very stable, which is one reason why it is a favoured target for planned spacecraft missions. In 1983 the IRAS satellite detected an extensive dust trail behind the comet. Normally the light curve is highly asymmetric with a late turn on. There is a rapid rise in brightness as perihelion approaches, which continues more slowly for a couple more weeks after perihelion, followed by a slow decline until activity switches off. With a 5.5 year period alternate returns are favourable and this is one of them, although not the best. A combination of summer twilight and a southerly declination will make viewing from the UK difficult until mid July, when it will be near its brightest at 10th magnitude. It remains a morning object in Cetus throughout the UK apparition, slowly fading and moving south. Circumstances are better in the Southern Hemisphere and it will be visible throughout the apparition, although best in the morning sky.



Visibility of 10P/Tempel (UK)

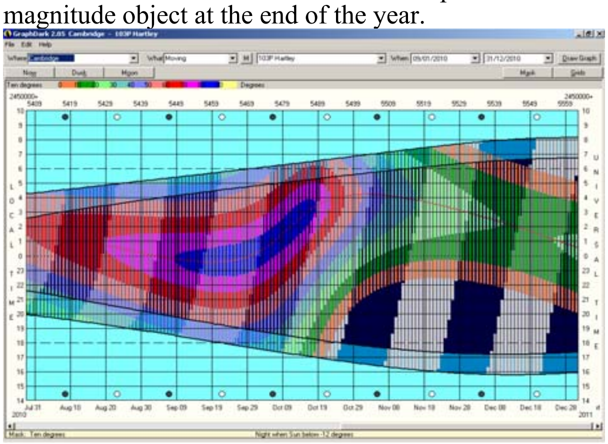
29P/Schwassmann-Wachmann is an annual comet that has outbursts, which in recent years seem to have become more frequent. The outbursts were more or less continuous in 2008/9 and at some the comet became as bright as 10^{m}. The comet is an ideal target for those equipped with CCDs and it should be observed at every opportunity. The comet begins the year retrograding in Leo and reaches opposition on February 11, when it may show some additional brightening because of the small phase angle. It returns to Cancer in mid March and resumes direct motion in mid April. It is still in Cancer when UK observers will loose it in mid May. The comet passes through solar conjunction in late August and will emerge into the morning sky in Leo in late October. It crosses the celestial equator in early December, and remains a morning object at the end of the year.

81P/Wild is a new comet that made a very close (0.006 AU) approach to Jupiter in 1974. Prior to this it was in a 40 year orbit that had perihelion at 5 AU and aphelion at 25 AU. The comet was discovered by Paul Wild with the 40/60-cm Schmidt at Zimmerwald on 1978 January 6. The Stardust spacecraft visited it in 2004 and the recovered material was returned to earth in 2006, throwing more light on the origin of comets. The 2010 return is a good one and the comet should be visible in binoculars at around 9th magnitude when at its brightest in March. It is a good apparition for UK observers, starting the year as a 10th magnitude morning object in Virgo and will remain in that constellation until lost in the mid-summer twilight.



Visibility of 81P/Wild (UK)

In 1982 comet **103P/Hartley** made a close approach to Jupiter, and it was discovered by Hartley four years later, around nine months after perihelion. It was accidentally recovered by T V Kryachko of Majdanak, USSR, on 1991 July 9.85, returning 5.6 days earlier than predicted. It was well observed by the section at this return and observations showed that the brightness peaked around 13 days after perihelion. The 1997 return was also good, with the comet peaking at 8th magnitude, but the 2004 return was poor. This return is exceptionally good and the comet will pass only 0.121 AU from the Earth on October 20.8. If it behaves similarly to previous returns it should be recovered visually in July or August and will be a well placed binocular object in Cygnus in September. Remaining in Cygnus for most of October, it should be visible to the naked eye throughout October and into November as it fades and still be visible in telescopes as a 10th magnitude object at the end of the year.



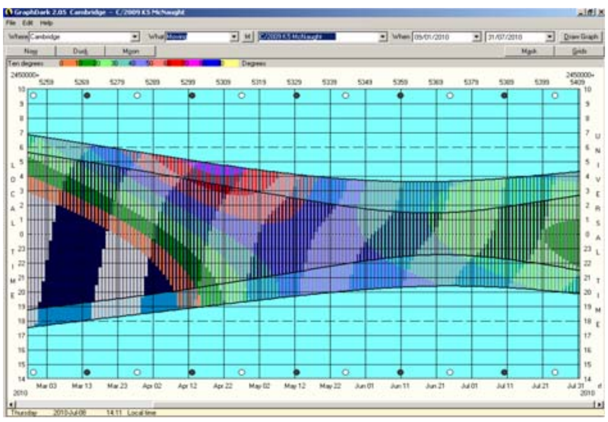
Visibility of 103P/Hartley (UK)

The orbit comes close to that of the Earth and it could produce a meteor shower at the descending node in November. Calculations by Harold Ridley gave a radiant of 19h56m +14°, some 5° Nf Altair, with a likely maximum around November 17, however Robert McNaught gave 19h50m +29° around November 2. No meteors were seen at the favourable return in 1997 and later calculations suggest that there are no favourable encounters with likely dust trails until 2062.

Donald Machholz discovered **141P/Machholz** with his 0.25-m reflector at 10m in August 1994. It proved to have multiple components, first reported by Michael Jager (Vienna, Austria). The four secondary components could all be described by the same orbit, but with perihelion delayed by up to half a day from the primary. At times there seemed to be a faint trail of material linking the components. The comet has a short period of 5.2 years with a perihelion distance of 0.75 AU and aphelion just inside the orbit of Jupiter. The orbit has been slowly evolving, with progressive changes occurring about every 50 years, thanks to approaches to Jupiter. The most recent close approach was in 1982. With a relatively stable perihelion distance, which is slowly increasing, it is perhaps surprising that the comet was not discovered earlier. There was a favourable return in winter of 1978/79 when it might have reached 8th magnitude and very favourable returns in the autumns of 1920, 1936 and 1957 when it might have reached 6th magnitude. The fact that it was not discovered at any of these returns suggests that the absolute magnitude at the 1994 return was not typical, and was the result of the fragmentation. At present the earth passes about 0.25 AU outside the descending node and the orbital evolution will slowly decrease this distance, raising the possibility of meteor shower from the comet in a few hundred years time.

The main component of the comet (A) again reached 10th magnitude in 1999, with the secondary (D) at least a magnitude fainter, but the last return was unfavourable and only component A was recovered. This is a very poor return and visual observations are very unlikely.

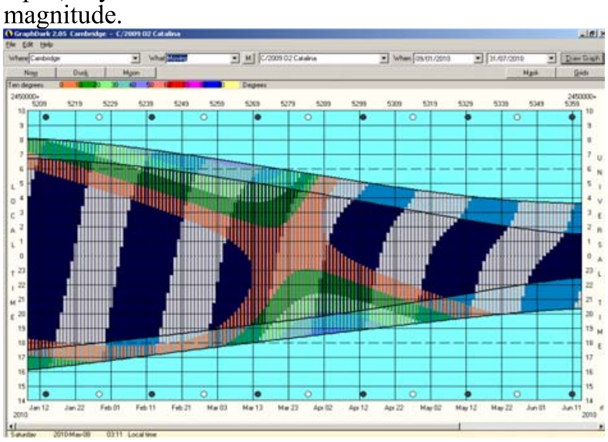
157P/Tritton was discovered by Keith Tritton in 1978 when working on the Southern UK Schmidt Sky Survey. The comet was only observed over a very short arc and it was very faint at discovery. The first return was very unfavourable, so it couldn't be seen, and the orbital inaccuracy was so large that the predictions for the second return had huge uncertainties and it was lost. In October 2003 Paulo Holvorcem reported that Charles Juels had found a fast moving cometary object at around 12th magnitude and this was confirmed by other observers. Following suggestions from Sebastian Hoenig, based on computations by Maik Meyer, Brian Marsden was able to confirm the identity with comet D/1978 (Tritton). The linkage showed that the period estimated from the 1978 apparition was incorrect and so the early searches were perhaps doomed to failure. The brightness in 2003 suggested that the object was in outburst and its future brightness is uncertain.



Visibility of 2009 K5 (McNaught) (UK)

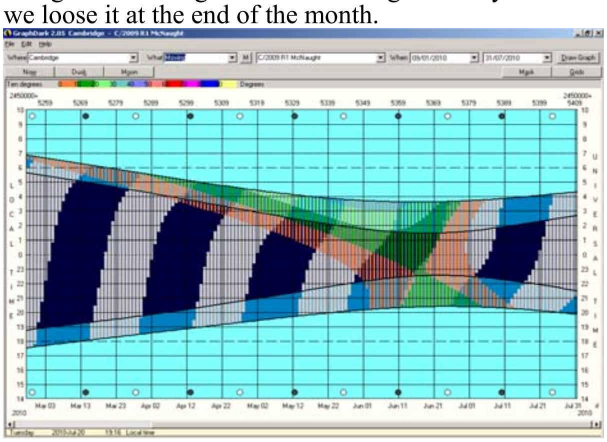
Comet **2009 K5 (McNaught)** is another of the many comets discovered by Rob McNaught during the course of the Siding Spring Survey. The comet could reach 10th magnitude in late April. It moves out from conjunction into the morning sky in late February as an 11th magnitude object and becomes circumpolar by mid April. It fades slowly, but remains relatively well placed in the northern sky until July.

Comet **2009 O2 (Catalina)** was discovered during the Catalina Sky Survey, but not immediately recognised as a comet until verified by other observers. It emerges from solar conjunction in late February at 12th magnitude and could reach 9th magnitude by the equinox, when it passes north of M31. Thereafter it heads south and UK observers will loose it by late April, by which time it will have faded to 11th magnitude.



Visibility of 2009 O2 (Catalina) (UK)

Comet **2009 R1 (McNaught)** was Rob's 51st discovery and promises to be an easily observable comet, though it will be low in the summer twilight when at its brightest. It emerges from solar conjunction relatively slowly and it will already be 9th magnitude before UK observers pick it up in late May. It brightens rapidly and moves into the evening sky, however it is never high in the sky. The best viewing will probably be around mid June, when it is highest in a moonless sky, though it will brighten another magnitude by the time we loose it at the end of the month.



Visibility of 2009 R1 (McNaught) (UK)

A couple of SOHO comets are predicted to return, and although both objects have been seen at two returns, the exact linkages of these members of the Marsden family of comets remain a little uncertain. Here I use a provisional numbering scheme for the periodic SOHO objects, as none has yet been introduced by the IAU. This follows the scheme for periodic comets that are known to return, and I number them in order of discovery of the second member of any pairings. A more permanent numbering scheme is also needed, although with incomplete SOHO coverage and cascading fragmentation this is difficult. M01 is 1999 J6 and 2004 V9, which split to give a minor component 2004 V10. M02 is 1999 N5, which split to give 2005 E4 (M02A), which returns in 2010 and 2005 G2 (M02B), which returns in 2011. Both M01 and M02 themselves probably split from a progenitor that was at perihelion in 1993 November.

The other periodic and parabolic comets that are at perihelion during 2010 are unlikely to become brighter than 12th magnitude or are poorly placed. Ephemerides for these can be found on the CBAT WWW pages. D/van Houten was observed for just over a month in 1960, but was not recovered at the two subsequent returns. D/Haneda-Campos was observed for four months at its discovery apparition, but was not recovered at the four subsequent returns. Searches at favourable returns in the intervening period have failed to reveal the comets and it is possible that they are no longer active.

Looking ahead to 2011 rather fewer comets make good returns, however comet 2009 P1 (Garradd) might reach 7th magnitude at the end of the year. 45P/Honda-Mrkos-Pajdusakova makes a close pass to the earth and will be well placed in the Southern Hemisphere prior to perihelion in September and in the north post perihelion. 73P/Schwassmann-Wachmann also returns, but it is not clear how many of the multiple fragments will be visible and even the brightest is likely to be fainter than 12th magnitude. P/Levy (2006 T1) may reach 9th magnitude at the end of the year.

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Jonathan Shanklin

Comet	T	q	P	N	H_1	K_1	Peak mag
Hill (2009 O4)	Jan 1.3	2.56			10.0	10.0	17
118P/Shoemaker-Levy	Jan 2.3	1.98	6.45	3	8.7	10.0	12
LINEAR (2009 T3)	Jan 12.1	2.28			12.5	10.0	18
82P/Gehrels	Jan 12.1	3.63	8.42	3	6.0	15.0	17

Comet	T	q	P	N	H_1	K_1	Peak mag
P/La Sagra (2009 T2)	Jan 12.8	1.75	20.9	1	14.0	10.0	17
224P/LINEAR-NEAT (2009 Q2)	Jan 31.8	1.99	6.29	1	15.5	10.0	20
Catalina (2009 K2)	Feb 7.5	3.24			10.0	10.0	18
203P/Korlevic	Feb 8.2	3.18	10.0	1	14.5	5.0	19
Boattini (2009 P2)	Feb 10.9	6.54			6.0	10.0	18
149P/Mueller	Feb 19.2	2.65	9.03	2	11.5	10.0	17
157P/Tritton	Feb 20.5	1.36	6.30	2	14.0	10.0	16
81P/Wild	Feb 22.7	1.60	6.42	5	6.9	11.4	9
126P/IRAS	Feb 22.8	1.71	13.4	2	8.5	15.0	14
P/McNaught (2004 R1)	Feb 23.7	0.99	5.48	1	18.5	10.0	20
65P/Gunn	Mar 2.1	2.44	6.79	7	5.0	15.0	12
219P/LINEAR	Mar 5.7	2.36	6.99	1	11.0	10.0	17
162P/Siding Spring	Mar 8.4	1.23	5.33	3	15.0	10.0	17
Hill (2009 U3)	Mar 20.3	1.41			13.0	10.0	15
Catalina (2009 O2)	Mar 25.1	0.71			11.0	10.0	9
P/LINEAR-Skiff (2001 R6)	Mar 26.1	2.18	8.52	1	13.0	10.0	19
94P/Russell	Mar 29.7	2.24	6.60	4	9.0	15.0	15
P/Kowalski (2009 Y2)	Mar 30.7	2.34	16.3	1	13.0	10.0	19
30P/Reinmuth	Apr 19.5	1.88	7.34	10	9.5	15.0	15
Spacewatch (2007 VO_5)	Apr 26.8	4.85			7.0	10.0	17
McNaught (2009 K5)	Apr 30.0	1.42			7.5	10.0	10
M01P/SOHO	May 1.5	0.05	5.50	2			
Boattini (2009 W2)	May 3.5	6.91			7.0	10.0	19
104P/Kowal	May 4.6	1.18	5.89	4	9.8	9.3	12
P/LINEAR (2010 A2)	May 7.6	1.36	7.17	1	16.0	10.0	17
141P-Machholz-A	May 24.5	0.76	5.24	3	13.0	10.5	13
141P-Machholz-D	May 29.7	0.76	5.25	2	13.4	29.8	?
142P/Ge-Wang	May 30.5	2.49	11.1	2	12.3	11.0	17
D/Haneda-Campos (1978 R1)	Jun 7.4	1.28	6.42	1	13.5	10.0	?
215P/NEAT	Jun 8.0	3.21	8.07	1	8.0	10.0	15
Grauer (2009 U5)	Jun 22.8	6.09			7.0	10.0	19
Hill (2010 A1)	Jun 24.1	1.02	??		12.0	10.0	??
43P/Wolf-Harrington	Jul 1.7	1.36	6.12	10	8.9	10.0	12
McNaught (2009 R1)	Jul 2.7	0.41			8.0	10.0	5
10P/Tempel	Jul 4.9	1.42	5.37	22	9.0	12.5	10
Garradd (2009 U1)	Jul 7.8	2.96			10.5	10.0	18
P/LINEAR (1999 U3)	Jul 18.5	1.92	11.0	1	13.5	10.0	18
2P/Encke	Aug 6.5	0.34	3.30	60	10.5	15.0	4
223P/Skiff (2009 L18)	Aug 14.5	2.42	8.45	1	11.0	10.0	16
227P/Catalina-LINEAR (2009 S4)	Sep 3.7	1.79	6.80	1	16.5	5.0	20
P/LINEAR (2002 UY_{215})	Sep 9.5	1.83	7.21	1	14.0	10.0	17
31P/Schwassmann-Wachmann	Sep 29.5	3.42	8.74	12	6.7	11.3	15
Lemmon-Siding Spring (2008 FK_7)	Sep 29.7	4.51			5.0	10.0	15
P/NEAT (2002 X2)	Oct 4.9	2.13	7.60	1	12.0	10.0	16
D/van Houten (1960 S1)	Oct 16.3	4.14	16.6	1	9.0	10.0	19?
103P/Hartley	Oct 28.3	1.06	6.47	4	8.7	24.0	5
M02AP/SOHO	Oct 29.8	0.05	5.67	2			
P/LINEAR (2000 G1)	Nov 13.9	1.00	5.34	1	19.5	5.0	21
P/LINEAR (2004 HC_{18})	Dec 29.6	1.71	6.52	1	16.5	5.0	20

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 (which must be regarded as uncertain) are given for each comet. D/Haneda-Campos and D/van Houten have not been seen for several returns. The orbit of D/ van Houten is based on only 8 observations and other predictions suggest a possible return in 2011. Note: $m_1 = H_1 + 5.0 * \log(d) + K_1 * \log(r)$

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