THE COMET'S TALE

Newsletter of the Comet Section of the British Astronomical Association

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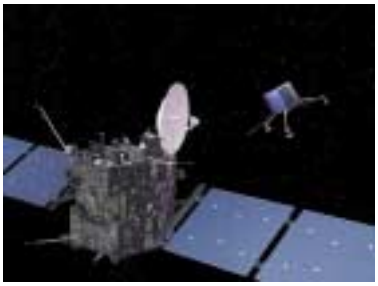
Cometary Science at the Launch of Rosetta

.An RAS Discussion Meeting

In the event, the Rosetta launch did not take place as planned due to the failure of the Ariane V launch vehicle on its trial flight.



The Royal Astronomical Society organised a discussion meeting on cometary science, which was held at the Geological Society Lecture Theatre in Burlington House on 2002 December 13. The organisers gave this summary: *Recent years have seen marked advances in the study of comets, largely through ground-based observations of Hyakutake and Hale-Bopp, and in-situ measurements of Hyakutake and Borrelly. The imminent launch of the Rosetta mission is taken as an opportunity to review progress made in this field, and to discuss the questions and challenges to be addressed in the future. The meeting will cover all aspects of cometary science, from studies of the nucleus, dust, and coma, to comets' interactions with the solar wind."*

Rita Schulz (ESA) started the proceedings with a description of the Rosetta mission, entitled *Rosetta goes to comet Wirtanen*. If the launch goes ahead as planned, the spacecraft will rendezvous with the comet after aphelion and follow it through to perihelion. She described the scientific instruments on Rosetta, which include: a grain impact analyser, visual and infra-red thermal imaging spectrometer (which can measure the temperature of the surface and some of the coma), OSIRIS (optical, spectroscopic and ir imaging camera), which has 2 cm resolution, ALICE (uv imaging spectrometer, especially designed to look at water), CONSERT, MIDAS (imaging microscope for dust grains), COSIMA (composition of dust particles from an ion analyser), ROSINA (same for gas), MIRO (Sub-millimeter telescope looking at water, ammonia, carbon monoxide, methanol and subsurface), RPC, RSI (radio science, giving the gravity field and mass of the comet).

The spacecraft is 2.8 x 2.1 x 2.0m, with a 32m solar panel array and is designed to operate for 10.5 years. The Ariane 5 to be used to launch it is the basic version, which is different to the version that had failed a few days earlier. She said that there was no reason to delay the launch at the moment. The launch should take place on January 13, though the window is 1st - 29th, with a Mars flyby 1.5 years later, when the instruments will be activated. There are Earth gravity assists in 2005 and 2007, followed by asteroid flybys. First is Otawara, followed by Siva (a C type primitive asteroid 110 km across), which will be the largest asteroid yet encountered. The spacecraft will image the surface of 46P/Wirtanen from 4.6 to 3.0 AU, with the lander touching down at around 3 AU. It may detect a variation in the composition of the cometary output with solar distance and for the first time we will know what goes on in a cometary nucleus.

Jens Biele (German Aerospace Center, Cologne) spoke on *How to catch and land on a comet*. The nucleus of the comet is around 1km across, density 0.2 - 1.5 gcm^{-3}, albedo 3% and a rotation period of around 7 hours, possibly in an excited state, meaning that it is tumbling. The orbiter needs to get closer than 300 km (Hill's sphere of influence). The comet position as the comet approaches is uncertain by 20,000 km due to uncertain astrometry and non-gravitational forces. There are several phases to the encounter: it will take 158 days to close from 100,000 to 20,000 km, 120 days to 300 km and then 3 days to get within 60km before finally entering a 10 - 25 km orbit. This will not be easy due to continuous perturbations to the comet's orbit. In addition dust particles create false stars for the navigational camera, and orbit around a non-spherical body is unstable needing sufficient propellant reserves. There is a large variation in temperature between the day and night sides of the comet. The closest approach is 2km. The lander, which is 0.8 x 0.8 x 1.0m, will anchor itself with a harpoon and has ice screws in its feet. Its drill can sample down to 20cm.

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Subscription to the Section newsletter costs £5 for two years, extended to three years for members who contribute to the work of the Section in any way, 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.

Section News from the Director

Dear Section member,

It has been an eventful period since the last newsletter. I write this from on board the RRS Ernest Shackleton as we sail northwards towards the Falkland Islands across the Drake Passage. Renowned as one of the stormiest ocean passages in the world, it has been amazingly calm, albeit cloud has precluded any chance of observing. My stay at Rothera station in Antarctica went very well and the trial flights of our ozone balloons were completely successful. The weather there wasn't particularly good for observing either, indeed it was one of the cloudiest spells of Antarctic weather than I can remember. I did get a few glimpses of comet 2002 V1, the first on February 25, when it sported a short tail in the bright twilight. Although I had hoped to complete drafts of the papers on the comets of 1999 and 2000 whilst I was away, in the event, I was kept sufficiently busy that I only made a token start on them. My absence has also meant that this issue is rather thinner than usual. This is perhaps a benefit as I gather that the last issue was sufficiently close to the Post Office limit that some copies were surcharged. If this happened to you, please let me know and I will adjust your subscription accordingly.

Launching an ozonesonde at Rothera

In November we had a storm of meteors from comet 55P/Tempel-Tuttle. Not trusting the UK weather I decided to go overseas, and in the end made a last minute choice of destination based on weather information available on the Internet. I flew to Toulon and stayed at St Maximin, about 40km to the north. Here I had an excellent view of the meteors. It is now very easy, and cheap to fly to popular destinations and escape the vagaries of British weather and I can recommend this as an option should a really bright comet come along. A complete account of my trip appeared in the January issue of The Astronomer.

The Royal Astronomical Society had a meeting on December 13 devoted to "Cometary Science at the Launch of Rosetta". I gave a short talk on our activities and a full write up appears elsewhere in the newsletter. There are two events coming up in quick succession in May. First I am going to the Meeting on Asteroids, Comets, Europe, which this year is being held in Mallorca from May 2 - 5. The next weekend (May 10) is the pro-am discussion meeting at Milton Keynes and I hope that many of you will be able to attend. The star billing of the meeting is the first George Alcock memorial lecture and I am delighted to say that Brian Marsden has agreed to present the lecture, which is to be on 'Comets near the Sun'. Both John Alcock (George's brother) and Kay Williams (George's biographer) hope to be present. Other speakers include: Neil Bone, Andrew Elliot, Alan Fitzsimmons, Monica Grady, David Hughes, Nick James, Graeme Waddington and myself. There will be plenty of time for informal discussion during the lunch and tea breaks. Reports on both these meetings will appear in the next issue.

Space exploration of comets has encountered serious setbacks, with first the American Contour mission being lost, then the ESA mission to Wirtanen being postphoned due to problems with the Ariane launcher. Hopefully this spacecraft will now be launched towards 73P/Schwachmann-Wachmann, which will make a close pass by the Earth in 2006. There were also doubts about the Deep Impact mission, however this has only been slightly delayed and should provide the celebratory fireworks on schedule!

One of the few sunny days at Rothera during my stay – the instrument at right is a laser cloud base recorder.

I am pleased to announce that Cliff Meredith has been awarded the Keedy prize for 2002 for his enthusiastic observations over the last couple of years, using both visual and CCD techniques. The prize takes the form of a book and certificate and is awarded to BAA observers who make a significant contribution to the Section. David Keedy has supported the Section in this way for a good number of years, but has decided that the next award will be the final one. I would like to take this opportunity of thanking David for his considerable support, which has been much appreciated.

Nick James and Gerald North have just had a book called *Observing Comets* published by Springer as part of their 'Practical Astronomy' series (ISBN 1-85233-557-2). To quote from the advertising blurb: *Since comet Shoemaker-Levy collided with the planet Jupiter with stupendous force in 1994 there has been an upsurge of interest in comets. Most comets are first discovered by amateur astronomers, simply because there are so many amateurs looking for them. Techniques and instruments - not necessarily expensive - have improved dramatically in the past few years. Nick James and Gerald North describe comet hunting, photographing and imaging comets, and digital image processing.*

This comprehensive book is at once a "primer" for comet hunters and a reference text for more advanced amateur astronomers. The free CD-ROM that accompanies this book provides resources, comet images, and software. It can be used on almost any personal computer that is equipped with a CD-ROM drive and has an Internet browser.

Springer have generously made some copies available for competition prizes. BAA Members are also entitled to a 20% discount when ordering books from Springer - just quote your membership number when placing your order. For readers who are Members of the British Astronomical Association the competition is to submit a short essay of around 500 words on *'Why I observe comets*'. For any readers of these pages the competition is to submit a short essay of 500 - 1000 words on *'The importance of amateur comet observations*'. The winning essays will be published in the next issue of *The Comet's Tale*. The closing deadline for the competition was mid April, however as this is before the magazine will reach you, late entries will be accepted up to May 6. I hope to present the prizes at the meeting on May 10.

Since the last newsletter observations or contributions have been received from the following BAA and Section members:

RAS Discussion Meeting 2003 May 10

at

The Berrill Lecture Theatre, Open University, Milton Keynes

10:30 Doors open, registration, tea/coffee available

11:00 Welcome
11:05 **Monica Grady** (NHM), Meteorites
11:25 **Neil Bone** (BAA), BAA meteor observations
11:45 **Iwan Williams** (Queen Mary, London), Meteor streams
12:05 **Andrew Elliot** (BAA), Video meteors
12:25 Discussion

12:30 Lunch

14:00 **Jonathan Shanklin** (BAA), BAA visual comet observations
14:20 **David Hughes** (Sheffield), Cometary size distribution
14:40 **Alan Fitzsimmons** (Queen's, Belfast), Recent results in ground-based imaging of distant comets
15:00 **Nick James** (BAA), Amateur CCD observations of comets
15:20 Discussion

15:30 Tea

16:00 **Graeme Waddington** (BAA), Comet orbits and Ikeya-Zhang
16:20 **Brian Marsden** (SAO), *The George Alcock Memorial Lecture* "**Comets near the Sun**"

17:20 Discussion

17:30 Close

Refreshments will be available for purchase. **If you plan on coming to the meeting please let me know so that we can arrange adequate catering.** There is no registration fee. There will be plenty of opportunity for informal discussion during the breaks. Information on travel to Milton Keynes and maps of the location are available at http://www.open.ac.uk/maps/

James Abbott, Jose Aguiar, Alexandre Amorim, Alexander Baransky, Sandro Baroni, Sally Beaumont, Peter Birtwhistle, Nicolas Biver, Reinder Bouma, David Boyd, Nick Brown, Jose Carvajal, Julie Chignell, Emilio Colombo, Matyas Csukas, Alfons Diepvens, Kenelm England, Len Entwisle, Mike Feist, Rafael Ferrando, Sergio Foglia, Mike Foulkes, Martin Gaiger, Mike Gainsford, Stephen Getliffe, Guus Gilein, Juan Gonzalez, Bjorn Granslo, Mark Green, Werner Hasubick, Roberto Haver, Guy Hurst, Michael Jager, Andreas Kammerer, Manos Kardasis, Heinz Kerner, Attila Kosa-Kiss, Carlos Labordena, Martin Lehky, Rolando Ligustri, Mike Linnolt, Gordon MacLeod, Pepe Manteca, Michael Mattiazzo, Richard McKim, Cliff Meredith, Maik Meyer, Antonio Milani, Martin Mobberley, Alexandra Mormyl, Neil Morrison, Gabriel Oksa, Roy Panther, Andrew Pearce, Stuart Rae, Maciej Reszelski, Tony Rickwood, Hirohita Sato, Juan San Juan, Tony Scarmato, Carlos Segarro, Jonathan Shanklin, Oddleiv Skilbrei, Giovanni Sostero, Willian Souza, David Strange, Melvyn Taylor, John Vetterlein, Alex Vincent, Seiichi Yoshida and Mauro Zanotta (apologies for any errors or omissions). Without these contributions it would be impossible to produce the comprehensive light curves that appear in each issue of *The Comet's Tale*. I would welcome observations from any groups which currently do not send observations to the BAA.

Comets under observation were: 29P/Schwassmann-Wachmann, 30P/Reinmuth, 46P/Wirtanen, 67P/Churyumov-Gerasimenko, 81P/Wild, 92P/Sanguin, 116P/Wild, 2001 HT50 (LINEAR-NEAT), 2001 Q4 (NEAT), 2001 RX14 (LINEAR), 2002 O7 (LINEAR), 2002 Q4 (154P/Brewington), 2002 Q5 (LINEAR), 2002 R2 (155P/Shoemaker), 2002 T7 (LINEAR), 2002 V1 (NEAT), 2002 X1 (LINEAR), 2002 X5 (Kudo-Fujikawa), 2002 Y1 (Juels-Holvorcem), 2003 A1.

I look forward to meeting many of you on May 10.

Jonathan Shanklin

Tales from the Past

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

150 Years Ago: Professor Challis observed the following portion of Biela's comet from Cambridge in 1852 September. The publication of a new catalogue of "Cometic Orbits with copious Notes and Addenda" compiled and edited by Edward J Cooper was announced at the November meeting. He had arranged the orbits in tables and was induced to believe that to Sir John Herschell's hypothesis "that direct motion or a small inclination are favourable indications of a periodic comet" we may "a longitude of the perihelion and of the ascending node between 45° and 135°". January records the last observations of Westphal's comet, which had a period of around 60 years and just reached naked eye visibility. *[At its next return in 1913 it suddenly faded and has not been seen since]*. In March Signor Secchi discovered a new comet from Rome, and it was independently found by Prof. Schweizer at Moscow, Dr Hartwig at Leipsic and by C W Tattle [sic] at Harvard. The discovery by Charles Tuttle was telegraphed from Boston to New York and transmitted to the Astronomer Royal by the steamer Arabia, which was just on the point of sailing when the message arrived. The March issue is dated March 11 and the telegram was sent on the 9th! At the April meeting Dr Lardner presented a paper on "The Classification of Comets and the Distribution of their Orbits in Space", based on 207 orbits. He identified three groups - those whose aphelia are within Saturn's orbit (eg Encke, Biela), those whose mean distances are nearly equal to Uranus' orbit (eg Halley, Westphal) and those whose mean distances exceed the extreme limits of the solar system.

100 Years Ago: Mr Maunder reported on two comets discovered during the recess. One had been discovered by John Griggs of New Zealand, who appeared to be the only observer. A paper by A C D Crommelin described a method of "the determination of Comets' places without micrometers'. In November Mr Maunder presented the report of the comet section and showed lantern slides of comet Perrine (1902 R1). Captain W Noble commented that on October 8 and 9 the head of the comet had appeared granular as if made of very fine luminous sand, though other observers thought it nebulous. The President (Mr Saunder) commented that the lantern slides in the RAS collection of Swift's comet showed a V-shaped tail and there was in one of the photographs a great mass almost as big as the head of the comet itself, which had been thrown off. There are notes on a paper in Ap J by Peter Lebedew on "The Physical causes of the deviations from Newton's Law of Gravitation", which looks at what causes the repulsion of a comet's tail from the Sun. He concludes that Kepler's original theory (1608), that it is due to the repulsive force of the solar radiation, again holds the field. The December Journal has a repport on comet 1902 R1 (Perrine) by E W Maunder. He comments that it proved to be a disappointing visitor. Sixteen members contributed observations and the report includes drawings and photographs. A few rough magnitude estimates are also included. *[This is perhaps the first report that does so, though no light curve is attempted.]* In January a note taken from MN quotes "Mr Innes has been hunting the records of the Cape Observatory and quotes six observations of comets between 1684 and 1689. In those days they seem usually to have been known as "stars with tails" and one of them is quaintly described as having appeared in "the 5th house of the heavens", which looks as if our friends at that period had not shaken themselves free from the charms of astrology." At the March meeting Mr Maunder described a technique for drawing comets and also commented on a technique used to copy some of the lantern slides, which had much deteriorated.

50 Years Ago:. The December Journal has a note from the Irish Astronomical Journal stating that the problem of cometary tails has been solved by Biermann. The theory suggests that protons and electrons impact on molecular ions in the tail and this explains the disturbances seen in tails after magnetic storms. January sees a review of the new book by J G Porter entitled 'Comets and Meteor Streams'. He includes Whipple's new theory and notes that Whipple himself admitted that the evidence for the theory was preliminary in character and subject to alternative explanations!

Cometary Science at the Launch of Rosetta

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The next address, *In-situ Science on a comet - the Rosetta Lander*, was to have been given by Jean-Pierre Bibring (University of Paris Sud, Orsay) but was presented by Jens Biele. The lander has 11 instruments, looking at composition, physical properties, imaging and large scale structure, environment and evolution. CONSERT can measure the internal structure by sending radio waves through the nucleus to the orbit and achieve a 10m resolution. The lander has a five day lifetime on battery power alone, but should last three months on its solar panels. It is only designed to operate up to 2 AU (q is 1.06 AU).

Ian Wright (OU) spoke about *PTOLEMY*. This experiment is named after Ptolemy V, who is named on the Rosetta stone and is designed to measure the abundance and isotopic ratios in CHON. Comets (& meteorites) are the cosmogonical equivalent of the cosmic micro wave background - a relict from the birth of the solar system. The team wants to measure δD per mil to compare with SMOW (standard mean ocean water), meteorites etc to see if comets are a possible source of Earth's water. They use a stepped combustion principle to look at different components.

Iwan Williams (QMC, London) spoke about *CONSERT*. Rosetta should answer many questions on the nature of the cometary nucleus. CONSERT (COmet Nucleus Sounding Experiment by Radiowave Transmission) looks at the interior by using a 90 Mhz (3m) radio pulse emitted from the orbiter. The lander picks it up and sends a pulse back, thus acting as a probe of the structure by measuring the changes in transmission time due to path length and refractive index. They need to know exactly where the lander is, and also have a good map of the entire surface.

Chris Carr (Imperial College, London) described *The Rosetta Plasma Consortium*. The state of the art plasma experiments will look at the onset and development of cometary activity and its interaction with the solar wind. Imperial is a principal investigator, with the Mullard Space Sciences Laboratory as co-investigators. Andrew Coates (MSSL, UCL) followed up with *The cometary plasma environment: current knowledge and prospects for Rosetta*. Comets have a large interaction region with the solar wind. The size varies with cometary activity and there was a factor of 100 difference between comet Halley and Grigg-Skjellerup. Rosetta will see a factor of 1000 difference over the course of study. Gas pulls dust away from the comet nucleus, neutrals drift at a few ms^{-1} and escape at a few kms^{-1}. Production varies with solar distance and neutrals ionise in sunlight. The solar magnetic field is frozen into the flow of the solar wind, which slows as it picks up newly ionised particles. The tail of 1996 B2 (Hyakutake) was 3.8 AU long. 19P/Borelly had an asymmetric gas & dust emission into the coma. The relation of tail rays to in situ data is still not clear. Theory predicts a bowshock and ionopause. Many different boundaries are actually seen: a bow shock (Mach 1 - 2), a mystery boundary that shows as a change in the solar wind, a cometopause, where solar ions change to cometary ions, a magnetic field pile up, an ion pile up and finally an ionopause. There are many questions still to be answered by the plasma instruments on Rosetta, such as the permanence of the various boundaries, the structure of the inner coma, the structure of the tail formation region and tail rays, the magnetisation of the nucleus, and sputtering, charging and dust levitation on the nucleus.

The lunch break gave a chance for some informal chat to the various participants, though the sandwiches on offer do not give very good value for money, so many regular attendees at the venue had brought their own. After lunch, proceedings resumed with Alan Fitzsimmons (Queen's University, Belfast) on *Observing Distant Comets and the Nucleus Size Distribution*. Only four short period comets have well determined albedos (2, 19, 28 and 49). Ground based observations of distant comets may give no detection, which gives an upper limit for the nuclear magnitude and hence size. Alternatively they may give a strong detection, with lots of coma, which only gives a weak constraint on the size. Ideally he wants to see a point source, which gives a good measurement. Checks include comparison of the seeing disk with respect to stars, any rotational modulation and a consistent magnitude at different epochs. He showed the results of size distribution estimates by several authors: Fernandes et al (1999) gave $\alpha = 0.53$ for 64 short period comets (SPC), Hughes (2002) estimated $\alpha = 0.51$ from H_{10} magnitudes of 94 SPC with $H_{10} < 7.0$, Lowry et al (2002) found $\alpha = 0.32$ from 19 R band estimates of distant comets. HST observations of comets when close and therefore resolvable, combined with the best ground based estimates give $\alpha = 0.32$, but this might be biased by poor detection of small objects. The Kaplan-Meier statistic can be used to debias the estimate and confirms that $\alpha = 0.31$ for comets with radius > 1km, though it could still be biased as the data was selected from 94 numbered SPC. For smaller objects $\alpha = 0.03$, effectively implying that there are no very small comets. NEOs have a very similar value with α around 0.3.

David Hughes (University of Sheffield) followed this up with a talk on *The size Distribution of*

Nuclei and its Evolution with Time. In this context David equated SPC with Jupiter Family (JF) comets. He assumed that K = 10 in the magnitude equation and computed H_{10} values and then plotted this value against perihelion distance. There are four general regions. In region A (small q, bright H_{10}) the comets would be bright if they existed and in region D (large q, faint H_{10}) they would be too faint and small to easily detect. As SPC decay, comets with small q are quickly removed from the plot. For the relatively small set, α varies with q and at large q tends to $\alpha = 0.36$. From the change in current minimum magnitude versus q, it is possible to get some measure of the decay rate. Comets clearly do decay, for example 1P/Halley lost about 7m at its last return. This suggests that the average comet will last around 2500 years, and roughly a quarter of all comets inserted into the inner solar system are lost after 1500 years. We are currently finding about 1.6 SPC with $q < 1.8$ and 0.7 SPC with $q > 1.8$ per year and we need a greater discovery rate [*LINEAR and other search programmes have pushed this rate up recently*] There should be small comets to find beyond 3 AU.

Michael A'Hearn (University of Maryland, USA) then looked at *Diversity Among NASA's Cometary Missions.* There is a continuum in small bodies from the outer edge of the asteroid belt to the Oort cloud and interstellar comets. Space agencies have quite a few small body missions either planned or underway, including NEAR, DS1, Stardust, [Contour], Muses C, Rosetta, Deep Impact, Dawn and KBP. Deep Impact might go on to study P/Boethin. Small NASA missions have rigid cost caps (eg Deep Impact, Stardust). The resolution is steadily improving, for example Stardust has 10 - 20m, although imaging is a secondary component of the mission. Spectral resolution is also improving. The impactor on Deep Impact is made of copper because copper doesn't react quickly with water. Its target, 10P/Tempel, has a 2.6 km nucleus and an albedo of 7%. It will be targeted at the brightest nuclear region as the jets are much fainter than those of 1P/Halley and won't confuse the automatic system. It should form a crater, probably controlled by gravity, but it could be compressional. If it hits a snowdrift it will make a 2m diameter hole! Other possibilities were splitting the nucleus, shattering the nucleus or going straight through. The team needs Earth based observations, including those from amateurs. The encounter conditions for Stardust are not very favourable, with the comet at only 33° elongation, but for Deep Impact they are much better with the comet at 104°. To measure the comet's mass they would need a miss distance for the main probe of 2 km, however the comet's radius is 2.5km. Future US proposals include small discovery class missions for which an announcement of opportunity will be made soon. One will almost certainly be to a comet. A medium class mission will be the KBP, but a comet surface sample return has a less than 20% chance of being funded.

The final professional talk was by Mark Burchell (University of Kent) on *Laboratory Studies of what an impact in a porous ice target (eg comet nucleus) might look like.* The comet surface is likely to be eroded or resurfaced, but should have ice craters. Canterbury have a two stage gas gun that fires a 1mm projectile. Experiments started with slabs of solid ice, then went to porous packed ice flakes. They found craters with a deeper pit at slow impact speeds (1 km s^{-1}). It is possible to scale to larger sizes, but it is a long way to scale to values associated with typical real impact craters. The next stage was to go to spheres of ice, which required a lower energy to disrupt for a solid sphere, but formed craters or spallation from porous spheres. They are working on modelling the impacts.

I concluded the discussion meeting by describing *Amateur contributions to cometary science.* This talk demonstrated the work that many of you are undertaking, beginning with cometary discovery and ending with some of the detailed CCD work and visual magnitude estimation. One point that I made was that I thought that the days of amateur visual discovery were ended thanks to SOHO, LINEAR and other search programmes and that in the future PanSTARRS would remove all chances. Kudo and Fujikawa proved this speculation spectacularly wrong, almost as the meeting was taking place, with the discovery of 2002 X5!

Jonathan Shanklin

Professional Tales

COMET'S FEATURES LOOK A LOT LIKE SOME ON EARTH Diana Jong, Space.com, 21 October 2002 © Space.com

Venus has its volcanoes. Mars has a canyon grander than any on Earth. Eros the asteroid is pockmarked by impact craters and littered with boulders. Many Sun-orbiting objects have geologic features that are analogous to those here on Earth. New research reveals that even comets, the dirty balls of ice from the edge of the solar system, can remind us of home.

Last September, while on its last leg, the Deep Space 1 (DS1) spacecraft zipped by comet Borrelly, taking some of the most detailed images ever of a comet's core. Examining these images, scientists noticed mesas, ridges and hills, all resembling terrestrial surface features. The geologic features on Earth and Borrelly are formed through the same basic processes.

The new colour-enhanced composite of Borrelly images taken by DS1 was released earlier this month. It shows features of the comet's nucleus, dust jets escaping the nucleus and the cloud-like coma of dust and gases. On Earth, analogous structures are carved out largely through the erosive forces of wind and rain. On a ball of dust and ice (with perhaps some rock) hurtling through space, however, geology is formed when a material turns directly from a solid into a gaseous state, a process called sublimation. "It's basically all physics," says Dan Britt, a geologist from the University of Tennessee and a member of the DS1 science team.

The mesas on Borrelly are more than 100 meters tall and can be 20 times as wide. Britt says they resemble the mesas in the American Southwest, which are formed when a cap of hard rock overlies softer material that erodes faster. The cap acts as a type of shield. On Borrelly, the caps are made of the dust and rock left behind when volatiles, such as water and methane ice, sublimate. Sublimation continues from the sides of the mesa, and a resistant cap finally drops down when it is undermined, Britt said. During the course of Borrelly's seven-year orbit around the Sun, Britt adds, the mesas erode as much as 10 meters.

There are also regions on Borrelly that experience slower sublimation-related erosion, a fact Britt figures is responsible for making the hills and linear features on the comet. Overall, he says, sublimation removes about 1 meter of Borrelly every cycle. "That's actually pretty active erosion, even in geologic terms," Britt said in a telephone interview. "If your yard eroded one meter every seven years, you'd be upset."

Britt and his colleagues also observed ridges on Borrelly. These were formed, they believe, when one part of the comet broke off and was pushed back at an angle. "When you have two moveable objects pushing against each other, you make ridges," he said. "That's how you make mountains on Earth."

As simple as it may sound to draw a correlation between Earth and comets, these findings are somewhat surprising, Britt says. "Comets, up until now, have been really astronomical objects, sort of dots on a photographic plate, or blobs," he said. "I've never really thought that a ball of ice and dust would make interesting surfaces and have interesting processes and produce interesting pictures."

Britt and his colleagues compiled DS1's images of Borrelly to create 3-D composites. They then carefully examined and measured the features on the comet. They presented their findings earlier this month at a meeting of the Division of Planetary Sciences in Birmingham, Alabama.

Astronomers have been taking pictures of comets for more than a decade, but none have been as detailed as those of Borrelly, made when DS1 passed within 2,000 kilometers of the comet.

In 1986, the European Space Agency's Giotto mission took pictures of comet Halley. Those images, however, did not resolve the surface of the comet. In 2003, ESA will launch Rosetta, which will visit comet Wirtanen. It will be followed in 2004 by NASA's Deep Impact, designed to slam a probe into a comet while the mother ship monitors the event from afar, so as to learn more about comet insides.

DS1, launched in 1998, was designed primarily to test new technology, including an ion engine. Science was a secondary objective.

ROSETTA TO PLAY ORBITAL MECHANICS TO REACH COMET 67P/CHURYUMOV-GERASIMENKO by Bruce Moomaw, SpaceDaily, 23 March 2003 © SpaceDaily

"SpaceDaily" has now acquired additional information on the favoured new mission plan for Europe's Rosetta comet-rendezvous spacecraft, whose planned January launch to comet Wirtanen had to be cancelled due to the disastrous failure of the immediately preceding launch of its Ariane 5 booster.

While a delayed launch to Wirtanen next January cannot be completely ruled out, the most probably replacement mission for the craft is a launch next February. Since this comet's nucleus is thought to be considerably bigger than Wirtanen's, this will require considerable replanning of the landing procedure for its small ejectable comet-nucleus lander.

But simply getting to the comet also requires major redesign of its flight plan -- and part of this is trying to find new replacements for the two asteroids Rosetta was supposed to rapidly fly by for additional science observations during its circuitous 9-year trip to Wirtanen.

The first of those two asteroids was 4979 Otawara -- only a few kilometers wide, which may actually be a small chunk of the third-biggest asteroid Vesta broken loose by an ancient impact. (Vesta is the only big asteroid with actual flows of volcanic basalt on its surface; America's "Dawn" spacecraft is scheduled to visit it in 2010 and spend almost a year orbiting it for detailed study.)

The second would have been 140 Siwa -- a big "C-type" asteroid, thought to be made of the same darker "carbonaceous chondrite" rock that makes up most rocky bodies in the outer Solar System, which condensed out of the original solar-orbiting nebula out of which the Solar System formed at lower temperatures than the silicate rock bodies of the inner System, and so is much richer in water and even in organic compounds. (Siwa, at 110 km, would have been the biggest asteroid yet visited by a spacecraft.)

Those, however, are now out of reach. Rosetta's new flight plan calls for it to match orbits with comet 67P/ with an even more complex set of loops around the Sun than its original flight plan to Wirtanen did. It will still make a gravity-assist flyby of Mars -- but if the Feb. 2004 launch to 67P/ is chosen, it will also make three gravity-asist flybys of Earth instead of only two.

The new plan would involve Rosetta being initially launched into a near-Earth orbit with a period of exactly one year, allowing it to return to and fly by Earth at that time to get a boost into a more elongated orbit that will take it to Mars. (If it misses this launch window, it can be launched a year later directly from Earth to Mars -- but since Mars will be farther from the Sun in its mildly elliptical orbit than it would have been for a launch last January, such a direct flight to Mars will require a more powerful booster: either a Russian Proton, or the improved "Ariane 5 ECA" which failed so disastrously in December and might not be ready for this mission even by early 2005.)

However it gets to Mars, Rosetta will fly by that planet in Feb. 2007 (making some science

observations as it does so) and getting a gravity-assist boost to further elongate its orbit. It will then return to Earth to make its second gravity-assist flyby of our home planet that November, putting itself into a still more elongated orbit with a period exactly two Earth years long -- so that it will return once again to make its third and last gravity-assist flyby of Earth in Nov. 2009, putting itself into a still more elongated orbit taking it almost as far from the Sun as Jupiter.

As it sails away from the Sun on that orbit, it will fire a burn on its main engine in mid-2011, moderately adjusting its path to help match orbits with 67P/. Then -- three years later, as it starts to approach the Sun again -- it will close in on the comet's nucleus and carry out a months-long string of finer manoeuvres to rendezvous with it after a total journey of about 10 1/2 years (two years longer than the originally planned flight).

Rosetta's planners have already carried out an extensive hunt for any asteroids it could fly past during this revised series of loops around the Sun, and have indeed found two. The first is 437 Rhodia, which it would fly past in Sept. 2008 at a speed of about 41,000 km/hour.

Rhodia -- only about 25 km wide -- may be a particularly unusual asteroid. It is thought to have an albedo higher than that of any other known asteroid, reflecting fully 56% of the light hitting it -- which would imply that it is made of some mineral as white as chalk (possibly a chance extrusion of some white rock like anorthosite, which formed on a bigger asteroid and was later broken loose by a collision).

The second asteroid target would be 21 Lutetia, a big asteroid about 100 km wide which Rosetta would fly past at about 55,000 km per hour in July 2010. While Lutetia is about the same size as Siwa, it is definitely odder -- it's one of the biggest of the so-called "M-class" asteroids, which until recently have been thought to be made largely of metallic nickel-iron alloy of the type that makes up many recovered meteorites.

M-class asteroids (tagged, like the other declared classes of asteroids, by the near-infrared spectra of their rocks as seen from Earth) are rather uncommon -- they make up only about 4 percent of asteroids. They have been thought to be pieces of the metal cores that formed at the centers of the dozen or so large "planetesimals", several hundred km wide, that orginally formed in the Asteroid Belt, before most of them were gradually shattered into smaller fragments by repeated collisions over the eons.

However, more detailed near-IR spectra recently show some signs that most of the bigger M-class asteroids -- including Lutetia -- may not be metallic at all. Instead, they may be made of silicate rocks that were exposed to some water during their early history. Many of the smaller M asteroids -- as well as 16 Psyche, the biggest of all -- don't seem to show such evidence, and may be the real thing. If Rosetta does visit Lutetia, its color photos, close-up IR spectra and magnetic field measurements will likely settle this question.

There, is, however, a catch. Matching orbits with 67P/ will require more manoeuvring fuel than Wirtanen would have. And so, in order to take the orbital paths needed to intercept the asteroids, Rosetta would have to rendezvous with its main comet target when the comet is closer to the Sun than Wirtanen would have been -- only 540 million km from the Sun, as opposed to the 600 million km planned for Wirtanen.

Since, as a comet approaches the Sun, the "coma" of gas and dust boiling off it dramatically increases, as 67P/ reaches its perihelion it will get much harder for the comet-orbiting spacecraft and its lander to make their observations. (Rosetta's design specifications only guarantee its full operation beyond doubt until the comet approaches within 490 million km of the Sun.) Scientists therefore would very much like to rendezvous with the comet when it's still 600 million km from the Sun as originally planned, to prolong their detailed observation time there. They will thus have to decide which they prefer: those two asteroid flybys, or as much as six extra months of time studying 67P/ itself in detail.

They have plenty of time to make that decision, however -- it can actually be delayed until after launch. At any rate, given the initial alarming indications immediately after the cancellation of last January's launch that they might be unable to find a workable replacement target for Rosetta at all, ESA scientists are quite happy even to have such a choice.

New Launch Date for Deep Impact Deep Impact Project April 1, 2003

A new launch window is announced for the Deep Impact project, the first mission to look deep inside a comet. Technical and management issues, including contamination in the propulsion system and late deliveries of key spacecraft components, resulted in delays in the pre-flight testing schedule. These concerns led Deep Impact Principal Investigator, Mike A'Hearn, to recommend to NASA a delay of launch. A launch window beginning December 30, 2004, previously identified as a back-up date, provides more thorough testing for the spacecraft systems before launch and allows the spacecraft to arrive at Comet Tempel 1 to impact it as originally scheduled on July, 4, 2005. NASA management approved the recommendation.

Deep Impact will be the first mission to make a spectacular, football-stadium-sized crater, seven to 15 stories deep, into the speeding comet. Dramatic images from both the flyby spacecraft and the impactor will be sent back to distant Earth as data in near-realtime. These first-ever views deep beneath a comet's surface, and additional scientific measurements will provide clues to the formation of the solar system. Amateur astronomers will combine efforts with astronomers at larger telescopes to offer the public an earth-based look at this incredible July 2005 encounter with a comet.

The following items are from Distant EKO news, the Kuiper Belt Electronic newsletter. You can find more items at http://www.boulder.swri.edu/ekonews/issues/

2060 Chiron - Chaotic Dynamical Evolution and its

Implications Ryszard Gabryszewski, Acta Astronomica, 52, 305 (2002 September)

Chiron--one of the Centaurs orbiting chaotically among the giant planets--is treated as an asteroid and a comet (95P/Chiron) as well. Since the day of the discovery many papers discussed its past and future fate.

This paper considers a possibility of Chiron's dynamical evolution to different cometary orbital types. An ensemble of orbital elements was used to describe Chiron's dynamics in terms of probability. The ensemble was generated using an unique scheme of elements creation. Dispersion of elements obtained by this method is much smaller comparing to ranges obtained by varying the original elements in the ellipsoid of their mean errors. The chaos in Chiron's dynamical evolution can be seen in 5 to 9 kyrs, although the dispersion of orbital elements is small. Halley type orbits are the rarest noticed orbital types but the number of these objects is 3 times greater than the number of apparent Halley type comets. The variations of probability of different cometary orbits as a function of time is also presented. The rate of HTC orbit production is only 4 times lower than the production rate of JFCs after the first 50 kyrs of integration. Some remarks on small body transportation mechanisms are also included.

143P/Kowal-Mrkos and the Shapes of Cometary Nuclei David Jewitt, Scott Sheppard, and Yanga Fernandez To appear in: The Astronomical Journal

We add 143P/Kowal-Mrkos to the small but growing sample of well-observed cometary nuclei. Photometric observations from 3.4 to 4.0 AU heliocentric distance reveal a point-like object with no detectable outgassing. Periodic modulation of the scattered light ($\Delta m_R = 0.45 \pm 0.05$) is attributed to rotation of the bare nucleus with a double-peaked period 17.21 ± 0.10 hrs and a projected ratio of the shortest to longest axes of about 0.67/1. We also measured the phase coefficient (0.043 ± 0.014 mag/deg), the *BVRI* colors ($V - R = 0.58 \pm 0.02$) and the absolute red magnitude ($m_R = 13.49 \pm 0.20$). The effective circular radius is 5.7 ± 0.6 km (geometric albedo 0.04 assumed).

We study the properties of 11 well-observed Jupiter Family Comet (JFC) nuclei. On average, the nuclei are systematically more elongated (average photometric range $\Delta m_R = 0.54 \pm 0.06$) than main belt asteroids of comparable size ($\Delta m_R = 0.32 \pm 0.05$), and more elongated than fragments produced in laboratory impact experiments. We attribute the elongation of the nuclei to an evolutionary effect, most likely driven by sublimation induced mass loss. However, we find no evidence for any relation between the nucleus shape and the sublimation timescale. This may be because the timescale for evolution of the nucleus shape is very short compared to the dynamical timescale for the JFCs, meaning that most nuclei in our sample are already highly physically evolved.

Review of comet observations for 2002 October - 2003 April

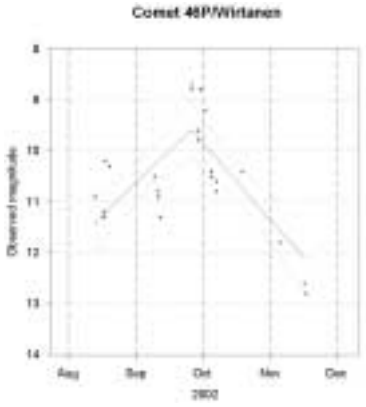
The information in this report is a synopsis of material gleaned from IAU circulars 7980 – 8116, The Astronomer (2002 October – 2002 April) and the Internet. Note that the figures quoted here are rounded off from their original published accuracy. Lightcurves for the brighter comets are from observations submitted to The Astronomer and the Director. A full report of the comets seen during the year will be published in the Journal in due course. I have used the convention of designating interesting asteroids by A/Designation (Discoverer) to clearly differentiate them from comets, though this is not the IAU convention.

Numbered periodic comets

29P/Schwassmann-Wachmann Carlos Labordena (Spain) reported the comet in outburst on November 1, at 12th magnitude with a well condensed coma. Michael Mattiazzo (Australia) also reported the comet bright, with the comet at around 14th magnitude through most of October, brightening at the end of the month. The degree of condensation was quite variable suggesting a series of outbursts, with perhaps one around October 27 and another around November 4. A further outburst may have taken place in early December.

30P/Reinmuth A couple of observations in the first quarter of the year put the comet at around 13.5.

46P/Wirtanen Observations suggest that the comet peaked at around 9th magnitude in late September. I observed it on October 19.18, estimating it at 10.4 in my 20cm LX200 x75. The observations are currently best fitted by a linear type light curve, with the comet brightest about a month after perihelion. The last observation was made in mid November when the comet was nearing 13th magnitude. Observations received (26) give a preliminary light curve of 7.7 + 5 log d + 0.0427*(t-T+30.4)



67P/Churyumov-Gerasimenko. A couple of observations made in December suggest that the comet was around 14th magnitude.

81P/Wild A couple of observations made in December suggest that the comet was around 14th magnitude.

92P/Sanguin. Observations by several observers suggest that the comet faded from 13th to 14th magnitude in the autumn.

116P/Wild was at perihelion in January 2003. Michael Mattiazzo estimated the comet at 12.5 in early February. It should brighten to 12th magnitude in April as it nears opposition but is a long way south and will be difficult to observe from the UK.

Comets discovered with the SOHO LASCO coronographs and not observed elsewhere.

1999 O4 (SOHO) D. Hammer reports measurements for a comet near the sun found by R. Kracht on October 20, on archival SOHO website C3 coronagraph images. The reduced astrometry and orbital elements (showing no known group identity) by B. G. Marsden appear on MPEC 2002-W34. [IAUC 8025, 2002 December 2]

2003 G3 (SOHO) is a non group comet that was discovered by John Sachs on April 4 on C3 and C2 coronagraph images. The preferred retrograde orbit suggests that it will be around 30° elongation from the Sun in late April and early May.

Meyer Group comets
2002 R8 (IAUC 7984, 2002 October 5)
2002 T2 (IAUC 7991, 2002 October 12)
2002 U6 (IAUC 8025, 2002 December 2)
2002 V4 (IAUC 8073, 2003 February 14)
2002 X6 (IAUC 8073, 2003 February 14)
2002 Y2 (IAUC 8073, 2003 February 14)
2003 B1 (IAUC 8065, 2003 February 4)

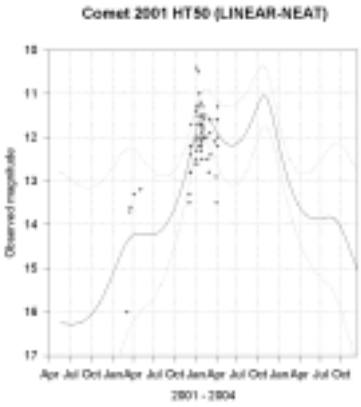
Kracht Group comets
2002 S4 (IAUC 7984, 2002 October 5)
2002 S5 (IAUC 7984, 2002 October 5)
2002 S7 (IAUC 7986, 2002 October 7)
2002 S11 (IAUC 7991, 2002 October 12)

Marsden Group comets
2002 V5 (IAUC 8073, 2003 February 14)

SOHO Kreutz group comets
1999 M4 (IAUC 8022, 2002 November 24)
2000 G3 (IAUC 8073, 2003 February 14)
2002 S6 (IAUC 7986, 2002 October 7)
2002 S8 (IAUC 7991, 2002 October 12)
2002 S9 (IAUC 7991, 2002 October 12)
2002 S10 (IAUC 7991, 2002 October 12)
2002 T3 (IAUC 7991, 2002 October 12)
2002 U1 (IAUC 8000, 2002 October 26)
2002 U3 (IAUC 8022, 2002 November 24)
2002 U4 (IAUC 8022, 2002 November 24)
2002 U5 (IAUC 8022, 2002 November 24)
2002 U6 (IAUC 8025, 2002 December 2)
2002 U7 (IAUC 8025, 2002 December 2)
2002 U8 (IAUC 8025, 2002 December 2)
2002 U9 (IAUC 8025, 2002 December 2)
2002 V3 (IAUC 8073, 2003 February 14)
2002 V6 (IAUC 8099, 2003 March 25)
2002 V7 (IAUC 8099, 2003 March 25)
2002 W1 (IAUC 8100, 2003 March 25)
2002 W2 (IAUC 8100, 2003 March 25)
2002 W3 (IAUC 8100, 2003 March 25)
2002 W4 (IAUC 8100, 2003 March 25)
2002 W5 (IAUC 8103, 2003 March 31)
2002 W6 (IAUC 8106, 2003 April 3)
2002 W7 (IAUC 8106, 2003 April 3)
2002 W8 (IAUC 8111, 2003 April 8)
2002 X3 (IAUC 8034, 2002 December 14)
2002 X4 (IAUC 8034, 2002 December 14)

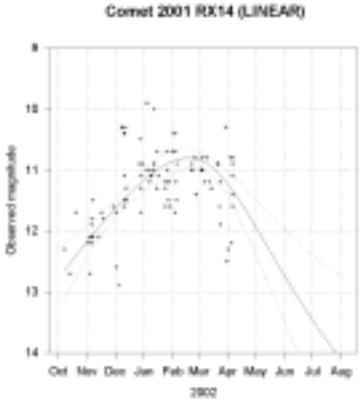
Comets with a preliminary designation

2001 HT50 (LINEAR-NEAT) This is a relatively distant comet, and has been quite tricky to see. Generally observers began to report it in December, when it was 13th magnitude according to Andrew Pearce and Michael Mattiazzo. It brightened a little, perhaps reaching 11.5 in the late winter. The comet is currently approaching conjunction, but will come to a second opposition later in the year, when it could reach a magnitude brighter. It should remain brighter than 13th magnitude throughout the year.



The 67 observations reported so far give a light curve of m = 6.4 + 5 log d + 6.5 log r

2001 RX14 (LINEAR) BAA observers first recorded the comet in early October, when it was around 13th magnitude with Nicolas Biver, Carlos Segarra and myself all making reports. It is a relatively distant comet and it slowly brightened, with some observers reporting it as bright as 10th magnitude over the winter months, though the majority suggest that it reached 11th magnitude. It was still quite an easy object in early April, but it is now past perihelion and will fade quickly.



The 94 observations reported so far give a light curve of m = 7.4 + 5 log d + 9.0 log r

2001Q4 (NEAT) A few observations over the winter suggest that the comet was near 15th magnitude. It should soon be coming into more general view, but remains a Southern Hemisphere object. It could become a naked eye object in May 2004.

2002 J4 (NEAT) The comet will not reach perihelion until October 2003, at 3.6 AU. It could reach 13th magnitude when brightest. It was around 16th magnitude according to CCD observations in early April.

Brian Marsden notes on MPEC 2003-G46 [2003 April 9] that the "original" and "future" barycentric values of 1/a are +0.000026 and -0.000278 (+/- 0.000007) AU**-1, respectively. The original value implies that the comet is a new visitor from the Oort cloud.

2002 O7 (LINEAR) Brian Marsden notes on MPEC 2003-A30 [2003 January 6] that the "original" and "future" barycentric values of 1/a are +0.000027 and -0.000307 (+/- 0.000024) AU**-1, respectively, suggesting that this is a "new" comet from the Oort cloud. It should soon come within visual range, but no observations have been reported so far.

2002 Q4 (154P/Brewington) A couple of observations in December suggest that the comet was around 13th magnitude.

2002 Q5 (LINEAR). Brian Marsden notes on MPEC 2003-C40 [2003 February 8] that the "original" and "future" barycentric values of 1/a are +0.000058 and -0.000885 (+/- 0.000006) AU**-1,

respectively, suggesting that this is a "new" comet from the Oort cloud. A handful of observations suggest that the comet has been around 12th - 13th magnitude over the last six months.

2002 R2 (155P/Shoemaker) The observations suggest that the comet faded from 13th to 14th magnitude over the winter.

A/2002 RN38 is an asteroid, of 18th magnitude, discovered in 2002 September. It is in a 7.4 year orbit, with perihelion at 1.24 AU and an eccentricity of 0.67. It is at perihelion in mid December and will fade as its distance from earth increases. [MPEC 2002-T84, 2002 October 14, 34-day orbit] The orbit is typical of a Jupiter family comet, though there have been no recent encounters.

A/2002 SQ41 (NEAT) is an asteroid, of 20th magnitude, discovered by NEAT at Heleakala on 2002 September 29.41. The preliminary two day orbit puts it in a 5.6 year orbit, with perihelion at 0.50 AU and an eccentricity of 0.84. It will reach perihelion in early December, but unless it shows cometary activity will not brighten past 17th magnitude. It is a PHA, passing 0.006 AU from the Earth's orbit at the ascending node. On this occasion the closest approach is 0.09 AU. [MPEC 2002-T03, 2002 October 2, 2-day orbit] The orbit is typical of a Jupiter family comet, though there have been no recent approaches.

2002 T1 (P/LINEAR) M. Blythe and S. Partridge, Lincoln Laboratory, Massachusetts Institute of Technology, report the LINEAR discovery of a 16th mag comet showing a coma and a possible tail in p.a. about 260 deg on October 3.26. Following posting on the NEO Confirmation Page, other observers confirmed the cometary appearance, including P. Birtwhistle, Great Shefford, England (Oct. 4.11 UT, m_1 = 15.4, faint 1' tail in p.a. 231 deg), and J. McGaha, Tucson, AZ (Oct. 4.33, nuclear condensation of mag about 15.3 and diameter about 6", with a tail 45" long and about 12" wide in p.a. 235 deg curving toward the north). [IAUC 7983, 2002 October 4]

The comet is periodic and is near perihelion and will fade. The period is around 6.7 years and the perihelion distance 1.2 AU. BAA Member Peter Birtwhistle was amongst the first to confirm its cometary nature.

2002 T4 (54P/de Vico-Swift-NEAT) K. Lawrence, S. Pravdo, and E. Helin, Jet Propulsion Laboratory, report the discovery on Oct. 11.22 UT of a 19.3 mag comet (with a nuclear condensation of diameter about 4" and a tail about 20" long toward the south-southwest) on NEAT images taken at Palomar. M. Hicks reports that images taken by J. Young at Table Mountain on Oct. 12.3 (through cirrus clouds) show a diffuse coma and a faint 5" tail to the southwest. D. Balam, University of Victoria, reports that images taken by J. Clem with the 1.82-m Plaskett telescope (also on Oct. 12.3) also show the object to be cometary in appearance (3 pixels, or 3".3, larger than nearby stars). [IAUC 7991, 2002 October 12] The comet was named 2002 T4 (P/NEAT), but it was quickly realised that this was not a new comet: A. Nakamura, Kuma, Ehime, Japan, reports that K. Muraoka (Kochi, Japan) has identified comet P/2002 T4 (cf. IAUC 7991) with 54P, last seen in 1965. The indicated correction to the prediction on MPC 34423 (ephemeris on MPC 46016) is Delta(T) = -7.5 days. Calculations by B. G. Marsden, Smithsonian Astrophysical Observatory, indicate that the comet passed 0.16 AU from Jupiter on 1968 Oct. 18.[IAUC 7992, 2002 October 13]

2002 T5 (P/LINEAR) An apparently asteroidal object of mag 18.4 reported by LINEAR on October 5.39, posted on the NEO Confirmation Page due to unusual motion, has been found to be cometary in appearance. D. T. Durig and J. A. K. Blackwood, University of the South, Sewanee, TN, report that CCD images taken with a 0.30-m reflector on Oct. 18.4 UT show the object to be diffuse with a hint of a tail 12"-15" long in p.a. 330 deg and a soft coma of diameter 5"-8". Images taken by G. Hug, Eskridge, KS, also with a 0.30-m reflector at about the same time, show a nearly stellar coma with extension about 10"-15" long in p.a. about 280 deg. [IAUC 7998, 2002 October 22]

Although some 9 months from perihelion, it is a distant object and will only brighten a little. The period is around 18 years and the perihelion distance 3.9 AU. Observers contributing to the preliminary orbit include BAA Member Peter Birtwhistle.

2002 T6 (P/NEAT-LINEAR) An object reported as asteroidal independently by the NEAT (October 4.50, mag 20.1) and LINEAR surveys (October 7.26, mag 19.4), and later placed on the NEOCP, has been found cometary in appearance. P. Birtwhistle, Great Shefford, U.K., reports that CCD images taken with a 0.3-m reflector on Oct. 27.9 UT show two faint, thin, straight tails in p.a. 107 deg (36" long) and 310 deg (39" long) and a nuclear condensation with diameter about 8". T. B. Spahr reports that 5-min exposures taken with the Mt. Hopkins 1.2-m reflector on Oct. 29.2 show a small coma of diameter about 6" and an extremely faint tail about 10" long in p.a. 330 deg. [IAUC 8002, 2002 October 29]

Although some time from perihelion, it is a distant object in a periodic orbit and will initially fade. The period is around 21 years and the perihelion distance 3.4 AU. Observers contributing to the preliminary orbit include BAA Members Peter Birtwhistle and Stephen Laurie.

2002 T7 (LINEAR) Another object, of mag 17.5 found on October 14.42, and reported as asteroidal by the LINEAR survey has been found to be cometary in appearance. P. Birtwhistle, Great Shefford, U.K., writes that CCD images taken on Oct. 28.0 UT show the object to be slightly 'softer' than stars of similar brightness. T. B. Spahr reports that Mt. Hopkins images taken on Oct. 29.4 show the object to be very slightly diffuse, again with it being slightly larger than the FWHM of nearby stars. The available astrometry (some giving the comet's magnitude as bright as 16.5), including an Oct. 12 prediscovery observation, is given on MPEC 2002-U43. It is possible that this comet could reach naked-eye brightness around April--June 2004. [IAUC 8003, 2002 October 29] Observers contributing to the preliminary orbit include BAA Members Peter Birtwhistle and Stephen Laurie. Comet Section

contributor Rafael Ferrando also made positional measurements. Brian Marsden notes that the "original" and "future" barycentric values of 1/a are +0.000045 and -0.000595 (+/- 0.000005) AU**-1, respectively. [MPEC 2003-E58, 2003 March 14] The first value suggests that this is a "new" comet from the Oort cloud. Michael Mattiazzo gives the orbital plane crossings as 2002 December 26, 2003 June 27, 2003 December 25, 2004 December 25.

The comet is some 18 months from perihelion, which will be reached in 2004 April 23 at 0.61 AU. The comet could be an impressive object in the spring and early summer of 2004, however it will then be a southern hemisphere object. Making reasonable assumptions about the rate of brightening suggests a likely peak of 1st magnitude in early May, giving the opportunity of viewing two naked eye comets at the same time [2001 Q4 should be around the same brightness]. Only a couple of CCD observations have been reported so far, putting the comet at 16th magnitude in mid November.

A/2002 TV55 (LINEAR) is an asteroid, of 20th magnitude, discovered by LINEAR on 2002 October 2.32. It is in a 5.1 year orbit, with perihelion at 0.98 AU and an eccentricity of 0.67. It is at perihelion in mid December, but will fade as its distance from earth increases. [MPEC 2002-T11, 2002 October 4, 2-day orbit] The orbit is typical of a Jupiter family comet, though there have been no recent encounters.

2002 U2 (LINEAR) M. Bezpalko, Lincoln Laboratory, Massachusetts Institute of Technology, reports the LINEAR discovery of a comet of mag 17.3 with a tail in p.a. about 270 deg on October 25.44. L. Sarounova, Ondrejov, reports that images taken with the 0.65-m reflector on Oct. 26.0 UT show a 10" coma (m_1 = 15.5) and a narrow tail at least 2' long in p.a. 280 deg. [IAUC 8000, 2002 October 26]

It reached perihelion at 1.16 AU in early January and could have reached 14th magnitude from the end of November. This is LINEAR's 95th comet.

Brian Marsden notes on MPEC 2003-C41 [2003 February 8] that the "original" and "future" barycentric values of 1/a are +0.001075 and +0.000717 (+/- 0.000012) AU**-1 , respectively, suggesting that this is not a "new" comet from the Oort cloud.

A/2002 UN (NEAT) is an asteroid, of 17th magnitude, discovered by NEAT at Palomar on 2002 October 22.15. It is in a 5.4 year orbit, with perihelion at 1.18 AU and an eccentricity of 0.62. It is at perihelion in late December, and will brighten a little. [MPEC 2002-U30, 2002 October 24, 2-day orbit] The orbit is typical of a Jupiter family comet and it approached within 1 AU of Jupiter in 1962..

A/2002 UO3 (LINEAR) is an asteroid, of 18th magnitude, discovered by LINEAR on 2002 October 28.32. It is in a 4.8 year orbit, with perihelion at 0.59 AU and an eccentricity of 0.79. It is at perihelion in January, and will not brighten significantly. [MPEC 2002-U46, 2002 October 30, 2-day orbit] The orbit is typical of a Jupiter family comet.

2002 V1 (NEAT) Steve Pravdo, Jet Propulsion Laboratory, reports the NEAT discovery, on CCD images taken with the 1.2-m reflector at Haleakala on November 6.60, of a mag 17.3 comet with a tail about 10" long in p.a. 225 deg. Following posting on the NEO Confirmation Page, other CCD observers have confirmed the cometary nature: P. Pravec and L. Sarounova (Ondrejov, 0.65-m reflector), coma diameter 0'.4, faint tail 0'.4 long in p.a. 250 deg; M. Lehky (Hradec Kralove, Czech Republic, 0.40-m f/5 reflector), slightly diffuse coma of diameter about 5"; M. Blasco and S. Sanchez (Mallorca, 0.40-m Schmidt telescope), coma diameter 15". [IAUC 8010, 2002 November 6]

M. L. Sitko, University of Cincinnati; and D. K. Lynch, R. W. Russell, and D. Kim, The Aerospace Corporation, report that 3-14- micron spectroscopy of C/2002 V1 (NEAT), obtained on Jan. 9.2 UT with the Aerospace Broadband Array Spectrograph System at the NASA Infrared Telescope Facility 3-m reflector, revealed a thermal- emission spectrum showing a trapezoidal-shaped silicate emission feature with shoulders at 9.0 and 11.2 microns. The underlying continuum was well fitted with a 290-K black body, approximately 14 percent above the black-body radiative equilibrium temperature of 254 K. Narrow-band magnitudes (+/- 0.1) in a 3".5-diameter aperture were M [4.5 microns] = 8.5 and N [10.2 microns] = 3.1. On the following night, the comet was about 10 percent brighter, but otherwise unchanged. [IAUC 8050, 2003 January 15]

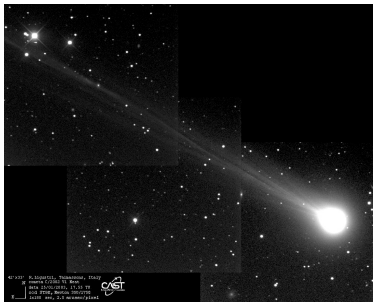


Image by Rolando Ligustri on January 25

M. Honda, University of Tokyo, and colleagues (T. Yamashita, H. Kataza, T. Miyata, T. Fujiyoshi, S. Sako, Y. K. Okamoto, T. Onaka, T. Sekiguchi, D. Kinoshita, and J. Watanabe) report on mid- infrared observations of two comets with the 8.2-m Subaru Telescope (+ COMICS). N/Q-band imaging of C/2002 V1 on Jan. 11.2 UT yield the following total fluxes within a 2".73-box aperture: 8.8 microns, 0.83 +/- 0.01 Jy; 11.7 microns, 1.55 +/- 0.02 Jy; 12.4 microns, 1.95 +/- 0.04 Jy; 18.8 microns, 2.79 +/- 0.06 Jy. Low- resolution (250) N-band spectroscopic observations (range 8-13 microns) of C/2002 V1 showed a broad amorphous silicate feature with a 11.2-micron local peak, indicating the presence of crystalline olivine. Total fluxes for C/2001 RX_14 on Jan. 11.6 (measured as above): 8.8 microns, 0.066 +/- 0.004 Jy; 12.4 microns, 0.279 +/- 0.016 Jy; 18.8 microns, 0.356 +/- 0.022 Jy. Low-resolution N-band spectroscopy of C/2001 RX_14 showed the possible shallow silicate feature, but no 11.2-micron local peak was found within the error bars. [IAUC 8053, 2003 January 16]

C. B. Cosmovici, Istituto di Fisica dello Spazio Interplanetario, Consiglio Nazionale delle Ricerche, Rome, reports that he and the rest of the ITASEL team of the Medicina 32-m radio telescope (M. Teodorani, S. Montebugnoli, and G. Maccaferri) detected the 22-GHz water-maser

line in comet C/2002 V1 at perihelion, using a fast, high-resolution spectrum analyzer (8192 channels; bandwidth 8 MHz) on Feb. 17, 18, and 19 (when r = 0.101-0.121 AU), during the strong coronal mass ejection (CME) detected by the SOHO spacecraft. The beam size was 2', corresponding to an observed region at the comet of about 80000 km. The mean antenna temperature was 140 +/- 38 mK, giving an integrated flux of 0.70 +/- 0.17 Jy km/s (FHWM = 47 KHz). The neutral water molecules show a velocity shift of -12.2 km/s with respect to the nucleus, confirming the previously observed peculiar strong acceleration of neutral water molecules in C/1996 B2 at perihelion (Cosmovici et al. 1998, Planet. Space Sci. 46, 467; in C/1992 B2, the shift varied between 22 and 44 km/s). Neutral water molecules normally are ejected from the nucleus at velocities around 1 km/s. This peculiarity could be explained by assuming the sublimation of excited water molecules from accelerated ionized icy grains that form an extended source around the nucleus. The strong CME may have contributed to the acceleration mechanism. Evaluation of the water-production rate is in progress. [IAUC 8094, 2003 March 16]

Image by Martin Mobberley, January 27

Brian Marsden notes on MPEC 2003-E59 [2003 March 14] that the "original" and "future" barycentric values of 1/a are +0.002297 and +0.001008 (+/- 0.000002) AU**-1, respectively, suggesting that this is not a "new" comet from the Oort cloud. The comet reached perihelion at 0.1 AU on 2003 February 18.3.

Some tentative visual observations in late November suggested that it was approaching 14th magnitude. By early December reports were suggesting that it was around 13th magnitude. I observed the comet with the Northumberland refractor on December 4.94 estimating it at 12.3 and a much easier object than 2001 RX14. A report from Mike Linnolt also suggests that the comet was 12th mag. It seemed to be brightening quite rapidly and CCD observations indicated that it was a gassy comet. Reports by December 10 suggested that the comet had brightened to 11th mag. Michael Mattiazzo reported that on December 23.53 it was 9.4, with coma dia.=8', DC=3 in 25x100mm B. I observed it with 14x100B on December 28.76, making it 9.0 with a DC s5, 6.1' coma. Some observers put it as bright as 7.8 by December 30. On January 1.83 it had brightened to 8.2, DC4, diameter 9.0' in my 20x80B. On January 3.91 it was 8.0, but seemed more diffuse at DC3. On January 8.93 it was 7.2 and a little more condensed at DC4. Despite strong moonlight on January 11.80 the comet was quite easy in 20x80B at an estimated magnitude of 6.9. On January 15.74 it was a similar magnitude and appearance. By January 23.75 the condensation had increased to 6, and the coma had shrunk to 6.2', with a total magnitude of 6.2. Observations in late January suggested only a slow brightening.

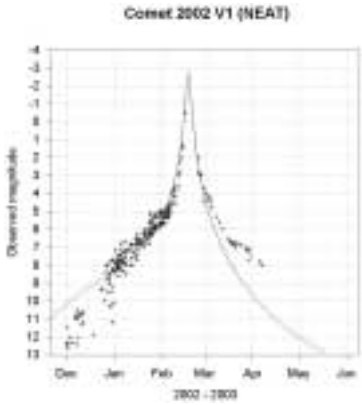
Image by Tony Scarmato on February 8

By early February tail development was becoming significant with around 2 degrees or more being visible. Moonlight and low altitude then interferred with observation. With a frontal system sitting over Cambridge on Feb 11 I decided to travel west to find clear skies. After a couple of hours driving I encountered clear skies near Droitwich, and found a country site south of Ombersley. The comet was surprisingly easy in the twilight, showing a short tail and a creamy coloured nucleus. The total magnitude was 3.0, coma diameter 3' and DC8 in 10x50B.

A few days later I travelled south to Antarctica and was able to re-observe the comet from Rothera (67.5°S) station in deep twilight on February 25.10 when it was mag 2.9: with a 0.7 degree long tail. The weather down South was however much cloudier than normal and I only had a few opportunities for observing. I made a final sighting from the Falklands in a brief gap between rapidly drifting clouds, hours before I was due to fly home. The comet was then mag 7.7 in 10x50B.

As it passed through perihelion the comet traversed the SOHO coronagraph fields, and was one of the brightest comets seen by the spacecraft.

297 observations received so far give a preliminary light curve, corrected for aperture and where possible for systematic observer differences of m = 7.0 + 5 log d + 9.4 log r however the comet is currently around 2 magnitudes brighter than the mean curve.



2002 V2 (LINEAR) An apparently asteroidal object of mag 18.6 discovered by LINEAR on November 5.31 and posted on the NEO Confirmation Page has been found to have cometary appearance. M. Tichy found a compact 6" coma on KLENOT images taken at Klet on Nov. 7.13 UT. Images taken by P. R. Holvorcem and M. Schwartz with the Tenagra 0.81-m reflector on Nov. 7.4 and 8.4 show the object diffuse with a coma diameter of about 8". [IAUC 8013, 2002 November 9] Although a few months from perihelion, it is a distant object and will only brighten a little. Brian Marsden notes on MPEC 2003-E19 [2003 March 6] that the "original" and "future" barycentric values of 1/a

are +0.000447 and +0.000437 (+/- 0.000012) AU**-1, respectively, suggesting that this is not a "new" comet from the Oort cloud.

A/2002 VP94 (LINEAR) is an asteroid, of 19th magnitude, discovered by LINEAR on 2002 November 5.31. It is in an 8.0 year orbit, with perihelion at 1.52 AU and an eccentricity of 0.62. It is at perihelion in January, and will brighten by about a magnitude. [MPEC 2002-V70, 2002 November 15, 10-day orbit] Brian Marsden notes that it is not clear if the object is in fact a comet. The orbit is typical of a Jupiter family comet and it can pass within 0.4 AU of the planet.

A/2002 VQ94 (LINEAR) is an asteroid, of 19th magnitude, discovered by LINEAR on 2002 November 11.24. Brian Marsden notes that it is not clear if the object is in fact a comet. [MPEC 2002-V71, 2002 November 15] It is in a 3000 year orbit, with perihelion at 6.8 AU and an eccentricity of 0.97. Currently at 9.8 AU from the Sun it reaches perihelion in February 2006, when it may be mag 17.5 or brighter if it shows some cometary activity. [MPEC 2002-Y67, 2002 December 30]

A/2002 WW17 (NEAT) is an asteroid, of 19th magnitude, discovered by Heleakala NEAT on 2002 November 28.55. It is in a 5.1 year orbit, with perihelion at 1.04 AU and an eccentricity of 0.65. It is at perihelion in late March but will remain near its present magnitude. [MPEC 2002-X35, 2002 December 6, 8-day orbit] The orbit is typical of a Jupiter family comet, though there have been no recent passes close to the planet.

2002 X1 (LINEAR) An object of mag 18.0 reported as asteroidal by LINEAR on December 5.44, and placed on the NEO Confirmation Page due to its unusual motion, has been found to be cometary on CCD images taken around Dec. 7.4 UT by D. T. Durig (Sewanee, TN, 0.3-m reflector; 25" coma, m_1 = 15.5), by P. R. Holvorcem and M. Schwartz (Nogales, AZ, 0.81-m telescope; diffuse with coma diameter about 10" and a hint of tail at p.a. about 300 deg), and by G. Hug, R. Valentine, and B. Leifer (Eskridge, KS, 0.30-m reflector; diffuse). [IAUC 8028, 2002 December 7]

The preliminary low inclination, small perihelion distance orbit was quickly replaced by a retrograde, larger perihelion distance orbit after Sebastian Hoenig pointed out that no object had been detected in SOHO images. It is some 7 months from perihelion and will brighten by a couple of magnitudes and could reach 14th magnitude in February. Some CCD observations put the comet at 16th magnitude. Brian Marsden notes on MPEC 2003-C44 [2003 February 8] that the "original" and "future" barycentric values of 1/a are +0.000790 and +0.001222 (+/- 0.000011) AU**-1, respectively, suggesting that this is not a "new" comet from the Oort cloud. A single observation put the comet at around 14th magnitude in January.

2002 X2 (P/NEAT) K. J. Lawrence reports the discovery of a comet of mag 18.4 by the NEAT team (which now includes also R. Bambery, E. Helin, S. Pravdo, M. Hicks, and R. Thicksten) from CCD images taken with the 1.2-m Schmidt telescope at Palomar on December 7.17. Following posting on the NEO Confirmation Page, J. Ticha and M. Tichy found the comet to show a 7" coma and a 14" tail in p.a. 45 deg on Klet images taken on Dec. 8.8 UT. P. Holvorcem that the co-addition of three 120-s exposures taken with the Tenagra II telescope at Nogales, AZ, on Dec. 8.20 shows a coma with diameter about 7" and a tail about 14" long in p.a. about 55 deg. F. B. Zoltowski, Edgewood, NM, notes that CCD images taken with a 0.3-m reflector on Dec. 9.15 shows the comet as diffuse with a 15" coma diameter and a possible faint tail in p.a. 240 deg. [IAUC 8029, 2002 December 9] It is a moderately distant and intrinsically faint periodic comet of 18th magnitude. Although a few months from perihelion it will fade. It has a period of 8.1 years and a perihelion distance of 2.5 AU.

2002 X5 (Kudo-Fujikawa) S. Nakano, Sumoto, Japan, reports the visual discovery of a comet by Tetuo Kudo (Nishi Goshi-machi, Kikuchi-gun, Kumamoto-ken, Japan Nikon 20x120 binoculars. Coma diameter 2'; central condensation visible, but no tail detected). This was confirmed by K. Kadota (Ageo, Saitama, Japan). 0.25-m f/5.0 reflector + CCD. Coma diameter 5'.5; tail at least 18' long in p.a. 331 deg. [IAUC 8032, 2002 December 14]

Image by Martin Mobberley, December 25

J. Watanabe, National Astronomical Observatory of Japan, reports the independent visual discovery of this comet by Shigehisa Fujikawa, Oonohara, Kagawa, Japan, (Dec. 14.858 UT, 9:, 4' 0.16-m reflector); report received by Watanabe prior to the issuance of IAUC 8032). T. Lovejoy, Thornlands, Qld., Australia, reports that C/2002 X5 appears faintly visible at mag approximately 10-11 (based on the appearance of other comets in SWAN images) on SWAN images that were taken on six dates, Nov. 6-13, and posted at the SOHO website. [IAUC 8033, 2002 December 16]

R. W. Russell, D. K. Lynch, and D. L. Kim, The Aerospace Corporation; M. L. Sitko, University of Cincinnati; and W. Golisch, NASA Infrared Telescope Facility (IRTF), report that spectroscopy of comet C/2002 X5 was obtained on Jan. 9.1 and 10.05-10.14 UT at 1.5-3.4 airmasses with the Aerospace Broadband Array Spectrograph System at the IRTF 3-m telescope. They observed a relatively smooth thermal-emission spectrum, over most of the spectral range covered (3-14 microns), whose shape resembled a blackbody near or slightly above the blackbody radiative equilibrium temperature of 340 K. A silicate emission feature, if present, would be no more than about 15 percent of the continuum. A 3.4-micron C-H feature may be present in emission. Narrowband magnitudes (each +/- 0.05) on Jan. 9.1 in a 3".5-diameter aperture were L [3.5 microns] = 8.3, M [4.5 microns] = 5.8, and N

[10.2 microns] = 1.7. The emission at 10.2 microns was extended at least 18" east-west and 10" north- south, using a 29" north-south chop. The beam only needed to be moved about 3" east-west to get to the half-power location, suggesting that the infrared emission was concentrated on the peak with an extended coma component. On Jan. 10, the spectrum was essentially unchanged, though perhaps 5 percent brighter. [IAUC 8062, 2003 January 30]

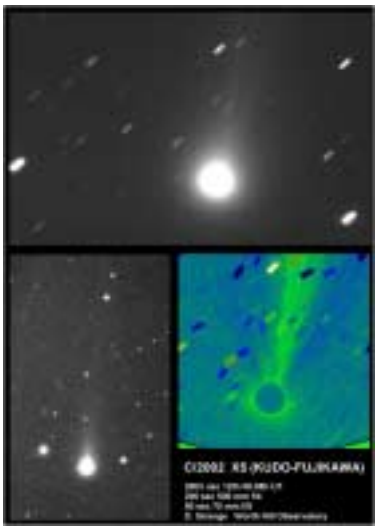


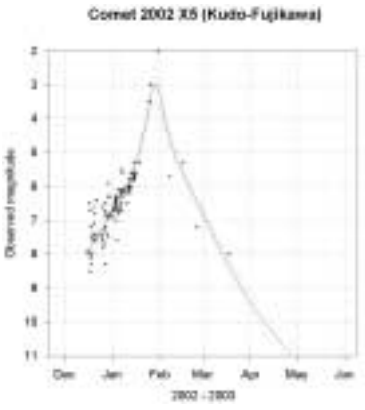
Image by David Strange on January 12

Initially reported as 9th magnitude, some observers report it as bright as 7th magnitude. It has a coma perhaps 5' in diameter and a faint tail. The preliminary orbit indicated that the comet could have been found a month earlier. Inspection of SOHO SWAN imagery by Terry Lovejoy and confirmed by Sebastian Hoenig found images that do show the comet and confirm the general form of the orbit and the absolute brightness of the comet.

This is Shigehisa Fujikawa's 6th comet, the others being C/1969 P1 (Fujikawa) C/1970 B1 (Daido-Fujikawa), C/1975 T1 (Mori-Sato-Fujikawa), 72P/Denning-Fujikawa (=1978 T2) and C/1983 J1 (Sugano-Saigusa-Fujikawa). He was also an independent discoverer of C/1968 H1 (Tago-Honda-Yamamoto), C/1968 N1 (Honda) and C/1988 P1 (Machholz). He used nearly the same telescope for these discoveries, but has replaced the original f5 primary mirror with a new f6 one.

After a long spell of overcast skies, it cleared for Cambridge as dusk fell on December 17 and I was able to observe the comet with my 0.15-m reflector x80, making it 8.5, DC3 and diameter 2.4' on December 17.73. This contrasts with observers using binoculars, for example Tony Scarmato, Calabria, Italy on December 17.70 made it 6.7, coma 5' in 7x50B and Guus Gilein from the Netherlands on December 18.21 made it 7.2, coma 5' in 10x50B. I observed it with 20x80B on December 18.73 making it 8.0 with a 5' coma. On December 28.74 I made it 6.9, DC5 in the same binoculars, and on January 1.80 approximately 6.6. Observing in poor conditions on January 10.27 I made it 6.6:, compared to 6.1 on January 7.74. During the second week of January the magnitude seems to have stalled. On January 12.26 under poor conditions I estimated the magnitude at 6.1 in 20x80B. On January 14.28 in brightening skies I found it at 5.8, DC7, diameter 2.3' in 20x80B.

The comet was visible in the SOHO C3 coronagraph from January 25 to 31. It reached perihelion at 0.19 AU on January 29.0, when it showed significant phase angle effects and faded significantly. After perihelion it appeared to brighten again, reaching around 1st magnitude. I compiled a movie loop of the images, which show the comet heading in towards the Sun, and as it heads out again, the tail swings round and it leaves tail first.



Michael Mattiazzo reported it at 5.7 on February 7.51 on 25x100B, low in the twilight. I had a good view of it from the Falkland Islands prior to heading further south, and at this time it appears to have been anomalously bright, as I made it 5.3 in 10x50B and could see a 15' tail in my 9cm Orion refractor x20. It returned to UK skies as a binocular object in mid March, but faded rapidly and was soon a couple of magnitudes fainter than the mean light curve.

149 observations received so far give a preliminary light curve, corrected for aperture and where possible for systematic observer differences of m = 7.2 + 5 log d + 6.9 log r

A/2002 XA (LINEAR) is an asteroid, of 19th magnitude, discovered by LINEAR on 2002 December 1.22. It is in a 5.1 year orbit, with perihelion at 1.04 AU and an eccentricity of 0.65. It is at perihelion in early February but and will brighten by at least a couple of magnitudes. [MPEC 2002-X08, 2002 December 2, 1-day orbit] The orbit is typical of a Jupiter family comet. It is also a potentially hazardous asteroid, passing 0.034 AU from the Earth's orbit at the ascending node. This February it will pass at 0.1 AU. It can also pass within 0.2 AU of Jupiter.

A/2002 XG36 (LINEAR) is an asteroid, of 19th magnitude, discovered by LINEAR on 2002 December 5.31. It is in a 5.9 year orbit, with perihelion at 1.54 AU and an eccentricity of 0.53. It was at perihelion in early October and will fade. [MPEC 2003-A54, 2003 January 8, 33-day orbit] The orbit is typical of a Jupiter family comet, and it has approached within 0.8 AU during the last century.

A/2002 XE84 (LINEAR) is an asteroid, of 20th magnitude, discovered by LINEAR on 2002 December 13.44. It is in a 4.7 year orbit, with perihelion at 0.95 AU and an eccentricity of 0.66. It is at perihelion in mid January and will fade. [MPEC 2002-X85, 2002 December 15, 1-day orbit] There have been no recent approaches to Jupiter due to the high (30 degree) inclination orbit.

2002 Y1 (Juels-Holvorcem) Charles Juels and Paulo Holvorcem have discovered a 15th magnitude comet on CCD images taken with a 0.12-m f5 refractor on December 28.44. The preliminary orbit suggested that the comet will reach perihelion on April 15 at 0.75 AU. It is a morning object. The comet reached 6th magnitude in early April.

A comet has been found on CCD images (discovery observation below) taken with a 0.12-m f/5.0 refractor by Charles W. Juels (Fountain Hills, AZ) and Paulo R. Holvorcem (Campinas, Brazil). Holvercem reports that co-adding five 45-s and one 90-s exposures taken around Dec. 28.5 UT reveals a coma 1'.8 in diameter. Following posting on the NEO Confirmation Page, several other observers reported on the cometary appearance of the object, including D. T. Durig (Sewanee, TN), who noted that 300-s CCD exposures with a 0.3-m reflector show an inner coma of diameter 30" and a wider, diffuse glow of diameter 2'.5. [IAUC 8039, 2002 December 29]

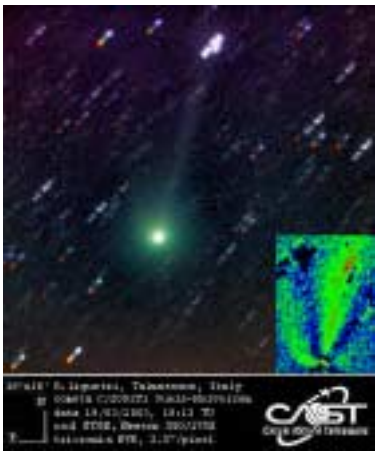


Image by Rolando Ligustri on March 19

D. K. Lynch, R. W. Russell, and D. L. Kim, The Aerospace Corporation; M. L. Sitko, University of Cincinnati; and R. B. Perry, Langley Research Center, NASA, report that 3-14-micron spectroscopy of comet C/2002 Y1, obtained on Feb. 20.6 UT with the NASA Infrared Telescope Facility 3-m telescope (+ Aerospace Broadband Array Spectrograph System), yielded a narrowband magnitude of N [10.2 microns] = 3.5 +/- 0.1. The spectrum shows a smooth featureless continuum with an 8-13-micron color temperature of about 280 +/- 20 K, roughly 12 times higher than the radiative equilibrium blackbody temperature. The comet was not detected between 3 and 8 microns, and an upper limit to the silicate emission feature was approximately 10 percent of the 8-13-micron continuum. [IAUC 8083, 2003 February 27]

Notes on the comet mail list suggest that the discoverers were using a 12cm f5 refractor, on a high-end mount and using a SITe CCD yielding a 2.35 x 2.35 degree field of view. The discovery was made on the very first night the equipment was commissioned! Paulo Holvorcem provided this background information:

Image by Martin Mobberley on March 22

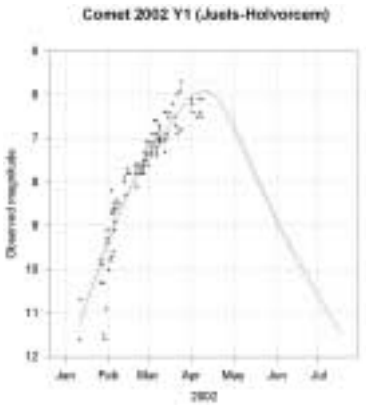
Charles Juels and myself collaborate over the internet, with the help of "fast" ADSL internet connections, which makes it easy to communicate and transfer images in near-real time between Fountain Hills (near Phoenix, Arizona) and my home in Campinas, Brazil. From here I can schedule search and follow-up runs at Fountain Hills using software I wrote for this purpose (or they can be planned by Charles), and we can split the tasks of data analysis by transferring images over the internet. The astrometric observations from codes 926, 848, and 860, which you see in MPECs are obtained in an analogous way. These days I hardly leave my house to observe! We were very lucky to find C/2002 Y1 on the first night with the new 0.12-m refractor on an automated mount. For some time we had considered the idea of doing wide-field searches for new "bright" objects, and this was our first experiment. The field of view is about 2.3 x 2.3 degrees. On that first night (Dec. 28) we searched some 300 square degrees and were surprised to find an object of apparently diffuse appearance. Co-adding the discovery images and a few others taken for follow-up on the same night suggested a coma about 1.8' in diameter, which we didn't immediately report (it seemed too much luck, maybe it was not real). But we reported the positions immediately to the MPC, which posted the object (then referred to as HJ0080) on the NEOCP. It was soon confirmed by others, so we were sure that it was real. And if it was real, then the co-addition of the images showed that it was a comet. We then reported the detection of the coma on Dec. 29, and soon afterwards the comet was announced on an IAUC and a MPEC.

Some observations in early January suggested that it might be around 13th mag. Seiichi Yoshida estimated the comet at mag 10.7 in his 0.32-m reflector on January 11.79 and I made a low reliability estimate of it at 11.6 in the Thorrowgood refractor on January 11.13. Observations later in January after the moon left the sky suggest that the comet had brightened to 10th magnitude. Observing on February 3.1 with 20x80B and 25x100B the comet was a large, diffuse object of approximately magnitude 8. By late February Gabriel Oksa reported it as 7.3 in 20x80B and he made it 6.5 by mid March. It rapidly moved out of the evening sky and was then visible in the early morning, which always reduces the number of observations, even for a bright comet. Observing from my bedroom window in Cambridge on April 2.17 I estimated the comet at 6.4 in 20x80B. It quickly sank into the morning twilight, but I made a final positive observation at 6.5 from my observing site outside Cambridge on April 8.16. Although we lose it from northern skies, it should continue to be visible from the Southern Hemisphere for several months.

Brian Marsden notes on MPEC 2003-G13 [2003 April 3] that the "original" and "future" barycentric values of 1/a are +0.004113 and +0.004506 (+/- 0.000020) AU**-1, respectively, suggesting that this is not a "new" comet from the Oort cloud. Such comets usually have consistent light curves, giving some hope that the comet will perform at perihelion.

107 observations received so far give a preliminary light curve, corrected for aperture and where

possible for systematic observer differences of m = 6.6 + 5 log d + 11.8 log r



A/2002 YK29 (LINEAR) is an asteroid, of 20th magnitude, discovered by LINEAR on 2002 December 31.30. It is in a 5.9 year orbit, with perihelion at 1.48 AU and an eccentricity of 0.55. It was at perihelion in mid October and will brighten a fraction towards opposition before fading. [MPEC 2003-A63, 2003 January 10, 9-day orbit] The orbit is typical of a Jupiter family comet, though there have been no recent approaches.

2003 A1 (????). LINEAR discovered a 19th mag comet on January 5.07. [IAUC 8044, 2003 January 8] Although parabolic orbital elements were published, Brian Marsden noted on MPEC 2003-A56 [2003 January 8] that the object was probably of short period, and that its orbit was rather similar to that of comet D/1783 W1 (Pigott). Further observations, published on MPEC 2003-A86 [2003 January 15] confirm the short period nature of the orbit, with perihelion at 1.91 AU, a high inclination of 46 degrees and a period of 7.1 years. The ephemeris suggests that it will fade. This is LINEAR's 100th comet.

Orbital calculations by Maik Meyer, Nakano and Muraoka tend to confirm the identity of the object with D/1783 W1, though no completely satsifactory linkage has so far been computed.

If the comet has made 33 revolutions from 1783 to 2003, this provides a good linkage between D/1783 W1 and P/2003 A1. Because the period of the comet is not certain, the number of revolutions of the comet could be between 37 and 29. Furthermore, in the case of 33 revolutions, the comet made close approaches to Jupiter: on 1923 9 16.0 to 0.35 AU, on 1864 6 1.5 to 0.57 AU, and on 1852 7 3.0 to 0.98 AU with an approach to 0.67 AU on 1793 4 7.5. The closest approach to the earth during this time was at the appearance of 1783.

An apparently asteroidal LINEAR object discovered on January 5.07 with m2 18.4), posted on the NEO Confirmation Page, has been found to be diffuse by CCD observers elsewhere, including at Haleakala (1.2-m reflector, with K. Lawrence reporting the object as slightly diffuse on NEAT images taken on Jan. 7.3 UT, and again somewhat diffuse on Jan. 8.3), at Klet (where M. Tichy found a coma diameter of 8" on images taken on Jan. 8.7 with the 1.06-m KLENOT reflector), and at Ondrejov (where P. Pravec found a faint, small coma that was "marginally apparent", on images taken close to the moon on Jan. 8.8 with the 0.65-m f/3.6 reflector). The object is likely of short period, with the angular orbital elements quite similar to those of D/1783 W1. [IAUC 8044, 2003 January 8]

2003 A2 (Gleason) A very distant, 20th magnitude object, first observed by Spacewatch II on January 10.39 has been found to show cometary activity. The preliminary orbit assumed that it was near perihelion, and was at 11.52 AU. Brian Marsden notes on MPEC 2003-A78 [2003 January 14] that the assumed perihelic parabolic orbit is very tentative. It seems likely that the object is a Centaur, showing cometary activity as (2060) = 95P/Chiron has shown near perihelion.

The latest orbit [MPEC 2003-C07, 2003 February 1] puts perihelion in 2004 January at 11.4 AU, with the comet currently 11.5 AU from the Sun. A revised orbit [MPEC 2003-C47, 2003 February 8], including prediscovery observations by Palomar/NEAT (found and measured in NEAT data by Sebastian Hoenig and R Stoss), confirms these perihelion circumstances. The perihelion distance is the largest on record.

Arianna E. Gleason, Lunar and Planetary Laboratory, reports her discovery of a slow-moving comet of 20th mag on Jan. 10.39 UT with the Spacewatch II telescope at Kitt Peak; J. V. Scotti adds that there was a more-or-less symmetrical coma about 20" across. On making follow-up observations on Jan. 11.3 (after placement on The NEO Confirmation Page), D. T. Durig and H. H. Fry (Sewanee, TN, 0.3-m f/5.75 Schmidt-Cassegrain reflector) confirmed a coma 15"-18" in diameter, and F. B. Zoltowski (Edgewood, NM, 0.3-m f/3.3 Schmidt-Cassegrain reflector) noted that the coma/tail structure had the appearance of a broad fan from p.a. 20 deg northward through p.a. 200 deg. On Jan. 12.0, J. Ticha and M. Tichy (Klet Observatory, 1.06-m KLENOT Telescope) indicated a coma diameter of 8"-10", with m_1 = 20.2 and m_2 = 21.0. The object's cometary nature was also noted by T. Gehrels (Spacewatch II) on Jan. 11-13 and by J. G. Ries (McDonald Observatory, 0.76-m reflector) on Jan. 14.3. [IAUC 8049, 2003 January 15]

Brian Marsden notes on MPEC 2003-E63 [2003 March 14] that the "original" and "future" barycentric values of 1/a are +0.000065 and +0.000158 (+/- 0.000017) AU**-1, respectively, suggesting that this is a "new" comet from the Oort cloud. The current orbit is now strongly hyperbolic.

A/2003 AC1 (LINEAR) is an asteroid, of 20th magnitude, discovered by LINEAR on 2003 January 1.43. It is in a 5.7 year orbit, with perihelion at 1.09 AU and an eccentricity of 0.66. It is at perihelion in mid February and will brighten a little. [MPEC 2003-A13, 2003 January 3, 2-day orbit] The orbit is typical of a Jupiter family comet and it can approach within 1 AU of Jupiter, though it has not done so over the last century. It approaches to 0.20 AU of the Earth at this return and this is one of its closest approaches.

A/2003 AK73 (NEAT) is an asteroid, of 19th magnitude, discovered by Palomar NEAT on 2003 January 11.22. It is in a 5.1 year orbit, with perihelion at 0.76 AU and an eccentricity of 0.74. It is past perihelion and will fade. [MPEC 2002-A73, 2003 January 13, 2-day orbit] The orbit is typical of a Jupiter family comet and it has made several encounters within 1 AU of Jupiter

over the last century. It can also approach quite close to the Earth and was 0.11 AU away in December. It can approach within 0.07 AU of our planet.

A/2003 BM1 (NEAT) is an asteroid, of 20th magnitude, discovered by Palomar NEAT on 2003 January 24.32. It is in a 7.8 year orbit, with perihelion at 1.86 AU and an eccentricity of 0.53. Perihelion is in mid March, but the brightness will not change significantly. [MPEC 2003-B29, 2003 January 27, 3-day orbit] The orbit is typical of a Jupiter family comet. The object encounters Jupiter at both nodes and can approach within 0.35 AU.

A/2003 BD44 (LONEOS) is an asteroid, of 19th magnitude, discovered by LONEOS on 2003 January 30.31. It is in a 5.6 year orbit, with perihelion at 0.67 AU and an eccentricity of 0.79. Perihelion is at the beginning of July, but the brightness will not change significantly. [MPEC 2002-B54, 2003 January 31, 2-day orbit] The orbit is typical of a Jupiter family comet. It approached within 0.3 AU of Jupiter in October 2001 and will approach within 0.3 AU of the Earth in July. It is a potentially hazardous object, passing 0.011 AU from the Earth's orbit at the ascending node.

2003 CP7 (P/LINEAR-NEAT) A 18th magnitude comet discovered on NEAT Palomar images obtained on March 10.36, and posted on the NEO Confirmation Page, was reported by K. Lawrence as showing a nuclear condensation of diameter about 7" and a tail about 8" long toward the west. The cometary nature was confirmed by J. Young at Table Mountain on Mar. 12.4 UT. The Minor Planet Center has linked this object to an apparently asteroidal LINEAR object of mag 19.0 on Feb. 1.39 and 4 that was designated 2003 CP_7 (MPS 73383-73384, Feb. 16). [IAUC 8092, 2003 March 12] The comet is a distant one, with period of 8.05 years and will fade.

A/2003 CO1 (NEAT) is an asteroid, of 20th magnitude, discovered by Palomar NEAT on 2003 February 1.42. It is in a 96 year orbit, with perihelion at 10.94 AU and an eccentricity of 0.48. [MPEC 2003-F03, 2003 March 17, 1-year orbit] The orbit is typical of a Chiron like object. It is still approaching perihelion, which is in August 2006, so it may yet show cometary activity.

A/2003 CC11 (LINEAR) is an asteroid, of 19th magnitude, discovered by LINEAR on 2003 February 4.16. It is in a 5.0 year orbit, with perihelion at 1.26 AU and an eccentricity of 0.57. It is at perihelion in mid February and will fade. [MPEC 2003-C31, 2003 February 5, 2-day orbit] The orbit is typical of a Jupiter family comet and it can approach within 0.6 AU of Jupiter and 0.30 AU of the Earth.

A/2003 CC22 (CFHT) is an asteroid, of 22nd magnitude, discovered by a team using the 3.6-m Canada-France- Hawaii and 2.2-m University of Hawaii telescopes on Mauna Kea on 2003 February 8.34. It is in a 21 year orbit, with perihelion at 4.20 AU and an eccentricity of 0.44. It is at perihelion this summer and will fade. [MPEC 2002-G16, 2003 April 3, 1-month orbit] The orbit is unusual, crossing that of Jupiter and Saturn.

2003 E1 (NEAT) S. Pravdo reports another NEAT comet discovery, found on March 9.51 at 20th magnitude, the object having a tail extending about 8" in p.a. 215 deg on Mar. 11. Young also found it cometary on Mar. 12. The available astrometry, very uncertain parabolic orbital elements [T = 2004 Mar. 13.3 TT, Peri. = 110.8 deg, Node = 141.9 deg, i = 37.6 deg (equinox 2000.0), q = 2.950 AU], and an ephemeris appear on MPEC 2003-E48. [IAUC 8092, 2003 March 12] Follow up observations show that comet is an intermediate period one, returning every 51 years and a month past perihelion at 3.2 AU. Its brightness will not change significantly over the next six months.

A/2003 EJ59 (LINEAR) is an asteroid, of 18th magnitude, discovered by LINEAR on 2003 March 12.24. It is in a 5.8 year orbit, with perihelion at 1.21 AU and an eccentricity of 0.62. It is at perihelion in mid March and will fade. [MPEC 2003-E55, 2003 March 14, 2-day orbit] The orbit is typical of a Jupiter family comet and it can approach within 0.2 AU of Jupiter and the Earth.

2003 F1 (LINEAR) was discovered by LINEAR on March 23.43. It has a perihelion distance of 4 AU and a period of 96 years. It will not brighten significantly from its current 16th magnitude.

2003 F2 (P/NEAT) is a distant periodic comet discovered by NEAT on March 27.20. It has a perihelion distance of 2.9 AU, a period of 16 years and will fade. Syuichi Nakano notes that the orbit of the comet is very similar to that of 2001 BB50 (P/LINEAR-NEAT) and that they were both at perihelion in late July 1987. Maik Meyer notes that the minimum separation of the two was only 0.016 AU in March 1989.

2003 G1 (LINEAR) was discovered by LINEAR on April 8.45. It has a perihelion distance of 4.9 AU. It is a couple of months past perihelion and will not brighten significantly from its current 16^{th} magnitude.

2003 G2 (LINEAR) was discovered by LINEAR on April 8.38. It has a perihelion distance of 1.6 AU. It is near perihelion and will not brighten significantly from its current 17^{th} magnitude.

A/2003 GS22 (Kitt Peak) is an asteroid, of 21st magnitude, discovered by R S McMillan with the 0.9-m telescope at the Steward Observatory, Kitt Peak on 2003 April 7.40. It is in a 5.1 year orbit, with perihelion at 1.15 AU and an eccentricity of 0.61. It was at perihelion in March and will fade. [MPEC 2003-G44, 2003 April 9, 2-day orbit] The orbit is typical of a Jupiter family comet. It can approach Jupiter to within 0.25 AU and approached within 0.18 AU of the Earth in February.

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

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