THE COMET'S TALE

Newsletter of the Comet Section of the British Astronomical Association

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COMET OF THE CENTURY ?

From a colour print by Mike Cook, Romford.

1997 March 29. 50-mm lens, 10 mins, Kodak Panther 1600

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Section news from the Director

Dear Section member,

Needless to say I have been overwhelmed with observations of comet Hale-Bopp! Despite going through the details for reporting observations at the section meeting last year, observers are still making mistakes in reporting their observations. This greatly increases the workload for Guy and myself as we have to correct or replace the observations at a later date. Some of the problems are listed in the observing section.

Comet Hale-Bopp has certainly been one of the most intensively observed comets in history and section members have made the most of the opportunity. I've included a few of the many images received in the newsletter and more will be on display at the exhibition meeting. The Astronomer magazine hopes to bring out a supplement in the autumn which will document the comet's apparition and at some stage in the future a BAA Memoir will also appear. I haven't documented the results of professional observations in great detail here as they will be reported in astronomical magazines over the coming months.

The Keedy award for 1996 has been awarded to Gabriel Oksa of Starohajska, Slovakia. Gabriel has been studying at Loughborough University on a Royal Society post-doctoral fellowship, but has now returned home. He started observing comets for the Section in March 1996 with the appearance of comet Hyakutake, and has quickly developed into an experienced observer.

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

James Abott, Sally Beaumont, John Bingham, Graham Boots, Denis Buczynski, Robert Bullen, Peter Craven, Clive Curtis, Eric Dinham, Jean Dragesco, Len Entwisle, John Fletcher, James Fraser, Mike Gainsford, Steven Goldsmith, Massimo Giuntoli, David Graham, Werner Hasubick, Michael Hendrie, Colin Henshaw, Guy Hurst, Nick James, Norman Kiernan, James Lancashire, Stephen Laurie, Ron Livesey, John Mackey, Glyn Marsh, Nick Martin, John McConnel, Hazel McGee, Richard McKim, Haldun Menali, Martin Mobberley, Stewart Moore, Bob Neville, Detlev Niechoy, Brian O'Halloran, Gabriel Oksa, Roy Panther, Terry Platt, Tony Rickwood, John Rogers, Jonathan Shanklin, Don Shirreff, James Smith, John Smith, Peter Stanley, Enrico Stomeo, David Storey, David Strange, Tony Tanti, Christopher Taylor, Melvyn Taylor, Alex Vincent, Greme Waddington, Richard Walters, Peter Ward, James Weightman, Paul Yates, Joe Young and the Mid Kent AS.

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and also from: Jose Aguiar, Cornel Apetroaei, Alexandr Baransky, Sandro Baroni, John Bortle, Reinder Bouma, Mike Cook, Tim Cooper, Matyas Csukas, Alfons Diepvens, Maurizio Eltri, Stephen Getliffe, Guus Gilein, Bjoern Granslo, Roberto Haver, Lars Heen, Andreas Kammerer, Heinz Kerner, Atilla Kosa-Kiss, Martin Lehky, Dee Levers, Romualdo Lourencon, Herman Mikuz, Antonio Milani, Sue Morley, John O'Neill, Robert Oseman, Rok Palcic, Amanda Peters, Ernie Richardson, Josep Rodriguez, Virgil Scurtu, Oddleiv Skilbrei, Steinar Thorvaldsen, Alin Tolea, John Vetterlein, Seiichi Yoshida and Vittorio Zanotta (apologies for any omissions or miss-classifications). Thanks to all of you for your contributions.

Comets under observation were: 22P/Kopff, 29P/Schwassmann-Wachmann 1, 46P/Wirtanen, 81P/Wild 2, 118P/Shoemaker-Levy 4, C/Hale-Bopp (1995 O1), C/Tabur (1996 Q1), C/Hergenrother-Spahr (1996 R1) and C/Mueller (1997 D1).

Some of the best material showing Hale-Bopp will be on display at the Exhibition Meeting, so do come along and view it. I hope to organise a section meeting in Cambridge during the autumn, but this will depend on there being a breather from bright comets! More details in the next issue, section web page, or BAA newsletter.

Some BAA membership milestones reached over the past year include the Director (25 years), David Frydman, Mike Gainsford and Richard Miles (30 years), Philip Vince (40 years) and Roy Panther (50 years). Congratulations to all.

Finally if you do have any comments on the newsletter, or requests for topics to be covered at the Section meeting do let me know. Clear skies,

Jonathan Shanklin

RAS Discussion Meeting on "Comet-Asteroid Connections"

The media have an interest in bombardment from space at the moment, but having watched "Asteroid" on TV recently it is fairly clear that they don't have much idea about what an asteroid is, or the links between asteroids and comets. This meeting was organised by Mark Bailey of Armagh Observatory and Iwan Williams of Queen Mary College, London and was held at Burlington House on March 14. I'm not sure that the media would have been much wiser after the meeting, and although one or two new ideas were presented, most talks were repeats of presentations at the ACM meeting last summer.

David Hughes (Sheffield) kicked off proceedings with a review of the 'zoo' of small solar system bodies in a talk entitled "Distinguishing between Comets and Asteroids". When the cumulative number of bodies larger than a certain size is plotted against the size, the slope of the line is different for asteroids (~-2) and comets (~-1.67). Several asteroidal families were formed by the collisional break-up of a parent; in the case of the Eos family this would be around 300 km in diameter. Most asteroids were solid, and consisted of several types, although a few might be re-aggregates after collisions. By contrast comets were formed by accretion and were low density irregular objects. He pointed out that there seemed to be no small comets. He didn't think much of the idea of dormant comets as they would be embedded in a meteoroid stream and would soon be reactivated by collisions.

Nathan Harris (Armagh) disagreed with this in his paper on "Inactive Comets Among the Near-Earth Asteroids". Plotting the aphelion distance Q against the perihelion distance q, allows various groups of small bodies, such as main belt asteroids (MB), Trojan asteroids, Jupiter family comets (JFC) and near-earth objects (NEO) to be distinguished. NEOs have q less than 1.4 AU and most JFCs have Q greater than 4.2 AU. The NEOs can be split into class 1 with Q greater than 4.2 AU (and thus affected by Jupiter) and class 2 with Q less than 4.2 AU. Computer models suggest that it is possible to produce JFCs from both the Oort cloud (OC) and the Kuiper belt (KB), but Halley type comets (HTC) only from the OC. They also suggest it is impossible to populate the class 2 region, unless non-gravitational forces are included. Comets in this class include 2P/Encke, 111P/Helin-Roman-Crockett, 82P/Gehrels 3 and 107P/Wilson-Harrington, which are all in some sense 'strange'. The current population of JFCs can be explained with an injection rate of about one per century and a dynamical lifetime for class 1 objects of around 10,000 years and 1500 years for class 2 objects. He would expect around 100 dead JFCs to be still hanging around, but many more dead HTC (between 3000 and 12,000).

Fabio Migliorini (Armagh) presented results of his study on "Resonant Delivery of Asteroids and Meteorites from the Main Belt" which is part of a European Community funded GAPTEC project to investigate the NEO impact hazard. This project has to be multinational in order to win EC funding and will use ESO telescopes etc. He showed many viewgraphs (often in far too small print) of simulations of resonant scattering into earth crossing orbits. Most end up in the sun after a few million years. He suggested that the cosmic ray ages of meteorites didn't reflect transport time since the parent collision, but possibly the time since the 'grandfather's' collision.

Neil McBride (Kent) spoke about "Meteoroids: the Debris of Comets and Asteroids". Meteoroids can be observed from the ground as meteors and as impacts on spacecraft. We have a good idea of the mass distribution in the mean isotropic flux. However meteoroids also occur in streams. The flux from these can be calculated and it works out an order of magnitude less than the overall flux, which can be split into helion/anthelion. north/south toroidal and north/south apex components. The Taurids do contribute a significant amount to the anthelion flux. Meteor radars give a velocity distribution, but in the past have missed a lot of fast meteors (~60 kms^{-1}). He suggests that the apex (fast) source is cometary as is the anthelion. The toroidal component probably is (but there isn't much of it anyway). The helion source is slow and probably asteroidal in origin. Overall more than 60% of the flux could be cometary.

The final talk before lunch was by Hans Rickman (Uppsala) who spoke about "Physical and Dynamical Interrelationships and Transition Objects". He first looked at the formation region and growth mechanism of comets and asteroids. Comets formed far out in the solar system and are fragile, low density objects. The Trojan region could be a potential reservoir of objects. Icy crust formation on comets is a rapid, common process which may turn comets into apparent asteroids. Occasional collisions in the asteroid belt may temporarily turn asteroids into comets and produce dust bands. Because these events are rare there are likely to be few examples at any one time. There is a relative lack of old long period comets (LPC) with respect to new ones, implying that fading exists and a comet is mantled within about 10 revolutions. There is also a lack of old LPC with large perihelion distance implying inactivation. There are no HTC with q larger than 1.5 AU. There are a number of asteroidal objects with cometary orbits: Don Quixote (JFC), Damocles (HTC), 1996 PW (LPC, P ~5000 years, q 2.5). Its possible to decouple the JFC from Jupiter by a combination of close encounters with the Earth and Venus and secular resonances (which gives evolutionary links between MB and JFC). We don't however know what fraction of comets, dead comets and asteroids form the transition NEOs. He also drew attention to the fact that there are no comets with H_0 fainter than about 12. Fainter comets might be missed or mistaken for asteroids, alternatively small objects might erode very quickly once smaller than 1 km, especially if this is combined with fragmentation. He concluded by pointing out that comet 46P/Wirtanen is just such an object and is a target for the ESA Rosetta mission.

Simon Green (Kent) resumed after lunch, on the topic of "Centaurs". Only seven of these strange bodies are known: Chiron, Pholus and five others which orbit between Neptune and Jupiter. They might originate as Trojans, but more likely come from the KB. Their size is much larger than typical short period comets (SPC) at around 200 km. Chiron has a relatively high albedo of 14%, but the others are more typically 4%. There are probably ~5000 within detectable range with several hundred larger than 100 km. Chiron shows cometary activity and the rotational light curve shows features which point to either non sphericity or albedo variation across the surface. As the coma brightens the amplitude of the curve decreases. Only a small fraction of the surface is active. Surprisingly the absolute magnitude is brightest at aphelion. According to HST measurements still under debate the density is less than one. Pholus is very red and the reflectance spectrum (which is similar to that of KB objects) is a good match to tholins. They could be made by cosmic ray bombardment of cometary ices. The question of what makes Chiron active and Pholus inactive and if they are SPCs remains unresolved.

Iwan Williams (Queen Mary) moved a bit further out to talk on "Edgeworth-Kuiper Belt Objects". KBOs are near the limits of detection at a distance of 50 AU with a size of 100 km. There are not enough routine astrometric observations being made (because these are not exciting) and once discovered many are lost; even observations over 6 months are equivalent to only one point on the orbit. Observational selection is a problem because searches are only carried out near the ecliptic (because that is where they are expected to be seen) and away from the milky way. Unfortunately this currently excludes searches near the location of Neptune so the absence of objects here is not surprising. There may be two classes - Pluto types and the rest. Following the reported detection of many KBOs in an HST field, Anita Cochran has imaged another field with negative results.

Vacheslav Emel'yanenko (Chelyabinsk) looked at the possibility of "Asteroids from Long-Period Comets". New comets are often subject to strong fading post perihelion. Mathematical simulations suggest that there should be around 4000 HTC compared to the 20 observed if there lifetime is around 200 revolutions. Asteroid 5335 Damocles, which shows no cometary activity, has a perihelion distance of around 1 AU and has probably made around 600 revolutions. He suggested that large nuclei with radius greater than 5 km might be preferentially deactivated.

Concluding the meeting Alan Fitzsimmons (Queen's University, Belfast) summarised observations of "Comet Hale-Bopp". The apparent standstill in the light curve last autumn could be explained if the large dust output gave rise to a strong phase effect. Careful selection of the observations gave a good straight line fit over the entire apparition to date, implying no outbursts or variations in behaviour. Similar molecules to those seen in 1996 B2 had been seen and new detections included SO, HCO^+ and HCCCN. The isotope ratios of $^{12}C/^{13}C$, $^{14}N/^{15}N$ and $^{32}S/^{34}S$ are very similar to those of the Earth suggesting that it formed in the same solar nebula that we did. Measurements of the rotation period gave results ranging from 12 hours to one year. The one year period was based on the fact that there was no apparent rotation of the jets over 13 days, however these images did show shells of material being emitted one the image from one day was subtracted from an image on the previous day. In a recent INT image 6 dust shells were visible and these implied a 12 hour rotation, however the lack of rotation of the jets couldn't be explained. The latest telescope on La Palma is a 50mm camera lens attached to a cooled 2000 pixel CCD camera installed on the INT roof which had been specially made to follow the evolution of the gas and dust tails.

Jonathan Shanklin

Low-tech spectrometry: A suggestion for observations of bright near-solar comets.

Christopher Taylor

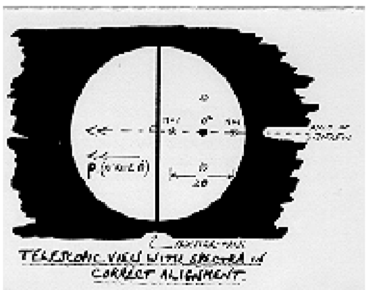
Most observers, I imagine, would welcome the chance to use their telescopes for new types of observation that reveal interesting phenomena not accessible to simple direct imaging. It is perhaps surprising then, that there is such a possibility which is very little used despite the fact that it requires only a telescope on a simple altazimuth stand, a stopclock and a few minutes preparation time. There is no need for an equatorial mount, a drive, photography, a CCD, computer or any investment in ancillary instrumentation. Pretentiously it could be called "zero-technology objective-grating spectrometer"(!).

Take a piece of plain, unpatterned nylon gauze curtain such as is to be seen in suburban front windows, preferably with a mesh as fine as 1/3 mm and stretch it flat over the main aperture of the telescope, being careful to keep the threads as straight as possible. The result, as is well known[1], is a crude and rather inefficient means of producing spectra of celestial objects. What appears to be much less well known is that such a primitive device can actually be used for quantitative spectrometry. It is possible to make absolute measurements of the wavelengths in emission line sources such as planetary nebulae and the heads of near solar comets. All that is necessary is a measurement of the diffraction angle q, an absolute count of the threads in the gauze to establish their precise mean spacing D, and a simple application of the grating formula:

$$nl = D \sin (q)$$

Essentially, the theory of the method is this: the 1^{st}-order (n=1) q-value is of order 5-6 arcmin., for which the grating formula may be approximated to better than 1 in 10^6 by l = Dq (q in radians). D is determined from the aperture of the grating and a direct count of the threads using a strong magnifier. q is obtained as q = 0.5 dq.Dt, where dq = 7.2921 x 10^{-5} cosd sec^{-1} is the diurnal rate at declination d and Dt is the time taken by the image, drifting at this rate, to pass over the interval between the two 1^{st}-order spectra. The latter must, therefore, be aligned fairly carefully 'fore and aft' to the preceeding-following directions in the field. One great advantage of a nylon curtain as dispersing element is that we can determine the grating constant D by actually counting the individual threads as stated above, and this determination of wavelength is therefore, an absolute one requiring no use of comparison spectra or interpolation formulae.

The nylon used should have a reasonably uniform mesh, without superimposed patterns and should be stretched flat over and fixed to a rigid diaphragm which is placed over the entrance aperture of the telescope in such a way as to be freely rotatable about the optical axis. The results below were obtained with one of 250 mm clear aperture, having 894±2 threads, hence D = 0.2880±0.0006 mm (±0.3%). The transit timings Dt were made with an electronic darkroom stopwatch by watching the two opposite 1^{st} order spectra proceed in tandem across a register mark in the centre of the field; on bringing the object into view and rotating both the grating and the register mark appropriately, one obtains an arrangement of 0^{th} order and four 1^{st} order images which should be thus:-



It follows that the true field of the eyepiece must be at least 4q, preferably rather more, but one should use the highest power that gives this - a typical comet eyepiece giving 30 - 35 arcmin. at x100 is ideal. It is obvious that another huge advantage of this method is that one looks straight into the eyepiece, at a normal telescopic view with full unrestricted field uncluttered by additional optics - there is, for instance, no awkwardness of keeping a narrow spectroscopic slit on target.

At most declinations the transit time Dt generally ranges from 50 to 80 seconds, so it only takes a few minutes to repeat the timing in order to improve accuracy by averaging: I generally take sets of four to six measures. The single most important procedural point is to ensure that the axis of dispersion (see diagram) is square to the register mark and that the latter is square to the p.-f. direction (i.e. N.-S.), both to within a tolerance of say ±3°. The second pair of 1^{st} order spectra will be found very useful in making the first of these adjustments (assuming that the 'mesh' of your nylon is truly rectangular); an offset here will cause a systematic negative bias in the results, while an offset of the p.-f. direction will have the opposite effect. Neither of these systematic errors is significant if the offsets are at the 2°.level but start to become serious at about 4°. Undoubtedly a rather thick and accurately square pair of cross-wires in the focal plane would be a great advantage here but my trials of the method used nothing more than a matchstick glued across the field stop of the eyepiece! Other sources of systematic bias to watch out for, which will not be apparent in the random scatter of the Dt measures themselves, include inaccurate clock rate, wrong D-value (error likely to be ±0.3%), systematic over estimation of Dt due to the angular diameter of the source (likely to be 0 - 1%) and finally the dq rate may need correction for the object's own proper motion in the case of a very fast moving comet.

The miracle is that such an absurdly crude 'grating' is at all capable of giving spectra of sufficient purity for any meaningful measurements. I have recently put this to the test by using some bright planetary nebulae as 'standard sources', all having visual spectra completely dominated by the [OIII] emission, which has a centre of intensity at l = 499.5 nm. Among the resultant sets of measures, that with the smallest scatter was also the best: NGC 7027 (visual mag +8.5) gave l = 500.8 ±3.0 nm, allowing for both random and systematic errors, a result only 0.3% above the expected value. The miracle actually works!

Other sets of 4 - 6 measures were also taken for each of NGC 6826 (m_V = 8.8), 7009 (m_V = 8.3), 7662 (m_V = 8.3) and 3242 (m_V = 7.7) with a worst case result only 2.7% in error, this being a rather rough first attempt.... and all this with only an altazimuth telescope, a piece of old nylon curtain and a darkroom stopwatch! I have no doubt on the basis of these results that more careful use of this primitive instrumentation would be quite capable of ±1 - 2 nm accuracy. Theoretically, the resolving power in 1^{st} order of this piece of nylon is nearly sufficient to split the sodium 'D' lines.

Planetary nebulae are rather boring objects in this sense - they always yield the same wavelength, but near solar comets are much more interesting, being essentially dynamic phenomena and displaying a rich variety of emission lines. (Novae would make another interesting field of application for the same reasons.) Comets at solar distances of 0.5 - 1.0 AU usually radiate strongly the molecular bands of C_2 at 473.7 nm, 516.5 (often the dominant visual wavelength) and 563.5 (band-head l's) and of CN at 388 nm. Sun-grazers, by contrast, are exercises in atomic spectra rather than molecular chemistry. An earlier and much cruder attempt in this direction which I made with the same piece of nylon 20-odd years ago yielded a value of l = 523±15 nm for comet Kobayashi-Berger-Milon on 1975 August 24. Subsequently published professional spectra showed the C_2 band-head at 516.5 nm as the brightest visual emission at that time. In addition, my further observations over the days following gave at least a strong hint of night by night changes in the spectrum.

The nylon grating method clearly has more than sufficient spectral discrimination to reveal very quickly which of the major cometary bands is the dominant emission and with a really bright comet - Hale-Bopp in April and May 1997 ? - we may reasonably expect to be able to see them all separately and so to determine their wavelengths one-by-one, and make rough visual estimates of relative intensities. This certainly has the capability of showing up nightly spectroscopic changes that would be quite beyond the reach of direct imaging with or without colour filters. I would strongly urge members of the Comet Section to add observations of this sort to the more usual direct imaging planned for Hale-Bopp this spring. Given that the comet will, when sufficiently near the sun to produce strong line emission, be at least 6 magnitudes brighter than NGC 7027, there will not be a single telescope user in our Association who will be prevented by lack of equipment from making some potentially very interesting measurements with this truly minimalist method - why not give it a try ?

Reference

1. North, G. Advanced amateur astronomy, pp284-6, 1991

CME-Fried Comets

Robert D Brown

This item was taken from the usenet and is reprinted as an example of its genre. No doubt it also explains the cometary origin of Venus! Note that the author has not provided any calculations which could attempt to justify the hypothesis, though an order of magnitude calculation is quite straightforward.

There is a potential for a parity-breaking interaction between coronal mass ejections (CME's) and comet tails that may explain the asymmetrical distribution of comets in prograde and retrograde moving orbits and explain the origin of asteroids as "CME-Fried Comets".

The long period comets are split 50-50 between prograde and retrograde moving orbits and arrive in the solar system from any direction (randomly). The intermediate period comets have an average inclination of 28 degrees to the ecliptic plane and 75% move in prograde orbits. The short period comets move within the ecliptic plane and all display prograde orbits.

CME's maintain their angular momentum as they traject away from the Sun. Comet tails, in contrast, are radially-oriented in respect to the Sun. Because the Sun's rotational rate is faster at the equator than it is toward the poles, the potential for a parity-breaking CME-comet tail interaction is greatest at the ecliptic plane.

Hypothesis: CME's tend to have head-on interactions with retrograde-moving long period comets that result in the explosive demise of the comet nucleus, while prograde moving comets tend to have tail-first interactions with CME's that result in a slow cook-off of comet volatiles. The plasma-mediated magnetic connection of CME's with comet tails converts parabolic orbits to elliptical orbits more characteristic of asteroids. An asteroid is what one gets from this process.

R. D. Brown, M.D.
Pelorus Research Laboratory

Letters

Graeme Waddington points out that the period I gave for comet Hale-Bopp in the Journal note is only true for the epoch of perihelion. He goes on to say: This is not the orbital period prior to the comet's current passage through the solar system, as it was changed as a result of the 115 million km approach to Jupiter in April 1996. The period of the previous orbit was around 4200 years - hence we should be looking for cometary apparitions around 2200BC and not 500BC as implied by your wording. As it happens, both Baldet and Hasegawa's comet lists give a candidate comet visible from Egypt in -2191 (or -2024); in both cases the comet "record" has been taken from Pingre's Cometography (1783), p 246. Pingre got his entry from Hevelius' Cometographia (1668), p 794. Hevelius, in turn, got his information from the Sequunter Exempla Cometarum of Rochenbach's De Cometis (1600; published 1619), p114 where we find the following:

Anno mundi, millesimo, nongentesimo, quadragesimo quarto. Anno post diluvia, ducentesimo, octuagesimo octavo, Cometa in Aegipto naturam Saturni referens, circa Alcairum, in dodecatemorio capricorni visus est, hicque spatio sexaginta quinque dierum, tria signa in coelo percurrit. Hunc confusiones linguarum, & dissipationes gentium in toto terrarum orbe, sunt secutae. De quibus Genes, undecimo capite, prolixus textus dicunt.

Whereas Hevelius accepts this AM 1944 (=-2191), "record", Pingre rightly regards it as a pure fiction ("imaginees sans aucun fondement"), but neither Baldet nor Hasegawa picked this up. (The alternative dating of -2024, quoted by both Baldet and Hasegawa, appears to be due to Pingre - it depends on just when you think the "flood" occurred!). Given the paucity of reliable records from 2200BC it is indeed unlikely that the previous apparition of the Hale-Bopp will be identified in the historical record.

Graeme Waddington

The cosmonauts aboard the Mir spacecraft communicate with amateur radio enthusiasts all over the world. Amongst them is BAA Member Don Shirreff (G3BGM) who asked them about observing from space. The latest Captain of Mir is Alexandr Kalery who sent this reply on 1996 October 14; reception was not good and there are some gaps in the transmission:

Dear Don,

I saw both Tabor and Hale-Bopp comet. Tabor looks like a small diffuse spot having size approx. 7-8 arcmin. I couldn't see its tale. Only the head was seen through its coma. ...... I can say nothing about this star because it is absent on my star map. I can observe this comet by binocular -20x and monocular -6x only. Hale-Bopp comet is seen also by these instruments. But in binocular I saw only its head and in monocular I saw its tale too. I can estimate its head size in 14-15 arcmin and its tale 2-3 times longer. Now it can be seen in the first 10-15 minutes of shadow in .... (Communication was lost at this point, but Don thinks he was answering the question as to how close to the sun they were able to observe the comets by going on to say that they were observing them while in shadow before sunrise or after sunset.)

Alexandr Kalery

Tales from the Past

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

150 Years Ago: Monthly Notices contained an anonymous review of *A Historical Survey of Comets'* by Dr Michelsen, which seems to be a forerunner of recent books by authors such as Schaaf and Yeomans. According to the review it covered great and periodic comets, including apparitions of 1P/Halley back to 426 BC [though modern research gives returns in 391 or 466 BC]. Comet Encke was one of the few other periodic comets observed at several returns at this time and its motion was thought to demonstrate the presence of a resisting medium in space. F W Bessel died in 1846 and his obituary notes his studies of 1P/Haley, and particularly refers to his observations of jets in the coma and his realization that these could create a repulsive effect and alter the comet's orbit. The review of the year notes calculations by Professor Plantamour of Geneva in AN, on the motion of Biela's comet and gives a passage from Seneca's *Naturales Quaestiones* which seems to describe a double comet. The review also records comet discoveries of the previous twelve months, including 3 by de Vico, 2 by Brorsen and two by Hind. Hind had been co-discoverer of one with de Vico and had just missed out on another, but the one that carried his name alone became visible in daylight on March 30. Hind also predicted a return of the comets 1264 N1 and 1556 D1 for February 1848, however the modern orbits bear no relation to each other.

100 Years Ago: Volume 7 of the BAA Journal reported that a new rule for telegraphing comets came into operation on November 1, when the brightness of the object was included in the cypher. A C D Crommelin published a paper in the Journal on how to compute the orbit of a comet from three observations made at intervals of a few days. Observations of the Leonids were reported and prognoses given for the forthcoming return and that of 1933. A good return of the Bielids was also expected in 1898. It was reported that Dr Riem had linked comet Tebbutt 1881 K1 to a comet seen by the Chinese in 612 BC. Mr W T Lynn suggested that comet Tewfik, seen at the solar eclipse in 1882, might be linked to 'certain appearances' seen in photographs taken at the solar eclipses of 1860 and 1893. If so the comet would have a period of 10.9 years; however he also linked sunspots to swarms of meteors! AN 3416 contained a paper by J holetschek giving notes on many ancient comets, including several apparitions of comet 1P/Halley recorded by the Chinese. Linking comet orbits was a popular pastime and another attempted linkage was between comet D/Lexell (17770 L1) and D/Swift (1895 Q1). Swift had also seen a bright object about 1 degree east of the sun on the evening of 1896 September 21; this may have been a sungrazing comet.

50 Years Ago: The Reverend Dr Martin Davidson resigned as Director of the comet Section at the AGM in October 1946 and was succeeded by Dr Gerald Merton. At the January meeting Manning Prentice presented a paper on the Giacobinids and there was much discussion about the storm's relation to comet Giacobini-Zinner. Also in reference to the shower, known as the Draconids in the USA, Sky & Tel mentions 'No known comet can itself strike the Earth'. The March Journal (57, 3) contains a report of the comet Section for 1946 [such reports are fairly infrequent in the Journal]. Section member Albert Jones had discovered a comet (1946 P1) on August 6 the previous year whilst trying to find the variable star U Puppis, although he had carried out a comet search earlier. It moved north and was expected to be 9^m [the section archive records start the following year]. The Carter Observatory of New Zealand issued the announcement of the discovery of a comet by the Director of the RAS of New Zealand comet Section on September 2. Berry himself was doubtful and wanted to wait for confirmation. It turned out that flaws on three plates taken on separate days were coincidentally aligned.

Review of comet observations for 1996 November - 1997 April

The information in this report is a synopsis of material gleaned from IAU circulars 6496 - 6640 and The Astronomer (1996 November - 1997 April). 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.

A final observation of 22P/Kopff was made by Wener Hasubick on 1996 November 4.7 when it was mag 13.5. A preliminary analysis of the data gives a light curve of

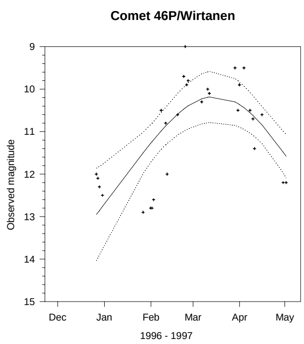
$$6.5 + 5 \log d + 12.9 \log r$$

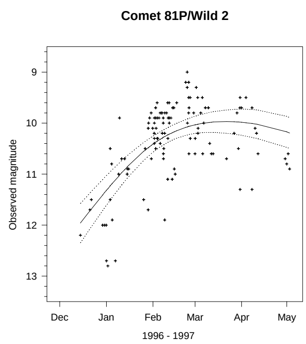
but this is a little indeterminate.

29P/Schwassmann-Wachmann 1 was again in outburst in February and early March, peaking at around 12th mag. This comet seems to spend a lot of time in outburst and is worth monitoring with CCD cameras on a regular basis.

46P/Wirtanen, the target for the ESA Rosetta mission, was visible for a short while in the evening sky this spring. A diffuse object, it peaked at around 10^m in late March, but was not too difficult to see. It faded rapidly in April. Observations received so far give a preliminary light curve of

$$8.2 + 5 \log d + 17.6 \log r$$





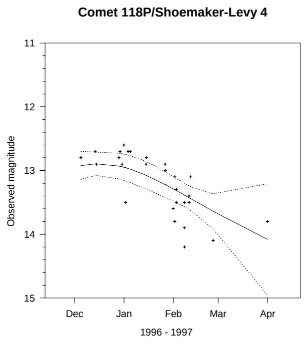
81P/Wild 2, a target for the NASA Stardust mission, reached peak brightness at around 10th mag in late March and is now fading slowly. Observations received so far give a preliminary light curve of

$$7.0 + 5 \log d + 11.6 \log r$$

not very different to the previous apparition.

118P/Shoemaker-Levy 4 never became very bright, but a number of observers recorded it fading from 13^m during the winter. Observations received so far give a preliminary light curve of

$$8.9 + 5 \log d + [10] \log r$$



126P/IRAS (1996 P1) was recovered at 13^m by Rob McNaught on a UK Schmidt plate taken by Q A Parker on August 8. For most of the apparition it was a southern hemisphere object, but became visible from the north late in the year as it faded from 12 to 13 mag during November and December.

C/1995 O1 (Hale-Bopp) has now disappeared from view to northern hemisphere observers. There are already over 2000 visual magnitude observations, and 400 graphic images of one sort or another in the archive, making it the most observed comet in the Section records. Although it was a 'great comet', it is presumptive to call it THE great comet of 1997 - there are 8 months of the year to go yet!

The comet faded a little in August and September last year, but during October brightened by about 1 mag and reached 4.5 to the naked eye in mid October. During the rest of the year it did not brighten much and reached 4th mag by the end of the year. It brightened rapidly during January and February peaking at around -0.5 in late March. It is now fading. The equation

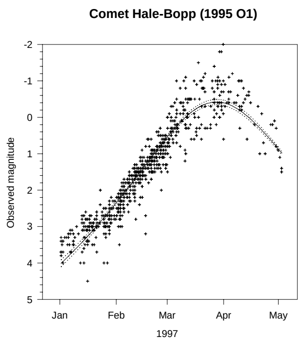
$$-0.5 + 5 \log d + 7.2 \log r$$

fits all the available observations (corrected for aperture), but there are long period variations about this mean curve of around a magnitude. Alan Fitzsimmons has suggested that because it is a very dusty comet the light curve is better fitted by including a phase term and the observations do bear this out, at least until February. A presentation by Alan at the RAS meeting on March 14, gave a nearly perfect straight line fit with no apparent variations.

Since the beginning of the year the comet brightened more rapidly at

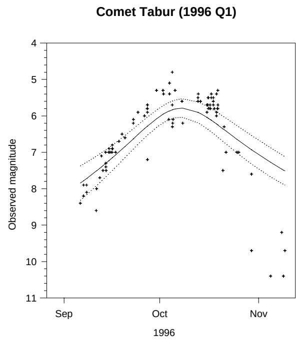
$$-0.7 + 5 \log d + 10.5 \log r$$

suggesting that peak brightness was around -0.4.



C/Evans-Drinkwater (1996 J1) was discovered by Robert Evans and Michael Drinkwater (a former PhD student at the Institute of Astronomy in Cambridge) on UK Schmidt plates taken on 1996 May 10. Despite being at perihelion at the end of December, no observations have been reported as it has been too close to the sun. It is now fading below $13^{m.}$

C/Tabur (1996 Q1) was visually discovered by Vello Tabur of Wanniassa, Australian Capital Territory on August 19 at 10^m. It brightened rapidly and moved north, becoming an easy target for northern hemisphere observers. It broke up and faded during late October and the last observation was made in mid November. The light curve is a power law best fit over the apparition, but the observations are clearly much fainter than this in late October and November.



1996 R3 Details of a faint comet discovered by Claes-Ingvar Lagerkvist on an ESO Schmidt plate taken last October were given on IAUC 6564 (1997 February 21). The object was eventually confirmed on images taken by the Spacewatch and NEAT teams last September. It is an intrinsically very faint comet and may be periodic, though there are not enough observations to confirm this.

C/NEAT (1997 A1). The NEAT (Near Earth Asteroid Tracking) Team discovered a very faint comet (19th mag) with the USAF/GEODSS telescope on Hawaii. It is a distant object and unlikely to be observed visually, however at least one UK amateur has obtained CCD images.

P/Kobayashi (1997 B1) was initially reported to the IAU by S Nakano as an asteroid discovered by Takao Kobayashi, but subsequent observations showed that it was in a cometary orbit and further observations by W Offutt showed it to have a coma and tail. The nuclear magnitude of the comet is around 17, but visual observations may put it brighter. This is the first amateur CCD discovery of a comet and is also the faintest amateur discovery and shows that the field is not lost to the professional search teams.

P/Gehrels (1997 C1). Tom Gehrels discovered a comet by eye during the course of the Spacewatch survey. The comet is a periodic one, and is currently 17th mag and fading.

C/Spacewatch. Details of the orbit of an unusual asteroid, 1997 BA6 were given on MPEC C-13. The orbit is very eccentric, with a period near 4500 years and a semi-major axis of several hundred AU. This is more typical of a long period comet and subsequent observations with large telescopes showed a small faint coma. Currently it is nearly 20th mag and located at around 12 deg dec, but will be at high southern dec when near perihelion. The asteroid is currently some 8 AU from the earth and nearly 9 AU from the sun, and is heading for perihelion at 3.4 AU in 1999 December when it may be around 13th mag.

C/Mueller (1997 D1) is a new comet discovered on plates taken by Jean Mueller for the 2nd Palomar Sky Survey with the 1.2-m Oschin Schmidt Camera on Feb 17th. The object was reported as 16th mag, but appears brighter to visual observers. This was confirmed by an observation made with the Northumberland 0.30-m refractor x170 on March 6.11, when I made the comet 13.7, DC4, diameter 0.4'. Although it should remain around this brightness until conjunction in late May, no positive observations have been reported since early April. It should reappear in the autumn slightly brighter.

55P/Tempel-Tuttle (1997 E1) has been recovered by observers using the Keck 10-m telescope and confirmed using the ESO 3.5-m NTT at mag 22. The parent comet of the Leonids, it will not reach perihelion until 1998 Feb 28 when it may get as bright as 9^m. It will pass 0.35 AU from the earth in mid February when it gets within 8° of the pole.

The comet was originally discovered on 1865 December 19 by William Tempel in Marseilles and on 1866 January 6 by Horace Tuttle from Harvard. The comet was then around 6^m and reached perihelion on January 12 when it was 5^m. It faded and was last seen on February 9. Once the orbit was calculated it was realised that it was very similar to that of the Leonids and previous returns of the comet were found in 1366 (when it made a very close approach to earth, 0.0229 AU, and reached 3^m) and 1699. It wasn't really looked for in 1899, and couldn't be found in 1932. At the last return it was eventually recovered some three months after perihelion in 1965 June.

The Leonid rates themselves last year seem to have peaked at a ZHR of around 50-60 between 06-10 UT on November 17. Many of the meteors were bright, which is similar to what was seen prior to the big display in 1966.

C/Montani (1997 G1) was announced on IAUC 6622. It is a 19th mag object discovered by Joe Montani of the Spacewatch team. The preliminary orbit suggests that it is a distant object, with a perihelion distance of 4.3 AU and will not become any brighter. It may be a periodic comet.

C/Montani (1997 G2) quickly followed. It is another distant comet, but may just become visible to southern hemisphere observers when it reaches perihelion next Spring.

P/McNaught-Hughes (1997 H1 = 1991 S1) was recovered at its first return by Jim Scotti with the Spacewatch telescope and A Nakamura with the Kuma Kogen Astronomical Observatory 0.6-m f6 Ritchey-Chretien reflector. It is not expected to become much brighter than 18^m.

C/Mueller (1997 J1) is another new comet discovered on plates taken by Jean Mueller for the 2nd Palomar Sky Survey. The object was reported as 14th mag, but appeared a little brighter to visual observers. Just past perihelion and at high northern declination when discovered, it will fade.

Several sungrazing comets have been discovered by the coronograph on the SOHO spacecraft. Formal discovery designations will be announced when the CBAT has sufficient details to give accurate positions or orbits.

For the latest information on discoveries and the brightness of comets see the section www page: http://www.ast.cam.ac.uk/~jds