Meetings

Ordinary Meeting, 2006 November 25

held at New Hunts House, Guys Hospital, London Bridge, London SE1

Richard Miles, *President*
Hazel Collett, Ron Johnson and Nick James, *Secretaries*

The President opened the second Ordinary Meeting of the 117th session by inviting Hazel Collett to read the minutes of the previous meeting, which were approved. Sixty one new members were proposed for election and one hundred and eighteen, proposed at the previous meeting, were approved by the members present. Ron Johnson advised that no presents had been received since the last meeting.

The President then announced that a new award for meritorious service to the Campaign for Dark Skies would be made by that group at the 2007 Exhibition Meeting. The award would be named after Joy Griffiths who died this year. CfDS had hosted a successful European Symposium in Portsmouth and representatives were to meet DEFRA Parliamentary Secretary Ben Bradshaw MP in the near future.

The next Ordinary Meeting, preceded by a Christmas Lunch, would be held at Guy's Hospital on December 16. The Christmas Lecture would be given by the Astronomer Royal for Scotland, Professor John Brown.

Technical problems delayed the start of the meeting by fifteen minutes and necessitated a move to an adjacent lecture theatre after the President's announcements. Dr Miles then introduced the first speaker of the evening, Prof Mike Barlow from the Dept of Physics and Astronomy, University College, London.

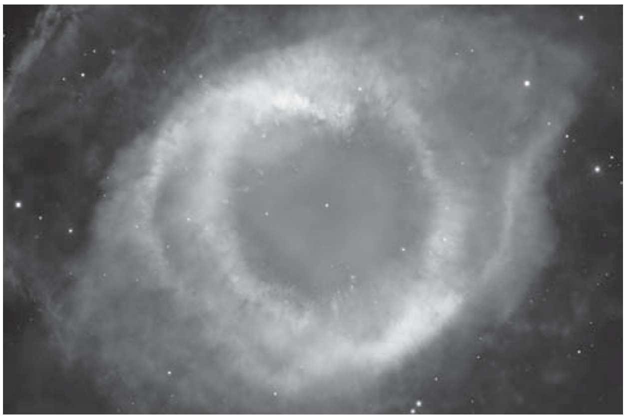
Planetary nebulae – from red giants to white dwarfs

These nebulae were so named by John Herschel as they appeared to resemble planetary disks. Subsequently the Hubble Space Telescope revolutionised our views of these objects and many superb images, from Hubble and other sources, were shown during the course of the presentation. Prof Barlow's lecture was divided into four parts: Where do planetary nebulae (PNe) come from and where do they go?; PNe as probes of galaxies and galaxy clusters; PNe as sources of heavy elements, molecules and dust particles; and how are PNe shaped?

Planetary nebulae form during a star's evolution from the main sequence via the red giant stage to becoming a white dwarf. Initially the star passes through a sub giant stage to become a red giant. Subsequently the star forms a helium-burning core surrounded by a hydrogen-burning shell. Then at its peak surface temperature and luminosity the star forms a carbon core surrounded by helium and hydrogen-burning shells. Helium-burning flashes cause carbon to rise to the surface of the star, causing a change from an oxygen rich to a carbon rich environment. Such objects are known as AGB (Asymptotic Giant Branch), Mira or Carbon stars. Mass is lost from the star's surface to form the surrounding planetary nebula (PN). The final stage of the star's evolution is to become a white dwarf. The mass distribution of white dwarfs shows a strong peak at 0.59 solar masses, with a tail extending up to the Chandresekhar limit of 1.4 solar masses. Exceeding this, by gaining mass from a companion star for example, will cause the white dwarf to explode as a Type 1a supernova.

PNe are strong emitters in a narrow band centred on 500.7nm (5007 angstroms). They are now routinely used to determine galaxy rotation curves and mass distribution, including dark matter, within galaxies. Intracluster PNe were detected in both the Virgo and Fornax galaxy clusters. These had formed from stars tidally stripped from their parent galaxies, and such stars could account for up to 40% of all stars within the Fornax cluster and 50% within the Virgo cluster. Intracluster stars are a source of baryonic dark matter and tell us something of the cluster's dynamical history.

Prof Barlow then moved on to describe the dust and molecules found in PNe. ESA's Infrared Space Observatory (ISO) detected crystalline silicate grains in many types of objects, an example being the oxygen rich Type 1 bipolar PN NGC 2440. Spectra of the massive oxygen-rich bipolar PN NGC 6302 indicate the presence of calcite, diopside, dolomite, water ice, enstatite and fosterite. Comet Hale–Bopp's spectrum indicates the presence of crystalline silicates also present in PNe.



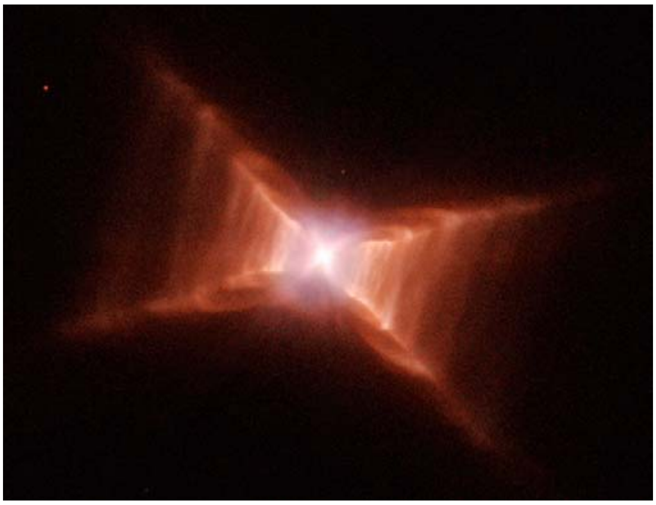
NGC 7293, the Helix Nebula, imaged by the Hubble Space Telescope. *NASA/ESA/STScI*

The first cooled infrared telescopes were flown in Aerobee sounding rockets by the USAF in the 1970s. Such flights assisted the development of heat-seeking missiles by ensuring that they homed in on enemy rather than astronomical targets. These flights detected 2363 sources, examples being AFGL 2688, the carbon-rich Egg nebula in Cygnus and AFGL 915, another carbon rich nebula also known as the Red Rectangle.

The mid-infrared spectra of many PNe, e.g. AFGL 915 and NGC 7027, show emission features called 'unidentified infrared bands' (UIBs). These are believed to be due to the stretching and bending of polycyclic aromatic hydrocarbons (PAH's). New Zealand amateur astronomer Albert Jones observed CPD 56 8032, V837 Ara over a thirteen year period. The lightcurve constructed from his observations showed three dimmings during that time.

Prof. Barlow next described the types of molecules found in PNe, illustrating this part of his presentation with images of the Ring Nebula, NGC 6720 and the Helix nebula, NGC 7293 taken at various wavelengths. The comet like globules in the latter are composed of molecular hydrogen and oxygen, carbon monoxide and dust. The Egg nebula has a very complex four-lobed structure, the reasons for which are not yet understood. NGC 7027 is a massive carbon rich PN with an ionised core, an H_2-emitting photo-dissociation zone and a cool dust-scattering molecular envelope. The spectrum of AFGL 618 is similar to that of the Murchison meteorite and exhibits absorption bands indicating the presence of HCN and C_2H_2.

The final part of Prof Barlow's presentation related to the shaping of planetary nebulae, illustrated with images of Abell 39, an



HST image of the planetary nebula known as the Red Rectangle, HD 44179. *(NASA/ESA/STScI)*

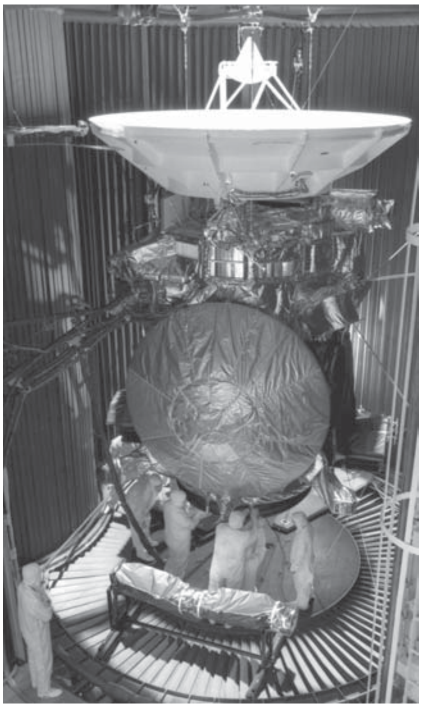
almost perfect circle; NGC 6720, elliptical; NGC 650, bipolar; and IC 4406, cylindrical. In summary, in a survey of PNe within 6.5 kpc, round PNe account for 26% of the total, elliptical, 62% and bipolar, 12%. The Generalised Interacting Stellar Winds (GISW) model, developed in 1978, can account for round and elliptical shaped PNe but not the bipolar type. In this model a nucleus is surrounded by a shell of gas and warm dust beyond which is a further shell of gas and cold dust all inside the remnant of the circumstellar envelope of the progenitor red giant star. In the 1980s and early 1990s the GISW model was modified to include an equatorial disc which would channel outflows into polar directions.

HST images showed PNe properties which could not be explained by these existing models, therefore in 2004 two versions of the Magneto Hydrodynamic (MHD) model were proposed. One version has a rapidly rotating magnetised core and the other a magnetised accretion disc. The latter needs a binary companion whereas the former does not. There is evidence that a high proportion of the central stars of PNe may be binary and the possibility exists that all may be so. The speaker ended his presentation by suggesting that the measurement of the lightcurves of central stars might make an interesting and useful amateur CCD project.

Following applause the President then welcomed the next speaker, Dr Andrew Ball from the Planetary and Space Sciences Research Institute, The Open University, Milton Keynes.

The Cassini–Huygens mission to Saturn – an update

Dr Ball opened with brief descriptions of the spacecraft and Saturn's moon, Titan. The *Cassini* spacecraft, launched in 1997, was an ESA/NASA cooperative effort with ESA being responsible for the *Huygens* probe/lander and NASA for the *Cassini* orbiter. The *Huygens* component weighed 319kg and was 2.7m in diameter. Its science payload consisted of six experiments: two to sample the atmosphere, a Doppler wind experiment,



The *Cassini* orbiter undergoing flight testing at JPL before launch. The *Huygens* probe is the round conical object attached at the front; the technicians give a sense of scale. *NASA/ESA/JPL*

atmospheric structure instrument, a camera and the Surface Science Package.

Titan has a diameter of 5150km, a surface gravity of 1/7 G and a surface atmospheric pressure 1.5 that of Earth. It is the only planetary satellite with a significant atmosphere – mostly nitrogen and methane. For methane to remain present in the atmosphere it must be continually replenished either from methane lakes or from sub-surface reservoirs. Infra red imaging allows the surface to be seen through the atmospheric haze. Methane clouds have been imaged near to the South Pole close to what appear to be methane lakes detected by *Cassini*'s radar. Other surface features detected include a small number of impact craters and dunes oriented in the direction of the prevailing wind. Discoveries were not limited to Titan's surface. Images taken by *Cassini* of Saturn with the Sun behind it showed previously undetected rings.

For the rest of his presentation Dr Ball concentrated on the *Huygens* probe/lander. It was designed to land on a solid, slushy, muddy or a liquid surface. The spacecraft arrived at Saturn on 2004 January 15 after swingbys of Venus, Earth and Jupiter. The *Huygens* probe was released from the *Cassini* orbiter on 2004 December 25. The entry sequence started 1270km above Titan's surface. Deployment of the pilot parachute was followed by the opening of the main parachute. Due to the density of Titan's atmosphere the main parachute slowed the probe to a greater degree than required near the surface. To counteract this the main chute was jettisoned and a smaller one deployed.

During the descent data obtained allowed atmospheric density, pressure and temperature profiles to be determined. At this time the tilt sensor detected sideways movement or buffeting of the probe. This turbulence was at a maximum after the main parachute was discarded and the smaller chute deployed. Below about 80km the *Huygens* camera could image the surface in visible light, and such images were later stitched together to form a mosaic. 3D topography showed that the lighter ground was higher than the darker ground, the latter forming a network similar to river valleys and tributaries on Earth. Surface alteration is due to cryovolcanism, impacts, wind and hydrocarbon rain. Accelerometer readings on landing suggested that the surface at the landing site was composed of wetted (by liquid methane) granular material. After landing 70 minutes worth of data was transmitted by the probe. Unfortunately one of the two receiving channels in *Cassini* did not switch on and thus some of the science data was lost.

A mission to return to Titan in 2020 is a possibility. Such a mission might include a Titan orbiter, in situ measurement of the materials and environment at the landing site and mobility in the form of a helicopter or airship allowing reconnaissance of the various types of terrain.

More details of the mission can be found at **http://pssri.open.ac.uk**.

Following applause for Dr Ball's presentation, Dr Miles said that he himself would now present the monthly observing notes.

The November and December sky

The President opened his presentation with a summary of Solar System highlights for the coming month. The Moon passes through the Pleiades between 01:00 and 07:00 UT on December 4, the next Full Moon falls on December 5 and the following New Moon on December 20. The Winter Solstice occurs at 00:22 UT on December 22. Mercury was at greatest western elongation this morning (November 25). Venus will be visible in the evening sky and Mars and Jupiter in the morning sky but all will be difficult to observe. December 10 offers the chance to observe a rare triple planetary conjunction involving Mercury, Jupiter and Mars. Saturn will be occulted by the Moon as it sets on December 11 and the ringed planet, positioned to the right of the Sickle in Leo, is a spectacular object during the month. Uranus and Neptune are both also visible at this time.

A number of comets can be observed: C/2006L1 (Garrard) will be visible until May, C/2006M4 (Swan) similarly but is now fading, C/2006P1 (McNaught) reaches perihelion at 0.17 AU on January 12. At this time it should be visible in SOHO LASCO C3 camera images and may also be visible to Earthbound observers before sunset on January 10. This comet is believed to come from the Oort Cloud and is on its first pass through the inner solar system. Periodic comet 4P/Faye is at 9th magnitude as it approaches perihelion. 2006 U1, discovered a month ago, has a strange appearance in that it appears as an asteroid-like point source but with a long, narrow cometary tail. 2006 VZ13, discovered on November 13, is in a highly eccentric orbit with a perihelion of 1.1 AU but with an aphelion of many hundreds of AUs. It is predicted to reach magnitude 14 next July. It may be a comet and more astrometry is needed.

The first observation of an occultation by a binary asteroid, 22 Kalliope and its satellite, 22 Kalliope 1 (Linus), was recorded by twenty observers of which five noted the satellite event. Occultation predictions of interest to UK observers include: 498 Tokio on December 13/14 (Wales and Southern England) and the same asteroid on December 15/16 (Northern Ireland and Northern England).

The Leonid meteors exhibited a peak ZHR of less than 10 on November 17/18 with a further peak ZHR= 50, on November 19. Meteors were typically magnitude 5 or fainter. A favourable Geminid shower is predicted for December 13/14 and a very favourable Ursid shower with a peak ZHR of 10 is predicted for December 22.

Moving further afield Nova Cygni 2006/V2362 Cygni is brightening. A new variable star, Var Cas 2006, brightened from magnitude 11.4 to 7.5 in 10 days. The lightcurve is symmetrical about a sharp peak. No colour change has been noted. This is a normal A2 star with no unusual emission lines. It appears to be the first case of a gravitationally lensed star discovered by an amateur, A. Tago, on 2006 October 25. Gravitational lensing occurs when a massive object passes in front of the star being observed. Professional surveys are finding some 600 such objects each year in the 16–20 magnitude range.

The final item was a mention of a powerful gamma ray burst, GRB061121, detected by the *Swift* spacecraft on November 21.

The President then adjourned the meeting until the Christmas Lecture on December 16, to be held at the same venue.

Roger Dymock

Ordinary Meeting, 2006 December 16

held at New Hunts House, Guys Hospital, London Bridge, London SE1

Richard Miles, *President*
Ron Johnson, Hazel Collett and Nick James, *Secretaries*

The President opened the third meeting of the 117th session and invited Dr Nick Hewitt to read the minutes of the previous meeting, which were approved by the audience and duly signed. He announced that 26 new members were proposed for election; those 61 who had been proposed at the previous meeting were approved and declared elected. Nick James, Papers Secretary, said that three papers had been approved by Council for publication in the *Journal*:

Scaling the magnitude: the fall and rise of N. R. Pogson, by Vishnu Reddy
The BAA observatories and the origins of the instrument collection, by R. A. Marriott
HR Lyrae (Nova Lyr 1919), from outburst to active quiescence, by Jeremy Shears

The President gave details of a forthcoming joint venture between the Campaign for Dark Skies (CfDS) and the Campaign to Protect Rural England (CPRE) to map light pollution across the UK. On the moonless evenings of December 20–24, between 20:00 and midnight GMT, members of the public were invited to conduct naked-eye star counts in the rectangle of sky in Orion enclosed at its four corners by the feet, shoulders and head of the Hunter – i.e. by the stars Betelgeuse, Bellatrix, Rigel and Saiph. Even from the most heavily light-polluted areas, some stars would be visible, but from dark skies many more could be seen. Observations could be submitted via the BAA website. In case these nights were clouded out, the exercise would be repeated around the time of the following New Moon, on the evenings of January 14–21.

The President announced that the next Association meeting would be a *Back to Basics* workshop on January 20 in Ipswich, including a talk by Dr Laurence Newell marking the first appearance of the Radio Astronomy Group (RAG) in the series. The next Ordinary Meeting would take place at the present venue on January 31.

Finally, before moving on to the afternoon's talks, the President expressed his gratitude on behalf of the Association to Mrs Jean Felles, Office Manager, and her husband, for having worked beyond the call of duty in overseeing the Office relocation from Burlington House to its temporary accommodation on Hallam Street. Both were presented with a token of the Association's thanks, which members applauded.

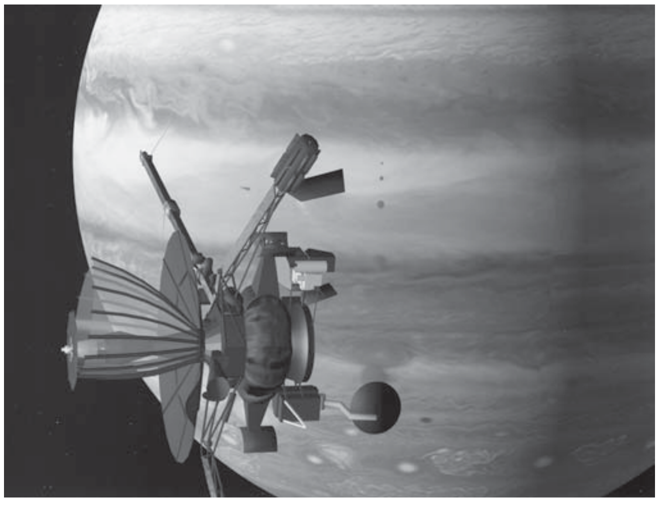
The President then introduced the afternoon's first speaker, Mr Doug Ellison, host of the spaceflight imaging website *www.unmannedspaceflight.com.*

Farce and fortuity in the exploration of space

Mr Ellison explained that his talk would outline a few of the turns of fortune which had affected the history of spaceflight. His first example was the *Cassini–Huygens* mission; he recalled how, after launch, its engineers realised that they had overlooked the Doppler shift in the telemetry between the *Huygens* lander and the *Cassini* orbiter which resulted from their relative velocity. It was then too late to change the frequencies to which the telemetric hardware was tuned, but with a stroke of genius, the ground team redesigned the orbital trajectories of the two probes to minimise their relative velocities to within tolerable limits.

This had not been the only technical hitch in that mission; Mr Ellison further recalled how all of the data from one of the two communications channels between *Huygens* and *Cassini* was lost as a result of a software bug on *Cassini*; the relevant receiver had not been turned on. Fortunately the second channel was designed as redundancy so only those teams who had tried to 'cheat' by using each available channel for separate experiments had lost data.

He turned next to the Jupiter *Galileo* probe, recalling its long history; having been designed by NASA in the 1970s, built in the 1980s, and launched after a delay in 1989, it finally reached Jupiter in 1995. The primary antenna, rather like an umbrella, failed to unfold. The leading theory as to the cause was that grease from the antenna joints had shaken out during its many journeys between Florida and NASA's Jet Propulsion Laboratory (JPL) in Pasadena, CA, making it too stiff to open.



Artist's impression of the Galileo probe in orbit around Jupiter, with its main antenna only partly deployed. *NASA*

Without this antenna, *Galileo* was seriously crippled: its low-gain antenna could transmit only 10 bits/second, whereas the lost antenna would have transmitted 138 kbit/sec. Once again, engineers devised ingenious workarounds. By upgrading ground-based antennae and improving the data compression software used on the spacecraft, they achieved a final communication rate of 120 bits/sec. Whilst many of the mission's planned activities had to be cancelled, *Galileo* had still achieved many of its original aims.

Mr Ellison turned next to the *NEAR Shoemaker* probe, sent to asteroid (433) Eros. He recalled how, on its final approach to the asteroid in 1998, a 15-minute orbital-insertion burn had failed and *NEAR* had subsequently gone radio-silent for 27 hours. Upon realising the situation, the engineers had little time to redesign the mission, yet they were able to take data during a flyby of Eros three days later, and then achieve orbital insertion upon its next close approach in 2000. The speaker noted that the subsequent mission had been a resounding success, ending in touchdown onto the surface of Eros in 2001.

He then turned to discuss the many turns of fortune which had affected missions to Mars. He recalled that the failure of *Mars Observer* (1992), three days prior to orbital insertion, led to a feeling that NASA should not have risked all of its instruments on one spacecraft, but should instead have sent a larger number of cheaper probes. This philosophy was now known by the motto

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'faster, better, cheaper'. It had some early success with the fruitful missions of *Mars Pathfinder* and *Mars Global Surveyor* (1996), but less luck with *Mars Climate Orbiter* (MCO) and *Mars Polar Lander* (MPL) in 1998, both of which were sunk by design flaws. He noted, however, that these had both had second lives: much of the technology from MCO had been reused in *Mars Odyssey* (2001), meanwhile *Phoenix* (scheduled 2007) would be similar to MPL.

In 2003, NASA made the daring decision to send two identical rovers to Mars – achieving complete redundancy against accidental failure, but also risking the combined failure of both in the event of design errors. These, the *Spirit* and *Opportunity* rovers, were tremendously successful: both remained to this day fully operational. Before launch, however, their mission had seemed in great doubt; 15 months beforehand, tests revealed serious problems with both their parachutes and airbags; furthermore, the suitability of the chosen landing sites was questioned. As in previous cases, mission engineers effected a miracle in rectifying these issues within the time available.

These had not been the only problems for the mission. Early in *Spirit*'s explorations, an issue with its memory filing system left it crippled for several days; more seriously, *Opportunity*'s arm joint heater was always jammed in the 'on' state, forcing engineers to power the rover down into a 'deep sleep' mode each night. In consequence, *Opportunity*'s hardware was frequently exposed to temperatures well below its minimum rated tolerance; how it had survived this treatment remained something of a mystery.

The speaker closed by posing the open question of whether the space industry had learnt from these brushes with fortune, but praised the engineers for their often-ingenious fixes to problems.

Following applause, the meeting broke for tea. The President then introduced the afternoon's second speaker, Prof John Brown, who would be presenting this year's Christmas Lecture. Prof Brown holds a Regius Professorship in Astronomy at the University of Glasgow, and is also the Astronomer Royal for Scotland.

Abra Cad Astra

Prof Brown explained that the theme of his Christmas Lecture would be 'Christmas Crackers'; he presented descriptions of astrophysical explosions on scales ranging from the Big Bang, through the collision of Comet *Shoemaker-Levy 9* with Jupiter, to that of lightning strikes on Earth. These, he interleaved with a show of magic tricks.

He remarked that many of his serious-minded academic colleagues might find his passion for magic somewhat flippant. He thought, however, that there was much of relevance to science which could be learnt from the art – about observation and reasoning, for example. He had observed when performing tricks how much sharper young children's apparently unconditioned eyes could be, as compared to those of adults. He also tried to weave stories around magic tricks to illustrate aspects of physics. By so doing, he could produce memorable analogies to effects such as relativistic length contraction, which could never be demonstrated for real.

Following the applause for Prof Brown's lively and festively-themed mix of astrophysics and magic, the President presented a brief Sky Notes for the month.

The December sky

Dr Miles opened with an update on Nova Cygni 2006 (aka. V2362 Cygni), which had flared in early April. At the last meeting, an anomalous brightening was reported; Dr Arne Henden, Director of the AAVSO, had then predicted that the lightcurve would plateau for a time, but fade within 2–3 weeks. Observations by a number of BAA members had since confirmed this prediction.

Turning to meteor showers, Dr Miles reported that the Ursid maximum would be on December 22. Though this shower normally yielded rates of only around 10 ZHR, Esko Lyytinen and Markku Nissinen had published predictions of an enhanced rate of up to 35 ZHR this year, resulting from the Earth's orbit intersecting a stream of dust laid down by the shower's parent, Comet 8P/Tuttle, 75 orbits ago, in AD 996. The enhanced rate would likely peak at around 19:27 UT, though it might extend from 18:10 to 20:50 UT. The speaker noted that the observing conditions were forecast to be good: the evening of maximum would be Moon-free this year, and the radiant of this shower was at high altitude in the UK sky.

Dr Miles closed by mentioning an exciting comet prospect for early January: 2006 P1 (McNaught), discovered in August. Currently at around mag 5 and 14° from the Sun, it would reach perihelion on January 12, passing within Mercury's orbit and skimming a mere 0.17 AU from the Sun. On the evenings of January 7–9 it would be briefly visible in evening twilight shortly after sunset at around 5pm, positioned vertically above the azimuth where the sun had set, at a similar altitude to Venus, which lay 20° away in azimuth. Given its close approach to the Sun, this could be a spectacular object despite the necessity of twilight observing.

After January 9, the nucleus itself would be too close to the Sun for observation, though it would appear within the field of the LASCO camera on the SOHO satellite. If it grew a substantial tail, however, this might be visible stretching above the western horizon after sunset.

The President then welcomed Dr Stewart Moore, Director of the Deep Sky Section, to present the meeting's final talk.

The winter deep sky

Dr Moore began by defining the 'winter sky'. Though constellations normally associated with summer were still visible in the west at dusk, and those associated with spring were already visible in the east at dawn, he would concentrate upon those which presently transited at around midnight, such as Orion, Gemini and Taurus. Reading the popular literature, one might be forgiven for concluding that the Orion Nebula (M42) was the only deep sky object among these constellations. Dr Moore argued that there were, in fact, many other beautiful but widely-neglected objects on offer; given that he would say nothing further about M42, he conceded that his title should perhaps have been 'The *alternative* winter deep sky'.

The sword of Orion contained an often-ignored string of nebulae apart from M42. Immediately north of M42, and physically associated with it, was M43 – a complex of emission/reflection nebulosity which repaid detailed study. A little further north still, one came to another cluster of nebulae: NGC 1973, 1975 and 1977. These were likewise associated with M42 and actually formed a single continuous whole; Dr Moore explained that the small-field telescopes used in the compilation of the NGC had often hindered the identification of large-scale nebulosity. At the northern end of the sword lay NGC 1981, a beautiful open cluster.

Turning to more challenging targets in Orion, Dr Moore mentioned planetary nebula Abell 12 – easy to find on account of being a mere 1.2' from mag 4 star μ Ori, but very tricky to distinguish from its glare. This nebula was more accessible to CCDs than to visual observers, but in both cases an OIII filter was essential; the speaker showed a recent CCD image by Andrea Tasselli. Despite its fame, the Horsehead Nebula (B33) often disappointed. It too was a highly challenging target, requiring a large aperture – minimum 14" for visual work – good transparency, and Hβ filter. As with Abell 12, it had become much easier to image since the advent of CCDs.

Further north lay M78, a comet-shaped region of both emission and reflection nebulosity, appearing to have two nuclei. It repaid both filtered and unfiltered observation to reveal its emission and reflection components respectively. It had achieved brief fame in 2004 as the site of McNeil's Nebula, though this had now faded from sight. Dr Moore urged members to keep watching this sky region; McNeil's Nebula was previously seen in 1966–'67, and so might recur. He concluded his tour of Orion by briefly mentioning two further bright objects: planetary nebula NGC 2022 and open cluster NGC 2169.

He then moved south to Lepus, a constellation seemingly ignored by many UK amateurs. Though it lay south of Orion, its centre still culminated at 20° altitude, making it accessible from all but the most light-polluted areas. Dr Moore started his tour with M79, a bright globular cluster; at 9' across it was an ideal binocular target. It was midway in concentration and had a bright central condensation.

The Spirograph Nebula (IC 418) was a visually easy planetary nebula. Through a 6" aperture, a disk of 12 arcseconds diameter was visible; through a 24" aperture, signs of mottling began to appear within this. At high power, it was possible to resolve the mag 10 star which lay at its centre. Using an OIII filter, an outer ring was also discernible.

Finally, Dr Moore mentioned open cluster NGC 2017 and carbon star R Leporis, which Hind had described as 'the most intense crimson, resembling a blood-drop on the black background of the sky'. It was a long-period Mira-type variable star, and its colour varied from deep crimson at minimum to a more coppery hue at maximum.

He then turned to Gemini. The most famous globular cluster here was M35, in which more than 150 stars could be counted within a 1° diameter. But the speaker urged members to look also at NGC 2158, less than 30' away, and much more compact on account of being six times more distant. Two open clusters also lay nearby: IC 2157 and NGC 2129; a little further afield was NGC 2266.

Gemini offered two easy planetary nebulae. The Eskimo Nebula (NGC 2392) was well known, but the double object NGC 2371-2 less so. Measuring 55" across, this latter object was larger than Jupiter; it had a bipolar appearance, especially apparent through an OIII filter. The Medusa Nebula (Abell 21) was much more of a challenge; through the speaker's 14" it was discernible but not bright. A final challenge for Gemini was supernova remnant IC 443.

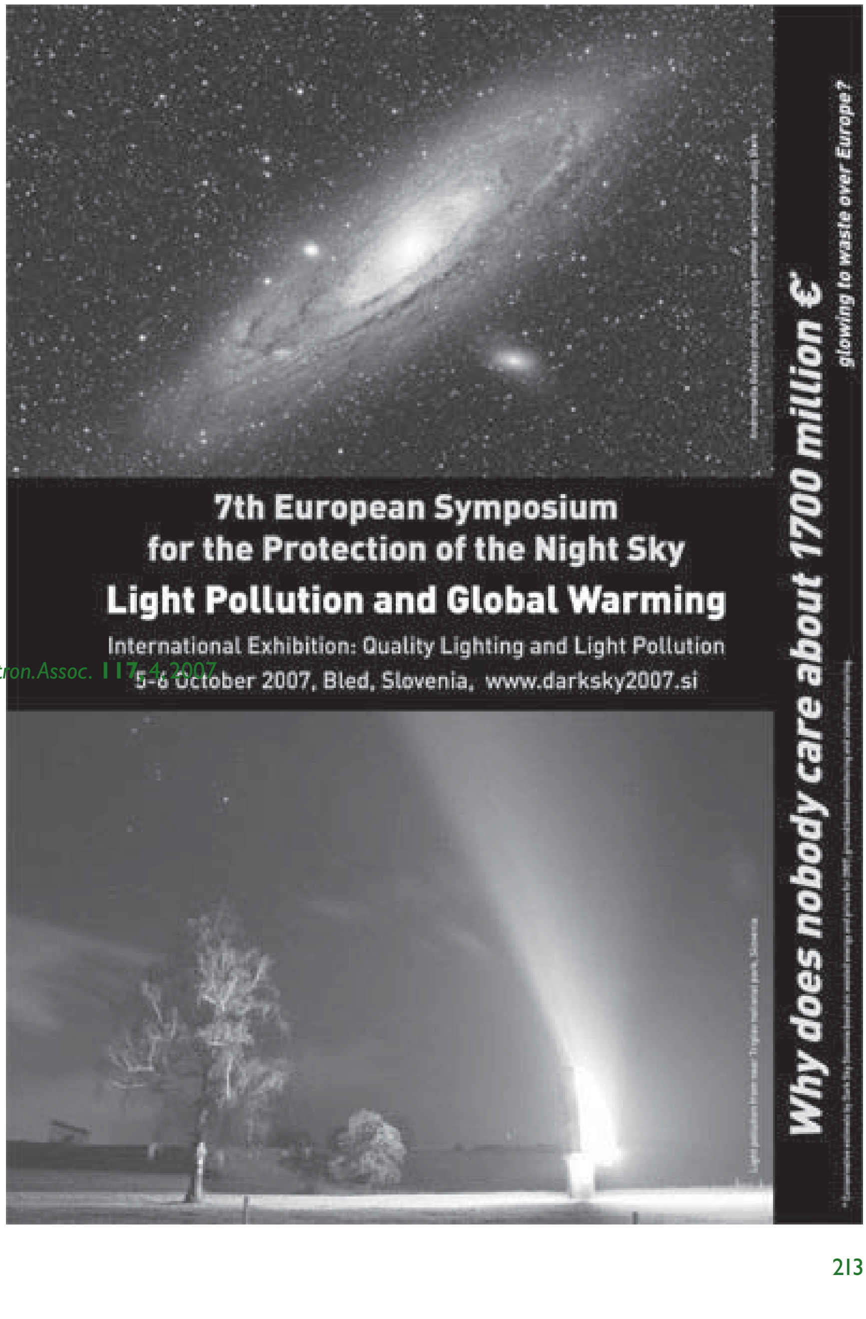
Dr Moore then turned to Monoceros – not a widely known constellation, probably on account of its complete lack of bright stars. It could be found immediately to the east of Orion. Its most famous deep sky offering was the Rosette Nebula (NGC 2237, 2238, 2239, 2246), a vast swath of emission nebulosity, in the centre of which lay the open star cluster NGC 2244; this was a site of very recent star formation. Its most appealing open cluster was M50, a grouping of 50+ stars within a 15' diameter. Visually, it appeared arrow shaped. Monoceros was also home to Hubble's Variable Nebula (NGC 2261), a bright and easy patch of emission/reflection nebulosity, varying in both brightness and structure on timescales of months.

The speaker concluded his talk with Taurus – home to M1 and M45, but also to some lesser-known objects. The Hyades (Mel 25) were an appealing sight through binoculars, more so than through a telescope – it was nice to see this large cluster with its surrounding field.

Dr Moore closed by remarking that December 14 had been the 200th birthday of the Revd Thomas William Webb (1806–1885); Webb was one of the first popularisers of astronomy, and the modern-day Webb Society was named in his honour.

Following applause, the President adjourned the meeting until 2007 January 31 at the present venue.

Dominic Ford



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