Meetings

Ordinary Meeting, 2006 January 25

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 116th session, and invited Mrs Hazel Collett to read the minutes of the previous meeting, which were approved by the members. Mr Ron Johnson, Business Secretary, reported that no presents had been received. Dr Miles announced that 69 new members were proposed for election; he then put to members the election of the 80 who had been proposed at the December meeting, and, this being approved, declared them duly elected. He invited any newcomers to introduce themselves to him after the evening's talks. Mr Nick James, Papers Secretary, said that one paper had been approved by Council for *Journal* publication:

> *Measurement of the orbital and superhump periods of the eclipsing cataclysmic variable SDSS J170213.26+322954.1,* by David Boyd, Arto Oksanen & Arne Henden

Dr Miles said that the next Ordinary Meeting would be held with a Special General Meeting on March 22 at the present venue. Before then, the seventh in the Association's series of Observers' Workshops would take place at the Open University in Milton Keynes on February 25, concentrating on solar and lunar observing techniques. There would also be a meeting of the Deep Sky Section on March 4.

The President then welcomed the evening's first speaker, Mr Martin Mobberley, to present his Sky Notes.

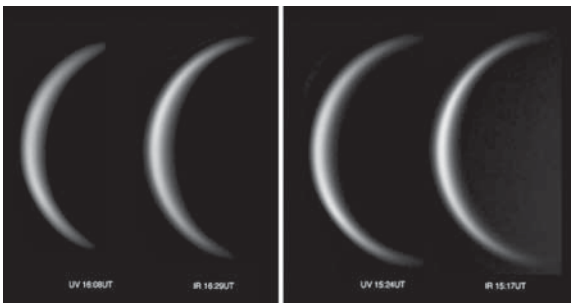
The January sky

Mr Mobberley opened by noting that, during the meeting, Saturn and its rings would occult the magnitude 7.9 star BY Cancri, although the planet would be at a low altitude during the interesting early passage behind the rings. Hazel McGee had discovered a Near Earth Object (2006 AT3) after downloading and checking over four thousand CCD frames from the Kitt Peak Spacewatch telescope. This was the third UK success using this public outreach facility, the first two being by Ken Pavitt and Roger Dymock.

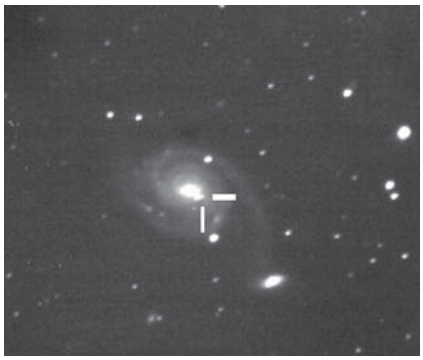
Moving on to planets, Mr Mobberley said that Mercury would make a favourable appearance in the evening sky around Feb 24, and he showed some fine crescent Venus images taken in December by BAA member David Arditti. Venus was now moving into the evening sky. Despite Mars still being below 10 arcseconds in size Damian Peach continued to secure high resolution images of the red planet. Saturn was especially well placed in the January evening sky and Mr Mobberley urged members to watch the ringed planet on opposition night, in two days time, when the rings should appear very bright due to the Seeliger effect. Saturn would be travelling through the lower half of the Beehive Cluster over the coming weeks which should make a nice photo opportunity.

Jupiter was now observable again in the dawn sky, although it was painfully low. However David Arditti had persevered with the planet from his Edgeware location and obtained some images in the last few weeks. In Japan Hideo Einaga had discovered a new mid-SEB outbreak of white spots which was a development well worth following.

Moving on to comets, a new one had been picked up by the ASAS patrol team and had been named after its discoverer Grzegorz Pojmanski, of Warsaw University. 2006 A1 (Pojmanski) had a similar orbital path to that of the famous Comet Bennett in 1970 but, unlike Bennett, would most probably not be a spectacular object by the time it came into northern skies. Comet 2005 E2 (McNaught)



Images of Venus by David Arditti, Edgeware, Middx. *Left:* 2005 December 25; *right:* 2005 December 28. 254mm Dall–Kirkham Cassegrain with Philips Toucam webcam, UV and IR filters.



Supernova 2006A, discovered by Tom Boles in NGC 7753 at 2006 January 02.856.

was still reasonably bright, at around magnitude 10, but very low in the SSW evening sky. A Centaur asteroid, similar to the famous object 95P/Chiron had been seen with a coma recently and thus would almost certainly be designated as a periodic comet. The object, 2000 EC98, was currently magnitude 14 in Virgo, despite being 13 AU from the Sun. Mr Mobberley drew members attention to comet 73P Schwassmann–Wachmann, currently 16th magnitude with an 18th mag fragment accompanying it. From the audience Jonathan Shanklin pointed out that this comet would be making a very close passage to the Earth in May, and some estimates predicted the largest fragment could be 6th magnitude in our skies at that time. Mr Mobberley also expected 41P Tuttle–Giacobini–Kresak to rapidly brighten into amateur CCD range in the next month or two.

Mr Mobberley was pleased to announce that three more UK supernovae had been discovered since the last meeting, two by Tom Boles and one by Mark Armstrong. Tom had bagged the prestigious SN 2006A, the first supernova of the New Year, and was now only five away from his 100th discovery. Only two other individuals had their names associated with more supernovae in the IAU listings, namely the legendary (if abrasive) Fritz Zwicky and the US amateur Tim Puckett, who had just overtaken Zwicky's total of 123 discoveries.

Moving on to asteroids, Mr Mobberley showed recent images by Maurice Gavin of Juno and Vesta, as well as an image and light curve of the BAA's own asteroid 4522 Britastra, secured by the President, Richard Miles. He also pointed out that asteroid 3697 Guyhurst would reach opposition around the start of April. Mr Mobberley then showed some results from last July's Charon occultation in which a team from Paris had measured the diameter of Pluto's satellite as roughly 604kms. Andrew Elliott had successfully recorded an occultation of a star by 134 Sophrosyne on Dec 27. Finally, Mr Mobberley looked ahead to March when there would be a deep penumbral eclipse of the Moon and a total eclipse of the Sun. Many BAA members were heading for the region of totality which would cross Libya, the Mediterranean and Turkey on March 29.

Following applause, the President invited Dr Chris Lintott of University College London to present the evening's second talk. Dr Lintott was a long-standing member and former Council member of the BAA, who would be a familiar face to many from his frequent appearances on the BBC's *Sky at Night* television programme. His talk would review the latest developments in cosmology.

Cosmology: into the unknown

Dr Lintott began by asking - How old is the Universe? What will be its future? He went on to describe the so-called Standard Model and how differences from this could lead to a very different universe in the distant future. Recent observational studies appeared to show departures from the standard model, but more evidence was needed to be able to predict how the universe will evolve. (It is hoped to present a fuller summary of Dr Lintott's authoritative contribution in the *Journal* in due course).

Following several questions, Dr Miles thanked Dr Lintott for his dynamic and lively talk, and introduced Mr Doug Ellison to speak on the Mars exploration rover *Spirit*.

The *Spirit* Mars rover: an update

Doug Ellison began his talk by showing a cartoon that compared *Spirit* to the 'Energiser Bunny', explaining that despite being designed for only 90 Martian days of operation, *Spirit* was still alive and conducting science after 734 sols (martian days).

As part of NASA's Mars Exploration pathway of 'Follow the Water', *Spirit* was launched in the summer of 2003 toward Gusev Crater, a 150km wide feature that appeared to have acted as a lake in the distant Martian geological past; so in essence, *Spirit* landed on an ancient lake bed.

The speaker apologised to those who had not seen his talk in April 2005, but for brevity, and using what he called a 'road trip movie' of frames taken by *Spirit*'s front hazard avoidance camera, he mentioned brief highlights of the first 400 days of *Spirit*'s traverse from its landing site, to a nearby crater called 'Bonneville' and then 2.5km across the surface toward a set of hills called 'Columbia' and its tallest peak named after the commander of the lost Space Shuttle crew – Rick Husband.

Spirit found little evidence of the ancient water for which it was searching, until arriving at the foot of 'West Spur' which juts out from Husband Hill. Low on power and with struggling mobility, *Spirit* slowly crawled its way to the top of West Spur, and by Sol 400 had reach an outcropping of rock called 'Larry's Lookout' where instruments showed the rocks to contain minerals that usually form in water, particularly Haematite and Goethite. At this point, a remarkable series of wind gusts cleared *Spirit* of much of the dust that had covered its solar arrays. From about 800 watt hours of power at landing, power levels had dipped as low as 300 watt hours before these cleaning events returned power to more than 700 watt hours and saved the mission.

The speaker then took the audience through the drive toward the summit of Husband Hill, alternating between the stunning panoramas taken by *Spirit* at several points en route, and short driving movies that linked them.

By Sol 530, *Spirit* had reached the summit, and Mr Ellison tried to demonstrate the resolution of the panorama that was taken by explaining that it would require 32 of the largest computer displays available, or 3 Imax screens to show it at its full resolution.

To laughter from the audience, the speaker then suggested that *Spirit* might form member 0001 of the 'Mars Astronomy Association' and would be an active participant in

Part of a 360-degree panorama recorded by the Spirit rover from the top of 'Husband Hill' in early October 2005. *NASA/JPL.*

the Lunar, Deep Sky and Meteor sections, showing images that had been taken with the high resolution 'Pancam' of Phobos and Deimos, the Orion Nebula, and possible meteor trails by virtue of the large power surplus that allowed *Spirit* to operate on fully charged batteries late into the night.

The audience then donned the anaglyph glasses with which they had been issued, and were shown stereo images that showed the 'Hillary' outcrop at the absolute summit of Husband Hill, and a stereo image generated from orbital imagery that showed the planned route from the summit to an large raised, flat, light coloured feature that scientists had called 'Home Plate' half a mile south of the summit, and through a series of route maps, the speaker showed the route *Spirit* had taken to a point approximately half way to Home Plate, finishing with imagery taken at 05:19 am on the morning of the meeting.

The speaker then highlighted the longevity and scientific productivity of *Spirit* by comparing the design specification of 90 Sols, 600 metres driving and 1 full panorama, to its achievements at the time of the talk of 734 sols, 6096 metres, and 12 panoramas. He then took a map of central London, and by way of transposing the route that *Spirit* had driven demonstrated that it had, by pure chance, covered a route that would have taken it from the former BAA meeting venue of the English Heritage Lecture Theatre, to the new venue at King's College.

Before concluding with a beautiful image of a Martian sunset and the strange fact that terrestrial skies are blue with red sunsets whilst Martian skies are red with blue sunsets, Mr Ellison reminded the audience that *Opportunity*, *Spirit*'s twin rover, had been operating for just as long and been even more productive scientifically on the other side of the planet, and hoped he would see many of the members at the Out of London meeting in April when he would be talking on 'Eagle, Endurance and Erebus: *Opportunity* at Meridiani Planum'.

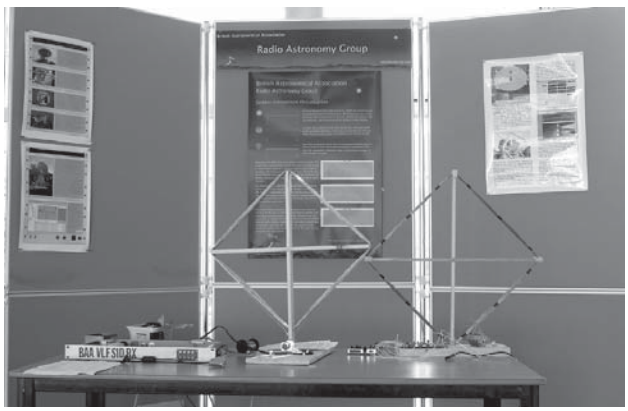
After the applause for Mr Ellison's enthralling account, the President adjourned the meeting until 2006 March 22 at the same venue.

Martin Mobberley, Doug Ellison & Hazel McGee

The 7th BAA Observers' Workshop

The 7th BAA Observers Workshop took place at the Berrill Lecture Theatre of the Open University on 2006 February 25, covering the topics of solar and lunar observing. Speakers were Nick James, Alan Wells, Kevin Smith and Laurence Newell.

Right: Drawing the Moon, with Nick James; lunar sketch by Gary Poyner.
Bottom right: Hazel Collett and Nick James set up a viewing session with the Faulkes Telescope on Hawaii.
Below left: observing the Sun with a hydrogen-alpha telescope;
Bottom left: Display by the Radio Astronomy Group. *Photos by Kevin Smith.*



Ordinary Meeting, 2006 March 22

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

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

Dr Miles opened the fourth Ordinary Meeting of the 116th session, and invited Mrs Hazel Collett, Meetings Secretary, to read the minutes of the previous meeting, which had taken place at the seventh Observers' Workshop in Milton Keynes in February. These were approved by members and duly signed. Before moving on, the President commented that the proceedings of that meeting had included half an hour of observing time booked on the Faulkes Telescope in Hawaii. In the event, the intended observing slot had been clouded out, but the telescope operators had offered to place a 30-minute observation request into an offline queue as compensation. A raffle had been held at the meeting to choose a target, but a month on, it seemed that the weather in Hawaii was still poor, and so the Association's request was still awaiting telescope time.

84 new members were proposed for election; the 69 who were proposed at the previous meeting were approved by members and declared elected. The President invited any new members in the audience to introduce themselves to him at the end of the meeting. Mr Nick James, Papers Secretary, announced that six papers had been approved for publication in the *Journal*:

The Iapetus magnitude puzzle, by Edward Ellis;
Flaring in the dwarf nova V1316 Cygni, by Jeremy Shears, David Boyd & Gary Poyner;
The lightcurve of (150) Nuwa, by Fiona Vincent;
Insights into enthusiasm: the 1897–1898 Venus notebooks of P. B. Molesworth, by Richard Baum;
CCD photometry and visual observations of V1663 Aquilae (Nova Aql 2005), by David Boyd & Gary Poyner;
BAA Instrument no. 93, by R. A. Marriott.

The next Ordinary Meeting would take place in Liverpool, during the Out of London weekend, to be held on April 21–23 in association with Liverpool Astronomical Society. The weekend's programme would include, amongst other distinguished speakers, two talks by Dr Allan Chapman. In the meantime, the Winchester Weekend, this year celebrating its 40th anniversary, would take place on April 7–9. The Alfred Curtis Memorial Lecture, now in its 30th year, would be given by Dr John Mason.

The President then invited the evening's first speaker, Martin Mobberley, to present his regular Sky Notes. Before handing over, Dr Miles remarked that Mr Mobberley had recently given notice of his intention to step down from the job of giving these talks after the Exhibition Meeting in June. His ability to mix lively banter with an authoritative guide to the sky would be a hard act to follow, and so instead of looking for a permanent replacement, the President planned to arrange for a series of volunteers to present their own sky diaries at future meetings; any interested members were invited to get in touch.

The March sky

Mr Mobberley recalled that the Sky Notes at meetings had a long history, dating back to the 1950s, and that Sir Patrick Moore had presented them at one time. He himself had given his first presentation in November 1990, at the suggestion of Mrs Hazel McGee, then Meetings Secretary. He could hardly have imagined back then that he would still be giving regular presentations sixteen years later. He had retired from the job on becoming President in 1999, but Guy Hurst had persuaded him to make a return in 2002 for the duration of his own Presidency. Having now served through Tom Boles' Presidency also, he felt it time to pass the buck on, and to see what hidden talents lay among the membership.

This month, he opened with a report of recurrent nova RS Ophiuchi's recent outburst, discovered visually at mag 4.5 by Japanese observers Kiyotaka Kanai and Hiroaki Narumi on February 12. This was an unusual object, one of only seven novae which had ever been observed to recur. RS Oph's previous outbursts had been in 1898, 1933, 1958, 1967 and 1985, and so, after 21 years' wait, another had been widely anticipated, although its timing had not been predictable in advance. The first known BAA observation of the new outburst had been by Gary Poyner on February 15, through cloud breaks and a bedroom window. As an indication of what the latest outburst might do in coming weeks, Mr Mobberley added that the 1985 event had faded at a rate of 0.1 mag/day for its first 38 days, then returned more slowly to its normal brightness over a period of 3–4 months.

Looking further back through recent events, January 25 had seen the occultation by Saturn of mag 7.4 star BV Cancri; a few observers had imaged the merger of the two objects, though the speaker was not aware of any animations or videos. Generally the huge difference in brightness of the two objects had reduced this event's visual appeal.

Turning to the planets, Venus' present apparition was shortly to climax with its reaching dichotomy – i.e. half phase – in the morning sky on March 26. The circumstances of this apparition were not ideal: at this time of year the ecliptic was so oriented that the maximum solar elongation of Venus would be a little under three hours of RA, placing it rather low on the horizon in morning twilight. The speaker paused briefly to show a pleasing gallery of images by David Arditti of Venus' thin crescent from late January and early February.

Saturn had passed opposition on January 27, and the speaker showed a selection of this year's images. Many observers had noted a bluish tint to the northern polar region. Dave Tyler had captured an image on the exact night of opposition, January 27, and

Special General Meeting, 2006 March 22

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 2006 SGM and invited Mrs Hazel Collett, Meetings Secretary, to read the minutes of the previous year's meeting. After these had been approved and duly signed, the President invited Dr David Boyd, Treasurer, to address the meeting. Mr Boyd reported that the finances of the Association were, in the view of Council, in a healthy state, despite a continuing rise in operating costs. In order to ensure that the Association's finances remained this way, however, Council had proposed a rise in the annual subscription rate for Ordinary Members by £2 for the 2006–'07 session to £39; members paying reduced subs rates would see a pro-rata rise. The Treasurer proposed this motion to the meeting, and it was duly seconded and passed.

There being no further business, the President closed the SGM, and the fourth Ordinary Meeting of the 116th session followed.

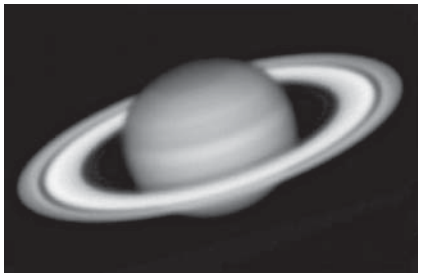
Dominic Ford

had observed the rings to brighten quite dramatically for a brief time. This phenomenon, known as the *Opposition Effect,* had been discussed around the time of the previous opposition[1] – it was essentially a result of the near alignment of our line of sight with the direction of the Sun's rays. Tyler's image of the effect this year showed exceptionally brilliant rings, with the planet appearing rather dull behind; the speaker compared its grey appearance to that of a potato. Mr Mobberley closed with an animated series of frames by Damian Peach from the night of March 14–15. The passage of white spots across the surface in the Southern Tropical Zone showed clearly the rotation of the planet.

Mars' disk continued to shrink ever smaller following its close approach of October 2005; in April its diameter would fall below 5 arcseconds. For those whose interest was not deterred by this, it could be found in Taurus and would cross eastward into Gemini on April 14 before passing about one twin-separation to the south of Castor and Pollux in late May. Damian Peach had continued to produce some impressive images in recent weeks, of which the speaker showed a selection. He closed with a fine animation of Mars' rotation by Dutchman Richard Bosman, constructed from a compilation of Bosman's best images. All of these frames had been taken with a Celestron C11, although the motion of the moons with respect to the planet had been superposed by software.

Jupiter was now observable again after passing through solar conjunction in 2005 October, but this year's would be a very southerly apparition at around −15° declination. For comparison, Spica was at −11°, so it was clear that Jupiter would be very low indeed in the southern sky.

Quoting from John Rogers, the speaker gave a brief account of surface activity to watch out for. In the South Equatorial Belt (SEB), an outbreak of activity discovered by Hideo Einaga in 2005 December was still vigorous. In the North Equatorial Belt (NEB), white spot Z was moving even faster than in previous years. Preceding it, a merger of two dark 'barges' was taking place, the fourth such event to have been seen preceding Z in as many years. Perhaps most exciting of all, Oval BA had been reported by several observers recently to appear unusually red in colour. It was now the only remaining great oval in the South Temperate Region, and it would be interesting to see whether this colour persisted. The oval had been around since 2000, and by Jovian standards, six years was an exceptionally long time for a feature to persist. No one knew how the Great Red Spot (GRS) had formed, and some were asking whether Oval BA might be turning into a new spot. Certain parts of media were already claiming this, as the speaker showed in a recent Science@NASA article.[2] If this were true, Oval BA might tell us something about the history of the GRS.



Saturn at opposition on 2006 January 27, imaged by Dave Tyler. Note the brilliance of the rings compared with the globe of the planet.

Comet C/2006 A1 (Pojmanski) imaged on 2006 March 5 between 04:45 and 05:30 UT. 8 separate 1-minute exposures stacked in *Photoshop*. 127mm f6 refractor with ST2000 CCD. *Eddie Guscott*.

Mr Mobberley briefly paused his tour of the sky to express the gladness with which he received the news of Sir Patrick Moore's swift return to health after having an operation earlier in the month to have a pacemaker fitted, as the media had widely reported. Sir Patrick had been taken ill only days after a lavish celebration at his Selsey home in honour of his 83rd birthday.

Turning to comets, there was rather a lack of good observing prospects at present. Over the past few months, C/2006 A1 (Pojmanski) had been observed by many; it had been discovered at mag 13 on January 2 by Grzegorz Pojmanski of the Warsaw University Astronomical Observatory in images from the *All Sky Automated Survey* (ASAS) – a robotic f/2.8 telephoto lens situated in Las Campanas, Chile, and managed by Pojmanski. At perihelion on February 22, 2006 A1 had approached naked-eye visibility at mag 5, but had now faded to mag 7, and the speaker estimated that it would sink below mag 11 by the end of April. The comet's orbital plane was inclined at i=93° to the ecliptic, meaning that its orbit now carried it rapidly northwards. It remained primarily a morning object for the time being, but was fast becoming evening-observable also.

Comet C/2005 E2 (McNaught) had also recently passed perihelion in late February, though it had been somewhat fainter at mag 9. In Aries, it was still just about observable in evening twilight given a low western horizon.

Looking ahead, the return of 73P/Schwassman–Wachmann – not to be confused with comet 29P of the same name – was an exciting prospect. 73P was known to be breaking apart, and to have already shed half a dozen fragments. This stream of debris would pass the Earth in late April and early May, and over this period, several large fragments would approach the Earth to varying degrees of closeness. The stream itself would make closest approach, passing within 7 million miles of the Earth, on May 12. When, in 1930, it had passed only fractionally closer than this, a meteor shower of fragments had been seen, and Mr Mobberley wondered whether such a show might be repeated. 73P itself would peak at approximately mag +5, but show a very diffuse coma of ~30"; the speaker recommended the use of a telephoto lens or binoculars rather than a telescope to observe it.

Presently 5° south of Arcturus in Boötes, 73P's nucleus would pass through Corona Borealis, Hercules and into Lyra over the next five weeks. A photographic challenge would come in the early hours of May 8, when fragment 'C' of the debris stream would pass within about 5' of the Ring Nebula (M57), potentially making a photogenic combination.

Turning to UK supernova patrolling, Tom Boles had discovered four events in as many days earlier in the month: SN 2006ao on March 1, 2006ap on March 2, and 2006aq and 2006ar on March 5. These brought to 99 his tally of discoveries; Mr Mobberley wondered when he would make his century. Though not a UK discovery, the speaker also mentioned SN 2006X in M100, discovered independently by Shoji Suzuki of Japan and Marco Migliardi of Italy on February 4. Supernovae in Messier galaxies often seemed to be picked up by amateurs rather than professional patrollers, as had happened on this occasion; presumably this was simply because these galaxies were so well observed. 2006X was the sixth supernova to have been

seen in a Messier galaxy since 2000, and the fifth in M100 since 1900. Given the brightness of its host galaxy, 2006X was recommended as a comparatively straightforward target for amateur imaging.

The period April 19–25 would bring the Lyrid meteor shower, for which the Moon would be in a favourable waning crescent phase. This shower typically produced rather meagre rates of around ZHR 10; in practice 6–8 meteors might be observed per hour in dark skies. However, in compensation, they did produce a fair abundance of bright events with lingering ionisation trails.

To close, the speaker mentioned the forthcoming total solar eclipse, which would be visible across central Africa and Asia on March 29. Greatest eclipse would be seen in Libya at 10h10 UT, lasting for 4m07s. From the UK a modest partial eclipse would be seen, reaching a magnitude of just under 30% in the far south-east, but barely reaching 15% in north-west Scotland. An Explorers' Tours expedition would be observing from a site in Libya close to the point of maximum eclipse, combining the spectacle with a weeklong Mediterranean cruise.

Following the applause, the President added to Mr Mobberley's comments on Sir Patrick Moore's health that he had sent a card to Sir Patrick at the time of his operation on the behalf of the Association. Sir Patrick had asked him to extend his warmest thanks to the membership for the many kind words of support that he had received from them in recent weeks. The President then invited Dr Stewart Moore, Director of the Deep Sky Section, to present the evening's second talk.

Seven nights on a bare mountain

Dr Moore reported that he had recently travelled to Tenerife with Owen Brazell to spend seven days observing in the Teide National Park between 2005 October 30 and November 6. He started by outlining some of the island's attractions for prospective astro-tourists. Being a popular tourist destination, it had cheap and abundant transport links; low-cost airline Ryanair served it, for example, albeit not directly from the UK. At 3,718m above sea level, the volcano Mount Teide yielded very clear skies. And being situated 23° to the south of the UK's latitude brought further attractions. Many more of the southern constellations were visible from Tenerife compared to our native skies, and in the summer, the skies were considerably darker: even in June, Tenerife saw 90 minutes of true astronomical darkness each night, whilst the UK saw none between mid-May and late July.

The attractions to the astro-tourist extended beyond the astronomical, the speaker added – the island's volcanic geology was truly fascinating to see. Geographically, Tenerife was the largest of the seven Canary Islands, an archipelago off the north-western coast of Africa, owned by Spain. The islands remained actively volcanic to this day, and Tenerife's landscape was dominated by the towering heights of Mount Teide. Though presently dormant, it had erupted as recently as 1909.

Owen Brazell with the 622mm Dobsonian.

Teide's attractions as an observing site had long been recognised by the professional as well as amateur communities; the history of its use by astronomers could be traced back to an 1856 expedition by Charles Piazzi Smyth, then Astronomer Royal for Scotland, to make experimental observations to test the supposed benefits of mountain-top observing. Smyth had tested the seeing conditions using double stars, and over the three months of his investigation, concluded that observations were possible in Tenerife which were quite incomparable to anything he had ever achieved in Edinburgh. Systems which he had found utterly irresolvable in Edinburgh became trivially separable in Tenerife. Smyth had gone on to assert that the limiting magnitude of his 18cm refractor had been extended from mag 10 in Edinburgh to mag 14 in Tenerife. Ever since Smyth returned his favourable reports, astronomy continued in the Canaries; Tenerife was now home to the extensive *Observatorio del Teide*, and meanwhile the neighbouring island of La Palma hosted the better-known Isaac Newton Group (ING) of telescopes, including the 4.2m William Herschel Telescope.

The volcanic cone of Mt Teide towers over Tenerife.

Describing his own trip, the speaker explained that he had stayed at the Parador Hotel, at an altitude of 2,000m above sea level, which had a selection of telescopes in a back shed, which the owners allowed experienced observers among their clients to use on occasion (contact details would be given at the end of the talk). The hotel presently housed a 24½" [622mm] f/4.4 Dobsonian with high quality optics by AE Optics/Jim Hysom, and a 10" [250mm] f/6 Newtonian; there were plans to extend this collection. The Dobsonian was a huge instrument, but had no drives or setting circles, and so required a user who could star-hop. A large stepladder was needed to remove the lens cap, and some care was required; it had been unusable on one of the nights of the visit due to high winds making it impossible to use the ladder. A second night was lost to cloud, but five nights of very fine observing had been possible. Dr Moore's only other complaint about the instrument was that it was kept in a rather warm shed in the daytime, and the optics had taken a long time to cool to a stable temperature.

Seeing the observing site, the speaker had initially been concerned to see the peak of Teide towering above him to the east; it seemed to block a substantial portion of the sky. In the event this had not been much of a problem; being in the east, one simply had to wait for objects to rise over the obstruction. Light pollution was minimal, bar a few car headlights coming up the mountain pass. Low altitude cloud layers forming below the hotel were helpful in blocking light from the sea-level tourist resorts below. Generally, the most annoying source of light pollution was Sirius, appearing as a giant beacon in the sky. The speaker had placed the na-

ked-eye limiting magnitude at ~6.0 on most of the nights of his stay, sufficient for Uranus to be a naked-eye object, though a bit disappointing in contrast to the mag 6.7–6.8 limits which he had experienced on past trips to the neighbouring island of La Palma.

Dr Moore than described the range of objects which he had been able to observe. Giving an overview of the parts of the sky accessible from Tenerife in November, Scorpius, Sagittarius and Corona Australis had all been early evening constellations, meanwhile Leo and Hydra were among those which rose later in the night, as dawn approached. He remarked that Sagittarius was not a constellation that one associated with northern November skies, but it had been quite observable at a latitude of 28°N; this rich part of the Milky Way was an exceptional sight in such dark, steady skies.

Of the 83 objects which he had observed, a few stood out especially, perhaps the Orion Nebula (M42) most of all. Through such a fine telescope, it had possibly appeared even more beautiful to the eye than John Herschel's drawings implied. The detail accessible in the Veil Nebula (NGC 6960, 6979, 6992, 6995) was stunning; sweeping the telescope around, nebulosity appeared everywhere. The speaker wished he had been able to sketch its whole extent, but that would have proven very time consuming.

The Horsehead Nebula (Barnard 33) had also stood out as a remarkable sight, especially with the use of an H filter. Turning the Dobsonian to the Fornax galaxy cluster, eleven galaxies simultaneously fitted into its field of view; the speaker never recalled having seen so many galaxies in a single field before.

To sum up, Dr Moore concluded that this had been a very rewarding trip, albeit not especially cheap – the final cost had been £734 per person. He felt on balance that this had not been an unreasonable price to pay for the observations he was able to make. He recommended the Parador Hotel to any members who might be interested in following in his footsteps; the big Dobsonian was potentially available to experienced observers on application to Rod Greening,[3] although some evidence would be required that users knew how to handle such an instrument. The speaker's observations had, out of preference, been entirely visual, but those wishing to bring their own photographic equipment would also be welcome.

The President thanked Dr Moore for his account, and then introduced the evening's final speaker, Dr Serena Viti of University College, London. Dr Viti's research interests included astrochemistry, the modelling of the clumpy nature of interstellar gas, and ultimately, the formation of stars from those clumps. Tonight, she would be talking about recent ground-breaking observations of low-mass stars.

Low mass stars, brown dwarfs and hot Jupiters

Dr Viti opened with an apology that hers was not a field which could yet produce nice images; the objects she would be describing were too faint to be meaningfully imaged. Yet she would be arguing that even without images, a tremendous amount had been learnt from such objects in the past decade, and that there were exciting prospects for the future.

The primary subject of this talk would be low mass stars (LMSs), defined as those stars of around half the mass of the Sun or less. Apart from their mass, their next most obvious feature was that they were much cooler than larger stars, typically having surface temperatures no higher than 3,500K. For comparison, the temperature of the Sun's surface was 6,000K. Their core temperatures were also correspondingly lower, reducing the rates of nuclear fusion within them. This slowing of the nuclear reactions was so significant that it actually took LMSs longer to exhaust their fuel supplies than more massive stars, even though they had less of it to 'burn'. In other words, lower mass stars lived for much longer than more massive stars. In fact, lifetimes of LMSs were so long that they were longer than the present age of the Universe, and, to good approximation, it could be said that every LMS that had ever formed was still in existence. At the same time, LMSs were very faint, on account of their low surface temperatures, and this explained why they were so notoriously difficult to detect.

Brown dwarfs, the second class of objects in the speaker's title, were a subclass of LMSs – those which were insufficiently massive to fuse hydrogen nuclei at all – their core temperatures were too cool for nuclear reactions to take place. According to theories of stellar structure, stars with less than ~8% of the mass of the Sun (85 Jupiter masses) were expected to fall into this category. Their existence had been theorised since the 1960s, and it had even been proposed that all of the dark matter in the Universe might be made up of these cold, faint stars. It had since become clear, though, that a population of brown dwarfs so numerous to explain all of the dark matter in the Universe would be quite conspicuous by its sheer size, and the observational fact was that there had been no confirmed detection of a brown dwarf until that of *Gliesse 229B* in 1994.

Some considered the use of the term 'star' as applied to brown dwarfs to be inappropriate, feeling that only hydrogen-fusing bodies should be called 'stars'. The use of the term 'dwarf' was fairly uncontroversial; the speaker thought that 'failed stars' was a fairly accurate label.

The third and final class of objects that the speaker would be talking about were so-called 'hot jupiters' – Jupiter-like gas giant planets in orbit around stars other than our own. Though they might appear unrelated to LMSs, the speaker explained that their relevance to this talk was that observationally they were very difficult to distinguish from brown dwarfs. Being planets, hot jupiters did not shine appreciably in their own light, and orbited around parent stars. But if a brown dwarf were to be found in orbit around a larger companion star, it too would share these characteristics. Brown dwarfs did shine with a small amount of their own light, but this was also true of Jupiter itself. Moreover, the two classes of object were physically of near-identical size. Their surface temperatures were their only difference – 900K and under for hot jupiters, as compared to 1,800K or more for brown dwarfs – but in such cold, faint objects, temperature was difficult to measure.

Dr Serena Viti *(UCL)*

Clearly there were many motivations for wanting to understand the processes of planet formation, central to the questions of how our solar system came to be, and what proportion of other stars might host similar planetary systems. This indirectly presented one reason for studying LMSs: we needed to find ways of distinguishing them from planets. Lacking, as we did, any easy means of distinguishing these two classes of object at present, the number of extra-solar planet discoveries which had been reported to date – around 150 – was really an upper limit; some of these objects might not be planets at all. And, whilst planets and brown dwarfs might *look* alike, we could not pretend that they were not fundamentally different objects. From a theorist's viewpoint, they were very different, because they formed in different ways. Whilst planets formed by the clumping together of material in planetary discs around stars, brown dwarfs formed like stars, from the collapse of clumps of interstellar gas. Theorists wanted to understand the workings of these two processes in separation.

The speaker did not want to suggest, however, that her field of study was only of interest as a source of contamination in another field: on the contrary, there were many reasons for wanting to understand the properties of LMSs themselves. Because of their long lifetimes, and the slow nuclear reactions within them, any LMSs which had formed in the very early Universe would still exist today, and be composed of relatively pris-

tine primordial material. Thus they had potential in the future to provide an insight into the evolution of the chemical makeup of the Universe.

Another consequence of their long lifetimes was that they were expected to be quite pervasive, and so lock up a considerable proportion of a typical galaxy's mass. As mentioned earlier, this could not account for all of the dark matter which was known to exist, but the gravitational contribution of a large population of brown dwarfs might still be sufficient to make a difference to a galaxy's dynamics.

Turning to the process of star formation – the collapse of interstellar gas clouds to form stars – here, also, the speaker believed LMSs to have a contribution to make. Within modern astrophysics, the so-called 'initial mass function' – the distribution of masses of newly formed stars – remained a matter of contention. No theory could yet predict its form, but observations broadly suggested that lower mass stars formed much more frequently than their higher mass counterparts. Given the comparatively small number of known brown dwarfs – none up until 1994 – it was not yet clear to what extent this trend continued down to brown dwarf masses. The speaker's suggestion was that the trend was likely to continue down to some critical minimum mass, below which stars could no longer form. If that prediction turned out to match observation, the critical switch-off mass would be a parameter for which theorists could hope to find some physical explanation, as a first step towards the greater question of why stars formed with the range of masses that they did.

As a final motivation for studying LMSs, Dr Viti added that the environment in their vicinities might be curiously well suited for the development of life. Although such stars were very cool, an Earth-like planet in a close orbit could still be warm enough to become habitable. Given the long lifetime of the parent star, there would be ample time for lifeforms to develop. With this in mind, it was proposed that when the European Space Agency came to launch its *Darwin* probe – a specialist instrument for searching for terrestrial planets, presently planned for 2015–'20 – LMSs should be amongst the stars it would study.

The speaker then turned to discuss the challenges faced in trying to observe LMSs – essentially that of their sheer faintness, but compounded because such cool objects emitted the bulk of their light in the infrared, rather than at visible wavelengths. Though technology did now exist to observe in the infrared – for example, the United Kingdom InfraRed Telescope (UKIRT) in Hawaii – it was comparatively new, and poor atmospheric transparency remained a plague at these wavelengths. In any event, it was impossible to know anything about objects outside of the immediate neighbourhood of the Sun, as their faintness severely restricted the distance out to which they could be seen.

Measuring the surface temperatures of LMSs was vital, both to estimate their masses, and, as mentioned earlier, to distinguish them from planets. The blackbody spectra of such cool stars peaked well into the infrared, rendering their visible colours rather insensitive to temperature. Infrared spectra could only be taken from space, but here, astrochemistry came to the rescue. The atmospheres of these stars were sufficiently cool that some simple molecules did not dissociate, but could survive for long periods. These gave rise to a plethora of absorption lines in the spectra of LMSs, in contrast to the relatively featureless spectra of hotter stars. The exact details of which molecules were present, and which spectral lines were seen, was remarkably sensitive to temperature – typically a change of 50K produced a complete change in the line features of a spectrum. Understanding how to relate this chemistry to temperature was a hugely difficult task, but potentially, a lot of information could be gleaned.

As an example, the speaker illustrated how titanium oxide (TiO) lines were seen in the hottest LMSs, meanwhile calcium hydroxide (CaOH) was seen in slightly cooler objects. Towards the lower end of the mass scale, methane and water began to dominate. In recent years a breakthrough had been made in understanding how this chemistry related to temperature, arising from the recognition that sunspots, being cooler parts of the Sun's material, had a great deal in common with the surfaces of LMSs. Being so much more nearby, they could be studied in more detail, providing valuable insights.

In conclusion, the speaker summed up that low mass stars were probably very common in the Universe, but also exceptionally tricky to observe. In coming years, however, they might play a central role in our understanding of fields as disparate as star formation, planet formation, galaxy evolution and the search for extra-terrestrial intelligence.

Following the applause, a member asked how many confirmed brown dwarf discoveries had been made to date. Dr Viti replied that there had now been several hundred – many more than the number of known extra-solar planets, of which there were only around 150. The President asked whether amateurs could make any contribution to the field. The speaker suspected that this was one field where amateurs would have difficulty, as had professionals until recent times. Although some brown dwarfs were mag 16 in the V-band, they were often associated with more massive stars and very difficult to resolve from the glare. Moreover, most of the interesting science relied upon high-resolution spectra and infrared observations.

The President then adjourned the meeting until the Out of London weekend, to be held at the University of Liverpool from April 21–23.

Dominic Ford

References

1 Ford D. C., 'Ordinary Meeting, 2005 March 30', *J. Brit. Astron. Assoc.*, **116**(1), 44 (2006)
2 **http://science.nasa.gov/headlines/y2006/02mar_redjr.htm**
3 barrod@gerlos.freeserve.co.uk

The Messier star clusters of Auriga

Open star clusters are some of the most beautiful objects in the sky. And while clusters may look attractive on a computer screen, nothing can compare with the view of a rich and sparkling cluster seen through a wide-field eyepiece. In addition, while most galaxies, for example, need a large aperture to be seen as anything but a hazy patch, open star clusters can be enjoyed in almost any aperture and often a small rich field instrument will give a more aesthetically pleasing view than a large telescope. With Auriga high overhead on February evenings three excellent Messier open clusters are on view including,

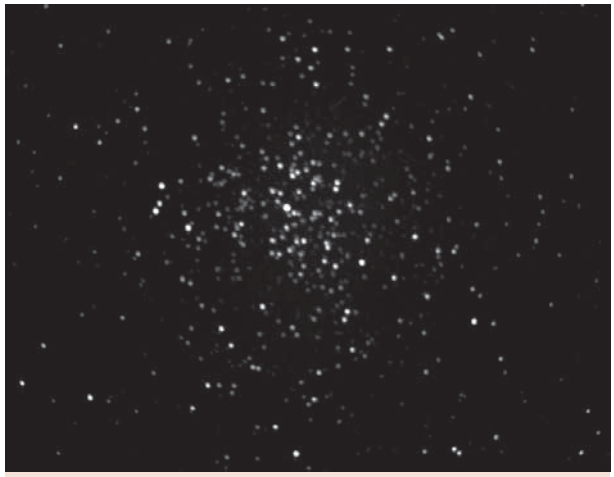
M36: 4×30s at f/3. *Cliff Meredith.*

in the opinion of the Director, possibly the finest cluster in the northern sky.

These clusters are nos. 36, 37 and 38 in Charles Messier's catalogue, although only one cluster, M37, was discovered by Messier, the others being reported by Le Gentil several years earlier. It is now known however that all of these clusters had been observed in the 17th century by the Italian astronomer Giovanni Hodierna, astronomer at the court of the Duke of Montechiaro; a fact which was unknown to Messier and his colleagues at the time.

M36 (NGC 1960) is located at position RA 5h 36.3m and Dec +34° 8.4' (2000.0), which puts it just inside the main body of Auriga. Trumpler, in his 1930 classification of clusters, called it a class 1,3,r, meaning it was rich, detached and with a strong concentration of bright and faint stars. All three clusters lie at a similar distance of around 4000 light years, although their ages differ significantly. M36 is the youngest at 30 million years, so has no red giant stars, unlike M37, which at an estimated age of 300 million years is far more evolved and contains several. At magnitude 6.0 and with a diameter of 10 arcminutes M36 contains around 60 stars, the brightest being magnitude 9.0. A feature of observing open clusters visually is that the pattern of stars, as seen in an eyepiece, often takes on a shape which is not always obvious in a photograph or on a computer screen. To most observers M36 takes on the shape of a crab or flying insect when seen through a 150mm or larger telescope.

M37 (NGC 2099) is the real beauty of the trio and a cluster to which I return to time after time. It is the object to observe to restore your faith in visual astronomy after a frustrating night of hunting some obscure nebula or galaxy. Located outside the body of Auriga, south-east and midway between a line joining theta Aurigae and beta Tauri, M37 is located at 5h 52.3m and Dec +32° 33.2'. At magnitude 5.6 and with a diameter of 15 arcminutes it can just be seen as a hazy spot with the naked eye from a really dark site. M37 is a very rich cluster containing around 1800 stars, many faint but the brightest being around magnitude 11. Its Trumpler class is 1,2,r, making it rich, detached and with a strong concentration of medium range brightness stars. The best way of appreciating M37 is to observe with an eyepiece giving a field of around 30 arcminutes, so that the cluster dominates a slightly sparse surrounding field. On a night of unsteady seeing the cluster will sparkle like a mass of diamonds. Smyth raved about this cluster and Webb called it '...one of the finest in its class'. Many observers remark that the cluster gives the impression of a fully resolved globular cluster. I find that it appears slightly crescent shaped, while others make it pear shaped.



M37: 3×30s at f/3. *Cliff Meredith.*

The final Messier cluster, M38 (NGC 1912) lies well inside the body of Auriga at RA 5h 28.7m and Dec +35° 51.3'. It is similar in diameter to M37, but contains far fewer stars (around 160), the brightest of which is a magnitude 7.9 yellow giant. The age of M38 is estimated at 220 million years, slightly younger than M37 but considerably older than M36. Trumpler classified it as rich, detached, a slight concentration and with stars of a medium range in brightness. It is another easy to find object, as it lies midway on a line joining two 2.6 magnitude stars, theta and iota Aurigae. Visually it is a beautiful cluster, with chains of stars forming a distinctive X shape. Just 30 arcminutes to the SSW of M38, and connected to it by a circlet of stars, lies another cluster, 8th magnitude NGC 1907. Much smaller than M38 with a diameter of just 5 arcminutes, but quite rich, it makes an interesting contrast with its brighter, bigger and looser neighbour.

M38: 4×30s at f/3. *Cliff Meredith.*

The images of the three Messier clusters shown here were obtained by Section member Cliff Meredith, observing from Prestwich, Manchester. Cliff uses a 200mm LX200 SCT with Starlight Xpress MX7-16 CCD. The field size of each image is approximately 27×18 arcminutes. Exposure details are given below each image.

Stewart L. Moore, *Director, Deep Sky Section*