Meeting of the Deep Sky Section, 2007 March 3

held at the Humfrey Rooms, Castilian Terrace, Northampton

Dr Stewart Moore, Director, opened the meeting with a summary of the past year's activities. Since the 2006 meeting, he had received in excess of 330 observations – an increase on previous years. The number of contributing observers had also risen, and he was especially pleased to see a growth in the number of visual observers: it was good to see that the art of admiring the aesthetics of objects at an eyepiece was still appreciated.

Three newsletters had been produced, available in hard copy for £4/yr (contributors receive them free), or later in PDF format on the BAA website. He remarked that the number of textual descriptions accompanying observations sent to him seemed to be in decline; he wondered if this was a result of the rise of CCD imaging, and urged members to keep up this art. In addition, he had sought to reach out to non-members by writing topical articles in the *Observers' Forum* section of every issue of the BAA *Journal*, and by getting images by DSS members published there. Gordon Rogers' image of the Christmas Tree cluster had been used on the cover of the December *Journal*.

Turning to observations, Dr Moore reported that Tom Boles had passed a milestone on 2006 April 3: the discovery of his 100th supernova; he had gone on to catch his 101st on the same night. His tally had since moved on to 105.

Considering the Section's observing programmes, Dr Moore remarked how the lack of popularity of the planetary nebulae programme had always surprised him – these were a varied selection of visually pleasing targets, and whilst some were quite challenging, others were visually accessible through even quite modest apertures. In the past year, their popularity had increased a little, and M27 remained the best observed.

At the previous year's meeting, Dr Moore had called for observations of Hubble's Variable Nebula, and these were still coming in. He was especially keen to receive regular observations made under similar conditions; one problem when comparing observations from different observers was trying to distinguish equipment-related variability from that intrinsic to the sky.

He was also keen to receive more observations of supernova remnants. In his time as Director, he had never received any observations of Simeis 147, despite its being a beautiful, large object in Taurus, subtending more than three degrees on the sky. Abell 85 in Cassiopeia was another fine target.

Among the Messier globular clusters, at the 2006 meeting Dr Moore had put out a special plea for observations of M3, 5, 10, 14 and 22. These were bright and aesthetically pleasing clusters, and seemed to be often visited by visual observers, but less so by CCD imagers. The speaker hoped in due course to compile an illustrated Messier guide with good modern images of all the objects, so was keen to fill these gaps.

To close, Dr Moore remarked upon the good turnout at the meeting. He had invited members to get in touch if they had views on Northampton's convenience and suitability as a venue for future meetings; in response, members expressed general approval. Andrea Tasselli was then invited to present the first major talk of the day.

Obituary

Donald Fletcher Hedley Robinson, 1935–2007

Don Robinson grew up under the guidance of his father, J. Hedley Robinson, who many BAA members will know of, in a house whose main functions were focused on services to both religion and astronomy.

As with many youngsters, and despite his father's best efforts, catching enthusiasm from a parent was a slow process that runs only to its own schedule, and it wasn't until returning from National Service with the RAF in 1956 that Don found himself hooked with the 'Astronomy Bug', as he called it.

Donald Hedley Robinson in 1990

That winter, just over 50 years ago, John Hedley was one student short of the minimum number required for an astronomy course for the Workers Education Association taking place at Widdecombe, Dartmoor, and he persuaded his son to come along to make up the numbers. One can imagine the appeal of a chilly hall in the middle of Dartmoor on a cold winter's evening, but within weeks Don was gripped by the subject and had unwittingly embarked on what would become a very prominent part of his life – spreading the astronomical word. He was always keen to help and encourage others, often embellishing his lectures with his great sense of humour, which, I remember, occasionally involved witty drawings of aliens, cartoon rabbits, and of course, green cheese.

In 1957 he joined the Torbay Astronomical Society, and whilst living in Exeter in the early 1960s he formed the Exeter Astronomical Society, serving as its Chairman for several years. Upon moving back to Teignmouth in 1968 he returned to the TAS, where he held several positions on the Committee including Observations Secretary and Chairman, eventually being honoured as Life Member and Patron of the Society in the 1990s. During these years Don gave lectures and courses for the WEA as well as the TAS in Devon and beyond, covering subjects ranging across the whole spectrum of amateur astronomy. Also he became an accredited Methodist Lay Preacher in 1987. In between all this, he spent most of his working career in the grocery trade.

When Hedley became ill in 1991, Don moved back to his parents' house to help care for his mother Mildred, who had been disabled by a stroke some years earlier. After his father's death, and being unable to actively observe in the night air due to his respiratory condition, he donated his 10-inch refractor to Teignmouth Grammar School, which he had attended from 1946 to 1951, and where it is still in use today.

Since those difficult years his own health steadily worsened and reduced his ability to travel, but he still kept in regular contact with many people, and socialised as best he could. Indeed he was always open to a conversation of any depth and on any subject, and was a great source of answers to me and many others. There was always a BAA *Handbook* or *Journal* on his coffee table, ever since he joined in 1965.

I will always remember those tricky theological discussions, as Dad and Hedley tried to bridge the subjects of Science and Religion, but at least their open-mindedness rubbed off on me a little, I hope. No doubt they now both have a greater understanding of the mysteries of the universe.

Don leaves behind a son and a daughter, Andrew and Linda, and five grandchildren, Katie, Hannah, Joshua, Nicky and James, and is sadly missed. His family have been very touched by the many kind condolences received, and they wish to express their thanks to all.

Andrew H. Robinson

High-definition imaging of planetary nebulae

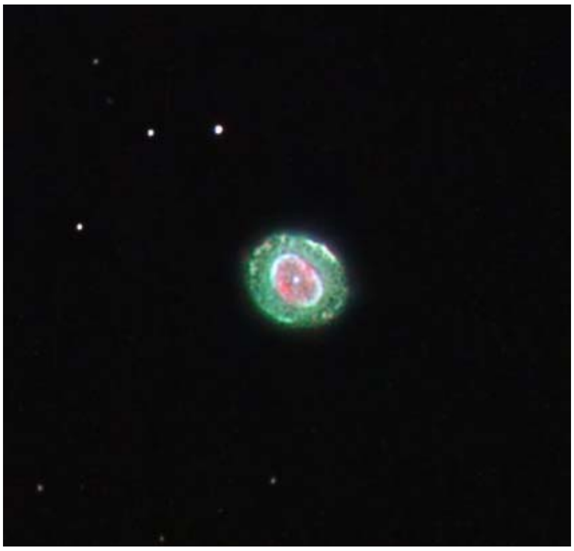
Mr Tasselli opened by describing his instrumentation: a 200mm Intes Micro M809 Cassegrain of working focal length 1400–2000mm, fitted with a Starlight Xpress SXVF-H9 CCD array, which yielded a resolution of 0.65–1" per pixel. For filters, he used a True Tech SupaSlim filter wheel with RGB, H and OIII filters.

The term 'high-definition imaging' could be interpreted in many ways; the speaker considered work to qualify as such when the full width half maximum (FWHM) of the point spread function (PSF) of the unprocessed frames was 2 arcseconds or less, and the spatial sampling of the CCD pixel array was fine enough to satisfy the Nyquist criterion – a requirement for subsequent deconvolution.

Outlining why he was attracted to imaging planetary nebulae (PNe), he explained that they comprised some of the brightest deep sky objects – many were brighter than Uranus and Neptune – and this made them quite easy targets. They tended to be compact, fitting readily into single CCD frames. Their edges were usually sharp, unlike those of galaxies, whose extremities tended to fade more gradually into the sky background; this meant that thorough flat-fielding was not so vital when imaging them. They showed a plethora of emission lines, and so responded well to the use of a wide range of narrow-band filters – of great help when observing from sites with significant light pollution. Put together, these considerations meant that expensive equipment was generally not required.

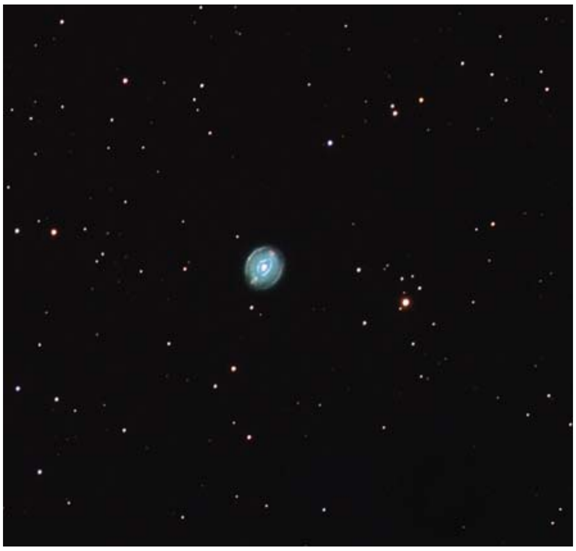
The array of objects on offer was itself a very pleasing crop, showing clear contrast and colour variations, and amongst them a great diversity of shape and form. Surprisingly, they seemed to be rather under-appreciated objects: many had never been imaged by either amateurs or professionals, let alone at high resolution.

Outlining what was required, the speaker identified good seeing as the single greatest prerequisite. Matters which were under the observer's control, those of equipment choice, were surely secondary. A telescope with good mechanical stability was a great help, but only to minimise the time spent tweaking instrumentation rather than taking images. Its optics needed to be good, but once again, nothing special. Good focusing was required, but no special hardware was needed to achieve it. A dew shield was, however, strongly recommended – dewed up optics were easy to miss, and it could be infuriating later to find many tens of minutes of exposures so ruined.



NGC 7662 in Andromeda, the 'Blue Snowball'. *Andrea Tasselli.*

The thermal stability of the observatory needed consideration. In winter, when daily temperature variations were usually only 3–4°, this was less important, but in summer, when they could reach 20°, it was much more so. The speaker's garden observatory had no roof, with the great advantage that there were no walls around it to retain heat and produce thermal currents. Even so, he still found the telescope's own heat retention was enough to make an internal fan necessary in summer. One drawback of this setup was that it needed to be polar aligned anew every night; it could take 1–2 hours to achieve 0.2"/minute tracking accuracy. He remarked, though, that even fixed plinth mounts could require similar treatment for their first few years, as their foundations shifted in the rain.



NGC 6826, the 'Blinking Eye Nebula' in Cygnus. *Andrea Tasselli.*

In good seeing, he aimed to focus to within 0.1" accuracy, which generally took around 30 minutes. In winter, he usually found that after one focusing session at the start of each night, a single quick check in the early hours sufficed. In summer, however, three to four full re-focusing sessions were often needed as the temperature fell through the night.

Mr Tasselli worked by taking large numbers of short exposures, no longer than 30 seconds each. He found seeing conditions often varied greatly from one 30-second period to the next; by taking many hundreds or thousands of such exposures and discarding all but the best, he could build up a long exposure whilst 'freezing' the best seeing. This also minimised the effect of tracking errors upon the final image; the speaker found that auto-guiding was unnecessary with this approach.

He worked only in the best seeing conditions, which usually accompanied anti-cyclonic weather in the summer months; high-pressure systems tended to yield a steady atmosphere. January and February could also bring similar conditions, though they had not in the winter just passed. The speaker avoided observing objects at low altitudes, where atmospheric distortions were greatest; as a rule of thumb, he restricted himself to altitudes of greater than 65°.

Having obtained raw data, he used four post-processing software packages: the standard Starlight Xpress image capture programme, the powerful free *Iris*[1] image processing suite for the bulk of his image enhancement, *Adobe Photoshop* to perform final retouching, and finally *Neat Image*[2] to reduce noise by filtering out the graininess of his CCD array.

After visually selecting his best exposures, he applied standard processing techniques to them: dark subtraction and flat-fielding. He then averaged them with sigma rejection – a technique good for filtering out especially noisy images, those with cosmic ray hits, etc. This yielded low-noise images, but the results were still typically quite blurry, due both to tracking errors and seeing conditions. To rectify this, he used three contrast enhancement tools: unsharp masking, Richardson–Lucy deconvolution, and – somewhat stronger – Van Cittert deconvolution. To achieve dark backgrounds, and to bring out contrast among the upper luminance contours, the speaker also applied some histogram modification, using the Digital Development Process (DDP) pioneered by Kunihiko Okano, and *Photoshop*'s non-linear curve modification facility.

He applied these in a fairly consistent pipeline. First he made a luminance image, to which he applied DDP to get the right distribution of grey levels across the image. He then filtered out any pixels with negative luminances – a prerequisite for deconvolution – before applying 4–5 iterations of Richardson-Lucy deconvolution, saving the result as a 'low-resolution' frame. He then applied a further 3–5 iterations of stronger Van Cittert deconvolution, used a weak low-pass filter to remove some of the resulting noise, and saved a second 'high-resolution' frame. In *Photoshop*, he blended the high-luminance levels of the latter image with the lower-luminance levels of the first. In the result, the fainter regions of the frame – typically the sweeping extremities of objects, dominated by lower spatial frequencies – were only mildly sharpened, to minimise noise, whilst brighter regions were sharpened quite strongly to bring out fine structure.

The speaker closed by showing a number of examples of his work: the Cat's Eye Nebula (NGC 6543), the Blinking Eye Nebula (NGC 6826), the Cheeseburger Nebula (NGC 7026), the Blue Snowball (NGC 7662) and the Ring Nebula (M57), in each case comparing the amount of detail resolved in his images with results from the Hubble Space Telescope (HST); he remarked that the comparison with early HST images was not a bad one.

Following applause, Dr Moore introduced the morning's second speaker, Paul Clark.

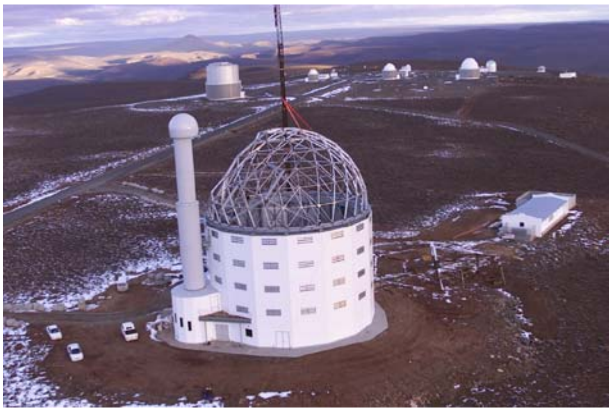
A pinch of SALT

Mr Clark explained that the 'SALT' in his title was the Southern African Large Telescope. He would be describing a 10-day observing expedition to South Africa upon which he and Mike Cooke had embarked in 2006 August, hoping to find skies better than those of his native Manchester. His destination was Sutherland, a remote settlement in the midst of the high-altitude Karoo desert of South Africa, 80 miles from the nearest town. Posting queries online put him in contact with the Astronomical Society of Southern Africa (ASSA), a ProAm society which proved to be an invaluable contact. He learnt that Sutherland averaged roughly 50% completely clear nights, 75% spectroscopically clear, and 25% cloudy, which would be roughly in line with his own experience there.

Mr Clark flew to Cape Town and arrived in pouring rain, but as he travelled inland, the weather greatly improved – this was apparently quite usual; such weather systems clung tightly to the coast. Along the final 80 miles of road from the nearest civilisation to Sutherland, he did not pass a single other car. His destination turned out to host a few B&Bs, a trade which it tried to build from its proximity to the South African Astronomical Observatory (SAAO); the town nicknamed itself the 'Gateway to the Universe'.

On his first night, Mr Clark took advantage of the lack of traffic to observe from the road, 3km outside Sutherland; he was able to set up his 100mm telescope on the tarmac undisturbed. As darkness fell, the Milky Way stretched across the sky from north to south, with its brightest part – Scorpius and Sagittarius, containing the galactic centre – roughly overhead; this remarkable sight was the focus of this entire night. A pair of 15×50 Canon image-stabilised binoculars proved a remarkable tool for observing it – the speaker could not recommend them more highly.

Subsequently, he gained access to the instruments in the public observatory on the SAAO site – a 405mm Schmidt Cassegrain and another of 355mm – about 200m from the SALT itself. He remarked that the instruments had proven to be quite poorly maintained; he was able to improve their collimation substantially, and wondered whether this show of expertise was responsible for the staff's subsequent willingness to give him free access to them. Their lack of dew shields was an initial source of anxiety, not entirely understood by the locals; he later realised that on a site with 20–30% relative humidity, such concerns were quite alien.



The dome for the Southern African Large Telescope under construction in the Karoo desert. *SAAO*.

At sunset, he was able to see the green flash quite easily, followed by the rising of a beautiful pearly-red Belt of Venus in the east. The sight was quite special in such clear air. As darkness fell, the most obvious view was that of the Milky Way – the Eta Carina nebula perched on the southern horizon, the Coalsack nebula just above it in Crux, the Sagittarius clouds overhead, the Scutum star cloud and the Wild Duck Cluster (M11) further north still, and the Dumbbell Nebula (M27) on the northern horizon. This whole complex of objects – all naked-eye-visible – was littered with dark clouds and dust lanes – a very rich sight. The speaker remarked how astoundingly bright a truly dark sky could be: whilst he couldn't have read a book by the light of Sagittarius, it had been quite bright enough to cast shadows, which were visible moving up the wall of the observatory as the night progressed.

The zodiacal light/band was readily visible, about 20–30° across, as well as the gegenschein; using the Bortle scale,[3] the speaker rated Sutherland as considerably better than an 'excellent dark site'.

Within the Milky Way, there was relatively little colour compared to the warmer hues of the zodiacal light, but it appeared remarkably broad; elements of its visual extent seemed to stretch right out as far as the Large Magellanic Cloud (LMC). Sweeping the 4° field of his 100mm into its path, the flooding of stars into view was a memorable sight. Around it were 8–10 naked-eye globular clusters, both Messiers and some which he had never before heard of. M5, 15, 2, 30 and 22 were all visible to the unaided eye. Telescopically, even many lesser-known galaxies and clusters were often quite breathtaking.

The Omega Centauri cluster (NGC 5139) was a remarkable telescopic sight, seeming to overflow the eyepiece with a sprinkling of diamonds – pin-points of light everywhere. As the night drew on, the Milky Way began to sink into the west, making other objects more inviting. In the southern pinwheel galaxy (M83), bright knots, dark dust lanes, and the beautiful spiral shape, were all accessible with minimal effort. The Hamburger Galaxy (NGC 5128, better known as the radio source Centaurus A) was another tempting target. Barnard's Galaxy (NGC 6822) passed virtually overhead later in the night, and lying back, looking through the 405mm, the speaker found its granular nature, emission nebulae and the structuring around, to be all clearly visible; it was incomparable to the meagre sight seen from the UK.

Later some degree of darkness was achieved as the Milky Way set further, and the southern galactic pole in Sculptor opened up, bringing with it a rich cluster of galaxies. In the Fornax group, NGC 1365 seemed to rival M51 in magnificence, having a very rich zig-zagging spiral structure. Visiting a few more familiar areas, the speaker found the Lagoon Nebula (M8) and Trifid Nebula (M20) to be well-placed – quite a contrast to their skirting along the southern horizon in the UK. All that he could say was how disappointing their appearance seemed upon his return.

In addition to his observing, the speaker also toured the research instruments on the SAAO site, including 1.4m and 1.9m infrared instruments, the southern SuperWASP exoplanet search array, and of course, the SALT itself. He remarked on how the 91 hexagonal mirrors of the SALT's 10m primary mirror appeared quite grey with dirt; he presumed that the cost of cleaning them was simply not economic. Amateurs with grubby optics might take some comfort from seeing that the mirrors of a premium professional telescope were no better.

Following applause, a member asked whether this opportunity to use the SAAO instruments was open to all amateurs. The speaker replied that when he flew out, he had not expected to have access to the 405mm and 355mm instruments – they were not generally available, but he had been very lucky in making contact with the ASSA and convincing them of his competence. Dr Moore asked of the security situation in South Africa. The speaker replied that remote areas such as Sutherland rarely experienced a problem; it was built-up areas which tended to have no-go districts.

After lunch, the Director invited Dr Richard Miles, BAA President, to speak.

Two-colour imaging of the deep sky

Dr Miles explained that his main interest was in the photometry of comets, asteroids and variable stars. However, the equipment that he had bought for this deep photometric work also happened to be quite well-suited to deep sky imaging; indeed, whenever he performed photometry on supernovae, deep galaxy images were an immediate by-product. His setup comprised a 28cm Celestron C11 with two co-mounted 60mm Takahashi FS60C refractors, one fitted with a V-band (500–700nm, green) filter and the other an I-band (700–900nm, infrared) filter, both from Norman Walker. Each Takahashi had a Starlight Xpress SXVF-H9 CCD array attached. In this talk he would be probing the deep-sky potential of these two 60mm refractors.

The speaker remarked that the separation in wavelength between the V- and I-bands was rather greater than that between the RGB bands. Consequently, some objects showed I-band magnitudes which were remarkably different from those seen in the V-band. Prototypical variable star Mira, for example, usually measured around mag 1.5 (I-band) versus mag 6.5 (V); at its recent maximum, it had reached mag –1.4 (I), making it one of the brightest stars in the infrared sky. More extreme still, RY Andromedae measured mag 8.8 (I) versus mag 15.7 (V); it was 850 times brighter in the infrared than in visible light. The response of his instrumentation was such that for average stars, the V-band filter reduced the amount of light collected from its white-light response by around one magnitude, while the I-band filter reduced it by two.

Dr Miles showed one of his earliest deep-sky images – a 33-minute stacked exposure of the Whirlpool Galaxy (M51), taken as a by-product of his making photometric measurements of supernova 2005cs. Comparing the result with an image by Martin Mobberley from 1992, taken through a 305mm aperture on film, showed that long exposures with modern CCDs could now compete, even when taken through small apertures. Comparing the I- and V-band images, there was a slight loss of detail in the I-band; specifically, the star-forming regions in the spiral arms did not stand out so clearly. The speaker reiterated how well these Starlight Xpress images responded to stacking. Even a comparison with imaging from the Palomar Sky Survey (POSS I; 1950–'57), which had used a 121cm Schmidt with 400 times the collecting area of the speaker's Takahashi, was not unfavourable.

The speaker then began to move south, explaining that objects at southerly declinations, which never rose very high in the UK sky, were more accessible in the infrared because atmospheric refraction – the plague of low-altitude imaging – was less severe at these wavelengths. He showed images of open clusters M46 and M47 in Puppis, around 1° apart at δ= –14.5°; at this declination, the level of detail seen in the I- and V-band images was comparable, though the former better differentiated red and blue stars.

Moving further south, Dr Miles turned to open clusters NGC 2571, 2580 and 2587, all in Puppis, at around δ= –30°, each of which he had imaged with sixty 30-second frames. He remarked that his infrared imaging was here beginning to show superiority, though the fleeting appearances of these objects severely limited the time available for imaging them. He also showed an image of the Galactic centre, at δ= –29°; he had been somewhat curious to see how it would appear. Whilst nothing was visible in the V-band, I-band imaging revealed a source with strange extended morphology, whose position matched that of radio source Sgr A.

A condensed globular cluster in Sagittarius, M69, at δ= –32°20', provided the next step in the southward journey, and a passable I-band image. By contrast, V-band imaging was now virtually impossible. The speaker explained that objects close to the horizon appeared at slightly higher altitudes than suggested by their celestial coordinates, as a result of refraction by the Earth's atmosphere. Moving down in altitude, this phenomenon became rapidly more pronounced in the final few degrees just above the horizon. At its most extreme, objects which appeared on the nautical horizon had celestial coordinates which actually lay ~0.5° below it. The altitude dependence of this effect was a serious problem when stacking long exposures; it produced a time-varying distortion of the sky along the altitudinal axis, causing stars to appear to set more slowly as they approached the horizon. The effect was also wavelength-dependent: blue light was affected more than red. This led to a chromatic dispersion of these sources; their blue emission was seen at higher altitudes than their red, an illustration of which was the green flash seen at sunset. This rendered it necessary to observe using fairly narrow-band filters to avoid altitudinal smearing, but also meant that the stacking of I-band images was much more feasible than that of their V-band counterparts.

Concluding his southward journey, the speaker showed images of NGC 6723, at δ= –36°37', and NGC 1808, at δ= –37°31'. His observatory's physical southern horizon was at δ= –38°09', but he had yet to identify any deep sky imaging targets in the final 30'.

Returning to where he had begun, Dr Miles showed an image which he had acquired as a by-product of photometry of the variable star SS Cygni, which he had studied intensively over the past couple of years. Nearby lay a mag 15.3 (V) galaxy, UGC 11799. By stacking 12 hours of his CCD frames, he had been able to obtain an image of this galaxy which revealed a comparable degree of detail to its POSS image. He added that he had applied no sharpening or other post-processing to his image; these, no doubt, could improve it further. Dr Miles concluded by arguing that the power of small aperture instruments for imaging was not to be neglected in the age of CCDs and frame stacking.

Following applause, the Director invited Grant Privett to speak.

Going deep

Mr Privett conceded that the term 'deep' was somewhat ambiguous; its meaning depended upon both site and equipment. A Londoner might consider the Crab Nebula (M1) to be so, meanwhile it had taken on a wholly different meaning in Paul Clark's earlier talk. He hoped to give advice which would be relevant irrespective of the definition chosen, and to both visual and CCD observers.

Some, he suspected, might ask the motivation for chasing faint objects, when such fantastic detail was to be found in the likes of M42, M57 and M27. He supposed that he saw them, first and foremost, as a challenge; imaging them required persistence, the refinement of some skills, and the learning of other entirely new ones. If the resulting images were not reward enough, the learning experience might later feed back to allow superior imaging of brighter objects.

The equipment requirements for deep imaging, were, above all, a setup which was in every way easy to use and maintain. A portable telescope, not too heavy, was ideal. Unwieldy instruments were to be avoided: the work involved in transporting them and setting them up would be a psychological barrier to their use. A driven mount was vital for CCD imaging and very useful for visual observers. More mundane items were equally important: a comfortable chair, a chart table at a convenient height, and warm clothing. Anything which made observing uncomfortable would bring on fatigue, and ultimately bring observing sessions to a premature close.

The speaker noted that even his comparatively portable arrangement, with which he was well practised, took him nearly an hour to set up. The advantages of fixed observatories were clear – the speaker admitted that he himself was tempted to set one up – but the drawback was that they didn't allow one to travel to find the best skies, and this was essential in most residential areas.

A dark site was essential, and to aid in finding one in the UK, the *Dark Skies Map* published by Philips was to be highly recommended. Likewise, a moonless night was also near-essential, though First Quarter skies were, at a pinch, usable late in the night, provided that the objects targeted were >90° and not exactly 180° from the Moon, to avoid light scattering into the telescope tube. The speaker used only the darkest area of the sky, which he typically found to be slightly displaced from the zenith, depending upon the directionality of local light pollution. He also only imaged during the hours of astronomical darkness, which meant not at all in June or July.

Mr Privett then turned to give advice specific to CCD imagers. He recommended trying several different eyepieces before imaging, to see which best framed any given target. Having a well-calibrated CCD was critical to minimise image noise. This meant that hot and cold pixel maps needed to be carefully constructed to filter out faulty pixels. Dark subtraction was vital even with the best detectors; he found it necessary to take several dark frames through the night as the detector temperature changed. Flat-fielding could also not be neglected. Finally, vignetting around the edges of frames was an effect to be mindful of; generally, the edges of CCD frames were best discarded. Whilst bright objects could be quite forgiving of these calibrations, they made a huge difference to deeper exposures, and no amount of stacking could average out poor calibration.

As an illustration of the power of image stacking, the speaker showed an animation of the improvement in image quality as more and more frames were combined. He generally recommended stacking large numbers of quite short exposures, as an increasing fraction of longer exposures had to be discarded due to cosmic ray hits, etc., though he noted that CCD read-out noise grew with the number of frames stacked, and, as it had non-Gaussian properties, was virtually impossible to remove. An equipment-dependent medium had to be found.

Good focusing must be maintained, and the speaker recommended re-checking this at least once an hour. Finally, before post-processing frames, he recommended applying linear gradient removal; the scattering of ambient light around one's observing site into telescope optics invariably produced some linear background gradient.

The speaker then presented some of the fruits of his work. Showing first some comparatively well-known objects, he began with M29, remarking how pleasing it was to have an image with not just the bright members of this open cluster, but also much fainter stars. Next, he showed a fine image of local group galaxy Leo I at mag 11.2.

Among some publicity stunts, he had imaged dwarf planet UB313 at mag 19, which, on the grounds of having been an object in the news of late, had impressed his work colleagues.

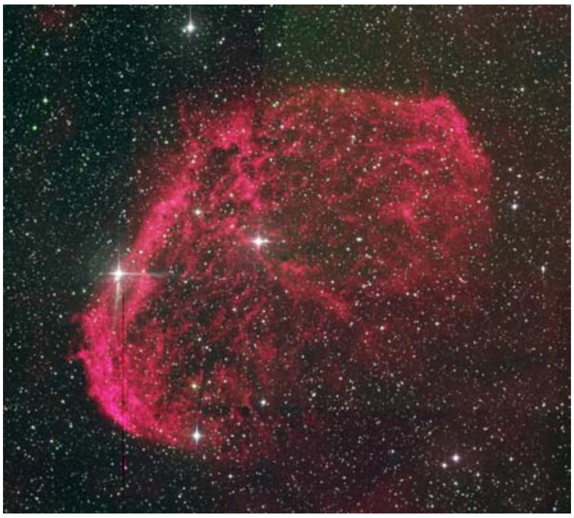
To conclude, Mr Privett remarked that he seemed to have found a niche for himself which he felt was much more rewarding than trying to compete with the fine images which already existed of brighter objects by means of post-processing. Following the applause, a member asked whether a conflict existed between the recommendation of easy-to-use equipment and that of a very portable instrument; as the speaker himself had mentioned, having a fixed observatory saved a lot of time. Mr Privett agreed that there was a conflict, but the majority of observers who lived in light-polluted areas could gain much better images by travelling to a dark site.

After a break for afternoon tea, the meeting resumed with a talk by a professional astronomer, Prof Janet Drew, of Imperial College, London. Prof Drew was the Principal Investigator (PI) of a project to survey the northern half of the galactic plane in Hα emission – the Isaac Newton Telescope (INT) Photometric Hα Survey of the Northern Galactic Plane (IPHAS) – which would be the subject of her talk.

The Northern Sky Hα Survey

Prof Drew explained that IPHAS[4] used the Wide Field Camera (WFC) of the INT to survey a 10° strip of sky following the northern galactic plane – an area totalling 1,800 square degrees. Images were taken using three filters: Hα, r' and i'. The latter two, pioneered by the Sloan Digital Sky Survey (SDSS), were similar to R- and I-band filters, but were preferred on account of their having more rectangular transmission profiles.

The survey collaboration consisted of 30–40 people, based in the UK, Spain and the Netherlands. Image reduction was being undertaken by the Cambridge Astronomical Survey Unit (CASU) of the Institute of Astronomy in Cambridge.



NGC 6888, or the Crescent Nebula, is the illuminated ejecta of the WR star, HD192163. The image combines data from all three IPHAS survey passbands (Hα, r' and i') in a false colour composite. IPHAS/Jonathan Irwin, Institute of Astronomy, Cambridge.

Prof Drew explained that the Hα line (656.3nm) was indicative of a range of interesting astrophysical environments. It was a transition line of atomic hydrogen, but was only excited where that hydrogen had become ionised; emission in it resulted only when free electrons and ionised hydrogen nuclei recombined. Astrophysically, exposure to ultraviolet photons was the principal mechanism for the ionisation of gas, and so Hα was a tracer of environments such as those around young massive stars, post-AGB stars, and accreting systems such as cataclysmic variable stars, which produced appreciable numbers of ultraviolet photons. In extragalactic astronomy, Hα was known as *the* tracer of star formation. Its position in the R-band was of practical use: this was the least dust-obscured part of the visible spectrum, allowing greater penetration of dusty environments, including the disc of the Milky Way.

From the surveys of the 1970s, it was clear that the population of Hα sources seen in the northern galactic plane was markedly different from that seen in the south; it was much sparser – presumably due to the geometry of the galaxy. Given the difference, it seemed worthwhile to complement the AAO survey with a northern counterpart, which IPHAS now sought to provide. It would detect all northern Hα-emitters between mag 13–20 (r').

To cover the 1,800 deg^2 survey area required 7,635 pointings of the INT; each field was exposed for 120s in Hα, 30s in r' and 10s in i'. Each field was observed twice, both to provide confirmation images, and to capture objects which fell between the four CCD chips of the WFC. As the filters used by IPHAS all lay at the red end of the spectrum, the survey was comparatively tolerant of Moon interference, and tended to be scheduled during Moon bright time, when there was a reduced demand for telescope time.

To date, 72% of the survey had been completed, with an average seeing of 1.7". It was hoped that the observations would be completed in late 2007. CASU was presently working to calibrate the data to ensure photometric uniformity throughout.

The speaker explained that whilst line emission was most commonly associated with nebulae, much of the science from IPHAS was actually stemming from unresolved point sources. The r'–Hα and r'–i' colours of main sequence stars provided superb diagnostics both of their spectral types and of the dust extinction along our lines of sight to them. This facilitated mapping of both stellar masses and dust extinction across the Galactic plane. Stars with strong line emission – Ae and Be stars, indicative of young systems still enshrouded in their natal gas clouds, and accreting cataclysmic variable stars – stood out on account of their bright H emission. Conversely, white dwarfs stood out as Hα-faint objects on account of significant absorption by circumstellar hydrogen.

IPHAS was also expected to detect many hundreds of new planetary nebulae (PNs), which appeared as extended Hα-bright objects. The first to be reported, IPHAS PN-1, had proven an especially interesting object. In the outer Galaxy, chemical abundances were expected to be radically different from those seen in the solar neighbourhood. Aside from its chemistry, its morphology was also strikingly unusual. An Hα-bright point source in the centre – rarely seen in PNs – suggested that the parent star was in an accreting binary system. Moreover, the nebula itself showed two distinct rotation axes, a phenomenon which had only before been seen in a handful of PNs; the formation of such nebulae was yet to be understood.

Prof Drew closed by adding that plans were already being made for a deeper survey of the southern Galactic plane after IPHAS. The Very Large Telescope (VLT) Survey Telescope (VST) Photometric H Survey (VPHAS) was scheduled to commence in 2008, and would image in Hα, u', g', r' and i'.

Following applause, the Director introduced two short talks to conclude the meeting. The first was by Gary Poyner of the Variable Star Section.

OJ287 – an update

Mr Poyner explained that OJ287 was a quasar which showed variability on all timescales from minutes to years; it was widely thought, though by no means confirmed, to be a binary pair of black holes, with an accretion disc viewed face-on, looking directly down its jet. In this model, its flaring behaviour was attributed to shock fronts in the jet.

Until recently it was thought to have a period of 11.5 years, though its most recent outburst, predicted for mid-2006, had occurred earlier than expected, in October/November 2005. It was now suspected that the object only showed periodic behaviour for around 50 years at a time before this became unstable, as had apparently just occurred.

The speaker showed a lightcurve of OJ287's behaviour since solar conjunction in 2006, up to the present. It had never been entirely quiescent in this time; initially it had appeared to flare every 31 days, though this period had recently reduced to 14 days.

The Variable Star Section had in recent times undergone a revolution; though visual observers remained, many now used CCDs to perform photometry of objects like OJ287. Noting that many of the deep sky observers in the audience also had CCD equipment, the speaker put out a call for them to consider contributing observations of this most enigmatic object. He closed by referring potential observers to the VSS's observing campaign webpage[5] for more details.

The Director then invited Owen Brazell to present the afternoon's final talk.

Planetary nebula Howell–Crisp I

Mr Brazell said there had been considerable activity in recent times among amateurs searching for previously uncatalogued planetary nebulae (PNs). One such observer was Richard Crisp in Texas; he was perhaps most distinguished as a pioneer of amateur narrow-band imaging in, for example, the Hα and OIII lines. In 2006 November, he and Michael Howell had noted a curious smudge close to supernova remnant IC443 in Gemini, which he believed might be a PN. This was subsequently confirmed by a professionally-obtained spectrum.

The speaker expressed surprise that this PN had not been noticed before; it was quite apparent in the Digitised Sky Survey (DSS), and since the announcement of its discovery, many other amateurs had succeeded in imaging it. However, he noted that it seemed to be far from unique; Crisp alone had several other PN candidates awaiting confirmation.

The Director then closed the meeting, expressing his gratitude to all who had assisted in organising it, and especially to all of the speakers.

Dominic Ford

1 **http://www.astrosurf.com/buil/us/iris/iris.htm**
2 **http://www.neatimage.com**
3 Bortle J. E., *Sky & Telescope,* **101**(2), 126 (2001)
4 **http://www.iphas.org**
5 **http://garypoyner.pwp.blueyonder.co.uk/oj_camp.html**