Meeting of the Deep Sky Section

held at the Humfrey Rooms, Castilian Terrace, Northampton on 2003 March 8

March 8 saw the return of an annual feature of the BAA calendar – the Deep Sky Section meeting. Held at a convenient, central location in Northampton, the meeting always attracts a good turnout, and this year's was no exception. In his introductory remarks, Section Director Nick Hewitt reported on another busy year for the Section. Many excellent CCD images had been received (the Director showed some examples), along with some double star measures and observations of active galactic nuclei. On the supernova-hunting front, Mark Armstrong and Tom Boles were now neck-and-neck, with about 40 discoveries each – all of them made since 1996. A notable new development was the detection by amateurs of the visible-light component of a gamma-ray burst. The electronic scanning of the Section's archive of visual observations, in progress at the last Section meeting (see *Journal*, 2002 October), was now complete.

Nick Hewitt gave the first of the main talks, on the subject of double stars, a field perhaps neglected by amateur astronomers in recent years. Double stars make good recreational observing, as they often show attractive colours. A more challenging task for the amateur is to measure their separations and position angles. This is difficult to do visually, but it is somewhat easier using photography, as photographs can be measured at the desk rather than in the field. Many of the most interesting double stars are just a few arcseconds apart and ordinary prime focus photography gives too small an image scale for useful measurements. The best photographic method to use is eyepiece projection, the same as for planetary photography. It is important accurately to calculate the effective focal length of your projection system, in order to get a correct image scale for making measurements. Exposures of only a few seconds are necessary – in fact, overexposure will reduce the accuracy of your measurements. Photography seems to show that the colours of double stars are real and not just psychological effects. Nick Hewitt concluded by noting that measuring binary stars (i.e. double stars in orbit around one another) is scientifically useful, as large numbers of pairs have not been measured for many years.

Martin Nicholson in his runoff roof observatory at Daventry.

The next speaker was Martin Nicholson, who continued the double star theme with the story of his remarkable work at the Daventry Observatory. The observatory is, in fact, a shed with a run-off roof in Mr Nicholson's back garden. His observing site is quite light-polluted, which is one reason why he took up the study of double stars, as they are less affected by light pollution than other deep-sky objects. His approach to double star work is two-pronged. He began by making measurements of known doubles. Of the 90,000 or so pairs in the Washington Catalogue of double stars, nearly half have only been measured once and nearly one-third were last measured more than 50 years ago. His second line of enquiry was to look for new double stars in images and published data.

His equipment for measuring double stars is high-tech: a 12-inch Meade LX200 and an SBIG ST-7E CCD, plus a battery of software, including the AIP image processing program, which has a module specifically for double star work. Measuring the separation and position angle of a double star is easy with this software, once the scale and orientation of the CCD image have been worked out. Using this setup he has measured more than 1,100 doubles since April 2002.

Mr Nicholson also began discovering many new double stars. Before he began his programme, just 18 new doubles were discovered in 2000 and 2001 by all astronomers, amateur and professional. But in 2002, Mr Nicholson alone found 85 new systems. He then came up with a new discovery technique. Rather than use his own images, he began looking in the Hubble Guide Star Catalogue for pairs less than 10 arcseconds apart in right ascension and declination. He used software techniques to isolate pairs of stars with the required coordinates, and then confirmed that they were doubles using images from the Digitized Sky Survey. Since October 2002 he has discovered a staggering 27,000 new pairs in this way. His future plans include searching the open clusters in the Messier and NGC catalogues for new double stars down to magnitude 18. It will also be important to measure his new discoveries at the telescope over time to determine whether they are true binary stars or just pairs of widely-separated stars that happen to lie in the same line of sight.

After an excellent cheese and wine lunch provided by our hosts, the Northamptonshire Natural History Society, this year's professional speaker, Dr Paul Crowther of University College, London, gave a talk on 'the birth, life and death of very massive stars'. The vast majority of stars in the Milky Way Galaxy are relatively lightweight objects like the Sun. Stars of more than eight times the Sun's mass are relatively rare. These massive stars burn up their energy quickly and have lifetimes of only a few million years – about one-thousandth that of Sun-like stars. They are also very luminous, with absolute magnitudes up to one million times that of the Sun.

Astronomers believe that massive stars are born in giant molecular clouds – nebulae much larger than the one from which the Sun formed. Precisely how they are created is still a subject for controversy. They may form by accretion of nebular material by gravity, as do normal stars, but they could also form as a result of collisions between mid-mass stars in the dense cores of the molecular clouds. Many young high-mass stars are shrouded by dust and so are invisible in visual wavelengths, but they show up strongly in the infrared and radio.

After they have exhausted the hydrogen in their cores, massive stars start to vary in brightness and pass through a phase when they are known as 'luminous blue variables'. This period only lasts for about 20,000 years – a very brief time in the life cycle of a star. Luminous blue variables rapidly change their spectral type as they vary in brightness. Dr Crowther noted that these stars are regularly monitored by amateur astronomers, as only they have the telescope time to monitor them continuously over a long period.

One particularly interesting class of massive stars is the Wolf–Rayet type. In addition to being very massive, they are also very hot, shining with more than 100,000 times the Sun's luminosity. They have lifetimes of just 3 to 6 million years and Dr Crowther noted that Wolf–Rayet stars seen in other galaxies are already dead, because they have ended their lives long before their light has reached the Earth. Only 230 Wolf–Rayet stars have been found in our Galaxy.

At the end of their hydrogen-burning phase, stars of more than 15 solar masses expand to become 'red supergiants', fusing successively heavier elements up to iron in the periodic table. They then end their lives as type II supernovae – or, in the case of the most massive stars, type Ib or Ic supernovae. One unsolved mystery, however, is supernova 1987A in the Large Magellanic Cloud, a type II whose progenitor star was a *blue* supergiant.

Bob Marriott then resumed the double star theme with a history of double star observing. Systematic observation of double stars was begun by William Herschel, who observed stars at intervals of 20 years in an attempt to determine their parallaxes. During the course of his observations he discovered many double stars and found that some of them were orbiting binaries. His observational measurements proved that Newton's gravitational laws applied outside the Solar System. The first comprehensive survey of double stars was begun in 1823 by Wilhelm Struve, using the 9-inch (228mm) refractor at Dorpat (Tartu) Observatory in what is now Estonia. Systematic observations of double stars in the southern sky were begun around the same time by James Dunlop and during the following decade William Herschel's son, Sir John Herschel, observed over 2,000 southern doubles from the Cape of Good Hope.

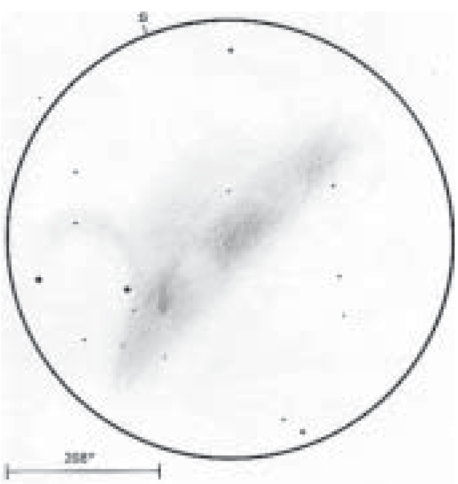
From the earliest days of double star observation, separations were measured using a micrometer, which consisted of a very precise grid of fine wires in the field of a telescope eyepiece, often made from spiders' webs. The invention of the Barlow lens in the mid-nineteenth century was a considerable boon to double star observing, as it increased the telescope's magnification without increasing the size of the micrometer wires, as would be the case if a higher-power eyepiece were employed. The British amateur W. R. Dawes made many measures of double stars with this new lens and established the 'Dawes Limit' – the resolution limit for double stars with a given telescope aperture.

Two other well-known observers during this period were Admiral W. H. Smyth and the Reverend T. W. Webb, but both concentrated on visual descriptions of the colours of the stars rather than measurements. One of the greatest of all double star observers was the American S. W. Burnham, an amateur astronomer who spent his entire life measuring double stars. His *General Catalogue*, published in 1906, contained .16,000 measurements. In the twentieth century, further important work was done by Robert Jonckheere and R. G. Aitken. Paul Couteau, a professional astronomer, continued making visual measurements into modern times.

Following afternoon tea, Campaign for Dark Skies director Bob Mizon gave a talk entitled 'Piercing the Veil', on how to observe deep-sky objects in light-polluted skies. Bob Mizon is very much a visual observer and prefers to hunt for deep-sky objects manually. He described using Go To telescopes as 'like fishing with a hand grenade'. The key to successful deep-sky observing from urban locations is to wait for good sky transparency, as the effects of light pollution are then at their minimum. From his location near Poole in Dorset, Mr Mizon has made many successful observations of galaxies, and has even seen detail in M33 in Triangulum with his trusty 8½-inch (216mm) Charles Frank telescope.

Mr Mizon noted that while many major roads now have sky-friendly lighting, sports lighting is becoming the worst pollution offender. The flood of lottery and millennium funding in recent years has resulted in many sports complexes being built, many of them choosing poor-quality lights that shine sideways instead of downwards. There is, however, cause for hope. The well-known DIY retailer B & Q have been persuaded to sell environmentally-friendly security lights and a Parliamentary Select Committee on light pollution had recently been set up.

The final speaker of the day was Lee Macdonald, who spoke on 'Drawing the Deep Sky'. Drawing deep-sky objects may seem archaic in our electronic age, but it still has much to be said for it. Making drawings trains your eye to look for detail, thus improving your observing. It is much cheaper than CCD imaging or photography and represents objects *exactly* as they appear in the eyepiece, with no over-exposure or bias towards the red end of the spectrum. Drawings also have considerable historical value, allowing us to appreciate what observers like Sir John Herschel or Lord Rosse might have seen through their telescopes.



Drawing by Lee Macdonald of the 6th magnitude emission nebula M17. 222mm reflector ×90 and ×232, 1993 July 12.

In addition to your telescope, the basic equipment for drawing deep-sky objects is a bound sketchbook with smooth cartridge paper, a pencil of grade B or HB, an eraser and a dim red torch. You should only carry one pencil at the eyepiece, as they are only too easy to lose in the dark. Choose a magnification high enough to show detail in the object, but low enough for some background sky to surround it. Begin by marking the object's position in the centre of the field and then plot the brightest stars by estimating their distances from the centre to the edge of the field. Draw the object itself, making its centre dark and sketching the outer parts in successively fainter bands, and then carefully smudge it with your forefinger to reproduce its nebulous appearance. Finally, fill in the details in the object itself and the fainter field stars. Later on, make finished copies of your drawings for display or sending to organisations such as the BAA Deep Sky Section.

The 9-inch Fraunhofer refractor at Dorpat, used by Wilhelm Struve for his study of double stars.

Nick Hewitt concluded the meeting by thanking all the speakers for such a wonderful variety of talks, showing both what the amateur can do and the latest developments in professional research. He also thanked the Northamptonshire Natural History Society for their hard work in providing the food and refreshments.

Lee Macdonald

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