TRANSIT

The October 2009 Newsletter of

Cleveland & Darlington Astronomical Society

NEXT MEETING

9 October 2009, *7.15pm for a 7.30 pm start*

Wynyard Woodland Park Planetarium

The eclipse of the century

Neil Haggath and Don Martin (CaDAS)

Contents

Editorial

Rod Cuff

Highlights from this issue include the first reports from the Expeditionary Force to the North Pole – see pp.6–10. There's also part 2 of Keith Johnson's beginner's guide to imaging solar system objects, and the first stage of a fascinating two-parter from Dave Weldrake on how he's been carrying out a time-intensive professional observing project at Siding Spring Observatory in Australia. .

In last month's editorial I enthused about the Astrotents (http://tinyurl.com/CaDAS003) that some other CaDAS members had at the Dalby Forest Star party, and sighed "more expense to come". Guess what I bought at a BAA meeting in Leeds a few weeks later ...

Many thanks, as ever, to all contributors to this issue. Please keep items rolling in. The next (November) issue of *Transit* will come out a little earlier, as I have other commitments at the end of this month. So if you will have material for that issue, please get it to me by **Friday 23 October** or earlier if you possibly can.

Rod Cuff, info@cadas-astro.org.uk,*1 Farndale Drive, Guisborough TS14 8JD (01287 638154)*

Letter to the Editor

From Keith Johnson:

Weather predictions

Dear Editor –

There are many weather prediction websites: the BBC (http://news.bbc.co.uk/weather), the Weather Channel (http://uk.weather.com), the Met Office (www.metoffice.gov.uk) etc etc.

How many of them predict that it's clear when in fact it's totally clouded out?!

I know that some CaDAS members have their own favourite sites and, like me, don't depend on just one weather forecast. But I've been monitoring one website for the past week that has got the weather spot on every day when the others have got it totally wrong. Take today (27 September), for example. The Met Office and BBC sites both predicted that it would be clear over the North-East all day when in fact it's been totally clouded out.

So instead check out the Sat24 site at www.sat24.com/gb – you get a choice between visual and infra-red seeing, too!

OBSERVATION REPORTS AND PLANNING

Skylights – October 2009

Rob Peeling

The Moon

4 Oct	11 Oct	18 Oct	26 Oct
Full Moon	Last Quarter	New Moon	First Quarter

Between 23:00 and midnight BST on 11 October, the last-quarter Moon passes just 1° south of Mars. This event will occur low in the east as both objects rise.

Planets

Jupiter continues to be the most obvious planet in the sky through October. The equatorial bands are the most prominent markings, but I can usually also see the southern temperate band if the conditions are reasonable. On 12 September I was delighted to catch a shadow transit of Io. The tiny black disk cast by Io's shadow on the planet could clearly be seen between the two equatorial bands.

Neptune is still fairly easy to track down. Sweep to the east and slightly upwards along the ecliptic from Jupiter with binoculars or your telescope finder and look for the obvious row of three 6th-magnitude stars – 42, 44 and 45 Capricornii (the brighter, 5th-magnitude μ [mu] Cap is a bit further east in the same binocular field). Neptune will look like an 8th-mag. star to the north-east of the middle star (44 Cap). Don't confuse it with a star of similar brightness to the east of 45 Cap (the lowest star in the group). If the three stars are the prongs, then Neptune makes the handle of the trident – rather appropriately. A medium-power telescope eyepiece should be enough to enable you to see the planet as a disk and confirm your sighting.

Uranus is beneath the circlet asterism of Pisces and is an easy binocular object. Once again a medium-power lens in any telescope should show the disk. It appears as a isolated 5.7-mag object to the east of ϕ (phi) Aquarii, which should make it a fairly easy target.

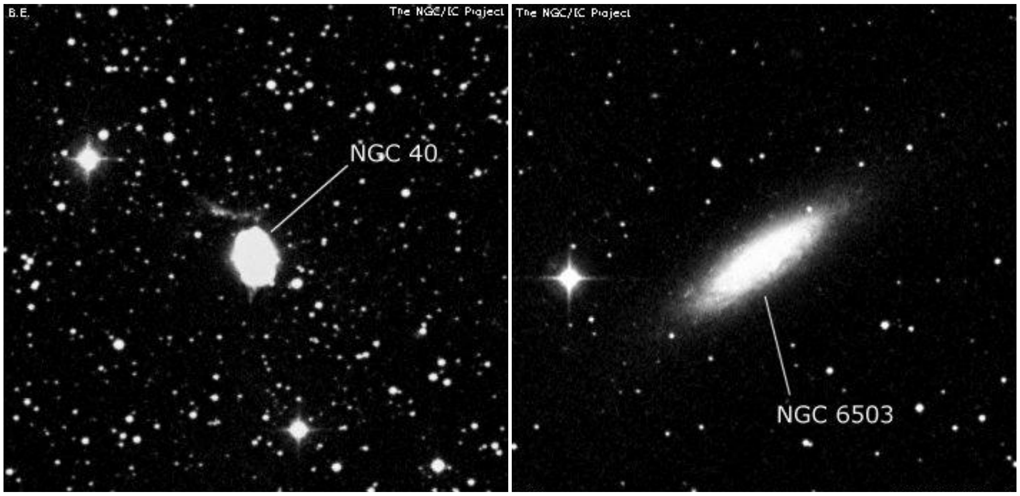
Mars is starting to rise in the late evening.

Meteors

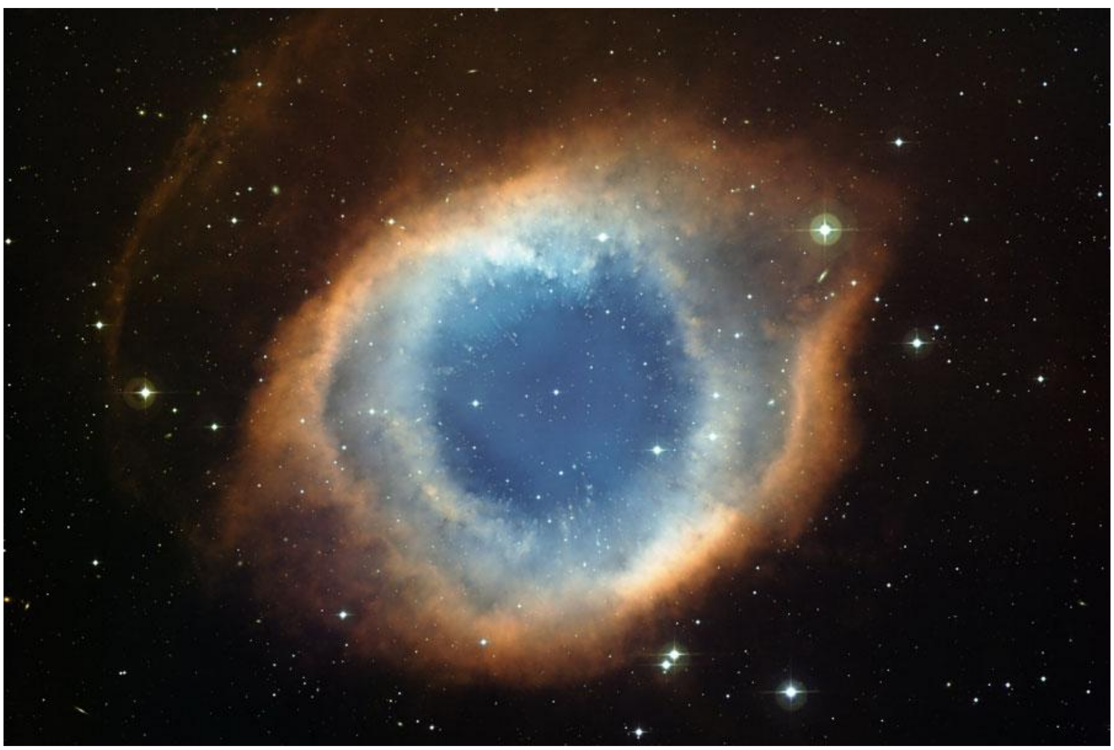
The **Orionid shower**, derived from Halley's Comet, peaks on 20/21 October.

Deep sky

I recommend looking for the planetary nebula **NGC 40** in Cepheus. The central star is clear, and is surrounded by the nebula. Unusually, seeing this planetary is not much helped by using an OIII filter. This indicates that the physics causing the light emission are unusual. I also recommend **NGC 6503**, an edge-on spiral galaxy in Draco, which appears as a sliver of light next to a 9th-mag star. Both NGC objects are illustrated on the next page.



Elsewhere in the sky, this month is probably the best chance in the year to catch the famous **Helix Nebula, NGC 7293**, low in the southern sky in Aquarius. This is a large object (so use a low-power lens). It is believed to be the closest planetary nebula to the Sun. It may prove elusive because of its low position in the Teesside sky.



I'm indebted to Nick Hewitt and his talk about Wolf-Rayet stars at the BAA Out-of-London Meeting in Leeds in September for encouraging me to look for the next object – the **Crescent Nebula (NGC 6888, and also Caldwell 27)** in Cygnus close to the centre star of the cross, Sadr (γ [gamma] Cyg). I'd always had the impression that it was fiendishly difficult to see and so hadn't bothered trying. Nick told me that if I could see the Veil Nebula through the light pollution from my garden, then I ought to be able to spot NGC 6888. I tried on 12 September and he is right. In fact it is brighter than the Veil Nebula (a long-standing favourite object for me). With a UHC filter and even at low power, I could see a streak of light stretching south-west from a brightish star. This observation is virtually identical to that of William Herschel when describing his discovery of the nebula in 1792. You'll see more than this from a dark site, and those with imagers will be able to record the entire ovoid nebula.

The nebula is caused by gas thrown off by a massive (Wolf-Rayet) star in a futile attempt to slim down enough to avoid going supernova. The Wolf-Rayet star is *not* the star from which the streak appears to come; that's just a line-of-sight effect. The central star is actually the similarly bright one nearby, close to the visual centre of the nebula in the image below by Daniel Lopez, using the Isaac Newton Telescope. The part of the nebula I visually observed stretches up and to the left from the bright star near the bottom edge.

Please don't forget the Expedition to the North Pole, launched in last month's *Transit*. See below for more on that!

An expedition to the North Pole

A CaDAS project to celebrate the International Year of Astronomy 2009
by collecting observations, sketches, images and *any* kind of information about
any object with a J2000 declination ≥70 degrees.

Send your reports, lists, or whatever to Rod, Alex or Rob (contact info for all three is at www.cadas-astro.org.uk/contacts.html) or, if you prefer, bring them along to a CaDAS meeting.

REPORT 1 — *Alex Menarry, 14 Sep 2009*

Just a few thoughts on my hopes for participation in the CaDAS Expedition. I look forward to hearing the results from our experienced observers.

i) This idea has lured me back into looking at the night sky again and rejoining the star-gazing public of Teesside and Darlington. Having been thoroughly idle and allowed my astronomy to become totally armchair-bound, this can only be a good thing. Thank you, Rob, for the idea.

ii) It was an inspired notion to choose a limited and well-defined area of the sky: always visible, circumpolar, with interesting targets varying from naked-eye objects through binocular-visible to the advanced telescopic objects. Like all good ideas, it is also capable of development to take in other well-defined areas of the sky at some future date.

iii) My approach is to find and record all the naked-eye objects visible from my drastically light-polluted back garden. Interference from street lights and neighbours' insecurity lights and uncurtained, lights-blazing windows was a major factor in withdrawing from regular observing. The other serious problem is the surrounding buildings, which restrict the lower view. This section of the log will demonstrate the naked-eye magnitude limit in my 'back yard'.

iv) The next step will be to find as many of the objects listed in *Transit* as possible with binoculars. Having new observing objectives prompted me to buy new, lightweight 15×70s. They are of plastic construction, bought from Strathspey Binoculars in Aviemore. Advice from an experienced observer – don't drop them!

v) Just beyond the street lights of Darlington is a farm where I used to do my observing of eclipsing binaries a few years ago. The folks who live there have agreed to have me around after dark again. Farms have serious security worries these days, so having strange people around after dark needs care. This site has the advantages of reasonably dark skies – apart from the inevitable yellow glow in various directions – views down to the horizon, being well away from the road and being tucked out of sight. My viewing plan is to repeat the searches already conducted from home and add a few more, such as looking for all possible planets, including Neptune and Uranus, and renewing my acquaintance with old friends, such as **β (beta) Per/Algol**, **RZ Cas** and other binocular eclipsing binaries.

vi) If all this works out, it may be worth taking up visual-magnitude estimation for variables and eclipsing binaries and sending them in to the BAAVSS (BAA Variable Star Section).

I hope so. There will even be an incentive to buy a new telescope; now there's an exciting prospect.

PS – Not a good start so far! September 1–8 has been 10/10^{ths} cloud after dark here. Viewing nights September 9 and 12 to date.

REPORT 2 — *Rod Cuff, 25 Sep 2009*

Last night promised some hours of clearish sky, though not particularly good seeing. The combination seemed right for tackling the list of double stars with declination > 70° that Rob tabulated in last month's *Transit*, and so it proved. I was observing with an 8" Meade LX90 at f/10, mostly through an unfiltered 26mm Plössl eyepiece, giving a magnification of 77× and a field of view (FOV) of 40 arcsec. Observations lasted from 21:40 to 23:50 UT.

First, though, the irresistible lure of three planets in the southern sky, even if low down. **Jupiter** always looks clear and sharp through this eyepiece, and the four Galilean satellites were nicely strung out, with Callisto on its own far to the east and the others to the west, with the one most distant from the planet noticeably brighter – as might be expected from Ganymede, the largest satellite in the solar system. The clarity broke up when I moved to a higher power – viewing through the rising air-currents from a neighbour's roof isn't ideal!

Nice though the 26mm view was that night, it didn't have the excitement of the previous night, where, in a cloud-strewn sky and in a forlorn last-object 'grab' of Jupiter, I happily caught it right in the middle of a **shadow transit of Ganymede** – the dot of the shadow was tiny but unmistakeable. I must work out sometime the visual angle subtended by the shadow – it must surely be a fraction of an arcsec.

(If you don't already know of it and/or don't have good planning software for observing Jupiter, http://homepage.ntlworld.com/mjpowell/Astro/Naked-Eye-Planets/Jupiter-Path.htm#JupMoons can be strongly recommended. If you supply it with a date, it will tell you the times of all the satellite events – transits, occultations, eclipses, shadow transits – that will occur on that date, along with all transits of the Great Red Spot.)

Following Rob's urgings in recent Skynotes, I then found first **Uranus** and then **Neptune**. Uranus showed as a tiny but distinct disk with a mild bluish tinge to it, and at mag 5.7 was brighter than any other object in the field. Adding a 2.5× Powermate (giving a magnification of nearly 200×) made the disk unmistakeable but drained the colour. Neptune (mag. 7.8) was, rather naturally, tinier – I found a clearer but fuzzy disk when moving to a 12.4mm (161×) eyepiece.

And so to the doubles. Rob's list is (of course) excellent. Here are some brief notes, with some of the original tabulated data from the September *Transit* repeated, a few items corrected (in **bold red**) and notes or other data added (in *italic red*). Data sources include SkyTools 2.2 (www.skyhound.com/skytools.html), *Norton's Star Atlas* and various internet sites. I'm adding SAO (Smithsonian Astrophysical Observatory) numbers because those are used by the Meade Autostar, and owners of a Meade GoTo scope can therefore get quickly to the object from the Autostar menu. I made rough drawings of the FOV in a few cases, but haven't the courage to show them here in their unartistic state.

Star	***Constellation/name***	***R.A.***	***Dec.***	***Separation [arc sec]***	***mag1***	***mag2***	***SAO***
Σ93	Polaris	02 31	+89 16	18.5	2.1	9.1	*308*

Cleanly split with 26mm. Norton says the pair given here is an optical double, but SkyTools and http://adsabs.harvard.edu/abs/2006DDA....37.1204T claim it as a physically linked system – in fact, at least a triple and possibly a quadruple. The primary is variable (1.86–2.13), period 3.9696 days.

SHJ136	Cam	12 10	+81 43	65.1	6.15	8.25	*1991*

Easy, widely separated. Rob had listed it as 'Sh136', but I couldn't find any information about that anywhere – 'Sh' is usually short for 'Sharpless', a couple of catalogues of nebulae and galaxies. I tracked the star down using its RA+Dec from the Eagle Creek Observatory list at http://astronomy.eaglecreekobservatory.org/doubles/cam.html, which gave the SAO number, and then typed that into SkyTools, which gave SHJ 136 as an alternative. Despite much searching, I've been unable to find out what the 'SHJ' catalogue is. Does anyone know?

OΣ28/OΣΣ14	Cep	01 19	+80 52	130.9	7.56	6.69	*218*

Very easy but attractive pair, looking more equal in magnitude than their listing implies. I picked up only the two obvious components, but SkyTools has the primary as accompanied by another companion at 0.88 arcsec (beyond my scope that night!), and another couple with mags 8 and 12 with a separation of 66.5 arcsec. I don't fully understand that – a problem for another time.

Σ1972	π^1 Umi	15 29	+80 27	31.1	6.64	7.3	*2556*

Another attractive pair, closely similar in magnitude. Because I was mentally tuned to picking up only double stars, I didn't notice that there is a third companion, at 154 arcsec from the primary and mag 11.4. The moral is to prepare more thoroughly beforehand!

Σ1625	Cam	12 16	+80 07	15.4	7.24	7.78	*2009*

Another attractive pair, closely similar in magnitude.

Σ2308	40/41 Dra	18 00	+80 00	220.2	5.7	8.34	*8996*

At first I thought my GotTo had Gone To Pot. Could this be the right star system? The separation looked more like 20–30 arcsec. But I was in the right place … Later, back at SkyTools, I found that this was another triple system, and that in fact Rob's listing was for the less obvious of the pairings (AC). The one that shouts at you is AB – mags 5.7 and 6.2 (I had written at the time "almost identical in magnitude: possibly 6th?", so I felt suitably smug), with a separation of 19 arcsec.

HN122	A = YZ Cas = 21 Cas	00 46	+74 59	36.1	var	9.4	*4216*

I didn't know what to expect from 'var', and at first thought I must have come across it at a particularly dim moment. With a 26mm eyepiece I could only just catch the fainter star with averted vision. However, back at SkyTools it became clear that what I thought was the mag 9.4 'normal' star was in fact this very faint one – perhaps there was thin high cloud dimming the whole FOV at the time. I'll check on another night. Meanwhile, the primary isn't all that variable: it's an eclipsing Algol-type binary with mag 5.65–6.05, a period of 4.4672 days and an *eclipse duration of 16.1 hrs. There's more in Wikipedia at http://en.wikipedia.org/wiki/YZ_Cassiopeiae .*

Σ1193 UMa 08 21 +72 24 43.1 6.1 9.1 *6504*

Behind trees.

Σ2241 ψ^1 Dra 17 42 +72 09 30.3 4.9 6.1 *8890*

I wrote, "Nice double, with a clear difference in brightness", not picking up that this is a quadruple system. Data above are for the AB pair; C is mag 11.4 at 90 arcsec, and D is mag 12.9 at 100 arcsec. The primary has a proper name, Dsiban.

Σ2675 κ Cep 20 09 +77 43 7.4 4.4 8.4 *9665*

Clearly split with 26mm, but this pair was much closer than all the previous targets found so far that night, with the big difference in brightness requiring a more careful look. It turns out there's a third companion, also mag 8.4, at 169 arcsec.

Σ2806 β Cep = Alfirk 21 29 +70.34 13.3 3.2 7.9 *10057*

Nice – very clear difference in brightness

h2200 γ Cam 03 50 +71 20 106 4.6 8.5 *5006*

Wide, but hard to distinguish this visually as a double, as the secondary looks just like yet another nearby field star. SkyTools has a third component listed, closer at 56.2 arcsec, but faint at mag 12.4.

Σ973 Cam 07 04 +75 14 13 7.2 8.2

A curiously satisfying pair, close in magnitude and fairly well isolated from other stars. An archetypical double? A third component at mag 16.7 I'll leave for someone else!

Σ1362 Dra 09 38 +73 05 5 7 7.2 ——

Behind trees.

Σ1415 UMa 10 18 +71 04 16 6.7 7.3 *7099*

Behind trees. There is a third component, mag 10.6, at 152 arcsec.

ΟΣΣ143 UMi 16 05 +70 16 47 6.7 9.3 *8415*

Observed. Nothing much to say! There is a third star of mag 8.56, separated at 0.23 arcsec – good luck with finding that …

Ku1=Hu917UMi 16 43 +77 31 2.9 6.1 9.4 ——

This was the only one that defeated me in a way other than hiding behind the trees. In theory my scope should be able to split it, but I couldn't at nearly 200×. With a 6.4mm eyepiece (313×) I could just discern two shapes, but not separate them. Anything more powerful wasn't possible under the conditions. This system isn't in the SAO catalogue, but is also known as ADS 10214 (Aitken Double-Star Catalogue) and HIP 81854, among other designations.

Σ2452 Dra 18 54 +75 47 6 6.5 7.4 ——

Easy with the 26mm, but it was the closest of all found doubles up until that point. Similar remarks as for Σ973 above.

Σ2603	ε Dra	19 48	+70 16	3	4	6.9	*9540*

I couldn't split this with the 26mm, though there were hints of where the secondary might be. The suspicion was confirmed by adding the 2.5× Powermate, which just separated them. The magnitude difference felt even larger than it actually is, as at only 3 arcsec separation the primary overwhelms its companion.

β pm	75 Dra	20 28	+81 25	197	5.5	6.7	*3408*

A walk in the park! It turns out there's a third star, mag 11.1, also with a wide separation at 109.8 arcsec.

Σ2923	Cep	22 33	+70 22	10	6.3	9.2	——

A very nice sight in a faint but rich starfield at the very edge of the Milky Way (nearly at the zenith when I was viewing it at UT 23:45). This system isn't in the SAO catalogue, but is also known as ADS 16062 and HIP 111325, among other designations.

OΣ481	Cep	22 44	+78 31	2.4	7.5	9.3	——

I couldn't split this with the 26mm, but with the added 2.5× Powermate and careful focusing plus averted vision, I could just split it at moments of better seeing. The same was true when moving to the bare 6.4mm eyepiece. This was right on the edge of what was possible on the night, and a good place to stop! This system isn't in the SAO catalogue, but is also known as ADS 16243 and HIP 112230, among other designations.

All in all, the most structured, enjoyable and rewarding night's viewing I've had for ages. I finished by treating myself to good views of M31, high overhead, and retired to bed happy. Now that I've written this up in conjunction with some PC- and book-based research, I can see that (a) I need to go back to some of these 'doubles' and tease out their other companions, and (b) there are a lot of other double and multiple stars in the Expedition area of sky to be tracked down and recorded in the same way.

ASTROPHOTOGRAPHY

A beginner's guide to imaging solar system objects

Keith Johnson

Part two: The hardware essentials

This month's edition focuses on the various hardware items such as telescopes, web cameras, filters and Barlow lenses.

Telescopes

Although any type of telescope will capture solar system objects, there is one type of telescope that is the instrument of choice by most of the top planetary imagers: **Schmidt–Cassegrain** (pictured on the next page). SCT scopes have the high focal ratios needed when capturing high-resolution images of the objects we're interested in here. These large and very often heavy instruments have to be attached to a mount capable of carrying

such a weight; so if you're upgrading your telescope to a larger size, it's not just a matter of upgrading the optical tube assembly (OTA) – you have to bear the mount in mind too.

Others imagers prefer **Newtonian reflectors**. It's all down to personal choice and, more importantly, to what you can afford. If and when you've been bitten by the astronomical imaging bug, you'll strive to attain better and better images. Don't be at all surprised that in doing so you'll probably at some point wish to upgrade to a larger and better instrument. The photo here shows my own 9.25" Schmidt-Cassegrain telescope attached to an EQ6 Pro.mount.

However… as this series of tutorials is aimed specifically at the beginner, I'll assume that you're the proud owner of modest but adequate equipment.

Web cameras

Whatever type of telescope you own, one fundamental factor in achieving a great image is having a good web camera. But why use a web camera?

These small, lightweight devices have revolutionised imaging to such an extent that real scientific information can be gleaned from the images that they produce of solar system objects.

When the camera captures a single-frame image of any given planet, the 'noise' level in that frame is typically very high. However, if a stream of video data or what is called an **AVI** (audio-video interleave file) is captured, the resulting AVI will consist of many hundreds or even thousands of frames. You can then use dedicated software to discard the poorer-quality frames that correspond to moments of bad seeing, retain the better-quality frames and stack them. The result is a stacked single frame with a much better signal-to-noise ratio. Using the same or different (and usually free!) software, you can then apply various 'wavelet' filters that will bring out lots of detail in the image.

But are these resulting images of any importance?

No longer are planetary images looked upon as 'pretty pictures'. Just recently an amateur astronomer happened to be capturing an AVI of Jupiter and discovered what transpired to be an impact scar. Only hours and days later, the world's largest telescopes followed up with investigations as to what may have caused the impact.

Web cameras employ one of two types of chip. Cameras having a **CMOS** (complementary metal-oxide semiconductor) chip create too much visual noise and are not suitable for astronomical purposes. Cameras that employ **CCD** (charge-coupled device) chips are more suitable.

There are particular makes and models that are favoured too – in particular, the Philips range of cameras, such as the egg-shaped Vesta Pro cameras and the ToUcam Pro.range, the 740K and 840K models of the latter being the most popular. Be aware that the ToUcam Pro II camera 840K CCD version looks very similar in appearance to the CMOS version! The CCD version has an all-silver casing as shown on the next page, while the CMOS version has a white-and-blue casing.

Philips ToUcam Pro 740K

Philips ToUcam Pro II 840K

Sadly, these two cameras are no longer in production and consequently are quite difficult to get hold of. However, they still appear on auction sites now and again – in fact, the day I typed up this tutorial I saw two ToUcam Pro II cameras for sale on a very well-known auction site. An 840K model (including the adaptor that enables it to be attached to the telescope) was for sale starting at £30. The other camera was a 740K model that didn't even sell! So keep looking and if you're lucky you'll eventually find one.

The adaptor I mentioned above replaces the camera's dedicated lens. You simply unscrew the lens (which has no astronomical use) and replace it with a 1.25" camera **adaptor** (see picture on the right), which has a standard internal filter thread that allows you to attach filters of your choice.

Filters

The manufacturer's lens that was supplied with the camera also protected the CCD chip from dust particles, so once this lens is removed it's important to keep the chip protected by some other means. For instance, you can buy a clear filter that simply screws onto the webcam's 1.25" adaptor to provide protection for the chip.

The original camera lens also has an IR (infrared) filter built in, and once this has been removed the performance of the camera suffers – it will respond to IR and UV wavelengths that human eyes can't detect, and result in a poorly defined image with the colours being dispersed. You'll need to screw a replacement 1.25" **UV/IR cut-off filter** onto the webcam adaptor, which will give you the more balanced colour and spectral range that you need.

A ToUcam Pro II web camera with adaptor and UV/IR filter attached

In addition, **coloured filters** are very popular with imagers. For example, green filters have been used to great effect when imaging the Moon in greyscale, as the relatively short wavelength of green light provides better contrast and detail.

Barlow lenses and the Powermate

Adding a Barlow lens increases the focal length (and hence focal ratio) of a telescope – for instance, attaching a 2× Barlow lens to an f/10 telescope will increase it to f/20.

It is important to be aware that some Barlow lenses are of poor quality, which would become apparent when viewing an object at high magnification. Most experienced planetary imagers use a more sophisticated image magnifier called a Powermate, produced by the American company Tele Vue, who are renowned for their high-quality, although quite expensive, products. This is one item well worth your while to consider purchasing. I myself would not be without my 2.5× Powermate (shown here attached to a ToUcam Pro II web camera) and view it as a valuable piece of hardware in my arsenal of imaging equipment.

Barlow lenses and Powermates come in various magnification ratios such as 2×, 2.5×, 3×, 4× and 5×. If you have a Newtonian reflector of f/5, for example, a 5× Tele Vue Powermate would increase the focal ratio to f/25, an ideal focal ratio when using the ToUcam Pro.

Next month's tutorial

Camera capture settings: Shutter speed, frames per second, gain, gamma, brightness and contrast, colour balance and compression

GENERAL ARTICLES

The Lupus Project: Looking for transiting Hot Jupiter planets

Dave Weldrake

Part 1: Observing with the Siding Spring Observatory 40-inch telescope

Transiting planets

When working in astronomy, there are two main areas towards which one can direct one's efforts, namely observational and theoretical astronomy. Both try to meet the same aim, in helping to understand a specific (and previously unstudied) scientific goal as determined by the researcher's own interests. However, the way in which this is done is very different depending on which area one chooses to work. Astronomy involves a great deal of travel, not just to attend conferences (of which there may be one or two in a year dealing with your specific subject, in any country), but also because there can be significant observing travel if one chooses an observational project.

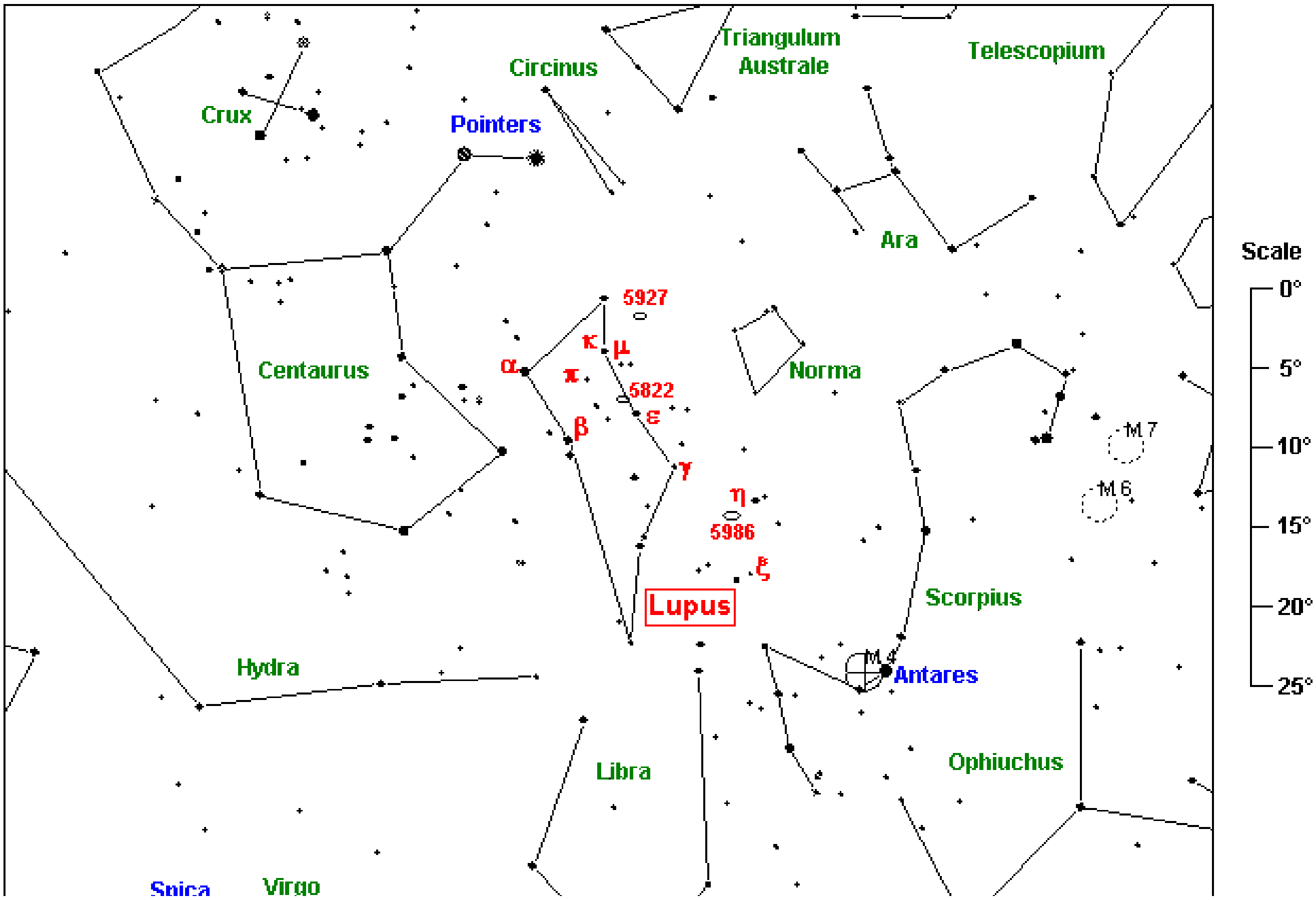
A research project starts with a thought experiment: can I accomplish the project's aims with easily available equipment and in a reasonable period of time? Access to large telescopes is strongly competitive, and so a detailed project proposal must be written and submitted to the time allocation committee for that particular telescope for ranking. Only the highest-ranked proposals will be awarded time, which will be allocated to the project in due course. Once this is known, arrangements must be made to travel to the telescope. Depending on the nature of the project, such travel can take place up to half a dozen times a year. Hence proposal writing and jumping on planes each form a substantial part of an astronomer's life.

Over the past eight years, I've been working on transiting exoplanets, particularly in the search for, and study of, transiting **Hot Jupiter planets**. Hot Jupiters are planets of approximately Jupiter's mass that orbit their parent stars in only a few days. As such, each one has a ~10% probability of transiting (passing across the face of its parent star) as seen from the Earth, depending on the planet's orbital period and the size of the host star. If one observes enough stars (tens of thousands) regularly enough (every few minutes) over a long enough period (at least a month), there is a chance that such a planet can be detected and studied. Finding a transiting planet enables us to find the true mass of a planet (as we know the inclination of its orbit), and its radius (from the size of the host star and the depth of the transit signal). We can therefore find its density, allowing study into the interiors of exoplanets (and even their atmospheres), which is clearly a great boon to planetary research.

A transit occurs once every few days and lasts for only a couple of hours, with multiple transits needing to be seen for the detection of a candidate to be assured. Furthermore, a planetary transit (depending on the size of the planet) reduces the brightness of its star by only at most 1%. Considering all this, tens of thousands of images (each taken within quick succession of the last) of the same sampled stars are needed to find a planet – the ultimate needle in a haystack. Clearly, a vast amount of telescope time is required with good, stable sky conditions to have a chance of finding one.

A significant part of my work over the past eight years has involved taking and analysing data to this end with the 40-inch telescope at Siding Spring Observatory, a spectacular location near a small country town called Coonabarabran in northern New South Wales, Australia. The telescope is often undersubscribed, so that obtaining months of observing time is easier than with most telescopes, and it is fitted with a **Wide-Field Imager**, or WiFi. This allows the telescope to image an area of sky ⅔ of a degree across, bringing into view enough stars to undertake a search for transiting planets on stars fainter than those usually targeted by transit projects, thus making the project original enough to satisfy the time-allocation committee.

So, in mid-2005 I decided to start up a project to do this, and applied for time to use the 40-inch for 33 nights in May–June 2005. I picked a suitable star field in the constellation Lupus (a field with a large number of stars, none brighter than magnitude 12, away from the path of the Moon, with little interstellar dust extinction, with a high fraction of solar-type stars etc). The project was named the 'Lupus' project (after the chosen constellation), and we would search for planets in association with 33,000 solar-type stars of magnitude 14–18 over our 33 nights (120,000 stars of all types). Statistically, we should find a small handful of planets. In May 2005, we started observing.



Siding Spring and Lupus observing

Siding Spring Observatory is an 8-hour drive north of Canberra, where I live and work. The Mount Stromlo Observatory, near Canberra, has cars available for people to make this trip. It's a very pleasant drive, travelling through small country towns and pastoral land, interspersed with rugged rocky outcrops and eucalypt forests. The vastness of Australia becomes clear after driving for most of a day, after which you've crossed only half of one state and seen nothing but endless expanses of land in all directions.

Siding Spring itself lies in the Warrumbungle National Park, the remains of a volcano extinct for tens of millions of years. The volcano has long since eroded away, leaving behind the plugs of harder igneous rocks rising like spires into the sky. It's a spectacular place for bushwalking and sightseeing. The telescopes are all bunched together on the edge of what remains of the volcanic crater. A small community, Siding Spring consists of several telescopes ranging in size from the 4m Anglo-Australian Telescope to the 16-inch reflector originally used for site-testing in the 1960s. There is also a lodge for observers to stay (with a staffed kitchen providing meals), and the nearest town (and hence beer and petrol) is 30km away. The 40-inch telescope, ours for the next month, is in a moderately sized dome at the end of the complex.


Siding Spring Observatory – a typical view of mountains and one of the domes

Upon arrival, we check into the lodge, move into our room and drive to the telescope to make sure all is ready for the night's observing. Typically, twilight in May starts at 6pm, with dinner in the lodge served at 5. After checking that the correct equipment is installed and filling the telescope Dewar with liquid nitrogen (to keep the 16 WiFi CCD cameras cold), we open up the dome to allow the ambient temperature to equalise and retreat to the lodge for dinner while keeping a close eye on any clouds.

After dinner, we return to the telescope and start taking calibration images. These are taken at the beginning and end of each night and allow us to perform image analysis correctly when the data have all been taken. When the sky is properly dark, we slew the telescope to the target starfield, and take a test exposure to check the sky conditions, the telescope focus and pointing. When these are all satisfactory, we begin taking science images. Each exposure lasts for 5 minutes (previously calculated to give us the best results on our target brightness range with as short a time gap between images as possible). After each exposure is finished, the quality of the image is checked and the next image started. This process is repeated as often as possible throughout the night, except for periods of cloudy weather or otherwise bad conditions. We stop observing when morning twilight approaches, or when our target field settles too low in the sky for suitable quality data to be taken. We take more calibration images in the morning twilight before retiring to bed. The process of checking the telescope, opening up, having dinner and starting observing is then repeated for the next 33 nights (all in a row!), weather permitting.

One particular night was spectacularly clear and, as the conditions were stable, I set the telescope to expose many images automatically, and then retired to the telescope dome balcony with my binoculars to scan the sky. As it was winter, the Sagittarius Milky Way was at the zenith and visually was absolutely stunning. The dust lanes through Scorpius, Sagittarius and Lupus were as clearly visible as in a photograph. Through the binoculars the Milky Way was broken up into countless millions of tiny glittering points, with nebulae and star clusters dotted here and there. I also looked at the same spot at which the telescope was looking, giving me a slight thrill to know that I was looking for planets in that same area at exactly that same time.

The sky is regularly clear at Siding Spring, but is susceptible to dust from the desert and has more unstable air than other higher-altitude observatories because of the heat of the day. This night, however, was one of the clearest and most stable I have ever seen there. The observers at the Anglo-Australian Telescope measured a ‘seeing’ of less than an arc-second – very rare, and techno-speak describing a particularly good night for doing science with the stars.

At the end of the 33 nights, a few of which were cloudy, I had accumulated more than 2000 images of the chosen Lupus starfield. As the field contains many thousands of stars, the potential for new discovery, not just of planets, but also of variable stars and newly discovered eclipsing binaries, was huge. After having lunch, I drove back to Canberra to begin analysing the images.

Next month

I’ll write about how the analysis was done on these images, and describe what we found, including the only transiting Hot Jupiter ever to be detected from Australia (and currently the faintest ground-based detection of a planet), and hundreds of newly discovered variable stars. All of this was done with an area equivalent to the apparent size of the Moon, in a relatively obscure portion of the Southern Milky Way. The potential for discovery across the vast areas seen through the binoculars that night are clearly very large indeed.

Auroras of different kinds

John Crowther

Our nine-year-old grandson from Canterbury has been given a topic to research – the aurora borealis. He soon had the science worked out, not being webless as I am. So I’ve sent him some further facts by snail-mail – such as that Aurora was the goddess of the dawn in the Greek world.

A personal coincidence was that last year I bought second-hand a book called *Aurora*, the story of the Royal Navy cruiser of that name. The ship’s motto was ‘After darkness, light’, with an emblem of the rising sun.

The author describes how the *Aurora* picked up the crew of a Whitby-owned merchant vessel that had been torpedoed by a U-boat in 1941. My father, Thomas’s great-grandfather, was Chief Engineer on that vessel. The crew, rescued after nine days in two lifeboats roped together, were fortunate because there were many British warships in the North Atlantic, all engaged in hunting the *Bismarck*.

Thomas’s teacher is Canadian, so he’ll be able to remind her how some years ago Toronto was affected by the radiation from a solar storm accompanied by spectacular auroras.

Book review: *The Photographic Atlas of the Stars*

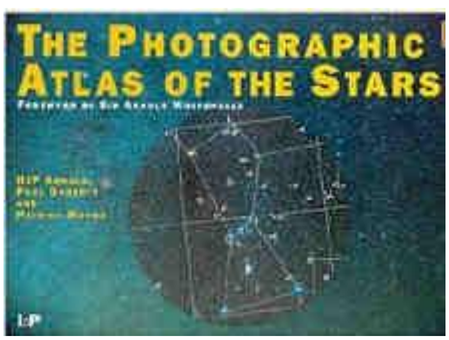
Alex Menarry

At conferences and courses, the value of serendipity is part of the reason for going. I can't remember the exact event – maybe a British Astronomical Association Variable Star Section or University of Central Lancashire practical weekend – but I remember the attractive and very intelligent lady who introduced me to this book. It was a birthday present and she was leafing through it in one of those quiet moments between official things happening. We fell into conversation, as you do, and as soon as she showed me the diagrams and photos and explained what it was all about, I knew it was a 'must have' object (the book, you understand).

Written by HJP.Arnold, Paul Doherty and Patrick Moore, with a foreword by Sir Arnold Wolfendale and first published by the Institute of Physics in 1997, it presents the whole of the night sky photographically to magnitude 8. The authors' original intent was to limit the magnitudes recorded to the best naked-eye level of about 6. However, this was wisely extended to those stars visible with a reasonable pair of 7×50 binoculars, a great boon to those who usually work in this area as their limit.

There are 45 photographs, all with matching maps, which for me are the next best thing to your actual sky. One big advantage is that the book can be held in the lap and leafed through in warmth and comfort. On many occasions when the stars have been clouded out, it has helped me to sort out a puzzle of where some interesting object is to be found. Another advantage is what I call the Ordnance Survey effect – while poring over the map, out pop all sorts of interesting things.

At the back there is a Messier Catalogue (could Messier really see down to magnitude 12.2?), a Caldwell Catalogue (down to magnitude 12.8, I see), a glossary of terms, a further reading list, a table of which constellation is on which map, a list of the proper names of more than 300 stars and a list of where the photographs were taken from. The published date gives the clue that the photographs were taken with chemical film (unobtainable now?); there is a lot of technical stuff on taking pictures with a steam-age camera, but none, understandably, on DSLR cameras. Will someone repeat the exercise with a digital camera a decade after the original idea? It is such a good idea that it seems inevitable. Please let me know if you come across a new edition.



This is very much a recommended book for any astronomer's library. Copies are still available from Amazon at between £30 and £80. Amazon also refers to several other Photographic Atlases but with a "currently unavailable" note. The ISBN is 0 7503 0378 6 (hard covers) and 0 7503 0654 8 (paperback).

COMMITTEE NEWS AND INFORMATION

Thomas Wright Trophy *and* Yorkshire Astromind

Just a reminder that the annual Thomas Wright Trophy quiz, this year between teams of three from CaDAS, York AS and Durham students, will be hosted by Durham AS on Friday 16 October at 7.30 pm. The venue is Redwood Lodge, School Lane, Durham (off Church Street) – see http://tinyurl.com/CaDAS002 for a map.

And the Yorkshire Astromind competition will be hosted by Bradford AS on Saturday 10 October, between 12.30 and about 4.00 p.m., in Eccleshill Library, Bolton Road, Bradford, West Yorkshire, BD2 4SR (*for a map, go to http://maps.google.co.uk and type in 'Eccleshill library'*). Rob Peeling will be defending his title, earned last year at his first attempt.

CaDAS support would be very welcome on either or both occasions!

THE *TRANSIT* QUIZ

Quiz questions for October

Q1. Where/what are Chara and Asterion? (*Hint: together they make up a constellation.)*

Q2. If Amalthea is V, what are I–IV?

Q3. If Astraea is 5, what are 1–4?

Q4. (a) Which is the least dense solar system planet, the only one less dense than water?
(b) Which are the other two planets that are less dense than the Sun?
(c) Which is the densest planet?

Q5. Which Messier object was described by Messier himself on discovery in 1773 as 'very faint nebula without stars', yet by his collaborator Pierre Méchain eight years later as 'double, each one with a brilliant centre, separated from each other 4' 35"'?

Answers in next month's issue

Answers to September's quiz

Q1. Which constellation:
(a) is the only one split across two areas of the sky? (b) is a cup?
(c) is a table? (d) has a teapot? (e) *[for extra points!]* has a carafe?

A1. (a) Serpens – into S. Caput (head) and S. Cauda (tail). Ophiucus (Greek for serpent-holder*) is between them – see http://stars.astro.illinois.edu/sow/ophser-p.html*
(b) Crater (http://stargazing.suite101.com/article.cfm/observing_the_constellation_crater)
(c) Mensa (www.astromax.org/con-page/southern/men-01.htm)
(d) The Teapot is the nickname of an asterism in Sagittarius – see http://tinyurl.com/ye599qx for something to put on your Christmas list …
(e) Cannon's Carafe Galaxy is in the constellation Caelum in the Southern Hemisphere. I'd not heard of it before last month, and had indeed barely heard of Caelum either – but

www.encyclopedia.com/doc/1O80-CarafeGalaxy.html had.

Q2. What's the astronomical significance of midday on 1 January 4713 BC?

A2. It's the start point from which Julian dates are measured – see http://en.wikipedia.org/wiki/Julian_day

Q3. What do these kinds of graphics illustrate:
(a) a Hertzsprung–Russell diagram? (b) a butterfly diagram?
(c) the Wilkins–Moore map?

A3. (a) For any collection of stars, an H–R diagram shows the relationship between the stars' luminosities (or absolute magnitude) and their spectral types (or colours, or temperature) – see http://cass.ucsd.edu/public/tutorial/HR.html
(b) If you plot the solar latitude of each sunspot against time across a whole series of solar cycles, you get a diagram that looks rather like a series of regimented butterflies – see www.windows.ucar.edu/tour/link=/sun/activity/butterfly.html
(c) In 1955, H. Percy Wilkins and Patrick Moore published "The Moon; a complete description of the surface of the moon, containing the 300-inch Wilkins lunar map". Over several editions, it remained the best and most detailed lunar map available to amateur observers. For more on this and other lunar maps, see Michael Roe's comprehensive article in the July 2009 issue of Transit.

Q4. If you double the aperture of a telescope (the clear diameter of the main mirror or lens), what happens to the resolving power (the width in arc seconds of the finest detail that it will show)? By how much does the limiting magnitude (the faintest star that can be seen by eye through the telescope) increase?

A4. The width of the finest detail discernible is reduced by half (equivalently, the resolving power doubles) – see among the ads at www.optcorp.com/category.aspx?uid=1-599. You might think that the amount by which the limiting magnitude changes would depend on how big the telescope was in the first place – but theoretically this is not so. Regardless of the original size, with double the aperture you can see objects 1.5 magnitudes fainter. (For those with a mathematical bent, the gain in magnitude in going from aperture D_1 to D_2 is $5 * \log (D_2 / D_1)$, which in this case is $5 * \log 2$ or approx. 1.5.) In practice, though, as http://tinyurl.com/y9bga4d points out, the improvements in background darkness and contrast allow much fainter objects to be seen. So you can stop snorting now … ☺

Q5. What might observers use these things for:
(a) a Bahtinov mask? (b) a Stonyhurst disk?
(c) a Zürich grid? (d) Wratten 8?

A5. (a) As an aid to focusing a telescope – see http://astrojargon.net/maskgen.aspx
(b) To orient an outline drawing of the Sun at the correct inclination of its axis – see section 5.13 in http://tinyurl.com/y95ke87
(c) To record the position of sunspots once you've done (b) above, using the internationally agreed Zürich classification of sunspot types –see http://tinyurl.com/2bowrm
(d) To bring out detail on a planet's surface – it's a pale yellow filter that you screw into an eyepiece. An English chemist, Frederick Wratten, developed a numbered range of coloured filters early last century. There's an excellent Powerpoint presentation on many aspect of using filters on the planets, at www.howardastro.org/documents/Telescope_Filters.ppt.