



# Current Notes

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Readers may remember that, some time ago, I conducted a survey of members of the Manchester Astronomical Society (MAS) to determine what your astronomical interests were. As you will know from my report of that survey in the Summer 2005 issue of Current Notes, the society is roughly evenly split between those whose main interest is Deep Sky observing, and those who prefer solar system observing, particularly the Moon.

In this issue of Current Notes, I am very pleased to be able to include two fine articles concerning Deep Sky observing, together with articles concerning lunar observing, and other topics. I am most grateful to two of our long-standing Deep Sky observers for submitting their articles which I hope you will enjoy, and which I hope will encourage those of us who rarely venture into the Deep Sky, to have a go.

On the issue of trying new things, I have recently turned my hand to lunar drawing, having been enthused by Nigel Longshaw's article on the topic in the Winter 2006 issue of Current Notes. The results of my early efforts are rather modest, but I intend to persevere. I found the whole exercise far more personally rewarding than I had ever expected it would be.

When I joined a few years ago, as a completely novice amateur astronomer, I was soon bitten by the webcam bug. Upon seeing the splendid images being produced by fellow MAS members, and other renown astro-photographers, I rushed in to webcam imaging with what I now see with the benefit of some hindsight, was with a haste that may have caused me to neglect other ways of observing and recording observations.

Of course, no method of recording telescopic views can ever fully and properly represent what can be seen at the eyepiece and, at least in terms of the level of detail and objectivity attainable, digital imaging will often better drawings. However, in my view, the requirement, when drawing, that the draughtsman looks long and closely at his or her subject, helps ensure that he or she will gain some insight about the subject which would otherwise be absent were only digital imaging used.

I urge you, the reader, to have a go at lunar drawing, or the drawing of another astronomical object. I am sure, like me, you will gain much from the exercise.

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**Dr Andrew Fearnside**  
**Editor of Current Notes**

## The King of Siam

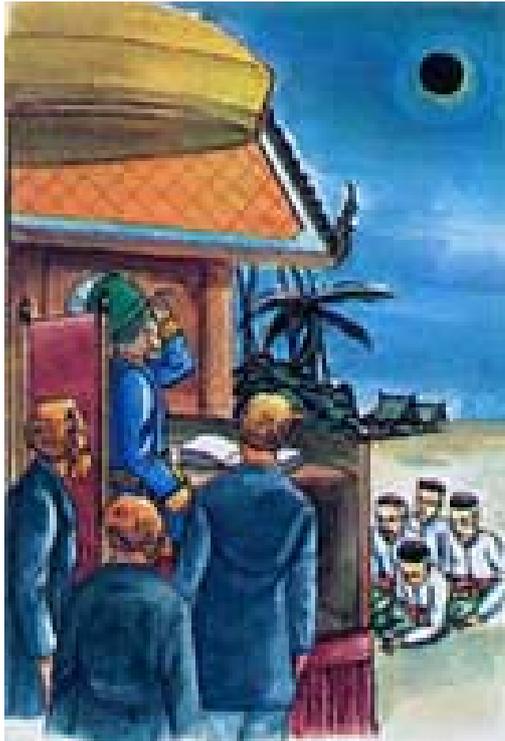
King Mongkut of Siam, a country now known as Thailand, was made famous by Miss Anna Leonowens. Miss Leonowens had taught English to the King's children and later greatly exaggerated her influence upon the King in a book on which the musical "The King and I", and various films, were based.

King Mongkut was born in 1804 and spent 27 years as a Buddhist monk before becoming the King of Siam at the age of 47. Siam at that time was surrounded by countries which were colonized: Pakistan, India and Burma to the east, Singapore and part of the Malay peninsula to the south - all by the British - and Vietnam to the east by the French. King Mongkut kept Siam independent by his statecraft, diplomacy and linguistic skills (he taught himself English, French and Latin). He was also fascinated with scientific instruments and taught himself astronomy, building an observatory in the grounds of his palace.

In 1868 King Mongkut accurately predicted a total solar eclipse and forecast that it could be best viewed from a remote place called Wah Gor Village located at 99° 42' East and 11° 39' North on the west coast of the Gulf of Siam, 240 km from Bangkok. A group of French astronomers accepted his invitation to attend a viewing of the eclipse, together with a retinue of British statesmen. The location was surrounded by jungle, but workmen had been sent months in advance to clear the land and to construct there a royal residence, guest bungalows and a viewing platform. They travelled to the viewing site by river boat and arrived to find not only a French chef for preparing their meals, but also magnums of champagne chilling in ice buckets (the ice being more of a luxury than the champagne).

The morning of 18 August 1868 was grey and overcast, with rain and clouds rolling in from the south. However, the clouds eventually parted to reveal second contact occurring at the exact moment predicted by the King's calculations. Totality lasted for 6 minutes and 46 seconds.

The King's astrologers had predicted that dire consequences would result from the eclipse. Apparent justification for their superstitions came when, after a few days, the King fell ill and died from malaria contracted on the marshy shores upon which the observing site was located.



King Mongkut observing the eclipse of 18 August 1868

The same eclipse was also viewed from India by astronomers. They used, for the first time, a spectroscope to obtain spectra of solar prominences occurring during the eclipse. From those spectra Sir Normal Lockyer identified a hitherto unknown yellow emission line, and identified it as part of the signature of a chemical element as yet unknown on Earth. He later named the element helium, after the Greek word for the Sun - Helios.



The emission spectrum of helium

Helium was first identified on Earth 27 years later. Subsequently it was found that the same spectrum could be obtained from the Sun's corona through a wide spectroscopy slit when the Sun was not eclipsed. This proved that the prominences, from which the spectra derived, emanated from the Sun and not the Moon.

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**Janet Maresh**

### Looking, but not Seeing

Following Nigel Longshaw's excellent article on lunar drawing in the Winter 2006 issue of Current Notes, I resolved to begin drawing lunar features myself.

With clear nights few and far between during the winter and spring of this year, my project suffered a faltering start. However, in advance of a family holiday in the Lake District in May of this year, I resolved to take with me my

telescope, a sketch book and pencils, and more hope of clear skies than bitter experience of Lakeland weather could ever give me just cause to have.

Once there, we were blessed with several clear, fine days, and two clear nights. More than I could reasonably have expected for the time of year. In the dead of the night bridging 3 and 4 May, I set about attempting my first sketch of a lunar feature. With the Moon approaching first quarter, the semi-illuminated crater pairing of Theophilus and Cyrillus presented a striking view of sharply defined shadows cast in stark contrast to well-defined sunlit inner crater walls. This, I thought, would be a good starting point.

Observing began at about 22:30 UT and consisted of nothing more than gazing at the two craters and drinking in as much of the shape and gross features as possible in order to try to gauge the relative proportions, dimensions and shapes of the features before thinking about any of the fine details. This exercise alone drew to my attention more detail and structure than I have ever before realized existed at these craters. They are popular targets for astrophotographers and imagers, and I had already seen a wealth of high-quality images of these craters. Nevertheless, none of those images came close to the level of detail that could be discerned at the eyepiece that night after half an hour of patient observing.

Of course, the seeing was not ideal - it never really is - and only for a split second or so would the craters become clearly visible without obvious atmospheric distortion. However, by patiently waiting for many successive such fleeting moments of clarity, I found myself able to identify aspects of fine detail which I doubt would have been faithfully represented in any webcam image, no matter how much image processing was involved.

Drawing began at 23:10 UT, and ended about 30 minutes later. Colongitude at commencement of sketching was  $341.4^\circ$ , corresponding to a 6.1-day-old Moon. The seeing was a little unsteady, but transparency was quite good, with only a little high, thin haze developing towards the end of the half-hour sketching period.

I used a sketch pad of good quality A4 paper, and pencils of H, HB and B1 to B4 in softness. Using a 127mm Maksutov-Cassegrain telescope, at  $f15$ , with a  $2\times$  Barlow lens and a pair of 28mm eyepieces mounted in a binocular viewer, I employed a magnification of  $\times 136$ . I found that binocular viewing was very effective at allowing me to better perceive detail and contrast on the lunar surface. The splitting of incoming light by the binocular viewer, as between both eyes, also effectively eliminated the dazzle I had suffered when trying to view the Moon with one eye using only the Barlow

lens and one 28mm eyepiece. With my right eye at the eyepiece, I focused my left eye upon the sketch pad, illuminated with a white-light torch. Given the brightness of the view at the eyepiece, there seemed little point in using a red-light torch as this would have compromised my view of the sketch I was producing. The two-eyed technique proved to be very helpful in guiding my hand at the sketch pad.

Starting with a general outline of the main features of the crater pair, I then set about recording the lightly shaded areas of the feature, subsequently shading in successively darker parts with successively softer pencils. I also made notes of details concerning certain features, such as "white", "black", "sharp edge" etc to remind me of what I had seen and perhaps not been able to faithfully represent in pencil. Once the preliminary pencil sketch was complete, and after the night's observing had ended, I added finer details to the sketch while indoors, and under better lighting, according to the notes I had made and with the aid of a putty rubber (a malleable artist's eraser) to define bright areas of the crater. The pencil sketch and notes then formed the basis of a final stippled drawing made using Rotring technical drawing pens, and shown as Figure 7 of the Picture Gallery in this issue of Current Notes.

I note that Kevin Kilburn's digital image of Theophilus, Figure 5 of the Picture Gallery in this issue of Current Notes, was taken at 20:02 UT on 3 May 2006 from Bollington, about four hours prior to commencement of my own sketch of the same feature. One can see how the shadows have receded in that time.

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**Dr Andrew Fearnside**

## **A Hole in the Sky**

On the day of the total solar eclipse at Side, Turkey, I initially thought I might set up my equipment - a 400mm telephoto lens, a Minolta camera and a digital camera - on the balcony of our hotel room. However other members of the MAS had set up on the bar terrace just before the beach, so I decided to set up there at round 10.30 a.m. local time. Several other parties were in the area, and rather nice equipment was being used by a party of German amateurs, including a Takahashi refractor (50mm or 60mm) with a Coronado Hydrogen-alpha (H $\alpha$ ) filter. I was able to have a quick look through the H $\alpha$ -filtered telescope, and saw a number of limb prominences on the Sun.

Time was then taken to set up my equipment. This included a low tripod, and as the Sun was rather higher in the sky than I had expected, it was a little difficult to operate the camera and look through the view finder. I checked the focus of the camera etc, and to add weight to the set-up, I suspended from the tripod a plastic bag filled with sun cream bottles. This

improvisation was a bit rough and ready, admittedly, but seemed to do the job. The images later developed show no signs of camera shake.

First contact occurred bang on time, at around 12.38 p.m. local time, with the Moon entering onto the solar disc at the right-hand leading edge as seen in the camera viewfinder. I took a few images of the partial phases with the camera set on automatic, and with a Baader solar filter on the camera lens. I also took several photographs of the images, formed upon the paving slabs around the patio in front of the bar, of the crescent Sun as sunlight filtered through the leaves on the trees nearby.

As totality approached, there was a marked drop in ambient temperature, with the light changing to a rather strange twilight. These were not the warm colours of twilight one sees as the Sun sets, but a sort of back lit twilight with a rather whitish and cold looking light which made things look a little artificial. At totality, I removed the Baader solar filter from the camera lens and took images throughout the whole range of the camera. By using the self-timer on the camera, I was able to set the exposure to snatch 10-second visual observations of totality. What an incredible sight! The whole eclipse looked very artificial, in the same sense that Saturn appears almost as a drawing when viewed in a telescope. Venus appeared very bright in the west, but I did not notice Mercury. Thin wispy clouds seemed to appear suddenly, and the sky became a very deep blue with a pale reddish colour of sunset around the full horizon. Deep twilight conditions made it difficult to see the buttons on the camera, and I had to operate it by touch alone.

I was struck by how incredibly black the Moon appeared in contrast to the solar corona, very much like the blackness of Venus during its solar transit of June 2004. The solar corona was beautifully defined, being much reduced at the poles of the Sun due to conditions of solar minimal activity. Streamers flowed from the equatorial region, and one streamer in particular had a beautiful conical form due, perhaps, to it being at the location of prominence activity, although I could not tell visually. The coronal streamers were so delicate, yet they wonderfully defined a very pure white light, being gossamer and ephemeral in appearance.

As totality drew to a close I was caught by surprise by the sudden appearance of the "diamond ring" at third contact. I had just completed a two-second exposure, and by frantically pressing the camera shutter again, this meant that an overexposed and blurred image of the diamond ring was the result. All too quickly totality ended, and it certainly did not seem anything like 3 minutes 40 seconds. Strangely, while totality was in progress, it felt like it would last forever - I was actually feeling

quite relaxed. With totality over, it was necessary to immediately put the filter back on the camera lens, as the slightest sliver of the Sun makes for an incredibly bright image.

After totality, many people packed up their equipment, but I and a few others continued to monitor the movement of the Moon off the solar disc. I took a few other shots of the partial phases with the camera set on auto. After the Moon had left the Sun I closed down and packed up my equipment. On the way back to the hotel room I stopped and chatted with Peter Drew and Paul Yates. They both enjoyed the eclipse, Paul taking many images, Peter observing visually.

It was almost a relief to have witnessed this eclipse after the disappointments of Cornwall in 1999. It is a privilege to witness this most wonderful of natural phenomena - one which now seems so surreal. It is no wonder that peoples of the past were terrified when they witnessed an eclipse. The Sun remains bright up until the very beginning of totality when it disappears suddenly. They would have been unaware that anything was untoward until the last moment, when there suddenly appears to be a hole in the sky - someone commented "almost as if you could poke your finger through". I am not sure if I will turn into an eclipse-chaser. I think that the 2006 eclipse from Turkey was almost perfect: a reasonable duration, the Sun high in the sky, and being able to observe from the grounds of our hotel - what could be better? The whole event worked out perfectly but, at another time and in another place, it might be a different story.

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**Nigel Longshaw**

## Lunar Libration

Following our President's clear and colourful explanation of the phenomenon of lunar libration on 25 May 2006 at the Godlee Observatory, I thought it opportune to remind members of a program I wrote a few years ago in Q BASIC called Selene.Bas. It calculates the degree of libration at any time from any point on Earth, and is freely available to MAS members.

It is located on the left-hand computer in the back room of the Godlee Observatory (as viewed when entering that room) under the Q BASIC icon. It is easy to use after a short explanation. The British Astronomical Association (BAA) Handbook also gives libration information, but only maxima and minima.

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**Guy Duckworth FRAS**

## The Turkey Eclipse Trip

### Introduction

Way back in August 1999, a total eclipse of the Sun was visible from a locus of points stretching across Earth from the Atlantic Ocean to the Indian Ocean. I was lucky enough to witness this event from a place close to Reims, in France, on a trip organized by MAS members. After this event, I was hooked. I wanted to see another total eclipse, but where from?

### Astronomical Cost

Some research suggested that the next few eclipses were only going to be visible at quite some distance from the UK. What was needed was an eclipse viewing site which was not going to cost a small fortune to get to, and which would also give a reasonably good chance of clear weather. Turkey, in March 2006, seemed a good bet. So I continued to look into ways of getting there for minimal outlay.

Various options were investigated. One option was to charter an aircraft, assuming that other members of the MAS would want to come too, and sell off the extra seats to other people not in the MAS. At a cost of over £75,000 for the hire of the plane alone, this proved to be too expensive. Hotel costs would have been extra.

Another option was to join an organized tour provided by a company such as Explorer Tours. This would also have been a bit pricey! A further option was to use scheduled air transport, and simply book a hotel myself in Turkey, but this would have entailed difficult flight connections and, again, would have been a bit pricey.

### The Epiphany

It was whilst investigating the path of the eclipse that I noticed that it appeared to pass very close to a holiday resort that features in UK holiday brochures, namely, Side. A little deeper research into the latitudes and longitudes of the eclipse path showed that it would indeed pass close to Side. But how close? In 2001, my wife and I went on holiday to Side and I took with me a GPS device in order to take a few readings up and down the coast from the hotel we were staying at, the Arum. On returning home, and upon inputting this GPS data into my computer, I found that the hotel was within two miles of the centreline of the eclipse. Ideal!

Talking things over with my local travel agent, Options Abroad in Ashton-under-Lyne, we came up with the idea of putting together a group of travellers, in multiples of 12 to get the best discounts from the holiday company, and

travelling with Thomas Cook who, at that time, were the only UK tour operator to feature Side in their winter programme. To cut short a long story - over six years of planning and arranging - I decided that this was the final choice.

### Here We Go...

Our group of 47 travellers arrived at Manchester airport at the very early hour of 5.30 a.m. on Tuesday 28 March 2006 to check in for the flight to Antalya, Turkey. Of the group, 37 were either members of the MAS or a relative of a MAS member, and the remaining 10 group members were non-MAS travellers. The non-MAS travellers were from various parts of England, including Hereford, Essex, South Wales, Cumbria, Yorkshire, Lancashire, and Cheshire. Mr Dave Whalley, an ex-Boltonian currently living in British Columbia, Canada, also joined us. Unfortunately, we lost one passenger - Sue Anspach - due to ill health on the evening before departure. Instead of being on the plane, she spent a day or so in Wythenshawe hospital

I had arranged for our very own check-in desk at Manchester airport, and this resulted in the whole of our group being seated together on the aircraft. A very lively and excited group made their way to Turkey. Some of us had never visited Turkey before, and at least one had never flown before. On arrival in Antalya, we were divided into smaller groups and loaded on to three coaches (yes, three) for the journey to the Arum Hotel in Side. We arrived at our hotel at about 18:20 local time, this being two hours ahead of UK time. I held a brief meeting later that evening to introduce our 47 travellers to the hotel and Side.

After the meeting, my wife and I made our way up to a local bar to arrange for a post-eclipse party the following evening. I had invited everybody who had contacted me via the "Turkey Eclipse Trip" webpage on the MAS website, to join us in either celebrating a successful eclipse viewing, or drowning our sorrows if the weather had been unkind. I told the bar owner to expect at least 50 people.

### The Big Day

On the morning of Tuesday 29 March, we all awoke to find a beautiful day promised. There were a few thin clouds in the sky, but generally it was clear and sunny. Breakfast was a little rushed that morning as most of the group were keen to find a good spot in the hotel grounds, or on the beach, to set up their equipment - which ranged from a basic tripod and camera, to small telescopes and solar telescopes. Some decided to just observe visually using Mylar film or solar eclipse glasses. Bob Parkinson, in particular, was keen to make sure that he removed the solar filter from his camera this time - something that he forgot to do when viewing an eclipse in France in 1999.

Unfortunately Mark Chamberlain, one of the non-MAS members of our group, succumbed to this omission on this occasion. Tony Cross, Mike Oates, Bob Parkinson and Colin Harrison and a few others were located down near the beach, ensconced at tables in the hotel's Beach Bar. Mark Adamson was near the main grassed area outside the hotel, and I was close to the hotel's Bonsai Snack Bar - the highest point in the hotel grounds - hoping to catch a glimpse of the Moon's shadow as it made its way across the sea towards landfall.

At about 12:40 local time, the Moon began to nibble its way across the face of the Sun - this was first contact. Totality was due at approximately 13:55 local time. The sky was almost perfectly clear, with just a little thin high-altitude cloud. The Arum hotel was roughly 1.25 miles east of the centreline of totality, and the duration of totality was expected to be 3 min 45 sec in Side. This is more than a minute longer than the duration of totality of the solar eclipse of 1999 that we had experienced in France, but even so, in the event, it seemed to last for a lot less time than that as we all busied ourselves photographing, digitally imaging or just visually enjoying the spectacle. I personally managed to miss the "diamond ring" of third contact - I was looking away at my timer to see to how much longer the eclipse would last just at the time the Sun made its reappearance from behind the Moon. Damn! It was a spectacular diamond ring too!



Total eclipse of the Sun, by Graham Hodson

Once totality was over, there remained only the partial phases until fourth contact at about 15:13 local time. Some of our group continued to photograph the final phases whilst others took to the bar for a celebratory drink.

### Party on

After dinner that evening, a good number of our group made their way up to the local bar for our post-eclipse party. Many other invited guests started to arrive too. The bar owner came over to me and asked "Where are all these people coming from? You said there would be about

15 people here tonight.” I replied that I had said there would be at least 50. “Oh! I’d better get some more tables and chairs then,” and he dispatched his staff to borrow furniture from other bars up the street.



**Revellers at the post-eclipse party**

In all, about 70 to 80 people turned up to the party, coming from as far as Durham, Norfolk and the south coast of England. All had seen our webpage and used the information there to plan their own trips.

### **Hangover**

The days following the eclipse were spent as each of our fellow travellers pleased. Some chose merely to stay around the hotel grounds and enjoy the many facilities on offer, whilst others took trips into Side town for shopping or to view the ruins of the old Roman town. A good number also took advantage of the various excursions offered by the Thomas Cook representatives, to visit ancient Roman sites such as Perge and Aspendos, or the waterfalls at Kürshunlu and Manavgat. Janet and Mike Maresh organized a hire car, and were joined by Robert Fletcher on a couple of outings to Perge, Aspendos and other sites of interest. However, an evening trip out to find a dark site was not quite successful, as cloud that night spoiled the view of the night sky.

I had also organized an evening trip, by coach, out to a dark site, but this too proved to be not without its problems. The original location, which had been recommended for use on a previous visit to Side, was obscured by low-lying cloud causing our coach to have to make its way further up into the Taurus Mountains to find a suitable location. Although not ideal, we eventually settled for a field to the rear of a disused roadside restaurant, and some good observations and photos were obtained for the next 90 minutes or so.

As part of the hotel’s evening entertainment programme, a Turkish Night was held in the Gazenia Disco area. This included a trio of belly dancers comprising two fine-looking young ladies, and a third of indistinct gender - the large hands and Adam’s apple could have been an indicator, although one or two of our

party were still confused as the real sex of the dancer. A couple of nights later, on the last night of our weeks stay in Side, there was a belly dancer performing at a bar close to the hotel and this time there was definitely no doubt about the gender of this lady. About 10 of our party had made their way up to the bar and an excellent evening was had by all.



**A dancer of unquestionable gender**

The journey back to Antalya airport the following afternoon was more or less a repeat of our in-bound coach ride - we were all distributed across three coaches, arriving at the airport at different times due to pick-ups at other hotels. This was where my problems began. Luggage is X-rayed on the way into all Turkish airport buildings and having myself taken a few meteorite samples with me to Turkey in the hope of selling some, I was taken to one side and spent the best part of twenty minutes trying to convince the authorities that these lumps of “rock” were not some ancient artefact stolen from a Turkish archaeological site. Fortunately, I managed to persuade them that these rocks were actually lumps of iron from Argentina, otherwise I would probably be writing this article in crayon from a damp, dingy prison cell.

Some members of our group sported a fez as they travelled home on the plane, obviously still in Turkish mood. Sadly, our party was a little more spread out around the aircraft than on our outward journey, and although we were all in good spirits, the jolly atmosphere was to some extent low-key. From reports received after our return, it appears that every single member of our party thoroughly enjoyed not only a superb total eclipse, but also a superb week’s holiday at the Arum Hotel, in Side. Some liked it so much that they are planning to return for a longer stay sometime soon.

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**Graham Hodson FRAS**

## High-Resolution Moon Imaging with a Simple Digital Camera

### Introduction

In the past five years amateur astronomical photography has been revolutionized by the availability of cheap digital cameras. There have been many articles published in the popular astronomy magazines covering most aspects of this, including video imaging, digital stills imaging and webcam photography. The latter really came into prominence during the opposition of Mars in August 2003 when amateurs using cheap webcams and image stacking and processing software, such as RegiStax, produced still pictures that exceeded the quality of professional pictures taken less than a decade earlier.

### Webcams

To enable a webcam to intercept a light cone from a telescope and focus it directly on to its digital sensor, the standard wide-angle lens of the webcam is usually removed. The telescope then replaces the wide-angle webcam lens and effectively acts as a super-telephoto lens giving very high magnification. Registax, developed by its author Cor Berrevoets, is downloadable freeware that has transformed webcam imaging into perhaps the most powerful tool for high-resolution lunar and planetary photography. If webcam imaging has any drawback, it is the need to have a cheap webcam connected to a relatively expensive laptop computer, or a dedicated desktop computer close to the telescope in an observatory, in order to capture the AVI files necessary for RegiStax to subsequently process into high-resolution still images. This requires a costly investment in a laptop computer or a small observatory.

### An Alternative

A totally mobile and stand-alone alternative, without the need for computer connection, is to use a digital point and shoot camera costing less than £200, or its dollar equivalent in the USA. Having non-removable zoom lenses, these cameras need to be used in an afocal arrangement that involves pointing the camera into the telescope eyepiece with the camera focused at infinity. The camera lens then intercepts the parallel rays of light exiting the eyepiece much in the same way that the observer's eye would. This arrangement is OK for taking individual shots of the Moon and planets, but is limited to relatively short exposures dictated by atmospheric seeing, telescope tracking accuracy and the necessarily low magnification needed to ensure that a sufficiently bright image is presented to the camera.

A compromise alternative exploits the best of both imaging techniques and at an affordable price.

Most digital cameras will take short duration movies, and enable one to produce the movie files needed to produce high-resolution images via RegiStax. My two-year-old Nikon Coolpix 5200 has a sensor chip comprising five million pixels and will store over six hundred still images on a 1Gb memory card or, alternatively, more than 11 minutes of video imaging in the highest quality TV video mode. Used afocally on a 125mm (5") Maksutov-Cassegrain telescope, fitted with a home-made telescope extender to give a higher optical magnification, I can record 20 30-second MOV files during an observing session. Once converted into AVI format, these video files may then be processed using RegiStax to produce images that can attain a resolution of one mile on the surface of the Moon. This is close to the theoretical resolving power of such a small telescope, and produces permanent images far better than I have seen visually with a much larger instrument such as my old 12" Newtonian. My lunar astronomy has taken a turn for the better. I now sit comfortably at my computer and can really study the lunar surface.

### Home Videos

The Nikon Coolpix 5200 camera, when in video mode, automatically adjusts its exposure levels and gives a far wider range of accommodation than a single snapshot would produce. Bright areas of the Moon are not burned out, whilst shadows retain detail that can be brought out in subsequent image processing. The technique is not without its drawbacks, however. My 1Gb camera memory card will hold about 20 compressed video files in MOV format, which may be downloaded to my computer hard drive. I then use the shareware program known as Smartsoft Video Converter, to change the video files from MOV format to an AVI format. Unfortunately, Registax still cannot use this particular format of AVI without further converting the video files to an old AVI format. I thank Cor Berrevoets who suggested using another freeware item, known as VirtualDub, to perform this additional conversion.

However, note that, because each 30-second compressed MOV video file is converted to an uncompressed 700Mb AVI video file, an accumulation of such files will rapidly mop up computer hard drive space, and can severely compromise your computer. I avoid this problem by saving the video files, in compressed MOV format, on a CD or DVD. I then delete the video files from my hard drive and subsequently convert them, individually, from the CD or DVD, to the required AVI format, immediately before processing them with RegiStax.

The final, processed, still image is then saved as a bitmap file. The AVI file from which the final bitmap image was derived, is then deleted from my computer hard drive to retrieve disk space. I typically convert and process no more than three or four such AVI files at a time. Converting from MOV format to AVI format, and then to old AVI format, takes about 15 minutes when using my old 650GHz, Pentium 3 computer, which has a 1Gb RAM. The processing, on RegiStax, of AVI video files typically comprising 600 to 700 frames, then takes another 10 minutes, and a further 10 minutes of processing with Photoshop is typically required - but the result is good.

### Tricks of the Trade

The key to the success of this low-cost technique is to present a highly magnified optical image to the camera, video it and then use computer software to do the image processing. My 127mm Maksutov-Cassegrain telescope has a focal length of 1500mm. Photographically speaking, it is working at an  $f$ -ratio of  $1500/127 = 11.8$ , but it is necessary to increase the focal length, and hence the magnification and  $f$ -ratio, by a very considerable amount. I use a  $\times 2$  telenegative lens, fitted to the telescope by a suitable adaptor, to double the focal length to 3000mm and increase the  $f$ -ratio to  $3000/127 = 23.6$ . Image brightness drops by a factor of 4 as a result. An eyepiece of either 25mm or 10mm focal length is then used to intercept the exit cone.

I prefer the latter for maximum optical magnification. The camera lens, at as near as possible to maximum zoom, then views the parallel rays of light exiting the eyepiece. The image is dim but the automatic controls associated with through-the-lens video capture take care of this. The resultant field of view is about 3 arcminutes wide, this being one-tenth of the Moon's diameter, equating to about 260

miles across near the centre of the lunar disc. In a  $640 \times 480$  pixel TV mode, the resolution is about 3.5 pixels per arcsecond, or about 2.5 pixels per mile. Even with moderately poor seeing, lunar details below three miles across are resolved.

The processing of video files using RegiStax then follows. This software registers not only the atmospherically turbulent image frames, but also follows any tracking errors in the telescope RA drive - an unguided SkyWatcher EQ5 mounting in my case. Trial-and-error image processing on RegiStax showed to me that wavelet-processing bottom-up gives me the best results. The six levels of wavelet manipulation in RegiStax are ranked top-down in the sense that level one sharpens image details at the smallest scale, while level six sharpens at the largest scale.

I found that if level six, the coarsest, is set at 25, level five at 15 and level four at 10, this gives a substantial gross improvement to the image without the "orange peel" effect that can be introduced by the more delicate (i.e. lower) levels - these should be experimented with. Saving the image as a bitmap file, final processing on Photoshop CS2 follows, to adjust the levels and shadow/highlights to bring out extra detail.

### Conclusion

The results speak for themselves. Representative images are illustrated in Figures 1 to 5 of the Picture Gallery in this issue of Current Notes. These images were taken under atmospheric seeing conditions ranging from poor to medium. Since I started lunar video imaging in February 2006, I have yet to experience high-quality seeing conditions. I hope to do better.

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Kevin J Kilburn FRAS

## Picture Gallery



Figure 1: Petavius, by Kevin Kilburn FRAS



Figure 2: Torricelli, by Kevin Kilburn FRAS



Figure 3: Atlas and Hercules, by Kevin Kilburn FRAS

Picture Gallery



Figure 4: Aristarchus, by Kevin Kilburn FRAS

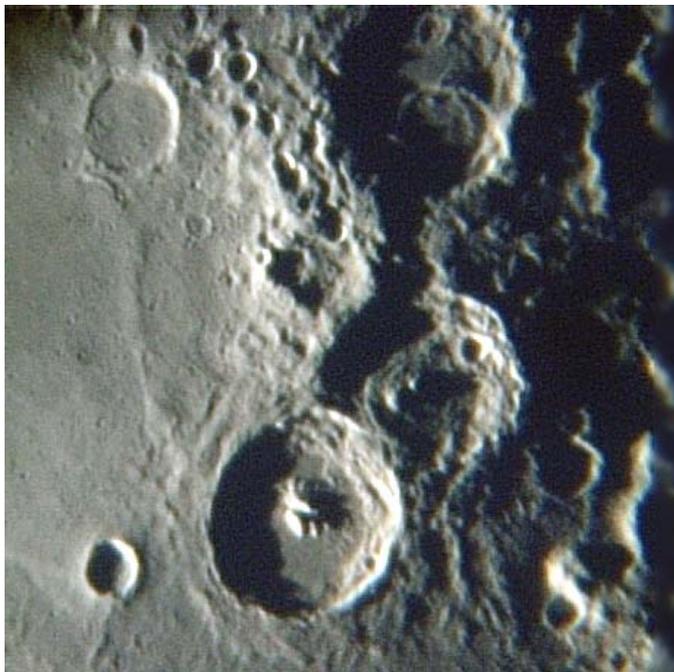


Figure 5: Theophilus, by Kevin Kilburn FRAS

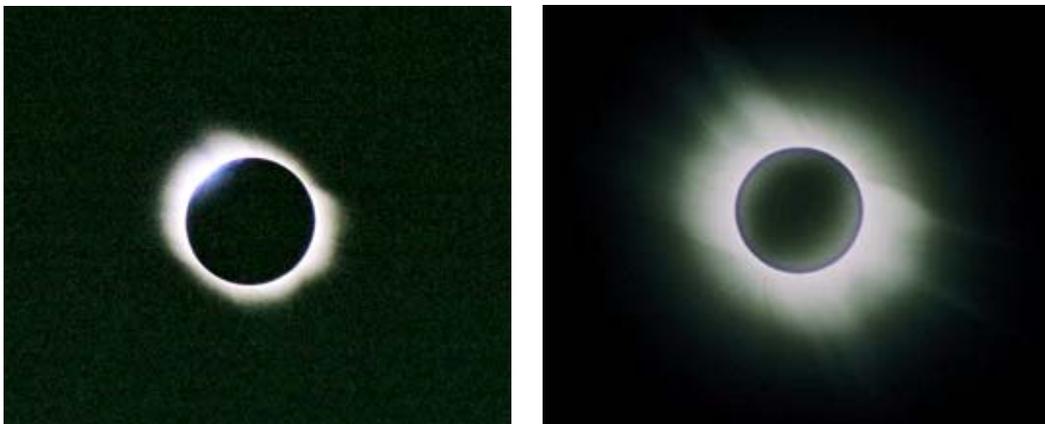


Figure 6: Total eclipse of 29 March 2006 from Side, Turkey, by Nigel Longshaw

Picture Gallery

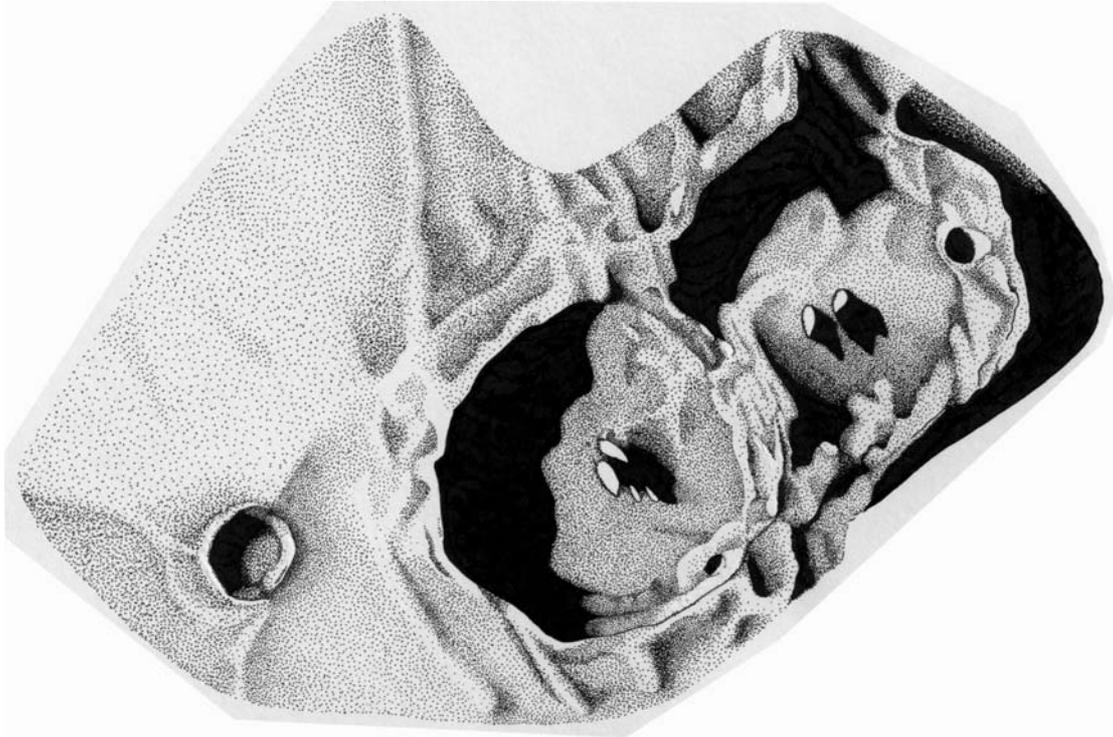


Figure 7: Theophilus, Cyrillus and Maedler at 23:10 to 23:40 UT on 3 May 2006, by Dr Andrew Fearnside

## Introduction

For more than four centuries astronomers have known that some stars vary in brightness. In 1596, David Fabricius realized that a star he had observed in August of that year, in the constellation of Cetus, had apparently disappeared by the following October. Bayer rediscovered the star in 1603 and, subsequently, Holwarda determined that the star varied cyclically with a 332-day cycle. Helvelius named the star Mira - "The Wonderful". This is the variable star  $\alpha$  Ceti, in modern parlance.

For almost three centuries, however, the number of known variable stars remained low in number. Today, the General Catalogue of Variable Stars now contains 40,000 variable stars, and the BAA records contain around a million variable star magnitude estimates.

## In a Galaxy Far, Far Away...

In 1920 Hoffmeister discovered a most unusual variable star - BL Lacertae - in the constellation of Lacerta. This star's brightness varied wildly, and its featureless spectrum displayed no absorption or emission lines. At about the same time Edwin Hubble, using the 100-inch Hooker Telescope, detected Cepheid variables in Messier 31, and determined that the spiral galaxy in question is actually beyond the Milky Way. Then, by making redshift measurements he realized that the majority of galaxies were moving apart. In 1943 Carl Seyfert discovered that some galaxies have very bright centres, or "nuclei" to use the proper term. Rather than displaying the usual dark spectral *absorption* lines displayed in the spectra of normal galaxies, Seyfert galaxies, as they came to be known, possessed nuclei with spectra displaying broadband *emission* lines.

By about 1960, astronomers had become puzzled by the spectrum of a radio source having the unedifying appellation of 3C48. However, in 1963 Maarten Schmidt realized that the peculiar spectrum of another radio source, known as 3C273, could be explained in terms of its spectral lines associated with hydrogen having redshifted by 16%. It was then realized that the spectrum of 3C48 could be explained in similar terms as being associated with hydrogen, and redshifted about 35% - a huge amount. These objects became known as quasi-stellar radio sources, or quasars, although it was soon realized that many similar such objects are not, in fact, strong radio sources.

Using occulting techniques, with very large telescopes, astronomers came to the realization that BL Lacertae is not simply a star

with an unusual spectrum. By occulting this "star" and thereby blocking out the direct light from it at the telescope, a spectrum of the faint outer regions adjacent to the "star" could be detected. It transpired that the "star" was, in fact, the bright and very small central area of a galaxy whose outer regions had previously gone unseen, but were now visible using the occultation method. It was thus appreciated that the more obvious bright object originally observed was not a single relatively nearby star, but the nucleus of a distant galaxy.

## A Hive of Activity

These rather strange objects collectively became known as active galaxies and, generally speaking, their behaviour can be traced to powerful activity within their nuclei; hence, the appellation active galactic nucleus (AGN). Although AGNs are bright, it must be said this not so by ordinary standards as seen from Earth. Even many of the more obvious AGNs are 100 times (i.e. six magnitudes) fainter than the faintest naked eye stars of magnitude 6. Furthermore, AGNs may alternately fade and brighten irregularly by similar brightness ranges. For example, bear in mind Messier 31, the spiral galaxy nearest to the Milky Way, which appears to us as a faint fuzzy object visible to the naked eye at magnitude 4 at a relatively neighbourly distance from us of 2.5 million light years. Compare this to the quasar 3C273, which has a brightness of magnitude 11.7 at best, but is an enormous 2.1 billion light years from us. Thus, the big question about quasars was, considering their large redshifts, what mechanism could make these galaxies, or rather more particularly their nuclei, so extremely bright.

## The Hole Story

In 1971 observations suggested that a strong X-ray source, known as X-1, in the constellation of Cygnus, was probably a black hole, the first black hole to be indirectly detected with reasonable certainty. It is now believed that many galaxies possess a massive black hole, weighing in at millions of solar masses, at their centres. The idea is that the black hole gobbles up nearby material in an accretion disc surrounding it, and in the process releases tremendous amounts of radiation, which accounts for the brightness of the AGN. Even relatively ordinary galaxies, such as our Milky Way, might contain such massive black holes at their centre, but there may be little or no nearby material to gobble up, and so radiation produced at the black hole is far less bright.

As well as being the engines creating the brightness of AGNs, compact supermassive black holes could solve the problem of how the apparent brightness of AGNs can change so

rapidly. There are four main categories of active galaxy, as follows.

**Seyfert galaxies:** an example is Messier object M106. In such galaxies, the galactic nucleus and the active accretion disc surrounding it are visible, but activity is weak.

**Radio galaxies:** an example is NGC 383. In galaxies such as this, the galactic central region is blocked from view by the dust ring, and only radio-emitting lobes are readily detected.

**Quasars:** an example is 3C273. Observers of this object can see the brilliant nucleus over the edge of a surrounding dust ring.

**Blazars:** an example is 3C279. Observers of blazars look straight down the jets created by the central black hole, and can peer into the bright nucleus.

It seems likely some of the apparently different categories given above may actually be simply different manifestations of similar objects.

## The Project

In early 2006, I received a BAA Deep Sky Section newsletter requesting magnitude estimates for a blazar OJ 287. Professional astronomers have been studying OJ 287 and other blazars for many years while amateur astronomers, collectively having more telescope time available to them, have also been monitoring several of the brighter similar objects. Blazar OJ 287 varies in brightness in unusual ways over a brightness range of magnitude 12.4 to 16. At its brightest, OJ 287 can be observed visually with a 6" telescope but, when faint, it is at the limit of even the biggest amateur telescopes for visual observation. Astronomers have found that the brightness fluctuations displayed by OJ 287 seem to have an overall periodicity of about 16 years, and some astronomers have predicted that a particularly interesting maximum in brightness will occur in 2006.

I use an 8" Schmidt-Cassegrain "Go-To" telescope (SCT), the Meade LX200, and a Starlight Xpress MX7-16 CCD camera for Deep Sky imaging. This equipment enables me to image stars as faint as about magnitude 19, even from my fairly light polluted observing location. A friend using similar equipment has imaged stars as faint as magnitude 20.5 stars from a similar sort of location. Using my 8" SCT and CCD, I found that I could satisfactorily image OJ 287 over its full range of brightness variations. My Starlight Xpress MX7-16 CCD is a 16-bit black and white camera. One-shot colour cameras are not suitable for photometric brightness measuring. By good fortune, I had received very valuable guidance on conducting CCD photometry, from Ken Irving a short time before receiving the Deep Sky Section

newsletter concerning blazar OJ 287. Thus, I was able to get stuck in to the OJ 287 project using an equatorial mounted polar aligned telescope driven in RA to track stars on a CCD camera and computer.

## First Light

The first imaging session took place on 8 February 2006, and it went surprisingly well, even though my LX200 is past its best, and both the "Go To" and tracking performances leave a lot to be desired. After an hour setting up and polar aligning the telescope - a regular chore for portable telescope users, avoided by those with a permanently set up observatory - and despite my telescope's dodgy "Go To" function, I found OJ 287 in six or seven minutes. The sky was quite transparent by usual standards, and I could see magnitude 4.3 stars in Ursa Minor with the naked eye. With my telescope and equipment behaving impeccably, or at least better than usual, I soon obtained four satisfactory 60-second CCD exposures of OJ 287, and then a series of short 2.2-second flat-field frames using a home-made light box. Equivalent dark-field frames were obtained with the telescope capped-over, as well as 60-second dark-field frames. My CCD imaging session ended at 23:10 UT, after which I observed Saturn and imaged it with a webcam.

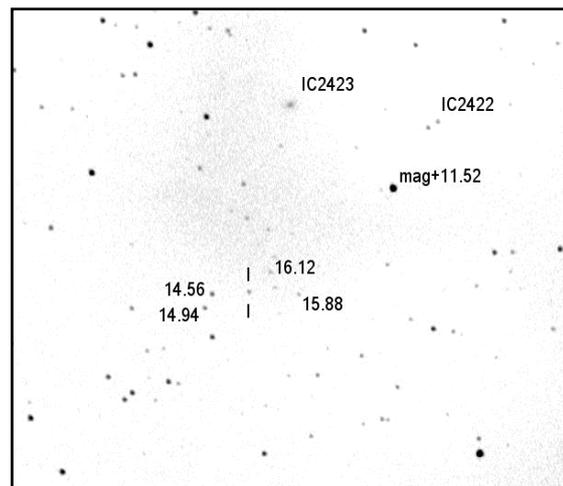


Figure 1: OJ 287, and comparison stars

The next day, I processed the OJ 287 images using Starlight Xpress software, by first applying flat-field and dark-field frames, then stacking the four calibrated 60-second OJ 287 images by averaging (not adding) them together. However, at the next stage of photometry, I soon had problems. My final image of OJ 287, illustrated in Figure 1, covered a field of 27x18 arcminutes of sky, and included only four known comparison stars approved by the BAA - the minimum number with which the photometric procedure would work. Unfortunately, though the photometric software would register the two brighter comparison stars displayed on my image, those of magnitude 14.56 and 14.94, the two fainter

stars at magnitudes of 15.8 and 16.12 would not register. I knew that applying image enhancement processing techniques would produce a result utterly useless photometrically, so what could be done?

After discussing the matter with Ken Irving, and both the BAA Variable Star Section Director, Roger Picard, and project co-ordinator Gary Poyner, it was suggested that I change my finalized OJ 287 image format from "5X" to FITS. Voila! In FITS image format, the necessary four comparison stars were registered by the photometry software I have. A few more mouse clicks produced a calculated magnitude for OJ 287 of 15.535 at 22:55 UT, 8 February 2006. However, although my result is given here to an accuracy of three decimal places, I note that the BAA comparison stars I employed had magnitudes quoted to only two decimal places. Furthermore, by not using calibrated *U*, *B*, *V* or *J* photometric filters, the photometric accuracy of this result may be slightly less than the 0.01 magnitude accuracy suggested. Even so, I think my magnitude estimate probably has an accuracy of better than 0.05 magnitudes, and an improvement on the level of accuracy that can be achieved by experienced visual variable star observers.

### Standard Practice

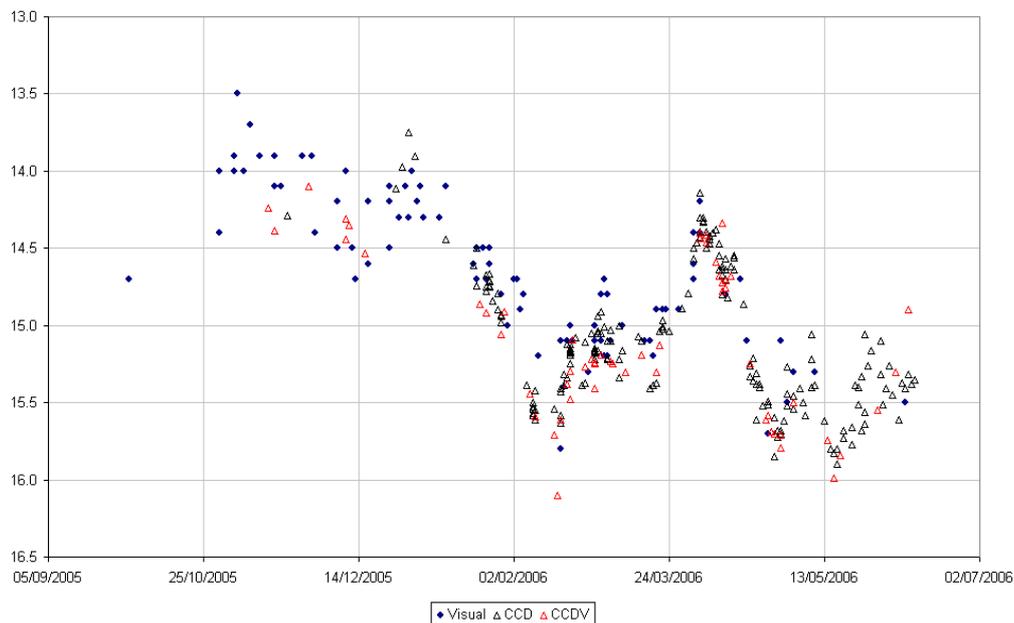
Both Roger Picard and Gary Poyner were satisfied with my first OJ 287 photometric magnitude estimate, and those that I subsequently reported to them, in contribution to the BAA Deep Sky Section project. In just over 100 nights of imaging, I imaged OJ 287 on 26 of them. After my initial success, I had intended to standardize my OJ 287 imaging technique, to ensure consistency, by using my LX200 at an *F*ratio of *f*6.3, and by taking four 60-second images during each imaging session.

This proved to be impractical at times, and so I sometimes took eight 30-second images using an *f*3 focal reducer, thereby widening the field of imaging to 36×27 arcminutes. This provided the advantage of including more of the BAA-designated comparison stars, but the disadvantage of increased vulnerability to light pollution. Nevertheless, over a four-month period, I obtained eight sets of CCD images of OJ 287 suitable for photometry, and the magnitude estimates derived from those images are listed in Table 1. The first four results were obtained using four one-minute exposures, while the last four results were obtained using eight 30-second exposures.

Date	Time (UT)	Magnitude
08/02/2006	22:55	15.54
18/02/2006	23:33	15.32
01/03/2006	21:12	14.95
03/04/2006	21:27	14.14
13/04/2006	21:14	14.64
21/04/2006	21:44	15.56
01/05/2006	21:37	15.27
09/05/2006	22:39	15.06

Table 1

Of course, my few meagre results alone do not provide a definitive scientific analysis of the characteristics of OJ 287. They do become useful as a contribution to the combined results of many more hopeful observers. Indeed, the more observers the better, both those using CCDs and those observing visually. I reproduce at the foot of this page, a graphical illustration of the activity of OJ 287 as observed by the many contributors to the BAA observing project [1], myself included.



The vertical axis of the light curve at the bottom of page 14 represents the magnitude of OJ 287, while the horizontal axis represents the date of observation. Both visual and CCD (filtered and unfiltered) results are shown.

### The Professionals

Some professional astronomers (not all) have predicted that OJ 287 would likely display an outburst in early to mid 2006. My own few early results seemed to indicate that an outburst might be in progress. However, having attained a brightness of almost magnitude 14 in early April, my results record a subsequent downturn, with brightness declining to magnitude 15.5 before the end of the month. Some authorities on the subject have suggested that this might happen. However, others have said that the outburst predicted to happen in mid May has, in fact, already occurred during the period of October-November of last year. The results shown in Table 1 just start to show that could indeed be the case. Unfortunately, by the end of the period of observations covered by Table 1, OJ 287 was heading westwards in the evening sky towards conjunction with the Sun, and I had to break off my observing project. Nevertheless, OJ 287 should be observable in UK morning skies in a few short months, but my circumstances are such (poor east horizon and late getting out of bed) that I am unlikely to observe OJ 287 again until late in the year or early in 2007.

The overall picture seems to be that the light curve of OJ 287 is quite complicated and tricky to understand. There appears to be an overall long-term 11.6-year periodicity of alternate rises and falls in brightness, with another 1.1-year cycle superimposed upon it. The overall magnitude variations have ranged between magnitude 16 to 12.4. Why should this be? One

intriguing suggestion [2] is that OJ 287 is certainly no ordinary object, and could comprise two separate massive black holes orbiting in the active core, i.e. an AGN containing a binary black hole system. OJ 287 seems to be worthy of long-term attention.

*[Editor's Note: I would like to thank Gary Poyner, with whose kind permission the light curve at the foot of page 14 is reproduced here, having been taken from his OJ 287 observing project website at [http://www.garypoyner.pwp.blueyonder.co.uk/oj\\_camp.html](http://www.garypoyner.pwp.blueyonder.co.uk/oj_camp.html).*

*Gary informs me that there will be a short piece on OJ 287 in the August edition of the BAA Journal. Any reader intending to begin monitoring OJ 287 should note that observations just after solar conjunction (mid September) are VERY important. If you do manage to get any data, please send it to Gary - his contact details are on the above website.]*

### References

[1] The light curve at the foot of page 14 is reproduced by kind permission of Gary Poyner, the coordinator of the BAA observing project. Contributors of data to this light curve are David Boyd, Steve Brady, Tim Crawford, Tim Haymes, Adrian Jones, Stefan Karge, Robin Leadbeater, Frank Melillo, Jennie McCormick, Cliff Meredith, Richard Miles, Martin Mobberley, Roger Pickard, Gary Poyner, Diego Rodriguez, Graham Salmon, Jeremy Shears, Dave Storey, Andrew Wilson, Tom Lloyd Evans, Chris Jones, Robert Paterson, Mike Simonsen, John Smith, Dave Storey, John Toone and Jani Virtanen.

[2] *OJ 287: Binary Pair of Supermassive Black Holes*. A. Sillanpaa et al, *The Astrophysical Journal*, **325**: 628-634, 15 February 1988.

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Cliff Meredith

## Introduction

The term “planetary nebulae” was coined by Sir William Herschel because of the resemblance of these objects, or more specifically, the resemblance of NGC 1514, in Taurus, to the planet Uranus with its greenish blue disc.

Planetary nebulae represent the latter stages of evolution of average sized stars like our Sun, namely, the stages occurring after the red giant stage and before the white dwarf stage. In these nebulae, an extremely hot and rapidly rotating star - often a Wolf-Rayet or O-type star with a surface temperature of 30,000 K to 250,000 K - has sloughed off large amounts of matter. This mass ejection typically produces a colourful, and strangely structured, surrounding nebulae, images of which have now been made famous by the Hubble Space Telescope. The green colouration seen in these objects is caused by the presence of doubly ionized oxygen atoms and this colouration can also be seen when viewed using amateur-sized equipment.

## Shape and Structure

Table 1 displays a current “VV” classification (after Vorontsov-Velyaminov) of shapes found in planetary nebulae.

VV Class	Shape
1	Stellar Image
2	Smooth Disc: 2(a) brighter towards centre; 2(b) uniform brightness; 2(c) traces of ring structure.
3	Irregular Disc: 3(a) very irregular brightness distribution; 3(b) traces of ring structure.
4	Ring Structure
5	Irregular Form (similar to diffuse nebula)
6	Anomalous Form

Table 1

Table 2 provides a list of brighter planetary nebulae for observing. When observing the objects listed in Table 2, see if you can categorize the object correctly using the VV classifications in Table 1.

Many planetary nebulae have high surface brightness and will withstand high magnification well. Indeed, you may need to employ high

magnification to properly determine the shape of the nebula you observe.

## Galactic Coordinates

In the list of objects in Table 2, I give either a Messier number or an NGC (New General Catalogue) number, to define the nebula. These numbers are followed by a PK number. The appellation “PK” represents the initials of the two astronomers, Perik and Kohoutek, who formed a catalogue in 1967.

The PK numbers represent the galactic coordinates of the object. The first block of up to three digits is the galactic longitude, while the second block of up to two digits, preceded by either a + or - sign, is the galactic latitude. The final digit, preceded by a decimal point, is the position within a square degree, going from north to south. Galactic coordinates are not very useful to amateurs so, following Table 2, I provide formulae with which to convert the PK galactic coordinates to celestial coordinates - ignoring the last digit of the PK number. I will leave you, the reader, to perform these conversions as an exercise, in order to enable you to locate the objects on a star map. Be careful when taking arctangents since the quadrant specified by the +/- signs of the numerator and denominator of the bracketed fraction must remain the same after inversion. If not, corrections of +/- 90 degrees, 180 degrees or 360 degrees must be applied. You will find a fuller article on this in the issue of Current Notes dated May 1999, including a program, which performs the calculation. The coordinates calculated are only accurate to one square degree.

## Observing Targets

Andromeda and Perseus are more properly autumn constellations, but the objects listed in Table 2 are effectively circumpolar. Both Aquila and Sagittarius contain many such nebulae, but most are very faint. Try using an 8” diameter, or higher, telescope to observe these objects, with a range of eyepieces and a Barlow lens. A telescope of 6” diameter would be OK for the brighter of the targets listed in Table 2. Unfortunately, binoculars are not ideal for observing planetary nebulae, except for the very brightest nebulae, such as M27. The central stars in planetary nebulae are much fainter than the surrounding nebula.

Whilst in the Sagittarius region, you might wish to try locating the following bright gaseous nebulae, which are also star-forming regions:

- M8, the Lagoon;
- M20, the Trifid;
- M16, “The Eagle” Serpens Cauda;
- NGC 6604, located to the north of M16.

The last object may possibly only be visible with a nebula filter, but all are spectacular objects for astrophotography, being much

larger than planetary nebulae. Use red sensitive film to bring out the best colours.

The equations following Table 2 are those with which to convert galactic coordinates to celestial coordinates. The variable  $L$  is the galactic longitude, and the variable  $B$  is the galactic latitude. The quantity  $a$  is the right ascension, and the quantity  $d$  is the declination.

It would be extremely welcome at the next AGM if any member, who has or will borrow a Society telescope, makes a respectable report to the MAS on his or her observations of these objects heretofore mentioned. The paucity of such reports in recent years has not been a good reflection on the Society.

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**Guy Duckworth FRAS**

Messier/NGC number	PK number	Constellation	Nickname	Photographic magnitude	Size (arcmin)
NGC 40	PK 120 +9.1	Cepheus	C2	10.7	1.0 × 0.7
NGC 6543	PK 96 +29.1	Draco	Cat's Eye	8.8	0.3 × 5.8
M97/NGC 3587	PK 148 +57.1	Ursa Major	Owl	12.0	3.23 diameter
NGC 6826	PK 83 +12.1	Cygnus	Blinking	9.8	0.5 × 2.3
NGC 7027	PK 84 -3.1	Cygnus	Proto-planetary?	10.4	0.25
M27/NGC 6853	PK 60 -3.1	Vulpecula	Dumbell	7.6	5.8 × 15.2
M57/NGC 6720	PK 62 +13.1	Lyra	Ring	9.7	1.2 × 2.5
NGC 6572	PK 34 +11.1	Ophiuchus	---	9.0	0.25 diameter
NGC 6781	PK 41 -2.1	Aquila	---	11.8	1.81, v. faint
NGC 6818	PK 25 -17.1	Sagittarius	Little Gem	9.9	0.3 diameter
NGC 7662	PK 106 -17.1	Andromeda	Blue Snowball	9.2	0.33 × 2.2
M76/NGC 650-1	PK 130 -10.1	Persius	Cork	12.2	1.1 × 4.8

**Table 2**

$$d = \arcsin \{ \cos(B) \cos(27.4) \sin(L - 33) + \sin(B) \sin(27.4) \}$$

$$a = \arctan \left\{ \frac{\cos(B) \cos(L - 33)}{\sin(B) \cos(27.4) - \cos(B) \sin(27.4) \sin(L - 33)} \right\} + 192.25$$

## The Work of the Rousdon Observatory 1886 -1921

### Introduction

This article is the result of a talk on the life of Charles Grover, given to the Society for the History of Astronomy at the Birmingham Midland Institute in the autumn of 2005. It was inspired by a desire to examine more closely the work of my astronomer ancestor.

### Background

The year 1882 brought together two men of widely differing social class, learning and status. One of those men was my great-great-grandfather, Charles Grover, born in Chesham in 1842, the son of a shoemaker. Orphaned at the age of eight, after a rudimentary education he was apprenticed to a brushmaker at the age of twelve.



Charles Grover

The other man, Cuthbert Edgar Peek, born in 1855, was the only child of a wealthy London merchant, Henry William Peek, who was created a baronet in 1874. Educated at Eton and Pembroke College, Cuthbert gained his BA and MA from Cambridge and was a Fellow of the Royal Astronomical Society (RAS), the Royal Geographical Society and the Society of Antiquaries.



Cuthbert Peek

Cuthbert employed Charles as his assistant for the transit of Venus expedition to Australia (for an account of the expedition see the Summer 2004 edition of Current Notes) and thereafter Charles worked in the observatory that

Cuthbert built on his father's estate in Rousdon, Devon.



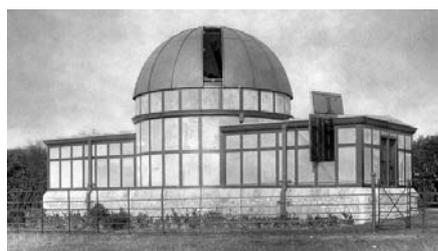
Henry William Peek

### The Work

Cuthbert's interest was the study of long-period variable stars, with a view to establishing their light curves, and thence, it was hoped, an understanding of the reason for their variation. Twenty-two stars were studied on a regular basis, and the continuity of instrument, observer and location added to the importance and reliability of the observations. Argelander's method was used, by which the observer visually estimated the difference in brightness between the variable star and two, or more, comparison stars of known magnitude. Rousdon used five comparison stars, in order, it was supposed, to achieve greater accuracy.

### Equipment and Observatory

The instrument used throughout was a 6.4-inch (160 mm) achromatic refractor of 74-inch (1880 mm) focal length, made by Merz of Munich, on an equatorial stand made by Cook of York. It was fitted with a weight-driven clockwork drive. Originally owned by William Garrow Lettsom, the instrument was bought by Cuthbert in 1882 in order for him to observe the transit of Venus. It was shipped to Australia for the event and, after its return to England, was installed in the Rousdon Observatory in 1884. The plan of the observatory was simple in design, the 16-ft diameter dome of the "Equatorial Room" being built above a circular "Photographic and Chemical Laboratory" at its ground floor. Symmetrically attached to the west and east were, respectively, a Computing Room and a Transit Observatory.



The Rousdon Observatory

## Results

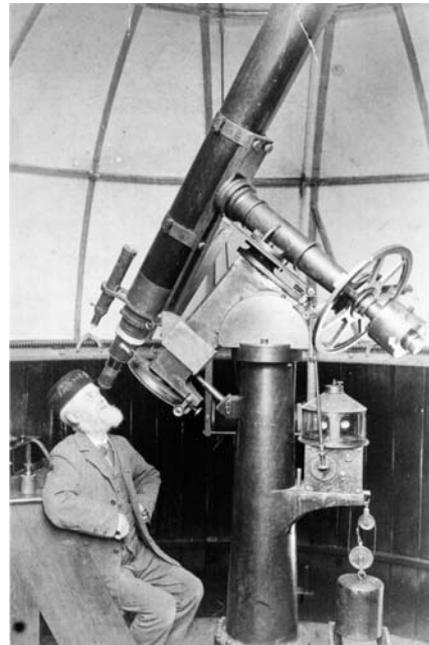
The Monthly Notices of the RAS contain annual reports of the Observatory for every year from 1886 to 1920. They include the annual total of the number of nights on which observations were made, and the total number of observations made. These are shown in the graph illustrated in Figure 1.

In addition, for the years from 1892 to 1910 the English Mechanic (EM) magazine published monthly reports under the heading Variable Star Observations (VSOs). The regularity, or otherwise, of these monthly summaries also gives an indication of the intensity of the work. They first appeared in 1892 with three reports. From 1893 until 1902 there were 12 reports for each year, with the exception of 1894 when only 11 appeared. There was a gradual decline from 1903 with nine reports, until 1910 - the year of the last two reports. The actual figures are: 1903, nine reports; 1904, six reports; 1905, five reports; 1906, five reports; 1907, seven reports; 1908, five reports; 1909, three reports; 1910, two reports. It seems that this decline in the number of VSOs is matched by that in the number of recorded observations for the same period.

## Analysis

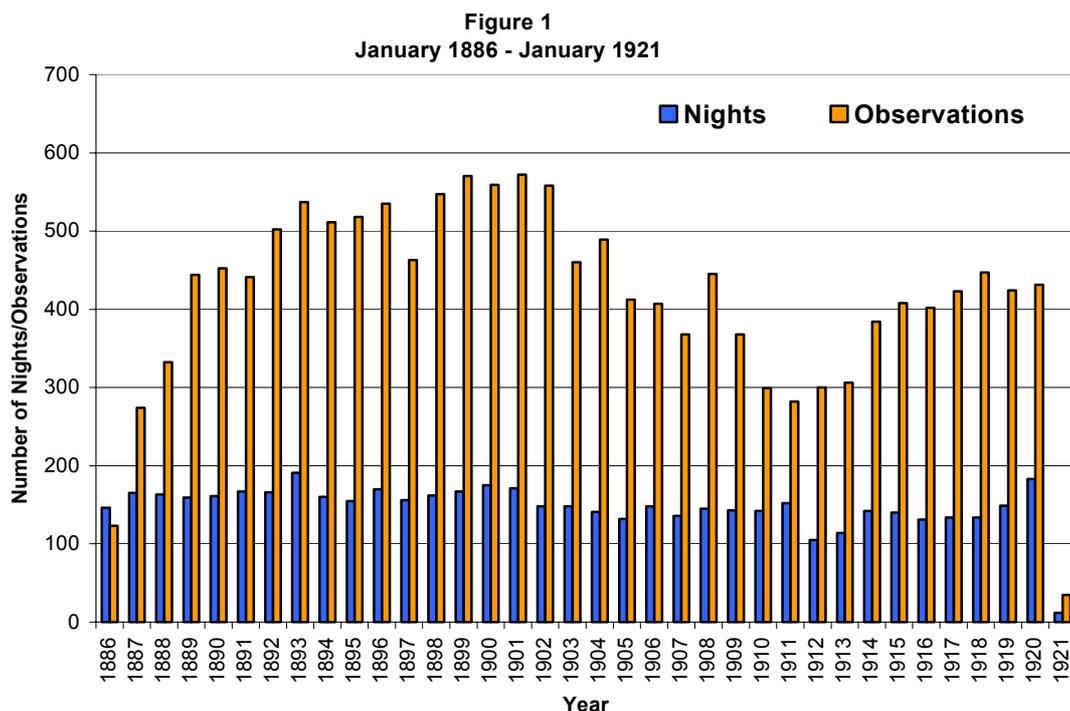
The number of nights spent observing probably included every occasion available, limited only by the prevailing weather. There is a constant theme in the monthly EM reports whenever unfavourable weather conditions prevented observation, whether as the result of cloud, fog or excessive cold. Fewer than 12 or 13 nights in a month were invariably described as poor or

disappointing, with the weather being "unfavourable" or just plain "gloomy". The maximum number of nights of observing in a given year was 191, the minimum 105 and the average 151.



Charles at work

The number of observations seems to display a steep initial learning curve for the first four years, after which there are fairly small variations that may be due to weather conditions. These variations also have a gentle upward trend, reaching a peak with the highest number of observations, 572, occurring in 1901.



Significantly, this was the year in which Cuthbert died, and consequently Charles Grover became Observer in Charge of the Observatory. His new employer, the third baronet, Wilfrid, seems to have taken little interest in astronomy, and this may account for the steady decline in the number of observations for the next ten years. However, the low point of 282 observations in 1911 marks a change of direction. Why should this be so? The answer may lie in another statistic.

In the publication of annual results, a running total of the number of observations made to date was also recorded. It is possible that this figure had some bearing on the progress of the work. In 1911 the running total was 11,469, and the prospect of amassing a total in excess of 12,000 would be, perhaps, the spur to greater effort. On reaching this, with 12,075 in 1913, would not the suggestion of reaching 13,000, 14,000 or even 15,000 seem a realistic goal? Although Charles was now an old man - he was 70 in 1912 - for whatever reason he managed to increase his output year on year for almost every year of his last ten years.

The last recorded total, for the year 1920, was 14,994. Charles died in February 1921, and was reportedly observing the night before he died. I think it is safe to guess that during January 1921 he may have made observations numbering 1/12 of the annual average for the previous 10 years, and these (11 nights and 31 observations) are also shown in the graph. This speculation would provide a final total of 15,025 observations, every one of which, it will be remembered, involved comparison with five known stars.

## Conclusion

I believe that, whether he intended it or not, Charles Grover made in excess of 15,000 observations in his 35 years at Rousdon. It would be interesting to see evidence for any other variable star observer having achieved more than Charles Grover's recorded total of 14,994. And all made, as noted by H H Turner in his introduction to the 1904 RAS publication,

"with the same instrument, by the same observer, on the same plan (i.e. location)."

Finally, it should be pointed out that, whilst the study of variable stars formed the core of the Rousdon work, many other astronomical events were regularly observed and recorded. For instance, Charles wrote eight letters to the EM in the 15 years from 1886 until Cuthbert's death in 1901. However, in the 18 following years, Charles had 39 letters published, of which 25 were between 1911 and 1919.

Thus, the increase in variable star observations was echoed in the number of his letters. The subjects covered included Espin's new star, the nova in Gemini, no less than nine comets (Keiss, Alcor, Brooks, Quenisset, Beljawski, Gale, Westphal, Delavan and Metcalf), and the planets Saturn, Mars, Venus and Jupiter.

## Sources

*Rousdon Astronomical Observations 1882 - 1885*. Published by Joseph Causton, London, 1886

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This research has made use of NASA's Astrophysics Data System, <http://adswww.harvard.edu/>

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**Jerry Grover FRAS**

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