TRANSIT

The March 2012 Newsletter of

Cleveland & Darlington Astronomical Society

NEXT TWO MEETINGS at Wynyard Planetarium

Friday 9 March 2012, *7.15 for 7.30 pm*

How the outer planets were NOT discovered

Dr Colin Steele, *Manchester University*

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Friday 13 April 2012, *7.15 for 7.30 pm*

The minor planets

Paul Money, *FRAS FBIS*

Contents

Editorial

Rod Cuff

First, welcome to new members Helen Norton and Ronnie & Harry Wheatley! We hope you enjoy what CaDAS has to offer in the years ahead.

Rob Peeling has been particularly busy recently, so hasn't been able to contribute his usual *Skylights* article this month. Since the deep sky is astoundingly similar from one year to the next, I've repeated that section from his March 2011 article, which is full of intrinsic interest anyway, and have written the Planets and Comets sections myself, based on material from the Society of Popular Astronomy's website.

This issue contains the second of Neil Haggath's very well-told pair of articles about the transit of Venus, this one being on the history of observations of the transit. We're very lucky in CaDAS, I think, to have people who can write so well about so many aspects of astronomy and its history.

In fact, February's issue led to several complimentary emails, including one indignant reaction to Ray Worthy's article: 'the story on Edwin Hubble was fascinating – what a swine!'. Do you have an iconoclastic take on the conventional view of an astronomer or astronomical incident of the past? Please send it in if so.

Our major CCD imagers have been impressively busy in recent weeks when the skies have let them, and we have a lovely gallery of pictures from Keith Johnson (now a committee member) and Jürgen Schmoll (now our chairman!). I often wish that I could send *Transit* out across high-definition TV, as inevitably the resizing and compression processes involved in getting high-dynamic-range astrophotos into these pages doesn't show them in their full glory. Mind you, nor does the curved Planetarium ceiling …

Although there are tantalising glimpses and a few sentences from some well-known CaDAS members in this month's *Sky at Night* programme on 'Citizen Astronomy' (along with Jürgen's M81/M82 photo – see p.14), the latest word is that the really gripping stuff is in a future programme (possibly next month?), which will have interviews and filming of some home-based observatories. Autographs may be on offer at the next CaDAS meeting, given a big enough bribe. Groupies welcome (possibly …).

Finally, the Sun has been producing some wonderful Northern Lights displays in recent months (sadly, nearly all of them so far in more northerly latitudes than ours), and if you've not seen the magical real-time video taken by Alister Chapman in Norway on 24 January, then rush off to www.xdcam-user.com/2012/01/real-time-aurora-video-shot-with-pmw-f3 at once.

We have so much good material this month that I've had to hold some over to the next issue, for which I apologise to the authors concerned – and (a little to my relief, I must admit), there's no room for the usual quiz this month – just the answers to February's quiz. Normal head-scratching will be resumed in the next issue.

Many thanks to this month's contributors, and don't forget that I (and everyone) will welcome contributions from any and all CaDAS members. The deadline for *Transit*'s April edition is **Wednesday 28 March**.

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

Skylights – March 2012[1]

Rob Peeling & Rod Cuff

Don't forget to put your clocks forward an hour for 2 a.m. on Sunday 25 March as we move into British Summer Time (though here we'll always continue to talk UT – Universal Time). The vernal equinox will be a few days earlier than that – to be precise, at 05:14 UT on Tuesday 20 March.

The Moon

1 March	8 March	15 March	22 March	30 March
First Quarter	Full Moon	Last Quarter	New Moon	First Quarter

The planets

It's a great month for the five planets most easily visible to amateurs, especially early in the month.

Mercury can be seen in the west as twilight deepens. It's at its greatest elongation east (over 18° from the Sun) on 5 March (see the discussion of Uranus below, too), shining as a tiny point of light at mag. –0.3 and setting an hour after sunset. If you can view it through a telescope, its 7.4 arcsec disk will be very nearly half illuminated. You should be able to track it for a further week or so, after which it gets too close to the Sun to view safely (or at all).

Venus remains spectacular and unmissable to the west and can readily be seen even before sunset. Its greatest elongation is on 27 March, 46° east of the Sun, dazzling at magnitude –4.4, 40° high at sunset and visible for more than four hours. Its 24-arcsec disk is, like Mercury's, almost half illuminated.

Early in the month, **Jupiter** is 45° high in the southwest at sunset, but by mid-March and once the sky is truly dark, it will have sunk to about 20°. It's not far from Venus for much of the month, the two planets being less than 3° apart on 14 March. By the end of the month the mag. –2.1 Jupiter is mostly visible only in twilight.

The centre of attention this month, though, is **Mars,** which reaches opposition on 3 March. At 13.9 arcsec it's the biggest it's looked for two years, and it will be visible all night, glowing very noticeably reddish at magnitude –1.2 in the easily recognisable constellation of Leo.

Saturn is in Virgo, the next constellation east from Leo. It rises at about 22:00 UT at the start of the month, transiting (i.e., standing due south) at 03:30 UT about a third of the way up from the horizon. Of course, this gets earlier and earlier as time moves on, so that Saturn ends March transiting at 01:30. Things will get even better in April.

[1] *[See Editorial on p.2. – Ed.]*

Finally, **Uranus** (at mag. 5.9, *just* visible with the naked eye from a properly dark site) is close to Mercury early in the month; on 5 March, they are 2½° apart and can be seen in the same binocular field of view.

Comets

Comet 2009 P1 (Garradd) is circumpolar for the next couple of months and readily findable through binoculars, although it's fading in brightness. It's at its furthest north on 12 March near κ Draconis (magnitude 3.8), Here are a few predicted positions for it at midnight:

Date	*RA*	*Dec*	*Mag*
1/2 Mar	15h 13.1m	+66.45°	6.6
7/8 Mar	13h 53.9m	+70.07°	6.7
14/15 Mar	12h 3.7m	+70.05°	6.8
21/22 Mar	10h 38.5m	+66.08°	7.0
28/29 Mar	9h 48.5m	+60.31°	7.2

Deep sky

If the weather cooperates, the southern sky in March is full of interesting objects.

Cancer

Look out for the large open cluster **M44** named **Praesepe or the Beehive cluster**. It is easy to find as a glowing patch either in your finder or binoculars just below the midpoint of an imaginary line between the bright stars Pollux in Gemini and Regulus in Leo. In the telescope it becomes a huge, bright cluster. Try to find it with the naked eye. I have been surprised at how visible it is through considerable light pollution. I've seen the Beehive with my naked eye both at home and at the Planetarium. Out on the North York Moors you can’t miss it. Once you've seen it with the naked eye, the [translated] Chinese name for it, Ghosts, becomes obvious.

The other Messier open cluster in Cancer, **M67**, is also worth seeking out. This cluster is 2600 light years away, containing ~ 300 stars. It is 4–5 billion years old, making it a similar age to our Sun, and it is one of the oldest open clusters you can easily view. Starting from M44, look for delta (δ) Cancri, which is the star slightly below and to the left of M44 in your finder. Now scan down (south) for the next star of similar brightness, alpha (α) Cancri. Fit a low-power lens and nudge the telescope about a field width or so to the right (west) and M67 should appear.

Leo

The pair of galaxies **M65 and M66** should be fairly easy to spot with a low-power lens in a moonless sky. Look for the right-angled triangle of stars made up of Denebola, Zosma and theta (θ) Leonis that marks the hindquarters of the lion. Centre your finder on θ Leonis, which marks the right angle of the asterism. Now scan with the finder below (south) θ to find a line of three stars, with 73 Leonis the brightest. Using the telescope, move left (east) a field width or two to spot the two galaxies. Can you detect a third galaxy, **NGC 3628**, which lies just to the north of Messier’s pair? All three are spiral galaxies like our own Milky Way.

Caldwell objects

For the last three suggested targets for March, I am leaving the well-known Messier catalogue and picking Caldwell objects. The Caldwell list is 110 of Sir Patrick Moore's *favourite* objects, first published by *Sky & Telescope* in December 1995. Mostly it picks up all the best views that Messier didn't include, but it also contains some harder-to-see objects because they are interesting. Caldwell is part of Sir Patrick's full surname, Caldwell-Moore.

Caldwell 39 = NGC 2392, the Eskimo planetary nebula in Gemini

This is a bright planetary nebula (almost as bright as M57, the Ring Nebula). You will almost certainly have seen professional images of this from the Hubble telescope or elsewhere. Search with a low-power lens and then increase the power to as much as it will bear once found. Starting from the bright 'twin' Pollux (Castor lies above), find the naked-eye star δ Geminorum and centre the finder on it. Scan downwards (south-east) to find a wide, bright pair. Switch to the telescope eyepiece and continue one or two field widths to the south-east to find Caldwell 39. If you have an OIII or nebula filter, you can use it to confirm your find. With the filter, the planetary nebula should seem roughly the same brightness as without the filter, but the surrounding stars will be dimmer. This works because of the physics of the way the nebula emits light.

Caldwell 25 = Globular cluster NGC 2419, the Intergalactic Wanderer in Lynx

Caldwell 25 is not a particularly easy object to find, being small and dim as well as in a sparse star field. It is worth the effort because it is one of the most distant globular clusters you can see. Its name came from the suggestion that it was so far from the Milky Way that it is drifting free in intergalactic space. However, the current theory is that it's actually attached to our galaxy. The most recent published distance is 275,000 light-years, making it half as far again as the Large Magellanic Cloud.

Starting from Castor, use your finder to steer your way north using the few brightish stars around to reach a 6th-magnitude star (check the position on a star chart). Then hunt northwards with a low-power lens.

Caldwell 53 = NGC 3115, the Spindle Galaxy in Sextans

Caldwell 53 is as bright as or brighter than many Messier galaxies. It is not well known because it's in the obscure constellation of Sextans. It is a lenticular galaxy viewed edge on, making it a long, thin splinter of light when you find it.

As with the Intergalactic Wanderer, it needs a little patience to find in a sparse star field. First you need to find α Hydrae – Alphard, or the Lonely One. This is the only bright naked-eye star in the huge region between Leo and Canis Major and underneath Cancer and Procyon (α Canis Minor). Centre Alphard in your finder and then move due east to find 5th-magnitude gamma (γ) Sextans forming a triangle with two 7th-mag. stars. Gamma points the way along a line between the other two stars to a pair of 6th-mag. stars. Look for another 7th-mag. star above this pair and then start searching to the west (right).

Derwent adventures

Keith Johnson

Knowing that the weekend of 18 February was a new Moon and clear skies were forecast (and that my wife and daughters were away that particular weekend too!), I thought it would a great idea to try out my motorhome and equipment as part of a dark-site observing night at Derwent Reservoir's Millshield car park, organised by Sunderland Astronomical Society (SAS), in preparation for March's Kielder star camp, which I'm attending. I contacted various members of SAS via Facebook to express my interest and was added to their 'free' mobile-phone text alert service; if they decide the weather conditions are good enough, they send out a text message announcing where and when observers should meet up.

Because the weather conditions were going to be good, I brought the vehicle home from the storage depot on Saturday morning. Before loading my equipment on board, I carried out a dummy run just to make sure everything was working OK (which it was). It's no fun going all that way and to the middle of nowhere to find out that either (A) something has malfunctioned, or even worse (B) you forgot to bring a vital cable or essential bit of hardware!

Once I'd gone through my checklist, I started to load my equipment on board. By this time it was around midday, and all that was left was to load milk, water and a few foodstuffs. At around 2pm I received the text announcing that we should arrive for around 7pm at the car park near the yacht club. Having a motorhome, I decided to set off on the 45-minute drive at 4pm, arriving at almost 5pm. Not surprisingly, no one else had yet arrived, so I parked up, put the gas on and made a cup of tea. One of the gate-key-holder members arrived half an hour later, and after another cuppa and a chat I set up my gear – perfect timing, as Polaris was just visible to the naked eye but it was still light enough to set up my equipment without having to use a torch.

About 20 or so observers arrived shortly after, and by 8pm there were about a dozen cars. By that time I was taking my first images of the Rosette Nebula (NGC 2237) – see Fig 1 on p. 7. Using the video-out socket on my Canon 1000D DSLR camera, I connected a video composite cable to the video-in socket on the TV monitor in the motorhome, enabling me to sit in warmth and comfort watching the resulting images being displayed as each exposure was captured! This set-up proves very handy, as I can monitor for star trailing due to autoguiding errors, or the passage of a satellite or aircraft through the camera's field of view, rather than having to watch each result on the tiny LED display on the rear of the camera, thus lighting up the surrounding area as the images are displayed, and ruining observers' vision.

At around midnight some observers started to leave, but I wasn't going anywhere just yet – I was there for the duration !

Figure 1. The Rosette Nebula (© Keith Johnson)

After a couple of hours of imaging with no problems at all, I decided to have a walk around, meeting other observers and imagers and looking through their various telescopes, which included an 11" Schmidt–Cassegrain and a TEC 140mm refractor. Arriving back at the motorhome about an hour later, I was pleasantly surprised to find my imaging camera, guide camera and telescope mount still capturing images and performing brilliantly!

At about 2am I realised that Comet C/2009 P1 (Garradd) was in Draco, so I punched the RA and Dec. co-ordinates into my HEQ5 Pro hand control, slewed to the comet and took a few exposures – WOW!! (See Fig. 2 on p.8.)

I decided to pass word around about the comet; most of the remaining observers were able to view it with their own equipment, and some came over to view my results.

As 3am approached, about four cars still remained, and soon I was contacted by a member informing me that everyone was about to pack up, leaving at 3:30am. I headed back to put the motorhome in the storage depot again, then crawled into bed at home at 05:45!

To sum up: anyone wanting to do visual or CCD imaging will struggle to find anywhere else better in County Durham. I highly recommend getting in touch with SAS on Facebook and arranging with them to pay a visit to their dark site. I had a fantastic time meeting some old and new faces and would like to thank everyone for making me feel very welcome. I look forward to seeing them at Kielder in March.

Will I be visiting the Derwent dark site again....? You bet I will!

Figure 2. Comet C/2009 P1 (Garradd) (© Keith Johnson)

Equipment for Figs 1 & 2:

Skywatcher EQ6 Pro mount.
80mm Doublet refractor (imaging OTA)
William Optics ZS66 (guiding OTA).
William Optics MK3 0.8x field flattener

Modified Canon 1000D DSLR camera
LVI stand-alone auto-guiding system.
Images aligned and stacked in DeepSkyStacker

Fig. 1: 20 x 5 mins / Fig. 2: 3 mins, both @ ISO 800

[and full credit to the delightful Adobe Photoshop image processing skills of John and George Gargett]

Backyard adventures

Keith Johnson

As well as having a fine time at Derwent, I've not neglected the quicker delights of planetary imaging from my own garden. Here are two images of Mars, as it approached opposition.

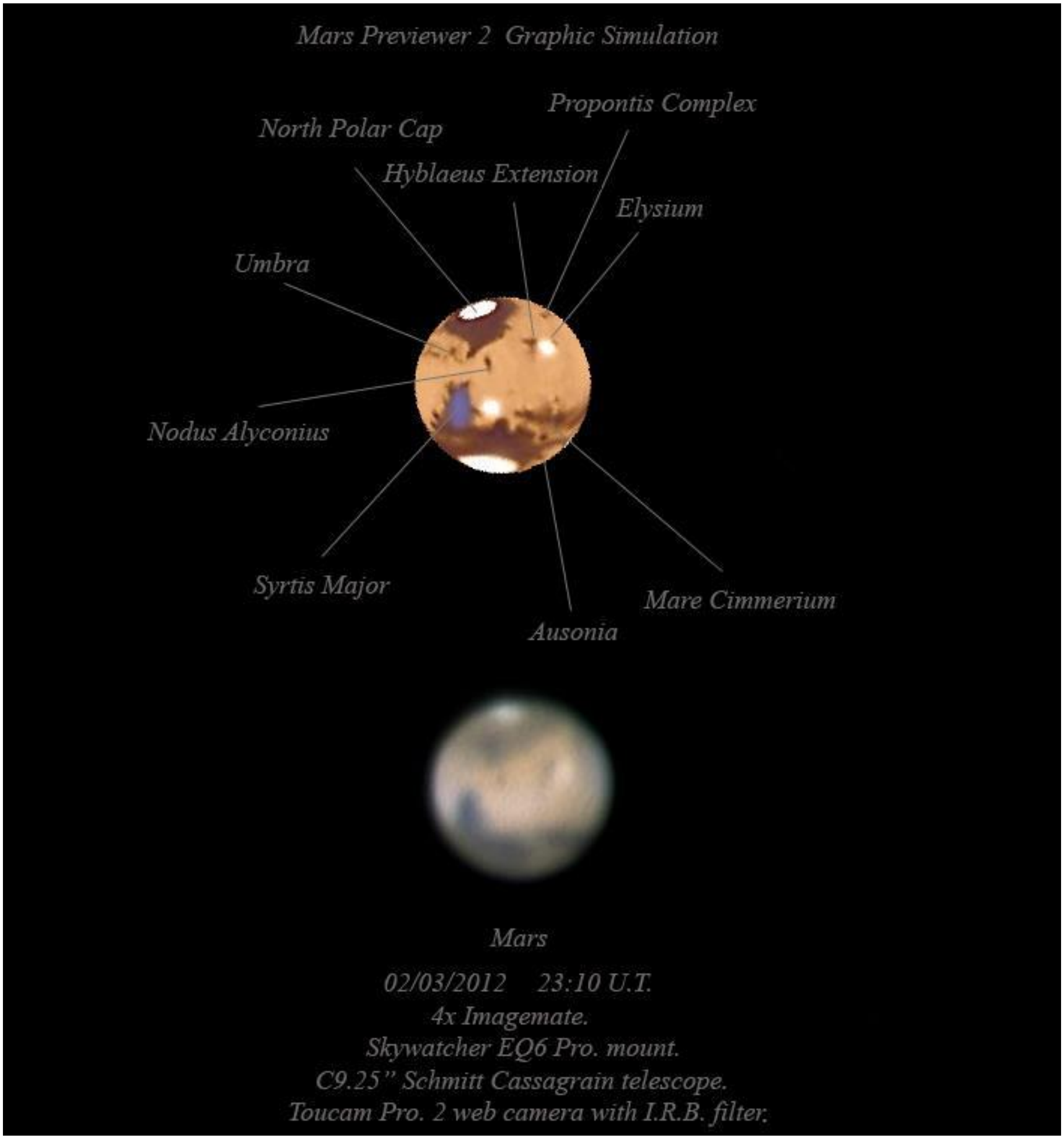
16 February 2012, 23:27:30

3 min. AVI captured @ 10 frames/sec.

AVI -IO capture software
FocusPal focuser software
SkyMap Pro.9 telescope control
Registax version 6 image processing

Equipment:

4× ImageMate
Skywatcher EQ6 Pro mount
C9.25" OTA with computer-controlled auto-focuser
ToUCam Pro2 web camera with infrared blocking filter



Cornforth adventures

Jürgen Schmoll

On the same clear night as Keith was enjoying the dark skies of Derwent Reservoir, I was taking images too from my backyard observatory in West Cornforth, County Durham, using two different telescopes. All images shown below were first bias-, dark- and flat-corrected, then stacked with DeepSkyStacker and levelled with Canon Digital Photo Professional.

Figures 3–7: GSO Ritchey–Chrétien 250/2000mm on Skywatcher NEQ6 Pro mount unguided, using a Canon EOS 40D modified camera, no light pollution filter, @ ISO 1600.

At this point, I tried unsuccessfully to image Mars with a webcam, using my Orion Optics OMC250. The seeing for Mars, still low in the sky that evening, was so bad that Registax refused to work on the results ... so – a change of player. The OMC went back to the bench, and I lifted the 8" Newtonian onto the mount instead.

Figures 8–9: Skywatcher 200/1000mm Newtonian on NEQ6 Pro mount, using a Canon EOS 40D unmodified camera, Astronomik CLS filter and coma corrector, @ ISO 1600.

Figure 3. Horsehead Nebula: 22 × 2 min (lack of photons, but the house moved in the way!)

Figure 4. NGC2903 in Leo: 49 × 2 min, plus 58 × 2 min from two nights earlier. Total exposure 3h 45 min

Figure 5. NGC3628 in Leo (the weakest galaxy in the Leo Triplet, which also includes M65 and M66)

Figure 6. NGC4565 in Coma Berenices: 51 × 2 min

Figure 7. M13: 19 × 2 min, before the dawn got in

Figure 8. M81/82, 89 × 4 min — nearly six hours of exposure time!

Figure 9. Comet Garradd: 4 × 4 min, aligned on stars (rather than tracking with the comet), so that many of the background galaxies in Draco become visible

Twice in a lifetime – Part 2

Neil Haggath

*On 6 June this year, we have our second and last opportunity to observe one of the rarest of astronomical phenomena – a **transit of Venus**.*

Last month, I explained why transits of Venus occur in that well-known strange sequence, in pairs eight years apart, with intervals of over a century between the pairs.

This time, I'm going to say a little about the history of transit observations: why transits of Venus were considered so important, and the lengths to which astronomers went to observe them. The story involves a couple of the greatest names in the history of astronomy, as well as some remarkable tales of dedication, perseverance and misfortune.

The first person to realise that Mercury and Venus could transit the Sun was none other than Johannes Kepler (1571–1630) – he of 'Laws of Planetary Motion' fame. In 1627, while compiling his famous tables of planetary motions, he predicted that both inner planets would transit in 1631 – Mercury on 7 November and Venus on 6 December.

The first transit ever to be observed, by Pierre Gassendi in Paris, was that of Mercury on 7 November 1631. Sadly, Kepler himself didn't live to see it; he died the year before. No one saw the Venus transit the following month, as it wasn't visible from Europe – and very few, if any, telescopes were in use outside Europe at that time.

Kepler calculated that transits of Venus would be extremely rare – but what he didn't realise was that they would occur in pairs. That discovery was made in 1639 by a young English amateur astronomer, Jeremiah Horrocks (1619–41), who lived in the village of Much Hoole in Lancashire. Horrocks was only 20 years old at the time, but was a rather brilliant young man by all accounts. It has been said that, had he lived, he might have been another Halley. But sadly, he didn't live to fulfil his great potential, and died at only 22.

A popular myth about Horrocks is that he was a clergyman. Some authors – Sir Patrick among them – have referred to him as 'the Reverend Jeremiah Horrocks', and said that he was the curate of the parish church in Much Hoole. He was not! As Dr Allan Chapman points out, it wasn't possible for anyone to be ordained as a minister at the age of 20 – though had he lived, he probably would have been. Allan believes that he *was* a church assistant of some kind, and was probably studying for the ministry – but a Reverend he certainly wasn't.

Using Kepler's planetary tables, Horrocks calculated that another transit of Venus would take place on 24 November 1639, according to the old-style calendar then still in use in Britain. And this one, of course, *would* be visible from Europe.

Horrocks decided that he was going to be the first person to observe a transit of Venus. Unfortunately, he only discovered that it was due a month before the event, so he didn't have time to publicise it. He managed to alert only two other people to it – his brother in Liverpool, and his friend William Crabtree in Salford. There is no record of his brother having observed it, but Jeremiah and Crabtree both did. By the way, like Gassendi before them, their method of observation was that which we all take for granted today – using their telescopes to project an image of the Sun onto a white card.

The day of the transit was a Sunday, and Horrocks had to fit in his observations when time allowed, between his church duties. By Sod's Law, most of the day was clouded out. But shortly before sunset, the clouds broke up, and he managed to observe Venus in transit for about half an hour.

Crabtree had even less luck with the weather; of the entire several hours of the transit, he managed one glimpse, through a gap in the clouds, for a few seconds!

Figure 10. Edmond Halley

But even from those brief observations, Horrocks was able to obtain some very useful scientific data. For example, he made the first accurate measurement of Venus' angular diameter at inferior conjunction, which would later enable people to calculate its true size. He wrote a paper, entitled in Latin *Venus in Sole Visa* (Venus in the Face of the Sun) – but for some reason, this was never published until 23 years later, long after his death.

The next character in our story was no less a person than Edmond Halley (1656–1742) (Fig. 10). In 1677, when he was only 21, he undertook his famous voyage to St Helena to map the southern skies. While he was there, he observed a transit of Mercury. It then occurred to him that observations of transits could serve a very useful purpose.

In those days, the distances of the planets from the Sun were not known very accurately. Kepler had shown that there is a relationship between a planet's orbital radius and its orbital period; as the latter could easily be measured, it was only necessary to measure one orbital radius – say, that of the Earth – and then all the rest would be known with equal accuracy from Kepler's Third Law. No one had yet found a method of measuring the Earth–Sun distance – what we now call the Astronomical Unit (AU) – to any better accuracy than about plus or minus two or three per cent, but Halley realised how it could be done.

If a transit of Mercury or Venus were observed from two or more widely separated places on Earth, it would be seen in slightly different positions against the Sun, owing to parallax. If the event was timed very accurately, triangulation could be used to calculate the Earth–Sun distance with unprecedented accuracy.

He soon realised that, although transits of Mercury are much more common, those of Venus would be far more suitable for the purpose. Mercury in transit, seen through a small telescope, appears as only a tiny black dot, and its ingress and egress are too quick to allow accurate timings. But Halley knew from Horrocks' paper that Venus would appear as a distinct disc and its motion would be much slower, so there would be four distinct 'contacts' that could be accurately timed – the ingress and egress of its leading and trailing edges.

Halley's genius was matched only by his farsightedness. He knew that the next pair of Venus transits would not happen until 1761 and 1769, but, even though he would not live to see them, he wrote two papers to alert the astronomers of a future generation to their importance.

When the time came, astronomers took up the challenge energetically, especially in Britain and France. In 1761, both the British Royal Society and the French equivalent, the Académie des Sciences, organised expeditions to diverse parts of the world, so as to obtain measurements from as many different longitudes as possible, and resolved to cooperate afterwards in analysing the data. This, of course, was in the days when intercontinental travel involved sea voyages lasting months, so the project was an enormous undertaking.

But there was a major problem. Britain and France, and their empires, were at war at the time. This was not unusual during that era, but this wasn't just *any* war: it was the 'Seven Years War', which was being fought across four continents, and could justifiably have been called the 'First World War'. The two governments, recognising the importance of the project, signed a treaty that supposedly guaranteed their transit expeditions safe passage through each other's territories. Alas, this proved unworkable in practice; several of the expeditions were caught up in fighting, and some of their members were killed.

Nevertheless, observations were obtained not only from across Europe, but also from North America, South Africa and India. One heroic French team, led by Jean-Baptiste Chappe d'Auteroche, even made a gruelling overland trek to northern Siberia, where they had to fight off packs of wolves, among other hazards! While the last previous transit of Venus had been observed by all of two people, this one was observed by some 120 astronomers, from 62 locations on four continents.

Unfortunately, after all that immense effort, the data turned out to be of little use! It proved near-impossible to time the contacts with the required accuracy, because of an unforeseen problem that came to be known as the Black Drop (Fig. 4).

Figure 11. The phenomenon of the Black Drop

When Venus is close to the Sun's limb – just after ingress and just before egress – it appears to be 'linked' to the limb by a blurred black filament. This is an optical effect, a result of two fuzzy, bright-to-dark gradients adding together. The fuzziness of the boundaries is caused by atmospheric seeing, diffraction in the telescope and the limb darkening near the Sun's edge. (Fig. 2 is an actual image, taken during the 2004 transit.) This makes it very difficult to establish the exact times of contact, which were crucial for calculating the Earth–Sun distance by Halley's method.

There's also another effect that messes things up; during ingress and egress, Venus is surrounded by a thin 'ring of light', caused by the refraction of sunlight through its atmosphere. In fact, Mikhail Lomonosov (1711–65), who observed this phenomenon in 1761, was the first person to correctly deduce that Venus has an atmosphere. This tends to cause timing errors opposite to those caused by the Black Drop.

Despite the huge disappointment, the British and French astronomers resolved to try again in 1769; now that they knew about the Black Drop, they could work out ways of correcting for it to some degree, so as to get more accurate timings. This time, they had to travel even further afield, as the transit was visible only from the other side of the world from Europe – but at least the war had ended by then, so the expeditions no longer had to worry about being attacked on the high seas!

One British astronomer, Charles Green, sailed with Captain James Cook aboard the *Endeavour*. The primary purpose of Cook's round-the-world voyage, which led to the discovery of Australia, was to observe the transit from Tahiti. Sadly, Green died during the return voyage, but his results were brought back and contributed to the overall effort.

This time, Chappe d'Auteroche, who had braved bitter cold and wolves in Siberia, was sent to what was then the wilderness of California, travelling overland via the jungles of Central America. He successfully observed the transit, but during the return journey he and most of his companions died of a tropical fever. Only one man survived, yet he managed to get the valuable data back to France.

This time, the data proved much more useful, and eventually led to a determination of the AU that was pretty close to today's accepted value.

A century later, the effort was repeated for the next pair of transits, in 1874 and 1882. Britain's Astronomer Royal, Sir George Airy, was mainly responsible for coordinating the project. By then, of course, steamships and railways had made worldwide travel much quicker and easier, and major observatories had been established in many parts of the world – so the global coverage of the transits was much more complete. And astronomical observations had been transformed by photography; by means of carefully timed photographs and precision measuring instruments, the position of Venus could be measured very accurately. As a result, the AU was determined with almost modern-day precision.

Today, of course, we know the planetary distances very accurately indeed, so *our* two transits have nothing like the scientific importance of the earlier ones. (Nonetheless, it's still an interesting exercise to repeat the measurements and try our own determination of the AU, as many groups did in 2004.) But remarkably, the last transit *did* still play a small part in cutting-edge astronomy. Some professional researchers used it to test and calibrate a new photometric technique, which would later help to detect extrasolar planets, by measuring the minute reduction in a star's brightness as a planet transits across it. One person involved in that sort of work is in fact an Honorary Member of our society, Dr Carole Haswell!

Finally, let's return once again to the eighteenth century. I couldn't possibly write about transits of Venus without once again telling you the sad story of the man who was surely the unluckiest astronomer who ever lived. The next time you're upset about an astronomical event being clouded out, spare a thought for this fellow…

One of the men despatched by the French Académie des Sciences in 1761 was an aristocrat, rejoicing in the sort of ridiculous name that could *only* belong to a French aristocrat! – Guillaume Joseph Hyacinthe Jean-Baptiste Le Gentil de la Galaisière (1725–92). We'll just call him Le Gentil for short! He was sent to observe the transit from Pondicherry in India, which was then a French outpost.

But the war intervened, and by the time he got there, Pondicherry had fallen to the British. He couldn't take advantage of the safe-passage treaty, as he was sailing aboard a warship, so he had to sail on to find a place that was still in French hands. He was still at sea on the day of the transit; although the sky was cloudless, it was impossible to make any observations from the heaving deck of a sailing ship.

Le Gentil was nothing if not determined. He knew that the 1769 transit would also be visible from India, so he decided to wait for it! Instead of returning to France, he spent the next eight years travelling around the Indian subcontinent and the Far East, where he carried out a remarkable variety of studies. Far from being the 'upper-class twit' that his name suggests, he was in fact a highly respected scientist, and something of a polymath – his interests included natural history, oceanography and ethnology. Come 1769, he made sure he arrived back at Pondicherry in good time; he could now go there safely, as the war was over.

He was made welcome there by the British governor, a Mr Law, who himself had scientific interests. Law not only offered to act as observing assistant, but also managed to obtain the loan of a telescope that was better than Le Gentil's own.

The day of the transit began bright and clear… But shortly before Venus made its first contact with the Sun, the sky clouded over – and then stayed that way. Le Gentil didn't see a thing!

But our hero's troubles were only just beginning. During his years away from home, he had forgotten about such niceties as writing to his family. His voyage home was delayed by a serious illness and a whole saga of lesser mishaps. When he finally returned in 1771, after more than 11 years away, he discovered he had been declared missing, presumed dead. His wife had remarried, and his relatives had divided up his estate. When he suddenly turned up again, they conveniently failed to recognise him, and denounced him as an impostor!

He then spent the next several years, and most of his remaining wealth, engaging in lawsuits against his family to get his property back. He finally succeeded, but he wasn't to enjoy it for very long. In 1789 came the Revolution, when France became a distinctly unhealthy place for the aristocracy. Le Gentil, however, was spared the grisly fate of many of his peers, as he died of natural causes in 1792.

Little Sir Echo

Ray Worthy

When I was a child – long ago, alas – my mother used to sing a song called 'Little Sir Echo'. It went:

> *Little Sir Echo, How do you do?*
> *Hello,-------- (hello), Hello, -------- (hello).*

These lyrics came back quite forcibly when I heard of a peculiar little astronomical titbit a week or so ago.

One hundred and seventy years ago, Sir John Herschel, the son of William Herschel, was mapping the stars of the Southern Hemisphere from South Africa, when he noticed the amazing behaviour of the star Eta Carinae. At first, it was thought that he was witnessing some sort of nova explosion, but the star did not completely fade away. Instead, it followed a programme of erratic brightness in a fairly short period. What was happening? It was not a nova explosion, but the whole sky was illuminated several times. If this happened today, hundreds of telescopes would be trained on the star and detailed spectra would be photographed to give a clue as to what was happening to it. Unfortunately, the modern spectroscope did not exist at that time and Sir John had to content himself with a meticulous recording of the brightness profile of the star over the period of his visit to South Africa.

Astronomers viewing the Southern Hemisphere a month or so ago were suddenly aware of a cloud of gas and dust becoming very much brighter than was its wont. Some inspired person thought of matching Herschel's Eta Carinae brightness profile with that of the cloud flare-up. The two profiles matched perfectly. It was realised that the only explanation was that the light from the gas cloud was a reflection from the Eta Carinae flare-up 170 years ago. The extra distance that the light had had to travel to reach the Earth was 170 light years.

The fantastic news is that modern-day astronomers have taken this unlooked-for opportunity to study the flare-up of Eta Carinae that happened so long ago. They can take advantage of all the modern instruments at their command to extract whatever clues there are to explain the erratic behaviour of that remarkable star. I look forward to their conclusions.

You're a nice little fellow, I know by your voice,
but you're ever so far away.

ANSWERS TO FEBRUARY'S QUIZ

1. In what kind of amateur observing equipment might you find BaK-4s or BK-7s? **Binoculars – they're types of prism.**

2. Why might an astrophysicist be interested in the proton-proton chain, the CNO cycle and the triple-alpha process? **They're nuclear fusion processes in stars, through which hydrogen eventually ends up as the heavier elements found in the universe.**

3. Which famous 16th-century astronomer was sometimes called 'the Lord of Uraniborg'? **Tycho Brahe, who founded the observatory of that name on the Danish island of Hven in 1576.**

4. The constellation Cancer is quite faint, and is unusual in that a certain Messier object is sometimes the only part of it than can be seen with the naked eye. What's the object? **M44, the Beehive Cluster.**

5. The Mars rover *Opportunity* recently found direct evidence of past water flow on the planet, in the form of something about 45 cm long and 2 cm wide. What is it? **A vein, nicknamed 'Homestake', probably of gypsum, which can only have been deposited by water.**

6. The Gemini North telescope in Hawaii has recently found evidence for the most massive black holes known. Are they roughly (a) a million; (b) ten million; (c) a billion; or (d) ten billion solar masses? **(d). They're in NGC 3842 and NGC 4889.**

7. What feature traditionally marks the 'Greenwich Meridian' of Mars – in other words, the zero point of longitude? **The Sinus Meridiani.**

8. Before 1500 or so, Achernar ('End of the River') was of spectral class A2 and magnitude 3.4, but now it's B9 and magnitude 0.5. How come? I**t's a different star! From Universe Today: 'It now marks the southern end of this great celestial river [Eridanus] that once ended at θ Eridani, which was renamed from the original Achernar to Acamar after α Eridani was seen by European explorers in the 16th century'.**

9. Because of Earth's precession, 12,000 years ago a first-magnitude star was the North Pole Star, and it will be again in about another 12,000 years. Which star? **Vega.**

10. Who first used the unfortunate term 'planetary nebulae' because in the telescopes of the time they looked like extended faint disks? **William Herschel.**