TRANSIT

The February 2011 Newsletter of

Cleveland & Darlington Astronomical Society

NEXT MEETING

11 February 2011, *7.15 pm for a 7.30 pm start*

Wynyard Planetarium

AGM and Members' Night

Contents

Editorial

Rod Cuff

It was a great pleasure to see such a packed house for January's CaDAS meeting. Although part of the credit undoubtedly goes to the intrinsic interest of Dave Newton's subject, 'Galaxies with proper names', I'm pretty sure two other factors came into it as well. One was the Brian Cox Effect (or possibly the Dara O Briain Effect) – the two *Stargazing Live* TV programmes and the associated activities around the region (especially through Ed and friends at the Planetarium) must have stirred up a lot of interest. The other factor could well have been reward for all the efforts Andy Fleming makes to send CaDAS-related information and stories to the local media, who are nicely keen to turn them into stories. Whatever the reasons: well done, guys.

The extra interest (and the clear skies) on the night of the meeting prompted Rob Peeling into overdrive – he may work in Reading, but at the moment his astronomical heart is still with CaDAS. Rob has no less than three observing articles in the current issue. We must all share his concern about the potential effects of funding cuts on the Planetarium, and it's good to have a record here of just what a great public resource it was that evening and indeed continues to be, week in, week out.

Finally, a reminder that our next meeting, on 11 February, is our AGM and Members' Night. At the time of writing, I understand there are at least three members' talks on the stocks. We hope to see a January-style turnout. If you'd like to present a short talk but haven't yet told Neil about it, please do so ASAP (mailto:meetings-secretary@cadas-astro.org.uk).

Many thanks to Rob and all the other contributors to this issue. The copy deadline for the March issue is **Wednesday 24 February**. This is a few days earlier than usual, and the issue should be with you before the beginning of March. There are astronomy-related reasons for this, which I hope to talk about in April's issue!

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

Letters

Non sequitur

from Ray Brown

In his letter to the January edition of *Transit*, Neil Haggath quotes a statement that illustrated a combination of ignorance, arrogance and superficial thinking by one unnamed individual. Neil then drew the conclusion that this was 'an appalling example of the state of today's education system'.

We know nothing about the schooling of the offending ignoramus: did he miss a crucial lesson on seasons as a result of illness or truancy or was he simply inattentive? Are we certain that his education was in Britain? Is it the scientific method to generalise from a particular case? We surely have no basis for concluding that the physical underpinning for the seasons is generally not taught in our schools. My 8-year-old granddaughter is currently studying the solar system in her state primary school.

Accurate judgments about the quality and effectiveness of our education system can only be made from statistical data based on large sample sizes. Neil's final sentence, 'I honestly have no idea what they are actually teaching kids at school these days!', seems to deny authority to his general thesis.

Statistics on such data as

- literacy and numeracy standards of children transferring from primary to secondary education,
- Britain's position in the OECD international league tables for education (e.g. www.trainingjournal.com/news/uk-schoolchildren-slide-down-international-league-tables), and
- the facts that 75% of the UK population have numeracy skills below the modest level of GCSE and that the reading abilities of almost 20% of school-leavers render them unfit for employment,

as well as evidence from media such as Channel 4's *Kids Don't Count* programme do indicate serious and growing problems in British education.

Neil is right to be concerned.

Ray

The Authenticated Meteoric Falls of the British Isles — *Keith Johnson*

I'm very excited and honoured to bring to your attention a book entitled *The Authenticated Meteoric Falls of the British Isles* by James D. Robinson. James happens to be the brother of my brother-in-law Steve Robinson.

Steve informed me of the book on 15 January and asked if I'd be interested in reading it. The next morning I received a copy, and after reading just a few pages I'm finding it very hard to put down!

Anyone who has an interest in the falls and finds of meteorites in the UK will find this book a fascinating read. Anyone wishing to purchase a copy can email James at james.robinson77@tesco.net .

Below is an article[1] about the book, taken from the British and Irish Meteorite Society (BIMS) website at www.bimsociety.org :

Keith

Many of you will be interested to hear about the publication of *The Authenticated Meteoric Falls of the British Isles* by James D. Robinson. The book was self-financed and published by the author. Having received my copy today I can tell you that it is a truly professional publication. It is just over A5 in size and runs to 148 pages, covering each of the British and Irish falls in chronological order from Wold Cottage to Leighlinbridge and

[1] *[Edited to remove non-UK and BMIS-specific material. – Ed.]*

very extensively researched. I'm confident in saying that this book is the most comprehensive single publication on the fall and recovery of these meteorites.

The book costs £5.49, plus £2 p&p inside the UK. You can order via mail, direct from the author:

James Robinson
10 BEWICK CRESCENT
NEWTON AYCLIFFE
CO DURHAM
DL5 5LQ.

PayPal payment is also possible.

OBSERVATION REPORTS AND PLANNING

Skylights – February 2011

Rob Peeling

The Moon

3 February	11 February	18 February	24 February
New Moon	First Quarter	Full Moon	Last Quarter

The planets

Jupiter and nearby **Uranus** will be setting earlier by the day in February. To see them you'll have to catch them in the narrowing interval between sunset and when the planets set.

Saturn will be a late-night object, rising at around 22:00 in the latter half of February.

Venus will rise before dawn, but the rising Sun will be competing strongly by the end of the month as the planet moves closer to it.

Deep sky

Beta (β) Monocerotis is a lovely triple of white stars (use high power).

To the north-east of β lie the **Rosette (NGC 2239)** and **Cone (NGC 2264) Nebulae**. These are worth a look to see the associated open clusters, but the nebulae themselves are very difficult to see. Something like a CLS or UHC filter will be needed, I think.

The star 15 Monocerotis marks the base of the **Christmas Tree Cluster**. Where the fairy should be on the top of the tree is the tip of the eponymous Cone nebula. You will need some sort of star atlas to help you navigate in this region of sky.

Below NGC 2264 in the sky is **NGC 2261, Hubble's Variable Nebula**.This is a tiny, arrow-shaped wisp emerging from the star R Monocerotis. Regular observations of this object will be welcomed by the BAA or SPA to provide a record of the light variations from the nebula, which occur on a timescale of a few weeks.

If you are up for a bit of a hunt, then try the **open cluster NGC 2301** further to the east. This is a lovely, bright little cluster.

Use Sirius and β Canis Majoris to its right as pointers to sweep eastwards (left) with binoculars or your finder to find first **M47** and then **M46** lying within 2° of each other in the constellation of Puppis. Both are **open clusters**. M46 (*see next page)* is a personal favourite because lying within the cluster is a **planetary nebula, NGC 2438**. Since the cluster is low in the sky from Stockton, you will almost certainly need a nebular or OIII filter to find this planetary for the first time. The planetary nebula is probably *not* associated with M46 itself, but it is not yet clear whether it lies in front of or behind M46. The problem is the lack of an accurate method of measuring the distance to a planetary nebula.

M46: Credit & Copyright: Roth Ritter (Dark Atmospheres)

Public observing at Wynyard Planetarium, 14 January 2011

Rob Peeling

There was a particularly large turnout for January's CaDAS meeting, with lots of new members, and the public observing session after the meeting was also very well attended. I thought I'd provide a record of the night, because strong support from the Society and the public is going to be essential to ensure that our Planetarium weathers the current political climate and the threat of spending cuts.

Observations using a 12" f/5 Dobsonian took place between 18:30 and 23:30, with a long break for Dave Newton's talk on galaxies to the CaDAS meeting (*see another article of mine that follows this one*). Seeing was good, with long periods of clear sky with patches of cloud. It

clouded over completely at the end of the evening. During the evening, one or two bright meteors were seen towards the northern horizon.

Jupiter, Io, Europa, Ganymede, Callisto	Good view with a 15mm lens, but 4.9mm was too much power. All four Galilean moons were clear. Callisto was far out to the east, with two more close in on the same side and a single one west. I couldn't guess the names of the three inner ones for the member of public who asked.
Uranus	Found by sweeping out to the west from Jupiter.
Moon	Waxing gibbous phase. Very good views with the 15mm and a polarising filter, and also with the 4.9mm without filters. In the early evening the view of the mountains forming the Sinus Iridum sunlit beyond the terminator as a sickle standing out into the darkness was stunning.[2] Later, the plain was lit to the feet of the mountains, and wrinkles in the plain were clearly visible with the low angle of illumination. I couldn't see any details in the plain of Plato. Copernicus showed the central mountains and the terraced walls clearly. All this was shown to several groups of visitors.
M42, M43	Very clear views of M42 and the Trapezium. They were pretty good with the 15mm, and despite the presence of the Moon I thought some green and brownish colour could be seen. I added a CLS filter for increased contrast to show the public, and then could just pick out M43. Again, these splendid sights were shown to many visitors.
M31,M32	M31 was just detectable in the finder. Using a 32mm lens, M31 and M32 were easily seen, but M110 was lost in the Moon's glare. Shown to many visitors.
NGC 457	The Owl Cluster, flying downwards to the right in the telescope view (with 32mm). Members of the public enjoyed trying to find the owl shape – one lad likened it more to a bat.
M81, M82	We moved to M81 and M82 with the 32mm several times, as the pair had featured in the CaDAS talk on galaxies. They were washed out a bit by the Moon, but with a little help most members of the public found M81 easily, and M82 (an elongated wisp) with a bit more concentration.
NGC 869, NGC 884	Observed once with the 32mm lens, impressing visitors.
M35	Fairly good view despite the Moon, though it was difficult to pick up in the finder.
M36	Another fairly good view; clear, but washed out in the finder.
Zeta UMa	Viewed once with the 15mm lens.
22° Moon halo	This was seen and shown to the public as the sky clouded over to close the evening's observing. A little girl correctly stated that ice crystals caused the effect.

[2] *[For a more sunlit view, see Keith's image on page 12. – Ed.]*

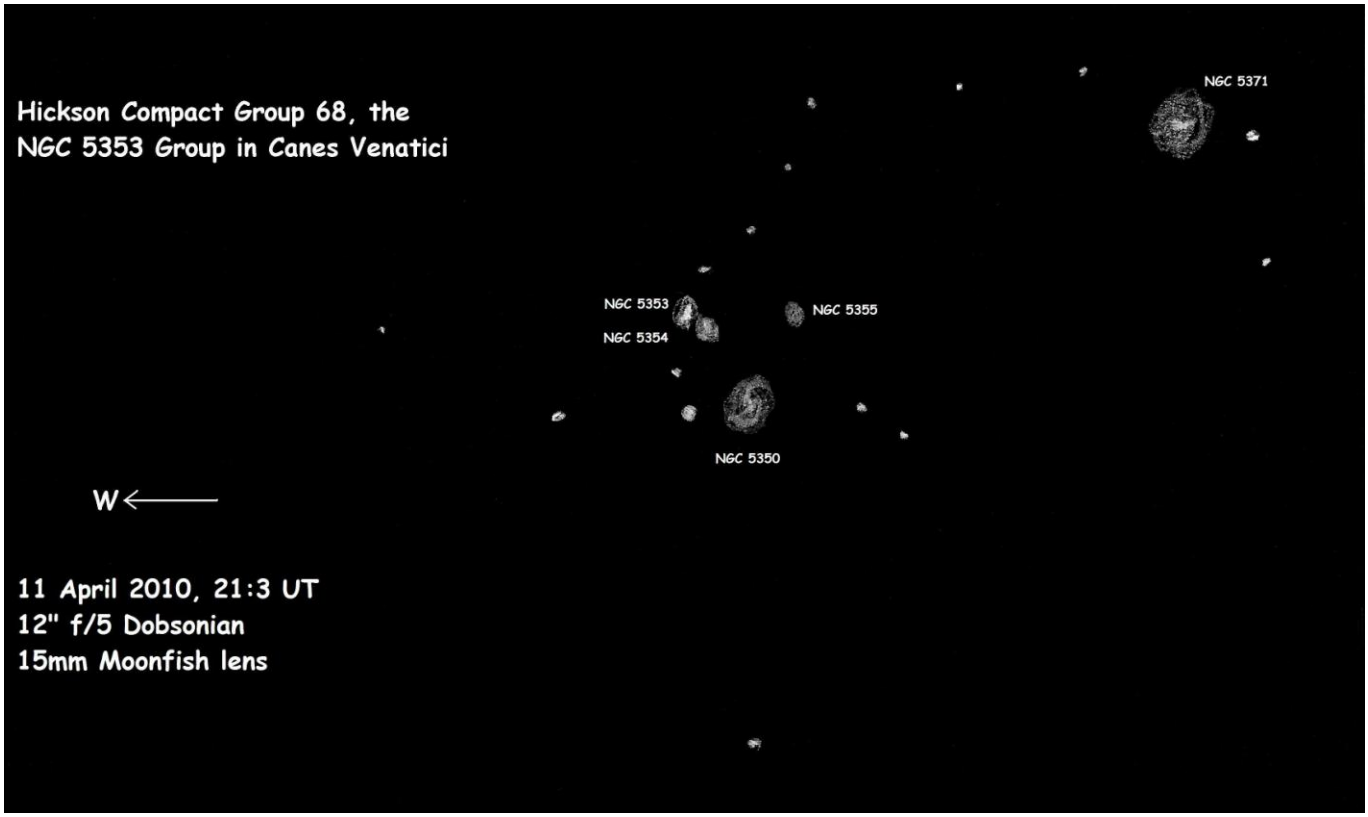
Galaxy sketches

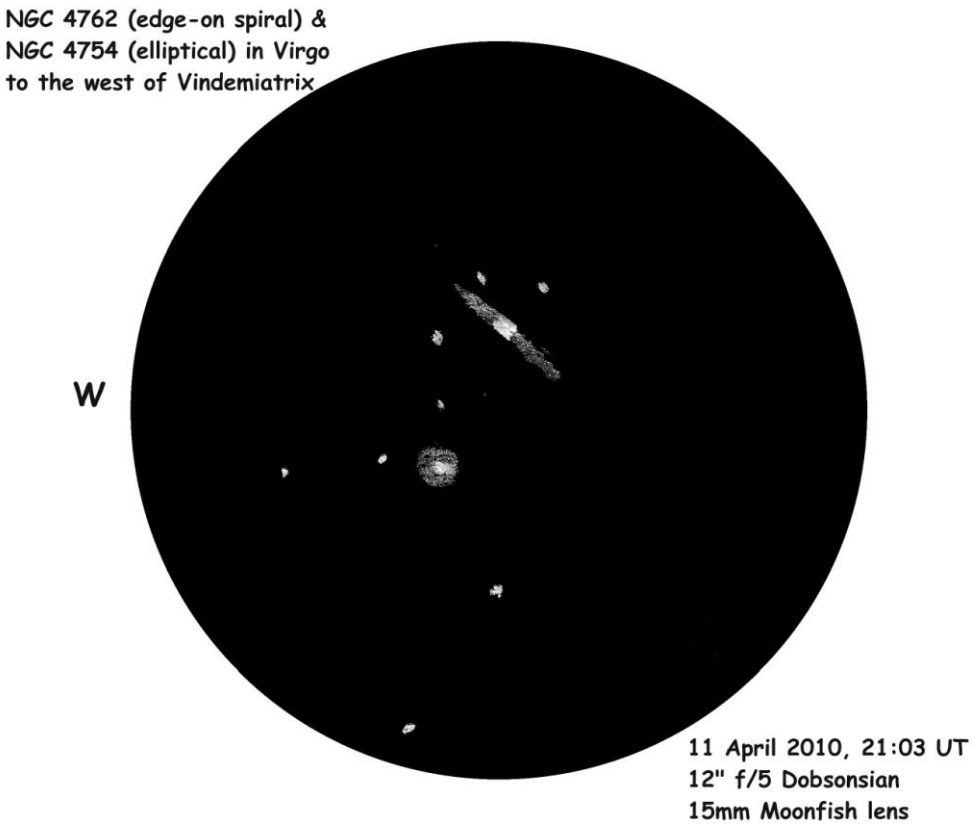
Rob Peeling

The excellent turnout for Dave Newton's talk on galaxies has prompted me to dig out some sketches of galaxies that I made last year. These are scanned and inverted versions of the original sketches. In particular I have sketched the Whale and the Hockey Stick galaxies which featured in Dave's talk. The Whale's 'Pup' is clearly seen and indicated. These are the fruits of visits to my regular dark-sky observing area at Square Corner, near Osmotherley.

The Whale & the Hockey Stick
NGC 4631 & NGC 4656
Canes Venatici

11 April 2010, 20:57 UT
12" f/5 Dobsonian
32mm lens & CLS filter


Hickson Compact Group 68, the
NGC 5353 Group in Canes Venatici
NGC 5371
NGC 5353
NGC 5354
NGC 5355
NGC 5350
W
11 April 2010, 21:3 UT
12" f/5 Dobsonian
15mm Moonfish lens


NGC 4762 (edge-on spiral) &
NGC 4754 (elliptical) in Virgo
to the west of Vindemiatrix
W
11 April 2010, 21:03 UT
12" f/5 Dobsonsian
15mm Moonfish lens

Recent lunar images[3]

Keith Johnson

Here's an image I recently captured of one of my favourite lunar features – Gassendi[4].

Equipment:

- C9.25" Schmidt–Cassegrain OTA
- EQ6 Pro mount, using *Skymap Pro* for remote telescope control.
- DMK Mono CCD video camera with red filter, capturing at 60 frames per second.

[3] *[Both looked very dark on the 'page', so I've brightened them a little to show more of the detail. Apologies to Keith for mucking about with his pictures, and I owe him a pint … – Ed.]*

[4] *[The excellent 'The Moon' Wiki introduces the walled plain Gassendi by commenting* 'One of the most beautiful telescopic objects on the Moon's visible surface, and structurally one of the most interesting and suggestive.'*]*

On another occasion I captured a series of AVIs (video sequences) and created a mosaic using the stacked results of five of them. The seeing got too bad to make it worth continuing, but had it remained OK I would have gone on to complete the full mosaic.[5]

Here's the result, which has been reduced in size by 50%.

[5] *[According to my Virtual Moon Atlas software, the 'sea' at the bottom of the picture is Mare Imbrium, the left-hand C-shaped part of it is Sinus Iridum, and the perfect-looking circular walled plain above its top centre is Plato. The Alpine Valley (Vallis Alpes) can be clearly seen to the right of that. – Ed.]*

Jupiter, the Moon and the ISS

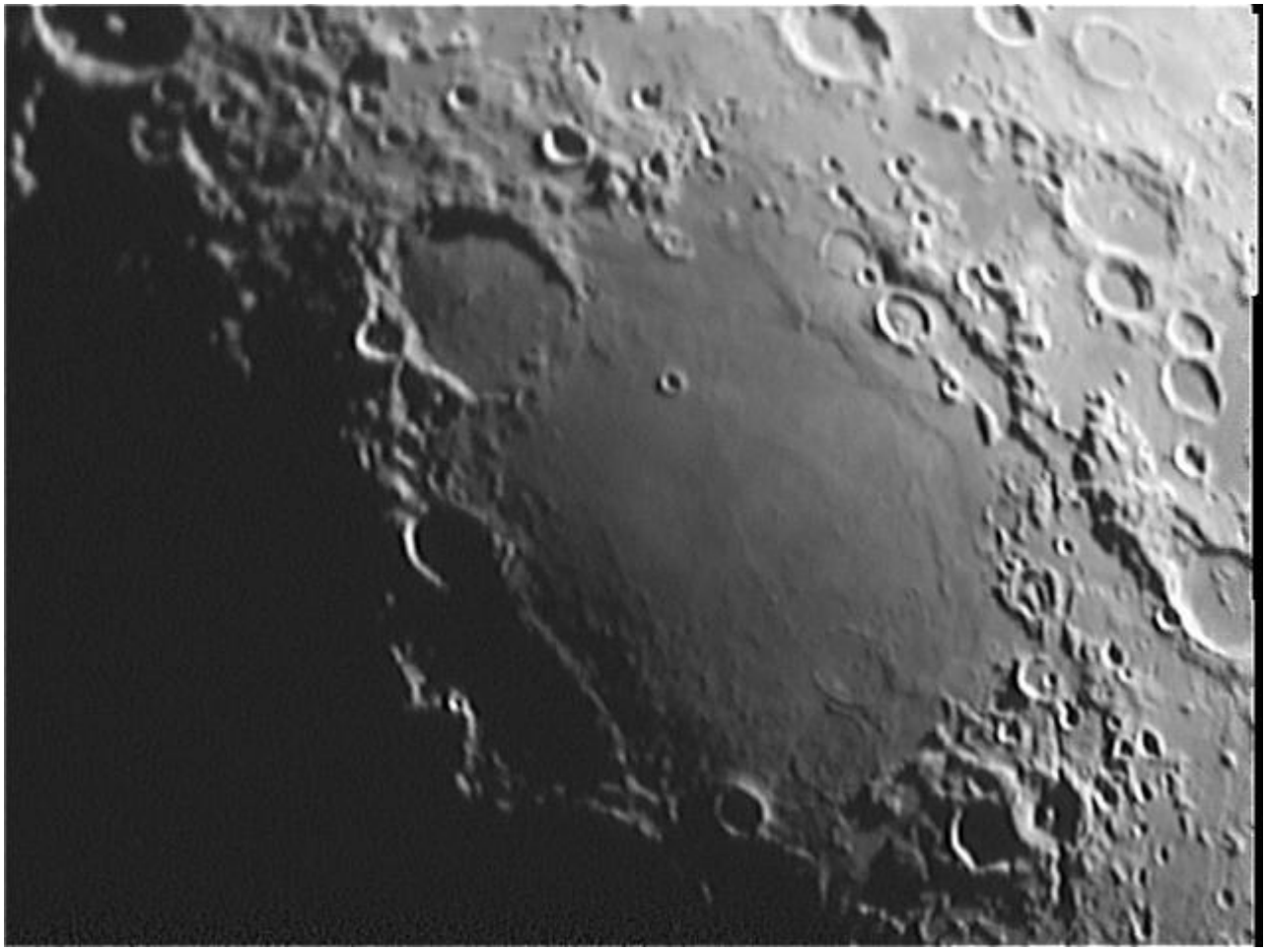
Rod Cuff

The evening of 9 January was a rare chance to do some experimental imaging without being immersed up to my mid-shins in snow. My main interest was in having a second attempt at capturing an image of the International Space Station as it crossed the skies not far from where Jupiter was shining. Misreading a scribbled time in the darkness, I found that I'd set up an hour early, so decided to do something useful while I waited.

Jupiter and the Moon were the obvious targets to tackle, especially as (see below) I was using Jupiter to help with preparation for the ISS. The modest results are below. The greyscale Jupiter shot shows three of the Galilean satellites.

The landscape of the 5-day-old Moon (*see next page*) has the terminator at the edge of Mare Nectaris. Note the delicate tracery of wrinkle ridges on the floor of the Mare, the fairly large (75 x 128 km) pincer-like crater Fracastorius at top left, and the navel-like Rosse crater just below it and to the right.

Another point of interest is the 'ghost' crater Daguerre on the Mare floor near bottom right, almost drowned by the lava flows when the Mare was formed. When John McCue saw this image, he noticed another ghost crater next to ('below') Daguerre, and checked various reference materials to find out its name. He couldn't find one listed, and nor could I. Chasing across the internet, I discovered that (very oddly to me) it doesn't *have* a name. How about CaDAS Crater?



The main novelty, though, was the ISS. I'd taken a sort-of image of it in March as it came close to occulting Alnilam in Orion's Belt (see *Transit*, May 2010), but what was imaged was a couple of long smears – better than nothing, but not what I'd had in mind.

This time I was more prepared, and was helped by the fact that Dave Thompson of Durham A.S. had reported on Facebook the day before on his own attempts to capture an image during that evening's ISS pass. Dave had found (from CalSky and/or Heavens Above) that the apparent brightness of Jupiter and of the ISS were similar at that time, and so experimented on the planet to get good focus, exposure, gain and alignment of scope and finder scope. This was clearly a good idea, and I did the same.

Those sites give very accurate details of where the satellite will be in the sky. Dave had done his best to anticipate where it would be, and on its appearance had attempted to follow it by moving his telescope by hand. As you can imagine, this was a difficult trick, and he managed to capture only a few frames – one of which showed the ISS's shape well, though.

I hoped to do better by using a nice feature of the Autostar software controlling my telescope. You can feed it precise information (known as 'two-line elements', or TLE) about the orbit of a satellite from one of the sites above, and the scope will start tracking it when it appears above the horizon.

So I was feeling pretty chipper when the scope started to move by itself eventually, even though at that stage it was pointing into my neighbour's kitchen, which hid the western horizon.

However, when the ISS emerged from behind the house, it was 5–10° higher than I was expecting, and some way out on azimuth as well. I too had to chase it, though using the Autostar controller instead of my hands – I managed about 20 consecutive frames in which a non-streaky ISS appeared at all (representing less than a second of flight, as I was videoing at 30 frames per second). This proved enough for me to stack later to produce the recognisable shape below, even if the clarity leaves a lot to be desired.

It was well into the next day until I discovered why the apparently predicted flight path was so much at variance with the actual one. For several years I'd been wearing a very accurate watch, radio-controlled from Frankfurt each night, and had got used to putting that time to the exact second into the Autostar controller when starting a session. However, the strap had broken and I'd forgotten I was using another watch, which I hadn't realised was over 20 seconds fast…

Next time I hope to do better…

Equipment:

- Meade 8" LX90 Schmidt–Cassegrain
- Philips ToUcam Pro II webcam with infrared filter, capturing at 30 frames per second
- Registax v4 for stacking frames and post-processing

The man who nailed Einstein's new theory

Ray Worthy

How can a man be one of the most intelligent people on the planet and yet be devoid of common sense? How can a man have a paper on astrophysics published when he was only sixteen and subsequently be elevated to be a member of the illustrious Academy of Science and yet, in spite of the fact that he was over forty, volunteer to become a soldier. He didn't have to go and yet he signed on and donned the uniform. How stupid can a man get? What a waste of a brain!

In that introductory paragraph, I have made my attitude quite clear. Let me calm down and tell you the story of a man called Karl Schwarzschild. Karl, born in Frankfurt of Jewish parents in 1873, soon became known as a child prodigy who was interested in celestial mechanics, and was welcomed into the scientific community after his paper on that subject was accepted for publication when he was only sixteen.

By the age of twenty-eight he was a professor in Göttingen, where he was also the Director of the Observatory. Rapidly climbing the ladder of prominence, in 1912 he was elected a member of the Prussian Academy of Science, something equivalent to our Royal Society. There is no knowing what he might have achieved. When the Kaiser's war broke out in 1914, Karl gave up his prestigious scientific post and volunteered to join the Artillery. He was drafted to the Western Front, but later was transferred to the Eastern Front to fight against the Russians.

Soldiers, if they have any brain at all, crave a quiet moment wherein they can let their minds have a little holiday. So, many men serving in the trenches during that horrendous war turned their minds to writing poetry.

I myself, many years later in the British Army in Germany, training to go to Korea, experienced something of this desire. I was an infantryman crawling in the mud to escape flying bullets. During a quiet moment, our sergeant major noticed that my ammo pouch was flatter than expected. It should have been bulging with rifle ammunition. He stood over me, bent down and pulled from my pouch a Penguin paperback edition of Bernard Shaw's play *Androcles and the Lion*.

'If the enemy comes over that hill,' he snorted, 'what are you going to do to them, read them the second act?'

Anyway, back to Karl Schwarzschild. Friends used to send him the latest scientific papers. He needed to get away from the constant banging of the big guns, so, being a lieutenant, he would

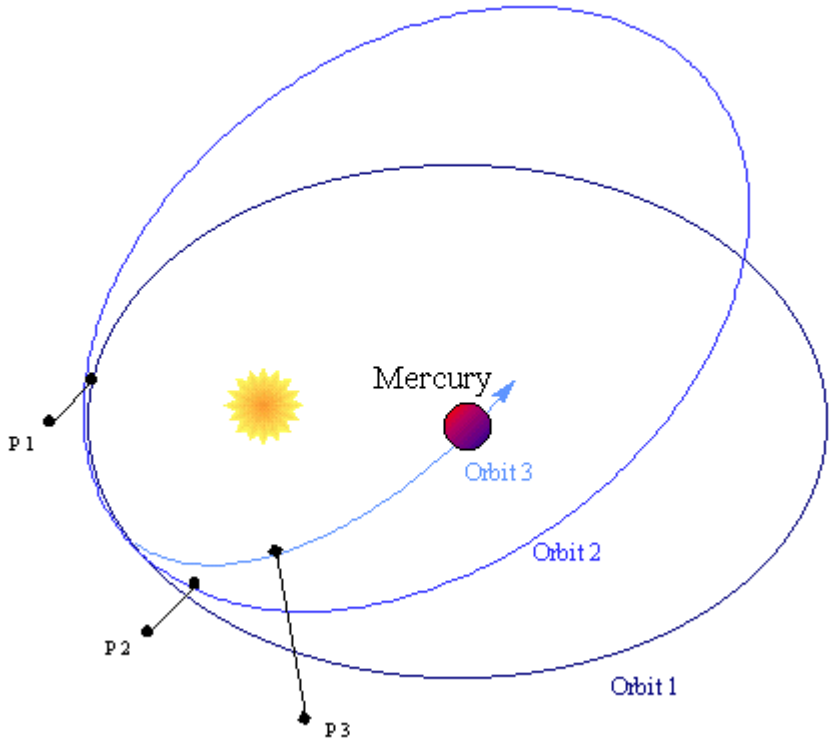
take a stroll to put himself some distance from the noise. He would then allow his mind to switch over to academic matters and escape the mayhem of the war.

Thus it came about that in 1915 he received the latest published paper of another German-born Jew. This one was born in Ulm, six years later than Karl. He was overturning some of the most cherished basic assumptions of classical physics. His name was Albert Einstein.

In 1915, Einstein was struggling to use his newly worked-out theory of General Relativity, and show that it could explain things where Newton's Laws had failed.

Newton's Laws had stood the test of time and were brilliant at predicting the movements of all the outer planets. Indeed, they were successfully used to predict the location of a hitherto unknown planet, subsequently called Neptune.

However, there remained the niggling fact that, no matter how good they were, Newton's Laws could not explain the peculiar behaviour of the orbit of Mercury, the planet closest to the massive Sun.



From www.astro.cornell.edu/academics/courses/astro2201/merc_adv.htm

Whereas the elliptical orbits of all the others planets have so little eccentricity that they are close to being circles, Mercury's orbit is highly eccentric and, what is more, the axis of the orbit slowly precesses around the Sun. It is a slow precession, only half a degree or so in a century, but it has to be explained and Newton's Laws cannot do it.

Einstein, with his new theory of General Relativity, thought he could give an explanation, but he was struggling with the mathematical exposition. Einstein had made a stab at it, but had to admit that his results were only rough. He had used the Cartesian co-ordinate system to describe the orbital mechanics, and found the results far from satisfactory.

Now, imagine this. Karl Schwarzschild read the paper, saw that it required deep concentration, and took it on one of his walks. Think of all the descriptions we have read about the conditions behind the lines in the First World War: the banging of the great guns, the teams of horses bringing up the supplies of food and ammunition, the duckboard walkways over the mud, hundreds of men going hither and thither.

Amidst all this, Karl finds a 'quiet' spot to cast his eye over the problem. To cut a long story short, Karl Schwarzschild found that the whole problem could be solved if he used the polar co-ordinate system rather than the more usual '*x* and *y*' system. His solution made Einstein's revolutionary ideas more acceptable to the wide world.

Not only that but, on other of his 'quiet 'walks, Karl, following a logical progression from the new ideas of General Relativity, generated a new mathematical idea that led, many years later, to the concept of 'black holes'.

Unfortunately for history, at this point tragedy struck. Being a member of the Jewish community from the Rhine valley, there was a chance that he could fall victim to a horrible autoimmune disease that disfigured the skin and the epithelial linings. The disease, called pemphigus, results in scaly patches growing on the skin. These grow in area and become more and more scaly. Cracks appear and become infected. The scales grow into the mouth cavity and can even spread down into the lungs.

All this happened to Karl, and he died in May 1916, only four months after his triumph.

Would he have survived if he had not been roughing it in the trenches? I don't know. Perhaps, but, given the lack of antibiotics then, perhaps not.

Apart from the names of Field Marshals Hindenburg and Ludendorf, I challenge anyone to remember the names of any German officers on that Eastern Front.

But the name of that artillery lieutenant will shine on into the centuries to come. Physicists will study 'Schwarzschild's Radius', ' Schwarzschild's Metric' and 'Schwarzschild's Solution', all products of those 'quiet ' walks on the battlefield.

I challenge anyone to name the General in charge of artillery on the Eastern Front.

96% of our universe is missing – what can the matter be?

Andy Fleming

It's an embarrassment of gargantuan proportions that lies at the heart of modern physics, a kind of cosmic elephant in the room. Put simply, physicists realise that when we look out 13.7 billion light years across the visible universe with our telescopes, whether at visible, infrared, gamma ray or x-ray wavelengths, we are only seeing a tiny proportion of all that there is. Modern physics and its key theories of Newtonian and quantum mechanics and general relativity, which have successfully provided us with everything from iPods to GPS systems, simply doesn't have a clue as to what makes up 96% of the universe.

The best estimates of cosmologists and physicists reveal that only 4% of the universe is constituted of normal baryonic matter, consisting of the things we see with our eyes and detectors. This is made up of atoms and their constituent parts -- and includes stars, planets and intergalactic dust. Einstein said that mass and energy are equivalent, and since the late 1990s astronomers and cosmologists have found that a staggering 73% of the universe is made of something called **Dark Energy**, which reveals itself by an anti-gravitational force. It turns out that the expanding universe as first revealed by Edwin Hubble isn't just expanding at a linear rate; the expansion is accelerating. One day in the far and distant future, cosmologists will no longer see galaxies outside our own cluster -- they'll simply be over the horizon, too far away for light to have had enough time to travel to Earth. For now, though, we have little idea as to what Dark Energy actually is.

We may have rather more success in identifying **Dark Matter**, first postulated by astronomer Fritz Zwicky in 1934 to account for the 'missing mass' needed to sustain the orbital velocities of galaxies in clusters. Subsequently, other observations have indicated the presence of Dark Matter in the universe, including the rotational speeds of galaxies, gravitational lensing of background objects by galaxy clusters such as the Bullet Cluster, and the temperature distribution of hot gas in galaxies and clusters of galaxies. It is believed that most Dark Matter, by its very nature, does not consist of atoms. It doesn't interact with electromagnetic radiation, and therefore we cannot detect it with our telescopes.

There are many possibilities as to what Dark Matter may be, including the following:

- normal matter that has so far eluded our gaze, such as dark galaxies, brown dwarfs, planetary material (rock, dust, etc.) or black holes. Some of these could be MACHOs (Massive Astrophysical Compact Halo Objects), which would explain the distribution of Dark Matter in galaxy halos;
- massive standard-model neutrinos;
- massive exotica. These can be divided into two possible classes:
    - axions (hypothetical elementary particles), additional neutrinos, supersymmetric particles, or a host of others. Their properties are constrained by the theory that predicts them, but by virtue of their mass they solve the dark matter problem if they exist in the correct abundance;
    - particles with unspecified properties, but that are merely required to be massive and to have other properties such that they would so far have eluded discovery in the many experiments that have looked for new particles. Possibilities include WIMPS (Weakly Interacting Massive Particles), CHAMPs (Charged Massive Particles) and a host of others.

Whatever Dark Matter turns out to be (and there are many experiments being conducted around the globe to detect it, including at the Large Hadron Collider at CERN and in subterranean laboratories), we are likely to have an answer as to what this fundamental constituent of the universe is, long before that for Dark Energy. Whichever way you look at it, it's an embarrassment for modern physics to only know what 4% of the universe is actually made of!

THE *TRANSIT* QUIZ

Answers to January's quiz

1. In what year did Apollo 14 land on the Moon, and who was its captain? ***1971; Alan Shepard***

2. Which planet has Helene as one of its moons? ***Saturn***

3. Which comet was visited by NASA's Deep Impact spacecraft on 4 November 2010? ***Hartley 2***

4. What's the name of the annual conference & exhibition for amateur astronomers held in Kensington Town Hall every February (4–5 February this year)? ***AstroFest***

5. What have 21 December 2010 and 15 June 2011 got in common? ***Each has a total lunar eclipse, with part of totality being visible in the UK***

6. What is the usual name for 'failed' stars of between about 5 and 90 Jupiter-masses? ***Brown dwarfs***

7. What part of the electromagnetic spectrum does NASA's Fermi space telescope study? ***Gamma rays***

8. … And what about NASA's Chandra space telescope? ***X-rays***

9. While we're on space telescopes: which one has just had its planned launch date delayed from June 2014 to September 2015 at the earliest? ***The James Webb Space Telescope – and its estimated lifetime cost has also just gone up from $5 billion to $6.5 billion***

10. What are parhelia better known as? ***Sundogs***

February's quiz

Alex tipped me the word recently that one of the experienced members of CaDAS had found some of Transit*'s quiz questions too hard (jolly good!). I hope you can get a decent score on these (mostly easier).*

In each group, which is the odd one out?

1. Arcturus, Aldebaran, Achernar, Andromeda, Alnilam
2. Mimas, Enceladus, Tethys, Dione, Galatea
3. Virgo, Ophiucus, Sagittarius, Leo, Aries
4. Rigel, Betelgeuse, M42, Crab Nebula, Barnard's Loop
5. Cartwheel, Trifid, Sunflower, Pinwheel, Whirlpool
6. Pegasus, Plough, Coathanger, Orion's Belt, Christmas Tree
7. Photosphere, corona, mesosphere, transition region, chromosphere
8. Eagle, Omega, Whale, Dumbbell, Wild Duck
9. Cassegrain, Newtonian, Gregorian, Dobsonian, Galilean
10. Sir Martin Rees, Sir Frank Dyson, Sir Martin Ryle, Sir Fred Hoyle, Sir George Airy