



TRANSIT

The March 2011 Newsletter of



NEXT MEETING

11 March 2011, 7.15 pm for a 7.30 pm start

Wynyard Planetarium

Presidential Address:

The history of Armagh Observatory
Jack Youdale, Hon. President, CaDAS

(Note: Dr David Jenkins' advertised talk will now be in April)



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Editorial

Rod Cuff



I'm very pushed for time this month, so here's an editorial in note form!

- The burning topic of the moment is of course the threat to the continuing operation of the Planetarium and Observatory, not to say Ed's post as Director. Bob Mullen's letter below is one of many contacts with press, radio, councillors, MPs and Mayors from the surrounding region that CaDAS members and others have made since and even before our February meeting. This is very much a live issue, and your committee will try to keep you in touch with how things develop.
- Many thanks to everyone for articles and letters – please keep 'em coming. I've had to hold over at least two articles until the next issue (sorry, John and Michael ...) Especial thanks to Rob Peeling, who composed his *Skylights* article while waiting for a plane in Cologne Airport!
- I've not had time to break up the text with more illustrations, nor put web links in. And no quiz this month, I'm afraid ...
- The copy deadline for the April issue is **Friday 24 March**.

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



Letters

No more Planetarium?

It is with sadness and disappointment we hear Stockton Borough Council is to remove the post of Planetarium Director at the Wynyard Woodland Park as part of their financial cutbacks

Since the opening of the Planetarium in 2002 the two Directors who held this post, Dr John McCue and Dr Ed Restall, have introduced a large section of the public and a considerable number of school children in the region to the fascination of the night sky and the universe we live in.

The Planetarium and its adjacent Observatory were constructed and equipped by the efforts of the local astronomy club, the Cleveland and Darlington Astronomical Society. Over the years their stock of telescopes increased and were made available to the visiting public and schools. Special events were organised at the Planetarium to cover eclipses of the Sun and the Moon, meteor showers, special Sun-observing days and any other astronomical event of special interest.

The Directors, both experts in teaching techniques, gave regular public presentations and organised public viewing of the night sky through the telescopes. Other events specially for children included a Harry Potter day, build and fly your own rocket and build and fly your own space shuttle.

from Bob Mullen¹



¹ [Bob was a long-time member of CaDAS until 2009, and my predecessor as editor of Transit. He also sent this letter to the Evening Gazette, Northern Echo and The Darlington and Stockton Times. – Ed.]

Stockton Borough Council have not yet advised how they intend to use the Planetarium after the departure of the Director in March this year. It is hoped that Stockton Borough Council can continue to offer the Planetarium and Observatory facilities to all in the region and maintain the interest of the public and school children in all aspects of astronomy.

*Bob Mullen,
Nunthorpe*

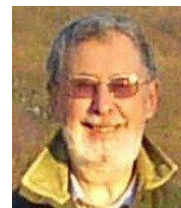


General points...

As usual I found last month's *Transit* informative and a good read. Ray Worthy's article on Schwarzschild as a soldier was an eye-opener. In answer to his final question², I suggest General Max von Gallwitz, General August von Mackensen, General Oskar von Hutier or General Max Hoffmann.

Ray Brown

Ray Brown



Derwent observing

Graham Darke (Sunderland A.S)³

Your astronomical society participated in a very successful meeting of local clubs that was held in Washington in June 2009. I had been hoping to organise something again to which all of your members could be invited. Rather than another lecture-based evening, I thought we could perhaps all meet up at a dark site for some observing? The site we regularly use at **Derwent Reservoir** is probably as central as anywhere, and so Sunderland AS would like to invite the local societies to join us on the evening of **Saturday 2 April** for some spring galaxy hunting from 7 pm onwards. Below are directions to the site, the Millshield Picnic Site, on the shores of Derwent Reservoir on the County Durham/Northumberland border.

We hope to see you along. Let me know if you have any queries.

Graham Darke (gd@smmi.co.uk)

Directions to Millshield Picnic site:

On the A68 at the Kiln Pit Hill Junction (which is 5 miles North of Castleside and the same south of the A69) take the turning marked 'Slaley Hall'. If you are travelling from the north, you will be turning right, if you are travelling from the south, you will turn left. Follow the road for about $\frac{3}{4}$ mile and turn left just after a house on the left-hand side of the road. The road sign at

² "I challenge anyone to name the General in charge of artillery on the Eastern Front."

³ [Sent to CaDAS and other local astronomical societies. – Ed.]

this junction points to 'Derwent Reservoir'. Follow this road for just over a mile and you will see the entrance to the picnic site to your left. Drive through the gate, which has a Northumbrian Water sign just to the right of it, head down the bank and bear right into the car park at the bottom.



[Educational standards⁴](#)

Neil Haggath

In his letter in the February issue, Ray Brown takes issue with my comments of the previous month, regarding today's education standards. In fact, Ray reaches a similar conclusion himself, but criticises my rationale for doing so.



As Ray rightly says, I know nothing about the education of the 'offending ignoramus'. (Of course, there was more than one ignoramus involved; as well as the author of the piece, his editor must have been equally ignorant, not to notice the stupid mistake.) He then says, also rightly, that you can't make a generalisation from a single example.

My apologies, if that's what I appeared to be doing; it wasn't exactly my intention. Far from it; the piece I quoted was simply the latest of many, many examples that have led me to despair about the state of our country's education.

Regarding the specific example – that reporter's belief that summer and winter are due to the Earth being closer to and further from the Sun – one of our CaDAS colleagues has told me that when he was at school, he was actually told that very same piece of stupidity... by *his geography teacher!* How damning a statement is *that?*

I could write several pages about specific examples that I've personally encountered – but I'll just tell you a couple. A year or so ago, I told the story here about the guy who couldn't work out from the position of the Sun which direction was north and which south. I've heard of people who don't understand such an elementary concept as time zones; when they go abroad on holiday, they put their watches forward or back, because the cabin crew tell them to – but have no idea *why* they are doing it! Understanding *that* involves nothing more than understanding that the Earth rotates!

But there are also the 'three R's' – reading, writing and arithmetic. For the first two, just look at the comments section of any internet news forum; you'll almost certainly find that comments written in anything resembling correct English are the exception. Many are written with such appalling spelling and non-existent grammar that it's hard to make out what their authors are talking about. Sometimes, this is because their authors are evidently genuinely near-illiterate; others, because they simply can't be bothered to write properly, but write in cryptic and abbreviated 'textese', and somehow expect everyone else to understand it.

⁴ [Neil suggested offline that I could have sent him Ray's February letter in advance to seek a reply from Neil then, to be published in the same issue. He's right, I believe, and I'll take that on board for any future such exchange. This particular correspondence is now closed, however. (In public, anyway!) – Ed.]

Then there are the signs which people put up in public places, with equally appalling spelling and/or grammar. A classic example once appeared at the entrance to a private car park in Derby, which stated, 'NO UNORTHERISED PARKING'. I kid you not!!

As for arithmetic: I've come across many, many younger people who literally can't add two and two without a calculator. Think of those sheets of stamps sold at supermarket checkouts; they now come in sheets of 6 and 12, but some years ago it was 4 and 10. I once asked a checkout girl for 'eight second-class stamps, please', and she replied, in all seriousness, 'We only have fours and tens!' (It occurs to me that the saying, 'It's six and two threes' would probably be met with expressions of bafflement these days...)

Another time, I asked for 100 second-class stamps in a post office. The assistant actually picked up a multiplication table and looked up what 100 times 19 pence was...

However, as Ray will rightly say, it's not the scientific method to draw a general conclusion, even from multiple examples. To do so correctly, we need statistical studies. Firstly, I invite any of you to take a look at any of those aforementioned internet comment boards; read through a few hundred of the comments – if your brain can stand it! You would be able to compile some pretty telling statistics about levels of basic literacy – the percentage of comments written in correct English, or perhaps the mean number of spelling and grammatical errors per 100 words.

But how about this – another example that I quoted here some time ago, with the very kind of statistics which Ray wants to see. A survey into UK education standards asked randomly selected people a series of general knowledge questions. One was: 'Does the Earth go around the Sun, or the Sun around the Earth?' Make sure you're sitting down, before reading on... Only 67% of the people asked answered that correctly! 19% actually gave the wrong answer, and 14% said they didn't know.

Need I say more?

Neil Haggath

OBSERVATION REPORTS AND PLANNING

Skylights – March 2011

Rob Peeling

The Moon

4 March	12 March	19 March	26 March
New Moon	First Quarter	Full Moon	Last Quarter



The planets

Saturn rises at around 21:00 in the evening through March. The rings are opening out after the planet's equinox, so see if you can spot the Cassini division between the A and B rings. With just binoculars, Titan should be visible near Saturn and the shape of the planet itself should be noticeably deformed from a circular blob because of the rings. My favourite test is to see how many of the moons I can detect. I'm disappointed if I can't see at least three. Do a little sketch of

what you can see and use any good planetarium program to mark up by name the moons you've found and sort out the odd star you may have picked up as well.

Mercury will be visible low to the west just after sunset from 10 March. On 16 March it will be 2.3 degrees north of **Jupiter**, which could give you a good opportunity to find this elusive planet. It will be at its greatest elongation from the Sun on 23 March, when it will be 16° above the horizon at sunset. After this it will quickly move closer to the Sun and be lost from view again.

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).

GENERAL ARTICLES

[Thoughts on February's Transit](#)

John Crowther

The small photo on the cover page reminds us of the educational value of astronomy, and was relevant to the threat that faces the Planetarium and



Observatory. On it, an adult points to an object in the sky and a youngster views it. The straight and pointing arm and finger are exactly parallel with the refractor.



As usual, Rob's drawings were of great interest, the sheltering Calf beneath its mother Whale being more realistic than the Hockey Stick (NGC 4631 and 4956). Rod's photo of Mare Nectaris is surely of a sea full of ghosts, for the pincer of crater Fracastorius seems to be fishing

for a number of these as well as for Daguerre and 'CaDAS'. Fortunately it's comfortable and easy to study these drawings and photos when one doesn't have the dedication or the telescope to go it alone! So, as always, modern technology enables knowledge to be shared, and long may we be able to continue doing this.

Ray's opening sentence shows an opinion that is reinforced in the rest of his first paragraph: 'How can a man be one of the most intelligent people on the planet and yet be devoid of common sense?' The answer surely is the power of peer pressure, including that coming from young women and nationalistic propaganda. We don't know how many young men from Britain and Ireland who received white feathers during World War I rushed to the nearest recruiting office, or what percentage ignored this symbol of supposed cowardice. But Prussia, where Karl Schwarzschild lived, was the most militaristic part of early 20th-century Germany. Here the aristocratic Junkers class had great influence.

We remember Manfred von Richthofen – the Red Baron – who awarded himself a silver cup for each enemy aircraft he shot down, for as a skilful hunter he needed trophies. He was the 'Hun in the sun' who stalked the enemy yet took care to watch his back. The latest research points to his death as being caused by shots from the ground rather than from a more skilful Allied pilot.

So Karl Schwarzschild wasn't stupid or without common sense in the Prussia of World War I; he was pushed into the army probably because of the propaganda with which he was surrounded. Patriotism and a sense of duty would have made it difficult for him to be different.

About thirty years later in post-war Germany, Ray managed to be different. He was probably the 'Lion' infantryman, the sergeant being a fierce 'Androcles', annoyed that a Bernard Shaw play was in a soldier's ammo pouch. Thanks, Ray – keep your articles coming, and may comments right or wrong be encouraging!



[A visit to the Armagh Observatory](#)

Jack Youdale

During the summer break of 2010, Malcolm Bannister and I, together with our respective wives, visited Northern Ireland. One of the highlights of this trip was a two-day stay in the ancient city of Armagh.

Before we made our trip, Malcolm contacted the staff of the Armagh Observatory in order to arrange a conducted tour of this establishment, which was founded in 1790.



[The city of Armagh](#)

The present city of Armagh can be traced back to the 5th century AD, during which the Kings of Ulster converted to Christianity. St Patrick founded his first church in Armagh. For the next four centuries Armagh was renowned throughout Europe as an ecclesiastical centre and regarded as the metropolis of Ireland!

During this period, the religious colleges in Armagh had several thousand students. Teachers at this monastic university recorded historical events, including various astronomical apparitions such as comets or eclipses. These are the earliest recorded astronomical observations from Armagh and are compiled in a medieval manuscript, *The Annals of Ulster*.

In later centuries, following both Viking and Norman invasions, the centre of power in Ireland moved to the coastal towns such as Dublin and Drogheda. The Archbishops of Armagh at this time visited their primatial capital occasionally but preferred to reside in Drogheda. One such Archbishop was James Ussher, renowned for his calculation in 1650 of the age of the world. Using biblical accounts in Genesis and Old Testament scripts, he determined that the creation of the Earth was in 4004 BC!

[An observatory for Armagh](#)

Archbishop Richard Robinson (1709–94) was a rich and influential man and the leader of the established Church of Ireland. He was not only Archbishop of Armagh but also an independently wealthy man. It would be fair to state that he was responsible for the building of the city of Armagh that we know today. It is believed that Archbishop Robinson may have been influenced to found an observatory in Armagh by the Rev. JA Hamilton, who became its first Director. Hamilton had his own private observatory in Cookstown, Co. Tyrone. In 1782 he observed a transit of Mercury and sent his observations to the then Astronomer Royal, Neville Maskelyne, who reported them to the Royal Society in London. Archbishop Robinson was so impressed with Hamilton's work that he decided to include an observatory in his plans for the city of Armagh.



The new observatory (*see left*) was the second to be established in Ireland, the first being the Dunsink Observatory near Dublin. The buildings of Dunsink (1785) and Armagh (1790) observatories were a revolution in observatory design in that for the first time the stability of the instruments took priority over any aesthetic considerations. Pillars were free standing and not joined to the rest of the building.

[Astronomical instruments at Armagh](#)

The first Director of the Observatory, the Rev. Dr JA Hamilton, was in touch with the leading astronomers of the day. Neville Maskelyne wrote a letter to Hamilton detailing the instrumental requirements for a modern observatory. The requirements for serious work on the position of stars were a transit instrument, a meridian circle and an accurate timepiece. I was very interested in seeing these important instruments, which are part of the development of astronomy over more than two hundred years! Both Malcolm and I were given a guided tour of all the historical instruments by Mr John McFarland, a research assistant and librarian.

The astronomical clocks were made specially for Armagh by Thomas Earnshaw of London. At the time, they were said to be the most accurate clocks in the world. Another remarkable instrument is an equatorial transit telescope by Troughton of London. Only one other instrument of its type exists in the world today.

There is also a mural circle and transit instrument by Jones of London, and this pair of instruments are the only pair known to exist to this day on their original site.

In 1834 Thomas Grubb built for the Armagh Observatory a 15-inch-diameter reflecting telescope that incorporated several innovations in telescope design:

- It was a Newtonian/Cassegrain telescope.
- It was the first large reflecting telescope to have a clock-driven equatorial mounting.
- It was the first telescope to have a novel lever-support system for the primary mirror.

By 1886 the Observatory had acquired a 10-inch-diameter Grubb refractor (*see upper right*). This is a superb instrument by one of the leading makers of the day.



In 1917 a new Director was appointed, the Rev. WFA Ellison, who brought with him to the job his own 18½-inch-diameter Calver reflecting telescope. This would be modified into a Schmidt camera during the late 1940s when Dr Lindsay was Director. Under Dr Lindsay's directorship new research programmes and new developments at Armagh were initiated. A planetarium was opened in 1968, with Patrick Moore as its first Director.

Alas, intervening years resulted in the deterioration of some of the instruments, particularly the Grubb 15-inch reflector and the 18½-inch Calver reflector (converted into a Schmidt – *see lower right, with John McFarland and Malcolm Bannister*). It was decided to have these instruments brought back to their original condition, work that was completed by David Sinden Optics. This was David's last major undertaking before he sadly died. I was delighted to see these instruments in their original domes in perfect working condition – a tribute to David Sinden's skills, both optical and mechanical.



If in the future you find yourself in the city of Armagh, do make a point of visiting this fine old observatory with its historical instruments. You will be made very welcome by the staff.



The demotion of John Couch Adams

Ray Worthy

In 1845 John Couch Adams was the most talented mathematical student in Cambridge University. He was the subject of an international brouhaha, because it was claimed that he had done all the mathematical work leading to the discovery of the planet Neptune. Because 2010 saw the re-emergence of some of Adams's relevant papers, I should like to discuss the matter in some detail.

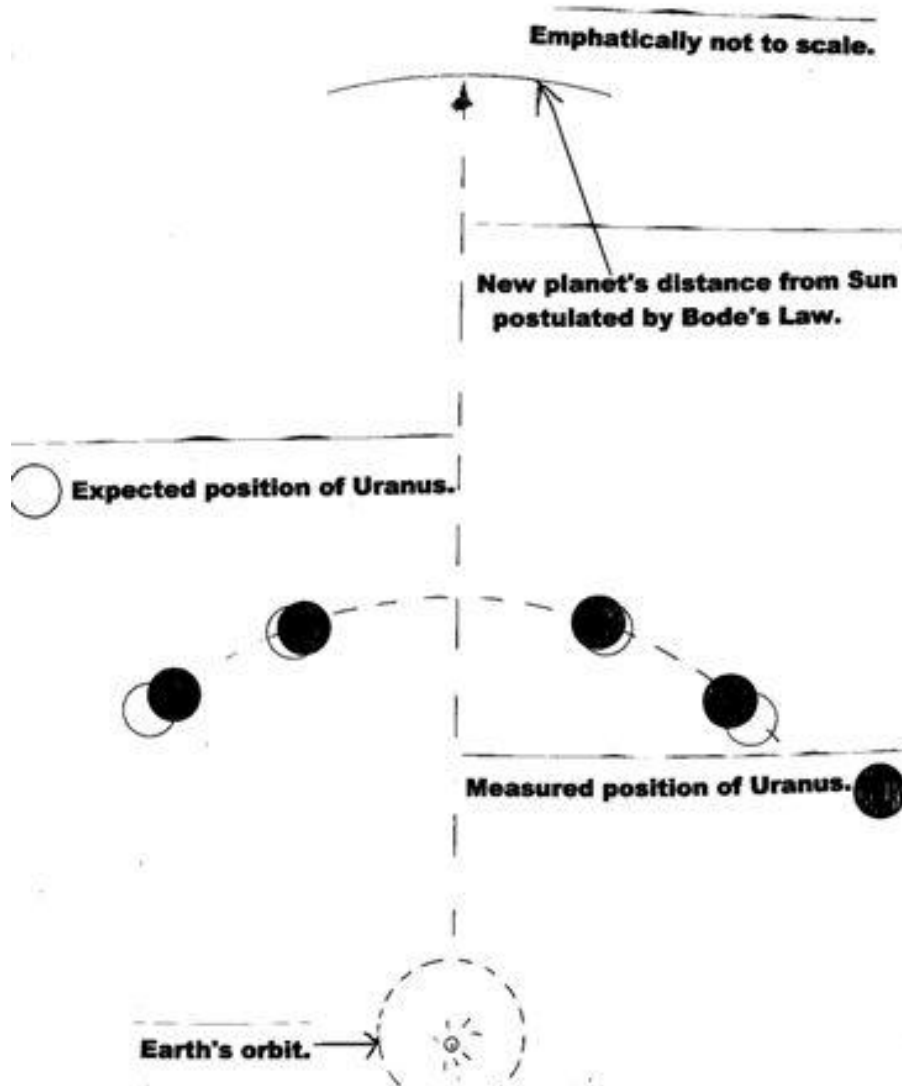


The story, as I was first told it, was that Adams had done all the hard graft whilst still an undergraduate. He knew that, after Uranus had been discovered by William Herschel in 1781, astronomers had searched previous charts of the ecliptic and established quite a number of sightings of the unrecognised planet. These, together with all the post-discovery data, provided a respectable body of positions with which to establish the orbital parameters. Astronomers noticed that the planet was simply not behaving according to predictions under the laws of

Newton. Sometimes the planet was in advance of its expected position and sometimes behind. Adams worked on the assumption that the movement of Uranus was being influenced by the gravitational attraction of another planet, yet to be discovered. I am pretty sure that I would not be capable of giving a mathematical account of the thinking, but it might help if I provided a graphical account.

It simplifies the problem when one realises that the planets, in the main, are more or less always to be found on the ecliptic, so that what might have been a three-dimensional problem reduces to two dimensions and can be displayed on a flat piece of paper.

Diagram to show Adams' method of deduction for discovering the unknown planet's position.



With the Sun at the base of the diagram, sections of the orbits of Earth and Uranus can be drawn. Plotted around the relevant parts of the orbit of Uranus are the expected positions of the planet at certain dates. Superimposed on the diagram are the actual dispositions of the planet observed on these dates.

The discrepancies thus show themselves, in roughly approximate symmetry. If there was another superior planet, then it might help to consider that, being twice as far out, the unknown

body would be orbiting so slowly as to be practically standing still. If one were to draw a line from the Sun's centre through the centre of symmetry of the orbital discrepancies, then the unknown body would be located somewhere along that line.

How far out from the Sun would the new planet be? To answer this, both Adams and Le Verrier (*see later*) used Bode's Law, even though no one could provide a logical reason for the law's veracity.

Why was this distance needed? Now, here we come to the feature that makes the calculation so difficult. The observation platform is necessarily the Earth, which is buzzing along its inferior orbit at a relatively high speed. The observer has to consider shifts due to parallax. On top of all this, the gravitational effects from Jupiter and Saturn have to be allowed for.

When you consider that all this calculation was achieved without the aid of calculators, the mind boggles. It was a tremendous achievement.

Adams knew he had achieved something important, but he could not get any established figure to give his result any credence. James Challis, the Professor of Astronomy at Cambridge Observatory, seemed not to want to know. Then, of course, there was Sir George Airy, the Astronomer Royal at Greenwich. Adams called at Greenwich at least twice, but found the great man absent, so he left a long letter for him to read at his leisure

It was said later that had Airy been told that the letter came from the current 'Senior Wrangler' in Cambridge, it would have been taken more seriously. As it was, the Astronomer Royal was travelling in Germany when the news broke.

Completely independently of the events in Cambridge, an equally young man in Paris had done the same calculation. However, this story had a different ending. Urbain Le Verrier, for that was his name, was in correspondence with a friend, Johann Gottfried Galle, who was an assistant to Encke at the Berlin Observatory. Here, as ever, telescope time was in great demand and it would normally have been difficult to get unscheduled time for such a madcap scheme. However, it was the Director's birthday and he was in a benign mood. As it happened, young Galle had access to recent charts of the relevant part of the ecliptic. Within the hour, he had found the new planet. It was only one degree from the predicted position, an absolutely phenomenal result.

Airy was quite close to Berlin when he heard the news. He immediately realised that the joy of discovery might have been his several months before, had he paid attention to that bright young man from Cambridge. He set about seeing what he could do to gather some laurels for Adams. He knew that he would be pilloried by the newspapers of the day when the facts became generally known.

Some historians maintain that Sir George actually attempted to cajole Challis into pretending that he had done the same work as Galle, but of course based upon the calculations of Adams; but he could not sustain the deception because he did not possess the relevant charts of the sky. The Astronomer Royal was under tremendous pressure from the British establishment. National considerations were invoked, and Le Verrier could not be left alone to garner the laurels.

At this point, I should like to make a digression and draw a parallel with a situation that occurred nearly seventy years later. This is to emphasise the power of British nationalism to distort the reporting of events and thereby distort history.

In 1912, Captain Robert Falcon Scott led an expedition to the South Pole. This was, in fact, a race, in which the runners-up came nowhere. In the event, Scott and his team got there, but only to find that they had been forestalled and upstaged by the Norwegian, Roald Amundsen. On the return leg, the members of Scott's polar team all died, including the famous Captain Oates, whose comment as he left their tent, 'I am just going outside and may be some time', rendered his self-sacrifice immortal.

Amundsen chose to have his sleds pulled by husky dogs. On the return leg, as the load became lighter, Amundsen planned to use some of the dogs as a food source. Because of this planning, he could travel three times as fast as Scott. Scott and his party trudged along, pulling their sleds by their own manpower. It was discovered later that Scott had made no provision for antiscorbutics, and in effect his party, weakened by scurvy, all died through exhaustion. Here you have to bear in mind that, over a hundred years earlier, Captain Cook had sailed around the world without a single one of his crew succumbing to that dreaded maritime disease.

This was the period of jingoistic nationalism, eventually leading up to the First World War. The press and the establishment of the day could not possibly tolerate a British failure. They could not tolerate the idea that a British officer had made such blunders. In their reporting, they laid their emphasis upon simple heroism leading to their tragic end.

It is my contention here, although I have gone topsy-turvy historically speaking in an effort to illustrate my point, that the establishment of 1845 simply could not tolerate the fact that a Frenchman, of all people, had scooped the jackpot.

Neither Sir George Airy nor Professor Challis could be rescued from the shambles, but John Couch Adams, the son of a West Country farmer, could. So the international brouhaha began, and the pressure was kept up until Adams was given co-billing with Le Verrier.

For one reason or another (and here I am leaning over backwards so as not to accuse anyone of a deliberate act), Adams's actual working papers went missing. However, they had not been destroyed. We know this because they have turned up. They were mixed in with a bundle of other stuff purchased at an auction and taken to an American university library.

Unfortunately for the reputation of John Couch Adams, it seems his results did not truly match those of Le Verrier. Whereas the Frenchman hit the nail on the head, so to speak, Adams's workings led to a scattergun approach to computing the final result. He provided as many as ten different targets.

I have read several papers which suggest that Adams displayed symptoms of Asperger's Syndrome. If he was autistic, it must have been quite mild, because he struck up a lasting friendship with his French rival with mutual visits and went out of his way to praise him.

I cannot think that this had any bearing on the outcome. No, the crucial fact was that the discovery of the new planet depended on teamwork and the British astronomical establishment simply could not provide this when it was most needed. The lack of relevant and recent surveys of the part of the sky in question would alone have caused the failure of the British effort.



Deep Impact: We now have the technology to avoid it

Andy Fleming

We all want a planet fit in the future for our children, and as a species we've become aware over the last few decades exactly how fragile the Earth actually is. We've realised the devastation that could be caused by a super volcano, an asteroid impact, earthquakes, coronal mass ejections from our local star, a gamma-ray burst aligned towards our planet, plus our own self-inflicted damage to our environment in the form of climate change, pollution, damage to the marine ecosystem, and ozone layer damage caused by chlorofluorocarbons.



A unique feature of homo sapiens amongst the other animals with whom we share the Earth is our ability not just to adapt to the environment, but actually to change it. Indeed we've changed it – but adversely when it comes to ozone depletion, pollution and climate change, although we're now making inroads into reversing our negative impact. However, all of these things are 'walks in the park' compared to the other threats, with one big exception – asteroid impacts.

We live in a cosmic shooting gallery. Anyone who disagrees should look no further than Comet Shoemaker–Levy 9, ripped apart by Jupiter's gravity and pummeling into the mighty gas giant in July 1994. If that collision had occurred on Earth, none of us would be here now.

However, Earth is not immune, and collisions with both asteroids and comets have happened in our planet's past and will happen again. The last time a civilisation-destroying asteroid 10km across hit our terrestrial bullseye was 65 million years ago at Chicxulub on the Yucatan Peninsula of Mexico. Luckily, there was no civilisation around to destroy, but it was a bad day for T Rex and its dinosaur cousins, along with 80% of the plant and animal species on the planet. The death of the dinosaurs resulting at least partially from the impact on the Yucatan had the benefit of allowing small mammals, and ultimately us, to exploit the ecological niches vacated by these most successful of animals (in terms of the longevity of their reign).

At the same time, though, it's a sobering thought that mass extinctions caused by incoming asteroids occur on average every 100 million years, and that the next one is likely to wipe out mankind. It's not a question of if, it's a question of when it will happen. Unlike in the T Rex case, though, the good news is that we can avoid such an unpleasant visitor from space, even with our present technology. Or rather we can ensure that such a potential impactor avoids us.

Worldwide, apart from the United States and NASA, most governments have not taken the issue of asteroid impacts seriously enough. Commendably, NASA has surveyed large parts of the solar system, especially in the vicinity of Earth for Near Earth Objects (NEOs) and Potentially Hazardous Asteroids (PHAs) – those that directly cross the Earth's orbit around the Sun. Such objects routinely pass between Earth and the Moon, even between Earth and some of our geostationary satellites. Full details of NEOs and PHAs discovered are available at <http://neo.jpl.nasa.gov> .

So what can we do if an NEO or a PHA is detected and has our name on it? If the asteroid is composed of a loose, barely gravitationally-bound conglomerate of ice and rock, the nuclear option of blowing it to smithereens with a detonation would replace one problem with a host of

them, as we would then face the prospect of many smaller fragments raining down on us, causing probably as much destruction.

One of the most considered scientific methods of removing the threat once one of these killer inbound asteroids has been located is not a Bruce Willis-style detonation at all, but concerns using the pressure of sunlight.

Light is composed of particles called photons, and, like any particles, photons from the Sun create pressure – albeit very little pressure. Use mirrors to focus the photons into an intense beam, find the asteroid early enough, and only a miniscule change of the object's trajectory by photon pressure is required.

The Planetary Society (TPS) based in Pasadena, California, the largest public space-interest group in the world, is now working with a team at the University of Glasgow to study a new technique that uses this concentrated light to move an asteroid gently -- a project they call 'Mirror Bees'. The researchers in Scotland, under the leadership of Massimiliano Vasile, became interested in this approach when they discovered that Mirror Bees would work more quickly and effectively than any other known approach apart from nuclear warheads (the problems with this option have already been discussed).

This new technique involves many small spacecraft each carrying a mirror and swarming around a dangerous asteroid. The spacecraft could precisely tilt their mirrors to focus sunlight onto a tiny spot on the asteroid, vaporising the rock and metal and creating a jet plume of superheated gas and debris. Alternatively, the satellites could carry powerful lasers pumped by sunlight, and the lasers could be used to vaporise the rock. The asteroid would become the fuel for its own rocket -- and slowly it would move into a new trajectory.

Major questions still remain about this technique. For example, would the plume of superheated gas ejected from an asteroid dissipate, or would it block sunlight to the mirrors? Would debris settle on the satellite mirrors? Could the asteroid's rotation be dealt with effectively? Would the gas plumes be enough to deflect the asteroid?

TPS is stepping in to fund a series of laboratory experiments to answer these and other questions. Vasile's group is working with Ian Watson and the laser lab of the University of Glasgow's Mechanical Engineering Department to devise some ingenious small-scale experiments. TPS will be funding equipment, supplies, and a graduate student dedicated to working on the experiments. Only through these types of studies, as well as additional theoretical research, can the details of this technique be worked out and understood. If it pans out, it will be a rapid, effective and safe option to use against the asteroid that inevitably will come Earth's way.

It is comforting to know that this valuable research is being undertaken against one of the biggest threats against our civilisation. Until we start seriously colonising space, the human race still has all its eggs in one basket here on Earth. It would be foolish and irresponsible to ignore the risk – to be *able* to do something about it and yet *do* nothing. T Rex had an excuse. With our intelligence and technology, we don't.

THE TRANSIT QUIZ

Answers to February's quiz

When introducing this quiz, I remarked that one of the experienced members of CaDAS had found some of Transit's quizzes too hard; and so I was making this one 'a little' easier. I later made the mistake of saying to Neil (who knows everything under and in the Sun) that I hoped he didn't find it too easy. 'It took me about a minute', he said ... Sigh ...

In each group, which is the odd one out?

1. Arcturus, Aldebaran, Achernar, Andromeda, Alnilam **All stars except Andromeda, which is a constellation**
2. Mimas, Enceladus, Tethys, Dione, Galatea **All moons of Saturn except Galatea, which belongs to Neptune**
3. Virgo, Ophiucus, Sagittarius, Leo, Aries **All Zodiacal constellations except Ophiucus, (although the ecliptic does pass through it)**
4. Rigel, Betelgeuse, M42, Crab Nebula, Barnard's Loop **All objects in the constellation of Orion except the Crab Nebula, which is in neighbouring Taurus**
5. Cartwheel, Trifid, Sunflower, Pinwheel, Whirlpool **All spiral galaxies except Trifid, which is a diffuse nebula**
6. Pegasus, Plough, Coathanger, Orion's Belt, Christmas Tree **All asterisms (patterns of stars, but not whole constellations) except Pegasus (although the Great Square of Pegasus *is* an asterism)**
7. Photosphere, corona, mesosphere, transition region, chromosphere **All layers of the Sun except mesosphere, which is part of Earth's mantle**
8. Eagle, Omega, Whale, Dumbbell, Wild Duck **All (named) objects in Messier's catalogue – in other words, they have M-numbers – except the Whale Galaxy (NGC4631 or Caldwell 32)**
9. Cassegrain, Newtonian, Gregorian, Dobsonian, Galilean **All types of reflecting telescope except Galilean, which is a type of refracting telescope**
10. Sir Martin Rees, Sir Frank Dyson, Sir Martin Ryle, Sir Fred Hoyle, Sir George Airy **All held the post of Astronomer Royal except Sir Fred Hoyle – more's the pity, as that would have been Interesting...**

