

Gnomon

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Things are getting (slightly) better for UK astronomy

For UK astronomy, the last year has been dominated by the funding crisis that threatens a large chunk of the research base and a whole swathe of projects. When the Government announced the science budget from the 2007 Comprehensive Spending Review (CSR), the headline figures seemed reasonable. The Science and Technology Facilities Council (STFC), the main body that supports UK astronomy, will receive a 13.6% increase over the three years to 2010.

But as with so many policy announcements, the detail revealed a different picture. In particular, two factors turned an apparently good outcome into a shortfall.

Firstly, the Government had agreed to fund the real costs of research to universities, many of which were artificially subsidising the costs of providing accommodation and infrastructure like labs. From now on STFC will pay for 80% of this via the Full Economic Costing (FEC) principle. This was included in the stated

increase, reducing the real uplift to 8.0%. With inflation and issues like a deteriorating exchange rate (at least for the Pound against the Euro) STFC was £80m short of the budget it needed just to fund the existing research programme.

This was something of a shock to the astronomical community. Over the last decade the science budget had increased dramatically, putting astronomers in the UK more in line with other European nations. British scientists are involved in the European Southern Observatory (ESO) in Chile, the two Gemini telescopes on Hawaii and in Chile, the e-MERLIN radio network centred on Jodrell Bank and a suite of space missions. And after the US, astronomers in the UK publish more papers than anywhere else.

Encouragingly, the national media picked up the story, with the threat of closure to Jodrell Bank and the potential withdrawal from the Gemini Observatory even getting slots on the *Today* programme. A total of some

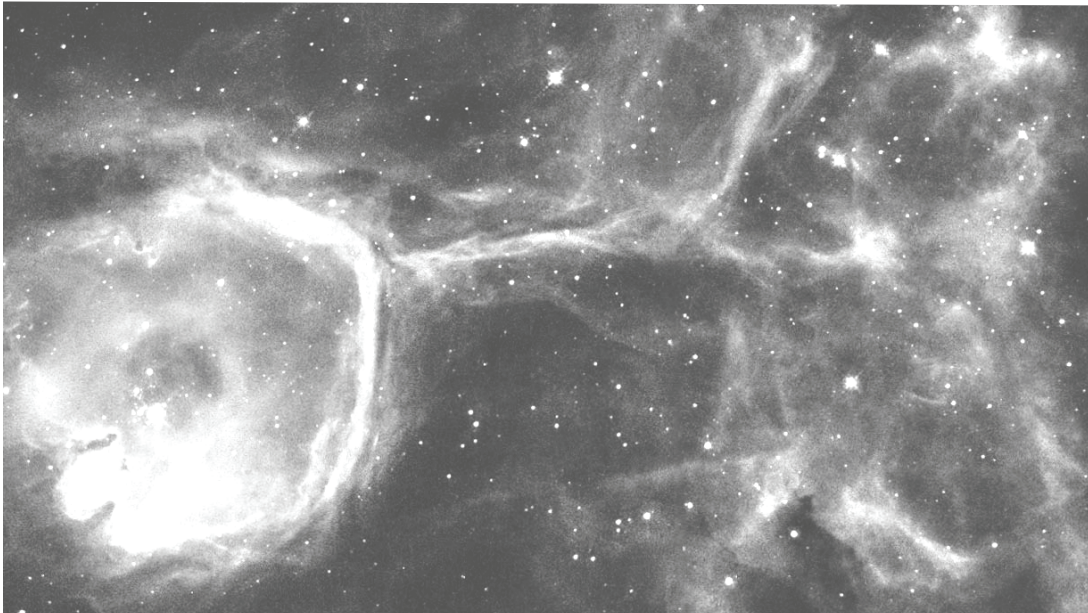
17500 people signed an e-petition against the cuts (including many members of the AAE), forcing a Government response.

Perhaps the worst aspect was the way the news reached the astronomical community. STFC announced the package at a "town meeting" at the end of 2007, with the hint of real pain to follow. With a potential economic slowdown, no one was surprised to see a tougher financial settlement, but to pretend that this was the best ever settlement for science simply was not, and still is not on.

After extensive lobbying by the RAS, the Institute of Physics (IoP) and the "Save Astronomy" campaign, MPs announced an investigation into the science budget. Witnesses including Professor Michael Rowan-Robinson, RAS President, explained their disappointment at the outcome and how the process had been handled. When the Select Committee on Innovation, Universities, Science and Skills produced its report, its MPs were highly

Stellar wind sculpts fantastic bubble

A fast and powerful wind from a hot young star created this stunning bubble-shaped nebula, poised on the end of a bright filament of hydrogen gas. Catalogued as N44F, the cosmic windblown bubble is seen at the left of this Hubble Space Telescope image. N44F lies along the northern outskirts of the N44 complex of emission nebulae



in the Large Magellanic Cloud, a mere 160,000 light-years away. The bright, blue, hot star itself is just below the centre of the bubble. Peering into the bubble's interior, the Hubble image reveals dramatic structures, including pillars of dust, aligned toward N44F's hot central star. Reminiscent of dust pillars in stellar nurseries within our Milky Way galaxy, they likely contain young stars at their tips. Expanding into the surrounding gas and dust at about 12km/s, N44F is about 35 light-years across.

critical of STFC and its senior management.

In the last few months things have improved a little. After an extensive consultation with the scientific community, projects like Jodrell Bank are now safe. But despite this good news, the shortfall remains and the UK is set to withdraw from excellent facilities like the EISCAT radars studying the magnetosphere. There will also be a 25% cut in the grants available to university research teams, one result of which will be a steep decline in the number of postdoctoral researchers.

On the bright side, STFC have at least acknowledged the weakness in their relationship with the scientific community and have pledged to rebuild it. There is now more of a shared commitment to promote fundamental science and a chance to work together for a better deal in future.

The next milestone in all of this is the review of the health of physics, being carried out by Lord Wakeham and due to report in the autumn. Universities, industry, the IoP and the RAS all gave evidence to Wakeham, including the value of astronomy to education in motivating young people.

If the Government listens at that point, it might just decide to mitigate this crisis. But whether or not this happens, astronomers need to be prepared to make their case, both now and in the years ahead.

Robert Massey

Three plutoids, four dwarf planets

We shall all be revising our classroom models and posters yet again! This summer the Kuiper Belt Object 2005FY9 was officially named and also designated a dwarf planet. When it was first detected around Easter 2005, this object was jokingly called "Easterbunny". Following International Astronomical Union protocol it was officially named after the god of fertility and creation of the Easter Islands, Makemake (pronounced "mahkeh-mahkeh"). The dwarf planet is about two-thirds of the diameter of Pluto and it orbits beyond Neptune in a highly elliptical path which is 53 astronomical units at aphelion and 38 astronomical units at perihelion. The orbit is also inclined to the plane of the solar system at 29°. Makemake is probably an oblate spheroid, which qualifies it to be in the new class of "dwarf planets" alongside Pluto and Eris and 2003EL₆₁.

In June the International Astronomical Union decided on the name "plutoids" for dwarf planets which orbit beyond Neptune. Thus Makemake is officially the third known plutoid. (2003EL₆₁ is cigar-shaped and therefore has not been classified as a plutoid).

So your wall displays, worksheets, exam questions, teaching notes and brain all need updating. But don't rush – there could be more soon. At least the confusion over the status of Pluto becomes more understandable in the light of all these new discoveries.

Would you like to be an astronomer?

Of all the questions asked by students "What shall I do when I leave school?" is one of the most important, and is followed up by "What does a librarian (engine driver, prison guard, or whatever) do?" and "What do I have to do to become a librarian (engine driver, whatever)?" In the case of astronomy, the questions are particularly difficult for teachers to answer, because they usually have less idea of what an astronomer actually does than they might have of a librarian (or whatever).

The AAE's own Anne Urquhart-Potts asked Emily Baldwin, a young graduate, to give a little background to the life of an astro-physicist. Anne chose to interview Emily as she is a young astronomer with a very unusual career path: she has not gone into pure research. She works on the editorial team of *Astronomy Now* magazine and is co-author of *Starlight*, the new free magazine for young people. This brief interview demonstrates well the need for a good deal of lateral thinking when making the transition from academia to the workplace.

What inspired you to study sciences?

I was interested in all things space-related from a young age, and never really grew out of the wanting to be an astronaut phase (by the way, I did apply for ESA's recent astronaut selection program, but I didn't even get through the first round! I'm pleased I tried though). It was my Dad who took me to an astronomy open night at my school, where local astronomical societies (I think they were Farnham and Guildford) had set up telescopes. I remember looking at the Galilean satellites and being impressed with how quickly things appeared to move! I also entered a competition to win a signed copy of Patrick Moore's Universe for the Under 10s, which I won! I've been hooked ever since.

What did you read at University?

I did an eclectic selection of A-levels (physics, geography, French, general studies, and A/S maths) and then read planetary science at University College London. I was amazed that such a perfect course existed that covered all my interests, from the geology of the planets, to the mechanics of the Universe and even some practical astronomy courses which were taken at the Mill Hill Observatory. After my first degree I did a PhD in impact cratering, also at UCL, and which I successfully completed earlier this year. I got to replicate tiny impact events in the lab using a "light gas gun", which is basically a 5-metre long gun that shoots projectiles at up to 8km/s, as well as making massive planet-destroying impact events (using computer simulations!)

What part of your job do you enjoy most?

I am now lucky enough to be working full-time at *Astronomy Now* magazine. As well as space science, my other passion is communicating science to the public and young people to try and inspire them, so my job lets me do both things at once! I mostly write news stories for our web-

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☞ site www.astronomynow.com and get to find out the latest exciting discoveries that are going on in our Solar System and beyond, often before they are released to the public. I also get to go to different astronomy conferences where I can interview scientists about their research. I am also in charge of the Young Stargazers youth section of the Society for Popular Astronomy, which is aimed at under 16s and offers a reduced subscription rate to the society, as well as loads of cool stuff sent to you over the year,



Emily Baldwin, viewing the partial solar eclipse of August 1 from Hyde Park, using special solar eclipse glasses.

Photo by Paul Sutherland.

including a welcome file containing observing projects, badge, stickers, and reduced entry to lots of astronomy and science centres across the UK. There are also four dedicated pages in the quarterly society magazine *Popular Astronomy*. You can find out more at www.popastro.com

If you would like to add your school to the *Starlight* distribution list we would only be too happy. Just send us an e.mail! admin@starlight-news.co.uk There will be at least four issues coming out between October this year and throughout 2009.

Cosmology meets the challenge

Uncovering the nature of the dark matter and dark energy in the Universe

One of the most surprising discoveries in cosmology is that most of the matter-energy in our Universe is invisible. In fact the stars, galaxies, planets and the occasional methane cloud that make up the wonderful tapestry of the night sky are but a tiny fraction of what is out there. A suite of spectacular observations by ground-based telescopes and satellites has found evidence that ordinary atoms are responsible for about only 5% of the Universe's contents.

Physicists believe that up to five times as much matter is in the form of as yet undiscovered dark matter. For 50 years, 'dark matter' has been the preferred toy of astronomers, but now particle physicists have joined forces with them to track down the super-particles dark matter might be made of.

According to a theory known as 'Supersymmetry', in the first milliseconds after the Big Bang the Universe was filled with both ordinary particles and their heavy-weight partners, 'shadow' particles called 'sparticles' (for supersymmetric particles). Within an instant, the sparticles had all disappeared, but for one particular type: the last remaining sparticles are expected to be still around today and make

up the dark matter of the Universe.

The global physics community is not leaving any stone unturned to track down the last Highlander of the sparticles: ongoing efforts include space observatories as well as the most complex machine ever built by humans, the LHC particle accelerator at CERN, which will try to produce dark matter in the lab.

Even dark matter pales in comparison with the problem posed by 'dark energy'. Over the last decade, the light of exploding stars on the edge of the visible Universe brought disturbing news to the astronomers observing them. The data imply that gravity, the glue holding spacetime together, is unravelling across the Universe, replaced by an unexplained, repulsive force, dubbed "dark energy". The existence of dark energy vindicates an idea originally held by Einstein himself over 70 years ago, who later recanted calling it "the greatest blunder of my life".

To explain dark energy, physicists are being forced to take a bold, revolutionary step in the way we conceive of the cosmos: the visible Universe, with its billions upon billions of stars, would be demoted to a tiny patch in a much grander reality, the Multiverse. Looked at across the Multiverse, the improbable existence of humankind in our Universe stops being an unaccountable accident and becomes a natural consequence of the fundamental laws of Nature. Much more work will be needed before this speculative idea can be tested, and some fear that this will never be possible.

Roberto Trotta FRAS

Oxford University Astrophysics department
and Imperial College London



Supernova 1994d (bright star in the bottom left) goes off in a distant galaxy. Such explosions have allowed astronomers to discover the existence of dark energy. (HST/NASA picture)

This article is a summary of one of the Keynote lectures at our AGM on 25th June this year at Burlington House. We thank Roberto Trotta both for the lecture which was very well received by the attending teachers, and also for this summary.

Letter from Japan Under

First off, let me apologise for the absence of a "Letter from Down Under" in the previous edition of Gnomon. I have recently changed roles within the Anglo-Australian Observatory, and now head the Australian Gemini Office (AusGO). AusGO manages Australia's use of its 6.2% share of the twin 8m Gemini telescopes in Hawaii and Chile, as well as access to the twin Magellan 6.5m telescopes in Chile. Instead of long drives to the AAT, I travel less frequently but much further, to meetings with our Gemini colleagues from around the world. I'll miss the "hands on" observing experience with the AAT, but am relishing the new challenges of supporting larger (and somewhat more modern) facilities overseas.

Anyway, back to astronomy education. Our radio astronomy colleagues at the Australia Telescope National Facility (ATNF) have developed a novel way of getting high school students excited about astronomy – by letting them carry out their very own observations with the famous Parkes 64m radio telescope! However, rather than have the students pick a random object to observe, they get to take data which is actually useful to astronomers.

PULSE@Parkes (PULsar Student Exploration online at Parkes) was officially launched by the Minister for Innovation, Industry, Science and Research, Senator the Hon Kim Carr, in Canberra on 18 December 2007. The aims of PULSE@Parkes are to provide a stimulating example of real science using a major national facility to engage high school students in science, and to provide role models of scientists to students through direct interactions. Using the context of radio astronomy to develop students' skills in science, information and communication technology problem solving and group work it will develop student investigations in astronomy and promote world-class astronomical research and facilities in Australia.

PULSE@Parkes is led by Robert Hollow (ATNF Education Officer) and ATNF astronomer Dr George Hobbs, with support from the Science Education team at Charles Sturt University in Bathurst.

Pulsars are rapidly spinning neutron stars, whose strong magnetic fields squeeze radiation out along the magnetic poles. If these beams sweep in the direction of Earth as the pulsar spins, we see a pulse of radio, X-rays, and perhaps even optical radiation. Pulsars are the fossil remains of stars about 10 times bigger than our Sun, massive enough to end their lives in supernova explosions, but not so massive as to collapse completely

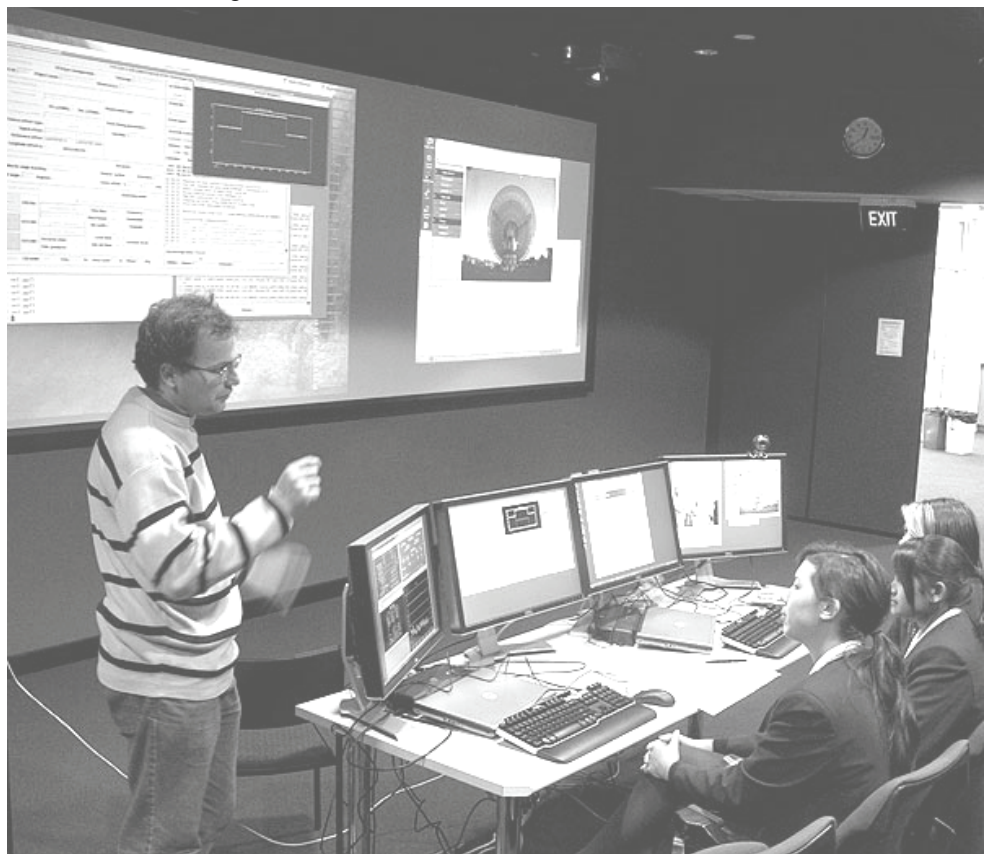
under gravity and form a black hole. They make exquisite clocks, and can be used to measure distances in the Milky Way, test out Einstein's Theories of Relativity, and may one day provide the first direct evidence of the existence of gravitational waves.

Currently PULSE@Parkes caters for one class per month of students in their final two years of high school. So far the schools have all been from the state of New South Wales, but it is hoped to take it interstate, and eventually overseas. In advance of the observing session, classes are given briefing notes on what to expect, and some background reading on radio astronomy and pulsars. On the appointed day, the class are brought to the ATNF headquarters in Sydney, and take their places in a lecture theatre equipped with multiple video projection screens. The students are given an introductory talk by an ATNF astronomer, then watch a short movie of an astronomer making their way to Parkes. A dedicated video link to Parkes allows the class to interact with a pulsar astronomer currently observing at the telescope. She or he in effect relinquishes control of the telescope to groups of 3–5 students who take their turn at a desk at the front of the theatre whose computer displays are identical to those in the control room at Parkes. The students have already decided among themselves which pulsar they plan to observe (from a set the astronomer would have observed anyway), and are even free to give it a more exciting name than the usual official telephone number-like name ("Death Star" seems to be particularly popular!). The students load up an observing file, then press "Go". The look on their faces as they see on a web cam the mighty Parkes dish slewing under their command is priceless.

After integrating on the pulsar for several minutes to get sufficient pulses for their needs (and at the same time for the needs of the astronomers too), the students download their data from Parkes, and perform some basic processing to see the shape of the pulses. By observing the pulsar over a range of frequencies, the students can see the effect of dispersion, namely that pulses at lower frequencies arrive later than pulses at higher frequency due to their interaction with free electrons in the interstellar

ATNF pulsar astronomer George Hobbs explains to a group of students sitting at a duplicate of the Parkes observing console how to observe a pulsar. The large screen displays allow their classmates to observe the Parkes dish in motion, as well as the pulsar data being acquired.

Image courtesy Rob Hollow (CSIRO).



medium. Indeed, by plotting the measured delay against frequency in an Excel spreadsheet the students derive just how many electrons there are along the line of sight, and comparing this with a map of the gas distribution within the Milky Way, they can see just how far away and in which spiral arm the pulsar lies. Not bad for a high school experiment! The astronomer meanwhile adds the student's data to their own previous timing measurements to help them refine values for the pulsar spin-down rate, its position, age, etc. Thus, the valuable Parkes time is in no sense wasted or sacrificed – the data collected by the students is just as valuable to real astronomers as it is to them.

The "remote observing" experience provided by PULSE@Parkes means that it could in fact be carried out at any sufficiently well-connected teaching site, and indeed successful trials have already been held from Western Australia. A big advantage of radio astronomy is that such "virtual field trips" can be done during the normal school day, whereas an equivalent experience at an optical observatory would necessitate a night visit, or (in the case of the Faulkes Telescope), accessing a telescope on the other side of the globe. Anyone interested in finding out more about PULSE@Parkes should visit their web site at:

<http://outreach.atnf.csiro.au/education/pulseatparkes/>
or e-mail: Robert.Hollow@csiro.au

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Magic Planet – a new teaching tool

Using a Magic Planet digital globe with young and old learners is proving an effective way of teaching global perspectives. Stunning animated images of both the planet Earth and the Solar System can be shown in seconds and the exhibit has a real "wow!" factor for audiences of all ages.

'Being made redundant certainly focuses the mind', says Paul Haley who invested in this new digital technology. 'I wanted to use my teaching experience in schools to develop a successful outreach model which could be delivered in even the smallest rural primary school. A friend already ran a mobile planetarium business so the appeal of something new was a big factor.' Initial feedback on the arts-science workshops (delivered jointly by Paul and his

Alisha Haley and the Magic Planet digital globe, available in the UK through Vivifeye



daughter Clarissa) has been very positive. Children role play being "space journalists" of the future and film each other "reporting back live" from Europa or another planetary moon. They use their creativity skills to produce artwork in a range of media and improve their presentation skills by explaining their ideas on DVD.

In a new venture, IHY: Frontier Science through Arts, funding from the Science & Technology Facilities Council (STFC) is being used to deliver four workshops per term to Key Stage 3/4 pupils in special schools across England and Wales. The magic planet has been used at Herefordshire Headway, a day centre for adults with acquired brain injuries, who produced their own original *Touch the Sun* mural (see photograph below left). The globe also proved a popular exhibit at the BAA Winchester weekend in April.

Paul attended the CAP-2007 conference in Athens in October 2007 and is involved in a range of projects linked to IYA2009. 'My personal challenge is to deliver one workshop for every year since the invention of the telescope! A target of 400 seems daunting at first, but with fifty schools already involved in our astronomy outreach programme it is beginning to look possible', he said.

Magic Planet digital globes are available in the UK through Vivifeye <http://www.vivifeye.com> and they are produced by Global Imagination:

<http://www.globalimagination.com>

A short film showing the globe in its storyteller mode can be downloaded from the Space Today UK website:

<http://www.spacetoday.com>

Further details are available from Paul Haley on [01981 251029](tel:01981251029) or

pahastro@aol.com



This original mural, Touch the Sun, was produced at the Herefordshire Headway day centre for adults with acquired brain injuries.

Curriculum Corner

The table of rising and setting times in the *Sky Diary* (on page 8) has been improved, I hope you'll agree, by the addition of information to show in which astronomical constellation the object (Sun, Moon or planet) will be at the time of rising on the date in the table (the 15th of each of the three months). To keep the size of the table the same as it has been for so long, I have slightly reduced the space required for the time, using the format 06:57 in place of 06h 57m. The abbreviations (as opposed to unit symbols) that I used were not very usual anyway the hour is usually abbreviated to 'r', and the minute to 'min' since m signifies metres! The symbols I have used for the constellations are the long established astrological symbols for the signs of the Zodiac. These, and others for planets, planetary orbit features such as perihelion, nodes etcetera, are about the only debt astronomers owe to astrologers.

However, I had a problem when it came to Ophiuchus, which is the well-known thirteenth constellation through which the ecliptic passes, and in which, as it happens, both the Sun and Mars find themselves on the 15th of December this year. So I borrowed a symbol from the famous Wingdings font used for various signs in this newsletter, which is a glorious ampersand (&) and appears only just beyond the astrological symbols in the listed font. It suggested to me a hero wrestling with a serpent (only a

& titchy snake wriggling in one of his hands, but that's a bit like Ophiuchus the Serpent Bearer, isn't it?)

So, a list of the 13 constellations of the ecliptic, including the Serpent Bearer, is given here just in case you haven't seen them before.

Aries ♈: Taurus ♉: Gemini ♊: Cancer ♋: Leo ♌:
Virgo ♍: Libra ♎: Scorpius ♏: Ophiuchus &: Sagittarius ♐:
Capricorn ♑: Aquarius ♒: Pisces ♓

Astrologers lump Scorpius and Ophiuchus together and call them Scorpio, but in fact while "in Scorpio", a body is more likely to be in Ophiuchus, with the Scorpion's tail well south.

SUN FUN

The Zodiac is merely a band across the celestial sphere extending some 7° above and below the *ecliptic*, which is the Sun's apparent path across the celestial sphere in a year. It means circle of the animals, since all but one of the names represent a creature or person. (Have a quick *Trivial Pursuit* type question: which is the exception?).

Humans and their ancestors have arranged their days by the rising and setting of the Sun, for obvious reasons. So it was only natural to design time-keeping systems by dividing one cycle of the Sun round the sky into intervals, which were eventually the hours we now know so well. But once the time could be measured with any accuracy it became obvious that the Sun was, in general, a rotten time keeper. As time machines then became even more precise, it became clear that the Sun was pretty consistent after all, if not regular day by day. It is rarely on the southern meridian at noon, and its altitude at meridian transit varies enormously. Its daily position in our sky (from the same spot) varies due to our planet speeding up or slowing down either side of January 2 and July 4 (nearest the Sun at perihelion, or furthest at aphelion respectively), and how much the axis of the Earth is tilting towards or away from the Sun's celestial pole. The first of these two cycles happens once a year.

Twice a year, the Sun wastes valuable easting by climbing quite a bit northwards as well, across the celestial equator at the start of northern Spring, and southwards as this coming Autumn season starts (about September

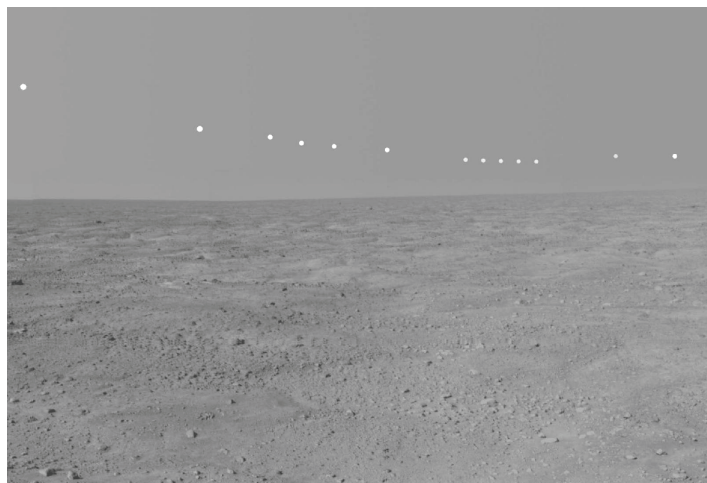
22). At the solstices, the Sun's apparent daily motion is closely parallel to the equator, and it is directed almost entirely due east. So the Sun appears to accelerate eastwards towards the solstices after each equinox, a cycle that happens twice a year and also upsets the sundial. The graph of Sun fast and slow is the correction that must be made to your sundial according to the date. It is called the *equation of time*.

This effects the Sun's east/west position according to date, while the tilt of the Earth's axis affects how high it appears in the sky. If the position of the Sun, *relative to your fixed observation point*, is measured and plotted every day or at frequent intervals at exactly the same clock time on each occasion, a figure 8 is plotted in the sky, called an *analemma*. This can be done using shadow sticks to plot Sun altitude as frequently explained in these pages by Eric Jackson (*Gnomon* Vol 27 no.3) for example, and a sundial to measure the equation of time. A Google search for 'analemma' will reveal several photographs in which the Sun is shown from a fixed vantage point at the same clock time for each of a series of exposures, of which this is one example (right).



Multiple exposures over a year are a tough assignment: the foreground can only be included once and the camera must be returned to the exact same position on the map, the exact same position for the photo frame, and I leave you to work out how it is done! But an easier assignment is to take multiple exposures from a fixed camera over a few hours. This can be used to demonstrate the development of an eclipse, for example (Sun or Moon), or a phenomenon such as the midnight Sun. I think you might find the sample below difficult to reproduce, however!

Richard Knox



This panorama mosaic, taken by the Surface Stereo Imager on board NASA's Phoenix Mars Lander, documents the passage of the midnight sun over several days. The foreground and sky images were taken on Sol 54, or the 54th Martian day of the mission (July 20, 2008). The solar images were taken between 10 p.m. and 2 a.m., local solar time, during the nights of sols 46 to 56. During this period of 11 sols, the Sun's path was slightly lower over the northern horizon (part of the analemma! Ed.), causing the lack of smoothness to the curve. This image captures the polar nature of the Phoenix mission in its similarity to time lapse pictures taken above the Arctic Circle on Earth.

Solar Physics Workshop for 11-16 year olds

In 2007 The Observatory Science Centre received a substantial award from STFC for the development of a workshop to literally look at the Sun! It is often difficult for teachers to find the time and money to be able to present astronomy related topics in a practical way using specialised equipment. The idea behind this venture therefore was for the Science Centre to become a gateway for teachers and students through which they could access solar telescopes, spectroscopes, become involved with a school-wide project to map Sun spots, "listen" to the Sun via radio waves and be involved with practical activities designed to help teach solar physics in a fun and interesting way. It certainly helps that the workshop is held in one of the domes with a giant historic telescope as a backdrop! The workshop was developed with the able assistance of John Adair an amateur astronomer specialising in all things solar and Stuart Constable who specialises in amateur radio communications.

The workshop starts with a scale model of the solar system which includes giant polystyrene balls, marbles, beads and some toilet roll! This helps to put things into perspective before embarking on 4 basic messages which are addressed using practical activities throughout: The Sun is made up of gaseous layers just like the layers of an onion; The Sun rotates but not all at the same speed; The Sun possesses a magnetic field; The Sun is made up of a lot of different elements.

Not all equipment used is specialised and simple materials such as CDs and crystals are used to discuss refraction and the spectrum of light. The centre's own interactive bubble wall is also a great example of refraction and is used before or after the actual workshop. The spectrum is explored further, using an LHIREs spectrograph mounted on a tripod which shows absorption lines and can be used on relatively cloudy days. The centre's interactive spectroscope also looks at white light and the emission spectra of sodium and neon light giving an ideal example of how different gases are detected using this technology. The activity culminates in building a simple spectroscope.

Recording sunspots is one of the main activities and this will be done using "Sunspotters", simple solar telescopes. Hopefully as more schools participate in the workshop, a Butterfly diagram devised by Edward Maunder, will be created and used to document increasing solar activity as sound waves, hopefully one day "hearing" magnetic field lines break. This is definitely one of the highlights of the workshop, introducing specialised equipment that most students would otherwise not have the opportunity to see being used in astronomy.

The centre's 2 specialised solar telescopes operate side by side. Students are able to look at the Sun through the Hydrogen Alpha scope to find sunspots, prominences,

plages and filaments. The H α scope is a fantastic piece of equipment allowing you to "see" what is happening with the magnetic field lines on the Sun. This activity is accompanied by experimenting with iron filings and magnets to show the 3 dimensional magnetic field lines.. The Calcium K PST telescope will be linked to a monitor for ease of seeing (especially for adults who generally find it impossible to see anything through this kind of scope). Sunspots or areas of potential sunspot activity are looked for and compared to the H α scope. It will be very exciting if we find any sunspots that are just forming!

The final part of the workshop is a discussion about the harmful effects of the Sun. This brings in more of the electromagnetic spectrum and helps to reiterate how the Sun is made up of a lot of different elements. Ultra violet radiation is detected using UV detector beads and filters, including a cheap pair of sunglasses!

Following trials, this promises to be an exciting workshop with senior school students gaining access to equipment that might otherwise be unavailable to them.

Sandra Voss
The Observatory Science Centre
 www.the-observatory.org

Changes to the National Curriculum

Revised programmes of study in force for secondary schools from September 2008. Schools now have greater flexibility to tailor their teaching to the learners' needs. Astronomy still features in the science curriculum but is not listed in such detail as previously.

The Key Stage 3 programme says that pupils should learn that "Astronomy and space science provide insight into the nature and observed motions of the sun, moon, stars, planets and other celestial bodies". This statement is just the framework around which the teaching will be constructed, and the attainment targets give a much better idea of the kind of knowledge and learning that is intended. Examples are given below and show how the learning is expected to progress.

Level 4: Describe ... the observed position of the sun in the sky over the course of a day.

Level 5: Explain processes and phenomena using a model, such as the length of a day or a year.

Level 6: Explain...the relative brightness of stars and planets.

Level 7: Explain how evidence supports some accepted ideas such as the role of gravitational attraction in determining the motion of bodies in the solar system.

Level 8: Understand why scientific ideas may need to be changed, such as the developing understanding of the structure of the solar system.



The Key Stage 4 programme is similarly over-arching: "The solar system is part of the Universe, which has changed since its origin and continues to show long term changes". The Levels are the same as above but with the addition of the Exceptional Performance level.

Sky Diary Autumn 2008

Welcome to this quarter's *Sky Notes*. This is a quick reminder that the clocks go back an hour on Sunday the 26th of October. To be more precise, the time will change at 0200 BST and become 0100 GMT.

October 2008 is certainly the month to promote astronomy education. It starts with a marvellous anniversary; this of course is NASA's 50th birthday. So make sure you make a fuss. I will definitely be using this as an excuse for a big astronomy display at school during the start of the next academic year. Don't forget from the 4th to the 10th of Octo-

ber is World Space Week.  www.spaceweek.org So there are no excuses not to enjoy yourself.

So what can be seen out there on all those wonderful clear and crisp mornings and nights during October? Well the planet Mercury is a good start and it is going to be a wonderful sight. For early risers it will be seen in the sky just south of east. The highest it will get will be between the 22nd and the 27th at an altitude of just over 10°. It will be best seen about 40 minutes before sunrise. Look out on-line for some new and exciting pictures of Mercury as the *Messenger* spacecraft  messenger.jhuapl.edu passes over the planet on the 6th. Zipping past at an altitude of  **7**

☞ only 200km, it is the second pass of a three pass manoeuvre designed to provide the critical gravity assist needed to keep *Messenger* on track for its March 2011 orbit insertion around the planet.

Moon phases for the fourth quarter of 2008				
	New Moon	First Quarter	Full Moon	Last Quarter
October	28	7	14	21
November	27	6	13	19
December	27	5	12	19

Jupiter is still a lovely evening object during this month. It crosses the meridian at around 18:30 mid-month. This is a bright object and will look fantastic in the twilight sky. This planet has been in the news recently with a new third red spot appearing and then possibly disappearing (observations are still ongoing).

Fantastic images were made of the planet by the Hubble Space Telescope's Wide Field and Planetary Camera 2. On the 8th, if all goes to plan, STS-125 will launch for the Hubble Space Telescope Servicing Mission No. 4. It is great to see that the life of this revolutionary telescope is to be extended.

Saturn is leisurely becoming a more noticeable object during October. Mid-month it will rise at about 03:11 in Leo. Something to look forward to soon. If you can't wait, then make sure you visit the website of the Cassini mission saturn.jpl.nasa.gov. During October Cassini will be making two close flybys of Saturn's moon Enceladus. The most anticipated will occur on the 9th when the spacecraft will pass at an altitude of only 25km.

On October the 21st we have the Orionid Meteor Shower. The Orionids are an average shower producing about 20 meteors per hour at their peak. This shower usually peaks on the 21st, but it is highly irregular. A good show could be experienced on any morning from October 20 to 24, and some meteors may be seen any time from October 17 to 25. This year, the last quarter Moon may cause a problem for seeing faint meteors, but the brightest ones should still be visible from a dark location. Best viewing will be to the east after midnight.

Just for fun here are two 'closet approach' details that might cause a laugh. Don't miss our newly named dwarf planet Eris as it whizzes past at 95.778 AU on the 14th (make sure you duck). And for all you fans, asteroid 13681 'Monty Python' is only 2.145 AU from Earth on the 31st.

Now moving into November we find Mercury fading back into the twilight sky. Venus is now taking over as the inner planet on show, and becomes more prominent in the evening sky. Looking south-west at civil twilight, around 17:00 mid month, you will see it travel through Sagittarius. This is a busy part of the sky with many interesting objects. You can use Venus as a pointer on the 13th to acquaint yourself with this region. The planet will pass 1° south of M8, 2.5° south of M20 and 3° south of M21 just in this one night.

Jupiter is sets not too long after sunset. But keep and eye on it at the end of the month as Venus starts to move up and they almost meet by the end of the month. Saturn can now be seen in the pre-dawn sky slowly gaining height as the month progresses. The crescent Moon on the 21st will make identification easier as it will lie 6° south from Saturn around 05:30.

I am really looking forward to the 1st of November and the opposition of asteroid No. 4, Vesta. I really hope for clear skies as this brilliant photo opportunity is on a Saturday night to the right of Taurus in Cetus. Vesta will easily be seen in binoculars at 6.5 magnitude. I will be trying for a **8** wide field shot including Aldebaran and the Pleiades.

The evening of November 16th sees the peak of the Leonids meteor shower. The Leonids form one of the better meteor showers to observe, producing an average of 40 meteors per hour at their peak. The shower itself has a cyclic peak year every 33 years where hundreds of meteors can be seen each hour. The last of these occurred in 2001. The shower should peak this year on the morning of November 17th, but you can usually see some Leonid meteors between November 13 and 20. A waxing gibbous moon will be a problem, so only the brighter meteors will be visible. Look for the shower apparently radiating from the constellation Leo after midnight.

A final point of interest for November is the STS-126 launch scheduled for the 10th when the Space Shuttle Endeavour is to visit the International Space Station.

December the 1st starts us off with a super spectacle. There will be an occultation of Venus by the Moon while Venus is also passing through its meeting with Jupiter. The two planets are just over only 2° apart. Finding both the Moon and Venus in daylight with binoculars *can* be done

Rising and setting times (UT): lat.52°N; long.3°W						
	October 15		November 15		December 15	
	Rise	Set	Rise	Set	Rise	Set
Sun	06:37 ♏	17:17	07:32 ♏	16h 20	08:13 ♏	16:00
Mercury	05:13 ♏	16:54	06:57 ♏	16:07	09:20 ♏	16:30
Venus	09:55 ♏	18:20	11:13 ♏	18:21	11:09 ♏	19:33
Mars	08:06 ♏	17:44	08:09 ♏	16:31	08:07 ♏	15:43
Jupiter	13:44 ♏	21:30	11:58 ♏	19:51	10:19 ♏	18:25
Saturn	03:11 ♏	16:27	01:26 ♏	14:13	23:33 ♏	12:36
Uranus	16:17 ♏	03:36	14:14 ♏	01:31	12:16 ♏	23:29
Neptune	15:24 ♏	00:58	13:22 ♏	22:52	11:25 ♏	20:57
Moon	17:00 ♏	07:37	17:44 ♏	10:48	19:35 ♏	10:45

Data for other venues and dates can be estimated from this (and Moon phase) table. Symbols after rise times show constellations where body is, at rising.

♏ is a symbol "borrowed" for Ophiuchus - (see Curriculum Corner, page 7) so you may see Venus disappear (soon after 16:30). But sunset is at 17:22 and Venus will reappear in the deepening twilight just after 18:00 at an altitude of about 12° for a special photo opportunity.

Saturn rises before midnight by the middle of the month. It is still in Leo and will make another 6° pass above the Moon on the 18th. Saturn's diameter will slowly start to increase from now until next year's opposition. At the end of the month it will be 18.5 arcseconds across and have a magnitude of +1. A related Cassini date of note is the 21st. This amazing spacecraft will make another pass of Titan at an altitude of 970km and will provide even more excellent images.

If like me you like spotting asteroids, then No. 2 Pallas at opposition on the 10th at 8.0 magnitude.

This month's meteor shower is the Geminids. Considered by many to be the best meteor shower in the heavens, the Geminids are known for producing up to 60 multi-coloured meteors per hour at their peak. The peak of the shower is on the morning of December 13th, although some meteors should be visible from December 6 - 19. Unfortunately, the full moon will block out all but the brightest meteors this year, even in dark locations. The radiant point for this shower will be in the constellation Gemini. Best viewing is usually to the east after midnight.

December sees the shortest daylight hours of the year on the 21st. The (northern) Winter Solstice occurs at 12:04 UT. The Sun is at its furthest south point in the sky and this is also the first day of winter.

James O'Neill