

# Gnome

Newsletter of the Association of Astronomy Education



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## The AAE looks forward to the future

The AAE General Meeting at Burlington House on 6<sup>th</sup> Dec provided a very positive and useful view of where we are now and what the priorities must be for the future. We recalled the reasons for the formation of our association which were to provide for mutual support of members and sharing of resources and, importantly, as a pressure group to get some astronomy onto the school curriculum.

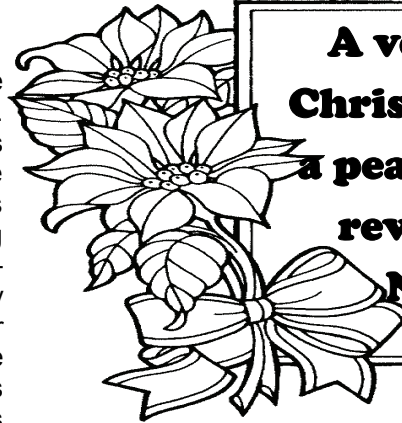
Now that many of these early aims have been fulfilled, the AAE needs a change of direction. The introduction of the National Curriculum firmly established astronomical topics at all key stages (currently Key Stages 2 to 4). Also resources are now widely shared via the internet and science textbooks have been rewritten to include much more astronomical material.

These and other factors may be

behind an ongoing decline in membership of the AAE. However, other changes were noted such as the sharp fall in the numbers of sixth formers applying to do Astronomy and Astrophysics courses, possibly discouraged by parents or teachers who seem to be advising straight physics courses instead. Why is this happening and is there a role for the AAE to play here?

Discussion in the meeting, chaired by the AAE President Mike Dworetzky, focused on what the AAE has to offer under new circumstances. The opinion of all the attendees at the meeting was that the AAE possesses and represents both teaching and classroom experience. Moreover it holds a

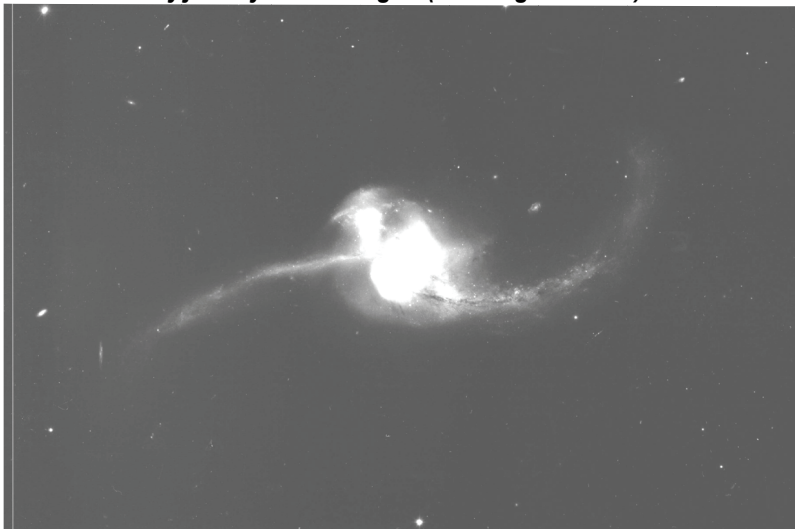
central position between the planetaria, represented by the British Association of Planetaria (BAP), and the professional astronomy world, mainly represented by the Royal Astronomical Society (RAS). Although there is considerable overlap in purpose with these other organisations, the AAE still has something to offer mainstream education. ☞ (cont. on p2)



**A very Merry Christmas, and a peaceful and rewarding New Year**

## Close encounter of the galactic kind

*This Hubble Space Telescope image captured what appeared to be one very bright but bizarre galaxy. It is actually the result of a pair of spiral galaxies that resemble our own Milky Way smashing together at breakneck speeds. The product of this dramatic collision, called NGC 2623, or Arp 243, is about 250 million light-years away in the constellation of Cancer. Interacting galaxies have a dramatic effect on each other. Studies have revealed that, as galaxies approach one another, massive amounts of gas are pulled from each galaxy towards the centre of the other, until ultimately, the two merge into one massive galaxy. The object in the image, NGC 2623, is in the late stages of the merging process with the centres of the original galaxy pair now merged into one nucleus. However, stretching out from the centre are two tidal tails of young stars showing that a merger has taken place. During such a collision, the dramatic exchange of mass and gases initiates star formation, seen here in both the tails. The prominent lower tail is richly populated with bright star clusters — 100 of them have been found in these observations. The large star clusters that the team have observed in the merged galaxy are brighter than the brightest clusters we see in our own vicinity. These star clusters may have formed as part of a loop of stretched material associated with the northern tail, or they may have formed from debris falling back onto the nucleus. In addition to this active star-forming region, both galactic arms harbour very young stars in the early stages of their evolutionary journey. Some mergers (including NGC 2623) can result in an active galactic nucleus, where one of the supermassive black*



*holes found at the centres of the two original galaxies is stirred into action. Matter is pulled toward the black hole, forming an accretion disc. The energy released by the frenzied motion heats up the disc, causing it to emit across a wide swath of the electromagnetic spectrum. NGC 2623 is so bright in the infrared that it belongs to the group of very luminous infrared galaxies (LIRG) and has been extensively studied as the part of the Great Observatories All-sky LIRG Survey (GOALS) project that combines data from some of the most advanced space-based telescopes, including Hubble. Additional data from infrared and X-ray telescopes can further characterise objects like active galactic nuclei and nuclear star formation by revealing what is unseen at visible wavelengths. The GOALS project includes data from NASA/ESA's Hubble Space Telescope, NASA's Spitzer Space Telescope, NASA's Chandra X-ray Observatory and NASA's Galaxy Evolution Explorer (GALEX). The joint efforts of these powerful observing facilities have provided a clearer picture of our local Universe.*

Photo: NASA, ESA; A. Evans (Stony Brook University, New York)

☞ (cont. from p1) Francisco Diego (UCL) summed up the general consensus by proposing that we must aim to carry on this vital role.

Some important issues for the immediate future were then outlined for urgent future consideration:

- Enhanced links with the RAS and BAP: Robert Massey is our link with the RAS and he outlined possible future directions for cooperation. Shaaron Leverment chairs the BAP and is also on AAE Council.
- Membership drive: we need some ideas for this. Events and training days are two possibilities.
- Resources: the re-publication of the Secondary Pack is on its way. Should this be free to members? Should it be available on-line?
- Gnomon: Should this be e-mailed to members to save printing costs (a substantial proportion of our income)? It was felt that some members would prefer to have paper copy and some Council members thought it would be more likely to be read in this form. It will need reformatting if we send it out electronically.
- Presence at teachers' conferences: AAE should have a presence at ASE's Annual meeting and the UK Space Conference.
- In-service Training for Teachers: Our event at Burlington House in 2008 was considered to be very successful and we should do more of these.

What do you think? If you have views, comments or suggestions on these issues please let us have them via e-mail to the secretary at [aae@erwen.com](mailto:aae@erwen.com)

After the meeting Peter Hingley, the librarian at Burlington House, gave us a much appreciated tour of the building and showed us some of the treasures kept by the RAS. We viewed portraits of famous astronomers, photos of eclipses from over 100 years ago and a book published in 1482!

Anne Urquhart-Potts

## The planetarium world in IYA 2009

### News from the British Association of Planetaria



From the Scottish Highlands to the Sussex Downs, UK planetaria have been keen to play a centre-stage role to get the message of the International Year of Astronomy out to school children and members of the public in 2009.

This year has been one of the greatest opportunities to get astronomy education firmly into the public eye and many planetarium domes have been upgrading equipment and writing captivating shows to do just that. Tying into 'Darwin200' – show titles such as *'the Environment'*, *'Human Evolution'*, *'Dinosaurs'*, *'the History of the Earth'* and *'The Voyage of the Beagle'* all bring astronomy to the public with new and innovative slants to the story.

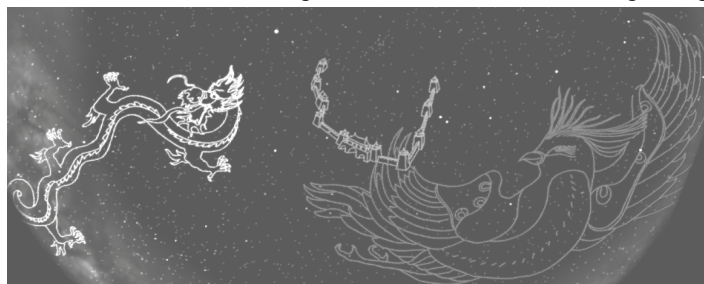
We have seen static and mobile planetaria, usually filled

to bursting with schools groups, making concerted efforts across the country to inspire adults and therefore get families to learn together. Combining a planetarium experience with hands-on astronomy workshops, lectures or observing evenings seems to have been a winning formula to draw in the crowds, such as at public events like the Telescope400 project.

On a smaller scale, many planetaria such as INTECH in Winchester, At-Bristol and the Royal Observatory in Greenwich have provided free advice events, public lectures and 'meet the expert' evenings - the emphasis being to put members of the public in touch with astronomers in order to gain information, skills and advice that can then last a lifetime.

Familiarising people with the night sky, with local cultural and community relevance, and forming links between countries around the world have been an important aspects of IYA.

Thinktank's Planetarium in Birmingham has taken the opportunity to explore far off lands, educating and inspiring visitors with the myths and legends from China. They have developed a stunning new presenter-led show about Chinese constellations - consulting with both Macao and Hong Kong



"Chinese constellation artwork by Pak-Keung Wan".

Image courtesy Mario di Maggio, Thinktank UK

planetariums to create the first, accurate and complete set of Chinese constellation drawings – 283 constellations in all!

At Explorer Dome (a mobile planetarium based in Bristol) we wanted to try to unite different schools through astronomy education. We focused on Orion - a constellation that dominates the night sky both here and in South Africa – but is seen from a different angle and during different seasons in each country.

Children, clustered in hives of creative activity, made up their own, new, English constellations and wrote stories (new myths) and drew astronomy-inspired cards that were sent over to the children in their link schools in South Africa. One of the imaginative constellations included Orion as "Robinicus" – a massive and terrifying robin from the underworld, and there were also tales of red-eyed box fish, killer Christmas trees and a kung-fu bunny that explodes to make the stars.

The return stories from Cape Town included a super-Porcupine, a Zebra with crutches and a large benevolent summertime giant... the stars do indeed look a lot like a face when seen from Cape Town perspective. It was certainly quite a poetic reminder that no matter how far

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There will generally be a 10% discount to AAE members on all publications and advertising rates.

Practising teachers may claim their subscriptions as an allowance against income tax, effectively reducing their contributions.

#### All communications (except those to the Editor) should be addressed to:

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#### Publication Dates:

These are at the equinoxes and the solstices, that is four times a year. Copy deadlines are four weeks before these dates.

apart we are, we all see parts of the same sky. IYA has given us all a focus and an opportunity to push for excellence and innovation. It has provided ways to create new community links both nationally and internationally and with the continued sharing of stories, our successes and mistakes and more communication within our community, I believe 2010 will also be a great year!

**Shaaron Leverment**



**Grade 7 pupils at Aloe Junior School in Mitchell's Plain, Cape Town, making a new constellation out of the stars of Orion to send back to the UK.**

*Image courtesy Shaaron Leverment*

## The BAP AGM, and an invite to join

One of the highlights of the BAP year was the 2009 AGM. Generously hosted by the Royal Observatory Greenwich, the programme for 2009 was designed specifically to help members to share experiences, keep up-to-date with new advances and technologies, and provide new inspiration and support for those of us who may need it more than ever in harder times.

Julia Riley (previous BAP treasurer, previous planetarium manager at MOSI in Manchester and current new mobile dome provider) sent this message following our event in May, which I feel sums up the importance of our yearly meeting:

"I never appreciated the invaluable support that BAP provides to people who are working so much on their own as I am now. It makes a real difference to be able to meet up with like-minded individuals all tackling the same sort of issues and I've returned home feeling rejuvenated!"

Our next meeting is to be held at INTECH planetarium in Winchester on 7<sup>th</sup> and 8<sup>th</sup> May 2010 and all AAE members are very welcome to attend. The British Association of Planetaria and the Association for Astronomy Education always have a large overlap both in the aims of our organisations and in the work we do, and so we hope you would also find the days rewarding, interesting and enjoyable.

We are a growing organisation and if you are interested in joining BAP, or if you have any astronomy talks that you would like to be advertised on our website, please do get in touch. A recent website overhaul means we now have a much stronger and more professional web presence and our website is the first and best way to advertise our members across the UK.

**Shaaron Leverment**

*We are delighted to welcome Shaaron onto AAE Council this year and thank her for the strong links to BAP. - Ed*

## Dark Sky report

On October 20 2009, several members of the Cardiff Astronomical Society met at the Senedd building of the Welsh assembly in Cardiff as a result of conversations with Assembly Member (AM) Nick Ramsay and Assembly colleagues. AMs, representatives from planning authorities, Welsh ecological and environmental bodies, retail organizations and national parks also attended what was a very entertaining and informative meeting: a seminar on the subject of preserving the dark skies of Wales. Bob Mizon and Martin Morgan Taylor from the BAA Campaign for Dark Skies spoke on the environmental and legal aspects of the topic, and Marc Delaney {CAS} gave a presentation of beautiful images taken in Welsh night skies.

An associated petition is available at

📄 [www.assemblywales.org/gethome/e-petitions/eform-sign-petition.htm](http://www.assemblywales.org/gethome/e-petitions/eform-sign-petition.htm)

The organizers call upon everybody interested to sign it. Many useful links between campaigners, politicians and other involved parties were formed at this meeting, and hopes are high that a positive dark-skies policy for Wales will result from it.

**Bob Mizon**

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## The year one thousand and sixty-six, and all that

It was with a sense of foreboding that I awaited "the year two thousand" as it was almost universally called. I thought people would soon get used to speaking out the name of a year in the new millennium so that everyone would know it was a year, and not their daily rate of pay or weekly expenses.

Alas! It was not to be. I suppose it could have been expected; after all we still count out our coppers in "pee", as we were taught when decimal currency was introduced in the UK nearly 38 years ago. We never used to talk of "dees" in the old money, they were "pence" or "pennies". Or just a number with "pence" (and shillings) inferred, as in "That'll be one pound two and six please. Would you like to pay in easy instalments, Sir?"

So please, please, please, teachers, set an example and refer to calendar years in the same form as they always have been, particularly since there has been a little bit of progress recently as 2010 approaches. So this coming January 1st, out with the old year ("two thousand and nine") and in with the new, "twenty ten".

**Richard Knox**

*This is the first of our honourable ex-editor's "Rants". He threatens to rant in a regular way for issues next year and beyond!*

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## Galaxy Zoo news

See the launch of the most advanced Galaxy Zoo project yet at: 📄 <http://mergers.galaxyzoo.org>

Using the specially built fruit machine, your computer will generate eight random simulations of a target galaxy merger chosen from the 3000 found by Galaxy Zoo users. All you have to do is find one that fits the observations - a task that is more suited to humans than computers. As you get closer to a good match, you can even take direct control of the simulation and select from the millions of possibilities.

**Chris & the Galaxy Zoo Mergers team.**

PS The main Galaxy Zoo site is still awaiting your classifications at: 📄 <http://www.galaxyzoo.org>

## Letter from Japan UMOJ Down Under

While astronomy has been the beneficiary of many technological and analytical breakthroughs over the centuries, it is not so often that astronomy gives something back to the world, let alone something with the potential to generate hundreds of millions of dollars in revenue, and which many of you probably have in your home already but take for granted.

“WiFi”, or Wireless Local Area Network (WLAN) to give it the technical term, is primarily a protocol that enables devices to communicate with one another wirelessly. Virtually all technology manufacturers produce WiFi-compliant devices, so that your Dell PC can communicate with your Canon printer, your iPhone, etc. One of the most common WiFi protocols in use today is the 802.11g standard, transmitting and receiving at a frequency of 2.4 GHz. What’s not commonly appreciated is that the 802.11g standard was invented and patented by radio engineers at the Commonwealth Scientific and Industrial Research Organisation (CSIRO) in Sydney. Indeed, it took a courtroom showdown in Texas this year to prove it!

The story starts way back in the mid-1980s, when a team of engineers led by Dr John O’Sullivan were trying to work out how to combine the signals coming from the six antennae of the Australia Telescope Compact Array (ATCA), then under construction near the town of Narrabri in northern New South Wales. Previous systems needed whole racks of electronics to compare the signal from each antenna with every other one, but this limited the speed at which data could be collected, and ultimately the sensitivity of the telescope. John O’Sullivan designed an integrated circuit (a computer on a chip) that was capable of performing thousands of Fast Fourier Transforms (FFTs) every second, breaking down electronic signals into their fundamental components. This was a great success, and the original design has only now been superseded 20 years later.

O’Sullivan’s team then turned their attention to trying to solve a different problem – how to send information rapidly and error-free using radio signals indoors. The difficulty everyone encountered was that radio signals echoing around a room cause most of the message to be lost and not understood, unless the data rate was slowed down so much that one may as well take the time to unroll a cable to connect the two devices! O’Sullivan and his team realized that they could use their FFT chip to transmit different parts of the message slowly, but simultaneously, as “packets” which could then be reconstructed at the other end, overcoming any lost information along the way.

The CSIRO team patented their approach but the technology was slightly ahead of its time. Once it was adopted as the new standard in wireless technology in 1999, manufacturers rushed to exploit it. Perhaps on the assumption that a publicly-funded research organisation in Australia would not be in a position to chase them for royalties (the “David and Goliath” situation), none of the manufacturers bothered to arrange a licensing agreement. When it became clear by 2005 how much revenue they were potentially missing out on, the CSIRO decided to launch a test case in the US. In typical fashion, 14 of the big manufacturers counter-sued, arguing that the CSIRO had not invented the technology after all.

It was not until April 2009 that the CSIRO finally had their day in court. While some lawyers put the CSIRO scientists on the stand and demanded that they explain notes written 15 years earlier (an experience not many scientists have to go through!), other lawyers were meeting behind the scenes to try and negotiate an out-of-court settlement. One

by one, the big manufacturers did agree to settle and

the case was abandoned. So although the CSIRO never got full legal recognition of their patent, they now have something just as valuable. The first \$150 million of proceeds from the WiFi technology licensing will go into a Science and Industry Endowment Fund, which will initially support a new joint CSIRO/Macquarie University Professorial Chair in Wireless Communications; up to 100 undergraduate and postgraduate scholarships, and postdoctoral fellowships in Information and Communications Technology; and \$10 million for CSIRO research into the next generation of wireless technologies.


Not bad for a small device that was only thought to be of



**The CSIRO’s Dr John O’Sullivan, seen here in front of the Parkes radio telescope, led a team which laid the groundwork for today’s wireless communication devices. (Photo credit: Bearcage Productions)**

use to radio astronomers. It is one of the great ironies therefore that the very place where this all began, the ATCA at Narrabri, is one of the few places where the use of wireless technology is specifically forbidden! The reason? The frequency band which 802.11g works in is near to one of the frequencies at which the Compact Array regularly observes and, while the signals have a relatively limited range, any such interference at the site can have serious consequences for astronomy. Nevertheless radio astronomy stands to benefit immensely as a result of this technology while John O’Sullivan and his team can finally bask in the recognition that something they developed for radio astronomy has ended up becoming an integral part of our modern world. In recognition of this, John O’Sullivan has just been awarded the 2009 Prime Minister’s Prize for Science. After spending a few years in private industry, Dr O’Sullivan rejoined the CSIRO in 2005 in order to apply his expertise to the next great challenge in radio astronomy: the Square Kilometre Array. Who knows what else he might accidentally discover along the way?

**Stuart Ryder**


 [sdr#aao.gov.au](mailto:sdr#aao.gov.au)

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## The 2010 RAS Newspaper Competition

The theme has been announced for the 2010 Schools Newspaper Competition. Pupils are asked to imagine the contents of the first message received from an extraterrestrial civilization. Students under 14 should work in groups to produce a small newspaper about the first message, while older students are asked to write individually an article suitable for a scientific magazine, reviewing the message.

For more information go to the RAS website:

 [www.ras.org.uk](http://www.ras.org.uk) where you can also find the names of the 2009 winners.

# Your Universe

## The UCL festival of astronomy celebrating IYA 2009

There have been two of these events set in the UCL Bloomsbury campus. The summer event targeted families and the general public, and the autumn event invited school groups as well as families.

Using the venues within the campus we were able to provide fixed displays, like Stars R Us, the Magic Planet, the Universe time line and several poster sessions, including life in the universe, extra-solar planets and dark energy. One of our major exhibits has been, of course, the University of London Observatory showing posters, videos and portable telescopes to observe the Sun, Venus, the Moon and Jupiter.

We were delighted to have the President and Provost of UCL, Prof Malcolm Grant touring the exhibits and delivering an exciting opening speech.

The autumn event allowed us to tour small groups of



**Molly Swanson holding a model of the Sun, (to a rather small scale) for her demonstration**

school children in our optical laboratories and research offices. For this, we had a strong team of post graduate students guiding the groups and explaining the diverse working environments.

Altogether we have had nine days with nearly 30 public lectures on a wide variety of topics, all by members of the Department of Physics and Astronomy at UCL. The attendance was very good, totalling 800 children and 1200 adults.

Our website was a fundamental medium of communication.



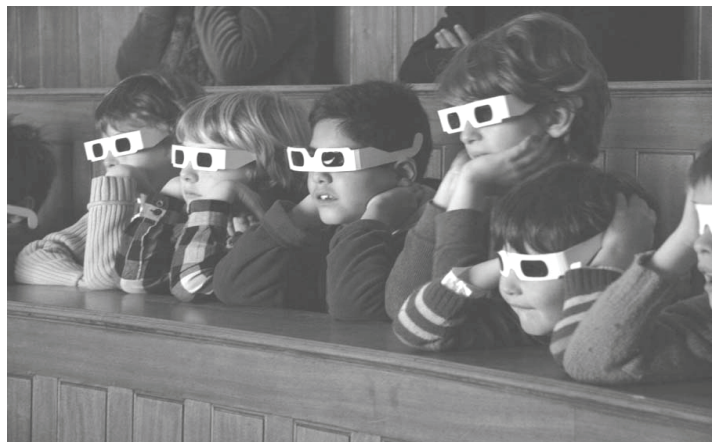
**Emily Hall, engaging kids around the image of Jupiter projected by the magic planet system.**



**Professor Grant using one of our telescopes indoors .**

The feedback from the public has been overwhelmingly positive in comments left on line. A couple of them are reproduced below:

*I'm a home-educating mother: my eight-year-old daughter enjoyed the day hugely. The talks have been captivating and the displays are just amazing. All the people who catered for the activities were just fun to be with, very*



**Young audience wearing 3d glasses looking at images from the stereo mission during the lecture by Professor Chris Davis.**

*approachable, friendly. We absolutely would love to come again and again, THANK YOU.*

*A fantastic day! Took a group of fifteen year olds and they were genuinely inspired by the work carried out at UCL. Our tour guide was really personable and engaged well with the students. Their highlight was the chance to observe Jupiter and its moons through one of the university's telescopes. They also found the lecture on astrobiology absorbing and rushed to buy books at the end! It is really positive that KS4 students can meet and talk with PhD students about the work they carry out. Thank you very much Francisco.*

Given the success of our format, we plan to have this festival at least as an annual event. The next edition will be during science week 2010.

For more information go to our website:

 [www.ucl.ac.uk/youruniverse](http://www.ucl.ac.uk/youruniverse)

### Working out solar noon (from a Daily Newspaper)

Solar noon is when the Sun is half way (in time) between sunrise and sunset.

Find local sunrise and sunset times given in the weather section of a daily newspaper e.g.:-

**Sunrise 6:44 a.m.**

**Sunset 6:02 p.m.**

Then work out the time of solar noon by using this method:

From 12 noon subtract sunrise time (e.g. 6:44 am) and add sunset time (e.g. 6:02 pm).

**Important: Remember to calculate in hours and minutes.**

$$12:00 - 6:44 = 5:16 + 6:02 = 11:18$$

There are therefore 11 hours and 18 minutes of sunlight for this day.

Divide your answer (i.e. 11:18) in half (5:39), and add it to the sunrise time (ie.6:44).

$$11:58 / 2 = 5:39 + 6:44 = 12:23$$

Therefore 12.23 pm is solar noon in this example.

The Sun is on the meridian, which is half way between sunrise and sunset.

The Sun's azimuth (direction) is true south at this time and all shadows point to the true North Pole.

Can the students work out other ways for finding solar noon, e.g. try 24 hour clock time?

**Vocabulary:** sunrise, sunset, solar noon, meridian

Another, observational, method of finding solar noon will be given in the March issue of *Gnomon*. Students could then compare the results of the two methods.

Eric Jackson

The Extended Schools initiative aims to open up schools' facilities outside regular hours for the benefit of its pupils, their parents and other members of the local community. It also aims to provide opportunities for students from different schools to learn together.

As part of a pioneering evening-class activity under this initiative, the students of Park House School in Newbury are being joined by some of their contemporaries from nearby St Bartholomew's School, several of their parents, and even some of the Park House staff to study GCSE Astronomy.

Most encouragingly, the class currently has more than 30 students. Its creation is a result of the Park House School Council making a specific request to their Headmaster, Derek Peale, for the chance to study astronomy. With enthusiastic support from Christine Chipperfield, the local Extended Schools coordinator, and Maureen Sims the Deputy Head at St. Barts, the course has come together very smoothly

The revised Edexcel syllabus which the class are studying, will be examined for the first time in Summer 2011, and this allows the course to be taught in roughly 60 one-hour lessons over a period of two years. The fact that the course is being run as an evening class has particular advantages, since it provides opportunities for practical lessons, and the supervised practical elements of the course can be completed with teacher supervision under dark-sky conditions.

The course is being taught by Dr Stuart Eves (FRAS) who, in his more sensible moments, admits to having a PhD in satellite constellation design, a satellite on display in the Science Museum in London, and a unique theory about eclipses. Fortunately those sensible moments are pretty few and far between and the rest of the time he lives up to his reputation as being something of an Astro-nut!

Clearly this course is something of an experiment, but if the introductory sessions are anything to go by, one thing that certainly won't be in short supply is enthusiasm!

Stuart Eves

### Telescopes for Schools

The Society for Popular Astronomy (SPA) decided to try to get 1000 telescopes into schools to celebrate the IYA2009. It was a great success with around one quarter of the UK's secondary schools participating in the initiative. The last few telescopes have now been given to STEMPOINTs, so that they are available for loan to schools. The Science and Technology Facilities Council (STFC) funded the purchase of the telescopes, the Royal Astronomical Society (RAS) funded the production of the DVD to support the project, and the SPA funded the website, the competition, and provided support for the project.

We know that primary school children are fascinated by astronomy and that by age 14, many pupils have lost their interest in science, so the SPA decided to target this group. The enthusiasm of the teachers is amazing, and a key part of the success of the project. After Spring Moonwatch at the end of March, we conducted a survey to find out what had happened. From the returns we estimate that up to 80% of the schools participated in Spring Moonwatch, most had looked at the Moon, and around 20% had looked at three or more astro-



Setting up a telescope at Hexham School

Around 30% of those who replied said they had either set up an Astronomy Club or were planning to do so. (One teacher's comment was that they are "frustrated waiting to be able to set up the club especially now we have such a fab resource!").

The SPA had offered the support of a local astronomer (using the Federation of Astronomy Societies network), but most teachers found the DVD gave them enough support, and many teachers found that once the telescope arrived their colleagues or parents were only too willing to help. Often telescopes were dragged out of cupboards, dusted off and brought into school to supplement the SPA telescope. One school had no sooner unpacked their SPA telescope than three more arrived. Some schools let

their pupils take the telescope home for the weekend. One

school jumped the gun, and decided to have an open evening during Science Week before the telescope was due to arrive. They were put them in touch with a nearby astronomical society who turned out on the night with their own telescopes; the evening was ☞ (cont. page 6, col.2)

## For your Library

*Einstein' Telescope. The Hunt for Dark Matter and Dark Energy in the Universe. Evalyn Gates. W.W. Norton & Company. ISBN 978-0-393-06238-0 hardcover. \$25.95.*

The Universe we study today bears little resemblance to the one we thought we inhabited a century ago. The Big Bang theory has been successful in describing the evolution of the Universe. However we do not yet know the answer to the question "What is the Universe made of"? Ninety-five per cent of it is dark matter and dark energy and we have little idea of what this is. It is one of the most compelling mysteries in science today. Evalyn Gates compares this discovery to "finding an elephant on top of a table impeccably set with the finest china".

This book explores the biggest issues in cosmology and describes the observational hunt for answers to these questions. The greatest tool in this quest is "Einstein's Telescope" which is the use of the warp of spacetime by gravity as a giant lens. This allows astronomers to probe the very distant and very early Universe and study the web-like structure of its matter.

The first three chapters are an introduction to particle theory, element synthesis, gravity, General Relativity, the Big Bang and the expansion of the Universe. Einstein's equation is translated into English for us and the text avoids a mathematical treatment. This is followed by an explanation of gravitational lensing and the discoveries that are being made by studying the distortions of distant galaxies, quasars and clusters. This is at the forefront of research, finding galaxies 12.8 billion light years away, inhabitants of the very early Universe.

This is a very readable account. The introduction claims that "Even if the last science book you opened was an eleventh grade textbook, you should be fine". However you do need a grounding of science to cope with the descriptions as some of the concepts are difficult to digest the first time through. It would be no problem for science teachers or undergrads but the level is too high for school age students. For example the introduction to the Standard Model of particle physics is too brief for a beginner in this field.

There is also an element of the poetic. Ordinary matter is described as "a pinch of the familiar sprinkled through the cosmos on a vast sea of dark felt". However Gates has a gift for explaining things in everyday terms. She describes the journey of a bungee jumper leaping into a black hole—how often have you needed to explain this in class?

The diagrams are clear with the exception of Fig 2.2 where the "ghosts" in pale grey did not stand out well enough in my copy. The colour photos of the lensed galaxies and clusters are breathtaking, although rather few.

The last chapters look to the future with a Dark Energy Task Force to test the models using better observations of supernovae and gravitational lensing. Modelling with super-


computers can select the conditions that best represent the Universe we see. A beautiful example of this may be seen on the website below (see footnote).


Such theoretical work together with new observations such as those from the newly launched Planck satellite will provide a much clearer description of the main components of the Universe. Gates even claims optimistically that the parameters of dark energy will be known to an accuracy of a few per cent!

This is an exhilarating read and I can highly recommend it.

**Anne Urquhart-Potts**


*Footnote: The Millennium Simulation:* This stunning movie shows the dark matter distribution in the Universe at the present time, based on the Millennium Simulation, the largest N-body simulation carried out thus far (more than  $10^{10}$  particles). By zooming in on a massive cluster of galaxies, the movie highlights the morphology of the Universe on different scales. Go to:

 [www.mpa-garching.mpg.de/galform/press](http://www.mpa-garching.mpg.de/galform/press)

 (cont. from p6) clear, and there was a very happy and excited message on the phone next day. One teacher has written: "Thought you would like to know that our first GCSE astronomy class completed their course in June and gained some great results including 2 A\*s. We now have another class of astronomers and the telescope also gets great use in both KS3 and KS4 science lessons. Many thanks once again, it is a great asset."

We took the sample telescope to the Big Bang event in London, and set it up to look at the statue outside Buckingham Palace, across the length of St James' Park. If we had had a pound coin for every 'wow' from a pupil, we would not have been able to walk out of the building. Most children found it very difficult to believe their eyes, that this tube would let them see something so far away that they could scarcely see even the statue itself let alone the laurel branch, and now each leaf was clearly visible in the telescope. Some schools have used their telescope during the day to look at birds. One school took their telescope on a school trip, another held a community 'Star Party' and 100 people turned up.

Another school which had a telescope is a school for 'difficult' children, i.e. the sort mainstream schools can't cope with for all sorts of reasons. It is a struggle to engage these children in anything yet they too have an astronomy club with a local astronomer supporting them. It has reached out to them and for once they feel someone cared enough about kids like them to give them something, and something that grabbed their attention - they weren't left out. Who knows the difference it will make to those children?

Further information on this project is on the SPA website at:  [www.popastro.com](http://www.popastro.com)


**Helen Walker**

*President of the SPA*

## Sky Diary Winter 2010

The first quarter of the last year of the first decade of the 21st millennium begins as always with the most spectacular display of stars to be seen at around bed-time in the northern hemisphere. Orion the Hunter, accompanied by his two faithful hounds Canis Major and Minor is highest in the sky at 22:00hrs in the middle of January. He is surrounded by brilliant constellations such as Auriga, Gemini, and Taurus, all containing several brilliant stars. As far as observational astronomy is concerned, this is the time of year that sorts the enthusiasts from the dabblers (I nearly wrote "the

men from the boys"- Anne would never have allowed that to appear on these pages!) with clarity of the sky always giving low temperatures to keep you moving!

"Orion's Belt" is often better known by the non-astro-minded populace than Orion himself (who after all, was an incredible waste of mythological space - achieved nothing of note really, other than boasting he could kill anything!). The three "Belt" stars form a reasonably straight line, starting from the northernmost, delta Orionis (Mintaka), sitting almost on the Celestial Equator. Mintaka therefore rises and sets almost exactly due east and west respectively. The other two Belt  **7**

☞ (cont. from p.7) stars,  $\epsilon$  (Alnilam) and  $\zeta$  (Alnitak), point south-east on the celestial sphere, on a line roughly at  $45^\circ$  to the Celestial Equator. As a result, Orion's Belt provides an excellent demonstration of the relative orientation of star patterns at different declinations as they cross the night sky, as seen from our intermediate latitude on Earth. As Orion rises in the east, the Belt can easily be seen close to the horizon on a clear evening, pinpointed by the Hunter's shoulders with the bright stars Betelgeuse and Bellatrix, and the small fainter triangle marking his head's position. As the Belt rises, it is seen to be almost at right angles to the horizon, and 12 hours later, the Belt is seen setting but now almost parallel with the horizon as the Hunter himself has twisted clockwise by  $90^\circ$  relative to his stance at rising. Look for Orion's Belt stars lined up along the horizon due west towards the end of the evenings at the end of March.

The Spring Equinox takes place at about teatime on March 20th. The Sun will then be at the zeros of celestial longitudes, both equatorial and ecliptic. This point falls in a part of the sky devoid of almost any star visible to the unaided eye at night.

While we are considering boring aspects of this coming quarter, we can also note that even the partial aspects of the annular eclipse of the Sun on January 15 will be totally invisible from the UK. To add to amateur astronomers' miseries, on March 28 you lose an hour in bed and BST begins once more, probably with all the usual cries that it should be extended to last all year - and probably be increased to double summer time between the Vernal and Autumn Equinoxes!

The start of 2010 offers a perfect time to see and study Mars, in general a difficult object as it is rarely large enough to suit other than very expensive telescopes! The reason for this is that the orbit of Mars, not quite our nearest neighbouring planet, is quite eccentric. At the best possible oppositions, Mars will also be at perihelion (closest to the Sun), when it is at a distance of about 1.38AU from the Sun. If it happens (alas rarely) that it is

Moon phases for the first quarter of 2010				
	New Moon	First Quarter	Full Moon	Last Quarter
January	15	23	30	7
February	14	22	28	5
March	15	23	30	7

also at opposition, then it will be at a distance of about 0.38 AU from the Earth. At such an occasion, the angular diameter of Mars is about 21arcsec. This last happened on August 28, 2003 ("Sky Diary" *Gnomon* Vol. 22 no.4) when Mars was at its closest to Earth for some 60,000 years (0.372719 AU). Mars was then one day from opposition and about three days from perihelion. (The next such approach will be at a minimum distance of 0.37279AU on August 24, 2208).

The bad news for most of our readers is that the best oppositions of Mars happen when Mars is well south (about  $15^\circ$ ) of the celestial equator. Although the position of perihelion of a planet round the Sun changes, it does so amazingly slowly, and it will be many generations indeed before the closest approaches of Mars take place when the planet is also in the northern latitudes of the ecliptic. This year, on January 29, Mars will be in Cancer, well to the north and a mere 14 arcsec in apparent diameter. But the planet will be around for quite a while as it travels round its orbit relatively slowly because it is rather more comparable to the Earth in orbital motion - at least, compared with most

Through the winter, Saturn rises higher in the evening sky, now sufficiently south that we can once more see its north pole and just make out the northern side of the rings. As the year wears on, the rings begin to close up again as our viewpoint from the Earth changes, reaching a minimum

Rising and setting times (UT): lat.52°N; long.3°W						
	January 15		February 15		March 15	
	Rise	Set	Rise	Set	Rise	Set
Sun	08:13 ☞	16:30	07:27 ♃	17:25	06:26 ☾	18:16
Mercury	05:10 ☞	17:04	06:56 ♃	15:26	06:38 ☾	18:16
Venus	08:24 ☞	16:27	07:54 ☿	18:06	05:59 ☾	19:37
Mars	17:49 ☿	09:47	14:38 ☿	07:20	12:34 ☿	05:14
Jupiter	09:42 ☿	19:37	07:53 ☿	18:16	06:15 ☿	17:05
Saturn	22:46 ♄	10:58	20:38 ♄	08:56	18:37 ♄	07:03
Uranus	10:23 ☿	21:55	14:22 ☾	01:55	06:35 ☾	18:20
Neptune	09:30 ♃	19:13	07:31 ♃	17:18	05:43 ♃	15:33
Moon	08:19 ☞	16:51	07:32 ☿	19:18	05:53 ☾	18:17

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, the "13th" zodiacal constellation.

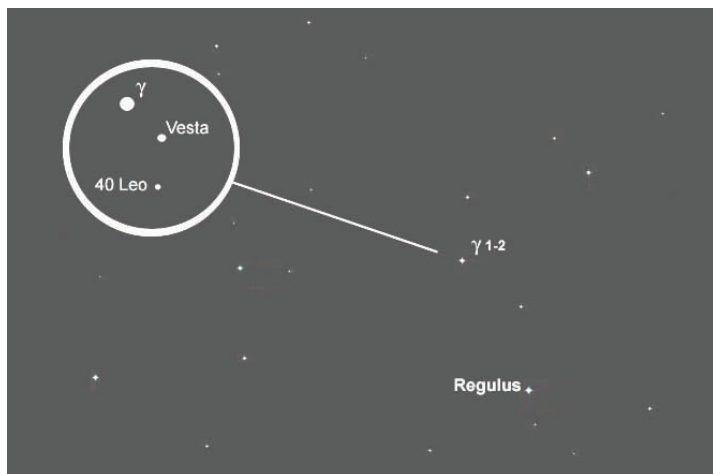
apparent width at the end of May, but as the planet moves ever southward around the ecliptic, the rings will resume opening out more noticeably before the end of the year. Saturn reaches opposition on March 22.

The other planets, including Uranus and Neptune, are gathered together in a dance around the Sun and will be an interesting challenge, mostly in the morning twilight, for the three months. These planets, and the Moon when it is near New, will be involved in several close conjunctions, but not much use for photos or observation so close to the Sun.

At the end of March, Mercury will be approaching its best evening elongation as seen from the northern hemisphere, reaching a maximum of  $19^\circ$  east of the Sun at the end of the first week in April. At around the Vernal Equinox, the ecliptic crosses the western horizon in the evenings at a steep angle, giving a much improved chance to spot the planet in the deepening twilight.

One of the first asteroids to be discovered, Vesta, will reach opposition on February 18. At a position of  $\alpha$  10h 20m 07s,  $\delta$   $+19^\circ$  39.5', the asteroid will be very favourably placed for detection with binoculars. The position is within 10 arcmin of the star  $\gamma_1$  Leonis (Algieba) at that time, and also close to 40 Leo in "the Sickle", the backwards question mark making the Lion's head (see below). Happy New Year and clear skies to all!

Richard Knox



Gamma Leonis (Algieba) is a perfect marker for finding Vesta at opposition (see inset) in Leo on February 18