Gnomon

Newsletter of the Association [illegible]ucation

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A very merry Christmas

and a peaceful and rewarding New Year

An important international initiative for children

I would like to draw your attention to a well organised initiative. Here are some quotes from their web site:

The Universe Awareness (UNAWE) Programme is an international imitative for economically disadvantaged young children aged four to ten. UNAWE will expose children in developing countries and in underprivileged communities in Europe to the inspirational aspects of astronomy. UNAWE is also a network of astronomy outreach/education professionals and volunteers worldwide.

A UNAWE pilot implementation will target economically disadvantaged children in a limited number of countries throughout the world. UNAWE implementation starting in 2009 is timed to coincide with the expected International Year of Astronomy, IYA2009.

At present it has contacts, collaborators and contributors in the following countries: Chile, Colombia, France, Germany, India, Indonesia, Ireland, Italy, the Netherlands, South Africa, Spain, Tunisia, Ukraine, United Kingdom, Venezuela.

For more information, go to

www.universeawareness.org

Alan C Pickwick

The first Astrophysics Olympics!

The First International Olympiad on Astronomy and Astrophysics (IOAA) is to be held during the period of November 30 to December 9, 2007, in the scenic city of the fabulous northern province of Chiang Mai, Thailand.

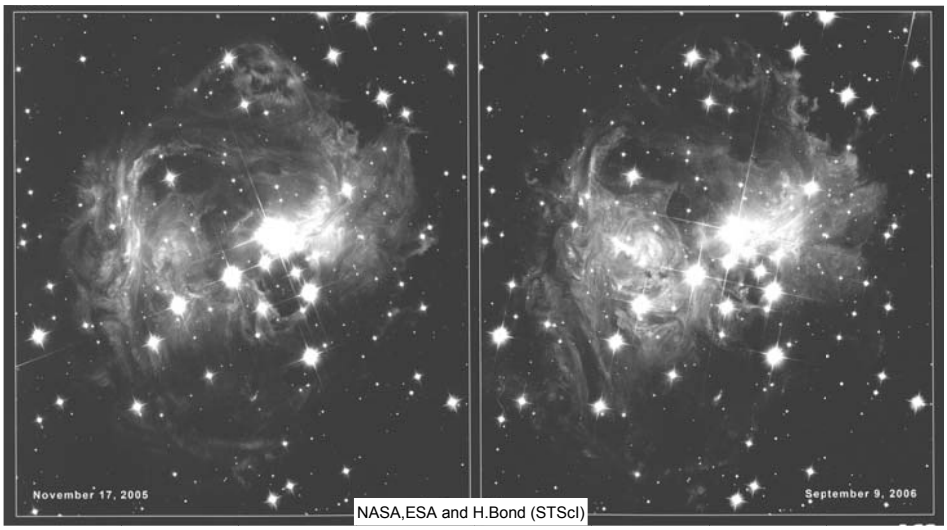
Since this is the first competition of the IOAA there will be no registration fee. The purpose of the IOAA is to promote interests and educations on astronomy and astrophysics of high school students. By participating in the competitions, students will have opportunities to meet fellow students of ☞

Spot the changes in the yodelling Unicorn

The Hubble Space Telescope has returned to the intriguing V838 Monocerotis many times since its initial outburst in 2002 to follow the evolution of its fight echo. Two new images provide the most astonishing views of V838 to date.

This unusual variable star continues to puzzle astronomers. The star was unknown until it underwent an outburst early in 2002, during which it temporarily increased in brightness to become 600,000 times more luminous than the Sun. Light from this sudden eruption is illuminating the interstellar dust surrounding the star, producing the most spectacular "light echo" in the history of astronomy. As light from the eruption propagates outward into the dust, it is scattered by the dust. The scattered light has traveled an extra distance in comparison to light that reaches Earth directly from the stellar outburst. Such a light echo is the optical analogue of the sound echo produced when an Alpine yodel is reflected from the surrounding mountainsides.

The NASA/ESA Hubble Space Telescope has been observing the V838Mon light echo since 2002. Each new observation of the light echo reveals a new and unique "thin-section" through the interstellar dust around the star. These photographs show the light echo from the Hubble Advanced Camera for Surveys taken in November 2005 (left) and again in September 2006 (right). The numerous whorls and eddies in the interstellar dust are particularly noticeable. Possibly they have been produced by the effects of magnetic fields in the space between the stars. The Hubble observations have been used to determine the distance to V838 Mon, using a technique based on the polarisation of the reflected light. Hubble has polarising filters that only pass light that vibrates at certain angles. This method yields a distance of 20,000 light-years for V838 Mon, suggesting that, during its outburst, V838 Mon was one of the brightest stars in the entire Milky Way. Although the reason for the eruption is still unclear, some astronomers have suggested it might have resulted from the collision of two stars.



NASA,ESA and H.Bond (STScI)

☞ the same interests and make friends. This will help lead to better understanding among countries and hence collaboration in future researches.

www.ioaa.info

Sites, cams and downloads

On Mt Teide in the Canary Islands has an excellent election of night-time cameras and movies of the night sky.

www.telescope.org

i-CAN constellation camera network shows the new Atacama Radio Telescope site.

http://rika.educ.kumamoto-u.ac.jp/I-CAN and

www.alma.info

The International Astronomical Union has a web site devoted to astronomy education and development. It has a wide range of reports on such initiatives. Good if you want to get a world-view.

www.astronomyeducation.org

It also has a web site devoted to communicating astronomy with the public. This has links to conference proceedings and important documents such as the Washington Charter.

www.communicatingastronomy.org

FREE DIGITAL UNIVERSE!

The *Digital Universe* can be downloaded from the Hayden Planetarium. This is a very large (70 MB) free download which comprises:

The Digital Universe - more than just an atlas! It covers the Milky Way Galaxy and much of what is outside our Galaxy, including a multitude of other galaxies and quasars.

Educator's Activities - Developed for use in the classroom, these five activities (PDFs) are accompanied by special *Digital Universe* data sets and "flight paths".

WISE Brown Dwarf Simulation - A hypothetical look at what the solar neighbourhood may look like once Wide-field Infrared Survey Explorer returns data.

Partiview User's Guide & Data -This is a powerful application that is suitable for advanced users. The interface is, in my opinion, not for the faint-hearted. However it has some rewarding journeys through the stars. The PDF activity sheets are very impressive and can be downloaded on their own.

http://haydenplanetarium.org

The Hands-On Universe – Europe is a large-scale initiative funded by the Socrates programme of the European Commission. The primary target group is school teachers.

It has an ever-increasing number of activities and also opportunities for remote observing. In the *Tools* section it has links to webcams, radio telescopes and optical telescopes. Definitely worth a close examination.

www.euhou.net

Alan C Pickwick

Science in School magazine

A new magazine venture has been announced by EIROforum (a collaboration between seven European intergovernmental scientific research organisations). As ESO and ESA are members of EIROforum, there are likely to be many astronomy and space articles. According to their web site *Science in School* is a non-profit activity, part of the NUCLEUS project supported by the European Union. Its aim is to promote inspiring science teaching by encouraging communication between teachers, scientists, science teachers and anyone involved in European science education. It will highlight the best in teaching and cutting-edge research. It will cover not only biology, physics and chemistry, but also maths, earth sciences, engineering and medicine, focusing on interdisciplinary work.

The contents include teaching materials; cutting-edge science; education projects; interviews with young scientists and inspiring teachers; education research; book reviews; and European events for teachers. An online discussion forum (coming soon) will enable direct communication across national and subject boundaries.

Science in School is being published quarterly and is freely available on this website; print versions in English are distributed across Europe. Online articles are published in many European languages.

: www.scienceinschool.org

Alan C Pickwick.

(Sounds like healthy competition for Gnomon! *Ed.)*

Spoil yourself – Summer School 2007

The 2006 EAAE Summer School was held in La Palma. Below are some comments from the three UK teachers who attended. I hope these comments will encourage you to consider attending the 2007 EAAE Summer School in Munich at the Headquarters of the European Southern Observatory, 19 -23 July 2007.

www.eaae-astro.org

Lynn Peek wrote: As a novice scholar I was uncertain what to expect exactly but I was not disappointed. No sooner had I arrived at the hotel than I was invited to go up the mountain and do some observing. Again as a novice this was without doubt the best thing I have done for a long time. I was coached in astrophotography and have some absolutely superb photos.

We worked very hard from 9 until 6.30 every day; my colleagues at school could not believe that I worked that hard. The classes were really enjoyable and varied from making simple sundials and models of planetary orbits to some very challenging lectures. I collected a large amount of useful material that will allow me to be comfortable teaching GCSE. Astronomy next year.

The people that I met at the school were very friendly ☞

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

☞ and spoke excellent English, which made communication really easy and I hope that I will be able to stay in contact with them.

The Summer School was the best thing I have done for a long time, the most useful in service training that I have ever had, the most value for money and the most fun.

John Bomphrey wrote: I was impressed with the Summer School in all its aspects. It was exceptionally well organised and all went according to plan. The content was all very well thought out and interesting, especially the visit to the observatory which was the highlight of the week. I did feel, in retrospect, that there was a missed opportunity in that there was really no reference to new developments in astronomy. All the workshops concentrated on the teaching of well known topics as is appropriate to school courses, but students will always read a little and will always ask questions.

Bernie Tedd wrote: This summer I was the envy of my school colleagues when I told them of my week planned in La Palma in the Canary Islands for the purpose of attending an astronomy summer school organised by the EAAE (European Association for Astronomy Education). The trip was even better for being funded by a Comenius grant from the British Council. One hundred teachers from 24 countries were able to pick up new teaching ideas and to exchange experiences.

The week was a tremendous mix of workshops, lectures, observing sessions and visits. Many new and novel ideas were passed on to the delegates by an experienced and enthusiastic team of instructors. I particularly enjoyed learning in the workshops how to construct a sun clock in the school playground, how to explain the Doppler effect by means of a story of a prince sailing away from his princess and how to construct astronomical models illustrating the motion of the planets, the Zodiac and the Sun.

Of course, the informal contact between teachers from many different countries (happily, English was the main language of communication) was fascinating, yielding opportunities in the future for collaborative projects between our respective schools.

However, the most cherished memory of the week was at the top of the mountain, looking down at the telescopes a little below us as the Sun set - breathtaking and magical!

Sit may be vac soon

Bill Samson is planning to retire as curator of the Mills Observatory in Dundee at the end of March 2007. This should leave a vacancy for a new curator.

If you, or anyone you know might be interested in applying for this post, please contact Bill in confidence, and he will try to make sure that you know when the post is advertised. If you would like to discuss what the job involves, please contact him at:

☎ 01382 435967 or 🖷 mills.observatory#dundeecity.gov.uk

London's New Planetarium

This summer the construction of the new Peter Harrison planetarium at the Royal Observatory Greenwich neared completion. After overcoming some novel engineering challenges, a giant set of bronze cladding plates were lowered and welded into position.

The Peter Harrison planetarium will have state of the art projection equipment, a commitment to 'live' astronomy presentations and 115 seats. Most of the building is below ground level, apart from a cone visible from within the Observatory grounds.

The photo shows the exterior of the Peter Harrison planetarium with bronze cladding in place

The shape was chosen by former senior astronomer, Dr Robin Catchpole and is aligned with the celestial pole, equator and zenith. When the planetarium, part of the £15 million Time and Space project, opens in May next year it will be London's largest centre dedicated to astronomy education and outreach.

Robert Massey

Did we all come from Orion?

Orion is the most prominent constellation in the sky. It contains an amazing variety of objects, from a dying red giant star, Betelgeuse, to the young blue stars of its famous Belt. Below the Belt is a fuzzy cloud of interstellar gas, the Orion Nebula. This is a stellar nursery where hundreds of stars and planets are being born in much the same way the Solar System did long ago from a similar cloud. The chemistry of planets and life comes from stars that died long ago.

Digital photograph taken in Scotland: Francisco Diego

Farewell fantastic Pluto

Pluto is still fighting from his corner. Alan Pickwick was at the famous IAU meeting, and he describes it thus:

I was at the IAU closing ceremony where the planets vote was taken, but did not have a vote myself - so you can't blame me! It was all very contentious as the original motions had been about stars and planets in general. Prior to the final meeting there was one where the original motions were announced. This caused uproar as the heads of various committees had not been consulted and there was little time for discussion.

So there was another emergency late-afternoon meeting chaired very effectively by Jocelyn Bell-Burnell. She allowed discussion but got aggrieved parties to move on. Anyway the original general motions would clearly not work in the context of the history of discovery and naming in our Solar System so after a lot of behind-the-scenes negotiation the motions were confined to our Solar System.

We very nearly had Plutonian Objects (not Plutons - nobody liked that) but the proposal was narrowly defeated. (I think Plutonian Objects may be proposed again for objects in Pluto's region.)

We also nearly had Classical Planets (eight of them!) but then there would have been “planets” and under them “Classical Planets” or maybe alongside them - so that motion was defeated. I expect a more general definition of extra-solar planets will be proposed in Rio de Janeiro in three year's time.

A NEW PERSPECTIVE FOR TEACHING ON THE SOLAR SYSTEM.

Francisco Diego writes that the International Astronomical Union has properly classified Pluto as an object belonging to a different class from the main solar planets. This provides a unique opportunity to teach about the formation and nature of the solar system. It is important to teach that, when Pluto was discovered a few decades ago, it was assumed to be a rocky object and from its apparent magnitude, its estimated diameter was larger than the Earth's.

Pluto became the ninth planet, despite its strange orbit well inclined to the plane of the Solar System and so eccentric that it brings Pluto closer to the Sun than Neptune for a few years. Much later, it was found that Pluto is an icy body that reflects light very efficiently. This brought its calculated diameter to just over that of the Moon. Then many more Pluto-like objects were discovered (around 1000 so far!), mainly made out of ice, two of them larger than Pluto and most of them also with elongated orbits at diverse angles from the plane of the Solar System. Pluto was clearly only the first object of many discovered in a region now known as the Kuiper Belt (after the astronomer who discovered it), just beyond the orbit of Neptune.

Kuiper belt objects, share characteristics that make them different from the main planets, in a similar way that comets, those tiny icy bodies that come from the remote Oort cloud, form another special family of objects.

Today we know that the gravitational collapse of interstellar clouds produces a variety of objects depending on their initial mass. At the higher end, we get the massive stars. At the lower end we find red and brown dwarf stars. Below them are the giant gas planets, which may be regarded as “failed stars”. The “failed-star” objects may or may not end up gravitationally attached to a star (orphan planets?). Then medium-size rocky planets, dwarf rocky planets or asteroids, icy dwarf planets and minute icy comets.

Our ways to name them have old historical roots. Once, the Sun and the Moon were considered as planets, since they also wander among the “fixed” stars (planet comes from the Greek for “wanderer”). In our Solar System, the three groups: planets, Kuiper Belt objects and comets reside in well defined regions around the Sun, implying a slightly different origin from that primordial interstellar cloud. The formation of objects in the outer Solar System is now a major field of research. Our knowledge of the Solar System has improved enormously in the last few years where old ideas had to be replaced or modified. It is important to teach that science is a cumulative body of knowledge that grows and improves as we develop new technologies and ways of thinking. The new Solar System is an excellent example.

THE PLUTOGAZER'S BADGE

Peter Ford entered the fray with news about the latest crop of Stargazer Badge activities with reference to the alternating definitions of Pluto. He writes: you may be heartened to know that during the Brownie game of “Planets” in which adults stand with paper plates decorated as planets for the Brownies to rush to. I held up the Pluto plate and had many visitors! All this is very Key Stage 2, and I like to think that the younger end are getting interested in astronomy. There is a surprisingly high level of space awareness among the younger ones.

Once again the 5th Lancaster Brownies (St Bernadette's Church) achieved a 100% pass rate for their Stargazer badge, taken over three meetings, with a few course and testing modifications this time. The new group has been unable to go outside with a telescope and binoculars, so one of the parents, set up his 6-inch reflector in the church foyer, trained on a street lamp!

Each group of six children had fifteen minutes learning about, and looking through the telescope. Evidence of alien life was detected in the form of a spider's web on a tree near the lamp. This was possibly just as effective as seeing small blobs become large blobs in demonstrating the power of the scope, although it was a pity not to see Orion's Sword or the craters on the Moon.

We did the obligatory Plough / North Star element with a game. “Pogo”ing to the Monty Python theme tune and jumping in a direction called out at the end of each line, viz.

Da – da-dadadada – da-da-da –daa “East!”

Da – da-dadadada – da-da-da –daa “South!”

you get the picture!

As always the Brownies were attentive and enthusiastic. Everyone remembered the cardinal safety rules for day and night. Respectively, never look directly at the Sun' and never go out in the dark without an adult you know.

Wordsearch starters leading to planet and constellation cut-outs were joined by designs for a badge for Brownies who have been into space (following discussions of possible future commercial sub-orbital space flight in craft such as Space Ship One).

One girl was quite indignant when told of Pluto's relegation from the planetary league, saying that she could no longer use her little jingle for remembering Solar System names and order - **M**y **V**ery **E**ager **M**other **J**ust **S**erved **U**s **N**ine **P**izzas. The group has been asked to come up with a new acronym either permanently or until such time as the tiny world is reinstated. Neptune will probably go **N**uts.

Every child deserved her badge and Mr. Tester was honoured to receive one of the coveted cloth patches for himself, presented by Brown Owl. Not everyone has one of those!

The Stargazer badge may be viewed on:

💻 **www.girlguiding.org.uk/members/brownies/forBrownies/adventure/badges/clipart.asp?page=4**

I think that however many icy objects may be out there, Pluto OORT to keep its planetary status.

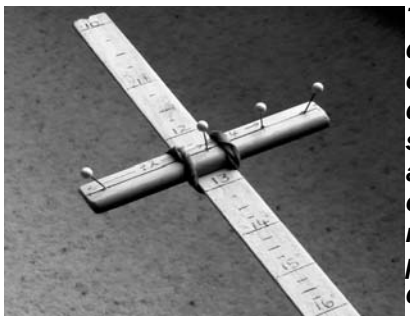
(*Ouch! Well, it's Christmas! - Ed.*)

Curriculum Corner

The Cross Staff: part 2

The cross staff described in the *Curriculum Corner* of the last issue is a useful aid to observing the night sky – and the daytime one as well, come to that! It was a very important instrument for navigation and star mapping for navigators and astronomers from ancient times, and in addition involves the practical application of geometry and trigonometry, so is a potentially valuable aid to mathematics, science and technical drawing. This article is to describe how the cross staff can be used for various projects, and to prevent the destruction of your house.

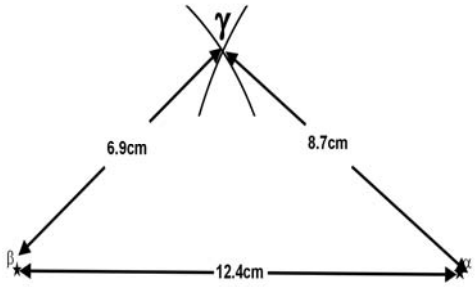
Firstly, using the cross staff involves measuring an angle. To do this look along the staff and line up a pair of pins



The scale reading under the cross arm centre line must be divided by 2 if the sighting is made with an outer pin and the central pin, or by 4 if made with the centre pin and the one immediately to its right.

with the stars, or other object whose position you are measuring. (I make no apology for warning again against moving around in the dark with the cross staff held with one end held below your eye – if the far end hits something in the dark it will be very serious, so don't move about with the staff in this position!). With the eyes focussed on the distant object, there is an illusion that you can actually see through the out-of-focus heads of the mapping pins. The outside pair of pins measure all the wider angles, down to 10°. For closer angles, you can use an outer pin and the centre pin, in which case you divide the angle given on the scale of the staff by 2. This allows measurements down to 5°. If you use the centre pin and the nearest adjacent pin (the "quarter" pin) you must divide the indicated angle by 4, allowing angles as small as 2.5° to be obtained.

The first area of application emulates the early navigators. Measure the altitude of a star, or other heavenly body by holding the staff with the cross bar vertical. If you cannot see the true horizon, you must make an estimate by finding some object near the horizon as best you can estimate, for example by sighting along a spirit level, or at right angles to a plumb line. If you can measure the meridian altitude of an object of known declination, with respect to your marker for the estimated horizon, you can work out the error in your estimate. (Plenty of scope for experiment there!). Put the lower pin on the horizon, or your chosen object estimated to be on the horizon, and slide the cross bar until the top pin is on the celestial object (or its centre, if you are measuring the Moon's altitude). Altitude measurements can then be used for simple navigation exercises.



Triangulation on a scale diagram of the stars' angular separation allows a scale diagram of the group to be compiled. Measurements from at least two stars of known separation and position are needed for each star to be added

The next set of exercises has obvious mathematical benefits. Measure the angle between any two stars (for example, α and β) in a constellation. Let's say they are 12.4° apart. Now choose an appropriate scale to plot these on a diagram, say 1cm per degree, and mark two points on the chart 12.4cm apart. Now measure the angles between α and γ, then between β and γ respectively. Let's say these are 6.9° and 8.7° distant respectively. So, using a pair of compasses, we set a radius of 6.9cm and strike an arc from α in about the position we observed γ and an arc of 8.7cm from β, and where these cross is our "fix", where we can mark the star γ.

This process of triangulation can then be repeated to fix δ, using two (or more – that makes it even more precise) angular measurements from any pair of the stars already fixed, and so on until we have added as many stars as we want to the diagram. Using this process we can build up a complete atlas of the sky if we had the patience! However, this would have to consist of many individual maps as otherwise we would run into problems with representing the map of a spherical surface on a flat page.

Plotting constellations provides excellent practice for another fascinating exercise that can be carried out with the cross staff. Plot the constellations or star patterns in the region of sky containing a planet. Mars near opposition is particularly good for this one. Plot the stars, then having drawn your map, plot the position of the planet, making sure you note the time and date against the plot. Repeat this as often as possible using the same base stars, so you have to repeat only the planet position fix. This will result in a locus of the planet's motion across the starry background for the duration of you experiment.

And the destruction of your house? Well, that tall tree that the council or your neighbours have said must come down can't be felled over the road, so it may have to be brought down on your front garden. Will it miss the house? Using the cross staff, all you have to do is set it to 45° and walk towards or away from the tree until the outer pins line up with the topmost branches and the base of the trunk. Where you are now standing is where the top of the tree will fall, more or less, depending on how it bounces! If, when you have finished the measurement, you are standing in your living room, then you are in trouble!

Richard Knox

The Dutch-German mathematician and cosmographer Andreas Cellarius is well known to map historians of cartography and astronomy as the author of the* Harmonia Macrocosmica *(first published in 1660), from which this is the famous frontispiece. Note the cherubic cross staffs!

Letter from Down Under

Old telescopes never die, but they often end up being refurbished for use elsewhere. In an extraordinary piece of astronomical recycling, antennas from a 40 year old radio telescope have had a new lease of life as a test-bed for the next generation of radio telescopes.

The Fleurs Synthesis Telescope was the fourth and last of several innovative aperture synthesis arrays constructed in the 1950s and 1960s on a site 40km southwest of Sydney by staff from the CSIRO Division of Radiophysics and University of Sydney School of Electrical Engineering. Beginning with the "Mills Cross" in 1954, and evolving through the "Shain Cross" and later the "Chris Cross", each telescope consisted of arrays of dipoles and mesh up to a kilometre in length, aligned in east-west and north-south lines. Although the angular resolution of these arrays was barely one degree or so, they were instrumental in mapping radio sources, from the Sun and Jupiter, to the galactic plane, to deepest space. The Fleurs Synthesis Telescope combined six new dishes 13.7m diameter with the 32 6m dishes of the Chris Cross to allow studies of radio galaxies and Galactic nebulae. With the construction of the Australia Telescope Compact Array in the late 1980s, Fleurs fell into disuse and the antennas were left to rust.

The Square Kilometre Array builds upon the pioneering work at facilities such as Fleurs, but will have both a collecting area and resolution over one thousand times greater. Following an extensive review of potential sites and host countries for this array, a shortlist comprising Australia and South Africa has been compiled. However, all the partner countries (including the USA, Europe, Canada, China, India, and Argentina) are also competing to offer the best technology, such as antenna design, receiver packages, software, etc. Each intends to build a modest "New Technology Demonstrator" to prove these ideas.

In Australia's case, the technology breakthrough on trial is the use of a focal plane array . Traditionally, a pair of antennas would measure the strength and position of a radio source by both pointing at the same part of the sky, then comparing the signals. However, to make a map or an image of large sources would require many such measurements, and take days or even weeks. A focal plane array is like a digital camera for radio astronomy, by placing many small radio receivers side-by-side at the focus of the dish. Although routinely used on large, single dishes like the Parkes radio telescope, focal plane arrays have yet to be proven for use with an array of antennas, in part because the computing power and network bandwidth required to handle the large amounts of data coming from many antennas at once is only now becoming available. Australian engineers procured a focal plane array from the Netherlands, and needed a couple of antennas about 15m diameter on which to demonstrate that this could work. But where would they find the right kind of antenna in such a short space of time, and (preferably) at very little cost?

It occurred to some of the engineers to go and take a look at the Fleurs antennas to see if they might fit the bill. Fortunately, a couple of the dishes appeared to be salvageable, and after sandblasting, new mesh, a new coat of paint, and a new gearbox for their drive systems, they have been erected on new pedestals at the Australia Telescope National Facility headquarters near Epping, in suburban Sydney (see the attached photo). Currently only one of the antennas has a focal plane array installed, while the other has a single receiver. Despite the high level of radio interference experienced in such an urban location, early results with this new, yet historic telescope have been quite promising.

This is not the only occasion when telescopes have been reborn. The 48in diameter "Great Melbourne Telescope" was the largest fully-steerable telescope in the world when it was brought to Australia in 1868. However, the optical performance of its speculum metal mirror was disappointing, and it was sold as scrap to the then Commonwealth Solar Observatory on Mt Stromlo near Canberra after World War II. It got a new 50in glass mirror, and lease on life in 1959, and many Stromlo graduate students made observations for their PhD theses with it. In the 1980s, it was modified to become an infrared telescope, but was then mothballed when a brand new 2.3m telescope was opened at Siding Spring Observatory. In the early 1990s, the telescope was again refurbished and fitted with the world's largest CCD array camera in order to search for evidence of dark matter in the form of Massive Compact Halo Objects ("MACHOs") by their magnifying effect on the light of stars in the Magellanic Clouds. Having successfully detected MACHOs (albeit at a much lower rate than required to account for all the dark matter), the telescope was about to embark on a southern extension to the revolutionary Sloan Digital Sky Survey underway in the north, when the devastating Canberra bushfires of 18 January 2003 finally brought an end to its long career. Admittedly by then about the only recognisable piece of the original "Great Melbourne Telescope" was the polar axis, and its "Grubb, 1868, Dublin" plaque. But like the "original axe" that has had two new blades and five new handles, it was still the same telescope!

Two of the 13.7m diameter dishes recovered from the Fleurs Synthesis Telescope, back in operation as the Australian New Technology Demonstrator for the Square Kilometre Array . The antenna in the background has a focal plane array (the large square package suspended above the dish), while the foreground antenna has just a single receiver.

Stuart Ryder

sdr#aaoepp.aao.gov.au

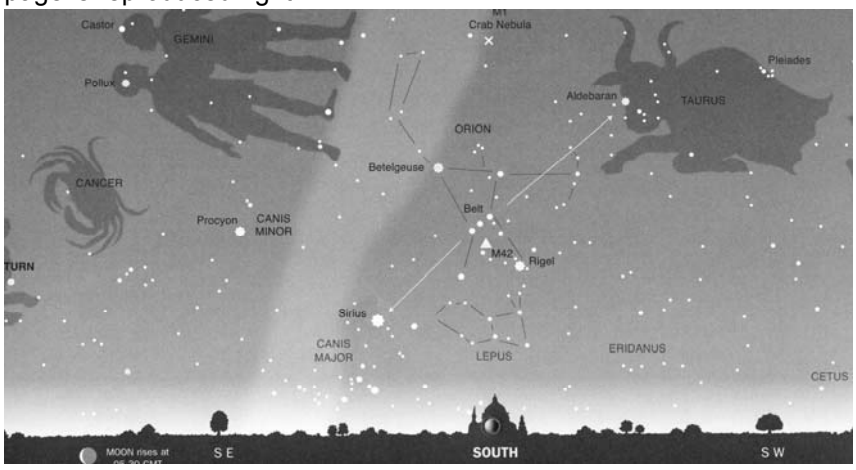
For your Christmas stocking

Stargazers' Almanac 2007—monthly guide to the stars and planets. Hawthorn Press. £12.99. ISBN 1 903458 67 6. Available from Booksource, 32 Finlas Street, Glasgow, G22 5DU, ☎ (08702) 402182, fax (0141) 557 0189, orders#booksource.net. *Or on-line from the publisher* www.hawthornpress.com.

This has become a well-established annual publication. Each year it has added, or modified some of the back-up material to maintain the novelty as much as is possible in a monthly guide to the night sky.

This year, the publication is complemented by some practical astronomy, with projects that are ideal for young astronomers as well as the more wrinkly ones. The theme is time by the stars, and this includes time by our nearest star - which is the only one easily found during daylight hours. The night sky timepiece is a star nocturnal, designed for use with the "Pointers" in the Plough (α and β UMa), or β Cas, so that at least one of these groups of stars should be reasonably accessible if the sky is clear!

In the daytime, the instruments described are sundials: one an armillary equatorial dial made of card or something more substantial if resources permit, and a useful alternative to the traditional horizontal garden dial, the human hand. The latter has a genuinely important orienteering application as a means of giving a continuous rough indication of east and west (although to discover this, you will need to follow up the more detailed instructions that are given on the publisher's website. A portion of the sundial page is reproduced right.



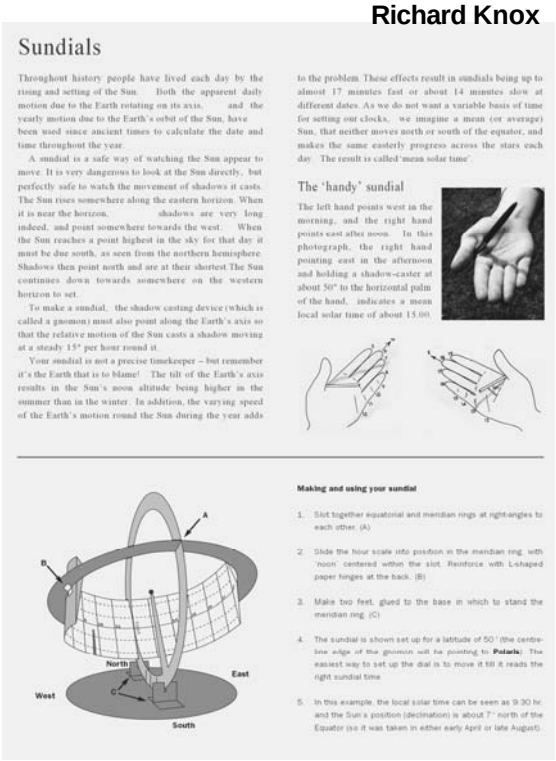
(Above) Looking south at 22:00hr on January 15, 2007, from part of the chart for this time in the new Hawthorn Press Almanac. The use of Orion's Belt is illustrated to point out Sirius and Aldebaran. (Right) From the sundial project, the almanac's "Curriculum Corner"

The two projects are beautifully illustrated (the excellent standard of artwork in this almanac is almost its trademark!) with clear scale diagrams of the components parts.

The monthly charts are produced for latitude 52°N, long 3°W (Middle UK) in an A3 landscape format opening as a spread, designed to be suspended on a wall, then it shows the north facing aspect of the sky, extending over 180° in azimuth and about 70° altitude, on the top and the southern aspect (the same extent) below. The stars overhead for the year are shown in a single chart towards the back of the publication. Each monthly spread is produced to show the sky at 22:00hr for the middle of the month, and each is cross-referred to other charts to show the approximate aspect of the stars for midnight, and early morning at the start of twilight. The Moon and planets are shown either in the sky or where they will have recently set or be about to rise where they are not actually in the sky at 22:00hr.

The Milky Way is shown together with a suggestion of horizon glow to remind you that, nearly all over Britain the glow of artificial light is encroaching on our view of the night sky. In the summer months the additional glow of the Sun close below the northern horizon is added to this effect. Finally, and in a spookily attractive way, the zodiac is indicated by the mythological figures after which each of the 12 zodiacal constellations are named.

Richard Knox


Sundials

Throughout history people have lived each day by the rising and setting of the Sun. Both the apparent daily motion due to the Earth rotating on its axis, and the yearly motion due to the Earth's orbit of the Sun, have been used since ancient times to calculate the date and time throughout the year.

A sundial is a safe way of watching the Sun appear to move. It is very dangerous to look at the Sun directly, but perfectly safe to watch the movement of shadows it casts. The Sun rises somewhere along the eastern horizon. When it is near the horizon, shadows are very long indeed, and point somewhere towards the west. When the Sun reaches a point highest in the sky for that day it must be due south, as seen from the northern hemisphere. Shadows then point north and are at their shortest.The Sun continues down towards somewhere on the western horizon to set.

To make a sundial, the shadow casting device (which is called a gnomon) must also point along the Earth's axis so that the relative motion of the Sun casts a shadow moving at a steady 15° per hour round it.

Your sundial is not a precise timekeeper – but remember it's the Earth that is to blame! The tilt of the Earth's axis results in the Sun's noon altitude being higher in the summer than in the winter. In addition, the varying speed of the Earth's motion round the Sun during the year adds to the problem.These effects result in sundials being up to almost 17 minutes fast or about 14 minutes slow at different dates. As we do not want a variable basis of time for setting our clocks, we imagine a mean (or average) Sun, that neither moves north or south of the equator, and makes the same easterly progress across the stars each day. The result is called 'mean solar time'.

The 'handy' sundial

The left hand points west in the morning, and the right hand points east after noon. In this photograph, the right hand pointing east in the afternoon and holding a shadow-caster at about 50° to the horizontal palm of the hand, indicates a mean local solar time of about 15.00.

Making and using your sundial

1. Slot together equatorial and meridian rings at right-angles to each other. (A)
2. Slide the hour scale into position in the meridian ring with 'noon' centered within the slot. Reinforce with L-shaped paper hinges at the back. (B)
3. Make two feet, glued to the base in which to stand the meridian ring. (C)
4. The sundial is shown set up for a latitude of 50° (the centre-line edge of the gnomon will be pointing to **Polaris**). The easiest way to set up the dial is to move it till it reads the right sundial time.
5. In this example, the local solar time can be seen as 9.30 hr. and the Sun's position (declination) is about 7° north of the Equator (as it was taken in either early April or late August).

Sky Diary Spring 2007

Winter stargazing in the northern hemisphere is what sorts out the keen observers from the couch potatoes, and the fact that the evenings are so long and the starry sky at its most beautiful is the only compensation. This winter, in addition to the magnificent array around the Milky Way and the Zodiac, the evening sky has plenty to tempt the observer and the sky photographer. And if you are armed with the cross staff that you made after the last issue of *Gnomon** then this issue will have explained some of the ways that you can use it to add to your interest in the star patterns and the changing positions of the planets.

The constellations that dominate the sky include (roughly from west to east and north to south) Cassiopeia, Perseus, Taurus, Auriga, Orion, Canes Major and Minor, Gemini and Leo, not to mention Hydra, Monoceros and Lynx. The main planet near the middle of all that lot this winter will be Saturn, its north pole now apparently getting very close to the northernmost point of the planetary disc as we see it from Earth, and the rings looking quite slim. The major event of the quarter is a total eclipse of the Moon.

There are two total lunar eclipses in 2007, March 2 and August 28. Only the first of these is at all visible from the UK. The corresponding solar events are very disappointing partial eclipses where the Moon's shadow skins over each of the Earth's poles in turn, the northern one on March 19, and the southern on September 11. Neither of these will be seen at any stage from the UK, so keep saving up ☞

**What d'you mean, you haven't had time to make the cross staff? Write out 50,000 times "I must do everything in* Curriculum Corner *as soon as* Gnomon *arrives through my letterbox"!*

☞ your pennies for your Outer Mongolian adventure of 2008 August 1.

The total eclipse of the Moon on March 3 takes place the friendly side of midnight! First umbral contact is at about 21:30hr UT and totality lasts from 22:44hr to 23:57hr.

Moon phases for the first quarter of 2007

	New Moon	First Quarter	Full Moon	Last Quarter
January	**19**	**25**	**3**	**11**
February	**17**	**24**	**2**	**10**
March	**19**	**25**	**3**	**12**

The last contact is due at 01:11hr on March 4. The Moon will be in the centre of Leo. There are occasions when the Moon virtually disappears during a total lunar eclipse, but these are relatively rare. The Moon has an eclipsed Sun in its sky, with a bright red halo round the Earth where the Sun's light is being refracted through its atmosphere. In effect, a bright red after-sunset glow all round the disc of our planet. This bright red reflects on the Moon, even though it is immersed in the Earth's umbral (i.e. total) shadow, and a beautiful glowing copper Moon in our night sky is often the result. Major volcanic eruptions on the Earth have propelled large volumes of ash into the upper atmosphere on some previous occasions of lunar eclipses, and a genuinely total black out has resulted.

Mercury makes a fairly promising evening elongation near the end of January and start of February. On February 4 the planet is about 6° southwest of Venus west south west towards the end of the evening twilight at around 17:40hrs UT. The planet Uranus is just about on the same line as the alread set Sun's horizon glow through Mercury, Venus and λAqr. that was described in the previous issue of *Gnomon*. The diagram below gives an idea of the apparent relative separations of these various bodies. Note that Uranus is shown by the faint point at 10 o'clock from λ Aqr. The planet will be about 1.5° from the star. All these observations will be much easier now that you have a cross staff to guide you (see footnote last page).

Venus begins a long evening apparition rightr from the beginning of the year, but it will be hard to spot in the twilight early in January. Towards the middle of the quarter it should become progressively easier.

Mars begins a slow haul away from the glare of the Sun in the morning twilight, and really will not get very far very fast until the middle of the year, when it will "turn the corner", as it were, and rapidly increase in visibility. So not much joy this quarter then.

Jupiter is approaching the winter solstice position throughout this year and is in Ophiuchus during this quarter. Although almost as far south as it can be, there is no difficulty in spotting the planet in the morning sky, but it will not be at its best for northern observers with telescopes. It is of academic interest to note that one could say, just to be intriguing, that Jupiter is not in the Zodiac most of this year. This would be totally wrong, as the "Zodiac" is in fact an astrological concept, and facts have never bothered astrologers very much! To be a bit more precise, pedantic even, Jupiter is not in a zodiacal constellation, as is usually meant by the word.

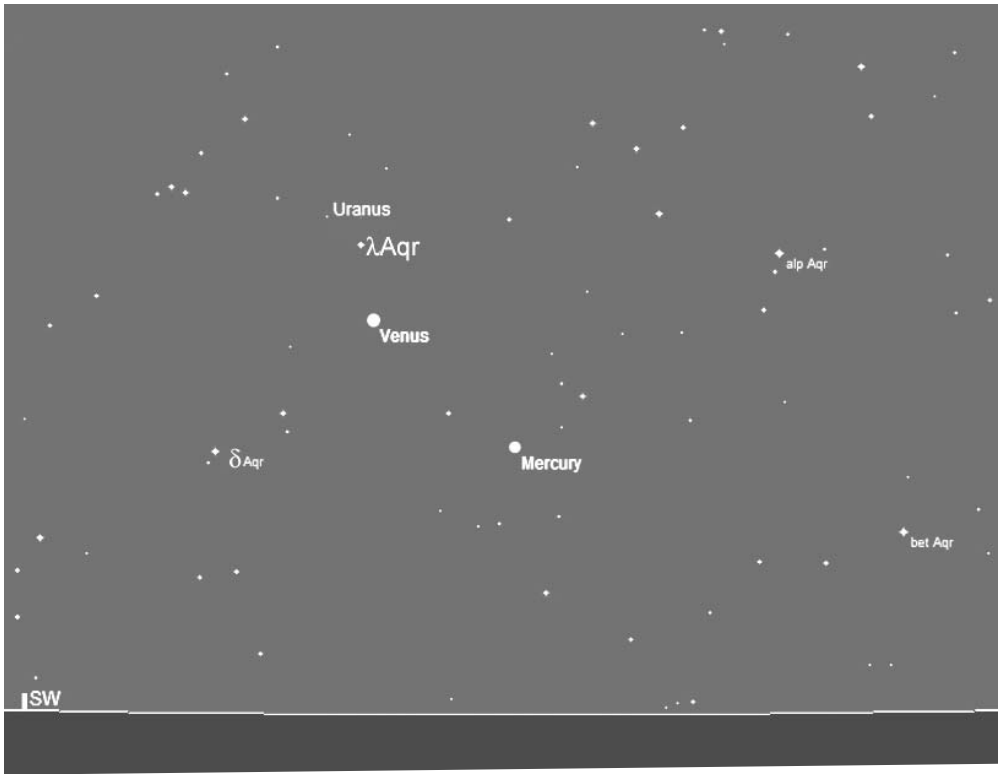
Rising and setting times (UT): lat.52°N; long.3°W

	January 15		February 15		March 15	
	Rise	Set	Rise	Set	Rise	Set
Sun	08h 14m	16h 28m	07h 29m	17h 23m	06h 29m	18h 13m
Mercury	08h 45m	16h 39m	07h 44m	18h 53m	05h 43m	15h 42m
Venus	09h 17m	18h 05m	08h 26m	19h 47m	07h 26m	21h 17m
Mars	06h 43m	14h 16m	06h 12m	14h 02m	05h 21m	14h 11m
Jupiter	05h 11m	13h 19m	03h 36m	11h 35m	02h 00m	09h 55m
Saturn	18h 59m	09h 46m	16h 14m	07h 40m	14h 41m	05h 46m
Uranus	10h 09m	20h 55m	08h 09m	19h 01m	06h 22m	17h 20m
Neptune	09h 21m	18h 41m	07h 21m	16h 46m	05h 34m	15h 02m

Saturn has moved into Leo from Cancer and will soon begin a rapid southerly motion through the starry background. Already the rings have closed noticeably from the wide open aspect we see when the planet is in eastern Taurus. It is sobering to think, at least for some of us, that the planet will not return to those northern heights for another 27 years by which time I will certainly be an even less active observer (and not be editor of *Gnomon,* among other things, much as it would give me pleasure to be!).

Uranus has been mentioned already, so that just leaves Neptune. It reaches conjunction during the quarter, so it goes from being extremely difficult unless you have a telescope, to being impossible. Pluto doesn't count any more.

One or two possibly especially attractive sky aspects during the quarter for which you may want to grab your camera to record, bedsides those already mentioned are the Moon passing 1° south of Mercury, on January 19 at 19:00hr, and 0.7° south of Venus the next evening. On February 3 at midnight the Moon is 0.8° north of Saturn.



***Looking WSW on 2007 February 4 at 17:42hrUT. Mercury is at an altitude of about 8° at the end of civil twilight at this time. Compare the position of Uranus with respect to λAqr. with that shown in the last issue of* Gnomon.**