# GNOMON

Newsletter of the Association for Astronomy Education

Vol. 21 No. 2 ISSN 0952-326X WINTER 2002


A Merry Christmas and a peaceful New Year to all Gnomon readers

## Progress with the Faulkes Telescope

The Faulkes Telescope Project is building two large astronomical telescopes, to be located in Hawaii and Australia, which will be dedicated to use by school students. Because of the position of the telescopes they will be available for use in real-time during the UK school day. The principal project sponsor is the Dill Faulkes Educational Trust.

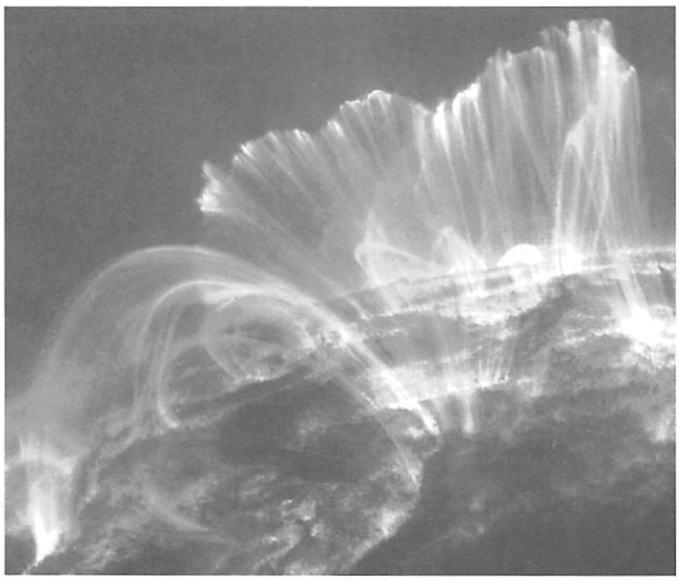
The first Faulkes Telescope (FT North) is nearing completion in the Birkenhead factory of Telescope Technologies Ltd. The telescope mirror is 2m diameter, making it the biggest telescope in the World dedicated to education. The building that will house the telescope on the mountain (termed the enclosure) is being built in Glasgow and is of a novel all-opening design. Pictures of the telescope and enclosure can be seen on the web site, **www.faulkes-telescope.com.**

Parts for the second (identical) Faulkes Telescope (FT South) are being manufactured and assembly of the telescope will begin at the end of 2001. The Faulkes Telescopes are to the same design as the Liverpool Telescope that is now being shipped to its own site in the Canary Islands. That telescope has been shown to have a good performance in early testing in the factory. (It took images of the sky through doors in the roof!) which bodes well for the Faulkes Telescopes.

The first telescope, FT North, will be installed on the peak of the mountain of Haleakala, on the island Maui in Hawaii. This is an important cultural site in Hawaii and the project has had to be very sensitive to local concerns. However, after a long period of negotiation, the University of Hawaii (who owns the site) has given its enthusiastic approval for placing the telescope on the mountain. We plan to start building the foundation for the telescope in November of this year.

FT South, will be installed at the Siding Spring observatory, approximately 500km North of Sydney. Design of the foundation and pier is nearing completion. We hope to have formal agreement with our Australian (*page 2*)

## The Sun in three-dimensional action



***This impressive display of solar flares is captured in a frame from a movie taken by the TRACE orbiting telescope. Cooled material lifted high above the Sun is raining back down onto the solar surface. The full-colour version of this picture is one of the 12 splendid examples from the Armagh Planeterium 2002 calendar (see page 3)***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**All communications (except those to the Editor) should be addressed to:**

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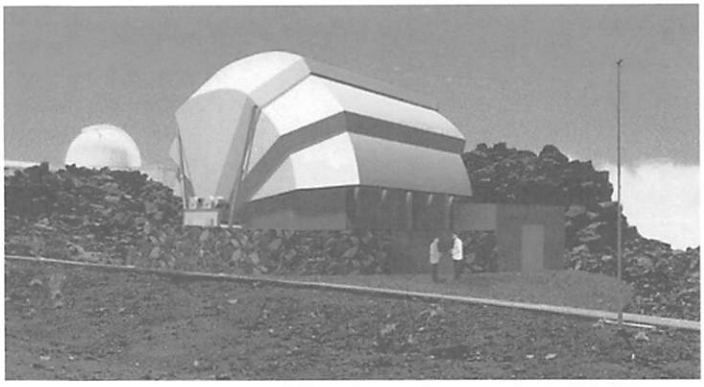
**Publication Dates:**

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

☞ *(from page 1)* partners by November and to start building work at the end of this year.

The telescopes will be controlled in real-time using a specially developed web interface, optimised for use in schools.



***The first telescope, FT North, will be installed on the peak of the mountain of Haleakala, on the island Maui in Hawaii. The building that will house the telescope (termed the "enclosure") is being built in Glasgow and is of a novel all-opening design. This picture, and an impression of the first telescope, are avaiable on the Faulkes Telescope web site (see page 1).***

This software is now being developed and trials of the system with schools will be important to check that it meets the requirements of teachers and students. Please contact the Project if you would like to be involved in those trials.

The new National Space Centre in Leicester has agreed to host the Real-Time Operations Centre for the Telescopes. This unit will support users in schools who are using the telescope in real-time. Liverpool John Moores University will host the Telescope Management Centre, which will be responsible for overall management of the telescopes.

The project is working closely with three of the 12 "Classrooms of the Future" projects funded by the education department of the British Government. The facilities will be state-of-the-art classrooms incorporating a host of ICT hardware including video-conferencing and intelligent building controls. Projects in Kensington & Chelsea (London), Camborne (Cornwall) and Telford & Wrekin (West Midlands) were selected as part of a £10 million government initiative. Kensington & Chelsea and Camborne will be incorporating astronomy, and in particular real-time use of the projects instruments, into the design and operation of the buildings.

The Faulkes Telescope project will be working with a number of regional centres that will offer users a local training and help contact, and access to hardware and/or expertise that will enhance a group's use of the telescopes. To date, the following centres have agreed to participate as community users: the Royal Observatory Greenwich (London); the Royal Observatory Edinburgh and Glasgow Science Centre (Scotland); Armagh Planetarium and W5 science centre (Northern Ireland); and Techniquest and Powys Observatory (Wales).

Discussions are ongoing with a number of other centres around the UK. In addition, the three Classroom of the Future projects mentioned above will also serve as local help and advice centres. If you have an idea for a potential community user facility in your area, please contact us.

The Particle Physics and Astronomy Research Council (PPARC) have awarded £60,000 to Paul Roche, through the University of Leicester, to run a national programme of teacher training for astronomy, in support of the Liverpool and Faulkes Telescope projects. Paul will be co-ordinating the INSET training programmes, along with sessions for PGCE students and pro/am astronomers, to develop awareness of the projects and teach the required ICT and astronomy necessary for successful observing. The TiE sessions will be based at community user facilities, universities and LEAs around the UK. If you are interested in hosting a training session (typically from 2 hours to half a day in duration), please contact Paul at the address below.

The Project aims to have the first telescope working with trial schools in mid 2002 and available more generally in September 2002. The second telescope will become operational a few months later. If you want to become involved in the Project as a teacher or student user, or in other ways, please contact us at one of the e-mail addresses below.

Project Manager and telescope enquiries, Richard Cole:

**richard.cole@faulkes-telescope.com**

Educational Programme enquiries: Contact Paul Roche:

**paul.roche@faulkes-telescope.com**

Project Web site: **www.faulkes-telescope.com**

The Faulkes Telescope project partners in the UK are the Dill Faulkes Educational Trust; the Particle Physics and Astronomy Research Council; the University of Leicester and the National Space Centre, Leicester; Liverpool John Moores University; and the Royal Observatory, Greenwich.

The overseas partners are the University of Hawaii, and in Australia, the Australian National University, Swinburne University and the Anglo-Australian Observatory.

## AAE at New Year ASE meeting

The Association of Astronomy Education is taking part in the Association of Science Education exhibition and meeting in Liverpool, January 3 - 5.

We shall have a stand at the Exhibition, and AAE members are holding workshops and giving lectures during the event. The workshop will use simple models and easily available astronomical instruments to demonstrate ways to explain the Earth's position in time and space. There will be practical suggestions for implementation in the classroom as well as the playground and outdoors, always with special attention to the requirements of all the key stages in the National Curriculum and the GCSE syllabus. Suggestions are welcome, and especially volunteers to plan and help with the demonstrations.

If you are attending the ASE meeting and can help, either with the AAE stand, or with the practical demonstrations during the workshops, please contact Francisco Diego as soon as possible at

**fd@star.ucl.ac.uk**

## Updating the celestial globe for the classroom

Teachers and astronomers in New Zealand have developed a new astronomy teaching aid called an Earth Space Simulator. It is currently being trailed by a number of Earth Science teachers here and in Australia, Canada and the United States. We are hoping to release it at the National Science Teachers Association conference in San Diego next March. It is likely to be handled by the Astronomy Society of the Pacific. The sphere can be either a globe of the Earth or a celestial sphere.

As a globe it can be configured for either the northern or southern hemisphere and is adjustable for any latitude between 0 and 90°. The disc at the extension of the pole is an equatorial sundial when adjusted for your latitude and aligned true north/south.

A Meridian line runs around the *(cont. bottom p.3)* ☞

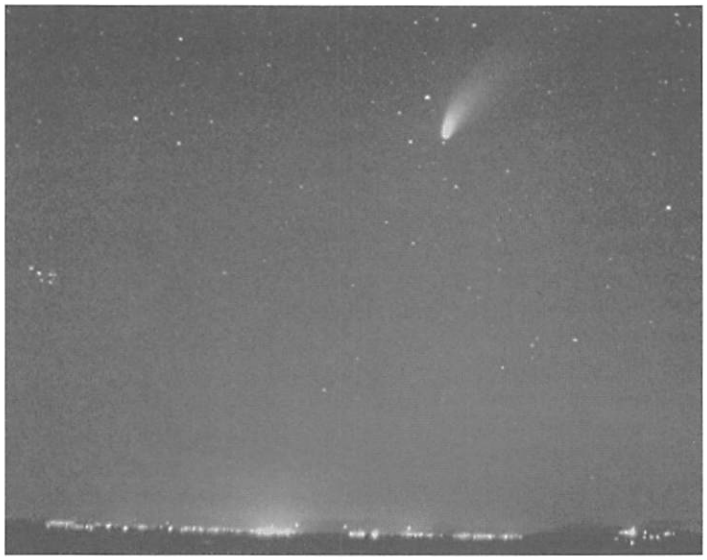
# Letters to the Editor

### *Memories of a Hale Bopp drama*

Attached is a picture of Comet Hale-Bopp over Morecambe Bay in April 1997. Like the "broken film" affair (*Gnomon*, last issue, *Ed.*) this also has a story. I like to include local scenes in my astronomical photographs when possible, so I had waited for a considerable time on Morecambe promenade, fully set up, for the comet to descend over Barrow-in-Furness within range of my telephoto lens.

Approaching midnight, the moment arrived and I was about to press the cable release when the (cheap) tripod snapped just below the camera mount, probably with the weight of the lens. Fuming with rage and frustration, I grabbed the heavy SLR just in time and plopped it on top of a plastic litter bin.

As advised in *Gnomon*, I clicked the cable release, removed the black felt lens cap with a flourish and hoped for the best. It worked out better than expected. The night was ideal for photography, and I had already taken several shots



from varying viewpoints around the district.

We also raised over £100 for our local hospital Cancer Unit through the sale of prints. It was encouraging to see people interested enough in an astronomical event to make this a success. This particular exposure was about 30 seconds (after all the drama, I wasn't counting!) at f4 using 1600 ASA film. I hope this tale provides a few chortles.

**Peter Ford**

*(I guarantee, Spode is rocking merrily in his grave. Ed)*

### *How old is the AAE?*

Re: "Hubble making waves" by Bob Mizon ( foot of page 1 Gnomon vol. 21 no 1) I am always puzzled by the various assertions made over the years as to how the AAE began. As the HMI responsible for Liaison with the AAE in the days before the ogre of OFSTED was created, I still have some of the original documents.

To the best of my knowledge the inaugural meeting of the AAE was held in Liverpool on the 16th May 1981, as a result of a preceeding DES short course. The AAE is therefore shortly to be 21. The report of this inaugural meeting is to be found in AAE News ( now Gnomon) vol.1 no.1, dated Sept 1981. The IAU reports the formation of the AAE in June 1981 In newsletter 46 Teaching of astronomy. Quite how the current gnomon is volume 21 is beyond me. My set of back numbers is not quite complete as I was a tad busy with other things some of the time.

May I permit myself an additional observation spanning the years from 1984 when I joined the inspectorate to 1992 when I left it? It is remarkable how much the quantity and quality of astronomy teaching grew over that period. At the time, I used to run a search over all the lessons seen about twice a year to find most of the astronomy lessons seen by anyone in routine inspection. In the earliest periods for which this was possible there wasn't much, and a significant number of lessons in which there was, plenty of misinformation was supplied by the teacher.

As the National Curriculum came in, the quantity and quality of the work rose, partly due to the great efforts put in by the AAE and RAS to train the trainers in the initial phase. However, I suspect that things have ossified somewhat now and my initial hope that children would actually look at the sky more and draw diagrams of circular things less, may have been misplaced.Perhaps a veritable storm of rebuttal will now occur and make me feel very happy about our little patch in the curriculum after all.

Like you, I am not impressed by the need to qualify to teach something that I have been teaching since I was 20. Especially so as I never obtained any teaching qualifications at all, as I entered the profession during one of those periods when science teachers could just walk in without one.

**Tony Lacey**
**info@wass.cosmosys.net**

(*Thanks for the letter, and the support. The volume numbering corresponds with your dates exactly, I'm happy to say! Ed.*)

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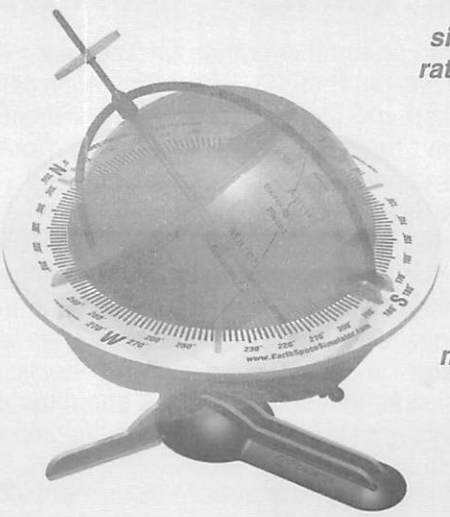
☞ *(from p.2)* globe to divide it east/west at noon, and the horizon disc has compass degrees printed on it to show the azimuth of sunrise and set throughout the year when the sun is marked on the sphere. The Tropics of Cancer and Capricorn mark the solstices. As a celestial sphere it has the plane of the ecliptic printed on a disc along with the 13 zodiac constellations. Circumpolar constellations can be marked and viewed from below as the sphere is rotated to show their circumpolar motion.

In November, John Dunlop (Auckland Observatory and Stardome Planetarium) and I presented our astronomy research at the Ontario and New York Science Teachers annual conferences. Considerable interest was shown in the simulator as a teaching aid for middle and high schools.

If any *Gnomon* reader is interested in more information about the device they can look it up on

**www.earthspacesimulator.com**

**Eric Jackson**



***The Earth/space simulator incorporates the principles of many ancient astronomical instruments, to demonstrate the concepts of hirozon, altitude, mean solar time, Sun's apparent motion and much more .***

# For your Christmas List

*Wonders of the Universe 2002.* Full colour calendar. Armagh Planetarium. £9.95.

This consistently brilliant calendar, sky diary, and astronomical anniversary reference is produced by the Hansen Planetarium in the USA and made available, as always, through Armagh Planetarium. It maintains its originality each year with the choice of its whole-page illustrations and the quality of the photographs, which is stunning! This year, there is a panoramic frontispiece taken from the recent 3½yr entire-infrared-sky project, carried out by the twin telescopes of the Two Micron All Sky Survey located in Arizona and Chile.

There are many unusual photographs from the Hubble space telescope, of course, but others offer surprising views of Mars, ocean currents around chains of islands in the Pacific, and wonderful three-dimensional views of complex eruptions of flares on the surface of the Sun (see the front page). There are many other gems, but I will leave a few of them for you to discover.

The months are each summarised, with the highlights of activity in the sky during the month, and the calendar pages provide a detailed description each day of specific events, still leaving space for your own hand-written memos for the day. Public and various religious holidays around the world are given on the appropriate dates, together with copious anniversary notes, ranging in coverage from, for example, the founding of NASA (1958 July 29) to the publication of the *Principia* by Newton in 1687.

The Hansen calendars may be produced in the USA, but they manage to be remarkably international, if aimed mainly at northern hemisphere. But *Gnomon* readers on any point of the globe will find more than enough to justify the purchase of this calendar. The photographs alone are worth the collecting, and most of the information can be simply adjusted to suit southern hemisphere inhabitants.

As in previous years, it appears to me to be a must-have for anyone interested in, employed, teaching, learning, or connected in any other way with astronomy. Or, of course, people looking for things to put on their own, or their friends' Christmas lists. Ring Armagh now - but if you are too late for Christmas, there's still Hogmanay!

**RK**

*Star and Planet Almanac 2002, a monthly guide to the sky at night*: 16pp 17X12in full colour spiral bound, with monthly calendar. Created by Liesbeth Bisterbosch and translated from German by John Meeks. ISBN 1 903458 13 7. Hawthorn Press, available through Scottish Book Source, Edinburgh. £10.99 + £3.00 P&P.

This is a beautiful calendar/almanac , with a novel approach slanted towards young observers and practical naked eye observation, but which will have wide appeal.

The 12 main charts show the evening sky as darkness falls in the middle of each month, together with two subsidiary charts showing the midnight and pre-dawn skies. The charts cover the sky from horizon to an altitude of about 75° and a complete circle in azimuth (actually overlapping slightly at the left and right hand ends of the chart, representing north.

The star charts, credited to Bert Stolker, Wil Tirion, and Mary Tji, are veritable works of art, with the ecliptic indicated by a band of faint zodiacal characters across the sky planetarium style. This provides a simple and attractive graphic way of showing the changing aspect of the ecliptic. It's a pity that Virgo looks like the figure of Death from Monty Python's Meaning of Life!

Each chart is carefully cross-referred to other months and times that show the same aspects of the stars (although it might have been made a bit clearer that the planets and Moon positions would be different). For example, the midnight stars in February are shown larger in the evening chart for April. This also helps to bring home the concept of the monthly changing aspects of the night sky due to the Sun's apparent eastward motion each day.

The charts are drawn with an attractive night-blue sky, with the glow of twilight indicated where appropriate (although it was omitted from the midnight charts of the midsummer months). Monthly notes describe the visibility of the planets and the Moon, with additional notes of interest such as the occultation of Jupiter by the Moon in February (see Sky Diary, page 7).

There are useful introductory notes about using the charts and for observing the night sky. There are also two appendices, with charts showing the overhead sky through the year, and an article by Bob Mizon on the problems of light pollution and what can, or should, be done about it. Rather incongruously, an order form for this year's publication is printed on the verso of the overhead sky charts, but cutting it out would be a crime!

Some purist quibbles: why mix the proper constellation names of the zodiacal constellations with ambiguous translations of the others (the Herdsman, Big Dog, etc), and why the astrological style "Scorpio"? New Moon dates are not represented on the calendar. There are one or two typographical errors - but let those without sin cast the first stone! Perfectly timed for Christmas, if you hurry.

**Richard Knox**

# Questions, quistions, quostions!

"Have you ever been on another planet, Mr Thompson?"; " What if an asteroid hits the Earth?"; "Why is the Moon called the Moon?"; "Are there any aliens?". These are just some of the questions which I have been asked during my "Tour of the Universe" talks to primary school classes (years 4 - 6), or by post afterwards. The questions which children ask, and their answers to my questions, can reveal a lot about their ideas and misconceptions about space and astronomy. Science fact and fiction tend to get jumbled up in their minds, not surprisingly since there is no prominent "government health warning" at the start of a TV space fiction drama to say it is fiction, and documentaries about the end of the world are tending more and more to give the impression that our demise is imminent.

To forestall the first of these questions, and variations such as "How long does it take to fly to another galaxy?", I emphasise (when I show slides of Apollo astronauts on the Moon) that the Moon is the furthest that Man has yet travelled, and that only unmanned spacecraft have visited other planets.

It also needs to be pointed out that only two British people have even been into space. Trying to demonstrate the relative distances of the Moon, planets, nearest stars, and other galaxies, and consequently the relative flight times to them, is one of the hardest tasks when talking to children, (and adults as well). Yet it is well worth spending time to explain the scale of the Universe, especially our little corner of it.

Catastrophes fascinate children, particularly boys. Comets and asteroids hitting the Earth, the Sun going supernova, meteoroids hitting astronauts - they thrive on these. Again it is necessary to dampen their enthusiasm somewhat by stating the facts, such as that there are millions of years between major impacts, billions of years before the Sun does anything nasty (and then becoming

only a Red Giant), and no astronauts have been hit yet after 40 years of manned spaceflight.

The third question is typical of a subset which could be classified as "the human angle", being non-technical. "Why is Jupiter the biggest planet?" and "What is your favourite planet?" I was tempted to write that girls ask this sort of question while boys ask about Big Bangs and Black Holes, but on looking through some of the questions sent with thank-you letters from schools, I find that there is no significant gender distinction.

Aliens always crop up, and the comments earlier about the boundary between fact and fiction becoming blurred is particularly relevant. Questions about aliens are linked with the existence of other planetary systems. Now that these appear to be abundant (say one out of ten stars have planets), I have to admit that there must be vast numbers of Earthlike planets in the Milky Way Galaxy, and that life may have formed on some, and aliens may exist. Yet we have no evidence that any have visited Earth. I sense a wave of disappointment in the audience when I say that.

Some questions are quite difficult to answer in a way which Year 5 children can understand. Gravity is always a problem: how can the planets stay up and why don't they all fall down? Can you fall off the edge of the Moon? for example. The first question implies that the planets should fall to Earth. To try to clarify the subject, I use a demonstration in which one child is the Sun and holds one end of a bicycle inner tube (which represents the Sun's gravity), while another (the planet) holds the other end and is told to walk in a straight line at right angles to the inner tube. Eventually the planet gets the message and concedes to walking in a circular orbit. At this point I explain that the planet is falling continuously away from the straight line because of gravity, even though it does not get closer to the Sun. I emphasise the fact that all objects, even the children themselves, exert a gravitational force on every other object in the Universe.

Many technical questions require straightforward technical answers. "How hot is the Sun?" "Which planet was made first?" and "How many stars are in a galaxy?" On the other hand there are some very taxing ones, such as "Is there an outside of the universe?" and "If the Earth is really that old, why hasn't the Sun burnt it up?" and "If the world stopped, would everything fly off?"

I was frequently asked "Can you walk on the rings of Saturn?" so I stuck some small stones and some pieces of polystyrene onto a sheet of polythene, to represent lumps of rock and ice in a small section of the rings. I have been meaning to stick a small astronaut among the rocks and ice to show how an astronaut could orbit along with them, and actually space walk in the rings.

It all seems worthwhile when I get a letter which says "You obviously did a very good talk because I haven't got any questions to ask."

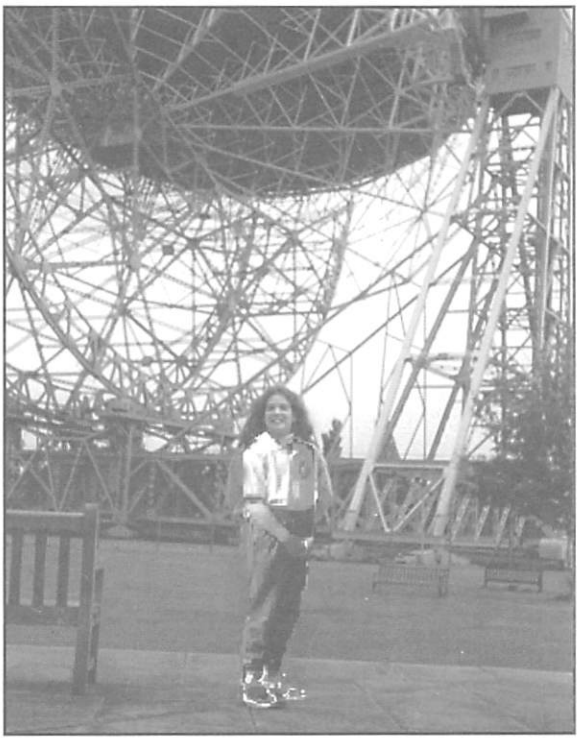
**John Thompson**

## Guides to the Universe

Enjoyment of the Great Outdoors is an important element in Guiding, and the process of gaining the Stargazer badge enables children to appreciate the sky as part of our environment. As a practical start, using the Plough for direction finding, the girls learn the shapes and names of other constellations. Both Guides and Brownies have outdoor sessions, but the older girls are required to keep a "sky diary" over three months.

Astronomy is not a "boys only" experience. How could it be, with role models like Heather Couper and Anne Cohen? As Dr. Cohen herself told us at a Starlab teachers' day, it is "the gentlest of sciences", suited to all. We generally have two meetings three months apart. We fit the skywatch in somewhere if skies are not clear on either of these occasions. On frosty nights, games such as "jump south-east . . . jump north" are welcome.

The advice given in *Gnomon* on what to do and what to avoid in outdoor sessions was appreciated. I must admit to having learned from experience after falling into a few of these traps, although I won't say which! Safety is central, and we have always had small well-staffed groups, with enough binoculars to go round. We usually manage to find



***A visit to Jodrell Bank was a very successful part of the indoor space camp week.***

a reasonably dark location, stressing to the children that they must always be accompanied by an adult out of doors at night. The perennial "don't look at the Sun" message is also well and truly driven home.

A bright planet is a bonus, as its progress may be observed during the course of a meeting. However, it has to be well up overhead owing to street lamps and buildings.

We use several fun activities, such as standing at scale planetary distances. I have my own set of Salter solar system models (poseur!), but the time-honoured peas and oranges serve equally well. The Pluto punch-line, "and you would need to get on a bus to Preston!" invariably produces a few gasps. While one group is outside, others may be making "star tubes" with pinprick constellations, to look through project on ceilings with torches. I have (ahem) my own battery-powered planetarium, but cardboard tubes, tissue paper and elastic bands provide more of a learning experience!

In summer 2000, local Guiders organised a Brownie indoor camp on the theme of "Deep Space 2000". This week-long feast of astronomical fun included a trip to Jodrell Bank. Another highlight was the visit of a local vicar, an avid space enthusiast, who showed the children meteoric rock samples, along with space rations and Shuttle crew uniform presented by an astronaut friend! (We also observed inverted cows with my small reflector telescope.) By the end of the week there was a colourful display of work, and every Brownies received a well-deserved Stargazer badge.

I find all this immensely rewarding, with Guides, Brownies and in special schools, where, as a supply teacher, I often have a free hand in choice of theme!

**Peter Ford**

# CURRICULUM CORNER

## A comment from Cosmology Corner

The question posed by Mike de Jong in "*The Things People Ask!*" in the Summer 2001 edition of *Gnomon* epitomised common misconceptions about Einstein's relativity theories and modern cosmology. I feel that the reply given by *Query* was too brief to fully resolve the apparent paradox (why do redshifts occur if the speed of light is constant?) and it actually contained some misconceptions itself.

I would like to add the following comments. The question refers to stars having observable redshifts (their light has been lengthened in wavelength). Stars can have redshifts or blueshifts (shortening of wavelengths) depending upon whether they are moving away or towards the Earth/Sun on their journeys around the centre of the galaxy. Their red / blue shifts are generally small and are caused by a Doppler shift effect (as noted by *Query*). How this effect works can be looked up in any good GCSE or A-level physics textbook.

*Query* correctly noted that, at very high velocities (about 30,000km/s, greater than those of the highest velocity stars in the galaxy by a factor of 100!) Special Relativity has to be taken into account (i.e. that the speed of light, c, is a constant for all observers no matter what their state of relative motion). This means that the observed redshift tends towards infinity as the relative speed approaches that of light (in the 'classic' Doppler effect the redshift only equals unity at velocity = c, as also noted by *Query*).

Cosmological redshifts - those caused by the expansion of the universe - are completely different to Doppler redshifts. The Doppler redshifts described above (classical and special relativistic) refer to relative motions through space. Cosmological redshifts (to which Mike de Jong is actually referring?) are caused by the expansion of space itself.

Stars within our own Milky Way galaxy are held in their orbits by mutual gravitational effects and the galaxy itself is not expanding. It is only by observing distant external galaxies (millions of light years away) that the expansion and hence cosmological redshifts become apparent. The correct way to think about cosmological redshifts is therefore not to think of galaxies as moving through space but to think of them as being stationary in an expanding space. The speed of light is a constant relative to space but the expansion of space during the time it takes the light to reach us from a distant galaxy 'stretches' the wavelength and causes a redshift.

As *Query* notes the expansion of space and cosmological redshifts are currently understood in terms of Einstein's General theory of Relativity. This contains the constancy of the speed of light relative to space but there is no such restriction on the speed at which space itself can expand. This means that, contrary to the answer given by *Query*, at high enough redshifts the galaxies really can be receding from us with velocities greater than light. Remember that because c is finite through space we see galaxies only as they were at the time the light was emitted ('then') not at the present time when we receive this light ('now'). The distance and velocity of a galaxy will be different 'then' to what it is 'now', however both velocities may exceed c for high enough values of the redshift.

The exact relationships between distance, velocity and redshift are determined by the equations of general relativity which themselves depend on the cosmological parameters - the rate of expansion (the Hubble constant), the deceleration of the expansion (caused by the mass density in the universe) or the possible acceleration of the expansion (caused by Einstein's famous cosmological constant). Currently all of these factors are known only approximately. The distances and velocities of high redshift galaxies therefore, can be determined only in the context of a particular cosmological model: i.e. they depend on the assumed values of the parameters noted above and are therefore themselves known at best approximately. The thing we actually measure is the redshift. In cosmological terms, this tells us how much the universe has expanded since the light left the galaxy that we are now observing.

I hope that the above has helped readers to appreciate the fundamental differences between Doppler and cosmological redshifts. As with all paradoxes, when looked at from the correct viewpoint, there is no paradox.

**Dr. Fred Stevenson**

## All Right on the Night?

There are two aspects of science which excite children almost without prompting: dinosaurs and space. Stars and planets are remote in both space and time, and the very strangeness of their forms and nature captures even the youngest imagination. Astronomy tutors must be careful to nurture this interest, and not pour cold water on it by promising too much from the heavens.

Many amateurs give talks in schools, and rightly enthuse pupils about what they might see in the sky that night: but, because of stray light, what the children of a Dorset village school may see is vastly different from the little that the skies over big cities have to offer.

In October 1999, children's television programmes and both national and local news bulletins painted literally a glowing picture of the coming Giacobinid meteor "shower" only a few days before the event. The terms "fireworks in the sky" and "raining down" were used. The occasional expert was interviewed to spice up the anticipation. But, to my recollection, not one word was uttered about the pall of cloud at that time covering the UK, and which the forecasts had already said was due to linger for days. Nobody mentioned the possibility that we might not see anything. And so it was. Bemused and disappointed, a lot of children must have lost a little faith in astronomy that week.

The Leonid shower was due the next month. A well-known children's television magazine programme featured an enthusiastic young expert. This time, it was "these things will be shooting everywhere", and "the firework display of a lifetime". A very brief mention was made of the possibility of poor weather. On the predicted evening, November 17th, most UK observers were clouded out, and those who saw anything agreed that it was no exceptional display. Before dawn on the 17th, meteors had been falling at the rate of well over 100 an hour, with some exceptional fireballs, but few non-astronomers were up at 4 o'clock in the morning. It was definitely not "all right on the night", and astronomy's credibility took another small dent.

It is only right that astronomers should be advising of coming events in the sky. The 1999 eclipse was vastly publicised, but never let us never forget that those flocking to Devon and Cornwall, and crossing the Channel in search of those two minutes of a lifetime, ran a definite risk of being disappointed. It was not, for most observers in western Europe, "all right on the day", either. Astronomers should always offer prophecies with reservations. Comet Hale-Bopp lived up to expectations, and was a real and timely "shot in the arm" for astronomy. Let us not shoot ourselves in the foot by forgetting that clouds do exist, and that prediction is still an imperfect science.

**Bob Mizon**

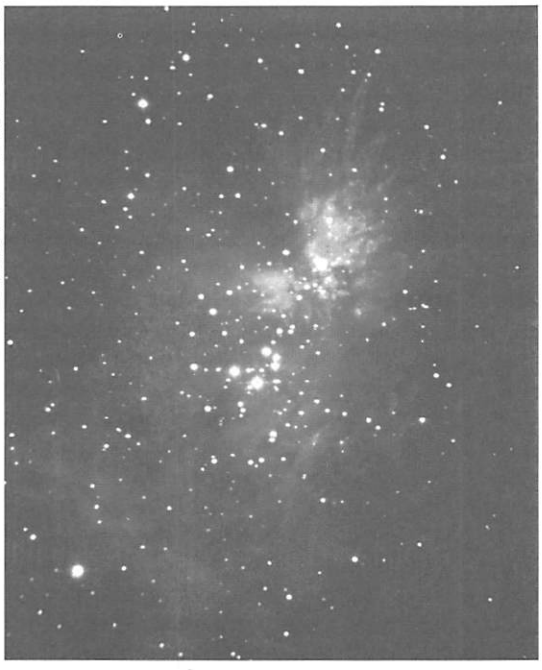
Coordinator of the BAA Campaign for Dark Skies

# News from Down Under

The delivery of a brand-spanking new instrument to the Anglo-Australian Telescope (AAT) is always a tense and exciting time. For the engineers, technicians, and project managers who have laboured long and hard to bring this moment to fruition, there is the nervous wait to see if it will all work as planned. For the astronomers, it means lots of hard work to fully debug and characterise the instrument, but also a golden opportunity to observe whatever they like, provided it has some scientific basis.

For some time now, the AAT has been without a serious infrared (IR) capability. Our existing instrument, the Infra-Red Imager and Spectrometer (IRIS) was state-of-the-art when it was completed in 1993. But its 128 x 128 pixel array is tiny by comparison with today's standard of 1024 x 1024 pixels (with 2048 x 2048 just around the corner), so it was imperative the AAT get a new IR camera and spectrograph.

With the completion of the revolutionary 2dF multi-fibre spectrograph in 1997, the observatory's staff turned their attention to the development of IRIS2, which would cost over £1 million to build. At first glance, IRIS2 looks a lot like a 44gal drum (albeit one made of highly-polished aluminium!). Since the main enemy of infrared astronomy is heat, the detector array plus associated filters and grisms (a combination of dispersing prisms and ruled gratings used for spectroscopy) must be cooled to temperatures approaching 200° below zero.



***The infrared image of the Great Orion nebula, as seen by the new IRIS2 instrument.***

The 1024 x 1024 array, supplied by Rockwell in the United States, sits in the main Dewar, which is pumped to near-vacuum and then cooled using a closed-cycle helium refrigerator. In the same Dewar are three wheels which allow various filters, grisms, and cold stops (which block out thermal emission from the telescope itself) to be positioned in the light path. Ahead of all this is a separate "fore-Dewar", which being smaller can be warmed up and cooled down much quicker than the main Dewar. The fore-Dewar contains a set of slit masks, which allow for imaging observations of the entire field, or spectroscopy of isolated objects, as well as masks purpose-made for a particular set of objects (e.g. a galaxy cluster).

Eventually, astronomers will be able to take an image of a field one night, have a slit mask cut and installed the following day, and be able to use the mask for spectroscopy that same night. No other infrared instrument has such a capability. Because Siding Spring cannot compete with higher and drier sites such as Mauna Kea (where I used to work for UKIRT and my letter came from Hawaii), IRIS2 has been designed to deliver a wide field of view in preference to extremely high-resolution images. For many purposes, such as identifying high- redshift galaxies or brown dwarfs in a cluster, this provides a significant advantage over similar instruments on a bigger telescope but having a smaller field of view.

The images reproduced here, illustrate how well IRIS2 performs on some of the more famous nebulae. The first (left) is of the Orion Nebula region (recognise the Trapezium near the middle?), in the light of shocked molecular hydrogen. Note the "bullets" shooting out to the NW. The second (below) is the Tarantula nebula, seen in K-band (2.2 microns), with the 30 Doradus cluster in the centre. This makes a good contrast with Dave Malin's optical image (see **http://site.aao.gov.au/AAO/images/captions/aat068.html**. (By the way, this is an exclusive for *Gnomon*, as no other publication has yet been given the chance to show these images!)

Having just come through its first commissioning run with flying colours, we can look forward to many more superb images, and telling spectra to emerge from IRIS2 in the years ahead. Innovative instrument design, and application to major survey projects means IRIS2 will also help to keep the AAT competitive in the era of larger and larger telescopes.

***The Tarantula nebula with the 30-Doradus cluster, seen in the K-band.***

**Stuart Ryder**

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# Sky Diary Winter 2002

The splendid Winter constellations are almost all prominent throughout the first three months of the year, including the bright stars of Orion, Auriga, Taurus, Gemini, Canis Major and Minor. These brilliant groups are complemented by Saturn and Jupiter as well this year.

With so may stars to choose from in the region, it is an ideal opportunity to suggest to students that they can watch, or better still, measure the changing positions of the two planets throughout the winter. There will always be plenty of background stars nearby with which to get a fix. It would also, of course, be a good time to remind students of the golden rule (or should that be Golden Rule?) that all observations should be written down with full background details such as date, time, observation site location, weather conditions and so on.

The suggested observation exercise would make a wonderful lead in to this year's spectacular opportunity for recording the Spring line up of the five naked eye planets. More of that in the next issue's *Sky Diary*.

One of the most important of the astronomical programs for the serious amateur until recently was called "Dance of the Planets" by ARC inc. of the USA. (The program appears to no longer be available, or perhaps the com-

**Rising and setting times (UT): lat. 52ºN; long. 3ºW**

| | January 15 | | February 15 | | March 15 | |
|---|---|---|---|---|---|---|
| | Rise | Set | Rise | Set | Rise | Set |
| Sun | 08h 13m | 16h 29m | 07h 27m | 17h 25m | 08h 13m | 18h 16m |
| Mercury | 09h 02m | 18h 10m | 06h 21m | 15h 03m | 06h 09m | 16h 16m |
| Venus | 08h 22m | 16h 24m | 07h 53m | 18h 03m | 06h 59m | 19h 34m |
| Mars | 10h 30m | 22h 20m | 09h 00m | 22h 28m | 07h 44m | 22h 34m |
| Jupiter | 14h 57m | 07h 34m | 12h 37m | 05h 17m | 10h 46m | 03h 27m |
| Saturn | 13h 09m | 05h 02m | 11h 01m | 02h 54m | 09h 13m | 01h 10m |
| Uranus | 09h 29m | 19h 01m | 07h 30m | 17h 10m | 05h 43m | 15h 28m |
| Neptune | 08h 50m | 17h 38m | 06h 51m | 15h 42m | 05h 03m | 13h 58m |

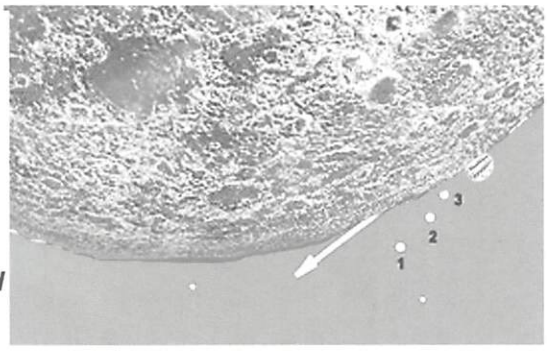
pany itself is no longer extant. If anyone knows different, please let me know - Ed.) The behaviour of the planets in the sky for the first half of this year easily explains this rather poetic title for the software.

There will be several close conjunctions between the planets themselves, and the Moon as it passes through the group in the middle of each of the three months covered by these notes. The most spectacular will be the occultations of Jupiter by the Moon in January and February.

The first of these should be visible in the north of the UK on January 26 at about 18:00 UT, an hour after sunset when the Moon will be due east at an altitude of just over 30°. Parts of Britain should see Jupiter graze the limb of the Moon while some its four bright satellites are occulted and others not.

The illustration below left shows the approaching occultation as seen from north of the usual sky map "middle of England" position, at latitude 53°N, longitude 3°W. The satellites are numbered 1 to 4 in both this and the diagram of the second occultation. They are: 1 Europa; 2 Io; 3 Ganymede; and 4 Callisto.

The white arrows in both diagrams show an approximate direction of the Moon along its celestial path. It indicates the close similarity between the Moon's apparent path at that instant and the average line of Jupiter's satel-




***The grazing occultation of Jupiter seen from notherly parts of the UK on January 26d 18h.***

lites. As the Moon overtakes the planet in the January encounter, each of the satellites may or may not be occulted, depending on where the observer is. The sky in the diagram is grey to emphasise that there will still be some twilight. Full Moon is on the 28th, and the grazed limb will be fully illuminated.

The second illustration shows the February occultation, making two in the same quarter visible from the UK. This time, the event can be observed from anywhere within the country. On February 23 at 2h UT, three satellites of Jupiter will precede the planet itself as they disappear behind the non-illuminated limb of the Moon. The fourth Galilean satellite, Europa, will itself disappear behind Jupiter a few minutes before the planet is obscured by the Moon! Quite a busy time for observers!

Jupiter starts the year off at opposition. The planet must qualify as the most amazing for modest telescopes since even relatively small apertures reveal ever-changing details of colour and shade in the planet's turbulent atmosphere. The motion of the four Galilean satellites is a constant delight and easy to watch in even a modest pair of binoculars. The timing of the eclipses and occultations of these four large moons of Jupiter was one of the several astronomical methods proposed by the astronomical establishment in the eighteenth century as a means of determining longitude rather than having to resort to relying on a mere mechanical device. Simply note when one of the many eclipses or occultations takes place, and look it up in an ephemeris based on Greenwich Mean Times. This would then be compared with the true local solar time, and hence give the longitudinal distance.

The theory was fine; the main snag (as with all astronomical observation solutions) was the extreme difficulty of making any observations from a pitching or rolling ship's deck! The epic tale of John Harrison's almost lifelong fight to prove his right to the £20,000 award offered by the British Government for the solution to the longitude problem, using his mere mechanical device, has now become well known, thanks to the splendid book Longitude by Dava Sobel.

**Moon phases for the first quarter of 2002**

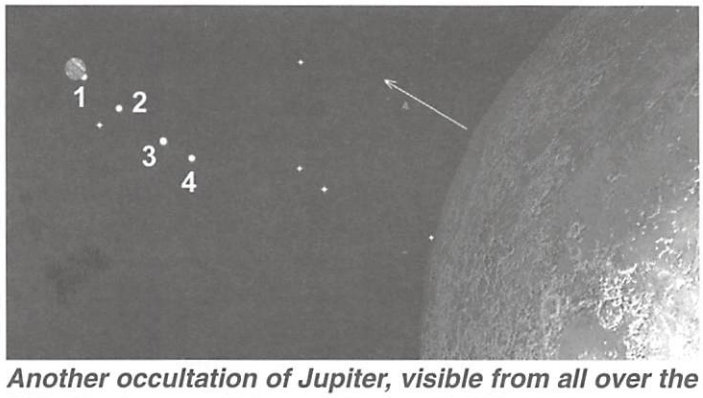
| Month | New Moon | First Quarter | Full Moon | Last Quarter |
|---|---|---|---|---|
| January | 13 | 21 | 28 | 6 |
| February | 12 | 20 | 27 | 4 |
| March | 14 | 22 | 28 | 6 |

Venus begins to move to prominence in the evening sky, reaching at altitude of about 15° at sunset by the end of the quarter. In the twilight, the lineup of four planets, Venus, Mars, Saturn and Jupiter (in order from the western horizon) will provide a wonderful indication of the ecliptic in its most favourable angular position relative to the horizon in the evening.

This is an ideal opportunity to explain why the more elusive sights, such as the very "young" Moon, sometimes less than 24 hours since new moon, may be spotted in the Spring evening sky low in the twilight. This time of year is best for finding Mercury when at a maximum eastern elongation, for the same reason. This year this occurs in April, so will be described in the next Sky Diary.

Saturn is moving slowly to its most northerly position in the sky, and the angle of the plane of the rings is still increasing, so that for over two more years the apparent polar diameter of the planet will be smaller than the minor axis of the rings as seen from Earth, and the planet appears "engulfed" by the rings.

Mars fades from a magnitude of just brighter than 1 to almost magnitude 2 over the three months as the distances between Earth and Mars increase rapidly. Mars always surprises us at its ability to keep plodding ahead of the Sun,




***Another occultation of Jupiter, visible from all over the UK this time, on February 23d at 2h UT.***

and it is not until mid-August that it will finally lose its version of the Tortoise and the Hare race. It will become increasingly difficult to spot as it becomes both fainter and closer to the Sun throughout the first half of the year.

**Richard Knox**