GNOMON

Newsletter of the Association for Astronomy Education

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Catch a Star!.. and discover all its secrets!

The European Southern Observatory (ESO) and the European Association for Astronomy Education (EAAE) welcome all students in Europe's schools to this exciting web-based competition as part of the EC-sponsored European Week of Science and Technology (EWST) - 2002.

Groups of up three students and their teacher have to select an astronomical object - a bright star, a distant galaxy, a beautiful comet, a planet or a moon in the solar system, or some other celestial body.

Like detectives, they must then endeavour to find as much information as possible about 'their' object. This information may be about the position and visibility in the sky, the physical and chemical characteristics, particular historical aspects, related mythology or sky lore.

The competition is to write a short report, in HTML format, with images and text, about the selected object. All projects that fulfil the competition requirements will receive a lottery number and the first 1000 participants will receive a 'Catch a Star!' T-Shirt by mail.

The first prize is a trip for the members of the group to the ESO Paranal Observatory in Chile, the home of the world's largest optical/infrared telescope, the Very Large Telescope (VLT).

Closing date is 1st November. See

www.eso.org/outreach/eduoff/catchastar

for details.

The Association's AGM

The Anual General Meeting of the Association for Astronomy Education will be held at the Greenwich Planetarium on July 6, at 11 30am. All are welcome, but please register before the meeting with Alan Pickwick. Contact at

Alan_C_Pickwick@compuserve.com

Another leap forward for the Hubble Telescope

The Hubble Space Telescope's new Advanced Camera for Surveys (ACS) has exceded the highest expectations. This picture was intended to show detail of these colliding galaxies, nicknamed the "Tadpole" 420 million light years distant, which it did, admirably! But the unexpected bonus was the estimated 6000 distant galaxies in the background, far surpassing the "legendary" Deep Field photograph that had 12 times the exposure!

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There will generally be a 10% discount to AAE members on all publications and advertising rates.
Practising teachers may claim their subscriptions as an allowance against income tax, thereby effectively reducing their contributions.

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

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The Royal Astronomical Society,
Burlington House, Piccadilly,
LONDON W1J 0BQ.

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A 25% reduction is made for advertising in all four issues.

Publication Dates:

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

Would you like to use the Faulkes Telescopes?

The agreement to use the site for the second Faulkes telescope, FT South, at the Siding Spring observatory in Australia, has now been signed. The design of the site works has been completed and work is due to start on the site in April (see *Gnomon* Vol. 21 No.2)

Membership of the UK FT project will be open to all UK schools. Due to the programmes being offered at the start of the project, membership will be restricted to up to 600 secondary schools, at least to begin with. UK Membership fees are yet to be finalised, but will be about Aus$360 (£140) per year. For this, members will expect about one hour of real-time operation of the telescope (when the school is in direct control) in peak school hours, plus a further hour in off-peak time and the opportunity to make off-line observations. Off-line observations are made by requesting a target that is then observed automatically some time over the next few nights and the data returned to the member.

The UK project is also considering other classes of membership for amateur astronomical societies and adult education groups, plus other educational activities such as summer schools.

The Faulkes Telescopes will also be available, in their off-line mode only, to members of the UK's National Schools Observatory. The programme will not be taking formal registrations and accepting money until the schedule for the availability of FT-North is firm. Hawaiian and Australian users will be able to get access to the telescope via organisations in their own countries. The programme aims to have the first telescope working with trial schools in late 2002 and available more generally in early 2003. The second telescope will become operational a few months later.

Work on the educational aspects of the FT project continues, and good progress is being made on the development of the "education/research projects" (see below) which will form one of the most exciting aspects of schools' use of the telescopes. It is anticipated that schools will be able to choose from almost a dozen astronomical projects, directed by UK researchers. Students will gather data that will be used in various research programmes ranging from detailed studies of near Earth asteroids (led by Dr. Duncan Steel, Salford) to assembling a catalogue of distant colliding galaxies (Prof. Mike Merrifield, Nottingham).

Education team is at work

The FT education team (Dr. Paul Roche and Dr. Richard Beare) is busy talking to schools, exam boards, professional astronomers and amateur astronomical societies, to ensure that when the first of the telescopes is ready for schools' use, the programme will be in place. To maintain clear relevance with the National Curriculum and various A level syllabi, a series of classroom activities are being developed. These are linked to the research projects but can also be undertaken by groups who are not involved directly with any educational or research project covering science, maths and ICT topics. The team is working closely with teachers to ensure that projects and classroom activities will be directly relevant to the curriculum, and exciting and engaging for students.

The projects and classroom activities will focus on the two FT instruments (and in particular the "live" observing aspects of the project and an initial focus on GCSE and A level groups). The FT team is working closely with colleagues at the National Schools Observatory (NSO) in Liverpool to ensure that all material is as interchangeable as possible, for example, using the same software, and collaborating closely on research topics with astronomers at Liverpool. As a result, it is hoped, both the Liverpool Telescope and FT users will benefit.

Under his National Award from the Particle Physics and Astronomy Research Council, Paul Roche is visiting educational and astronomical groups all over the UK, to inform people about the FT and NSO plans. Formal courses featuring demonstrations and hands-on use of the schools software will start in the new school year, when the NSO software package is ready for testing.

Informal agreements have now been made with a number of science centres around the UK who will act as regional centres for "assisted observing sessions" (so you can let someone else stand at the front and talk your students through the night sky!), or for workshops, help and advice. These will be at Jodrell Bank (Cheshire), Techniquest (Cardiff), the Royal Observatory Greenwich, Royal Observatory Edinburgh, Intech (Winchester), Armagh Planetarium and at the telescope Real-Time Operations Centre located at the National Space Centre (Leicester). It is hoped that we will be working with the proposed astronomy centres in Liverpool and the Education through Space Centre in Camborne when these open in the next few years.

Education and research projects

Richard Beare has continued developing the first of the projects, on spiral galaxy morphology. This project is based on ideas suggested by Professor Mike Merrifield at Nottingham and involves obtaining images of galaxies in

three wavebands. These are then studied, along with full colour composite images, to identify structural features. The spiral arms are measured quantitatively by using a spreadsheet to overlay log spiral arcs. The surface brightness profile along cross-sections through galactic centres are analysed quantitatively using another spreadsheet to determine the radial extent of the galaxy's bulge and visible disc, as well as how quickly the surface brightness decreases with radius. Finally the various measurements and observations are correlated with each other to determine classification using a modified Hubble scheme.

This project has already been shown in outline form to a team from Edexcel and the Salters-Horners A-level physics project. They indicated that they thought it suitable for assessed A-level coursework and were generally enthusiastic about it and two other projects currently being developed.

These are on measurements of asteroid rotation rates and on plotting HR (star colour/brightness) diagrams for clusters with a view to finding their age.

Work has already begun on developing an html-based framework for documenting the education/ research projects. The spiral galaxy one, in particular, is being further developed with a view to its acting as an example to guide development of other projects. This should prove a useful move when participating teachers start working on projects in the near future.

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 these e-mail addresses:

Project Manager, and telescope enquiries: Richard Cole

richard.cole@faulkes-telescope.com

Educational Programme enquiries: Paul Roche,

paul.roche@faulkes-telescope.com

www.faulkes-telescope.com

School science services index on CD

A CD ROM of school science services has been prepared by the Association of Science Education as a contribution to Science Year. The CD will be distributed to primary schools throughout the UK soon.

The details listed are mainly descriptions and contact details of specialist presentation services such as mobile planetariums, travelling roadshows, theatre groups and similar facilities, with details of addresses, phone numbers web sites and services offered.

Further information is available from the ASE, College Lane, Uckfield, Herts AL10 9AA, Tel. 01797 283000, or

www.ase.org.uk.

In addition interested parties can contact the ASE Field Officer Caroline McGrath at:

caroline@sci-ence.demon.co.uk

FOR YOUR LIBRARY

Astronomy: The Evolving Universe. By Michael Zeilik. ISBN 0 521 80090. pp. 552. Full colour illustrations. Paperback £29.95.

Dr. Michael Zeilik is Professor of Astronomy at the University of New Mexico and, in his introduction to this, the ninth edition of his book, explains what is new. As well as updating the material (that alone would explain the need for the new edition. New developments are taking place so rapidly there has been a veritable explosion of new information in the subject) the book's structure has been streamlined. In particular, Dr. Zeilik has introduced what he has dubbed the "celestial navigation" of each chapter. This is basically a flow diagram to guide the reader through the chapter, showing the connections between the major concepts introduced so that the reader acquires a feel for the evolution of the subject historically and intellectually.

The text is commendably up to date, especially considering the typical writing and publishing lead times for a heavily illustrated book such as this.

There are a few misleading comments. For example, the description of what is described as "the Great Dark Spot" on Neptune, discovered by Voyager II in 1989, makes it sound a feature as permanent as Jupiter's Great Red Spot. While the first enthusiastic reactions by NASA to the Voyager photographs gave it the definite article, it has, more recently, been shown by the Hubble Space Telescope to be a transient phenomenon, more like spots in Saturn's atmosphere, and elsewhere in Jupiter's.

The whole book is structured for study and learning, as far removed from a coffee table approach as possible, which may put some people off, but in fact the author's style is very easy to get along with and the academic regimen not obtrusive.The contents start from an explanation of the daily and yearly appearances of the night sky, and from these, the earliest explanations of the observations of the sky, and the growth of the study of the universe in ancient Egypt and Greece. Emphasis is on *how* things were, and are, found out (how do we know how far it is to the Sun?) and *why* theories arose to explain the observed phenomena. From Pythagoras to Ptolemy, from Copernicus to Newton, and so on the book covers all you can wish for historically to the present state of modern cosmology - including the paradoxes and problems that have been occupying cosmologists so much in recent times. Dr. Zeilik is frank about his own opinions ("I judge the conclusions about cosmic acceleration to be reasonable, but not yet firm. More observations, say in the next ten years, will solidify or evaporate (*sic*) the interpretation. Stay tuned!").

There are useful and interesting Appendices on the metric system, the periodic table, planetary data, mathematical constants and much more, plus a comprehensive glossary. In fact there is not much a serious student of the subject will find that Dr. Zeilik has left out.

Illustrations are copious and excellent, and cover the ordinary (a portrait of a contellation) to the deepest (well, not quite - see page 1 of this issue) of Hubble's photographs. Perhaps a hard back version might be worth the extra cost.

Richard Knox

Mike Dworetsky (*Query*) adds that the book would be very useful for someone teaching GCSE astronomy or a similar level course, because of the emphasis on the learning outcomes. It really is a rather slim volume in many ways, especially compared with the competition, for University courses in the UK, he writes. But it has many good points, and, Mike adds, the sections on ancient Greek astronomy and Copernican revolution is remarkable for the amount of explanation and detail.

The wonderful planisphere (part 1)

A planisphere is a simple, yet extremely helpful device for getting to know the brighter stars and constellations, and for finding one's way around the sky in general.

Despite the increasing use of computer software, the planisphere still holds its own ground firmly as an observational tool, and will continue to do so for many years to come. It is true that automated telescopes allow the instrument to lock onto any particular object of interest without the need to even identify the constellation in which the object lies, but such observers may never become familiar with the majestic constellations in their perpetual celestial march.

The Philips planisphere must be the most familiar of all designs. This example is designed for latitude 32°N.

It will certainly be a different eye contemplating the heavens if the friendly stars and constellation patterns have become familiar. A planisphere will unforgettably and dutifully reveal all this and more to us.

But isn't the planisphere such a beautiful (and cheap) device in itself? Every owner is proud of such a possession and with care will practically last a whole lifetime!

Planispheres come in various shapes, sizes, observer latitudes and amount of information they contain. When purchasing a planisphere, the most important characteristic to look for is to see that it suits the latitude of the observer's location. That depicted on the planisphere needs to be at, or close to the observer's latitude, say to within about 10°. Planispheres are not made for each and every parallel of latitude but for low, medium and high latitudes and the observer therefore selects the one closest to his location.

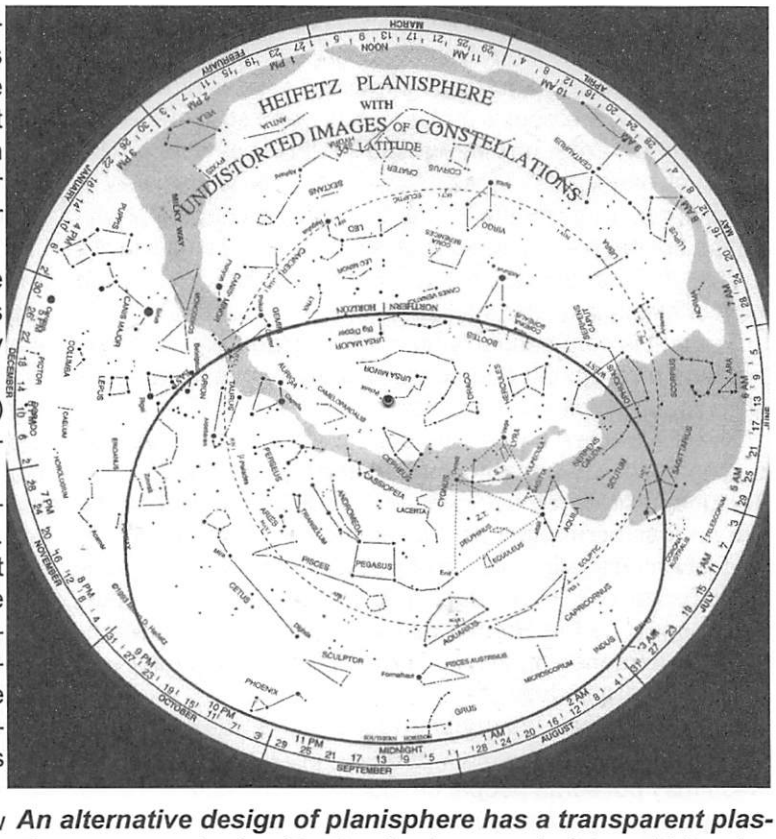
A planisphere for latitude 36°N (e.g. Malta) will show more southern stars than those intended for higher latitudes like Newport, Oregon, USA (44.5°N), London, England (51.5°N), Inverness, Scotland (57.5°N) or Tromso, Norway (70°N). But then, the higher latitude planispheres will correspondingly show a greater proportion of circumpolar stars that never rise and set and that are consequently visible all night throughout the year.

A typical planisphere consists of two basic components, namely a base plate, a dial that rotates against the base plate. These are sometimes attached with a small, central rivet around which the dial can rotate, or the dial is partially enclosed within an envelope, acting as the base, with an aperture revealing the visible sky. The disk is printed with the "fixed" objects that appear in a star map, such as stars, constellations, the Milky Way and the path of the ecliptic.

At its periphery, markings depict 24 hours of the mean solar clock, which double as Right Ascension, while the outer scale of the base is marked in dates through the year. The rotating star map is either concealed behind the mask with a cut away oval for the horizon, or, on a transparent plastic contruction, the horizon may simply be printed. North, east, south, and west points around the horizon may marked or indicated.

Planisphere sizes vary considerably. The most common in use is the 21.5cm diameter model. The smallest must be a relatively recent novelty - no less than a planisphere wristwatch!

Whenever using a planisphere is being used, it must be remembered that the device shows a three-dimensional star sphere on a two-dimensional, flat surface. *(cont. on next page)* ☞

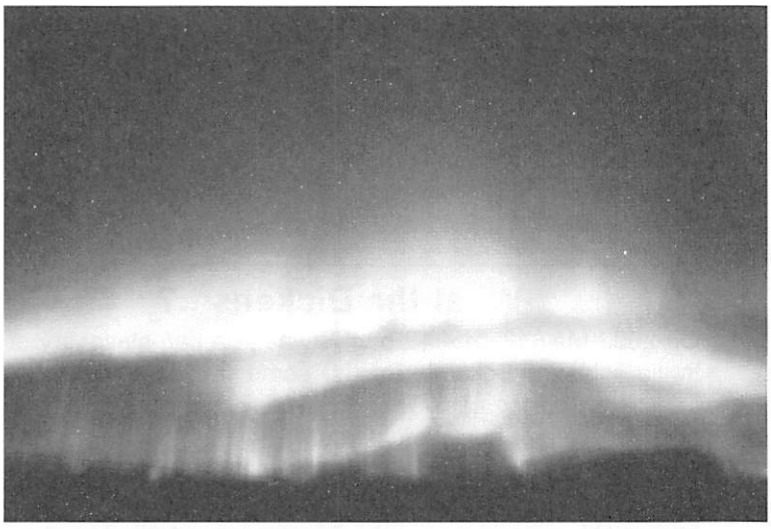


An alternative design of planisphere has a transparent plastic cover marked with the horizon and dates. This also claims undistorted star patterns

News from Down Under

Although Australia does offer some splendid views of the southern sky, it is for the most part too far north (I believe the politically correct term would be "latitudinally-challenged"?) to really appreciate the Aurora Australis, the "Southern Lights". The auroral ovals, where auroral activity is most concentrated, are centred on the geomagnetic poles, and in the northern hemisphere extend across Alaska, northern Canada, the southern tip of Greenland and Iceland, and the northern coast of Norway.

There are no major land masses underneath the southern auroral oval, with the southern tips of New Zealand and Chile coming closest. As a budding young astronomer growing up in the city of Dunedin in the South Island of New Zealand, at a latitude of 46° south, I was privileged to witness several wonderous displays of the Aurora Australis around the time of solar maximum in the early 1980s. To this day, I can recall a sky filled completely with flickering patches of light, with the most sublime green and red colours.



A splendid auroral curtain, photographed at Chena Hot Springs, Alaska, in March this year by Stuart Ryder.

Having lived in more tropical climates in recent years, closer to the equator, has meant that aurora viewing opportunities are rare indeed. So when a fellow eclipse chaser, Dave Moser, decided to organise a trip to Alaska last March specifically for aurora-watching, I didn't need much persuading!

Our group of 12 met up in Anchorage and travelled by train to Fairbanks, getting an excellent view of America's tallest mountain, Mt. McKinley on the way. In Fairbanks, we were able to see some incredible ice sculptures at the World Ice Art Championships, which look even more impressive when colourfully lit at night. At 65°N latitude, Fairbanks is well positioned for aurora watching, but even here in the Interior, light pollution has ruined one of their premier tourist attractions.

To really appreciate the Aurora Borealis, we had to go about 50 miles out of town, to the lovely Chena Hot Springs Resort. Chena Hot Springs had been recommended to us by the Editor of *Gnomon*, following his visit there a couple of years earlier. As the name implies, there are geothermally-heated outdoor rock pools, which make for an interesting contrast with the usual sub-zero air temperatures. Although the resort offers activities ranging from dog-sledding to a golf simulator, aurora watching is definitely the best (and the cheapest!).

On our first night there, we were treated to one of the brightest and most dynamic displays I have ever seen. It looked as if a great waterfall was dropping from the sky above us, dancing and rippling so fast that even 10 second photographic exposures came out blurred, or saturated. I had no idea aurorae could change so rapidly! My own attempts to capture the aurora on film produced mixed results. Using 800 ASA film and a 24mm lens set to f/2.8, I was able to get quite pleasing results with exposure times of between 10 and 30 seconds, one of which is shown here (*Alas in glorious monochrome - Ed.*).

Because our eyes rely on the retinal "rods" to see at night, which are not as colour-sensitive as the "cones", we tend to miss the wealth of aurora colours brought out in photographs. This includes the greens and reds due mainly to oxygen, and the blues and purples arising from nitrogen. You can see more of these photos in full colour by going to

http://www.aao.gov.au/local/www/sdr/aurora/main.html.

Of the 10 nights we spent in Alaska, we saw auroral activity on five. Usually it would begin as a diffuse arc filling the northern half of the sky. By 11pm or so, rays and arcs would appear to the east and the west, perhaps culminating in a curtain-like display running from horizon to horizon. Often, just when it seemed like the aurora was all done for the night, more patches of activity would flare up, but usually by that stage I was so frozen I could hardly feel my extremities. The coldest it got down to one night was -30°C!

So my advice to anyone who wants to see an aurora is go to Alaska, preferably in the next year or so before solar activity starts to wind down, but be sure to wrap up warm! And take plenty of film and spare camera batteries.

Stuart Ryder

sdr@aaoepp.aao.gov.au

(*Remember that batteries are almost useless at such sub-zero temperatures, so you must contrive to keep them warm -Ed.*)

☞ There are several ways that this can be achieved. Stereographic projection, centred on the south celestial pole, is normally used for planispheres of the northern hemisphere. Such a projection accurately portrays the positions of stars in the northern circumpolar region but shows increasing distortion for constellations the closer they are to the celestial equator. Star patterns which appear close to the margins of the planisphere appear distorted (flattened) while the position of stars relative to one another seems magnified. This may be somewhat confusing at first glance, but the same problem arises with all representations of spherical surfaces on a flat plan, such as maps of the world. Some planispheres are designed to do away with the distortion of this kind of graphic projection. But then the star positions on the planisphere are not an accurate representation of those in the sky.

A planisphere combined with a wristwatch.

Dr. Alex Gatt

(Part 2 will be in the Autumn issue. Ed.)

Sunspot newspaper competition

Imagine the year is 2010. Reports in the newspapers and on radio and TV say that 10 years have passed since sunspots were last seen on the face of the Sun. At first you don't take much notice but then you realise that sunspots might really matter. Your teachers start to talk about mini ice ages and times past when the River Thames froze over.

You must compile a newspaper covering events that are taking place. A winning entry could contain, for example:

- a good, relevant, witty headline and lead story
- reports on what sunspots are and who spotted them first
- the effects of previous sunspot cycles on our climate
- the possible future impact on our climate
- the possible future impact on our society
- how observations of the Sun are made
- the reactions of people in the street
- one or two other events that occurred in 2010
- an illustration showing the nature of the colder world
- a cartoon about the climate
- an original poem about the climate
- and one or two advertisements related to the climate.

The competition is open to groups of pupils in age ranges 7-11, 11-14, 14-16 and 16-19 years. Committed individuals may also enter. The newspaper must be four sides of A4 if a desktop publisher is used, or four sides of A3 if hand-written. For teachers, this is an excellent opportunity to forge cross-curricular links and a real reason to use the Internet and your library to search for material.

The competition is organised by the Education Committee of the Royal Astronomical Society. Closing date 2002 August 1. Please consult the full competition rules (see below) before starting work.

Full information from: **www.ras.org.uk** and follow the Education Committee links, or email

Alan_C_Pickwick@compuserve.com

A visit to the JKT

At the bare, windswept summit of the Roque de los Muchachos (*Rock of the Lads*), the 2350m high volcanic peak at the northern end of La Palma, in the Canary Islands, sits the Isaac Newton Group of telescopes.

Several other domes and installations make this a Spanish-administered European astronomical site of prime importance. The group comprises the 2.5m Isaac Newton Telescope (INT), the 4.2m William Herschel Telescope (WHT), and the 1m Jacobus Kapteyn Telescope. The three telescopes of the ING are administered on behalf of the Particle Physics and Astronomy Research Council (UK) and the Nederlandse Organisatie voor Wetenschappelijk Onderzoek (Holland) and form part of the principal European observatory complex in the northern hemisphere.

In November 2001, I accompanied a party of sixth formers from Dorchester's Thomas Hardye School for a night's observing at the JKT, as part of the programme whereby schools can book time on the ING instruments.

A visit starts with a drive up a sinuous road, with hundreds of hair-raising bends, from La Palma's tropical lowland scenery of poinsettia and cacti, through an almost Scottish-looking belt of cloudy pine forests, to the gorse and scrub of the summit, to arrive eventually at the Residencia. This is an hotel where observers shelter from the sometimes fierce mountain-top weather. As night falls, the visitor can marvel at the enormous sea of clouds below, hiding the lower peaks and the enormous Caldera de Taburiente, a gigantic chasm caused by half the island slipping into the sea aeons ago. Above, the coal-black sky glitters with countless stars. Later, as dawn approaches, the Zodiacal Light is bright enough to look like a second Milky Way.

Working through the night, under the tutelage of resident astronomer Javier Mendez Alvarez, the students located and imaged several star clusters and galaxies, and their work will become part of a schools' observing library kept at the ING. The use of guide-stars, filters and CCD techniques was carefully explained. Information on these excellent facilities can be had from Señor Alvarez at **jma@ing.ac.es**

It may be, however, that the days of both the Isaac Newton and Jacobus Kapteyn Telescopes are numbered because, as part of the move towards joining the ESO, PPARC may withdraw from the two instruments, concentrating their efforts on adaptive optics involving the Herschel telescope. As I enjoyed the atmosphere in the control room and the enthusiasm of the students, I felt that such an outcome would be a great loss to astronomy education.

Bob Mizon

What the Dickens ..?

On 2002 May 13, at 4.12 p.m., I was in a car, stationary at traffic lights at Bolton-le-Sands, some five miles north of Lancaster, looking east. There was fairly high cloud, with frequent showers. I saw a bright, meteor-like light about the size of a pinhead held at arm's length and leaving a trail, descending to the horizon at about 60° to the vertical, towards east-north-east. The 'head' was teardrop-shaped. The trail remained visible throughout the 3 to 4 second sighting.

It looked very similar in colour to a firework rocket, (orange-yellow, fading to orange) although I had seen nothing go up. I rang my friend Keith Robinson of the Moor Park observatory, Preston, but he had heard nothing of any object of this kind. As the sighting was in daylight, anything above the cloud would have had to be very bright and large indeed. Also, the light would have been diffused.

I think it likely that I saw some kind of local atmospheric phenomenon, possibly even of the ball lightning type, rather than a true astronomical event. I have tried to remain objective, and I can discount nearby lights, windscreen reflections etc., with a clear conscience.

I should be very interested to hear of any object seen at this time. It could have been over the Yorkshire moors or anywhere east of the Lancaster area, for that matter. I do not expect to discover anything more about the sighting. It may be obvious, but a vast amount of small-scale or low altitude activity must remain entirely unobserved, because there happens to be no-one looking in the right direction at the right time!

I am usually quite wary of 'distancing' objects. When I saw the famed Bovedy meteor in flight on 25th April 1969, I thought it was a few hundred feet up. A Royal Observer Corps member estimated its height at 1500ft and the local paper described it as flying "low over the City". In fact, it was some 30km high and 150km away!

Peter Ford

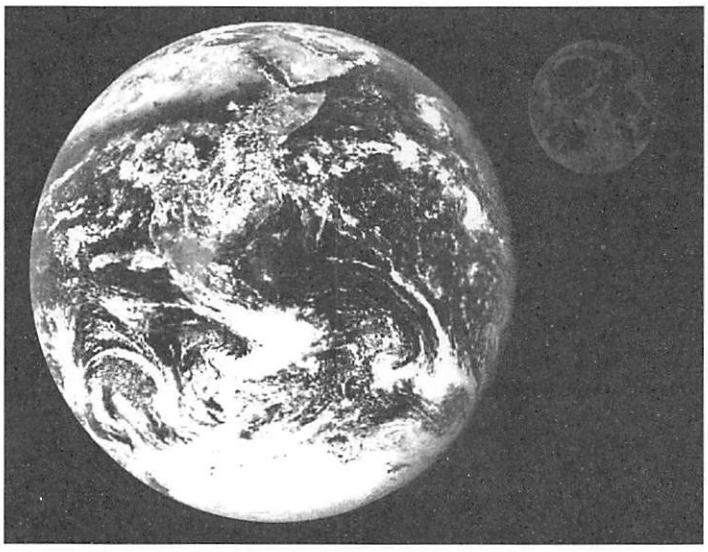
Mike Dworetsky (Query) commented: I have no idea what this might have been! It sounds very strange. If the sky had been clear, I would have said a satellite re-entry, because meteors are much faster, usually, than spacecraft (50 km/s as compared with 8 km/s).

CURRICULUM CORNER

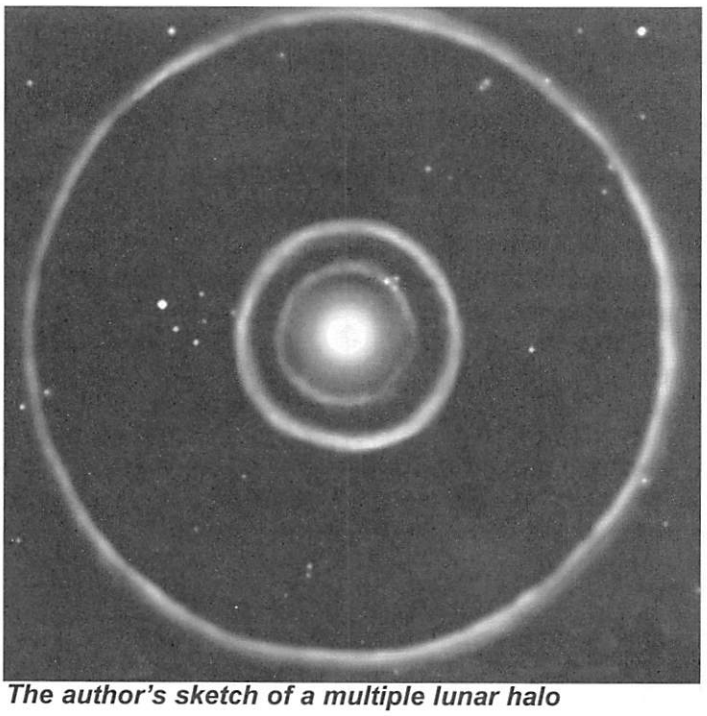
Does moonlight become you?

The Moon is a very dark object. It is one of the least reflective worlds in the entire Solar System, having an average reflectivity of just 7%. In other words, only 7 out of every 100 photons which hit the lunar surface manage to bounce back into space - the rest are absorbed by the dark surface and re-radiated at other wavelengths.

Moonlight's intensity is only a quarter that of a burning candle placed 1m from the observer (technically this amounts to 0.25lux). Most of the Moon's surface is rough and irregular. Largely because of the shadows of features near the lunar terminator, the brightness of the half Moon (first or last quarter phase) is not one half of the full Moon's value (as might be expected) but just one ninth. If the Moon were a smooth sphere then its average reflectivity would be raised a couple of points. Even though the full Moon may appear bright, sunlight is half a million times brighter.



The Earth is very much brighter than the Moon: bright enough to bathe the Moon's night side with earthlight that makes the "old Moon visible in the new Moon's arms" when reflected back to the Earth again, even at 7% efficiency!



The author's sketch of a multiple lunar halo

Terrestrial landscapes bathed in moonlight are perceived to have a ghostly monochrome appearance because the scene is not well enough lit to trigger all of the colour receptors in the human eye which work well in daylight. To test this lack of colour perception, prepare ten different coloured squares of paper say white, grey, pink, light brown, pale green, lilac, sky blue, bright red, bright green, and yellow and label them on the back. On a clear night, select a dark spot outside that is illuminated by the light of the Moon only, well out of the way of any other sources of illumination. After shuffling the pack of coloured cards hold each card in front of you and by moonlight alone attempt to identify each colour. The red card may turn out to be the only one out of the pack that you can identify with confidence, and only then if the moonlight happens to be bright enough. This illustrates the dimness of moonlight compared with daylight or artificial illumination. It also reveals the limits of human colour vision.

Those living near orange sodium street lighting will be able to perform another interesting experiment, this time illustrating a psychological aspect of human colour perception. When the night is clear and the Moon is high and near full, walk a short distance away from an orange streetlamp, going in the direction of the Moon. A few metres away, observe the colour of your shadow being cast on the ground by the lamp. It will seem indisputably blue, though in reality your shadow is being faintly illuminated with moonlight which is actually white. This striking effect comes about because our brains have evolved to acknowledge that the brightest source of illumination in nature is the white light of the Sun and the Moon. We therefore imagine our bright sodium orange surroundings as being illuminated with white light, and the blueness of the shadow is simply caused by colour contrast an effect obvious in double stars like Albireo (Beta Cygni) whose brighter yellow component greatly enhances the blueness of its companion.

Atmospheric effects

Lunar rainbows are created under the same circumstances as those produced by the Sun a coloured arc of 42° radius situated diametrically opposite the light source. However, lunar rainbows have a maximum brilliance of a mere 500,000 times less than their daytime counterparts and as such they are a rarer phenomenon, very dim and rather colourless.

A bright pearly white region can often be seen around the Moon. Called a lunar "corona", it is caused by moonlight's reflection and diffraction amid water droplets in the lower clouds. Nothing like the solar corona, a region of extremely hot glowing gases that are physically near the Sun, a lunar corona is a product of the Earth's atmosphere alone. In addition to the corona, the Moon is sometimes encircled by one or two (on rare occasions even three) rainbowcoloured lunar haloes caused when moonlight is diffracted by countless water droplets or ice crystals in the upper atmosphere (see sketch). Lunar haloes can be particularly vivid when moonlight passes through a thin homogeneous cloud layer composed of very minute water droplets. Sometimes the lunar halo may be host to "mock Moons" or "Moon dogs" which are diffuse images of the Moon located 22° either side of it, caused by the refraction of light among ice crystals in Earth's upper atmosphere.

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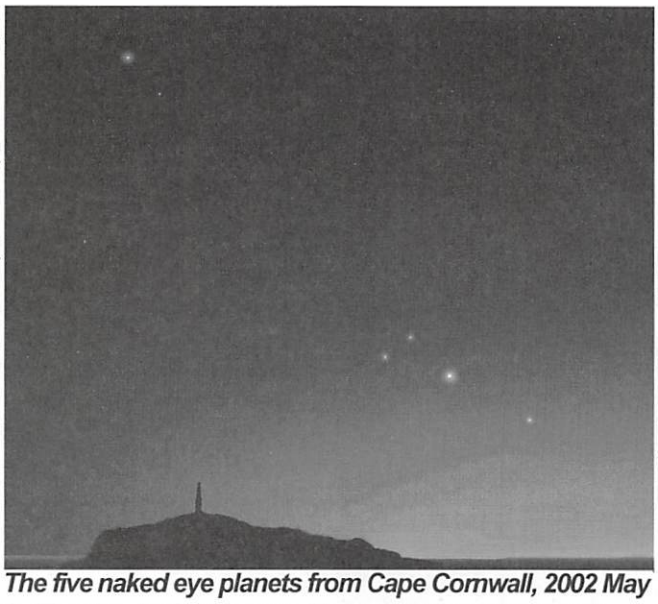
Sky Diary Summer 2002

The Spring evening line up of the planets was well worth the effort to see, considering that Spode was doing his best. The near conjunction of all the naked eye planets (if you exclude Uranus, which sometimes is quite easy to pick out - but not while it is as far south as at present!) resulted in a fascinating public argument between the astrologers over what it all signified. Just goes to show!

The photo reproduced here was taken from one of a set of slides that I took of the May 3 evening at Cape Cornwall, where more than the entire quadrant of sky centred on about the north west is visible over a sea horizon and from a reasonable elevation also. It was more or less as shown in the last issues Sky Diary for April 30, with four of the planets making a huge arrow with Jupiter at the tail and Venus at the point, and aimed at Mercury below. The reproduction here is far removed from the original. The slide has been scanned, reduced to greyscale, and the contrast enhanced ("faked!" my wife would exclaim) and at the time of writing I have only the printer's word that the planets will be visible in the illustration you, Dear Reader, have in front of you. The AAE printing budget does not stretch to running off proofs!



The five naked eye planets from Cape Cornwall, 2002 May 3. (E. to W. Jupiter, Saturn, Mars, Venus and Mercury)

By July, the planetary dance team will have split up. Venus brilliant in the evening sky, closing on the Sun throughout the three months. Mars is getting even fainter as conjunction approaches on August 10, but at the very start of the quarter, Mars may be found alongside Jupiter, also closing with the Sun and at conjunction on July 20.

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

	July 15		August 15		September 15	
	Rise	Set	Rise	Set	Rise	Set
Sun	04h 09m	20h 25m	04h 55m	19h 36m	05h 46m	18h 27m
Mercury	03h 28m	20h 11m	07h 04m	20h 16m	08h 00m	18h 33m
Venus	08h 08m	22h 08m	09h 24m	20h 46m	10h 13m	19h 08m
Mars	04h 52m	20h 55m	04h 44m	19h 39m	04h 37m	18h 13m
Jupiter	04h 29m	20h 34m	03h 05m	18h 52m	01h 39m	17h 06m
Saturn	02h 01m	18h 17m	00h 12m	16h 30m	22h 16m	14h 38m
Uranus	21h 39m	07h 34m	19h 40m	05h 30m	17h 35m	03h 21m
Neptune	20h 55m	05h 54m	18h 55m	03h 51m	16h 52m	01h 45m

Saturn now appears in the morning sky, rising about an hour before the Sun at the beginning of July, and getting easier by the day through the quarter. Mercury can be forgotten about until mornings in early October.

By the middle of the quarter, Saturn is already rising before midnight again and will soon become prominent in the midnight sky. It is a must for telescopic observation. It has a "Wow! coefficient" among young observers (and come to that, any first time observers) surpassed only occasionally by the Moon, again seen for the first time. It is not in the least spoilt by having seen such wonderful photographs of the planet taken close up from Voyager spacecraft, or from Hubble, or, more recently, from the ESO's very large telescope. However small, even when seen in a powerful pair of binoculars, the reaction is the same. It is almost as if we never believed the photographs we have seen of the planet: we have to see it for ourselves.

Other events during the quarter include the peak of the delta Aquarid meteors towards the end of July, which are rated as a "fine southern shower with a double radiant . . . . Meteors tend to be faint" according to the *BAA Handbook*. These are followed by the iota Aquarids early in August, rich in faint meteors also.

The Perseids are due to peak at about August 12d 21h which may well be a favourable meteor shower. A worthwhile event for photography experiments.

A concept that always seems to bother students is the basis of time. Sidereal time is useful in estimating the time by the stars, it is also essential for stellar navigation and to allow the observer to work out the date and time when celestial objects will culminate from wherever the person is based. In a nutshell, solar and sidereal time are both given by an hour-angle of in the first case, the Sun, and in the second case, the Vernal Equinox. Mean solar time, with which most of us are comfortable, is a measure in 15° intervals called "hours" of where the Sun is relative to the north point. Local sidereal time is a similar measure, in 15° intervals called "hours", of where the Vernal equinoctial point is relative to the south point, in other words when in transit, or on the meridian, or culminating - all meaning due south. Since we measure celestial longitude, called "right ascension" in 15° intervals eastwards from the same equinoctial point, the sidereal time is given by (but not defined as) the right ascension on the meridian. Which is how we know that if a newly discovered faint comet is, for example, at right ascension 6h 30m, we know that it will be on the meridian at a sidereal time of 6h 30m.

But since the Sun appears to move eastwards in our skies each day by just under 1°, it apparently gains on the stars. It so happens that if the mean Sun is on the meridian, the mean solar time is 12h 00m. Now the Sun is also at 12h 00h right ascension at the *Autumn* Equinox, so that will also be the sidereal time at that moment. So the two clocks, the normal mean time clock, and the observatory sidereal clock, should both read 12h 00m at the instant of the Autumn Equinox (with the usual caveats of remembering we are talking about mean Suns and local meridians.) After that, the sidereal clock stars to gain by just under 1° per day, or about 3.9 minutes. This adds up to about two hours per month, and 24 hours per year. So on September 23, (at 4h 55m UT), check your sidereal clock. Look for beta Cassiopeiae, which is approximately at 00h right ascension, at this date. It is the brightest star in the W of that constellation, at the western end when on the meridian. Its position marks the end of an invisible clock hand telling sidereal time on a 24-hour rotating disc!

Richard Knox

Moon phases for the third quarter of 2002

Month	New Moon	First Quarter	Full Moon	Last Quarter
July	l0	17	24	2
August	8	15	22	1/31
September	7	13	21	29