GNOMON

Newsletter of the Association for Astronomy Education

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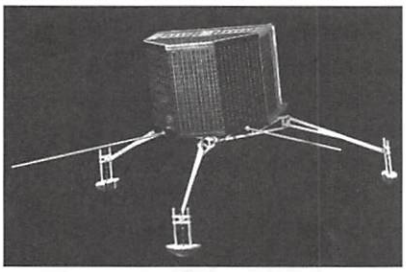
Win a place at the CERN science festival

Alan Pickwick is calling on all readers in the UK to promote the Europe-wide competition described below. The closing date is very near, so teams must start work as soon as possible.



Rosetta is to search for life in the Solar System. It looks a bit like a weird lifeform itself!

The aim of the competition is to raise awareness in science and the emerging discipline of astro-biology.

Life in the Universe - European Competition

Win a trip to CERN in Geneva for your team by entering the European-wide"Life in the Universe" competition. For European Science Week this November, the European Space Agency, the European Southern Observatory and CERN are organising a competition for 14-18 year olds.

Entries can be either Scientific or Creative. Scientific entries can be a newspaper, web site, scientific essay, interactive CD-ROM or a video.

Creative entries can be a theatrical or musical performance, painting or sculpture, fictional essay or a poem on the theme. Teams comprise up to 4 pupils and their teacher. Winning teams from the Scientific and Creative groups will travel to CERN to take part in a science festival.

Closing date for entries is Monday 1st October. To get more information:

www.lifeinuniverse.org

Alan_C_Pickwick@compuserve.co

Climate change projects invited by EURISY

The Ninth Information Youth Forum will be held by EURISY in Spain from the 1st to 4th of November. The topic this year is *Climate change: past and future* and projects under this title are invited.

The aim of the ninth Forum is to encourage-rage secondary school pupils and teachers in Europe, the Mediter-ranean countries and Argentina, to take an active interest in space-related activities.

It is intended that this event will draw the teachers' attention to the merits of including space-related topics in the school curriculum as well as fostering international communication and exchange of ideas among pupils and prominent scientific experts.

With the present debate over the Kyoto "agreement", the theme "Climate Change: Past and Future", is particularly topical. It is considered broad enough to allow free rein for the imagination and inventiveness of secondary school students. For example projects could be set up with the themes of the ice age, global warming, melting ice in the Arctic and the Antarctic, El Niño, La Niña, or even the unusually long period of rainfall being experienced in Northern Europe.

The students will present projects developed during this year. They will demonstrate knowledge of programmes, ability to find information, and capacity to analyse the usefulness of research and technological development. They will be able to present topical and futuristic projects on an individual or group basis. Participation in the exhibition is obligatory. Basic exhibition furniture and equipment will be provided (panels, ☞

Please note the changes

Please note the changes on the masthead column (right). The AAE web site is now **www.aae.org.uk** and the editor's e.mail address is changed to **gnomon.editor@virgin.net**.

Subscription Rates:

Individual Members	£10.00
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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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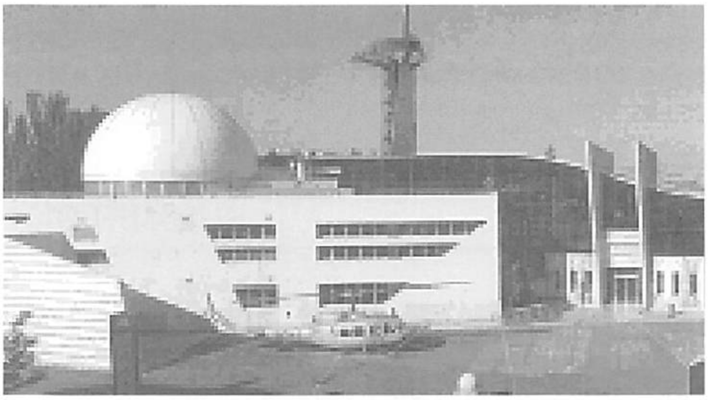
Advertising Charges:

Whole page	£120
Half page	£60
Quarter page	£30
Inserts	£75

(inserts may be of any size which may conveniently be inserted in the newsletter. There may also be an additional charge for postage if inserts are heavy.)
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.

☞ tables, chairs, electrical outlets, lighting). Prizes will be awarded to the three best projects. Each team will have a slot of 10-15 minutes to present its project to the jury.



The Parque de las Ciencias, Granada, venue for the November EURISY Ninth Information Youth Forum

The working lauguage of the Forum will be English. It will include introductory and specific lectures by experts on themes connected with climatology worldwide, covering the role of the Sun in climatic change, possible man-made influences, paleoclimatology, geographical considerations, climate monitoring from space, etc. Participants will meet prominent people, including an astronaut, and they will visit the Parque de las Ciencias and the Alhambra, participate in social events and more. The Forum venue is the Parque de las Ciencias, Granada, Spain and more information on the Parque can be found on **http://www.parqueciencias.com**

To be eligible, students should be age 15-19 years and attending secondary (pre-university) school. Students from Europe, the Mediterranean and Argentina are welcome. Partipants are advised to register for participation via their own school. Registration fees are 305 (2000Fr. Francs) per person, which covers participation in the Forum and Exhibition, local transport, accommodation and meals. Contact details: EURISY Association, 3-5 rue Mario Nikis, 75015 Paris, France; ☎+ 33 1 4734 0079; Fax: + 33 1 4734 0159;

eurisy@micronet.fr: **http://www.eurisy.asso.fr**.

Sue Flanagan writes: I took a group of Year 11 girls from Haggerton to the last meeting, which was held in Lucerne last November. It was a really good event with teams from Austria, Denmark, France, Germany, Northern Ireland, Norway, Romania, Russia and Switzerland as well (I've probably left some out). Each team prepared a presentation and attended talks and workshops - one of the highlights was the astronaut Claude Nicollier who gave a fascinating insight on his work and life on the Space Shuttle.

The kids learned a lot of new science as well as gaining from other formal learning experience. They also had an opportunity to meet others from around the world, and much else to contribute to excellent personal development.

OBSERVATIONS

There are many popular misconceptions about blindness, the most obvious being that blind people cannot see. In fact, 8-10% of the 120,000 registered blind have useful vision. Sighted people use the "visual shorthand" of their eyes, but congenitally blind persons can get to know an object in more depth than a sighted person. If you show an object to a sighted child and to a blind child and ask them what it is, the sighted child will just look at it and tell you. The blind child will have to feel it, smell it and perhaps taste it.

The "visually impaired" covers a multiplicity of different eye conditions on a wide spectrum, from "wears glasses" to "has never seen". Each person copes with their impairment in a different way, depending on its nature, their personality and the quality of previous experience. We live in a sighted world, but the person who has never seen learns to make sense of the world using a combination of touch, smell, taste and hearing. When presented with an object, the blind child will probably explore with fingers, and will smell the surface, sometimes tapping the object at the same time.

People who have a visual memory can be divided into those with some vision, and others who have lost all the sight they once had. By working alongside a blind person, providing them with visually stimulating material, we who rely on visual input may learn how blinkered we can be by sight!

A sighted person may be tempted to suggest ideas or the use of a particular colour, but it is important to enable the visually impaired to make their own images based on visual memory or on their own scheme. If they ask "What colour is ...?" reply "What colour do you see?". People who are losing their sight can distinguish yellow when other colours have gone. This is important: when working on a computer the screen can be yellow print on a black background, the use of yellow paper or card provides a clearer contrast, and so on.

Here are some interesting comments by the visually impaired.

"To me the word 'green' is the smell of grass"

"I can see yellow only when it's next to blue - but I'm not sure what blue is"

"I really like yellow - it's easy to see"

"People say I'm visually impaired, but as far as I'm concerned my sight is perfect"

"I can build images in my mind from sounds; like when I hear the frying pan I can image a river flowing by" (a student blind from birth).

"Can you just draw me a Universe?"

Two years ago Alex Barnett, a Director of The National Space Centre in Leicester approached me with the idea of writing an astronomy book for the visually impaired in "English" Braille script. This has now been completed, with thanks to Alex for the inspiration. The project was funded by PPARC and presented to the Minister for Science. The first edition was widely used in its research by the students in our Leicestershire schools and a loan box was produced for any visually impaired person and their carer to borrow. During SET 1999, AAE President Francisco Diego and I held an event at Greenwich for the visually impaired. My *Seeing Stars* booklet was presented to all who attended who then "watched" my planetarium show.

After the show, a workshop was held using tactile handouts produced by Babbington College in Leicester and three-dimensional models of some of the constellations produced by a student from Groby College as part of his 'A' level Design & Technology project. Francisco and I took them to "see" the real stars, using the Greenwich telescope.

This year PPARC asked for a reprint of the book and it can now be obtained in Braille, on disc, in large print and as a teacher's handout. Contact me at :

jco@star.le.ac.uk

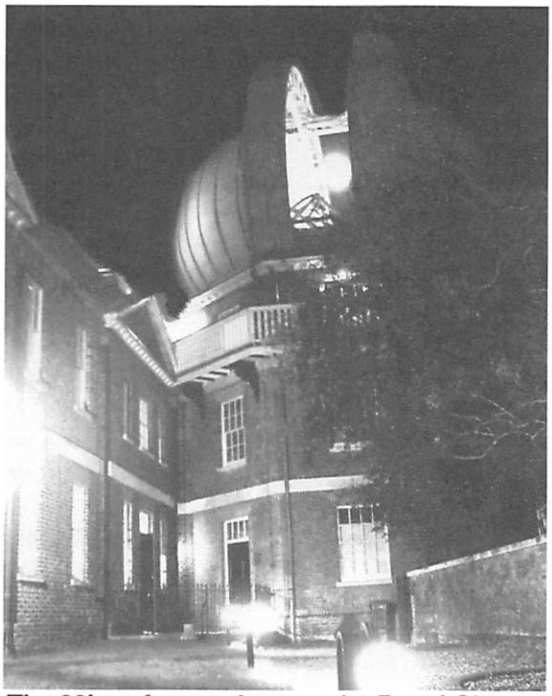
Jean Collins

Astronomy education at the Royal Observatory

Over recent years the Old Royal Observatory - now once again the Royal Observatory - has been quietly developing a strong educational programme aimed at teachers, students and the wider public.

In 1998, following the closure of the Royal Greenwich Observatory in Cambridge, the Particle Physics and Astronomy Research Council (PPARC) set up a new Public Understanding of Science (PUS) initiative at the Royal Observatory. This team is made up of several ex-research astronomers who contribute to the development of modern astronomy on the site. We have been able to help with a substantial expansion of education work here.

Our core education team is made up of Graham Dolan and Dr. Harry Ford. Graham has been involved in teaching at different institutions throughout his career, and Harry recently received an honorary doctorate in recognition of his many years' work on planetaria across the UK. Both of them have a huge enthusiasm for astronomy education, something reflected in the number of return visits made by schools around the country. Together, the PUS (can anyone think of a less unfortunate acronym?) and education teams aim to generate a spark of interest in astronomy and physics in general, something we believe we genuinely achieve.



The 28in-refractor dome at the Royal Observatory. The overexposed full Moon can be seen through the open shutters, taken during the penumbral phase of the total lunar eclipse on January 9, 2001. **(Courtesy: Anton Vamplew.)**

The team delivers programmes for visiting primary and secondary school groups targeted at specific but diverse components of the National Curriculum. Amongst other topics, students at KS1 and KS2 can look at the seasons, the calendar or the optics of pinhole cameras. The big advantage of carrying out this work at Greenwich (apart from the day out - a huge plus in itself) is the ability to demonstrate concepts with the planetarium and purpose-built models and artefacts we have on site. Perhaps the biggest selling point is that all our primary programmes are entirely free of charge.

Older students have recently been given the opportunity to use the telescopes on site for the first time. A series of special days are aimed at students taking the Astrophysics and Cosmology components of A-level Physics or GCSE Astronomy courses. We offer a programme which includes a planetarium show, observing prominences on the Sun with a hydrogen-alpha filter and using the 28in refracting telescope (one of the largest in the world) to observe stars and planets in the daytime sky. Dr Robin Catchpole, our Senior Astronomer gives a lecture on stellar evolution before the students get to see a real astronomy group at work at Queen Mary College.

Over the last two years we have started two GCSE Astronomy classes in conjunction with local schools and Lewisham College. With around 40 entrants this year and probably 60 next autumn we are rapidly becoming one of the largest providers of this course in the country, almost certainly because of our status as the spiritual home of astronomy in the western world. Any schools or students wishing to take this course are welcome to get in touch.

Perhaps the greatest privilege of working here is the ability to use our giant refractor at night. Since the repair of its dome in 1997, we have run immensely popular "Evening with the Stars" events where members of the public can use the telescope to view the planets, Moon and binary stars. Although the telescope dates from 1895, it still delivers stunning views of the night sky - anybody who has never seen the Crepe Ring around Saturn or subtle detail in Jupiter's weather systems will be blown away by the view. I still am after 3 years!

We aim to have a genuinely accessible observatory. We also try to link in with special events in the calendar, both astronomical and terrestrial. For example, the Observatory came into its own during January's total lunar eclipse. Over 300 people came on to the site to watch it from a battery of telescopes in the courtyard, some straddling the meridian line itself. At this event I was touched by the genuine interest and warmth of the visiting public - despite the cold and misty weather everybody seemed to have a wonderful time.

During Science Week this year we ran the largest number of events of any institution (in conjunction with the National Maritime Museum) in the country. Visitors chose from a variety of activities including taking part in a comet-making workshop, watching a live link to the Mt. Wilson observatory as part of the Telescopes in Education programme, and learning about the discovery of Neptune.

Finally, one resource we can offer is available to almost everyone. Part of our commitment to PPARC is the operation of an astronomy website and information service (Astroline). The astronomy team answer around 7500 public enquiries per annum - a facility students and teachers are encouraged to use - and send out a number of education packs and leaflets free of charge.

The Observatory's website is accredited by the National Grid for Learning and receives as many 'e-visits' as there are real visitors to the physical site! We spend a great deal of time updating it - for example one of the best resources are our information leaflets on current topics in modern astronomy. I'm happy to say that all of these materials are copyright-free and can be freely reproduced for educational use.

For the future, we're looking at modernising our planetarium as part of a new 'Astronomy Centre' which would greatly extend our educational work. In addition, I'm currently working with the National Schools Observatory team to bring that project to London and the south-east. Projects of this kind should keep the Royal Observatory in the forefront of astronomy education for some time to come.

You can view our website at: **www.rog.nmm.ac.uk.** Questions on any aspect of astronomy can be sent to the Astroline service at **astroline@nmm.ac.uk.**

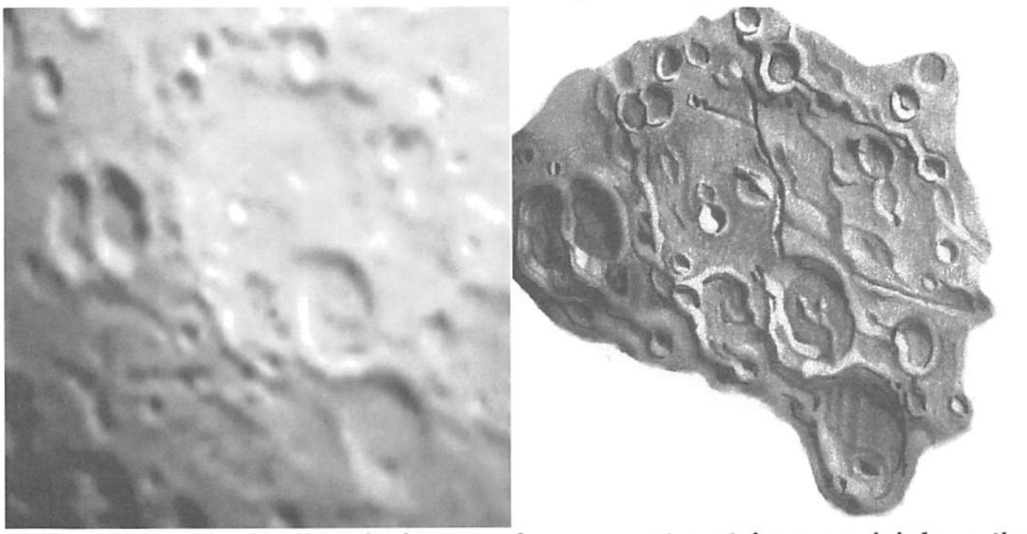
Robert Massey

CURRICULUM CORNER

Drawing the Moon

Through binoculars and small telescopes the Moon's surface resolves into a remarkable collection of "seas", mountains and many hundreds of craters. In a telescope as small as a 60mm refractor just about every class of lunar feature can be seen, including faults, rilles, clefts, dorsi (wrinkle ridges) and domes.

Lunar observation is undoubtedly the most visually rewarding branch of astronomy. A lunar observer can be defined as anyone who looks at the Moon with a purpose. That purpose may be to pursue serious and painstaking research. Alternatively (and, it must be stressed, just as meaningful an activity), most amateur astronomers observe the Moon for unashamed visual pleasure. The constantly-changing vistas of the Moon's surface are every bit as stimulating as the contemplation of an impressionist painting - the beauty is that the Moon belongs to everyone and doesn't cost a penny to look at.



A photograph of a detail on the lunar surface may not contain as much information as a careful drawing, even when made by someone not famed for artisitic skill!

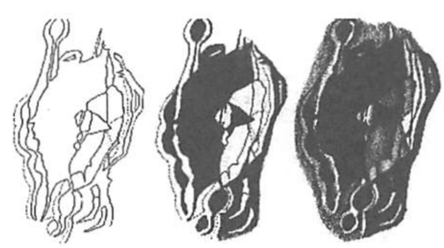
Most lunar observers regard the telescope eyepiece as if it were the porthole of their very own Apollo command module. The privilege of just seeing is satisfying enough, yet ever since Galileo sketched the lunar craters nearly four hundred years ago, many observers have striven to keep some kind of permanent record of their forays around the Moon's surface. Powerful CCD technology is becoming ever more commonplace. Instantaneous and highly accurate records may be secured and later enhanced to reveal features which the eye alone could not hope to discern. It may be tempting nowadays to dismiss the efforts of the observer who sketches the Moon's features (and, for that matter, any other celestial object), for what possible reason is there to engage in an activity which appears to belong in the distant past?

There is no doubt that the amateur astronomer who takes the opportunity to make lunar drawings will discover an activity which improves every single aspect of his or her observing skills. The Moon is packed with very fine detail, and the ability to discern this is found to constantly improve with hours spent at the eyepiece. During a course of lunar "apprenticeship" the apparent confusion of the Moon's landscape becomes increasingly familiar.

I have had the honour of seeing the work of hundreds of newcomers to lunar observation in the SPA Lunar Section, and without exception everyone's observing abilities have been enhanced.

Do have confidence in your own drawing abilities: disregard everything your art teacher ever told you! The lunar observer isn't some kind of weird nocturnal art student. Marks are not given for artistic flair or aesthetic appeal. Observational honesty and accuracy counts above all. Few of the great lunar observers have been "good" at drawing - the Hanoverian selenographer Johann Schröter (1745-1816), the American Fred Price and Patrick Moore (I'm sure the latter will agree) are just three famous examples of the non-artistic Moon-mapper.

To improve your sketching skills I recommend that you practice by drawing sections of lunar photographs which appear in books and magazines. Invest in a set of soft-leaded pencils from HB to 5B and an A5 pad of smooth cartridge paper. Basic outlines are first drawn lightly, using a soft pencil, giving you the chance to erase anything dubious if the need arises. When shading dark areas try to put minimal pressure onto the paper; the darkest areas are ideally shaded in layers, and not in one mad frenzy of pencil pressure. After several attempts at "arm-chair" Moon drawing you will surprise yourself at how quickly you improve. The most important thing to remember is to be patient. Do not rush, even if you are only practising. Binoculars should be on a steady mount or tripod, leaving your hands free. When the Moon is sharply focused in the eyepiece don't be intimidated by the sheer wealth of detail. Find your bearings with a decent map of the Moon. Select and identify just a small target area of the Moon's surface, such as an individual crater, preferably one close to the lunar terminator where most relief detail is visible. If possible, go back indoors and make a light outline drawing of your chosen area; this will save time and give you a distinct advantage at the eyepiece. It is reasonable to set yourself about an hour or two per observation. Patience is vital because a rushed sketch is bound to be inaccurate and frustrating. Make your drawing at least 50mm across, larger if you are attempting a region full of detail. Unusual and interesting features should be highlighted by making short written notes. Of course, record the usual essential observing information, such as date, start and finish times (UT), instrument and seeing. Remember to produce your neat drawings (one for your own files and one for your astronomical society observing section) as soon as possible after the observing session, while the information is still fresh in your mind.



Building up a drawing of a lunar feature - do it as soon as you can after making the observation.

Peter Grego
Editor, *Popular Astronomy*

Happy birthnight?

The challenge: Here is an activity that really excites children (young and old), and is a test to find those who understand astronomy. It was "discovered" by a year 8 class in New Zealand. All the children in a school classroom have a birthdate but about half don't have a birthday. Anyone born in the southern hemisphere after September 23rd and before March 21st have a birth*day*. Those born after March 21st and before September 23rd have a birth*night*. Can any year 8 children in the UK workout why?

Are the dates for birth*days* and birth*nights* the same in the northern hemisphere? What happens if a person born in the northern hemisphere moves to the southern hemisphere or *vice versa*?

Some comments: This idea was first explored by some year 8 students who suggested that the Pipehenge that they had in their school would look better if it was painted. The choice of colours was a source of some considerable debate. The four cardinal compass pipes were settled first with four obvious choices (for the southern hemisphere): north (the hot end), red; south (the cold end), blue; west (the sunset side), yellow or golden; east (starboard), green (although I like to think that the predominant colour in nature is green which is produced as chlorophyll by sunlight. No sun, no green. The daily rising of the Sun in the east ensures that green is maintained.)

A problem arose as to what to paint the horizon pipes on either side of the structure that joined the summer and winter arcs (longest and shortest days, or solstice pipes). The students discovered that these pipes were six months long between December 21 to June 21 and six months long between June 21 to December 21. It was discovered that all the students in the class could plot along the horizon pipe where their birthdate fell.

Half way along each horizon pipe was an equinox pipe (represented by the east or west pipe) at which time day and night were of equal length. After much discussion it was decided to paint the horizon pipe white when the "days" were longer than the nights, and black when the nights were longer than the "days". That is when birthday and birthnight became obvious and the words were coined.

This is fun for kids to work out and reinforces the changing length of daylight. There is much more to this story!

Eric Jackson

Is it easy to avoid the confusion of the term "day" meaning hours of daylight with the definition of a day meaning one axial revolution of the Earth, Eric? - Ed.

FOR YOUR LIBRARY

Astronomy for GCSE. 2nd Edition, by P. Moore & C. Lintott (Duckworth, London), 2001. Pp. 206, 24.5 x 19 cm. Price £12.99 (paperback; ISBN 0 7156 2969 7).

The GCSE Astronomy examination is taken by about 600 people each year. About half are in school and half are adults in what might be described as recreational education. This book is aimed at the slightly revised syllabus that will be examined from 2003. It is an excellent match to the syllabus and has plenty of questions at the end of each chapter. It also has good worked examples on calculations related to position and time. These topics can seem hard to the newcomer and to the adult with rusty mathematical skills.

The syllabus requires candidates to undertake actual observations and to choose from graphical, computational or constructional coursework. The book has many good suggestions for this work that are sufficiently complex to attract good marks but straightforward enough to be achieved in the often limited time available.

However I am slightly concerned about the style of the book. You can almost hear Patrick Moore talking when you read it and this continuous, conversational style is not typical of modern school books. Most recent GCSE science books are dominated by bullet-pointed lists, whereas this book does not even have section headings within its chapters. I think that most beginners would need to be led through it by a class teacher. At least it has a satisfactory, if not comprehensive index.

There are a few unfortunate errors. The amplitude of the wave on page 46 is shown as peak-to-peak, on page 59 the VLA is described as having 80 telescopes and on page 166 the Doppler shifts in the spectroscopic binary diagram do not correspond to the caption or to the paragraph text. Whilst these errors would confuse a student, a science teacher should be able to deal with them. Also there are old-fashioned units scattered throughout the text. The Ångstrom is never used in school science, the micron has been replace by the micrometre and the syllabus requires the use of the Kelvin.

As this is the only book specifically written for the examination I would have to recommend it but I feel that it really does need a more thorough revision.

Alan C. Pickwick

THE THINGS PEOPLE ASK!

We are learning about the Sun, Moon & Earth and I was wondering if you have any proof that the Earth is round (no, I don't believe it's flat!) *Christopher Cummins, a school pupil, asked.*

There is a slight problem with questions like this: it depends to some extent on what you mean by "proof". Let's assume you would be happy with the evidence that an ancient Babylonian or Greek astronomer would accept.

1. Eclipses of the Moon only occur when the Sun and Moon are on opposite sides of the sky, hence the cause must be the Earth's shadow cast on the Moon. The edges of that shadow are always parts of the circumference of a circle and never any other shape, no matter where in the sky the eclipsed Moon is located. The only kind of body that can cast a circular shadow from any angle is a sphere; hence the Earth must be a sphere.
2. The stars in the southern sky appear to be at different angular elevations above the horizon when they are on the meridian of observers who have journeyed many days or weeks to the south or north of Athens. A simple explanation is that the Earth is a sphere so that a change of latitude causes the change in angle. (An alternative but far-fetched argument is that the stars are fairly close to a flat Earth, so going south brings them more closely overhead.)
3. When ships sail away towards the horizon, the hull disappears first, then the sails. This would be a natural occurrence on a spherical Earth, because the ship is sailing on a spherical sea.

Here is some more evidence that is available to us only because of more advanced technology: ☞

☞ These days we can fly around the world in a couple of days. Satellite photographs always show the Earth to be round. We can see with telescopes and space probes that all the other planets are spherical (or slightly flattened ellipsoids of revolution) and the Earth is a planet, so it ought to be round like the others. There may be other arguments, I'll let you work on these yourself. Carl Sagan wrote a delightful article on this topic, entitled "On Teaching the First Grade", which can be found in his book *The Cosmic Connection.*

A consequence of Einstein's special theory of relativity is that the speed of light is always the same, regardless of the observer's frame of reference. So the light from a star always reaches the Earth at the same speed. But the light from stars can have an observable red shift, which suggests that the light waves are stretched during their journey and end up with longer wavelengths. If light always travels at the same speed relative to the Earth then every part of every wavelength travels at the same speed and should take the same time to reach us. *Mike de Jong posed this paradox during our open day at University of London Observatory.*

Your first assertion about relativity is correct, but only for frames of reference that are not accelerated, i.e., only if their relative velocities are not changing with time. To tackle the more general problem of light, acceleration and gravity, Einstein developed the General Theory.

Note that because the Universe is expanding, distant galaxies are accelerating: as they move away from us, their recession speeds increase. Also, the rate of expansion is itself slowing down with time. So the problem involves much more complicated mathematics. As space expands with time, the light waves stretch out. The further away a galaxy, the longer the light travels through space and the more it gets stretched out. The speed of light in a vacuum remains constant, so we observe a red shift. You might think of the two 'ends' of a single light wavelength from a distant galaxy being emitted at two slightly different times, and during the time between the two 'emissions' the source has moved away from us. (This is perhaps easier to visualise if you think of a very low frequency radio wave with only a few thousand oscillations per second.) Thus a red shift is seen.

This happens in classical physics too. The Doppler shift is seen in moving stars, radial velocity measurements, for example. The actual calculation of recession velocity for extreme redshifts uses the relativistic formula relating redshift to v and c (the speed of light in a vacuum). This should exclude silly statements such as "a galaxy has been discovered to be moving away from us at 5.2 times the speed of light." No matter how great the redshift, the recession velocity is never faster than light.

The lunar phase cycle is 29.5 days, but we see the Moon for only about 2 weeks (during both the day and night). Is this because of the Moon' s orbit is inclined by about 5° to the ecliptic? If the Moon's orbit was on the ecliptic plane would we be able to see it all the time - except of course near new? *an AAE member asked.*

Aside from the weather, the only times we are prevented from seeing the Moon are when the phase is too close to New or when the Moon is below the horizon. In lower latitudes (e.g., tropics), the main factor is the phase of the Moon, so observers from, say, Hawaii can see the Moon each night (or morning) at some time, except for a period of about 4 days around New Moon. This could be reduced to about 2-3 days with careful observing directed at locating the thin crescent in twilight. In the Spring months in high northern latitudes, the Moon at Last Quarter will be very low in the sky when it transits the observer's meridian. It will not be above the horizon for more than a few hours - just like the winter Sun.

The Autumnal equinox gives rise to the "Harvest Moon" which is visible early each evening for several nights in a row as the Moon shifts to more northerly declinations in the sky, keeping its rising time near Full Moon approximately constant. Indeed, these effects can be exaggerated by the inclination of the Moon's orbit, so that in some years at certain dates observers at more northerly or southerly latitudes can see the Moon at night for only about 16-18 days.

How does a CCD camera and its image compare to an emulsion film in terms of resolution and quality? *asked Mark Chatterly, an Advanced School teacher.*

For most photographic emulsions and CCD cameras, the resolutions are comparable. A CCD chip has a square array of thousands or millions of picture elements, or pixels, which each measure, typically, from 10 to 20μm. This is comparable to the resolution of commonly used astronomical emulsions, usually measured as the inverse of the number of line pairs per millimetre which can be resolved. A typical astronomical emulsion which resolves 500 lp/mm is directly comparable to a CCD with pixels about 20μm (microns) square. This is simplistic, but the order of magnitude is correct.

The photographic emulsion has a great advantage over the CCD: there is no limit to the size of the image that can be recorded. The large Schmidt telescopes used at Palomar and in Australia use glass plates that are as large as 34cm

Ask an Astronomer

"The Things People Ask!" is selected, and edited, from the many questions received, and answers given by the Association of Astronomy Education's "Ask and Astronomer" Service conducted by Dr. Mike Dworetsky, University College, London. *Query* reminds senders of e.mail that plain text format is preferred, not Microsoft Word documents which can transmit computer viruses. The service is available to members of the AAE by e.mail:
query@ulo.ucl.ac.uk, or via the AAE home page:
www.aae.org.uk

Spot the gaffes, again!

In the last issue of *Gnomon,* Mike Dworetsky's report of last August's General Assembly of the IAU produced some wonders from the mystic realms of word processing and page layout programs, which broke words and paragraphs in the wrong places. Alas, your Editor did not spot them. I could say I was introducing the mistakes to encourage the lack of any further contributions from *Gnomon*'s readers in the mistake department. But alas, that would be a porkie. *Mea culpa*. Sorry Mike!

Mike wanted to say, in paragraph 4, that: The small nations of Central America are too small, individually, to mount successful astronomy programmes, but they have cooperated and combined to produce a nascent Astronomical Observatory in Honduras, where they are training the first few professional astronomers. . . . . They are also working to bring astronomy into the school curriculum in science

In Vietnam a simple radio interferometer was made from two TV aerials, Mike explained. His conclusion to those paragraphs should have read:

> Radio astronomy might also be a good way forward in schools in the UK, using such simple techniques. Students learn about both astronomy and electronics.

on a side. This makes it very useful for surveys of large areas. A typical astronomical CCD may be only 1cm on a side; the largest in general use are about 4cm on a side.

The CCD has an advantage in the ability to record small variations over a wide range of intensity of light. The term for this is dynamic range. A photograph can give a dynamic range of 30-40; a CCD can give a useful dynamic range of 500-1000. Another advantage of a CCD is that the output is linearly proportional to input, so that accurate calibration allows quantitative measurement of light intensity. And of course if the objective is to analyse the observation by digital methods, the CCD can be read out directly whereas the photograph must first be scanned.

The CCD requires flat field measurements for the best results; it compensates for the pixel-to-pixel variations in sensitivity. This type of calibration is ordinarily not available in commercial digital cameras but is normally used in astronomical work. A CCD can be cooled in order to reduce the effects of thermal noise. This allows long integrations on faint sources without the disadvantage of the photographic problem known as reciprocity failure, the tendency of emulsions to be disproportionately less sensitive to very faint sources than to much brighter ones, during long exposures. The choice of detector depends on the application and the sophistication of the user, and also on the bank balance.

Query

News from DOWN UNDER

Stuart Ryder is busy in the UK for a short while so his letter would have had to be from "up top". Eric Jackson steps into the breech for this quarter. Ed.

On May 21st I worked with the year 4 to 6 classes at an Auckland primary school, recording the shadow of pupils on the playground every half hour. At solar noon each class recorded the shadow of one pupil on a length of paper putting in their name, time and date. They also ran a piece of string from the top of the pupil's head to the end of the shadow of the head and measured the angle with a blackboard protractor. (This was 33°).

In a month's time (June 21st, and our winter solstice) they will record the same information with the same pupil, at the same time, on the same paper, and repeat on the 21st of each month until our summer solstice. This is mainly a mathematics activity, but springing from it are a whole range of other activities.

The school principal said that all the classes are networked with computers and asked that I send regular activities for the pupils to do. This has opened a new way of reaching pupils with astronomy activities both here and anywhere in the world. I am very keen to involve any schools in the UK who would like to exchange observations and records with schools here. In the first instance contact should be made through my email: **pipeheng@voyager.co.nz**.

2. For the week July 2-6 New Zealand is holding a "Bump into Science" week. The Royal Astronomical Society of New Zealand held its annual conference in Auckland (June 29 to July 3) organised by the Stardome **www.stardome.org.nz**. On the 2nd there was a whole day professional development for teachers and the 3rd, astronomy related activities for children.

Several overseas astronomy teachers have been invited to take sessions including Bob Riddle whose web page **http://currentsky.com** was recognised recently by *Sky and Telescope* magazine as one of the best individual web sites. I would recommend it to schools in the UK.

3. UK members interested in viewing southern sky objects will soon have the opportunity of doing so through the robotic telescope being set up at the Auckland Observatory. See the Stardome web site for details.

4. Comet Linear has been a spectacular sight in our southern skies, particularly with binoculars.

Eric Jackson

Sky Diary Summer 2001

The map (back page) is this quarter once again the whole sky. The chart shows the sky half way through the Summer quarter (2001 August 15 at midnight) as seen from a point roughly in the middle of Britain, at latitude 52°N and longitude 3°W. The map covers nearly everything visible in the sky above magnitude 4.5. The south point of the last quarter's map was the constellation of Scorpius, and in this issue, the south point has moved to the obscure realms of Microscopium and, further east, Piscis Austrinus, the Southern Fish.

The low southern constellations are not completely covered by successive whole-sky diagrams. For example, the handle of the "Teapot" in Sagittarius is all that can be seen of the constellation in this quarter's chart as the constellation sinks below the horizon in the south-west (looking something like the Plough, but smaller). A chart of the sky at the end of June would have shown the southernmost parts of the Scorpion, and the whole of Sagittarius. In a future issue, the four whole-sky charts (together with some fill-in charts for the southern constellations) will be used for a "Curriculum Corner" project, so please keep your copies carefully.

Piscis Austrinus marked well by the 1.16mag star αPsA, Fomalhaut. At declination 29° 37' south, this star is 3° further south than Antares, and almost as bright, making it about the most southern star that can be seen easily with the unaided eye from British latitudes. To find Fomalhaut, choose a place with as clear as possible southern horizon and at a sidereal time close to 23hr (that's close to 2hr 30min BST at the date of our map) look south, following the line of the western stars of the Great Square of Pegasus down towards the horizon.

The other constellation groupings shown in the chart include Auriga, a five-sided figure low in the north east containing the bright star Capella. Preceding Auriga across the night sky is Perseus, seen in the chart immediately below Auriga. Perseus includes the famous naked-eye eclipsing binary star Algol. To the right of Auriga, half way across the chart in the north-west, is the Plough, "upside down" if you think of it as a saucepan. Its curved handle arcs down to Arcturus, the brightest star in the northern sky, and seen here low in the west-norwest.

The Plough "Pointers" indicate Polaris, and if that same line is extended and bent a little towards Perseus the W of Cassiopeia is found. A line from Polaris through the western end of Cassiopeia (β, the brightest star in Cassiopeia) passes through the eastern side of the Great Square of

Rising and setting times (UT): lat. 52ºN; long. 3ºW						
	July 15		August 15		September 15	
	Rise	Set	Rise	Set	Rise	Set
Sun	04h 09m	20h 25m	04h 55m	19h 35m	05h 46m	18h 26m
Mercury	02h 44m	19h 00m	05h 46m	20h 02m	08h 25m	18h 53m
Venus	01h 23m	17h 10m	01h 39m	17h 52m	02h 54m	17h 37m
Mars	18h 07m	00h 58m	16h 26m	23h 11m	15h 24m	22h 14m
Jupiter	02h 24m	18h 57m	00h 51m	17h 22m	23h 11m	15h 40m
Saturn	01h 19m	17h 12m	23h 23m	15h 24m	21h 26m	13h 29m
Uranus	21h 34m	07h 13m	19h 30m	05h 05m	17h 26m	02h 56m
Neptune	20h 52m	05h 44m	03h 38m	16h 45m	16h 45m	01h 32m

Pegasus (and like the Plough, not a constellation, just a large and convenient asterism). Andromeda curves away from the north-east corner of the Square towards Perseus (who else!). The three bright stars forming another unofficial asterism called the Summer Triangle, dominate the south-west quadrant of the sky with Deneb (αCygni) the bright star almost in the centre of the chart, Vega (αLyrae) to the west of Deneb, and Altair (αAquillae) to the south of Vega. Between Vega and the southwestern horizon is the large, sprawling constellation of Ophiuchus.

In mid-August, the planets Saturn, Uranus and Neptune are in the sky as indicated. Saturn is low in the north-east sitting between the horns of the Bull. Uranus and Neptune are drawing further apart, but both still in Capricornus as described in detail in Gnomon in the "Summer 1999 Sky Diary". Uranus can be spotted with a determined effort with the unaided eye once you know exactly where to look. If you are able to observe it over several weeks it becomes easier. At the date of the chart, Uranus is just south of a small group of stars all of about the same magnitude as the planet, mag. 5.5, and close to the north of δCap. It is sobering to think that once you have spotted Uranus, you will not see it in that position in the sky again unless you first observed it at a fairly young age. It takes 84 years to get back to any given position in the sky!

Mars, riding on the Scorpion's back, sets in the south-west about 50 minutes before the time shown in the chart.

Shortly after midnight on the date of the chart, the waning crescent Moon rises, soon to be followed by Jupiter, which is in turn followed by Venus 40 minutes later. These three bodies mark the line of the ecliptic clearly across north-eastern sky.

Events during the quarter include the Earth reaching aphelion (furthest from the Sun) on July 4 and the northern Autumn Equinox on September 22.

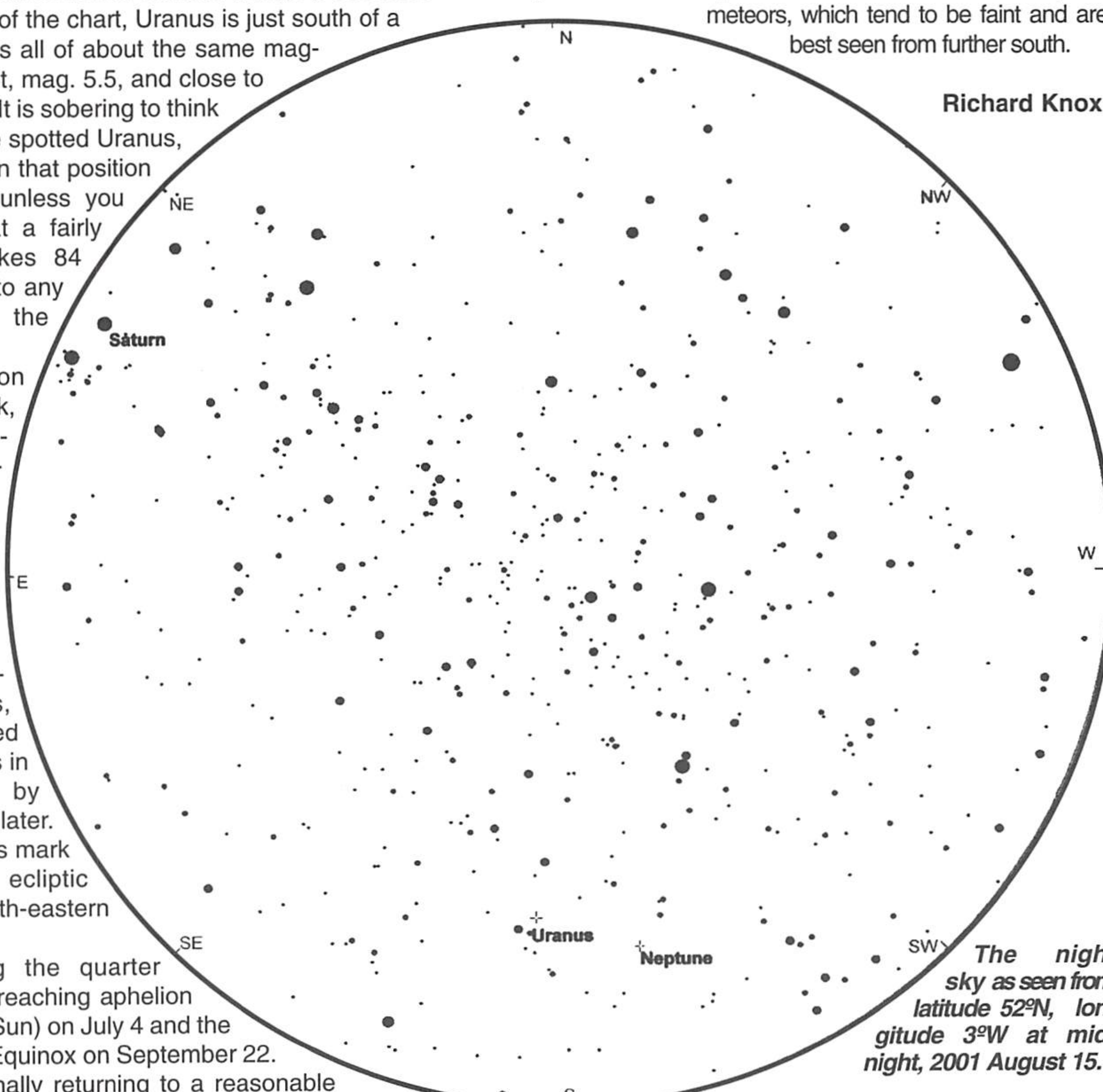
With twilight finally returning to a reasonable level, the photographic opportunities improve as the equinox approaches. There are a number of attractive conjunctions and line ups, but mostly in the morning sky. On July 15, in the morning twilight you may be able to see Saturn and Venus side by side. Actually Venus passes to the south of Saturn and is within 0.7°. On August 6 before 4:00hr or so (UT, so 5:00hr BST. Could be worse!)
Jupiter and Venus form a pair just over 1° apart at an altitude of about 20°. Sunrise is is at 4:40, so you may be able to spot the two brightest planets together in the morning twilight. It would be worth a look a day or two either side of the 6th as well. If the twilight is getting bright, the exposure for such photographs becomes more critical. A useful exposure setting can be obtained by taking a light-reading

Moon phases for the third quarter of 2001				
Month	New Moon	First Quarter	Full Moon	Last Quarter
July	20	27	5	13
August	19	25	4	12
September	17	24	2	10

directing the camera, or its light-reading sensor) into the bright twilight. Then reduce that exposure by two stops (using either or both aperture and shutter speeds in the usual way). If the planets fail to show, then the twilight had almost swamped them.

July 28 marks the expected maximum for the Delta Aquarid meteors, which tend to be faint and are best seen from further south.

Richard Knox



The night sky as seen from latitude 52ºN, longitude 3ºW at midnight, 2001 August 15.