GNOMON

Newsletter of the Association for Astronomy Education

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A grant from The Royal Astronomical Society enables "The Universe in the Classroom", the Newsletter of The Astronomical Society of the Pacific, to be sent to members with issues of "GNOMON".

We say farewell to our Editor . . .

Eric Zucker and Gnomon were thought almost inseparable. Eric has compiled and edited the AAE's Newsletter for ten years, seeing it through several changes and a new name! He has also written many of the articles and reviews himself. We thank him for his dedication to this task over the years, and we would also like to send thanks to his wife Ethel who had given him secretarial support.

In recognition of Eric's long service and commitment, Council have awarded him life Honorary Membership of the AAE.

. . . and welcome a new Editor:

The hard work of producing Gnomon has been taken on by one of our Vice-Presidents, Alex Lovell. Alex has an astrophysics degree from Leicester University and has worked for the BBC as a researcher on several programmes, including 'Heavenly Bodies' and 'Spaced Out'. Recently back from a years planetarium experience in the USA, she is turning her considerable energies to organising the articles that we send in. Keep them coming for the next issue please!

We all welcome Alex back onto the team and wish her well in her new role.

Dr Anne Cohen, *President.*

EDITORIAL COMMENT

At our last council meeting, held at the London Planetarium, I was pleased to notice that we had to go begging for extra chairs, to accommodate all those attending. The AAE has representation on council from a number of astronomy and space related bodies, attendees from some of the major science and astronomy facilities in the country and the elected council members.

The council always finds it a challenge to get through the items on the agenda in the time that we have for our meetings. This is solely due to the volume of correspondence, issues and organisational affairs that are dealt with on behalf of the AAE.

Many council members wear several 'hats' and represent more than one organisation. Such a person is Eric Zucker who has served as the AAE representative on more associations than we can remember and through Gnomon has done an unequalled job of keeping many of the organisations with an interest in astronomy education, up to date and informed. It is with tentative steps that I take on the position of Editor.

Over the coming issues I hope to include more information on the current projects that the AAE is involved with and also more information on the different astronomy and science resources around the country. In particular, I hope to focus on where you can get resources for free or very little outlay, and useful addresses.

If there is anything that you would like to see in Gnomon then I would encourage you to contact me (see side panel for address) to discuss your ideas. I would like to thank everyone on council for their support during this transitory phase.

MEMBERSHIP of the AAE costs £7.50 a year for individual members, £15 for corporate membership and £5 for retired persons. For more information, contact Nik Steggall (address letters to: AAE, Royal Astronomical Society, Burlington House, Piccadilly, London W1V 0NL). Members receive 4 issues of GNOMON a year.

GNOMON - definition from the **Concise Oxford Dictionary:**
Pillar, rod, pin or plate of sundial, showing time by its shadow on marked surface; column, etc. used in observing sun's meridian altitude

Subscription Rates:

Individual Members	£7.50
Retired Members	£5.00
Corporate Members (e.g. schools, colleges, etc.)	£15.00

Corporate Members will receive three copies of *Gnomon*.

Extra Copies:

0-10	£1.00 per copy
11-50	£0.75 per copy
51-	£0.50 per copy

Back numbers, not less than one year old, half these prices.

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:

The Association for Astronomy Education,
The Royal Astronomical Society,
Burlington House, Piccadilly,
LONDON. W1V 0NL.

Editor: Alex Lovell, 6 Red Hill Crescent, Wollaston, Wellingborough, Northants NN29 7SX - for all enquiries concerning the Newsletter.
(Tel 01933 665875/664646)

Advertising Charges:

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

* These may be of any size which may conveniently be inserted into the newsletter. There may also be an additional charge for posting if the inserts are heavy.

The prices are for *one* issue.
A 25% reduction is made for advertising in all four issues.

Publication Dates:

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

FOR YOUR INFORMATION . . .

Lancaster University's Open Studies programme is looking to extend its programme of astronomy and cosmology courses for adults in the South Cumbria / North Lancashire area. To do this they need to find some suitable tutors who could deliver existing courses at a first year undergraduate level.

Anyone who thinks they might be able to help is asked to contact Peter Wade, Associate Tutor, Open Studies, Lancaster University, The Storey Institute, Meeting House Lane, Lancaster. LA1 1TH. (01524) 849494

The National Maritime Museum is pressing ahead with its renovation of the historic building on the Old Royal Observatory site. The Grade II listed South Building, dating from the 1890's, is familiar to many people as the home of the Caird Planetarium. This magnificent red brick edifice has now had one hundred years of grime removed, and the fine terracotta busts and plaques can now be seen clearly.

The Caird Planetarium is available for schools shows and seats 48 students. Telephone (0181) 858 4422 for further information.

'SPACED OUT' is a new ten part series on astronomy to be broadcast on BBC Radio 5 for ten consecutive nights starting December 23rd at 11:30 PM. (Check your listings magazine for details) The content is extremely varied, with interviews, location stories and studio chat. Readers may find it worthwhile to tape these programmes for use in the classroom.

It is still possible to get hold of the **BBC Astronomy Project Pack and the Open Evenings Leaflet.**

The leaflet contains an up to date listing of astronomical societies around the country, night sky information and some general hint and tips for observing evenings. For a copy, send a large SAE to ' Open Evenings', PO Box 7, London W5 2GQ.

The Project Pack can be obtained by sending a cheque or postal order for £9.99, made out to 'BBC Education', to 'Astronomy Pack', PO Box 7, London W5 2GQ.

'FINAL FRONTIER' is a new six part series for BBC Radio 4 as part of their 'space season' so keep an eye on the listings magazines around the beginning of next year to see what else is part of this 'season'. It will cover many aspects of space and astronomy like its Radio 5 cousin (see above). It will probably be worth recording both. Transmission for this series is on Saturdays starting on January 18th and finishing February 22nd at 1630-1700. It will be repeated on Sundays of those weeks late in the evening from 2245 to 2315.

NEW TRENDS IN ASTRONOMY TEACHING The International Astronomical Union Colloquium No.162 is taking place July 8th-12th 1996 at University College London and The Open University.

This Colloquium will discuss all aspects of teaching astronomy from public to university education. There will be a day (July 9th) at the Open University to discuss Distance Learning in Astronomy. The roles of planetaria, schools, colleges and universities in providing education in astronomy at all levels, and examples of how they achieve their aims, will from a major part of the presentations (invited, contributed and poster papers) at the Colloquium.

Those wishing to present a paper or seeking travel grants should consult with the chairman of the scientific organising committee, Professor Lucienne Gouguenheim, (ARPEGES, Observatoire de Meudon, F-92195, Meudon Cedex, France).

Organisational matters should be addressed to either Dr Derek McNally (University of London Observatory, Mill Hill Park, London NW7 2QS) or Dr Barrie Jones (Physics Dept. Open University, Walton Hall, Milton Keynes, MK7 6AA) joint chairmen of the local organising committee.

The registration fee will be £100 for participants and £20 for accompanying persons (if paid before May 31st 1996 and £40 thereafter). The registration fee will include transportation to the Open University. Accommodation (bed and breakfast) in UCL's Ramsey Hall can be provided at £20 per person, per night.

'TALKING SCIENCE +' is a national database of speakers on science and technology that the British Association are administering. These speakers have indicated a willingness to be used for any type of science speaking from large formal lectures, to small discussion groups. After your initial enquiry, the data base is searched for speakers who closely match the requirements and full details are sent to the event organiser. Local speakers are used whenever possible. Just about all subjects are covered from musicology to environmental sciences and many speakers do demonstrations or use audience participation.

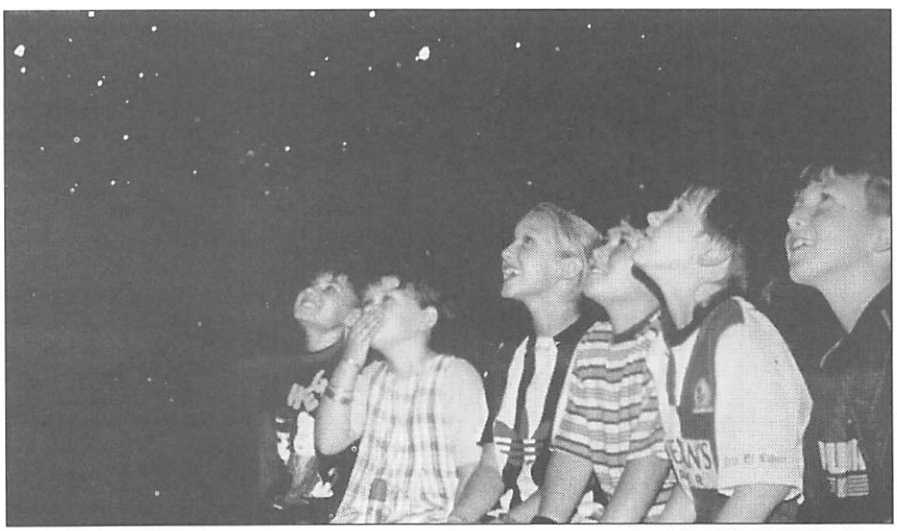
A wide range of other community science services are offered. If you want further details, write to: Talking Science+, British Association, 23 Saville Row, London W1X 2NB or telephone (0171) 287 0980. The Association also welcomes enquires from potential speakers.

'RISING STARS' is a small regional astronomy and space competition for secondary schools currently being run by London Planetarium in association with BAYS (British Association for Young Scientists). The grand prize is a 4.5 inch Newtonian Telescope with accessories and a Challenge Trophy. The final will take place during SET week 1996 at the Planetarium.

This pilot quiz is involving only a small number of schools from the Home Counties area and if successful, the format could be extended to a national competition. While this round is well under way, the London Planetarium and BAYS would like to hear from you if your school or a school you know of would be interested in taking part in a national quiz competition to win prizes like a telescope or books for their school. Please drop a line with your thoughts to: Teresa Grafton, 'Rising Stars' London Planetarium, Marylebone Road, London, NW1 5LR.

EUROPEAN ASTROFEST 1996 takes place on Friday 2nd and Saturday 3rd February 1996 at the Royal Borough of Kensington and Chelsea Town Hall, Central London. Lecture topics include telescopes, astrophotography, galaxies, comets and many more. While taking a break from the lectures, browse among what is usually the largest congregation of astronomy related exhibitors under one roof. Buy some slides, posters, books or just pick up lots of information.

Call the ticket hotline for further details (01903) 266165, or see the latest issue of *Astronomy Now*. Tickets for the exhibition only are £3.00. Tickets for the four lecture sessions start at £10.99 for one session and you save if you go to more than one session.



Techniquest

FOCUS ON . . . "TECHNIQUEST"

Techniquest - an educational resource

Techniquest is not a museum, it is a hands-on science discovery centre which stands in the heart of the Cardiff Bay Development. Since starting life in 1986, it has moved twice and now sits as the largest purpose-built science centre in the UK. This is not a place to wander about with hands in pockets - the 160 or so exhibits invite you literally to get to grips with science. Nearly all of the exhibits were designed and built by our workshops and are capable of fascinating all ages, from 4 to 94! On hand are a team of helpers to welcome and ensure that everyone gets the most from their visit.

In addition to the exhibition, Techniquest has a 30-seat planetarium. The presentations, at weekends and during school holidays, are very popular and the six daily sessions are invariably full. Our Key stage 3 "Earth in Space" theme weeks are supported by other relevant activities and "work-cards" deigned to focus attention on the topic in hand. Our ageing inflatable Starlab is still a vital part of our outreach programme, along with our lecture service and science KITs programme. The planetarium has also provided a perfect site for shadow show and story time for the younger audiences.

There is also a 100-seat Science Theatre which provides a focus for our Theme Week programme which runs, during term times, for both primary and secondary schools. It is in this mini Royal Institution theatre that pupils take part in an interactive and exciting presentation which is designed both to stimulate and motivate.

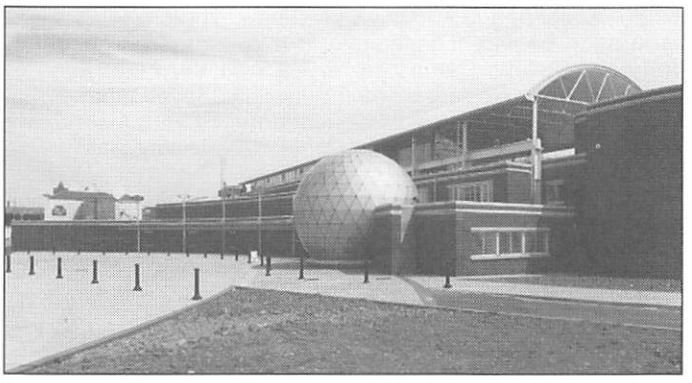
Our developing INSET programme has run a number of sessions for Key stage 2 teachers, and we are looking to further this for Key stages 3 and 4 with our links with the AAE and the local Cardiff Astronomical Society.

As a Resource Centre we hold a number of materials which teachers can review or buy at cost, including videos and CD ROM.

The "Discovery Room" has a number of boxes, each containing a series of activities which groups of children or families can investigate together. Getting the children to leave at the end of the session is often easier than the adults!

There is complete wheelchair access to all parts of the building, including the Planetarium, café and shop!

For further information about Techniquest and its Education Programme, please contact: Bill Dines, Secondary Schools Programme Manager, Techniquest, Stuart Street, Cardiff CF1 6BW (Tel 01222 475475, Fax 01222 482517).



ASTRONOMY - THE EVENING CLASS

In spite of government policy the demand for astronomy classes in my area has never been higher. The changes in funding mean that adult education classes, whether through a local FE college, the WEA or the adult education department of a university only attract financial support if they have some element of academic/ vocational qualification attached to them. Most popular astronomy classes do not fall into this category. The result, for me, has been a mad scramble to produce learning outcomes and performance indicators for students in three different formats, one for each employer. I doubt whether this will enhance their learning, as most students will hardly be aware of them, and the necessary paperwork is a distraction from the more important job of preparing teaching materials.

As the learning environments, course lengths, resources and student groups are all completely different, the teaching materials need to be flexible to be of real use. I have just begun four classes for the autumn session and a thumbnail sketch of each will illustrate what I mean.

Group One:

This takes place in a familiar building in a bright room, with blackboard and chalk and AVA only available if booked in advance. Fourteen students enrol varying in age from 30 - 70 and ranging in knowledge from two returning after last spring's introductory course to complete beginners. The course is "Cosmology from the Big Bang to now" After a register and minimal paperwork we are away or at least they are talking. A quick start was possible because all had seen the course outline and had positively enrolled.

Group Two:

This took place in a shambling, complex building where tutor and students spent time finding the room which was too small, with an OHP that didn't work, three pianos and a jumble of chairs and tables. Of the eighteen students (aged 16 - 50) none had seen the course literature. They had enrolled on the basis of the single word Astronomy in a list. Not surprisingly they had very different personal aims and as a result the first evening was hard work.

Group Three:

The course was set in a small, hot room, which was completely full with fifteen older students when I arrived. They had all seen the pre-course literature and knew why they had come. So apart from being a daytime course and only having the resources in my bag we could make a good start.

Group Four:

Wonderful, almost everything I could hope for! A new village hall with a dark sky and a good southern horizon. They are a group of older students, but they all know each other and have plenty of lively questions about their basic course in popular astronomy.

Not surprisingly, after only two or three sessions with each group their needs have diverged and the topics range from where is north and basic constellation finding with two groups to galactic recession with another. Most have no interest in learning outcomes and records of achievement and only a minority want to pursue a formal GCSE qualification.

One slightly worrying trend in contrast with previous years is the total absence of active teachers. None of the 70 or so students are currently teaching, whereas in the past there were one or two teachers on every course. I suspect they are too exhausted by the demands of their work to spare the energy for even light hearted study.

One final note: I turned down as many classes as I accepted so if you have the energy, contact your local WEA, community college or adult education centre and offer a short course on Popular Astronomy, Astronomy from the Big Bang to now, Practical Astronomy or even The Sky Tonight. There's plenty of enjoyable and worthwhile work to be done. Good Luck.

Tony Lacey.

STAR WATCH UK

A SURVEY OF SKY BRIGHTNESS

In this issue of Gnomon you will find two inserts. These are the charts and forms mentioned in the article below. This project could be a useful one to try with older students and is a good one to emphasis the point that astronomy is one of the few sciences where a contribution to research can still be made with only the simplest of equipment (your eyes!). Gnomon would be please to receive any news and views of your experiences with this project or indeed any hints and tips.

Introduction

In recent years the increasing amount of lighting (street, security, advertising lights etc.), has meant that a dark sky is a rarity. This is of concern to astronomers and the general public because the sight of the stars is one of nature's wonders. No-one wishes to deny our children the opportunity of viewing this wonder.

Star Watch UK is a project to observe and record the brightness of the sky from all parts of the UK. It is an opportunity for everyone, experienced astronomer or the youngest school child, to take part in a nationwide survey. The project is a collaboration between Association for Astronomy Education, Astronomy Now, Campaign for Dark Skies, Federation of Astrononomical Societies, Open University, Royal Astronomical Society, Royal Greenwich Observatory, Royal Observatory Edinburgh and the Society for Popular Astronomy and follows similar surveys undertaken in Japan, the USA and elsewhere.

Star Watch UK has two parts: visual observing - for which you only need your eyes and a pencil; and photography. Anyone can take part in either or both categories by photocopying and completing the forms.

The RGO will co-ordinate the analysis and a report will be issued at the end of each year. Any data received will be used in a manner appropriate to the survey and may include publication of selected photographs. The project is not a test of the individual observer, the observer is the record keeper of the actual sky brightness in their area.

Visual

Two star maps are supplied: one of the Pleiades - which is the region of the sky used in the Japanese and American Star Watch surveys; and one of Ursa Minor. Choose a night when the Moon is not above the horizon (moonlight can be very bright and will affect what you can see), go into the darkest part of your garden/area and allow your eyes to become dark adapted (accustomed to the dark) by waiting at least five minutes. Then look at the appropriate area of sky and circle the stars you can see.

Send each completed map (you may do either one of the areas or both if you can) accompanied by a completed form to the address below. Please photocopy the blank maps and forms as required.

Photographic

The goal is to photograph the region overhead (the zenith) at night during cloud-free conditions. The slides are sent in with the report forms as used in the visual survey. Please photocopy the blank forms as required. Slides will be scanned with a densitometer to determine sky brightness.

Nights are to be selected in November and February only. The Moon must not be above the horizon. The zenith should be cloud-free for at least the time required for the longest exposure. Select the darkest part of your garden/area. Take exposures between 19:00 (7pm) and 05:00 (5am) only. Avoid making more than two sets of exposures per night (to make your film last several nights).

Film should be processed as standard (no "push" or "pull") using the E6 process and frames mounted as separate slides.

Send completed forms to:

Star Watch UK
R.G.O.
Madingley Road
Cambridge
CB3 0EZ

All other enquiries also to this address please.

Write your name, date and time of exposure on each slide frame. Send in each set of three exposures with its own report form. Please photocopy blank forms as required.

Equipment Needed

- SLR camera with manual override
- Cable shutter release
- 50mm focal length lens, f/2 or less, with a lens hood to screen out stray light
- 400 ISO Ektachrome elite colour-slide film

It is important that the equipment and film are as specified.

Procedure

1. Use first two frames of film on a bright scene.
2. Set lens aperture to f/4 (to avoid vignetting that can occur when lens is open fully).
3. Remove lens cap, set camera to manual exposure and attach cable release.
4. Lay camera on its back to point straight upwards. A small spirit level laid across the rim of the hood can verify the aim.
5. Take a set of three exposures: 80 seconds, 150 seconds, 300 seconds.
6. Fill in one of the attached report forms for each set of three exposures. Add comments if you took more or less than the required three.
7. Ideally take a photograph of the completed report form, otherwise take a photograph of a bright scene to mark the end of the set of three exposures.

Notes for Filling in the Form

Your position should be recorded as accurately as possible, for example by quoting the grid reference taken from an ordnance survey map. Check your watch against the speaking clock or the teletext pages on the television. This is local or clock time. Record the date as follows: year, month (first three letters), day (as two figures), time (24 hour clock time), e.g. for an observation made at 10.30pm on the 3rd February 1996, put: 1996 FEB 03 22:30. You are asked to record your age because this has a bearing on eyesight. Note eyesight with glasses/contact lenses if worn. Your site is brightly lit if you can read the form without extra light, has some direct light if you can see the form has writing on it, and dark if you cannot see the writing.

SNIPPETS

The Royal Institution Christmas lectures will be almost underway by the time you get this. However, for those interested, the subject this year is 'The Earth Puzzle' and the lecturer is Dr James Jackson from the University of Cambridge. The lecture dates are all in December. They are: Saturday 16th, Tuesday 19th, Thursday 21st, Thursday 28th, and Saturday 30th. All lectures start at 3:00 PM and last for one hour. Enquiries about ticket availability to The Royal Institution of Great Britain on (0171) 409 2992 or (0171) 493 6470.

If you haven't seen **Apollo 13**, make an effort. The film is a close reconstruction of the real event, so close that some critics thought it was too much like a science documentary! There are a couple of exaggerations and places where the truth has been sacrificed for a good story, but they are not major and do not detract from a marvellous film. Even though we all know it turns out OK in the end, it's very hard not to be on the edge of your seat. My only quibble was that after several days in space, with no waste disposal and cleaning facilities, the crew emerged from the capsule after splashdown looking like they'd been auditioning for the latest Persil advert. Still, Lovell's mother did say that if they could put a washing machine in space, Jim could fly it.

INTERNATIONAL SPACE ACADEMY 1995

Earlier this year, the AAE helped to sponsor a student, Dylan Pugh, who had won a competition to attend the International Space Academy

During my last Easter holidays, at the suggestion of Mr Best (the former Head of Physics at Durham School), I attended the Brunel University Space School. There, I took part in an essay competition organised by the British National Space Centre and judged by Professor Heinz Wolff. I won the competition, and as a result I went to America this summer as one of the two British delegates at the International Space Academy in Huntsville, Alabama. The air fare was sponsored by top British aerospace companies. This is an account of my stay in America.

After one brief night in the cramped quarters of the US Space Habitat we were woken at six in the morning and told to get washed and dressed in time for a general gathering on the grass outside. One hour later I was looking down at the Space and Rocket Centre from the basket of a tethered hot air balloon. The whole experience was admittedly rather short but fast it was the first time for me I found it all very exciting.

The rest of the day was mostly taken up with the registration procedures and the division of the trainees into teams. We were split up into three main groups, each comprised of three different "tracks" - aerospace, engineering and technology. The selection process was entirely random but as luck would have it I was placed in the category which suited me best. I was in Johnson team engineering which meant that throughout the week I would be coached as a mission specialist. Mission specialists are the people who perform EVA's (Extravehicular Activities) and deploy satellites from the Space Shuttle.

The next day our training began in earnest. We were woken at six again and told to meet in the lecture room where we would be issued with our timetables. My day began with a robotics lecture and continued with various other activities such as rocket construction, harness training for EVA work and a lecture about the design of the Space Shuttle, until ten at night when we were allowed to go back to the Habitat. Our only breaks were two half hours for lunch and dinner. After that thoroughly exhausting but exhilarating day we went to bed without any complaints as we realised that the rest of the week would follow a similar pattern.

On the third day our mission briefings began. These were in preparation for the three two-hour missions that we would perform later in the week. In each mission we would hold a different position according to the track we were in. As I was in the engineering track the possible positions for me were mission specialists 1,2,3, INCO/EVA or PROP. The mission specialists are the people who work in and around the Shuttle, INCO/EVA is the person in Ground Control who communicates with the mission specialists, and PROP, also in Ground Control, has the job of monitoring the fuel consumption of the Shuttle (a very boring job). After the mission briefings were finished we were ready to practice the skills that would be required in the simulated missions in two days time. One of these skills was manipulation of the extremely unpredictable, twenty-foot robotic arm in the cargo bay of the Shuttle. That was fun - especially when there was a very worried mission specialist strapped into the chair at the end of the arm, completely at the mercy of the occasional "accidental" twitch of the controller's hand. Of course that kind of prank would almost invariably backfire because it was likely that the next day the situation would be reversed and you would find yourself strapped into the arm with a controller eager for revenge wielding the joystick.

The next few days continued in a similar vein and we gradually became more familiar with the mission profiles and time lines that we would follow in our simulations. The training was very intensive and included sessions in a centrifuge which recreates the high G-forces that astronauts have to withstand during lift off. We also had zero-G simulations in the UAT (Underwater Astronaut Trainer) which, for me was the highlight of the week. Another activity I enjoyed was the Space Shuttle Flight Simulator - I was one of the few people who managed to land the Shuttle and I did so quite a few times.

In two of my three SDM's (Short Duration Missions) I was a mission specialist and in the third I was INCO/EVA. All my missions were very successful - there were no deaths on board the Shuttle or in Mission Control, unlike some other teams. In Marshal team's SDM the EVA crew didn't get back inside the Shuttle in time and all burned up on re-entry. And in Kennedy team the flight commander died of a heart attack due to high levels of stress during what was by all accounts a very hectic mission. (Happily all the cadavers were miraculously reincarnated in time for the next activity.)

After my SDMs were over the whole of Johnson team was taken to an Air Force Training Camp where we did a water survival course which involved being dropped into a lake, six at a time, inside a large metal box full of holes which was supposed to represent the body of a helicopter. We then had to escape from the rapidly sinking box by swimming through one of the holes up to the surface. After that we had to swim to the place where a harness was lowered into the water and get winched to safety. The instructors evidently thought that this was far too easy and decided to add a little interest by telling a few people that they would suddenly contract various diseases and phobias when they got into the water. A Canadian friend of mine was told to pretend he couldn't swim so I had to drag him to the pickup point whilst he screamed and thrashed around, hindering me as much as he possibly could - I'm sure he would make a very good actor but, quite frankly, that wasn't much consolation at the time.

At the end of the final day of our training was at hand - it was time for our EDM (Extended Duration Mission). First thing in the morning we had two and half hours of training and preparation and then the mission began. From eleven in the morning until eleven at night we would be inside a mock up of the Space Shuttle, the International Space Station or Mission Control and every second of those twelve hours would be taken up with problems and malfunctions. For the first six hours I was a mission specialist in Discovery (one of the four Space Shuttles currently in operation) and then, following a successful docking, I was transferred into the International Space Station for the remaining six hours of my mission.

When I was in the Shuttle one of my duties was to build a solar array to supplement the ship's dwindling power supply (the existing array had been destroyed by micro meteorites) but during the EVA my fellow mission specialist's space suit was punctured, and, to her great distress, she was told that she had exploded. So I had to complete the solar panel on my own and very nearly died of exhaustion in the process. I triumphantly returned to the Shuttle only to discover that the commander was dead and the medical officer was unconscious - the Primary Life Support System had malfunctioned and the crew members were dropping like flied because of carbon dioxide poisoning. Mission Control eventually solved the problem and we were able to get the Shuttle back in working order in time for docking. The commander was revived with ten minutes to spare but unfortunately he wasn't much use because he was reincarnated as Darth Vader and kept prattling on about the Dark Side instead of flying the Shuttle.

The six hours in the Space Station were rather uneventful by comparison (I only had to heroically and singlehandedly save the entire crew once) and by the end of the day we were all so tired that we were practically keeling over at our posts. When it was all over we had a debriefing session and then gratefully collapsed into our respective beds.

The next day was the graduation ceremony and the farewell party, I received a special award for my leadership and teamwork abilities and also got my NASA Space Academy Wings.

I hope to participate in the Australian International Space School as I have been invited to represent Britain there next year. The International Space Academy has been one of the most valuable and inspiring events of my life so far and I am extremely grateful to the sponsors listed below, whose support made it possible for me to go.

Acknowledgments

AEA Technology, The Association for Astronomy Education, APECS Ltd, Barclays Bank, C. T. Bowring Space Projects Ltd, British Association for Youth Science, British Telecom, Dowty Aerospace, Intereurope Technical Services Ltd, Irvin Great Britain LTd, HRA Technology, Matra Marconi Space, Thorn Communications and Telecontrol Systems, Vega Group PLC.

BOOK REVIEWS

OBSERVATIONAL ASTROPHYSICS, by Robert C. Smith. Publisher: Cambridge University Press, ISBN 0521 27834 1, paperback, pp 443, price £16.95 (US$34.95), 1995. (Also available in hardback, £45.00 (US$69.95) ISBN 0521 16091 4.)

There are only a few texts available which are at the appropriate mathematical and physical level for an undergraduate major's introductory course in astronomy in UK universities. Until now all these texts were produced for the USA market, whose requirements are similar. The author and publisher of this book must be congratulated for producing a thorough and comprehensive account of both observational methods and astrophysics at exactly the right level for the first-year UK students, which is also suitable as supplementary reading for the new Sixth Form astrophysics modules being offered as parts of several A-level physics courses. This reviewer predicts that it will quickly become a strong competitor in the world market for texts at this level.

Observational Astrophysics devotes its first half to a critical account of observational methods, including optical, infrared, radio, ultraviolet, X-ray, and gamma-ray techniques. There are numerous good problems posed in exercises at the end of each chapter. There is a particularly good discussion of signal-to-noise in the presence of a background signal (pp 88-92).

The second half explores the universe outside the solar system. This begins with discussions of stellar astronomy, binaries and clusters, then proceeds to stellar structure and evolution, galaxies and cosmology. The presentation is consistently excellent, with emphasis on physical understanding and basic mathematical formulation of concepts which are pitched at exactly the right level. All chapters include summaries and exercises. There is a lengthy general bibliography and suggestions for further reading, and a useful index.

Any new text of this length contains errors; what impressed this reviewer was how few could be found, and how minor these were. For example, the Herschelian telescope is described as a variant on the Newtonian, although it was really an off-axis prime focus arrangement. The Keck telescope has a 10-m aperture, not 8-m. The MK system was first published in 1943. The zero point of the V-magnitude in the UBV system is not defined by one star, λ UMi, but by the average of numerous standard stars distributed over the sky. A few other minor problems with technical definitions appear to be due to the author's effort to simplify concepts. There were very few, if any, proof reading errors.

This book is excellent value for money. It should be added that the physical construction and binding of the paperback edition is robust; while being reviewed, my copy stood up well to four transatlantic crossings, two transpacific flights, dry air at 14000ft elevation, and was carried in a rucksack for several weeks. It emerged virtually unscathed. Highly recommended.

Mike Dworetsky,
University College, London

The Great Comet Crash - The collision of Comet Shoemaker-Levy 9 and Jupiter. Edited by John R Spencer and Jacqueline Mitton. ISBN 0 521 48274 7 (hardback) £16.95 (US$24.95)

The Great Comet Crash is about the spectacular collision of July 1994.

The book contains contributions from researchers who were involved with the events. Their carefully detailed personal accounts have been edited and explanatory text and chapters added where necessary to give a grand overview of science at work. This makes the whole a definitive account of the whole event.

The book chooses to follow the crash chronologically which introduces the reader to all the speculation and then the actual event, and the excited atmosphere comes through quite well in some of the pieces. There are chapters on comets generally and also on The comet and its discovery. Very useful is the overview of Jupiter with its examination of the different structure and composition of the giant planet. This helps the reader to understand the reasoning and the words behind all the speculation in later chapters.

The photos, as you would expect, are chosen from some of the best that were available from the Hubble Space Telescope and observations at other wavelengths. The Glossary is comprehensive and accurate, and the index is also quite extensive which is useful in a 'bits and pieces' book like this.

The book ends with two chapters. One summarising what we have learnt so far and the other, titled "What if?", explores in detail the possibility and effects of impacts on Earth.

I find it quite hard to fault this book as I thoroughly enjoyed reading it. Its target audience is 'anyone interested in astronomy', which is just as well since much of what is explained is quite technical and requires at least some knowledge of basic physics. As most people that have an interest in astronomy are familiar some physics then the nature of the text won't be a problem. However, as the subject matter is so 'famous' the layman might well be attracted to this book. I think s/he would find it a little tough going.

A. Lovell

THE HEAVENS ENCOUNTERED - EDUCATIONAL SLIDES FOR 8-11 YEAR OLDS

South East Kent Astronomical Society

As we went to press, I received a pre-production copy of the above teaching resource. The pack consists of 20 slides, and a set of notes and experiments that can be done to reinforce the concepts introduced by the slides. The whole is presented in a plastic folder with the slides on one side and the accompanying material on the other side.

The slides are all taken by SEKAS members and are a nice set of examples of what can be seen with the naked eye or a simple telescope. There are some great illustrations of various moon phenomena like halos, earthshine and eclipses. The star trails slide is clear and there are photos of Orion and the Great Bear. Unusually there is a slide of Jupiter and its four moons as you would see it through binoculars or a small telescope. This is a real bonus as all too often the only slides you can find show glossy, full colour versions of objects which can unrealistic.

The teacher notes are fairly brief but comprehensive. They are clearly written in and match nicely with the slides. Drawings in the text to help you identify what is what in the slide - very useful. However, I found the text a little strange to read in that it is written at student level and is a commentary for the slides. The teacher may want the information written with a bit more detail so that they can put it in their own words to their class rather than read it verbatim. A few diagrams that could be drawn on the board or photocopied would be useful for clarifying exactly what to do in the experiments, or to amplify the text. In the final product, it is expected that the teacher notes will be laminated for durability.

The accompanying suggestions for experiments are the 'standard' but invaluable ones involving a playground sundial, moon phases sketching and demonstrating the phases with a ball and light source. There are also some tips for observing at night.

On the whole this is a highly commendable effort by a society that has been active for 23 years in amateur astronomy. The pack will cost £16 which is not bad for 20 slides that will probably get a fair amount of usage. Enquiries to SEKAS on (01304) 365918.

A. Lovell

THE GREEN FLASH

Some of you must be wondering why I am writing about a comic-book hero in an astronomy newsletter, but please be assured that no such hero ever existed! The green flash is an astronomical, or rather, an atmospheric, event. When conditions are right, at the last moment of the setting Sun, its upper edge or limb blazes with an emerald green colour for a few seconds before disappearing below the horizon. Few people have seen the green flash, yet it is one of the most startling and colourful of sunset or sunrise phenomena, requiring patience and good luck to be seen. Until recently, I had personally never been fortunate enough to observe this remarkable sight, and many of my astronomical colleagues say they have never seen it despite repeated attempts. So, what is it, and why is it so elusive? I explain all below, and at the end of this article I'll give some hints about how you can join an exclusive club - the green flash observers.

To understand the green flash requires some background knowledge. Even the most cursory everyday observation reveals that the Sun fades and appears to turn reddish-orange as sunset approaches. (All effects described in this article are seen in reverse order at sunrise, of course.) This reddening is caused by Rayleigh scattering of light by molecules in the atmosphere. These molecules are very small compared to the wavelengths of visible light, which has the consequence that the scattering is proportional to the inverse fourth power of the wavelength. Thus scattering of violet light (400 nm) is 7 times more effective than that of red light (650 nm). The result is that the Sun looks red because so much blue light is removed from the line of sight.

Astronomers use the term "air mass" (symbol A) to describe the Earth's atmospheric thickness in the line of sight. An object overhead (altitude 90 degrees) is seen through one air mass, at altitude 30 degrees through two air masses, and so forth. If the Earth were flat, the formula A = sec (90 - altitude) would apply. But the Earth is spherical, so at sunset we look not through an infinite amount of air but (as detailed calculations show) about 38 air masses. In a clear atmosphere the setting Sun is about 1/1000 its mid-day brightness, but even a moderate amount of dust or haze can reduce this figure by a further factor of 10 to 100 or more. (It occurred to me, as I wrote this paragraph, that the fact that the setting Sun does not disappear but is only dimmed is yet another proof that the Earth is not flat!)

A more detailed examination of the setting Sun shows that it also appears somewhat flattened and may show horizontal structure and banding. (Note: viewing precautions are needed as the setting Sun can be too bright for safe viewing without using dark filters, although quick glances, once parts of the disk are below the horizon, should not cause more than dazzling and after images.) The flattening or ellipticity is due to atmospheric refraction, which raises the Sun's lower limb by about 35 minutes of arc, while the upper limb is raised by only about 29 minutes, when the lower limb is tangent to the horizon. The banding effects are due to layers of differing temperature and density in the atmosphere.

The setting Sun's disk is made up of light of all colours. Green and blue light are refracted by air slightly more than red light, so the disk actually consists of a flattened red disk, with a yellow disk slightly above it, a green disk above that, and blue and violet disks at the top. This phenomenon is called atmospheric dispersion and is easily visible to anyone who looks through a telescope with high magnification at a bright star or planet low in the sky. The vertical separation of red and green varies with conditions, but is typically about one minute of arc at the horizon.

In the case of the setting Sun, the upper limb is green (or sometimes blue). If the horizon is provided by the sea or by very distant flat land, and the air is very clear for a hundred kilometres or more towards the sunset, then it is possible to see the green flash. As the upper rim of the setting disk approaches the horizon, it begins to spread into a thin bar of light, then runs through the spectrum from orange to yellow, then pale green, and finally reaches a deep emerald colour for two or three seconds. Under favourable conditions a brief blue blob of light may be seen after this, but exceptional clarity of the air is needed.

During the summer of 1995 I had to travel to California and Hawaii for guest investigator observing runs at Lick Observatory near San Jose and at the Mauna Kea Observatory's Canada-France-Hawaii Telescope. Between these runs I also visited relatives in Los Angeles with my family. Thus my travels took me to several places with clear air and unobstructed ocean horizons, ideal for seeking a view of the green flash. I was not disappointed.

My first sight of the green flash was memorable. The Lick astronomers on Mt Hamilton (height 1280 metres) would gather on the catwalk of the 3-metre telescope dome each evening, to watch the sunset (and check for signs of approaching clouds). On 23rd July 1995, at 18:29 PST, Dr Elizabeth Griffin and I observed an excellent 2-3 second green flash, which rapidly faded into a distinctly blue bar of light for about half a second before disappearing. Although we had a run of twelve clear nights, this was our only sighting of the green flash. Conditions that evening were exceptionally clear as we could see the Pacific Ocean beyond the San Francisco peninsula. A blue flash is a rare sight indeed.

A month later my family and I were staying in a delightful ocean front apartment in Redondo Beach (altitude 10 metres - we were on the top floor) with panoramic views of Santa Monica Bay. The first week of our stay was rather misty, but each night during the second week we would stand on our balcony and watch the setting Sun, hoping to see the green flash. Only once, on 27th August, were conditions just right to see a classic display of emerald green. On other occasions when no flash was seen, we could see indications of very distant clouds on, or just over, the horizon.

Although the astronomical work I did at Mauna Kea (altitude 4200 metres) in the following week was extremely successful, no green flashes were observed because one rarely sees the true horizon from the peak - it is almost always cloudy over the surrounding sea. But I was rewarded with one final green flash as I was waiting on the evening of the 10th of September for a local flight from Kona airport, which is built on the west coast of the Big Island (height 4 metres). The waiting area is outdoors, with a clear view over both the runway and the Pacific. A jet aeroplane taxied out of the line of sight moments before the upper limb of the Sun reached the horizon, and I witnessed one more green flash.

From reading I have done, it appears that the correct explanation of the green flash was surprisingly slow in emerging during the 19th century. There are apparently no known written descriptions of it from previous centuries. Some scientists speculated that, because most reports were from observers at sea, it was due to a filtering of light by the crests of distant waves. Others suggested that it was an optical illusion caused by after images of a red setting Sun which merely appeared green. The green flash even had a place in romantic Victorian literature, such as Jules Verne's 1882 novel Le Rayon Vert (The Green Ray), one of the first recorded mentions of it: "If there is a green in Paradise, it cannot be but of this shade, which most surely is the true green of Hope." (It has been a long time since I read it, but if I recall correctly, Verne's characters spend the entire novel travelling to remote places whence reports of the green flash have emanated, but something always happens to prevent them from seeing it. Meanwhile they philosophised a lot and had adventures.)

Right. If you got this far, I hope that I have intrigued you into trying to see the green flash yourself. Or, perhaps you will encourage your students to look for it. First, it is regrettably more difficult, though far from impossible, to see the green flash from Britain. The best time to try is on a very clear day from a sea-side location with a clear view of the setting Sun, any time of the year. It is more likely that you might see a green flash during a seaside holiday abroad, although you would need to make sure your chosen location has open sea to the northwest (assuming it is a summer holiday), or in the appropriate sunset direction at other times of year. Next, never ever miss an opportunity to watch the last moments of the sunset. Do not blink or glance away. One of my colleagues once saw a brief but intensely green flash from a mountain in Oman. He excitedly asked his companion, "Did you see that?", to which the reply was, "See what?"

It is, of course, possible to observe a green flash at sunrise. But a good deal of preparation is needed to note as accurately as possible beforehand where the Sun will first appear, preferably using fixed direction markers overlooking open sea. And, unless you are a very early riser the discipline needed to check every sunrise probably won't exist. Of course, you may have been up partying all night, but chances are that you would not then be in suitable condition to observe anything. . . .

Mike Dworetsky
University College London

CURRICULUM CORNER

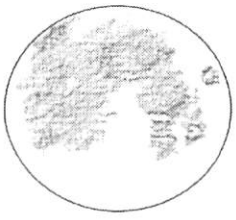
by Bob Kibble

SKETCHING THE MOON

We have all seen the Moon and often make no more than a passing remark about it such as "the Moon looks brighter tonight" or even "with all this moonlight I won't see many stars". But what you may not realise is that amateur astronomers around the world are at that very time sketching the Moon. To them the sight of the Moon is the signal to reach for their sketch pad and pencils. You too can try your hand at making some Moon sketches. Here are some hints.

A NAKED EYE SKETCH

You don't need binoculars or a telescope. If the sky is clear and the Moon bright prepare by drawing a circle or two on a white sheet of paper. Don't make the circles too large, perhaps 10cm diameter. Remember to wrap up well before going out - it will get very cold. It also helps to have something to rest your paper on like a piece of stiff card. It is a good idea to be with a friend for company and for safety.



If it is a Full Moon the brightness of the Moon can start to hurt your eyes. Don't spend too much time staring. Give your eyes a rest. The light from a full Moon should be enough to let you see what you are drawing. I doubt you'll need a torch. I use a soft pencil, HB, 2B or 4B. This helps to make shading easier. On a clear night you will find that after a while you'll be able to shade in all the major grey areas, the "mare" or seas (of course they are not really water!).

USING BINOCULARS

If you have a pair of binoculars you will find that there is more detail to be seen. My advice is to start by doing a faint naked eye sketch to fill in all the dark areas. Then use your binoculars to help you add more detail. You may be able to see some of the larger craters such as Copernicus with its white streaks or "rays". Binoculars really do help when you have the Moon's terminator in view. This is the edge of the shadow you see when the Moon is not full. Binoculars will enable you to pick out some of the uneven surface details like the edge of craters.

Sky Diary Winter 1995-96

By Eva Hans

Solstice: 1995 Dec 22^{d} 08^{h} 17^{m}
Equinox: 1996 Mar 20^{d} 08^{h} 03^{m}

MOON PHASES:

New Moon	First Quarter	Full Moon	Last Quarter
	Dec 28^{d} 19^{h} 06^{m}	Jan 5^{d} 20^{h} 51^{m}	Jan 13^{d} 20^{h} 45^{m}
Jan 20^{d} 12^{h} 50^{m}	Jan 27^{d} 11^{h} 14^{m}	Feb 4^{d} 15^{h} 58^{m}	Feb 12^{d} 08^{h} 37^{m}
Feb 18^{d} 23^{h} 30^{m}	Feb 26^{d} 05^{h} 52^{m}	Mar 5^{d} 09^{h} 23^{m}	Mar 12^{d} 17^{h} 15^{m}
Mar 19^{d} 10^{h} 45^{m}			

MERCURY

Mercury is an evening object until January 13th when it becomes too close to the Sun for observation. It reappears in the morning sky from January 25th to March 19th.

VENUS

Venus is very bright in the evening sky. It comes into conjunction with Saturn on February 3rd.

MARS

Mars is too close to the Sun for observation.

JUPITER

Jupiter is in the morning sky in Sagittarius.

SATURN

Saturn is an evening object in Aquarius until the end of February when it becomes too close to the Sun for observation. It is in conjunction with Venus on February 3rd.

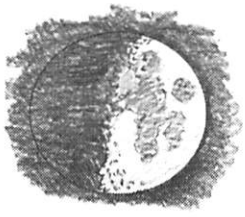
OCCULTATION

An occulation of Venus by the Moon happens on February 22nd. It is not visible from the UK.

METEORS

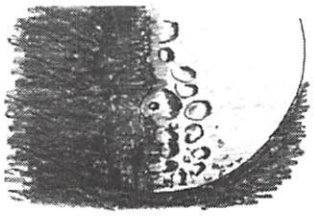
The Quadrantid meteor shower takes place between January 1st and 5th. The best night to view is January 3rd/4th. Before midnight the radiant is low and few meteors may be seen: however after midnight you may have more success. The hourly rate is variable but may be 50-100. The best direction is east. Unfortunately the Moon is almost full and its light will mask all but the brightest meteors.

For a free set of astronomical postcards please send a large sae to:
THE PLANETARIUM, SOUTH TYNESIDE COLLEGE, ST. GEORGES AVENUE, SOUTH SHIELDS, TYNE AND WEAR NE34 6ET.
TEL: 0191 427 3589.



USING A TELESCOPE

With a small telescope you will start to see an amazing amount of detail. There will probably be too much detail to sketch in one evening. My advice is to make a detailed sketch of one area. Perhaps part of the edge of the Moon or better still a part or all of the terminator. You will find that you need to practise your shading skills. You might need to show every shade of grey from jet black shadow to almost white. Once again



start by roughly outlining the area to set out the main features, perhaps a key crater. Then gradually add detail and more shading. Lightly shade the brightest parts first and work towards the darker area.

With a high power eyepiece you don't need to start with a circle as you will not see the whole Moon. A target for you is to find a crater which is just on the

A sketch of the crater Plato, May 1995.

terminator. You might be able to sketch the shadows cast by the rim of the crater. This will give you an idea of the actual heights of the crater wall. You could even make a clay or papier mache model of the crater once you have finished your sketch. Or better still go to bed and make it tomorrow.

So sharpen those pencils, happy sketching.