



GNOMON

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*This issue of 'Gnomon' has been sponsored by
The Royal Astronomical Society*

This enables the newsletter of the Astronomical Society of the Pacific, 'The Universe in the Classroom', to be included as pages 5-10 of this issue.

EDITORIAL COMMENT

Commander Dougherty's letter to this Newsletter, briefly summarized in the last issue of Gnomon, has given rise to much (expected) controversy. So far there have been no letters supporting his argument - that it might not be so dangerous after all to attempt to observe the Sun directly. The reaction of the majority - that it is *extremely dangerous* to do so - was to be expected. A medical view on this subject is published in the letters column of this issue.

I have in my possession a so-called "Sun Filter" which I acquired as one of the bits of ancillary equipment which went with a Japanese 2 inch refracting telescope - a very common instrument costing about £100 (whose optics, incidentally, leave much to be desired.) A simple calculation shows that the amount of light collected by this telescope is about 60 times that of the unaided eye. The interesting feature of the "Sun Filter" is that it is split into two semicircular discs! This is because, in setting up the telescope and filter (*not* by viewing through the telescope, needless to say), the concentrated sunlight was so intense that it cracked the filter. I can remember the sharp "crack" when it split. I now use the Filter at exhibitions, with the self-explanatory caption: "AN AWFUL WARNING!"

* * *

I noticed recently that the number of books on Astronomy at my local library (a branch of the County Library) was considerably less than a few years ago. Admittedly several Astronomy books might have been out on loan, but there were only about thirty books on the shelf. One might have thought that, with the advent of the National Curriculum, there would have been *more* books on Astronomy, not less.

It would be interesting to find out the position in other public libraries, and I invite readers of *Gnomon* to carry out a little exercise by counting the number of Astronomy books on the shelves. It is appreciated that there are small libraries, particularly in rural areas, where the number of books on any particular subject is small: we are primarily concerned with the larger libraries. Participants should, if possible, answer the following questions:

- (a) Name and locality of the library
- (b) Number of adult Astronomy books on the shelves now, and a rough estimate of this number one or two years ago
- (c) Will your local library obtain Astronomy books from other libraries on request and, if so, is this a speedy process?

Any other relevant information would also be appreciated. A separate exercise might be undertaken for children's libraries.

There is no form to be completed - just send in your replies (to the Editor, address on this page), and your name and address - this is just for the record, not for publication.

Newcomers to the Astronomy scene may not be aware of the library facilities offered by the British Astronomical Association, the Royal Astronomical Society and many Astronomical Societies throughout the land.

* * *

Mystery photograph: what was the crescent-shaped object in the last issue of *Gnomon*? Well, it was *not* the Moon *nor* Venus *nor* Mercury exhibiting phases. I came across this quite by chance when visiting the town of Fiuggi, about 50 miles east of Rome. The town boasts a thermal spa ("Terme") with an enormous arena where the waters may be taken. At the centre of the arena is a gigantic concrete "mushroom", about 50m across, and just beneath this is a toroid of concrete, separated from the mushroom (see sketch). Sunlight, streaming through the gap between the mushroom and the toroid, produced a crescent-shaped image on the ground. The chairs give some of the idea of the scale.

So it is not astronomical after all - except that the image was produced by solar radiation!

A Happy New Year to all our readers



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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.

Addresses for Correspondence:

Secretary: Eva Hans, The Planetarium, South Tyneside College, St. George's Avenue, South Shields, Tyne and Wear NE34 6ET - for all general enquiries. (Tel: 091 4560403, ext. 477)

Treasurer and Membership Secretary: Bob Kibble, 34 Acland Crescent, Denmark Hill, London SE5 8EQ (Tel: 071-274 0530) - for all financial and subscription enquiries.

Editor: Eric Zucker, 35 Gundreda Road, Lewes, East Sussex BN7 1PT - for all enquiries concerning the Newsletter. (Tel 0273 474347)

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Whole page.....	£120
Half page	£60
Quarter page.....	£30
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* 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.

ALEXANDRA PALACE ASTRONOMY CENTRE

by Ken Creamer

After many years of discussion with the Alexandra Palace Trust and the AP Management team, the NW Tower of Alexandra Palace was given over to the Astronomical Society of Haringey to set up an Astronomical Centre.

The restoration work after the disastrous fire created the opportunity to design the new roof for the tower to accommodate an observatory which would house a 13" reflecting telescope on permanent loan from the BAA.

However, access to the Tower had only been temporary up to this point, and this was removed when the Palace reopened for business in March 1988.

To make matters worse, the storms in late 1989 removed the observatory dome which was installed late in 1987 and it was too badly damaged to be reused.

The financial position of Alexandra Palace thwarted many efforts over the past few years to obtain permanent access to the Tower, but this, at long last, is now coming about.

This proposed Centre in North London will have as a basic provision a large meeting room, an observatory, and display and library sections. Further plans could include a Radio Astronomy facility and a Planetarium. An update on this exciting project will be given at a later date.

LETTERS

Dear Editor,

Thank you for sending us the Autumn 1993 issue of *Gnomon*.

To end this year, here are some details of yet another ASSS competition, the closing date for which is 31 December 1993. Entrants must see how many words (minimum four letters per word) may be composed from: ASTRO SPACE STAMP SOCIETY.

The competition is open to *Gnomon* readers, their families and friends. Prizes will be awarded to "under 21's" and "over 21's". Entries should be either typed or legibly printed, and should be verified that the work is the candidate's own by a responsible person, who should also verify the age of the entrant.

Please send entries to the Astro Space Stamp Society, 20 Princes Park Avenue, Golders Green, London, NW11 0JP.

All words must be dictionary-listed. The prizes will be donated by the British National Space Centre, the Neil Armstrong Air and Space Museum, the Crown Agents Stamp Bureau and other anonymous donors.

Please mention that the competition was seen in *Gnomon* and send a photocopy of this letter proving the source of this information.

Yours very sincerely

Godfrey Winston
Press and PR Unit
ASSS

Dear Editor,

Thank you for the copy of Commander L M Dougherty's letter (*Gnomon* 13, 1, Autumn 1993) commenting upon the brief and sensible article by Merlin Ellis (*Gnomon* 12, 3, Spring 1993). The Commander is correct up to a point, but his comments are very dangerous if they are taken to imply that the blink reflex will always protect the eye when looking at the sun.

The Commander was on Malta convoy duty during the war, when sailors with 8x50 binoculars fitted with filters had to look for enemy aircraft coming out of the sun; occasionally a sailor might glimpse the sun without the filter by mistake, and have to stand down for some forty minutes until the after-image faded. Later the Commander tried looking through a 75mm refractor with a cracked sun filter and found it impossible to resist the blink reflex. From all this the Commander asserts that Merlin Ellis's advice that a

normal healthy observer should never look directly at the sun through any kind of optical aid is superfluous, because the blink reflex will prevent it.

But what may have to be accepted for trained men at war is not safe for children. The latent period of the optic blink reflex is about 0.1 seconds (DAVSON) and usually protects an experienced observer who gets an unexpected eyeful of sun; nevertheless every eclipse brings new cases of retinal burns (SORSBY; DUKE-ELDER) and the Commander and his sailors were lucky not to damage their eyes. A colleague of mine was asked to see a schoolgirl who had deliberately looked at the sun naked eye for a long time and lost central vision in both eyes. Nothing could be done for her as the maculae had been destroyed; she can find her way round the house but she will never read or drive a car. Accidents do happen; and the tragedy of a blinded child would leave a teacher

with life-long remorse, let alone legal damages. The Commander may feel Merlin Ellis's advice is over-careful, but I agree with it; projection is the safest method for showing a group of children the sun, and using even the safest of full aperture solar filters needs great care.

The blink reflex allows one to hope that an eyeful of sun by mischance will not lead to permanent eye damage; but it offers no excuse for failing to take rigorous precautions when showing other people's children the sun.

Yours sincerely,

Dr AJC Balfour

President, Federation of Astronomical Societies

References:

- Davson H: Physiology of the Eye, Churchill Livingstone, Edinburgh 1980, p493.
Duke-Elder S and MacFaul P D: System of Ophthalmology, Henry Kimpton, London 1972, Vol XIV pp885-894.
Newell F W and Ernest J T: Ophthalmology, C V Mosby, St Louis 1974, p166.
Sorsby A (Ed): Modern Ophthalmology, Butterworths, London 1972, p482.

COMPUTER PROGRAM AND DATA LIBRARY

The Computing section of the BAA has compiled a catalogue of available software which can be obtained by members or non members through their Program and Data Library (P&DL). Available in a number of disc or tape formats the user must register with the P&DL and pay postage. The catalogue of available items is impressive with CD rom disks, as well as planetaria displays, star data file, calendar information and much more.

Borrowers need to comply with a strict code of use. The service is provided by the BAA as a registered charity. AAE members can obtain a catalogue and further details by sending an A4 envelope and two first class stamps to: Robert Harrold, 10A Barker Avenue, Rose Heyworth Estate, Abertillery, Gwent. NP3 1SE. UK. Tel: 0495 320240.

Bob Kibble

SOUTHERN CROSS PHOTOGRAPHS

We have heard from Karenza Burk (AAE member in Australia) that some really excellent photograph-posters of the Southern Cross may be obtained from: Rick Twardy, Manager, Education Centre, Radio Telescope, PO Box 276, Parkes, NSW 2870, Australia. Please mention Mrs Burk's name when ordering. (We do not have the price.)

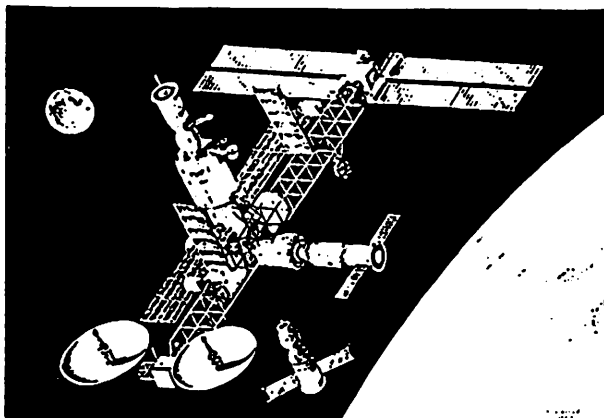
As an alternative, Mrs Burk is able to send ordinary photographs of the Southern Cross - this is a cheaper method. She also has photographs of the Southern Cross and the Eta Carinae nebula. The photographs are taken using a tripod, showing what can be done with simple equipment.

See leaflet on AAE publications with this issue for details.

INSTITUTE OF PHYSICS - SOUTH CENTRAL BRANCH

LECTURE: By Dr John Roche, Linacre College, Oxford: GALILEO
Venue: Hastings College of Arts and Technology
Date: 10th March 1994. Time. 2.30pm

Further details from Dr C. Greaves, West Sussex Institute of Higher Education,
Chichester, West Sussex, PO19 4PE. Tel: 0243 787911



"The Russian Space Directory 1994", Published by the European Space Report, PO Box 140 280, D-80452, Munich, Germany, pp 320 Price \$280 or 480DM (approx £200)

Reviewed by Tony Lawton, President of the British Interplanetary Society

This is an outstanding reference guide to over 750 space related companies, committees, design bureaux and cosmodromes and to date must be the most comprehensive document on the facilities, services and contact personnel so far produced. It is understood that a similar document is in preparation for 1995.

The scope coverage is immense. If you are interested in cell morphology, and biological radiation effects in space, then the Institute of Cytology of Prospect Maklina 32, St Petersburg, is there to advise and conduct research into the effects of spaceflight at cellular level.

Are you interested in Astronomy - covering Deep Space Astronomy, Solar Physics, Radio Astronomy? Then the Crimean Astrophysical Observatory - the largest observatory in the CIS - has the facilities at Krymskaya Oblast Nanchynny.

Do you want details of the rocket test ranges and cosmodromes? They are all there - Baikonur, Plesetsk, Kapustin Yar and their associated sub-sites and principal personnel - with details as to the type of Russian Launch Vehicle they can handle. The notation used ie SL-4, SL-16, SL-17 etc is based on the standard western terminology for the sake of clarity.

To further avoid confusion, miniature illustrations of each vehicle are placed alongside each site.

Another section is devoted to the Councils and Commissions of the Russian Federation; yet another to the Ministries of the Russian Federation. Each comes with a full list of telephone numbers of Ministers, Directors and their advisers and support staff.

Where do you seek advice on solar-terrestrial work?

The Scientific Council on the Problems of the Physics of Solar-Terrestrial Interactions (in Russian : Nauchny Sovet Po Probleme Fizika Solnechno-Zemnykh SVYAEY) is listed. It also has the shortened title of Sovet Solntse-

Zemlya ie "Council of Sun-Earth".

This council co-ordinates all Russian solar terrestrial work including research with satellite-borne instrumentation.

As a guide to would-be users of this Directory, one should *always* write to the Scientific Secretary of such Councils. Not only is it Russian protocol, it is the Secretary's function to channel and

handle all correspondence.

The Directory is prefaced with a series of briefs and interviews starting with a summarised history of the Soviet Space Industry. This contains several names very familiar to the reviewer eg Korolev, Glushko, Chelomei, Yangel.

There is a sobering note in this overall preface. Originally these energetic designers controlled huge empires. Although recast into Scientific Production Associations (NPO) these were still far too large for viable aerospace business - a "small" NPO had 50,000 or more employees.

This overburden has been reduced by 30% between 1988 and 1993. But the painful truth emerges in an interview with Yuri Koptev the Director General of the Russian Space Agency (RKA).

The original Soviet Space Organisation covered 600,000 space-related jobs.

This must be reduced to 180-200,000; the obvious difficulty is managing the absorption of the remaining 400,000 engineers and technicians, all of them professional or highly skilled personnel.

Educational matters are also well covered with about 145 Universities and Institutions specialising in space and space-related matters fully listed.

As further clarification, the "old" Communist town and city names are listed together with their "modern" (usually original) counterparts.

So who might use this very informative Directory? It is an obvious 'must' for Western business industry seeking Russian expertise, cooperation and partnerships - not only in the space or space related disciplines.

The purchase price is too high for the majority of educational establishments - but major Universities engaged in front end technology on a wide range of disciplines would find this Directory a useful library addition, as would various Societies and Institutes interested in spaceflight and its auxiliary applications.

To sum up, this Directory opens doors to an Aladdin's cave of Russian Space Technology Groups and Institutes.

It represents the culmination of a great deal of research and enquiry and is a publication that the techno-business sec-

tors of the west have long awaited.

Regular updating along the lines proposed should enable western eye properly to focus on the breadth, strength and abilities of the Russian Space Industry. No longer do we have to extrapolate from satellite or aerial images - the information is there at the end of a telephone or fax or postal letter.

Background of the reviewer

Mr Lawton, President of the BIS, is a Retired Chief Engineer of a very large UK Electronics concern and has spent over 45 years in the avionics and aerospace industry. He is an ex-member of the Barnes Wallis Research Team.

He is also a member of the Institution of Electrical Engineers and a fellow of the Royal Astronomical Society.

"Telescope Power", Gregory Matloff, 115p., published by John Wiley, £8.95, ISBN 0 471 58039 2, paperback

This book is an interesting hybrid of two formats which are usually presented as distinct books in their own right: the history of the telescope and how to use it, and a list of relatively simple activities and projects that amateurs can carry out.

The author is a consulting astronomer for the New York Department of Parks and Recreation. He writes with great clarity, and readers will soon find themselves pulled along by his easy style.

This book is divided into seven sections, ranging from the history of the telescope, to how to select the best instruments and tips on how to get the best out of planetary and solar observing. The text is laid out in a user friendly manner, with dozens of short sub-headings. Interspersed with these are a total of 52 very worthwhile experiments or projects (call them what you will) ranging from recognising constellations, to observing refraction and estimating magnitudes, constructing a solar projection screen, observing the Andromeda galaxy, using a star atlas, telescopic observations of the planets, comparing lunar features and making your own finder cards. This element of the book alone makes it an attractive proposition for AAE members.

In recent years there has been a growing public recognition of the important historic role played by women astronomers. In keeping with this, the author includes an interesting passage on Annie Cannon, an American spectrographer who analysed the spectra of 500,000 stars in the first half of the 20th century.

As this is an import, the book is rounded off with a list of companies in the USA which sell astronomy equipment. There is also a handy glossary of common astronomical terms.

On the negative side, there is a typographical error on p.10; Saturn circles the Sun in 29½ years, not 25. The author states later on that Jupiter only needs to

be 'a few times' its present size to become a star. Surely the agreed figure is 50-100 times? He also believes that Pluto may be an enormous comet. Agreed, the planet is peculiar, but I don't believe that anybody would seriously go along with this theory.

I would like to have seen fewer pencil sketches and more photographs breaking up the text, as the former tend to lend a slightly cheap look to what is otherwise an excellently presented book. Finally, it is surprising that the publishers didn't see fit to include in a book all about the power of a telescope any pictures of what various celestial objects look like through amateur telescopes.

All this aside, though, I can recommend this book to beginners or the rather more experienced amateurs who are looking for some activities that will test their observational skills.

Steve Tidey

"Sky Phenomena", A guide to naked eye observation of the heavens, by Norman Davidson, Pub. Floris Books, Edinburgh, ISBN 0-86315-168-X. Paperback. Price £12.99

What can be left in an astronomy book after alluring colour photographs, the star charts, the sections on telescope construction, space exploration, galaxies and modern cosmology have been removed? The answer can be found in *Sky Phenomena* by Norman Davidson, written for the 'conscious' (reflective) naked eye observer for whom a basic understanding of the motion of the heavens is of more interest than f-numbers and apertures.

Norman Davidson is a teacher of teachers and this book grew from his teaching notes used when teaching in Waldorf schools both in the UK and USA. The first half of the book uses the celestial sphere and observer's horizon to describe and explain the motion of Sun, Moon, planets and stars as might be noticed by an interested naked eye observer. Each idea is supported by several simple line drawings and to maintain variety the reader meets sections on mythology, comets, meteors, the Copernican revolution and the southern hemisphere. The second half presents a 42 page literary potpourri called 'The stars in poetry'. Collected together is a delightful range of short pieces, limericks, poetry and prose, each with astronomical reference. They range from an ancient Indian Hymn to a riddle from the Shetland Islands. One of my favourites is a piece from the North American Indians of Nebraska:

*Look as they rise, up rise
Over the line where sky meets earth;
Pleiades!
Lo! They are ascending, come to guide
us,
Leading us safely, Keeping us one;
Pleiades,
Teach us to be, like you, united.*

The book ends with a number of

appendices including glossary, dates of astronomical events and resources. Norman Davidson has produced a book which is technically accessible to the interested casual observer whilst being an enlightening resource for anyone interested in astronomy and in particular astronomy education. For students and teachers here is an educational resource. For deep-sky fanatics here is a back to basics book to bring you down to Earth when your CCD is clouded out. Recommended.

Bob Kibble

"Elementary Problems and Answers in Solar System Astronomy", by James A. Van Allen, published by Gerald Duckworth & Co. Ltd., 1993, ISBN 0-7156-2494-6. Paperback. £12.99

Professor Van Allen is best known to the public at large for his discoveries in space physics, and in particular for the radiation zones surrounding the Earth which bear his name. His qualifications to teach courses in Solar System Astronomy are self-evident, and this book is a distillation of questions from his quizzes, examinations, classroom discussions and homework assignments over a time span of seventeen years.

There are 924 questions and answers listed, but several questions are virtual duplicates of related ones. Some editorial judgement in weeding out these near duplicates would have reduced the size of the volume without significant loss of information. Many of the questions are fairly simple ones about planetary motions or the celestial sphere. The predominant style of multiple-choice questions may not be to everyone's taste, but these can usually be reworded to test knowledge of the same facts and principles. To this reviewer, the real gems are the clear derivations and discussions given for topics such as elliptic motion, Newtonian attraction by a spherically symmetric body, definition of mean distance from the Sun, gravitational assist of a space probe, tunnels through the Earth's core, why a rod would orbit the Earth along a radial line, sundials, shapes of minor planets, limits on the maximum heights of mountains, the tidal Roche limit, radar astronomy, optics and many others. These alone are worth the price of the book.

Errors in such a work ought to be rare and indeed mistakes appear to be extremely few. No. 645 asks for a deduction (which substances would be gaseous in Pluto's atmosphere?) based on supplied freezing temperatures. It would be more logical to have supplied boiling or sublimation temperatures! The answer to No. 39 (what is the single most significant objection to Ptolemy's model of the solar system?) is given as its incompatibility with Newton's laws. An earlier and more decisive objection was raised by Galileo's observations of the phases of Venus: it could never look gibbous or full in the Ptolemaic scheme, but this was expected in the Copernican one, quite independent of dynamics.

The book is not ideal in other respects. In answering dozens of problems that required a computed result, the author's practice was to supply the numerical answer with no indication of the methods or equations used. Though most teachers ought to be able to do most of these problems, it was felt that in at least some cases brief summaries of relevant formulae would help to overcome potential difficulties. The wary teacher should also be careful to re-cast certain questions in SI units; Americans are even more addicted to Imperial measures than Britons. Finally, the book has no index, which would have been highly useful.

The most likely buyers of Van Allen's book will be secondary school and university teachers who need to teach general astronomy and solar system physics in their A-level and degree courses. But perhaps it shouldn't be placed in the school library, as an enterprising student might then be able to glean all the answers to the next homework paper!

Mike Dworetzky
University College London

"Stars and Planets", a Collins Pocket Guide, by Ian Ridpath and Wil Tirion, Harper Collins publishers, 384pp (2nd edition), ISBN 0-00-2199-3

Englishman Ian Ridpath contributed the text for this book, and the Dutchman Wil Tirion provided the illustrations. This second edition is an improvement on the first, in both layout and content. As well as being a detailed catalogue of almost everything astronomical, not only the stars and the planets of the title, it is quite a readable publication. The introduction of Section 1 starts from scratch, and the newcomer to the subject will find it informative to begin reading here, and going on steadily throughout the book. But it may also be used as a work of reference: star charts for a range of dates, and for both northern and southern latitudes, occupy about one fifth of the book. The quality of these charts, and of the many assorted photographs, is high. There is an extensive index (5 pages). There are sections on stars (of various kinds), galaxies, the Sun and Moon, eclipses, the planets, comets and asteroids. The last two sections deal with astronomical instruments and astrophotography. I would certainly recommend this book to amateur astronomers of all ages.

Despite the excellence of the book, I have a number of criticisms. Firstly, the "pocket guide" will not fit into the pockets of most individuals. Secondly, and perhaps most important, the binding of the work has been carried out in such a way that it is impossible, without damaging the book, to open it out flat (it springs back when released!) Thirdly, page numbers are absent wherever a chart or photograph comes down to the edge of the page, so that one has to count pages from the last numbered page. Still good value for money, nevertheless.

Eric Zucker

COLD FACTS FOR COLD NIGHTS

by Roger O'Brien

It is unfortunate that the longest nights of the year coincide with Christmas. This means that a good many amateur astronomers are too busy opening presents, visiting relatives and consuming lots of lovely food and drink to do much observing. You have to get past January 1st to give the Scots a chance to enjoy Hogmanay. It is my subjective impression that the nights of the early new year are the darkest, but they are lit by the most dazzling group of constellations we see. Just look south on a clear night and try to avoid seeing Orion, Gemini, Taurus, Auriga and, in the otherwise unremarkable Canis Major, Sirius - the brightest star in the sky.

At eight and a half light years, Sirius is a good star to use as an illustration of distance, when dealing with Cubs, Brownies or other groups of young people, who might be interested. Eight and a half is the sort of number they will be familiar with. One of them might be roughly that age so, for all of that child's life, the light that they are now seeing has been speeding across the depths of interstellar space to reach them. By contrast, the Sun is only $8\frac{1}{2}$ minutes away as the light ray travels. There isn't anything reliably $8\frac{1}{2}$ seconds distant and the best bet is to settle for the Moon at little more than a second. Of course, it is quite a job to give some idea of just how fast light travels. I have tried the four and a half times round the world in a second routine, but it doesn't seem to work very well. There is another useful number in the same area. It does not do too much violence to the truth to describe Rigel as being "nine light centuries distant" and, of course, "Beetlejuice" is at least 8.5 (you could try introducing a bit of decimal notation as well!) light minutes in radius. While you are explaining all this, you are hammering home the fact that light years (and days, hours, minutes and seconds) are measures of distance.

I have also used a prepared tape to illustrate the scale of our Solar System. You have a spare cassette machine running while you talk and explain that your young audience must imagine a ray of light has just left the Sun. After $3\frac{1}{4}$ minutes, it crosses the orbit of Mercury; $2\frac{1}{2}$ minutes later it passes Venus; $2\frac{1}{2}$ to Earth; 5 more to Mars and 45 minutes from the start gets you all the way to Jupiter. To be honest, if you get this far, you may well have talked for too long. You can signal each planet by a simple beep or by a snatch of the appropriate section of Holst's 'Planets' suite.

Sirius is about 25 times as bright as the Sun. It has a faint companion. Because Sirius is known as the 'Dog' star, the companion is sometimes nicknamed the 'Pup' or, more respectfully, 'Sirius B'. Alvan Clark discovered it in 1862, while working at the US Naval Observatory in Washington. It soon became something of a scientific curiosity because it has a spectral type very similar to Sirius A (they are both in class 'A') yet Sirius A is

dominantly bright and Sirius B needs a good instrument and technique to find it amid the glare of its brighter primary. Similar spectral type means similar temperature and, therefore, faintness means smallness. Sirius B is no more than four times the diameter of the Earth, smaller than any of the gaseous, outer planets in our system. The two stars are near enough to us for their motions across the sky to be detected and plotted. They are clearly in mutual orbit and you can calculate their masses from the way that B moves, about 3 times as far on the median line as does A. Sirius B has about the same mass as our Sun.

Do the sums and it is clear that Sirius B is incredibly dense - a million grams per cubic centimetre! A thimbleful of White Dwarf matter, if brought to the Earth, would weigh a ton. This is not the densest form of matter we know: pulsars are neutron stars with masses of no more than a few times that of the Sun. Yet these strange collapsed stellar remnants are only a few tens of kilometres across. Technically, white dwarf matter is called 'degenerate'. This means that the electrons act like a liquid that cannot be further compressed. Subrahmanyan Chandrasekhar looked into this situation and worked out that a white dwarf cannot have more than about 1.4 solar masses or the electron liquid collapses under its own weight.

The dwarf was formed from when a somewhat larger star used up the hydrogen fuel in its core. Briefly, it burned some helium into carbon while the core shrank and grew hotter. The outer layers of the star probably escaped to form a 'planetary' nebula (a short-lived, but often beautiful, sphere of gas surrounding the star). The exposed shrunken core remains, initially very hot, perhaps up to $100,000^{\circ}\text{K}$. It is so small that it cools only very, very slowly over billions of years. The Milky Way Galaxy is not old enough for any of its white dwarfs to have cooled completely.

The brightest stars of, say, Orion or Taurus are mostly large and massive. Some of them are very bright. Rigel is tens of thousands of times as bright as the Sun. Aldebaran and Betelgeuse (the official name of Beetlejuice) are massive stars that are teetering on the verge of dramatic changes. Their bloated red surfaces conceal degenerate cores, which may collapse and power supernova explosions. It may be that they will continue to shed matter into dusty clouds around them and escape this violent fate.

It is worth remembering that the stars of Orion's belt are roughly as bright as Rigel, which looks so much brighter to us. Rigel is nearer. I once received a 'phone call from a very worried gentleman. He had seen a formation of three UFO's hovering over the southern horizon. He would not accept my identification of this formation as Orion's Belt!

ASE ANNUAL MEETING

ASE annual meeting and conference in Birmingham from 7-9th January 1994. AAE will be present and will contribute:

- (a) a free workshop on Post-16 Astronomy (Friday, 4.30-5.30pm).
- (b) an Inset course on Sunday 9th January, on Key stage 4 Astronomy, in parallel with a workshop and "brainstorming question time".

Further details from ASE or Dr. Anne Cohen, 9 Hurst Lane, Bollington, Nr. Macclesfield, Cheshire.

ASTRONOMY IN POLAND

A student at the University of Gdańsk, Poland, has appealed for assistance in developing his astronomical career - he says he is observing at the University and is interested in a variety of astronomical topics, in particular the Solar System. The staff at the Observatory number 15 persons. He wonders whether there are any groups in the UK (amateur and professional) who might help him obtain the information he would like; in fact, other members of his group would be interested in exchanging information.

Interested members should write directly to the student: Adam Gladysiak, PO Box 61, 80-876 Gdańsk 52, Poland.

AAE STUDENT SPONSORSHIP TO THE BRUNEL SCHOOL FOR SPACE EDUCATION

SUMMER SPACE 1994

The AAE will be sponsoring two students to next summer's space school. This premier event is designed to give sixth formers a thorough introduction to courses and careers in the space field. Next year's seven-day programme will include lectures, debates, laboratory and project work, visits to a research lab and space industry, and social events. The course is fully residential and costs £295 inclusive.

Selection of candidates for AAE sponsorship will be by competition. This competition is open to all students in the appropriate age range who:

* attend a school or institution affiliated to the AAE

OR

* whose application is endorsed by a member of the AAE or the AAE contact within an affiliated school or institution.

Unfortunately we are not able to fund the entire costs for both successful candidates, but it is past experience that further sponsorship can often be raised locally. The sponsorship we are offering is £200 for each winner.

The Competition - "Living in Space"

Imagine the problems of living in space! This could be in a space station or in a lunar or Martian colony. Your work on this topic could take the form of an essay about the design of the station and the practical problems of coping with life away from Earth OR could be artwork showing the detailed design of such a space station. Essays should be not more than 1,000 words, or artwork should be not bigger than poster-size so that it can be submitted rolled in a cardboard tube.

Submitted work should be accompanied by:

- * a completed application form
- * a short written reference from the candidate's teacher
- * written parental permission to attend the Summer Space 1994, if successful
- * the endorsement by AAE member or other, as specified above.

***The closing date for receipt of entries is
Friday 15th April 1994***

The winners will be announced at the AAE 1994 Annual General Meeting in early May 1994. The decision of the judges, appointed by the AAE Council, will be final.

Application forms and further details of Summer Space may be obtained from: Dr. A. Cohen (President), The Association for Astronomy Education, 9 Hurst Lane, Bollington, Macclesfield, Cheshire SK10 5LN.

LIVERPOOL ASTRONOMICAL SOCIETY

SYLLABUS FOR SESSION BEGINNING JANUARY 1994

- | | |
|-------------|---|
| January 21 | Mr. George Isaacs. Title to be confirmed. |
| February 18 | Dr. Alex Raga, UMIST. Title to be confirmed. |
| March 18 | Professor Archie Roy, University of Glasgow. "How to Speak ET". |
| April 15 | Ann Bonell, "Ladies of the Night" - (Women Astronomers). |
| May 20 | Annual General Meeting. Followed by Members' Slides and Films. |

All meetings commence at 7.00pm in the Liverpool Museum Lecture Room, William Brown Street, Liverpool, except as might otherwise be announced. Further details from the Hon. Secretary, Mr. K. Clark, 31 Sandymount Drive, Wallasey, L45 0LJ.

THE ASTRONOMICAL SOCIETY OF GLASGOW

CENTENARY PROGRAMME FOR 1994, JANUARY - APRIL

- | | |
|-------------|--|
| January 20 | MEMBERS' NIGHT
Videos, Slides, etc
Room M413, James Weir Building,
Montrose Street |
| February 17 | UNDER THE WIDE AND STARRY
SKY
Dr. Russell Eberst
Room M403, James Weir Building,
Montrose Street |
| March 17 | FOLLOWING IN LUNAR
FOOTSTEPS
Mr. Robert Law
Room M403, James Weir Building,
Montrose Street |
| April 21 | COMETARY TALES
(Annual General Meeting)
Dr. Fiona Vincent
Room M403, James Weir Building,
Montrose Street |

Ample opportunity is given for questions and discussion. Subscription rates are £8 (adults) and £3.50 (under 16s). Regular access to local observatories (members only). Meetings are on Thursdays at 7.30pm, and are free of charge. Further details from Robert Jackson, 97 Curzon Street, Glasgow G20 2HB.



SPACE - LINK

Compiled by Nik Steggall

MICROGRAVITY ROOM

NASA's astronauts scheduled to wear spacesuits for extra-vehicular activities train in the Weightless Environment Training Facility (WETF). The WETF is a swimming pool large enough to hold a Space Shuttle payload bay mock-up and mock-ups of satellites and experiments. Since the astronauts' spacesuits are filled with air, heavy weights are added to the suits to achieve neutral buoyancy in the water. The facility provides an excellent simulation of what it is like to work in space with two exceptions: in the pool it is possible to swim with hand and leg motions, and if a handtool is dropped, it falls to the bottom.

SPACE DEBRIS PROBLEM

The European Space Agency (ESA) held the first European space debris conference at Darmstadt, Germany, from 5th to 7th April, 1993. Attending were 251 world experts from 17 countries including China, India, Japan, Russia and the USA.

Three main conclusions were arrived at from the conference. Firstly, that ground-based observations with radar and optical facilities reveal the existence of about 7,000 objects in space, which do not represent an immediate danger. Adequate actions however should be taken to keep the debris hazard for manned and unmanned missions to within safe limits. Of most concern are the long-term prospects of the debris hazard, mostly in the regions which are heavily used such as low Earth orbits between 900-1,500km and in the geostationary orbits around 36 000km.

It was also decided that the clean-up of debris was neither technically nor economically feasible. Therefore the brunt of the action should be towards preventing the creation of the debris. Several preventative measures can be taken and implemented. One is the releasing of residual propellant in the upper stages of the launch vehicle to prevent a subsequent explosion and so causing many orbital fragments. Also the re-orbiting to higher orbits of geostationary satellite at the end of their mission could be taken to avoid collision with other satellites. Other possibilities include the destructive re-entry into the atmosphere to burn up the spacecraft such as occurs with the Russian Progress spacecraft which supplies the orbital space complex MIR or the selection of orbital parameters to limit the lifetime of the satellite. Whichever method is used, the space debris problem can only be solved effectively by international co-operation. Since 1987, bilateral discussions between space agencies have taken place to present results of their research activities, to identify possibilities for co-operation and to discuss methods for debris reduction.

There is much action to be taken with this problem and the realisation of the debris problem is a major step in the way to solving what could be a disastrous situation.

THE PLANET MERCURY

Even the best telescopic views from the Earth have shown Mercury as an indistinct blob lacking in surface detail. The planet is so close to the Sun that it is usually swallowed up in the Sun's glare. Although Mercury may be seen briefly on Earth's horizon just after sunset or before dawn, it is obscured by haze and dust in the Earth's atmosphere.

NASA's Mariner 10 spacecraft provided sharp pictures of about half of Mercury's surface and much other new information about the planet. The pictures reveal a desolate heavily cratered surface, the scars of impacts of huge meteorites that occurred billions of years ago. In many respects the surface resembles that of our own Moon. No volcanic activity or atmospheric erosion has occurred apparently since early in Mercury's lifetime, more than three billion years ago.

Mariner 10 discovered a trace of an atmosphere on Mercury. A trillionth of the density of the Earth's, it is composed chiefly of argon, neon and helium.

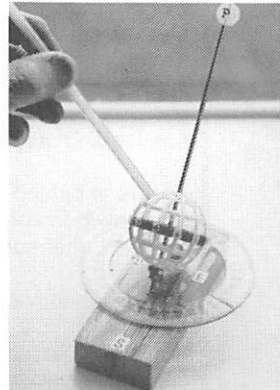
Mercury's magnetic field is only a hundredth the magnitude of the Earth's. It can divert the solar wind but cannot capture atomic particle radiation and create an intense radiation zone like the Van Allen radiation belts around the earth.

Mariner 10 reported Mercury's temperature to range from 510° Celsius on the sunlit side to -210° on the dark side. The planet is literally baked by day and frozen by night.

Life on Mercury is probably unlikely because of the absence of water, temperature extremes and the lack of a livable atmosphere.

SOMETHING FOR A CHRISTMAS STOCKING

My cat Leo, born under that sign of the Zodiac, invariably insists on accompanying me whenever I venture out to do a bit of sky watching. While looking round our local pet shop recently, I noticed a stock of cat toys at 24p each. These struck me as being ideally constructed to form the basis of a miniature star globe. I bought two of these toys, one for my cat and one for me to play with and adapt as a pocket star globe (see photograph) that might help sky watchers to identify celestial objects by finding their Right Ascensions and declinations at any particular time.



The toy has a small hole at each of its poles, through which a knitting needle can be passed to serve as the polar axis of the star globe. Radiating from the poles are twelve RA circles, spaced at intervals of 2-hour angles. The model has a well-defined equator, round which the RAs can be marked. Declination circles from 0° to 90°N and 90°S are shown in the photograph. The pocket star globe is shown mounted with its axis inclined to the horizontal base at an angle equal to the latitude of the

user. The model is shown set for use on December 18th at 22.00 Local Mean Time, for which the Sidereal Time is 04^h00; the RA circle of the model for 04^h00 is set on the meridian.

To locate a particular star or celestial object, for example the galaxy in Andromeda (M31), which has a RA 0^h41^m and declination 41°16', hold and point a knitting needle or a drinking straw at the globe in the direction which follows the line from the centre of the sphere to the point on the sphere defined by the RA and declination of M31, as shown in the photograph. The straw then points to M31. In addition, the straw indicates both the altitude and the azimuth of the body. A small circular protractor positioned with its 0°-180° line in the meridian makes a useful azimuth circle.

Readers who use altitude-azimuth graphs or calculators to find star positions will derive interest and satisfaction in checking the admittedly approximate positions provided by the pocket star globe.

Robert Mills

UNDERSTANDING GRAVITY - A WEIGHTY PROBLEM

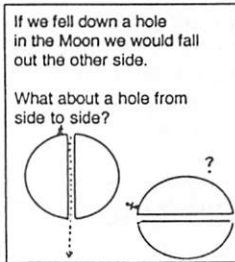
by Bob Kibble



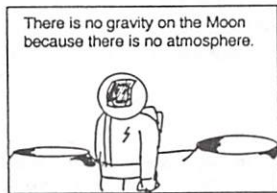
Gravity is an elusive character. Being a word in common use its understanding is often taken for granted. The recognition that objects fall "because of gravity" or that "gravity gives things weight" might be seen as a sign that a pupil has understood or

appreciated gravity. I have known students of A level physics who cope with inverse square laws and gravitational potentials but who still think that orbiting astronauts are weightless because their weight and the "outward force" keep them in a sort of equilibrium. Whilst it is fair to say that few science teachers are comfortable with gravitons or general relativity most of us have a working understanding of the radial nature of gravitational field.

I have used a set of true or false test cards to initiate discussion about these issues at teacher inset sessions. Here are some of the test situations which explore misconceptions about gravity.

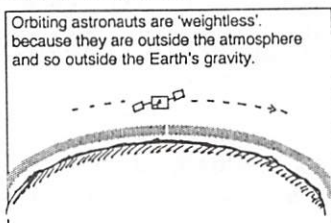


Getting pupils to draw pictures of the Earth can help to identify misconceptions. At key stage one the following

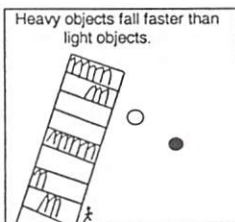


clues can be revealed:

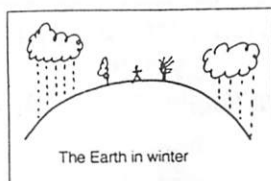
The first of these sketches displays the idea of an absolute "down". The second is a way of exploring and challenging this notion.



Finally the story of the person in a lift. The notion of "apparent weightlessness"



has always puzzled me. Why apparent? I would rather the weightlessness be real and so would my students. This is quite simply achieved by defining the weight of



a person as the upward "reaction" of the ground or, in my illustration, the weighing machine. In Fig 1 the weight = mg equality is not a definition, but a statement of Newton's first law ($mg - W = 0$). In Fig 2 the lift accelerates downwards at a $< g$ ($mg - W = ma$). The final situation has the lift and contents in free fall. $W = 0$ ($mg - 0 = ma$). Here we see that the per-



Sky Diary Winter 1993-4

By Fiona Vincent

The Winter Solstice was on Tuesday December 21st, when the Sun reached its most southerly point in the sky. From now on, we see more of the Sun each day.

The Spring Equinox is on Sunday March 20th. At this point the Sun crosses the celestial equator, and moves into the northern half of the sky.

PHASES OF THE MOON:

	Last ¼	New	First ¼	Full
January	5th	11th	19th	27th
February	3rd	10th	18th	26th
March	4th	12th	20th	27th

The Moon is most easily viewed around First Quarter and up to Full Moon at this time of the year.

PLANETS:

Mercury is behind the Sun at the start of January, but appears in the evening sky at the end of the month. It should be fairly easy to find in early February, low in the south-west just after sunset. It disappears in front of the Sun on February 20th. After this, Mercury moves into the morning sky, but it will be rising only minutes before sunrise and probably won't be visible.

Venus is behind the Sun in January, and comes back into view only gradually. It will probably become visible some time in March, shining like a brilliant "Evening Star" in the west after sunset.

Mars is effectively hidden behind the Sun throughout the first quarter of 1994.

Jupiter begins the year in the morning sky, rising some hours before dawn. It rises a little earlier every night, so by the end of March Jupiter is coming up about 10pm (GMT). It's easy to recognise, being brighter and steadier than any of the stars. Binoculars will show some of its moons as tiny points of light close beside the planet.

Saturn may be seen at the start of January, setting in the south-west shortly after sunset. It disappears behind the Sun in February and still won't be visible in March.

INTERNATIONAL PLANETARIUM SOCIETY

1994 Conference at Cocoa Beach, Florida, July 1994

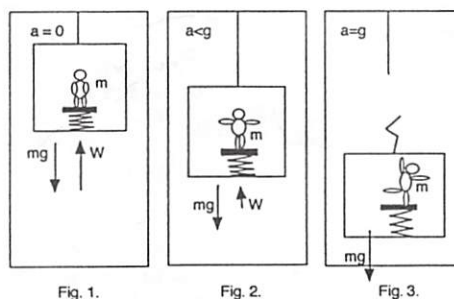
Registration Fee \$218 per person

Accommodation at the Howard Johnson Plaza Hotel - \$70 a night.

Further details from Undine Concannon, The London Planetarium, Marylebone Road, London NW1 5LR (071-486 1121).

son is actually weightless. There is no need for any "apparent" confusion.

Weight is what is read by a weighing machine. The attractive force due to gravity, mg , is not compromised in this approach. I first submitted this analysis to an editor in 1978. It was received with some ridicule. I was heartened recently to find an almost identical letter in a back issue of a science education journal from 1958. Perhaps it is not such a crackpot idea after all.



PRACTICAL ASTRONOMY,

by Robert Mills

A preliminary announcement

A leaflet describing this book, by Robert Mills, is included with this issue of *Gnomon*. It will be reviewed in the next (Spring 1994) issue.

ONE THOUSAND KILOMETRES ... !

A model, made out of strips of paper, which gives an idea of the large distances involved in astronomy, has been designed by Karenza Burk. We do not have the space available to print the details, but if anyone would like a copy of the article, a photocopy will be sent on receipt of a stamped, addressed envelope.