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*

ALL CHANGE IN THE EDITOR'S CHAIR

I am sure that I speak for all AAE members in heartily thanking Alex Barnett for all her hard work during her occupancy of the Editor's chair. She has provided us with many very interesting issues, and she has not bowed out yet, as you will see overleaf. My details are in the column on the right.

I would just like to reinforce what several past Editors have said, that *Gnomon* is produced to help you in astronomy education and to keep you in touch with others with similar responsibilities The continuing success of this publication is assured if we share our experiences, and don't leave all the effort to a few reliable regulars - so please send in items of news, practical tips, problems, or interesting articles that will help others in this area.

One early introduction that I am making in this issue is what I hope to be a regular letter from a young professional astronomer who works on the mountain tops in Hawaii (what a drag!) in one of the most important observatories of the world. I hope that his experiences will prove both interesting, and a possible firsthand inspiration to those who are looking at astronomy as a possible career and want to get a feel for what is going on, and what astronomers actually do.

As the designer and operator of the portable planetarium that I described in *Gnomon* some years ago, I am particularly interested in practical demonstration aids of all kinds for teachers and demonstrators, so this is an area in which I would welcome more contributions (see the photo of Francisco Diego below).

Finally, as we are now within a year of the first total solar eclipse to be visible from mainland Britain for nearly 72 years, the degree of interest is accelerating rapidly, so for the next issue or two let's have your experiences, comments, tips and questions as soon as you can. There are quite a few items on this topic in this issue with which to get going.

Looking forward to hearing from you.

Richard Knox

WHEN THEY LINE UP, IT ALL HAPPENS!

Francisco Diego, Vice President of the AAE, demonstrating his model to illustrate principles of a total eclipse of the Sun.

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.

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These are at the equinoxes and the solstices, that is four times a year.
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For your information

ECLIPSE NEWSPAPER COMPETITION FOR SCHOOLS

The Royal Astronomical Society is running a competition for groups of pupils to produce a newspaper as if written on that momentous day. Age ranges 7 - 11, 11 - 14, 14 - 16 and 16 - 19 years. The closing date is *Friday 12th November 1999.*

Timetable for 1998/99

Summer Term: Learn how to project an image of the Sun, plan what photographs to take and any experiments or observation to do. Collect material about previous eclipses and the science of eclipses.

Eclipse Day: Take photographs, perform experiments and make notes as planned. Observe safety precautions.

Autumn Term: Select material and write up the newspaper.

An information sheet is available from the Internet at http://www.ras.org.uk/ras, or by post from: Eclipse Competition, Royal Astronomical Society, Burlington House, Piccadilly, London, W1V 0NL.

ASSOCIATION FOR SCIENCE EDUCATION OFFERS RESOURCES

The ASE is to publish two workbooks for the eclipse, one for primary and one for secondary schools. Each will contain background information and lots of thing to do in class and at home. Publication is expected by December 1998.

Contact: ASE, College Lane, Hatfield, AL10 9AA, or Telephone 01707 267411: Fax: 01707 266532.
e.mail: ase@asehq.telme.com

The ASE Annual Meeting will be held at Reading University on 7 - 9 January 1999 and the AAE will be taking an active part. On Friday 8th, there will be training sessions for the 1999 Eclipse. On Saturday 9th, there will be a morning session on Sixth Form Astrophysics and an afternoon session on Middle School Earth and Beyond teaching.

The programme is available from the above ASE address and telephone etc. as above.

UK SEA AND SPACE WINNERS

Congratulations to these winners of the UK Sea and Space Competition. Anna Fidalgo, Suzie Wiseberg and Ailsa Longmuir of Withington Girls School, Manchester, are going to Lisbon to compete in the finals.

"ORDERS OF MAGNITUDE" POSTER COMPETITION

The Institute of Physics competition to create an A3 poster on the theme "Orders of Magnitude" is running this autumn. The closing date is 30th November.

Open to students from age 14 to 19, the poster must show the range of some part of nature from the smallest to the largest. The poster must use a logarithmic scale to represent the enormous range covered.

Alan Pickwick comments that astronomy linked to particle physics is a rich area for material, and hopes that AAE members will actively encourage entries.

OBSERVATIONS

ECLIPSE IS A UNIQUE OPPORTUNITY IN SCIENCE EDUCATION

Next year's total eclipse of the Sun will be a major vehicle for science education in 1999 and there is no time like the present to start your activities. The most obvious one is to start monitoring the Sun. Using one side of a pair of binoculars to project the Sun's image safely onto a screen (see page 5), a whole group of children can take part. The number of sunspots is likely to increase during 1999. You can make sketches of the spots from day to day. They take more than a week to cross the Sun's face.

You can compare your results with the mass of information on the internet. Recently the most useful resource has been the SOHO satellite. Unfortunately, in June, a series of command errors lead to contact being lost but attempts to reestablish contact continue. You can follow the saga on the internet, which will also lead you to many other solar resources. (http://sohowww.estec.esa.nl/)

Now I can hear you saying that the eclipse will not be total at your school and anyway it will be during the holidays. No excuse! In Manchester the Sun will be 90% covered and even in the North of Scotland it will be 70% covered. So this is going to be a major event! Use the momentum to raise interest in the Sun and its effects on the Earth. Plan activities that your pupils can do at home on the day.

Alan C. Pickwick

REVIEWS

A Practical Guide to CCD Astronomy *Patrick Martinez and Alain Klotz. Cambridge University Press 1998. ISBN 0 521 59950 4. £16.95* Towards the end of the last century, astronomy was revolutionised by the introduction of photography. Similarly, at the end of this century, another revolution has taken place; photographic plates have been replaced by silicon chips.

A charge coupled device (CCD) is a silicon wafer, a few millimetres square, that has diffused into its surface an array of photodiodes. These diodes store charge according to the amount of light that falls on them. When an exposure is complete, the charge in

each element of the array can be measured and that value stored in a computer memory. From there, all types of image processing are possible. The devices are more sensitive than photographic plates and data is much more easily handled.

The book is aimed at the keen amateur or the advanced student and covers most aspects of the use of CCD detectors. It does so in a detailed but nonmathematical way, showing how light is recorded by the CCD and how the data is transferred to a personal computer. It deals with mounting of the CCD on the telescope and the arrangements to keep it cool (CCDs produce much less background noise if cooled well below freezing point). It also covers the techniques of imageprocessing by personal computer.

An observatory with a 10 inch telescope, CCD camera and a personal computer can now be set up for a few thousands of pounds. The images it can produce are close in quality to those of the professionals just a few years ago. If you want to embark on such an exciting project and perhaps discover a supernova or planetesimal, this book is an excellent starting point.

SLIDES ON LIGHT POLLUTION

The Astronomical Society of the Pacific has available a set of 20 slides and an information booklet on the topic of light pollution. Although USA biased, the slide set covers a good range of topics, with satellite photographs of the Earth (spot your own town!), skyglow above a city, poor and ineffective lighting, spectra of streetlights and some interesting "before and after" images. In the booklet there is a good overview of the topic and a detailed description of each slide.

Order code AS 294. Price $26.95 + p&p. Fax credit card details to The Astronomy Society of the Pacific, 390 Ashton Avenue, San Francisco, California, 94112, USA. Tel: [Intl.]+1 415 337 2624. Fax: [Intl.] +1 415 337 5205. Website: http://www.aspsky.org

Alan Pickwick

PPARC SMALL AWARDS SCHEME - ROUND 98A

This is a summary of Public Understanding of Science projects funded by PPARC this spring, in our 'Small Awards Scheme'. Full contact information is given for each principal applicant, to enable best networking and for sharing ideas and resources. The next closing date is October 10. Details can be obtained from pr_pus@pparc.ac.uk or 01793442123.

1. Mr David Agnew, St Monica's High School, Bury Old Road, Prestwich, Manchester M25 1JH. Tel: 0161 773 6436 Fax: 0161 773 6650. £2857 for a Bury School's LEA Astronomy project. This will include a Meade LX200 Telescope as part of a dedicated astronomy centre at Bury Teachers Centre. There will be a display and teacher training package to support INSET training for science teachers in the region. There will also be links with the local Amateur Astronomy Centre and the Salford Astronomical Society in further "outreach" programmes.

2. Mr Spencer Allen, Breckland Astronomical Society, c/o 18 Baxter Rd, Hingham, Norfolk NR9 4HY Tel: 01953 85571 Fax: 01953 850804 email: c/o avondale@compuserve.com £1320 for "Project ORACLE" (Observing, Recording, Automated Celestial Learning Experience).

This is based on Cambridge Astronomical Association's "Project Odyssey" and includes a system comprised of a telescope, CCD camera, wide angle lenses, video projector and screens, taken to local venues, including over 70 Norfolk schools. Other venues will include scout and cub groups, local societies, evening classes, disabled groups, and society open nights.

3. Dr Toby Clark, British Geological Survey, West Mains Road, Edinburgh EH9 3LA Tel: 0131 650 0231 Fax: 0131 668 4368 email: t.clark@bgs.ac.uk £3672 toward the PUS's around a sailing expedition "In the Wake of the Paramore".

This is inspired by the 300th anniversary of Atlantic voyages of astronomer Edmund Halley to measure the Earth's magnetic field. The PUS' part of the work will include a Website about the project and the background science, including current PPARC and NERC - funded research, and writing articles for newspapers and magazines. It is hoped that the new voyage will inspire many people's interest in the Earth's magnetic field and our planet's near environment.

4. Ms Felicity Ford, Science Line, Union House, Shepherds Bush Green, London W12 8UA Tel: 0181 7355049 Fax: 0181 7355099 email: felicity.ford@bss.org £6500 towards a "National Eclipse Line".

Science Line will run a national information service to give the general public information, advice and scientific background about the eclipse, via its telephone and email services and its Website. Staff will have links to scientists (e.g. at major Observatories and University Departments) and to local authorities and tourist boards. The searchable Internet database, "ScienceNet" will contain previous questions and answers about the eclipse and solar physics. The site draws 51,000 page "hits' and 400 email messages per month.

5. Dr Monica Grady, Department of Mineralogy, The Natural History Museum, Cromwell Road, London SW7 5BD Tel: 0171 9389445 Fax: 0171 9389268 email: M.Grady@nhm.ac.uk 5000 towards a display of meteorites at the Museum.

The exhibition will be aimed at the general public of all ages, and will cover many aspects of meteorite research, focusing particularly on British meteorites, meteorites from Mars and micrometeorites. There will be a link to current UK research projects in this area. Specific questions addressed will include: what are meteorites, where do they come from, how old are they, how many fall on Earth,

and where are they found? Parts of the exhibition will be available for touring, and much of the input source material (e.g., text, design drawings) will be freely available to all.

6. Professor Mike Green, Physics Department, Royal Holloway University of London, Egham, Surrey TW20 0EX Tel: 01784 443454 Fax: 01784 472794 email: M.Green@rhbuc.ac.uk £3178 for a new printing of "Particle Physics Summary Sheets' for schools.

In this simple but highly popular and effective idea, six sheets summarising the subject of modern particle physics are made available freely to schools and teachers. There are A3 sets, suitable as posters, and A4 suitable for personal use. The six themes are Introducing Particle Physics, The Structure of Matter, The Forces, Particle Accelerators, Particle Detectors, and Particle Physics & the Big Bang.

7. Dr Philip Hill, School of Physics & Astronomy, University of St Andrews, St Andrews, Fife KY16 9SS Tel: 01334 463107 Fax: 01334 463104 email: pwh@stand.ac.uk £4000 towards a travelling "Astronomy Roadshow' taken to schools and other suitable venues, to promote awareness of the physical sciences, especially in young people.

There is a mobile planetarium and supporting display boards. The Roadshow is also used in teacher education, particularly in connection with the astronomy content in the Scottish primary school curriculum.

8. Mr Roger Hore, Pictorial Charts Educational Trust, 27 Kirchen Road, West Ealing, London W13 0UD Tel: 0181 5679206 Fax: 0181 5665120 email: info@pcet.co.uk £3000 toward the development of a new wallchart "Eclipses' which will cover Solar and Lunar eclipses generally but will also feature the 1999 Solar Eclipse. Public interest in the coming eclipse should stimulate interest in this subject, and the chart should provide educational insight into the nature of this phenomenon and help people understand the nature of scientific research associated with a Total Solar Eclipse.

9. Mr Barry Johnson, Industry Supports Education Ltd, 15 High Street, Wilburton, Nr Ely, Cambridgeshire CB6 3RB Tel: 01353 740389 Fax: 01353 741430 email: barry@iseltd.demon.co.uk £5000 towards an educational project "Modern Particle Physics: Support for GCSE'.

This will provide a school resource to introduce modern particle physics into GCSE Physics and Science courses. It is based on the idea that new science is slow to enter syllabuses and textbooks, sometimes because teachers, writers and syllabus developers themselves may lack confidence in dealing with the new ideas. The project will provide a 16page A4 booklet, which in part will be based on the coverage of the subject in the London GCSE Physics syllabus extension unit "Particles'. However, to broaden the appeal, it will also link to mainstream curriculum content through topics like the nature of scientific ideas, radioactivity, electrostatics, and forces & motion.

10. Professor Peter Kalmus, Queen Mary & Westfield College, London E1 4NS Tel: 0171 975 5042 Fax: 0181 981 9465 email: p.i.p.kalmus.@qmw.ac.uk. £5000 towards the costs of the Institute of Physics' Schools Lecture Tour.

This is a prestigious annual project, with a special lecture being given in about 40 venues around the UK during the 1998/9 academic year. The lecture, entitled "Particles and the Universe' will cover particle physics, astronomy and cosmology, and will be given by Professor Kalmus.

11. Mr William Marshall, Physics UG, Department of Physics & Astronomy, University of Leicester, Leicester LE1 7RH Tel: 0956 628424 Fax: 0116 252 2770 email: wsm1@le.ac.uk (or ukseds.fin@gbnet.net). £300 for the UK SEDS 10th Annual Space Conference.

The UK "Students for the Explorations and Development of Space' will hold this in Bristol on 2122 November 1998; the 1997 meeting was attended by 200 people and provided a good opportunity to increase public interest in space science. The programme will include lectures on space topics, debates, demonstrations, exhibits and a meeting to discuss new initiatives in public understanding of space science.

12. Mr Lee McDonald, Mullard Space Science Laboratory, Holmbury St Mary, Dorking, Surrey RH5 6NT Tel: 01483 204210 Fax: 01483 278312 email: lm@mssl.ucl.ac.uk. £1200 for public understanding of science talks to schools.

Postgraduate students at the Laboratory visit local schools to give talks, active presentations and scientific experiments. These are very popular because of young people's fascination with "space", and demand from the schools has grown greatly. "Handson" presentations and experiments are also provided for local groups such as Cub Scouts.

13. Dr Felicity Mellor, Faculty of Applied Sciences, University of The West of England, Frenchay Campus, Bristol BS16 1QY Tel: 0117 965 6261 Fax: 0117 976 3871 email: fmellor@uwe.ac.uk. £3500 towards a project "Build Yourself a Time Machine'.

It will be a multimedia educational game which will be available to schools on CDROM. Players will be presented with a series of options guiding them through the construction of a time machine. At each stage, basic ideas behind the physical concepts will be presented. Care will be taken that players do not get the impression that we really can build time machines. This is a partnership with Cotham Grammar school in Bristol.

14. Ms Nicola Moyle, Plymouth City Museum & Art Gallery, Drake Circus, Plymouth PL4 8AJ Tel: 01752 304774 Fax: 01752 304775. £5000 towards an exhibition and education programme entitled "The Dark Side of the Sun'.

This will be based at the Museum but there will be small exhibits placed at sites around the Plymouth region, such as schools, colleges, libraries and tourist centres. The material will give an overview of the Sun in history, explain our current knowledge, cover current spacebased research in this area, and give background to the total eclipse of August 11 1999, visible from Plymouth. The project is a collaboration between the Museum and Plymouth University.

15. Dr Tim O'Brien, Astrophysics Research Institute, Liverpool John Moores University, Byrom Street, Liverpool L3 3AF Tel: 0151 231 2475 Fax: 0151 231 2475 email: tob@astro.livjm.ac.uk. £4300 towards the Liverpool Solar telescope project.

This will comprise a small solar telescope sited in

For your information

Liverpool which will add "daytime astronomy' to the Department's PUS and outreach programmes. The telescope will be fitted with special filters and a video camera, to enable groups to view images showing solar activity. The outreach and education programmes includes a Website, visits by school parties to the observatory and visits by researchers to local schools. It is expected to link interest in the Sun with the August 1999 Total eclipse.

16. Dr David Pike, Space Science Division, Rutherford Appleton Laboratory, Chilton, Didcot, Oxon, OX11 0QX Tel: 01235 445835 Fax: 01235 446667 email: cdp@astro1.bnsc.rl.ac.uk. £1200 for a pilot project "Young Scientists at the Cutting Edge of the Sun'. This will involve multimedia presentations by UK research students and postdocs.

The main target audience is older secondary school pupils, but much of the material will be suitable for younger audiences and for the general public. The UK Solar Physics community is particularly strong at the moment, particularly with involvement in the Yohkoh and SOHO solar space missions together with related theoretical work. The project is expected to satisfy demand for background information about UK work on the sun in the year of the total eclipse and subsequently.

17. Mr David Smith, The King John School, Shipwrights Drive, Thundersley, Essex, SS7 1RQ Tel: 01702 558284 Fax: 01702 555636. £1300 for "Astronomy in the Community', which aims to make the study of astronomy available to students at King John, to local primary and secondary schools and to the local community.

Two telescopes will be restored and positioned at the school, and 6th form students will be trained as technicians and activity leaders. Activities will be run by King John and other schools' astronomy clubs, and there will be support for the astrophysics element in the physics Alevel syllabus.

18. Dr Richard St Denis, Department of Physics & Astronomy, Kelvin Building, University of Glasgow, Glasgow G12 8QQ Tel: 0141 330 5887 Fax: 0141 330 5881 email: stdenis@physics.gla.ac.uk. £5500 for a particle physics UK and European "Internet Game'.

This builds on the recent "masterclasses' in particle physics with a computer game on "particle physics event identification'. This will be accessible to schools and PC users through a Web site. Displays of electronpositron collisions recorded at the LEP accelerator at CERN will form the basis for the game. There will be tutorial help for players learning to identify the different decay modes of particles. The target audience includes secondary school children, adults with a *Scientific American* level of interest, and university students.

19. Mr Paul Taylor, Artistic Director, Physico Theatre Ltd, 15 Townend Street, Haslingdon, Rossendale, Lancashire BB4 5DF Tel: 01706 215463 Fax: 01706 215463 mobile: 0421 991973. £4870 for a project *Over The Moon*, a dramatic presentation covering topics in the "Earth In Space" series and aimed at primary school audiences.

Specific topics will include eclipses (with a link to the 1999 Total Solar Eclipse), phases of the Moon, comets, the life cycles of stars, and solar systems. Presentation methods include characterplay, poetry, music, dance, and mime.

20. Dr Susan Tritton, Royal Observatory, Blackford Hill, Edinburgh, EH9 3HJ Tel: 0131 668 8326 Fax: 0131 662 1668 email: sbt@roe.ac.uk. £1000 for a project to produce handout sheets on astronomy and space topics.

The material will be based on exhibition material previously used at ROE, which was centred around the themes The Solar System, The Milky Way, Galaxies, and Cosmology. The material will be put onto a computer database, for subsequent use on handouts, boards, etc, and can be made available to anyone.

Robin Clegg
Public Understanding of Science
PPARC

Observing the Sun - the overexposure of dangers

As the 1999 August 11 eclipse of the Sun approaches, so proliferates the ill-informed advice about how to look at it on one hand, or how you should never look at it on the other. It is still some time before the big day, and even if you are not able to squeeze in down here in Cornwall next August you will see a spectacular partial eclipse from wherever you are in the UK, and it's the partiality that causes most of the problems.

So now, while there is plenty of time, it is a good idea to introduce young people to safe ways of looking at the Sun. Sunspots make a fascinating study, and they will be around most of the time, so there is plenty to practice on.

It is quite right to stress first that looking at the Sun without proper precautions risks permanent blindness. But this can be overemphasised. From what I have heard "experts" threaten already so many times down here in Cornwall, you wonder why so many people are expected to visit us! It reminds me of the Northern India eclipse of 1995 during which the local population, having heard on the radio, TV and from government officials how dangerous it was to watch the eclipse, disappeared into their houses for most of the event, and avoided totality (all 51 seconds of it) in particular!

At this year's eclipse in Central America and the Caribbean, a story soon spread round about the child who had been watching the entire partial phase of the eclipse for an hour and a half. At the moment of totality he started screaming that he had been blinded - he could see nothing! Nobody had told him to take his filter goggles off when the Sun became totally eclipsed! Many people down here have told me that special filters are needed to watch the eclipse, and it turns out they think that means all of it!

What not to do

Don't look at the Sun, even for an instant, through any optical instrument like a telescope or binoculars, even a camera viewfinder. Even the unaided eye soon suffers from looking at the Sun, and sunglasses don't stop it.

Avoid the "good old fashioned ways" of risking your eyes, using smoked glass, or thicknesses of film

negatives. (The latter was a passable, if not very useful method once upon a time when we all used black and white film that was silver-based, but these days even monochromatic film can be based on colour film technology, which is NOT based on silver)
Don't point your camera at the Sun, and that includes video cameras. The damage to your eyes will be painful and the damage to the camera will hurt your pocket!

Now what you CAN do! Having told the horror stories, you can point out, with appropriate care, that the one time in someone's life when it is perfectly safe to look at the Sun is when it is totally eclipsed. For those few precious seconds, Nature will cut off all sight of the Sun's photosphere, the all too brilliant apparent surface of the Sun, and reveal the indescribably beautiful (so I won't try hard) pearly streamers of pale light that form the normally invisible outer atmosphere of the Sun, the corona.

The partially eclipsed Sun's image projected from the star diagonal and eyepiece of a 3in refractor. Useful hint: keep the lens cap on the finder 'scope if you have one, or you may be singed!

I can assure readers from experience, both my own and other people's, that to see this glorious outer atmosphere once is to become addicted to it for ever! It is even perfectly safe, indeed it is a very good idea, that WHEN THE BRIGHT PHOTOSPHERE HAS DISAPPEARED, you can turn your binoculars on the obscured Sun without any high density filters on them. When the eclipse is about to finish you will see the orange arc of the chromosphere, the layer immediately above the photosphere in which, if you are lucky, you will see curving prominences peeping out from behind the black disc of the obscuring Moon, and then the brilliant point of light that is called "the diamond ring" appears, when the first tiny portion of the photosphere becomes visible through a lunar valley on the Moon's limb as the Moon continues to overtake the Sun it their eastward motions. At that instant you will not need to be reminded to remove the binoculars from your eyes!

But how do you safely follow the Sun through the partial phases of the eclipse, or study sunspots? There are filters that can be bought for protecting the eyes. These include the densest grade of welding glass. This is usually obtainable at a reasonable price (less that £2) as a replacement for the glass in a welding mask from any good ironmongers shop (remember them?). Mylar film vacuum coated in aluminium is also obtainable, and is used to make the familiar cardboard eclipse spectacles or rectangular filters. These allow you to look at the Sun's photosphere in comfort, whether you are watching a partial eclipse, or looking for naked eye sunspots. The Mylar filter material has the great advantage of being easily cut to shape so you can also make filters for use with telescopes or binoculars. But this is a special use that needs to be done very carefully, following the instructions given. A Sun filter must prevent 99.99% of the incident radiation from the Sun at ALL WAVELENGTHS from even entering the telescope or binoculars. So the filter must be used to cover the objective (input) end of the device, NEVER the eyepiece end.

Many so-called "astro telescopes" are provided with Sun filters that fit over the eyepiece. These must absorb all the solar energy being concentrated in that one tiny region in a small piece of dark glass. The very real danger is that it will shatter, not only blinding you with solar radiation, but adding broken glass for good measure.

A Mylar filter for a camera is useful for partial phase photos, but more important, it simplifies manual guiding of your camera across the sky so that the camera is already aimed at the Sun when totality comes. You have not got time to spare for aiming the camera or adjusting its exposure during that precious short time! But don't be tempted to remove the filter until the instant of the diamond ring or Bailley's beads, which signal that totality is just about to begin. The most important feature of such a filter is to make sure that it has not been punctured, and that it is securely fitted when pushed onto the camera or binocular lenses, with the instrument in any position.

By far the simplest and safest way to observe the Sun and one that provides a view for all to share is to mount your binoculars on a tripod and keep one lens cover on, while you project the image of the Sun from the remaining half of the binoculars. (You could try leaving an eyepiece cover in place without an objective lens cap on: this provides a spectacular demonstration of potential danger of an eyepiece sun-filter. The Sun will drill a neat hole through the eyepiece cap producing voluminous clouds of noxious smoke within seconds! Point out seriously that this could be your eye!

To aim binoculars or a telescope at the Sun without looking through them, mount them on a tripod and put a screen of some sort behind the eyepiece (I use a piece of paper on a clip board). Adjust the position of the binoculars till the shadow is foreshortened. The image of the Sun will then pop into view on the screen. It may be faint, since the screen is lit up by direct sunlight. So the final touch is to cut a circular hole of the same diameter as your binocular objective lens in a large piece of paper or card (or an old A4 envelope) and place this over the instrument to increase the area of the shadow on the screen. A clipboard screen provides a ready-made drawing board for you to mark the shape and position of the Moon's limb. At any time the same technique could be used to plot the progress of any sunspots across the face of the Sun as it rotates on its axis (in just over 25 days). The shade problem is avoided with a small telescope having a star diagonal (see photograph) since the Sun's image falls at right angles to the direction to the Sun itself. With the image well shaded, projection of the image also shows the limb darkening and some granulation may be made out near the limb also.

Please write in with your eclipse experiences as we shall be returning to this topic in the next two issues of Gnomon.

Richard Knox

Letter from Hawaii

Aloha! I am Dr Stuart Ryder and I work as a scientist and operator with the United Kingdom Infrared Telescope (UKIRT) on top of the volcano Mauna Kea on the Big Island of Hawaii. With its 3.8m diameter mirror, UKIRT is the world's largest telescope devoted solely to the pursuit of infrared astronomy.

Many of the most interesting regions of the Universe, such as the molecular clouds where stars are born, and the centres of active galaxies powered by black holes, are shrouded by dust. It is only by going to infrared ("heat") and radio wavelengths that we can probe these regions. Infrared radiation is also absorbed by water vapour in the Earth's atmosphere, but at 4200m (13796 ft), the summit of the dormant Mauna Kea volcano puts us above 99% of that water vapour. It also puts us at only 60% of the usual sea level oxygen content, which makes working up here a real physical challenge.

The clear, dark, and dry skies of Mauna Kea have attracted some of the world's largest telescopes, including the twin Keck 10m telescopes. The United Kingdom, through the Joint Astronomy Centre in Hilo, operates two telescopes on Mauna Kea for the benefit of British and international astronomers: UKIRT, and the 15m James Clerk Maxwell Telescope (JCMT), which works at wavelengths shorter than 1mm. The JCMT, recently equipped with a new camera called "SCUBA" from the Royal Observatory Edinburgh, has made headlines recently with its stunning images of dust rings and disks around some of the nearest stars, suggesting that planets may be in the process of forming there.

The UK also has a 25% share in the first of two 8m telescopes known as Gemini, one in Hawaii and the other in Chile. Gemini North is scheduled for "first light" late in 1998, with Gemini South due to follow in 2000. The addition of several new telescopes in the 810m class will herald a new golden age of astronomy, allowing us to look deep into space to a time when galaxies were young, and perhaps take the first images of planets around other stars. I look forward to bringing you news of these and other developments in astronomy and telling you a bit about an astronomer's life in an important observatory such as this in future issues of *Gnomon.*

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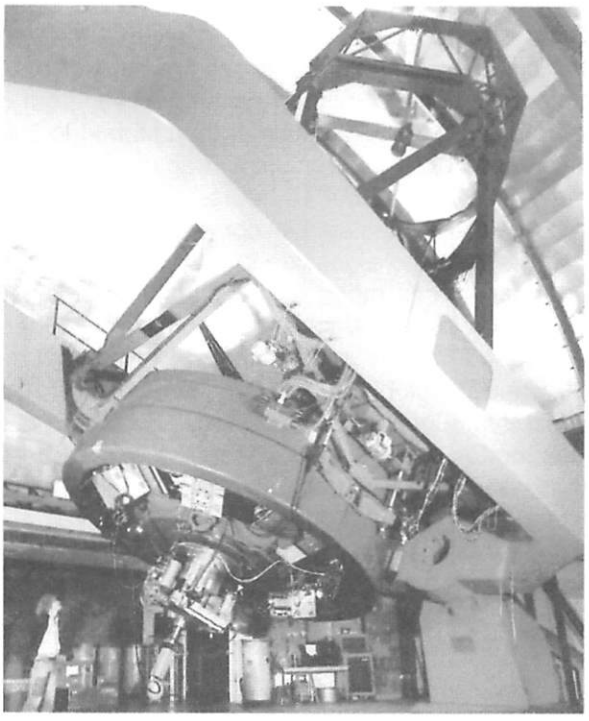


The 150inch UK Infrared telescope inside its dome on the 4200m summit of Mauna Kea, Hawaii. This is the largest infrared telescope in the world and is operated by the Royal Observatory, Edinburgh. Photo: B.W. Hadley Copyright: Royal Observatory Edinburgh.

Sky Diary Winter 1998

The main star groupings in this quarter's chart include Pegasus, in the southwestern corner. Its most striking feature is the large, almost empty square of stars often called the *Great Square of Pegasus.* In the northeast corner of the Square is a second magnitude star belonging to Andromeda (alpha And. or Alpheratz). A gently curving line of three moreorless equally spaced and similar magnitude stars points roughly north east towards alpha Persei. Starting from the middle star of the three brightest in the curve, beta And., you can find the famous Great Galaxy in Andromeda. From beta, two fainter stars point in a short line towards the W of Cassiopeia, and just to the west of the second is the hazy nucleus of the galaxy that can be seen with the unaided eye on a good dark night. The third, easternmost star in Andromeda's curving centreline is gamma, a glorious double star of gold and blue that needs at least a small telescope to see well.

For some reason, Perseus, whose brightest star alpha (Mirfak) is at the end of the line through Andromeda, manages to escape identification by many students. Perseus can be seen on the chart roughly in the centre horizontally, and about a quarter of the distance from the top, looking a bit like a parallelogram with the bottom side missing. Mirfak is in a curve of three or four stars (de-

Approx. rising and setting times mid-UK locations through the quarter

	1st October		15th November		31st December	
	Rise	Set	Rise	Set	Rise	Set
Sun	06h 15m	17h 52m	07h 35m	16h 38m	08h 23m	16h 11m
Mercury	06h 38m	18h 04m	09h 51m	17h 27m	06h 57m	14h 51m
Venus	05h 29m	17h 47m	07h 58m	16h 50m	09h 27m	17h 20m
Mars	02h 12m	16h 48m	01h 59m	14h 46m	01h 10m	12h 21m
Jupiter	17h 25m	04h 39m	14h 28m	05h 15m	11h 26m	22h 47m
Saturn	18h 46m	08h 31m	15h 49m	21h 59m	12h 33m	02h 01m
Uranus	15h 58m	00h 40m	13h 02m	21h 44m	10h 05m	18h 54m
Neptune	15h 26m	23h 51m	12h 30m	20h 56m	09h 33m	18h 02m

pending on how faint you count them) along the line of the Milky Way, just over a third of the way from the W of Cassiopeia to the V or Taurus. Two straggly lines of stars lead south from the arc from either side of Mirfak, the most obvious western one including the star beta Persei called Algol, the Demon Star, by the ancient Arab astronomers. Identifying Algol is very worthwhile as it is a fascinating star to watch over the weeks. Algol is a binary (actually a multiple system of some complexity) in which a faint components orbits a brighter one approximately in line of sight with our Solar system. As a result, about every 2.9 days, the dimmer companion partially eclipses the brighter one and the magnitude of the combined system as seen from Earth drops from 2.1 (only a little dimmer than Mirfak) to 3.4 and then increases back to its maximum again. This variation takes a total of only about 10 hours. It is easy to see the difference with the unaided eye: compare Algol with Mirfak, and with the star rho alongside it in the sky (rho is also a variable star, but its range of magnitudes is small). Best evening dates to spot Algol at minimum are October 22d 23h 40m and 25d 20h 30m, November 14d 22h 10m and 17d 19h, and December 4d 23h 50m, 7d 20h 40m, 10d 17h 35m, 27d 22h 30m and 30d 19h 20m.

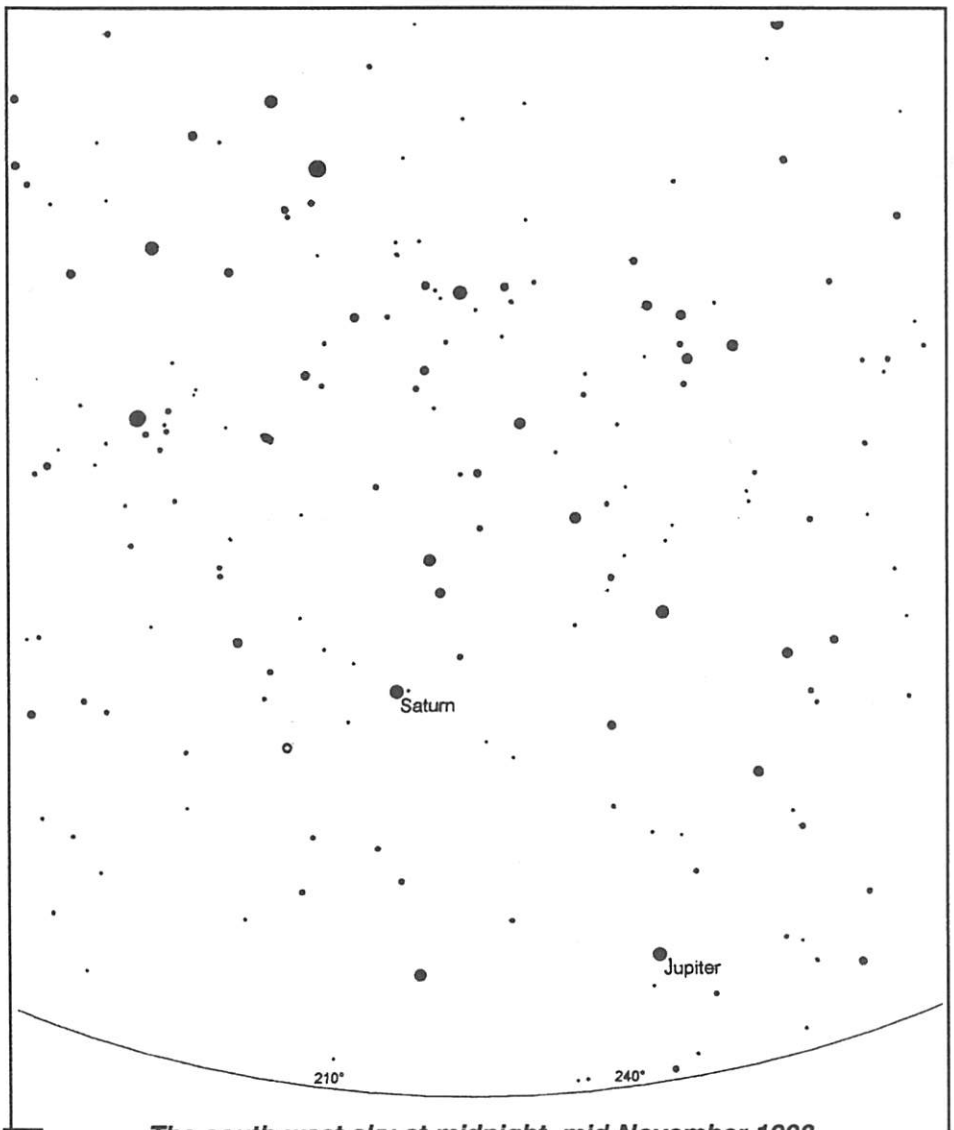
Look too for the bright double star cluster in the Milky Way half way between Perseus and Cassiopeia. These two clusters are really at very different distances, but appear close due to our line of sight. They were inexplicably missed by Messier in his famous catalogue of nebulous objects.

Another important variable star of a very different type is omicron Ceti, called Mira (the "Wonderful"). Mira varies from naked eye magnitude 3.4 to an amazing 9.3, which is invisible to the eye and faint even in a 6inch telescope. Mira is a long-period variable giant star whose extremes of brightness and period are both variable. The time of maximum brightness can be very roughly predicted, and should be about the end of the year. Mira can be found at the end of a straggling line of stars from the point of the V of Taurus. The 2.5 magnitude alpha Ceti (Menkar) is on that line about one third of the way from Aldebaran to the southern star beta Ceti (brighter than alpha!). Mira is marked on the chart with a small circle near Saturn.

Moon phases for the last 3 months of 1998

Month	New Moon	First Quarter	Full Moon	Last Quarter
October	20	27	5	12
November	19	27	4	11
December	18	26	3	10

Jupiter and Saturn appear on the chart. Their opposition dates in 1998 are September 16 and October 23 respectively. The two planets will make ideal long-term subjects for studying the apparent motion of the planets relative to the stars and to each other. The main task is to show how to find the two planets. Jupiter is so brilliant (magnitude 2.6) so that it is obvious among the feeble stars of Pisces to the south of the Great Square of Pegasus. Saturn is not so brilliant (magnitude +0.1), but is also all alone and easy to find south of Aries, roughly half way on the line from Jupiter to the red giant star Aldebaran in Taurus.



The south-west sky at midnight, mid-November 1998

Photo opportunities this quarter of note include the conjunctions of the Moon with Jupiter (0.2°S at closest on October 4 and again on October 31). Mercury reaches greatest elongation west on December 20, rising about 2 hours before the Sun in the south east. Mars is also brightening in the morning sky, reaching magnitude 1.1 by the end of the quarter in Virgo, getting higher in the December morning skies (Moon 2° N on December 12).

Summer time ends on October 25, so all times before that given in these notes and tables must have one hour added to arrive at the clock time. Don't miss any opportunity to tell your MP never to support the adoption of Central European Time!

Richard Knox