GNOMON

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Take part in these eclipse experiments

A number of practical projects and experiments are being run in connection with the forthcoming eclipse in which wide partipation is requested:

The Royal Astronomical Society is running an Eclipse Newspaper Competition for groups of young people. Write newspaper articles about the August 1999 Eclipse. Superb prizes are offered.

Eclipse Background Radiation. Does the background radiation change during an eclipse? Join a cooperative experiment amongst working teachers and senior students. The effect we are looking for may be very small so we need lots of help; all you need is a Geiger counter! This experiment can be done even if it is raining on the day! Information sheet by e.mail for both the above items from Alan_C_Pickwick@compuserve.com, or call 0161 973 6796.

Radio Listening Experiment. Scientists from the Rutherford Appleton Laboratory in Oxfordshire are asking the public to help with some unique experiments during the total solar eclipse on August 11th this year. The RAL, in partnership with universities across the UK, will be measuring the effect of the eclipse on the ionosphere that part of the earth's atmosphere that reflects radio waves, to improve our understanding of how the sun creates this important part of our atmosphere.

One such station is broadcast from La Coruna in northern Spain on 639 MW. In the UK, this station can only be heard at night. If we hear it on the morning of August 11th, we know the eclipse has had a dramatic effect on the ionosphere. The only equipment you will need is a radio with a medium wave band. All information is useful to us, so please

(Cont. on page 2)

The infrared Sombrero

***Stuart Ryder writes: I'm sure you recognise the galaxy (M104, the "Sombrero"). It is a mosaic pieced together from 30 images with UFTI, our new high resolution IR camera at UKIRT, at a wavelength of 2.2 microns. It makes an interesting contrast with Dave Malin's optical image (http://www.aao.gov.au/local/www/ dfm/aat100.html). The dust lane is much less prominent, but still obscures a lot of light from the bulge. This image has not been published anywhere else, and you have my permission to use it in* Gnomon.** (Letter from Hawaii *is on page 5*)

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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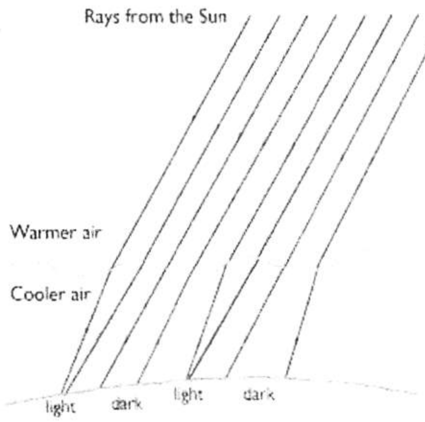
Eclipse Experiments *(cont.)*

let us know what happened, even if you did not hear the radio station. For those of you who are interested in doing this experiment in slightly more detail, follow the internet link -www.wdc.rl.ac.uk/ionosondes/eclipse/outline.html

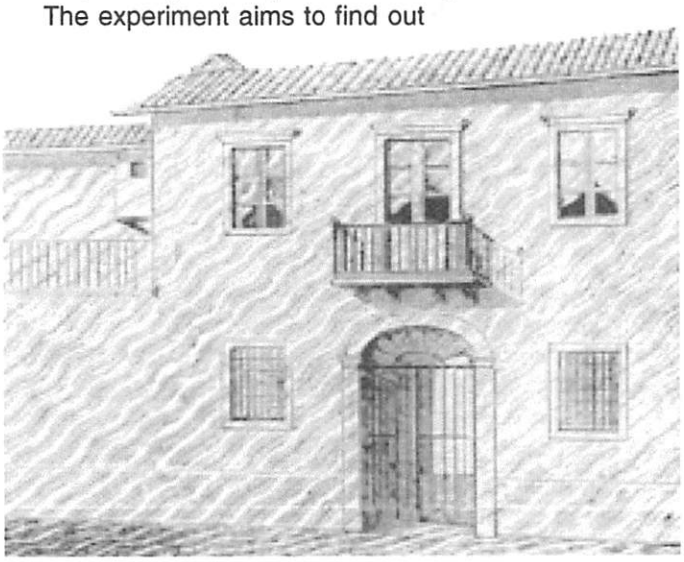
What are Shadow Bands? Shadow bands are visible just prior or after totality. They are an eerie phenomenon, looking like light and dark bands racing across the ground. They are often missed by eclipsewatchers, mainly because people are too busy looking up, but also because the shadow bands are usually faint and are best seen against smooth, white surfaces. In 1998 they were very clear against the sandy beach in Venezuela where a large British contingent watched the February eclipse.



The principles of the formation of shadow bands around the edge of the Moon's shadow during a solar eclipse

Because shadow bands occur immediately before and after an eclipse, you will be able to see them only if you live in the path of totality or right on its edge. People on the borderline may actually have a better view of any shadow bands, as they will be present for longer.

The experiment aims to find out more about shadow bands, since little research has been carried out on this phenomenon, and certainly nothing on the scale proposed. We want to find out whether you experience shadow bands in your area, when they appear, for how long, how clear they are, their spacing, their direction and speed.



A dramatic example of shadow bands, showing the advantage of a white expanse to be able to see them at their best

Shadow bands are somewhat like the light and dark streaks seen on the bottom of a sunlit swimming pool, caused by ripples on the surface of the water. Shadow bands are due to "ripples" in the air due to variations in the atmospheric temperature. These are the same variations that cause the twinkling of stars.

What happens when the Sun can't shine? During an eclipse the Moon has blocked the Sun's light. We can feel that it has also blocked out the Sun's heat. The temperature rapidly drops as the Moon's shadow arrives and then reverts back after the eclipse recedes. Using a wet and drybulb thermometer we can measure this temperature drop around the country and find out how the eclipse affects the atmosphere's humidity.

Temperature and humidity vary all the time with the weather, so to see what effect the eclipse has, it is important to take measurements on some days before and after eclipse day, as well as on 11 August 1999 itself. Ideally, record the temperatures in your location over five days, i.e. taking measurements from Monday 9th to Friday 13th August 1999. Even if you are unable to make checks on each of these days, please do send us what you have. All your research has real scientific value.

Shape of the solar corona. While the Sun is only partly covered by the Moon, you will need to wear solar viewers to protect your eyes. Use this time to sketch an outline of the Sun's shape.

When the Sun is totally eclipsed, you can remove your solar viewers. Look carefully at the corona. This is a pale, glowing halo around the Sun. It is the thin outer atmosphere of the Sun. As well as the solar corona, you may also see prominences. A prominence is a mass of hot gas rising up from the Sun's surface. These will require much more skill to sketch accurately.

As the Sun begins to appear again from behind the Moon, usually signalled by the reappearance of the orange band of the inner atmosphere of the Sun, the chromosphere, and followed by the brilliance of the "diamond ring" or Bailley's Beads, turn away and start to sketch what you saw. Don't forget to write on your picture the exact times the solar corona appeared and disappeared. Don't miss the experience of a lifetime! Sit back and enjoy the show while the eclipse is total. Once the Sun begins to reemerge, start to sketch what you saw.

More information on the latter three projects is available at: www.nmsi.ac.uk/eclipse/eclipselab

New planetarium director

The new director of the Auckland Observatory and Planetarium is Ian Griffen who used to be at the Armagh Planetarium. Ian slipped on a zebra crossing a few days ago and broke his ankle, so he will be in plaster for the next 6 weeks - a great way to start a new job!!

The recently-opened Auckland establishment has been visited by over 20,000 school students during its first year. The education staff have been hard pressed to cope with all the requests for astronomy sessions day and night. Astronomy has recently become a compulsory topic at all levels in the science curriculum. This means that many teachers now required to teach it, are attending teacher development courses. In May, a weekend astronomy camp was attended by 40 teachers. Invitations are constantly received to take teacher development sessions at schools, and daytime and evening sessions at school camps.. - **Eric Jackson**.

Life in the Old Curriculum yet!

Consultation on the review of the National Curriculum is taking place. As far as I can see, there are no significant changes to the Earth and Beyond section. Indeed there may be the addition at Key Stage 4 of "the possibility of life within the Universe and the limits of our knowledge", a particularly timely addition with the increased interest in Mars and SETI. - **Alan Pickwick**.

The New Millennium - 2000 January 1?

Whether you agree about the location, date and time of the start of the new millennium it matters not. The media has already decided: 2000 January 1 on Pitt Island, 700 km east of New Zealand!

Pitt Island is the most easterly inhabited island of the Chatham Islands nearest to the International Dateline. Its link to the rest of the Chathams was by single-engined aircraft which crashed into the sea in March, so now the only transport is the occasional fishing boat. The 18-pupil school is one of the remotest in the world. But being in such an interesting location, astronomy is an important part of the education: the children know well the glory of the southern skies (clear of any pollution); the tide times; and the determination of time and dates.

This is something that these children know, that lots of people wish for, and didn't know existed already. There are 48 hours in a day and eight days in a week! Being on the International Dateline means that everyone to their west is behind them in time but on the same day, while everyone to their east is ahead of them in time but still on yesterday.

For example, using standard times, say it is 9a.m. Monday on Pitt Island. It is 9.45 a.m. Monday in New Zealand (to their west), but 8a.m. Sunday in Samoa (to their east), meaning that the Earth has to turn once more before Samoa has Monday - by which time Pitt Island will be enjoying Tuesday.

This means that the Earth must turn twice before everyone on the planet completes the same day, and therefore eight times before everyone on earth completes the same week!! Confused? - **EJ**

Observations

OH WHAT A CONFUSING ECLIPSE!

First, and most sensational, there is not going to be an eclipse of the Sun on August 11 this year. There will never be an eclipse of the Sun, neither has there ever been. There will, however, be an occultation of the Sun by the Moon on August 11. Come to think of it, there is an occultation of the Sun by the Earth every day!

OK so I'm being pedantic and the proper terminology is never going to catch on -even the OED now allows "eclipse" (be obscured by passing into the shadow of another body") to mean "occult", but you might win the odd pint on a bet!

One of the best entrepreneurial efforts arising from the eclipse must be the electrical contractor who won the not insubstantial order from one of the rapidly decreasing number of organisations in Cornwall who are offering vast spaces for camping during the eclipse, together with facilities (water supply, and a Portaloo or two), a shop for supplies, entertainment etc. To meet the safety regulations, the camp owner must get floodlighting erected to prevent accidents to the campers during the darkness!

The horror stories from Cornwall about gridlocked roads, running out of supplies in the supermarkets and shops, overloaded sewers and water supply systems, hotels and guesthouses gazumping their regular customers and long-term bookings so that the price of a room can be quadrupled, huge bands of hippy travellers high on whatever is the flavour of the month covering the countryside in rubbish, spray paint and who-knows-what, holding 1000dB rock concerts and so on has inevitably borne fruit. Bookings are down on an average year, and cancellations are flooding in. Hardly surprising since the only purpose of being here on August 11 is to blind yourself (and not with the flavour of the month!).

So much advice is being banded about by, on the face of it, respectable sources who have obviously had no experience whatever of a solar eclipse, and must be getting their information either from similarly inexperienced "specialists", or hearsay. The following is a verbatim extract from a travel magazine that arrived unsolicited through my door earlier this week:

Even when it is completely eclipsed, observing the sun with the naked eye can burn the retina at the back of the eye, which can result in permanent loss of sight. A partial eclipse in Manchester in 1984, for example, left 11 people with partial loss of sight, and ...... the UK-based charity Fight for Sight advise that the only sure way of avoiding eye damage is to turn away from the sun and observe it indirectly through a device such as a pinhole projector ..... If you've still not decided where to be to view this momentous event, we've selected a few unusual options. UK. Climb the 332 steps to the top of Salisbury Cathedral, England's tallest spire, and then enjoy a champagne brunch in the medieval bell chamber (I have heard that the entrance fee for this event is £250, but that may be grossly in error: I hope so, because it is really upsetting to think that a church is undertaking such a confidence trick!). The article goes on to talk about "total darkness" in Ausburg and so on.

The worst of the errors in the rubbish given in this article, apart from the self-contradictions such as turning away "to view this momentous event", was the obvious complete ignorance of the difference between a partial eclipse and a total one. The large body of keen eclipse chasers that have watched many, many total eclipses through their telescopes and binoculars still pay handsomely to travel to the next one, even though they must have long since been struck blind, is testimony indeed to the momentousness of solar eclipses! How a sky can go "totally dark" while a blinding object is in view seems to escape the writer.

Let's hope this August's eclipse is seen, and watched safely, by as many people as possible across Europe, the Middle East and Asia. There will be accidents, alas, but over-reaction and badly ill-informed stuff such as this will do nothing to stop them. As in so many situations in life, a lack of understanding can be even more dangerous.

Richard Knox

For Your Library

Glorious Eclipses. A set of 19 square (2in) mount 35mm full-colour slides. Armagh Planetarium. £22.00 incl. p.p.. in UK.

The best answer to the questions "How do I photograph the eclipse of the Sun?" and "What exposure do I give?" is that whatever you do will be good, as long as the camera is on a sturdy tripod and you use a cable release. Whatever exposure you give will show something different! This magnificent set, published by *Sky and Telescope* (Sky Publishing Corporation) is very timely, in view of the growing eclipse fever in the UK, and contains some truly memorable slides. One of the problems with solar eclipses is that they look unimaginably beautiful - several orders of magnitude more so than in any photograph or video image ever made, however professionally. Aspiring eclipse photographers should take note: don't try to spend too much time taking pictures during those few precious seconds - just feast your eyes.

This new set contains some of the best photo representations of the outer corona that you are likely to see, but they are composites of several photographs of different exposures, taken with the best professional equipment, and assembled into a single frame by special techniques, not an easy task for amateurs!

Among the many other "hits" in this set is an annular eclipse in which the apparent diameters of the Sun and Moon were just about equal so that at the central eclipse, a wonderfully broken ring showed up lunar mountains all around the obscuring limb of the Moon. Another is a good example of a composite exposure of a lunar eclipse, tracking the camera with the Earth's shadow, thus clearly showing this shadow and its size and shape. This set is a "must-have"! - **RK**

Constellations of the Northern Hemisphere. A set of 24 square (2in) mount 35mm full-colour slides, with a free planisphere. Armagh Planetarium. £19.99 incl. p.p.. in UK.

This is the first of a new series, showing an approximately naked eye view (visible magnitudes down to about magnitude 6) of selected constellations, with a matching exposure showing the principle stars joined by lines. From an educators' point of view one could take issue with this encouragement to be lazy, since the basic photographs would be so easy to take and even improve upon oneself (the colours of the stars turn out very much better on original exposures than on these copied-from-original versions), and not all patterns as shown by the joined-up stars are as people visualise a constellation. But when I tried the set on some students, they seemed to like this idea. The notes describing the constellation and its mythological associations could be improved, with more notes on points of interest visible in the photograph. (For example, better to point out the Orion nebula that to write "this region is full of interesting objects suitable for modest telescopes". A problem that confused my students, even when warned about it, is that the slides are taken with a wide range of different focal length lenses, so the sense of scaleiscompletelyconfused.Cassiopeia'sWlooksasbig as Auriga's five-sided polygon. The free planisphere is a real bonus, but other versions are widely available: why not be original and provide the astrolabe that is described at length in the notes and which can so conveniently made with transparent plastic materials like these? Even better, though, make your own! - **RK**

The Cambridge Concise History of Astronomy. Ed. Michael Hoskin. Cambridge University Press. 362pp. Paperback (ISBN 0 521 57600 8) £16.95. Hardback (0 521 57291 6) £45:00

The omission of much of the copious illustration of the *Cambridge Illustrated History of Astronomy* has enabled this condensed version to be produced at a competitive price. This is an important addition to any science or history library: the history of the subject is so important in the history of the World. Although not providing such extensive and meticulous detail as the 1994 Fontana History of Science edition by John North, the new concise Cambridge book is very readable, and is very much better illustrated than the Fontana book (although the quality of many of the halftones in the new edition does not come up to the luxuriously illustrated Cambridge edition for some reason). - **RK**

Our Cosmic Origins. (From the Big Bang to the emergence of life and intelligence. Armand Delsemme. Cambridge University Press. 322pp. Hardback (ISBN 0 521 62038 4) £16.95.

Translated seemlessly from the 1994 French edition and updated, this is a daringly wide-ranging book covering the origins and evolution of "life, the universe and everything" in a style that allows the non-specialist to enjoy it. It makes a fascinating contrast with Dawkins, Hawking, and others, and tackles subjects as diverse as cosmology, geology, biochemistry and even a little philosophy with an approach all can appreciate.- **RK**

The Messier Objects. Stephen James O'Meara. Cambridge University Press. 304pp. Hardback (0 521 55332 6) £22.50

A great value for money book which will delight any keen deep space watcher. As well as describing in some detail every one of the Messier objects, and the additional ones (M104-110) for good measure, with a high quality photograph, author's telescopic sketch and starfield map for each object, each one has a full description of its appearance, physical nature and the history of its discovery and subsequent examination. Other sections include such practical information as how to organise a one-night M-object marathon! The 1968 book by Kenneth Glynn Jones, which O'Meara acknowledges with numerous references, is now, alas, long out of print, and is still the one by which others will be judged. O'Meara's book is short on biographical information, and its main shortcoming is that the lucky author lives on the sides of Mauna Loa in Hawaii, where, as he describes it, the Milky Way is so bright that it casts shadows! So his descriptions of the brightness of objects is too optimistic for most sites around the rest of this planet. Star maps are presented with north at the top (i.e. binocular view) but Glynn Jones also provided comprehensive star to star methods of finding each object, a vital item of information needed for those of us whose skies are not so splendid. An idea for the next edition? - **RK**

Astrophotography for the Amateur - second edition. Michael A. Covington. Cambridge University Press. 331pp. Hardback (0 521 64133 0) £60.00; paperback (0 521 62740 0) £21.95.

Complete revision, expansion and updating of the classic *vade mecum* really only needs notice of its availability: the quality speaks for itself. This book covers the simplest techniques with basic camera and tripod at one end of the scale, through advanced photography and techniques for telescopic work, to CCD imaging and computer processing. Photography is a practical exercise for astronomy available at some level to all, not necessarily needing telescopes, and has real potential for *Gnomon*'s Curriculum Corner. This year, astronomy students could be making a photographic record of the path of Mars through the stars. Star trail photographs allow clear demonstration of the apparent motion of the sky at different latitudes and declinations. A complete atlas of the observer's sky would not be an impossible project (watch out HJP Arnold!). Variable stars can be recorded, and it is not difficult to start taking time exposures with a Scotch (barn door) type home-made tracker. All of which are covered in this book, of course.

The special problems of each astronomical subject (eclipses, aurorae, comets, meteors and so on) are addressed, as are many practical problems, from basics like keeping warm, to the importance of mosquito repellents and why you should keep this off your hands! The practical tip that particularly took my fancy was on how eclipse injuries happen. This concluded with the words "the media often confuse totality with the partial phases, (see *Observations*, page 3) ..... Astronomers giving interviews should insist that their viewing instructions should be quoted complete and unaltered". As he really ever tried to insist successfully on vetting anything to be published by the media, a profession staffed, as we all know, entirely by Pulitzer Prize candidates?

A more comprehensive book would be difficult to imagine without the readability suffering greatly. It's an expensive book, so just grit your teeth when you buy it, because it will serve you till it crumbles to dust - **RK**

Letter from Hawaii

Aloha! One question I get asked a lot is "How does one become an astronomer?" There are almost as many answers to this question as there are astronomers. Perhaps surprisingly, very few professional astronomers started out with astronomy as a hobby, and then made it into a career as I did. Astronomy is just a branch of physics (albeit, the physics of extremes in size, temperature, etc.), and many astronomers began their training in pure physics, and only later chose astronomy as the subdiscipline that most interested them.

As with any career in the sciences, an early penchant for mathematics, coupled with a general curiosity about the universe, is important for the road ahead. Even high school may be too early to consider focusing oneself on a career in astronomy; it is better to take this time to broaden one's background and explore as many career options as possible. Specialisation can come later.

A good undergraduate degree, preferably with honours, is one prerequisite for an astronomy career. However, the subject that one chooses to major in need not be astronomy, nor even physics. Indeed, only a small number of universities offer much beyond firstyear introductory astronomy. Nevertheless, many professional astronomers started out in fields as diverse as chemistry, computer science, and statistics.

Although many people with bachelor's or master's degrees find gainful employment in universities, observatories, and planetaria, a PhD degree is a necessary further prerequisite for those considering a career in research astronomy. Here, the choice of which institution to study at, and the selection of a thesis topic and supervisor can all have a major bearing on one's future career prospects. What is hot and trendy one year can be passé the next, so again it is important that you choose a project that really does interest you, since you are going to be working full time on it for at least the next 3 years (usually longer). At the end of that time however, you can expect to be counted as one of the world's experts in that field, based on papers which you begin to publish in respected astronomical journals.

While once upon a time, a PhD degree may have been enough to land you a permanent job in astronomy, the norm nowadays is to undertake one or more postdoctoral appointments. These "postdocs" typically last one to three years, and are essential for establishing one's credentials further. To this end, it is a good idea to seek a postdoc position in another country, or at least another institution from that where you did your PhD. The contacts and experiences built up by moving around will serve you well for the rest of your career. However, the novelty of changing jobs, and even countries, every couple of years can wear off (particularly when family is involved). At some point, everyone seeks something more permanent.

There are in fact very few permanent jobs in astronomy. Most observatories and universities offer research positions with a limited term of three to five years, and even the prized lectureship with tenure is becoming rarer, as the concept of tenure is phased out. For every job on offer, there can be up to 400 applicants, depending on the qualifications being sought. The opportunity to conduct frontline astronomical research is a privilege only a few will get to enjoy. Nevertheless, astronomers who choose to leave the field often find just as much stimulation (and generally much better salaries!) in fields such as computer software and administration, medical imaging (since many of the techniques are so similar), and even forecasting the stock market (Don't tell me forecasts are in the stars! Ed.). And let's not forget the dedicated amateurs who devote much of their own time to monitoring the skies for all of us, often using equipment that was the envy of professional astronomers just 20 years ago. That is one of the great things about astronomy there is a place for everyone who wants to be involved, in learning and sharing the secrets of the universe.

Stuart Ryder
Joint Astronomy Centre: *sryder@jach.hawaii.edu*

Curriculum Corner

Manuel Liedel from Germany, a school pupil, asked:
I am interested in the solar eclipse on August 11 1999, and would like to know how to calculate an eclipse.
The detailed prediction of eclipses requires complex calculations of the celestial mechanics of the Moon's orbit, but amazingly good approximate solutions to the problem of predicting eclipses were known to ancient astronomers. The key to predicting solar or lunar eclipses is the Saros cycle, 223 ordinary lunar months. This periodicity was discovered by the Babylonians. It is 18 solar calendar years plus about 10.33 days. After that period of time, starting with a total eclipse at new Moon (after 6585.3211 days, to be more exact), the phase of the Moon is again exactly new and the Moon is again almost exactly lined up with the Sun, so another eclipse takes place, though it will be seen from a different place on Earth. Simply having a New Moon isn't enough because the Moon's orbit is inclined to Earth's, and so also to the apparent path of the Sun by a little more than 5°. For an eclipse to take place the alignment must be very close.

The two points where the Moon's orbit crosses the Sun's apparent yearly eastwards path (the *ecliptic)* around the celestial sphere are called *nodes.* Eclipses must take place when the Sun is close to these nodes. Because of gravitational effects, the nodes move westwards (regress) around the ecliptic in a period of 18.61 years. The Moon returns to the same node 242 times in almost but not quite exactly the same time as a Saros, 6585.3572 days (remember, the nodes are moving slowly towards the Moon in its orbit, so months defined this way are shorter than by other definitions of a month, such as New Moon to New Moon).

But a remarkable coincidence occurs. The Sun returns to the same node after exactly 6585.7806 days (after 19 so-called eclipse years of 346.62 days). On the first 241 occasions, the Sun is not near the same spot as the Moon, but on the 242nd arrival of the Moon at the node, the Sun will be almost exactly in the same position relative to the node and another very similar eclipse will occur. Hence we find that eclipses can repeat in series over a long period of time.

Ancient astronomers discovered that if a solar eclipse occurred on a given day, another eclipse would occur 6585.32 days later when the Moon and Sun again lined up almost exactly, although at a different place along the ecliptic. However, the resulting solar eclipse would be visible about one third of the way around the world and not always be visible from the original location, even in its partial phases. But, after three Saros cycles (54 years 1 month, and a couple of days) another solar eclipse would occur at the same approximate range of longitudes on Earth. This time, however, the eclipse would be some distance further north or further south of the previous track, depending on whether or not the eclipses happen on the descending node (Moon going south as it crosses the ecliptic) or the ascending node.

Query looked up some old eclipses in the Saros that contains the 11 August 1999 eclipse. The areas of visibility of some of these previous eclipses in this Saros are (going backwards in time):

1981 July 31, Pacific Ocean and Asia
1963 July 20, Alaska, Canada, NE United States
1945 July 9, Canada, Scandinavia, Russia
1927 June 29, England, Scandinavia etc.

Note that the 1945 eclipse was 54 years, one month, 2 days before the 1999 eclipse, at similar longitudes, but about 12-15° further north. So this particular Saros is moving steadily southward with each total solar eclipse and we can now predict that a solar eclipse will be visible from the Mediterranean, North Africa, and Arabia around mid-September, 2053.

These Saros cycles have one other wonderful surprise: the Moon returns to the same perigee or apogee, nearest or furthest distance from Earth, each anomalistic (or orbital) month. There are exactly 239 anomalistic months in a cycle of 6585.5374 days, nearly the same as the exact Saros interval. The duration of a total solar eclipse depends mainly on the distance of the Moon from Earth; its apparent size varies considerably because of the eccentricity of the orbit. Thus the Moon will be almost exactly the same distance away during each successive eclipse in a Saros, so the durations of two successive eclipses in a Saros will be similar. The 1999 eclipse will have totality lasting about 2 minutes, so we can also predict that the 2053 eclipse will have a similar duration.

by *Query*

Shadow Play

At 9.30 a.m. on a sunny day, take the class to an open paved area, clear of any trees and buildings that may cast shadows in that area later. Working in pairs, the students draw around each other's shadows, and separately round their shoes, with chalk (so that they can stand back in the same position later). The students should print their names and the time on their own shadow outlines.

At 10 a.m. the students should stand back in their shoe outlines, draw around their shadows again and record the time. Repeat this activity at 10.30 and discuss possible reasons why the shadows change. Get each student to draw a circle on the ground where they guess the shadow of their head will be at 11 o'clock.

At 11:00, the students should stand in their shoe outlines once again to see how close the shadow is to their guesses. Draw around the shadows again. It is likely that the students will want to keep recording their shadows until home time. Then ask them to draw a line connecting the top of the shadows of their heads. The point along the line where the shadow was shortest was when the sun was halfway between sunrise and sunset and was on the meridian at your location. This was the time of true local solar noon. Shadows outside the Tropics in the northern hemisphere, cast at true local solar noon, point to the true north, and vice versa in the southern hemisphere.

Alternatively, an 11 to 1p.m. series of observations may be made as a separate activity on a later occasion by starting the observations at, say 11 a.m. and making them every half hour until 1 p.m. Draw a line across the top of the heads (as above) and determine solar noon.

(Note: remember to take account of daylight saving time and for your longitude).

Eric Jackson

Sky Diary Summer 1999

The main chart shows the southern part of the sky at midnight on August 15 from a position in mid-Britain.

To the south, in Capricornus are Uranus and Neptune, with retrograde (westwards) motion against the background stars. High in the midnight sky are the three bright stars Deneb, Vega and Altair, which form the so-called "Summer Triangle". Watch for these three stars emerging in the deepening twilight. Once you have spotted Vega (by far the brightest, right in the northwest corner of the main chart) you can soon find the other two as you become familiar with the shape of the triangle.

I seem to have heard that there is an eclipse of the Sun during this quarter. There is less than a 50% chance that the sky will be clear, but if so, you may still be able to find a high observation point with a good long view to the west or east, or both. Even on a cloudy day you might see the Moon's shadow hurtling towards you from the west as totality approaches, and away to the east afterwards. If it is clear at any time during the partial phase, have a look at the ground under the trees where the sunlight is dappled. Multiple images of the Sun are caused by the pinhole effect of the interstices through the leaves of trees, particularly when fairly close to the ground. Normally this dappling is made up of circular images (have a critical look on any sunny day).

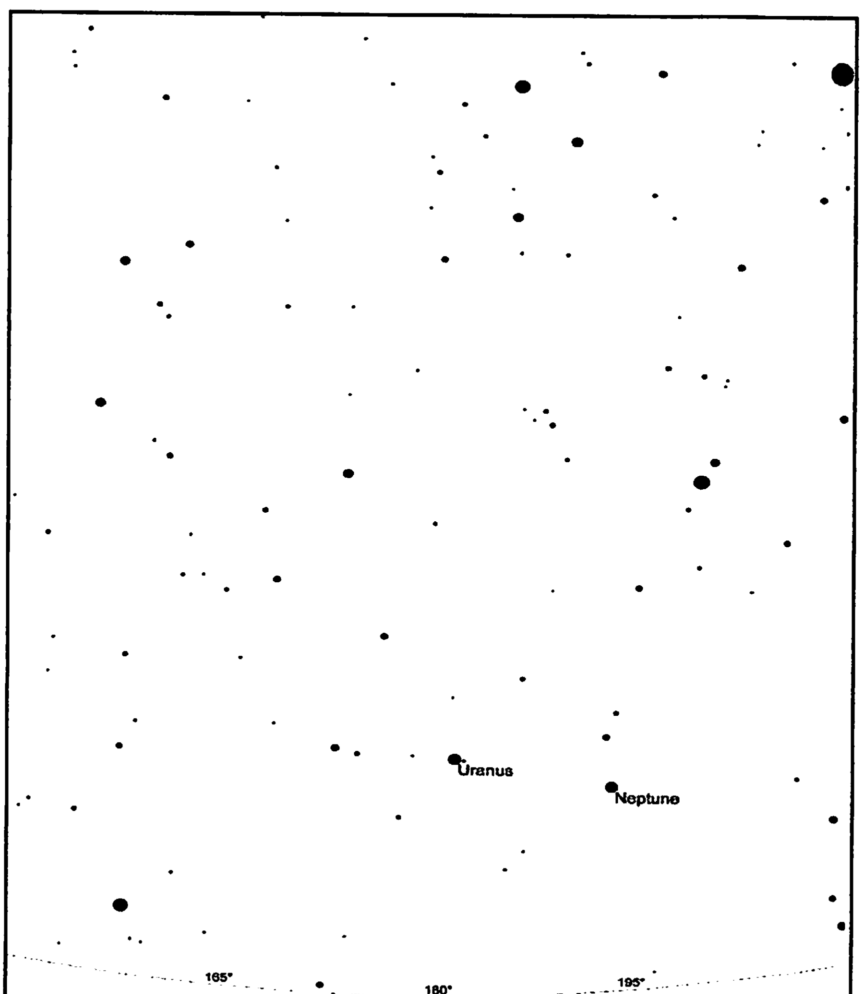
The constellation Cygnus, the Swan, is seen in the northwest corner of the chart. It is often nicknamed the Northern Cross, and it is far more like a cross than the diamond-shaped Southern Cross. In the chart, the crucifix is seen leaning eastwards at about 45°, with Deneb (meaning "tail" and referring to the Swan) right at the top of the Cross, and the northeast point of the Summer Triangle. Just to the east of Deneb is a curiously elusive nebula, the North American Nebula, so-called because it resembles at least the lower part of that Continent. This nebula will often appear glowing redly on simple photographs of the area, even non-tracked 30 second exposures, if taken in ideal conditions away from light pollution (man-made or lunar). Yet this nebula sometimes remains stubbornly invisible, even in photographs taken with long exposures on dark clear nights.

Cygnus' cross is footed by the head of the Swan, beta Cygni, Albireo. This is one of the most glorious double stars in the sky. It is so easy to split with a separation of over half a minute of arc that it can be resolved even in modest binoculars. A small telescope helps to get the best out of the contrasting gold and azure components of the star.

Many of the little constellations like Sagitta (the Arrow) and Delphinus (the Dolphin) were described in these notes a year ago. One of these, Vulpecula, the Fox, is a challenge for most casual observers to identify. It contains no stars brighter than magnitude 4.4. This, the brightest, is the only one to show on the main chart, a little dot between Albireo and the head of the Arrow, Sagitta. Most observers know where, approximately, Vulpecula is because of M27, the famous Dumbbell Nebula, bright enough to be visible in binoculars even from Britain!

The Milky Way can be stunning in dark surroundings on dark, clear nights. It is well worth slowly panning along with a pair of binoculars, mounted on a tripod, of course. The dark rifts in the Milky Way are caused by dust and other non-luminous matter collecting in the equatorial plane of our galaxy and obscuring the stars behind. The rifts divide the faint band roughly along its centre line in this part of the sky in Cygnus, passing right down to the "Teapot" of Sagittarius. M27, the Dumbbell Nebula, is on one of the edges of this rift somewhat to the north of the point two-thirds of the way along a line from Albireo to the point of the Arrow.

For several years Neptune and Uranus have been side by side, plodding through the most southerly constellations. As the evening skies get darker at a noticeably accelerating rate through August and September as we head for the Autumn Equinox (September 23) the more western of the extreme southern groups get caught up in the darkening sky, even though their midnight culmination is long past. This includes the Sagittarian "Teapot" (two stars from the "handle" of which is just shown in the extreme south-western corner of the main chart) which can often be picked out more easily in the darker August evenings, and by midnight Capricornus is at its best and In the main



The summer night sky, looking south at midnight on August 15

Approx. rising and setting times	July 15		August 15		September 15	
	Rise	Set	Rise	Set	Rise	Set
Sun	04h 09m	20h 25m	04h 55m	19h 36m	05h 45m	18h 27m
Mercury	06h 03m	20h 42m	03h 15m	18h 45m	06h 16m	18h 43m
Venus	07h 58m	21h 45m	06h 11m	19h 00m	03h 04m	16h 45m
Mars	13h 55m	23h 33m	13h 22m	22h 01m	13h 09m	20h 52m
Jupiter	23h 43m	13h 44m	21h 47m	11h 55m	19h 44m	09h 50m
Saturn	00h 17m	14h 54m	22h 20m	13h 00m	20h 16m	10h 57m
Uranus	21h 22m	06h 28m	19h 18m	04h 20m	17h 13m	02h 11m
Neptune	20h 45m	05h 23m	18h 41m	03h 16m	16h 38m	01h 11m

chart Uranus and Neptune are shown as large circles, only to differentiate them clearly from the surrounding stars. In fact, they would both be invisible on this chart, whose limiting magnitude is about 4. So first identify Capricornus. Far from resembling a sea goat (?) the constellation is very roughly like Noddy's cap on its side, or an inverted giant crow's beak. On the chart, disregard the two planets and start from the two in line almost north-south to the north of Neptune. The northern one is in fact a pair, very close but separable with good eyesight alone. This is alpha, and is shown in star maps as a pair, α1 and 2. These two stars are aligned by chance, being at very different distances from Earth. To the south of the pair is β, and if that line is continued a fairly faint star, π, (shown in the detailed constellation chart) is positioned close to this same line. But, as shown in the outline of the overall shape of the constellation, the line curves away westwards to the brightest star in Capricornus, delta (not alpha, oddly enough) which is just off the eastern edge of the detailed chart at the point of the "beak" but clearly seen in the main chart as the third in an almost equally spaced line from Neptune through Uranus (at the centre) to δ Cap.

Bearing in mind that Uranus can just be spotted with the unaided eye, if you know just where to look, but that Neptune is as dim on the detailed chart, as the faintest stars shown, one stands a reasonable chance of finding them in Capricornus this summer and early autumn. In more detail (see the detailed chart) the retrograding path of both planets is shown with arrows which start at the respective planet's July 1 position and the point of each arrow is at the September 30 position. Note that Uranus passes very close to the south of the star theta Cap. which it does on August 6, the day before its opposition, and Neptune passes very close to the south of sigma Cap. on September 2. On September 20, at about 22.25GMT, the gibbous Moon will occult Neptune as seen from Britain. The planet and Moon will be at an altitude of about 16° in the south west.

Other events for the three months starting July 1 include the continuing spectacle of Venus in the evening sky, changing into an increasingly large, but slimming crescent, getting quite low as she swings towards the Sun for inferior conjunction on August 20, being prominent in the eclipse sky on the 11th, still to the east of the Sun. Then the planet makes an equally spectacular appearance in the morning sky during September. This provides one of those rare chances of following Venus from its brilliant pre-dawn position, through the brightening dawn twilight into the daylight sky after sunrise with the naked eye. Once you know exactly where to look, Venus is easy to see in the blue of the daytime sky - but once you have lost it, you don't stand much chance till next day. Mars moves from 5° east of Spica, fading as it draws away from the Earth from the brightest "star" in the northern sky after Venus to a brightness and position close to Antares by the end of September. Antares, the red giant on Scorpius, means "Rival of Mars" and this coming conjunction will provide an excellent opportunity to see how it lives up to its name. However, Mars always seems to manage to keep ahead of the Sun for an incredible time, and will still be in the evening sky at the end of the year.

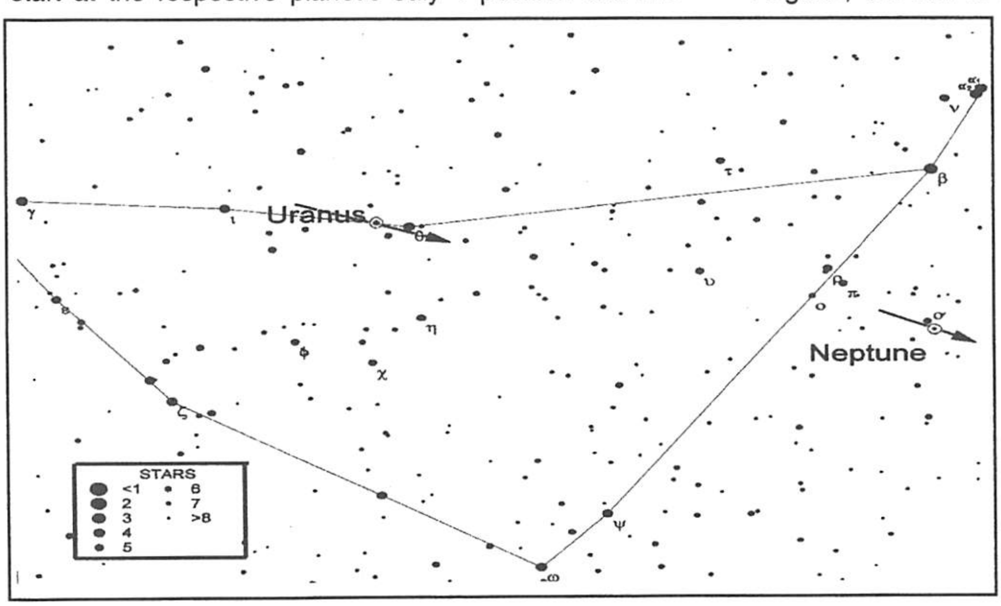
Moon phases for the third quarter of 1999

Month	New Moon	First Quarter	Full Moon	Last Quarter
July	12	20	28	6
August	11	18	26	4
September	9	17	25	2

Regulus, the star in Leo marking the "dot" under the backwards question mark of Leo's head, is very close to the ecliptic. The Sun will be just to the west of this star at the time of the August eclipse. On July 15, the 3-day old Moon will occult Regulus, and will present a challenge for Scottish observers, taking place very close to Moonset. With Venus close by, the trio will make an interesting photograph even if the occultation is not visible from where you are.

Jupiter becomes increasingly prominent in the morning sky throughout the quarter as it continues its relentless pursuit of Saturn. Mercury makes its best pre-dawn appearance for the year (including to the west of the Sun during the eclipse!) in the middle two weeks of August.

Richard Knox



The southern constellation of Capricornus is well seen during July/September. The arrow show the positions of Uranus and Neptune from July 1 to September 30, (August 15th position circled)