GNOMON

Newsletter of the Association for Astronomy Education

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Let Edexcel hear it for GCSE astronomy

Dr. P R F Stevenson, who teaches astronomy in his local adult education programme, noticed the news item by Alan Pickwick in *Gnomon* (Vol.19 No.3, Spring 2000) warning of the possibility that the GCSE in astronomy could be discontinued. Dr. Stevenson said that he has received a letter from the examiners Frank Flynn and Nigel Marshall that has made him realise how serious this was!

He wrote a letter of complaint to the examination board Edexcel and thinks we should all do the same. "For the past four years I have been teaching GCSE astronomy (Edexcel syllabus 1626)", he wrote "and was dismayed when I received a letter recently informing me that there is a 'distinct possibility' that the GCSE in astronomy may be discontinued from 2002."

He expressed incredulity that, in a modern scientific and technological age, the most basic and popular of science subjects could be axed. "Indeed", he added, "it is unbelievable with the purported 'education, education and education' policy that *any* subject could be withdrawn, let alone one of a scientific nature."

Edexcel is the only board offering GCSE astronomy, which, says Dr. Stevenson, is at just the right level to allow people to get to grips with the subject. The number of television documentaries in the astronomical area produced each year reflects the considerable public interest in astronomy, and courses should be available at all levels, he believes.

At least 46 university level institutions in the UK offer courses in astronomy, astrophysics or space science, he points out, but there could soon be no course available to provide the grounding in the subject, and the start of the academic opportunities, especially as there is no A-level in astronomy.

The astronomy GCSE course is also an excellent way of introducing and interesting students in other ☞

We're now making over 300pc/s, Captain!

A frame from a movie to shame all Star Trek *shows. The Anglo Australian Observatory 2-degree Field facility, recording the spectra of 400 objects at once over the past 2 years has registered 100,000 galaxies and 10,000 quasars in space by their redshifts.* *See page 7.*

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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☞ branches of science such as physics and chemistry, and especially mathematics. It has also been argued that the subject should be withdrawn because of the relatively few candidates sitting the exam makes it financially non-viable, despite the fact that the number of candidates sitting the exam increases every year. But in any case, Dr. Stevenson stressed, It was depressing that the subject might be stopped for financial reasons, ignoring the academic, educational and cultural arguments for keeping the subject alive.

The reply from Dr. Christina Townsend said that the problem was with the exam being in two tiers, foundation and higher. Not many students enter the foundation tier, leading to "quality assurance issues".

From this reply, Dr. Stevenson comments that it sounds as if the GCSE exam may be continued in another format, but it is still a good idea to express our view that GCSE astronomy must continue in some form!

If AAE is to be useful for anything, it ought to be of primary importance for its members to support Dr.Stevenson's view and Alan Pickwick's plea two issue back. The address to write to is Dr. Christina Townsend The Chief Executive Edexcel Foundation Stewart House 32 Russell Square London WC1B 5DN.

Letter to the Editor

Thank you for enclosing two copies of "The Big Bang" with the latest *Gnomon*. Do you have any idea why PPARC persists in printing one quarter of the reverse side upside down?

It means that, when I mount their posters for display, I have to cut out that quarter to stick it on the right way up. I've tried phoning and writing to PPARC about this anomaly but with out effect. I'm sure your comments would carry more weight! Best wishes. **Mary Winsch**

I think you have been pefectly eloquent and clear in your beef. For shame, PPARC, ignoring a very good suggestion! -Ed.

Robert Mills OBE.

It is with great sadness that we learnt of the death of Robert Mills. Robert was a long-standing member of the AAE and sat on Council from start of the Association. He retired from active AAE duties in 1990 when the trip from his home in Salisbury to London became physically too stressful.

Anyone who knew him would appreciate one of the reasons for this. Robert rarely travelled anywhere without a suitcase on wheels full of his latest astro gadgets. On many occasions he would pin me down during a coffee break and share his latest device for determining some aspect of local solar time or the altitude of a star. His enthusiasm for astronomy and in particular for sharing ideas was unmatched.

Robert spent much of his teaching life in India, where he became Principal of the Maharajah's College. He served in the second world war as an Instructor Lieutenant Commander in the Royal Indian Navy. Later in life, he became Director in Science and Engineering to the British Council.

He wrote extensively and his handbook for sky-watchers Practical Astronomy was a favourite and full of his home-made devices. He was a dynamic force in the British Sundial Society and in his later years was involved in the team to develop the Stonehenge site for visitors. Robert was one of that rare breed of people who it was a real pleasure and privilege to have known.

He spend his last days in a nursing home, no doubt reminiscing on 90 years of interest in science and sharing his stories of the skies to the end.

Bob Kibble

Observations

We have the privilege of living in an era of astonishing discoveries which day by day bring fascinating facts about the natural world, especially in its largest scale, the Universe.

We have probed the building blocks of the world around us. We have a clear idea of how the chemical elements of the entire universe have been, and are being made.

We have created a very accurate picture of the origin and evolution of the Universe, and of the origin and evolution of life in the Universe.

We see our beautiful planet, with all its mountains, valleys, oceans, plants and animals, reduced to a little speck of dust, trapped in orbit around the star that we call the Sun. We have evidence of many other systems of planets around other stars of our Milky Way galaxy. The detection of extra-terrestrial life seems to be just around the corner.

As Astronomy keeps guiding the human race along this colossal adventure of discovery, the role of institutions like the Association for Astronomy Education becomes necessarily more and more important and extensive to keep in line with the fast developments in so many facets of human culture. As the President of its new council, I would like to see the AAE expanding into the following areas:

- enhance its links with professional and amateur astronomical organisations
- enhance teacher training schemes
- promote cross-curricular links
- enhance links with international partner institutions (the AAE could become the BAAE)
- implement a much wider web page, including rich graphic material, lists of teaching resources and selected and well explained links to other relevant sites
- extend activities to the general public and the media

These are just a few ideas. Please let us know yours and let us work together towards the implementation of an ambitious programme facing the big challenge of bringing the oldest of sciences to a more prominent place in the cultural fabric of our modern world.

Francisco Diego

The astronomy demonstrator's saga

Have you ever tried showing groups of children the marvels of the night sky through a telescope? If so, you will know that it isn't always straightforward, and that there are many pitfalls (excuse the word!). I hope to be able to warn you of some of the worst things that may occur.

Firstly, assume that you have a nice dark, clear evening, and a place without too much artificial lighting around. You have set up your telescope and pointed it at, say, Jupiter since it is a prominent planet this autumn in the evenings.

You send a messenger into the house/school/Scout hut to bring the children out. This is possibly the first mistake. Out they all come, blundering around, falling over each other, babbling in a strange, positively frightening language! You have been outside long enough to become dark-adapted and you have quite forgotten that they are emerging from a brightly lit room. And there are 20 of them. And they home in on you, or your voice, or something, all crowding around, blundering into the telescope. It is now pointing vaguely towards Eric Jackson in New Zealand. Jupiter remains serenely unaware of the drama it is causing, still high in the beautifully clear sky!

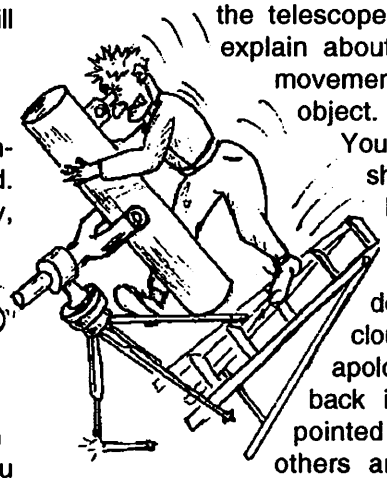
Eventually you get them to stand clear, in some semblance of order, and find Jupiter once more. You invite the first one to the telescope. "Where do I look?" he says, starting to crouch down behind the primary mirror and trying to see through it. He has never heard of a Newtonian reflector, let alone how it works.

You show him the eyepiece, so he rams his eyebrow against it. The telescope is now swinging merrily across the sky again, so you have to reset it once more. Finally, he gets it right. "It dunnarf look small!" he says with disappointment. Only half an hour previously you were showing them all some Voyager slides showing a 3ft diameter Jupiter in glorious NASAcolor, and the GRS wall to wall. But, you told them, it's not like seeing the real thing. It certainly is not!

The next little girl is not tall enough to reach the eyepiece so you have to lift her up, risking accusations of child molesting. Then you realise she has glasses on and can't get her eye near enough to the eyepiece to see, so you suggest she takes them off. (This involves putting her down again and very likely knocking the telescope once more). Now she tries again, but this time, without her glasses, so the focus is all wrong so you have to show her how to adjust it. By now, probably, you must find Jupiter once again.

Meanwhile the others are getting restless and larking around making the most of the darkness, which is a novelty for children these days. One by one they take their turn, some being interested, but some seeming indifferent. You ask one to describe what he can see, hoping for a description of equatorial bands, a red spot and four moons. "Two stars" he says, so you have a look - Ganymede and Callisto is all you can see, because Jupiter has drifted off the edge. Oh dear, how many of the children have only seen those two moons and not Jupiter, and have gone away disillusioned?

You press on, regularly having a look yourself to ensure that Jupiter is still in the field of view, only to discover that one of the children has found a good way of making Jupiter bigger, by turning the eyepiece grossly out of focus. Then some of the children nearby start to jump around, setting the telescope vibrating, so you have to explain about the telescope magnifying movements as well as the size of the object.



You still have not got round to showing Jupiter to everyone, let alone Saturn, and you have been watching with increasing despondency (or do I detect relief?) as the clouds begin to roll in. You apologetically send everyone back indoors. Some are disappointed at not getting their turn, others are glad because they are getting cold. You wonder when the next fine night will come along, and if any children will.

So what lessons have you learnt?

- Five or six children at a time is enough, so the rest of the group can be doing something useful indoors. When the second last observer is at the telescope, the next group can be sent for.
- You need some subdued lighting near the telescope, preferably red. If you are showing them the Moon or a bright planet, there is no need for the dark conditions necessary for viewing deep sky objects. Use a red torch to enable them to see where the eyepiece is.
- When each group comes out, line them up and explain the telescope briefly to them, so they know how the light gets to the eyepiece and how to adjust the focus. Explain why the image is quite small, and that it takes experience to see all that is available to see.
- Point out in the sky what you are going to show them, especially if you are using a Newtonian reflector when the observer is not looking in the direction of the object. Point out any planets which are visible.
- It is usually best to start with the outdoor telescope session, then go indoors and have the slide show, talk and questions. Make the most of a clear sky when it is there - it may not be there for long (c.f. Murphy/Spode etc.).
- Have a stepladder handy for when the eyepiece is high, and a stool for when it is low.
- Have a quick look in the eyepiece yourself after each child, to ensure the object is in the field of view and focused, even if the telescope is driven (an almost indispensable feature!).
- Make sure beforehand that they wear warm clothing.
- For first-time viewers, a wide angle low power eyepiece is generally better than a high powered one. It is better to show the whole Moon floating in a dark sky than to show only part of the Moon at high magnification, and you are less likely to lose the object from the field of view.

The adult educators tell me that their students are not much different, just greater masses more readily capable of disturbing the telescope setting. It's rare to have to lift anyone up to the eyepiece though!

I hope that this article will stimulate some discussion, which will reveal other pitfalls and solutions.

John Thompson

Curriculum Corner

Pipehenge Revisited: a song of the South

Pipehenge was first demonstrated at the 1988 Conasta conference in Canberra. At that stage the structure had just been developed in New Zealand through the need to teach the Planet Earth and Beyond strand in the new science curriculum.

The requirement for teachers to take astronomy at all grade levels was causing concern. Astronomy had not been part of most teachers schooling or their College of Education training. Their knowledge or understanding of the topic was little better than their students - in many cases worse! The idea to teach the principles of astronomy during the day when students were at school arose from an investigation into astronomy using the constructive approach. Working initially with grade 5 and 6 students it was discovered that the motions and interaction of our nearest star (the sun), nearest planet (Earth), and nearest moon (our moon) could be observed during the day and were caused by the turning of the earth. The same motions could also be observed with the stars at night, for the same reason.

The research aspect of Pipehenge has continued with the development of a portable Pipehenge that was demonstrated at Conasta 46. Supporting resource material now encompasses all grades from 1 to 12. It has been found that if senior students have not done the earlier basic observations they find it difficult to understand many aspects of astronomy. Pipehenge puts those aspects into perspective as it is so "hands on".

One of the most surprising findings was that, because our astronomical perceptions and vocabulary originated in the northern hemisphere, it still prejudices many of our words and understanding of the topic.

During the research, adults (teachers and parents) had problems with the students findings, but they made sense to other students. This is best illustrated by the breakthrough understanding that came when the students realised that if there was no "top" or "bottom" of the universe then there was no "top" or "bottom" of the Earth either.

It was only convention that put north at the top. By turning a globe of the Earth over and rotating it to bring New Zealand and Australia to the "top" a whole raft of observations began to make sense to the students, but adults said, "The Earth's upside- down!".

To demonstrate this, take a globe outside into the sunshine, hold it by the south pole, turn it until Australia is on "top" and pointing at the sun. Note the bright spot that the sun makes as its light is reflected from the surface of the globe. Rotate the globe in a clockwise direction to simulate the rotation of the earth and note what happens to the bright spot.

To make this demonstration much more dramatic, make a 30mm Blutak or Plastecine model of a human figure and stand it at your location on the globe with its shadow pointing to the south pole. Rotate the globe and note the way that the shadow of the "person" falls on the surface of the globe as it rotates. Try to simulate morning, noon, and afternoon shadows. These should match the movement of the shadow of each person standing observing the activity. This illustrates that it is the Earth turning that make the shadows change and not the Sun going across the sky.

Pipehenge takes this demonstration and puts it into context. The apparent daily and seasonal movements of the sun are always between the Tropics of Cancer and Capricorn as defined by the two pipe arcs. These arcs mark the Plane of the Ecliptic along which the planets, moon and constellations of the zodiac are to be found.

The north pipe of the structure, and its extention overhead as the meridian, acts as the gnomon of a sundial replicating on the ground the shadow movements through the day of the "person" on the globe. The meridian (or noon pipe) is aligned on a true north/south direction through the place where Pipehenge is set up.

Students can see the position of the morning Sun is "before" the meridian (ante meridiem, or a.m.). Watch the meridian cross the Sun at noon (solar noon) and see the Sun's position become post meridiem (or p.m. - after noon) as the day progresses. Eventually they would see the sun set over the western horizon pipe.

Observing these changes during the day predisposes the students for making observations at night when Pipehenge becomes a frame of reference as an observatory.

Pipehenge, Eric Jackson's versatile construction in use during a class in New Zealand

The outstanding value for students working with the structure is that the internalisation of the experience enables them to take that experience and apply it at another location. This is best illustrated when a person sits on the Navigator's seat in the centre of the structure and looks up through the circle. The circle marks the path of the Southern Cross at night. If the person touches the tips of thumbs and middle fingers together to make a circle and places this around their nose and eyes they imitate the circle of Pipehenge. Standing facing south after dark at another location and looking at the sky through the thumbs/fingers circle the Southern Cross will be found inside it.

There are many more similar, simple, practical activities that students have devised as they have worked with the structure. There are Technology opportunities making model "Wirehenges" or empty soft drink bottle "PEThenges". Demonstrating eclipses, tides, moon phases, day and night, seasons, retrograde motion of planets and many other astronomical phenomena have become easier to do. As one senior science teacher put it after working with their Portable Pipehenge. "Previously we knew about the topic, now we understand. Watching, recording and predicting the movements of the Pipehenge shadows was an enthralling exercise that put into context what the students had read about in their text books".

Eric Jackson

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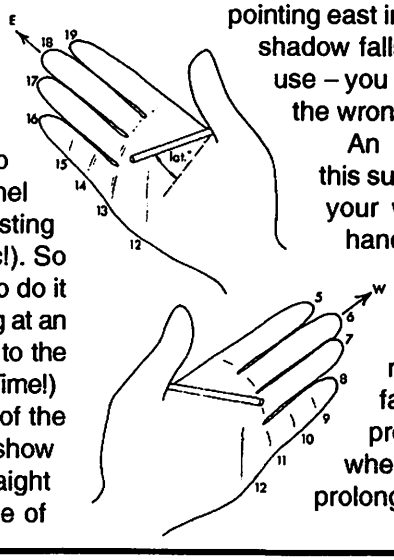
Editor's note: Eric's instructions for use in the southern hemisphere will have to be translated into northern hemisphere terms for most of our readers. A valuable exercise, not least in making you realise what antipodeans have to put up with when reading most practical astronomy books!

Time at any time (Part 1)

Telling the time, and finding your way, are about the most useful benefits of practical astronomy for anyone not primarily interested in astronomy (I have heard of such people). Here is a handy hint for the daytime.

The human hand gives a useful approximation to the ordinary garden sundial. The gnomon (see panel bottom page 1) of a sundial provides a shadow-casting edge that points to the north celestial pole (sorry Eric!). So if you are setting up a garden sundial, the hard way to do it is to ensure that the gnomon points north, and is pointing at an altitude equal to your latitude. (the best way is to set it to the right time, corrected for longitude and the Equation of Time!)

The diagram shows how the creases in the palm of the hand, the joints of the little finger and the finger tips show the position of the hours on the dial "plate". Hold a straight object like a pencil between the thumb and the edge of the hand at an angle equal (approx.) to your latitude. Use the left hand pointing west in the morning or the right hand pointing east in the afternoon and see where the shadow falls (you can't forget which hand to use – you won't get a shadow on your hand the wrong way round!).



An even more useful application of this sundial occurs if you are lost. Using your watch to tell the time, set your hand up to read the same time by the Sun, then your hand will be pointing east or west, depending on whether it is before or after noon. This could help stop the famous, but potentially dangerous problem of walking in part-circles when following the Sun's position for a prolonged period.

Richard Knox

THE THINGS PEOPLE ASK!

Which planet has a moon called Pandora? *(asked the enigmatically named Luigi)*

Pandora is one of the 18 named moons of Saturn. It was discovered in 1980 as a result of examining images taken by the Voyager 1 mission. It is irregularly shaped, about 90km across. Pandora and Prometheus, another small moon of Saturn, are called the 'shepherd moons' because their gravity keeps the narrow outer 'F' ring in place, with Pandora just outside and Prometheus just inside the ring. Another pair of small moons, Janus and Epimetheus, are called the co-orbital moons because they have very similar orbits, one just inside the other, and every four Earth years they pass close to one another and swap orbits.

Saturn's largest moon, Titan, has an atmosphere and its diameter is actually larger than the innermost planet, Mercury. It is thought that the complicated 'grooved' structure of Saturn's rings is governed by the gravity of several small moons, some of which are too small to have been discovered yet. **Query**

Tell me about constellations, please *(Sam, a school pupil, who described himself as "a beginner" asked).*

This is a very large topic, and it is not clear whether you are asking for information on the origin of constellations and their myths, on the boundary lines and numbering of stars within constellations, or about what interesting objects are found in each constellation.

Constellations are star patterns that began to be named over 2000 years ago when people pictured such patterns as representing gods, characters, animals, or objects from early mythology. Different civilisations had different constellations; for example, Chinese constellations were very different from those of Ancient Greece that were handed down to European civilisations. These constellations evolved over time, large areas of sky not being included in constellations - usually because the area in question was located in the southern sky, but also where areas had few even moderately bright stars. Others were changed or split up to make new constellations, and other constellations have eventually disappeared.

These include Antinous (who didn't survive because he was a real, not mythological person) and Argo Navis (Jason's ship on the golden fleece quest) which was far too big, so was "dismantled" into the sails, the keel, the poop and so on. Perhaps the weirdest (credited to Bode) was Machina Electrica, the electrical machine, a sort of Van der Graaf generator.

There are now 88 officially recognised constellations, which cover the entire sky north and south. The star patterns we see from Earth only rarely reflect the physical groupings of stars in space. Each constellation

☞

pattern is made up of stars that happen to lie in the same general direction, but possibly very different distances.

Individual stars that we see with the unaided eye belong to our own region of the galaxy and are relatively close in astronomical terms. But they are at widely ranging distances from us. Aldebaran in the "V" that marks the head of Taurus the Bull, is much closer than the other stars in the group, for example (see *Sky Diary* on the following page).

The twelve equal "houses" or signs of the Zodiac were named after twelve of 14 very unequally sized constellations through, or near to which the apparent yearly path of the Sun passes. The Moon and planets appear to move in the narrow band called the Zodiac on either side of this path.

There are a lot of resources on the World Wide Web that can give better and longer answers than I can here. I tried something you may not have heard about, called: Ask Jeeves.

If you have Netscape, try the Search facility and click on 'Ask Jeeves', then type in the question, "Tell me about constellations". This will produce a list of possible Web sites with answers to your question. If you have Internet Explorer, the URL for Lycos is:

http://home.netscape.com/escapes/search/netsearch_3.htm

There are lots of possible articles for you to choose from if you start your search this way. You can also type in the word `constellations' in an ordinary search and see what happens. The Salopian Web has a constellation page at:

http://www.r-clarke.org.uk/constellations/constellations.htm

I hope this will get you started. **Query**

Why is the UK's longest day of the year not the warmest day of the year ? *(asked Dominic Schreiber, , FNTF)*

Seasons are caused by the fact that the axis of rotation of the Earth is inclined by 23.5° from the vertical to the plane of its orbit. This means that during part of the year, the northern hemisphere is exposed more to sunlight, and six months later, the southern hemisphere is receiving maximum sunlight while the northern hemisphere get the least sun.

The reason for the delay in maximum temperature is principally that the components of the Earth's surface (e.g. rocks, soil, seas) have a high heat capacity (ability to store heat energy--it takes a lot of heat to raise the temperature by one degree C).

Although the maximum amount of sunlight falls on the date of the solstice in mid June, the storage of energy continues after this date, due to the fact that more energy comes in than is radiated or conducted away.

A maximum amount of stored heat (or maximum temperature of the surface) is not reached until about six weeks after the solstice. This heat is released into the atmosphere and raises the daily temperature. For the same reasons, in winter the UK receives much less sunlight, so the stored heat radiates away. However, there is still more heat going out than coming in at the time of the winter solstice so the lowest temperatures are not usually reached until February. **Query**

Ask an Astronomer

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

We know that the Universe is isotropic, ie looking the same in all directions and in keeping with the Big Bang theory. But should it really be isotropic? If we assume a big bang and the Universe always expanding up till the present, then an observer would view the Universe differently if, say, he looks towards the direction from where the Big Bang originated and he then looks "outward". I think that there is a similar situation which enabled Harlow Shapley to deduce that the Solar System was far from the Galactic Centre. In the attachment that I have included, looking in the directions of X and Y will reveal different structures than towards A. Quasars should lie at the outermost shell but even so this is not what is observed if one looks towards the region of the initial Big Bang explosion because we also see quasars in this direction. I would appreciate a short reply from you.

(A member of the AAE asked, posing a long question that might have exceeded the required "short reply"!)

The problem is that you are trying to impose reasoning based on flat Euclidean geometry on a non-Euclidean curved space-time in four dimensions, and this will naturally lead to misconceptions about the nature of space and time. In your imagination you are thinking of the Universe beginning in a specific place, and having edges. But the Universe is isotropic in all directions, so no matter which direction we look in the sky the distant Universe looks similar. That is because every point in the Universe originated at the same time, at the Big Bang.

During the expansion the Universe, no matter where it is viewed from, would look the same (more or less) to any observer located anywhere in space at some particular epoch after the Big Bang. Observers at different times will see different things.

There are no preferred directions in which we see quasars. They are distributed more or less uniformly over the entire sky. This is a natural consequence of the expanding Universe.What we observe when telescopes probe to very faint limits is that the early Universe was different from what we see at the present time.

Probing back in time still further, by observing the Cosmic Microwave Background Radiation at 2.73K, we see a time when there were no stars or galaxies, only small fluctuations in an otherwise uniform glow. This is the same in all directions except for small asymmetries due to the proper velocity of our own galaxy and solar system relative to other mass in the Universe.

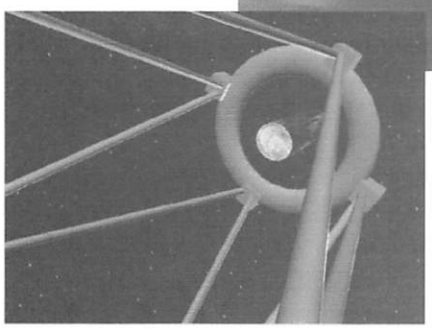
A better analogy for the expanding Universe is to imagine a balloon being blown up to larger and larger sizes, with everything confined to its outer surface (including light beams). The galaxies can be modelled as raisins glued to the surface, held together by internal forces (electromagnetic intermolecular forces for a raisin, gravity for a galaxy), so the raisin/galaxies do not expand but as he balloon expands they get further and further apart.

There is no preferred direction or origin point on the surface, and an imaginary observer (remember the curved light beams) would see the same sort of picture no matter in which direction he was looking. **Query**

LETTER FROM DOWN UNDER

Here at the Anglo-Australian Observatory, we are celebrating a major milestone. The 2-degree Field (2dF) facility, with its capacity to record spectra of up to 400 objects simultaneously using optical fibres, has now racked up 100,000 galaxy redshifts in just 2 years of operation. This is almost four times larger than any previous survey. At the same time, the spectra of some 10,000 quasars have also been obtained.

The eventual goals of the 2dF Galaxy Redshift Survey and Quasar Redshift Survey teams are to collect 250,000 galaxies and 30,000 quasars, so they are well on their way to meeting those targets. The Redshift Survey teams are comprised of some 30 astronomers, primarily from the UK and Australia. The teams work closely together to optimise the selection of targets in each field. The surveys currently receive about 72 nights of AAT time per year, but have had unusually rotten luck with the fickle Australian weather - a recent seven-night run produced a mere 6 hours worth of data! But even those 6 hours yielded over 2000 new redshifts, emphasising just how productive 2dF is.



Frames from the galaxies 3D tour movie

Although the major cosmological results must await the completion of the surveys, we can already glean a new appreciation of the scale and "lumpiness" of the local Universe, thanks to a unique computer-generated "fly through" movie of the 2dF galaxies. This movie, produced by the Swinburne University of Technology's supercomputer, combines the 3-D position of each galaxy with an actual AAT image representing the galaxy's type, thereby giving us a "Star Trek"-like (but much closer to the truth) view of our extra-galactic neighbourhood. The movie, in various downloadable formats, is available from

http://www.swin.edu.au/astronomy/2dfmovie/.

While the productivity of 2dF and other AAO instruments assures the immediate future of the AAO, the long-term outlook is less certain. The 50:50 partnership between the UK and Australia was formed in the late 1960s, and is up for renewal in early 2001. If either country wishes to pull out of the agreement, they are required to give 5 year's notice.

Although the astronomical communities in both countries are keen to maintain their close ties, there is strong pressure (particularly from the UK side) to divert more funding into larger (8m and greater) telescope facilities, which would necessitate reductions in funding for other facilities, including the AAO.

While the withdrawal of either the UK or Australia from the agreement would not be an instantaneous death knell for the AAO, the very possibility has already forced us to consider new modes of operation on a much-reduced budget, as well as expanding our rapidly-developing program for designing and building instrumentation for telescopes elsewhere.

The next few months will be crucial in deciding the AAO's future, but projects like the 2dF redshift surveys can be expected to keep the AAT in the forefront of astronomical research for some time to come.

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SKY DIARY AUTUMN 2000

The sky chart shows the area of sky filled mostly by Taurus looking about due south and an altitude of about 50° at midnight in the middle of the autumn quarter from a position "somewhere in the middle of England". This shows the positions of Jupiter and Saturn, and their retrograde motion during the three months. The arrows show the position of the two planets on October 1 (tail of arrow) to December 31 (tip of arrow) with the positions shown for the two bodies on the date of the map, November 15.

Although these planets do not move as rapidly and obviously as Mars, which is now pretty faint and can be forgotten about for a while now, the fact that makes them fascinating is that they are still side by side, as they have been to varying degrees over a couple of years or so and will continue to be for a year or so yet. They are also in a part of the sky with plenty of stars, the open cluster of the Hyades. So this all provides a wonderful opportunity to get your students watching their progress week by week, and better still, plotting it.

In addition, the reasons that the planets, Moon and Sun move eastwards against the background stars can be explained, as can Kepler's Laws to show that planets orbit more slowly the greater the distance to the Sun and why these two planets appear to be moving eastwards at different speeds at the moment, etc. etc. In fact a whole lot of practical examples are possible from these simple observations. Not least, there will be a wonderful sequence for taking simple photographs.

Jupiter and Saturn will be available for observation all through the rest of the year and well into next year. In a small telescope, the disc of the planet Saturn will become immersed in the widening ellipse of the rings as the tilt of the plane of the rings as seen from Earth reaches 24°. The tilt will reach a maximum of 27° in about a year's time.

The planets are both in Taurus, a zodiacal constellation that fills most of the area in the star chart on the next page. Taurus is an easy constellation to find, or at least its centre is. An obvious V of many stars, with the brilliant orange star Aldebaran, marks the face of the Bull, with Aldebaran as his right eye (a bit bloodshot!). The V-shaped group is called the Hyades (who were daughters of Atlas in mythology) and these stars actually are a physically linked galactic star cluster with the exception of Aldebaran. This red giant star, an interesting comparison with Betelgeuse

Approx. rising and setting times: lat. 52N; long 3W						
	October 15		November 15		December 15	
	Rise	Set	Rise	Set	Rise	Set
Sun	06h 36m	17h 17m	07h 31m	16h 20m	08h 13m	16h 00m
Mercury	09h 05m	17h 37m	05h 35m	15h 51m	07h 52m	15h 31m
Venus	09h 51m	18h 19m	11h 10m	18h 20m	11h 08m	19h 31m
Mars	03h 17m	16h 26m	03h 04m	14h 55m	02h 50m	13h 28m
Jupiter	19h 08m	11h 11m	17h 01m	08h 57m	14h 50m	06h 39m
Saturn	18h 45m	10h 06m	16h 41m	07h 56m	14h 37m	05h 46m
Uranus	15h 17m	00h 26m	13h 15m	22h 02m	11h 19m	20h 32m
Neptune	14h 39m	23h 16m	21h 16m	03h 25m	10h 42m	19h 22m

in Orion nearby, only coincidentally marks the end of the southern arm of the V. It is, at about 70 light years, only about half as far away as the Hyades proper.

The Bull is shown in ancient star maps as just a head and shoulders, head lowered and threatening Orion to the east. (Orion is holding up his left arm and is shown with a shield, or sometimes a goatskin, across the arm fending off the Bull - some hopes!). If you still cannot find the V of the Hyades, follow the line of Orion's Belt north-westwards for about 25° (the width of the fist over the four fingers' knuckles, is an angle of about 12° when your arm is fully extended - so you need two fist widths).

The V marks the head of the Bull, whose horns are both extensions of the arms of the V of about 15° (include the thumb knuckle in the arm's length fist). The southern arm (with Aldebaran) more or less points directly at 3 mag. ζTauri (Alheka). This star is a useful starting point to find the first object in Messier's famous catalogue, M1, called the "Crab Nebula" (because the Earl of Rosse drew it once making it look like a lobster!).

The nebula needs a modest aperture telescope and reasonably clear, dark conditions to find. In the very best conditions it may be found in a superior pair of binoculars. It is about 1° north and 1° west of ζTau.

If we go back to the line from Orion's Belt through the Hyades, and continue to extend it for a further four fist-knuckles' width (12°) we find the most famous and familiar faint group of stars in the sky, the Pleiades. The Pleiades were also the daughters of Atlas - they were half-sisters of the Hyades - and are also popularly called the Seven Sisters. All seven named in mythology are in the group plus Atlas himself and Pleione, their mother. Most people see only six of the group with the unaided eye, but I have known those who could see eight or nine. I challenged one of these, who claimed to see nine, to draw the group. I knew he was totally unfamiliar with the stars and a thorough non-astronomer. But his drawing was remarkably accurate. Use your binoculars on the group and they appear in profusion - a glorious sight. A test of visual acuity with a school form would be an interesting secondary result of an exercise in naked eye observation using the Pleiades as the subject!

The northern horn curves (southwards) a little to terminate at magnitude 1.6 beta Tauri (el Nath) a star shared by Auriga, and forming part of the large, irregular five-sided figure which marks that constellation. El Nath is the bright star in the top left corner of the star chart below. Both tips of the Bull's horns have the Milky Way in the background.

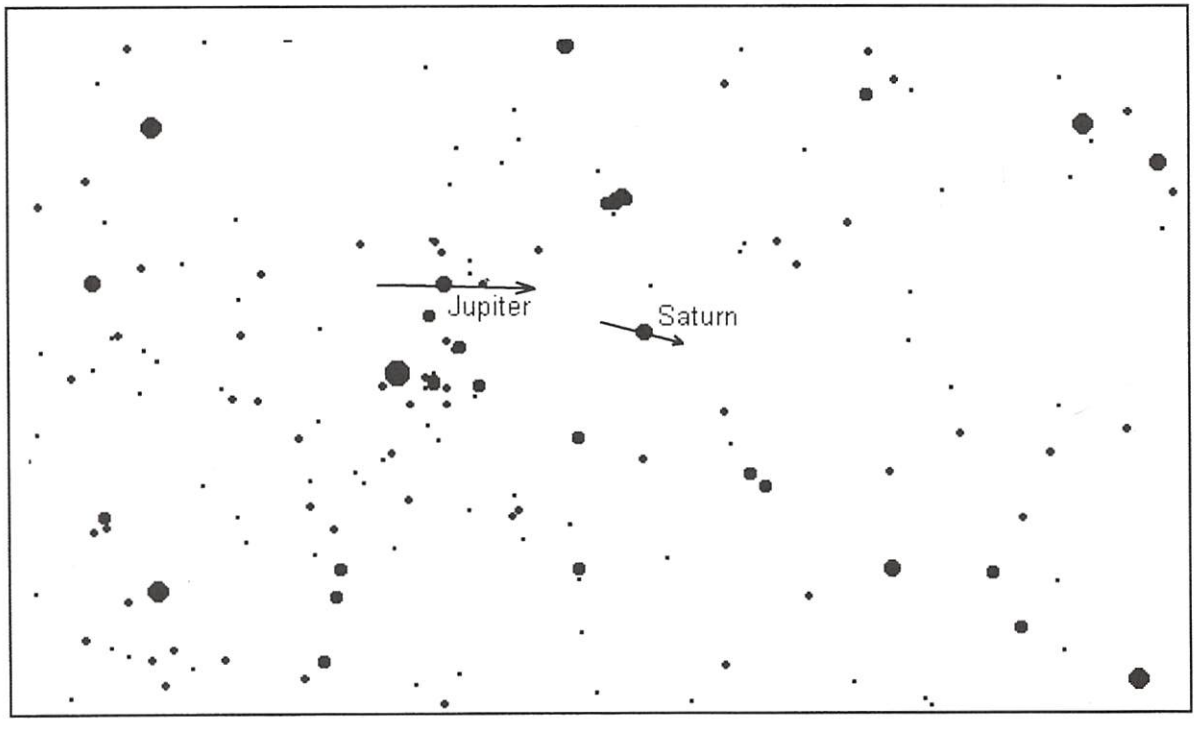
Moon phases for the last quarter of 2000				
Month	New Moon	First Quarter	Full Moon	Last Quarter
October	27	5	13	20
November	25	4	11	18
December	25	4	11	18

Apart from the double act, Jupiter and Saturn, Venus will be making an increasingly spectacular evening appearance in the approach to Christmas. By the end of November Venus will be setting after dark and by the end of the year will be setting about three and a half hours after the Sun. Early in the New Year the brilliant planet will be closing on Jupiter and Saturn to make another grand photo opportunity - but more about that in the next issue.

The Leonid meteors are due to reach their peak on November 17 and are expected to be quite spectacular, although not up to last year. Try the International Meteor Organisation web site

http://www.imo.net.

Richard Knox



Taurus, looking south on 2000 November 15, about midnight