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".

Goodbye and Hello!

Thanks to those who responded to the advertisement for a new editor for GNOMON. From the next issue, you will be guided through the world of astronomy education by Richard Knox of the Penzance Peripatetic Planetarium. Richard will be familiar to regular readers as the author of our excellent night sky pieces on the back pages. I'll leave it to Richard to introduce himself in the next newsletter, but I'd like to be the first to say how lucky the AAE is to find someone with his skills.

Please, please remember that this is your newsletter, and I would like to think that members can find some time to send articles and snippets to Richard when possible so that he doesn't have to write the whole issue himself. Notes about classroom ideas, observing sessions, good books or useful resources, conferences, meetings and sources for freebies - all are very welcome.

Anything which you think might fit the above description can be sent to

Richard Knox
Editor, Gnomon
3, Alexandra Terrace
Penzance
Cornwall
TR18 4NX

I'd like to thank everyone who has contributed during my time as editor, and thank the readership for continuing to support the aims and objectives of the AAE even when schedules slipped and a lack of articles contributed to a glitch in the arrival of Gnomon on your doormat.

In the next newsletter will be the news from the AAE AGM which was held at Jodrell Bank on June 13th.

I will be contributing news to GNOMON from time to time on the projects that are now taking up so much of my waking hours. I imagine that in 2001 we can hope to hold our AGM at the new Space Centre in Leicester!

Alex Barnett

Teacher Training Proposals

It is proposed that all PGCE students should be able to teach to KS4 in two of biology, physics, and chemistry. This is very controversial because of the limited time (33%) that students now spend in colleges and universities. There will be little time for them to acquire new subject knowledge. The consequence may be that courses feel compelled to admit only students who already have least A-levels in two of biology, physics and chemistry.

This is likely to have a devastating effect on the recruitment of those with a specialism in physics, as a significant number of these have maths and physics A-levels and no other science. In most cases they are likely to find themselves either compelled to do further study before joining PGCE courses or else just be ineligible. This is a dangerous proposal at a time when there is already a dire shortage of maths and physics teachers.

ACP

MEMBERSHIP of the AAE costs £10.00 a year for individual members, £20 for corporate membership and £7 for retired persons. For more information address letters to: AAE, Royal Astronomical Society, Burlington House, Piccadilly, London W1V 0NL. Members receive 4 issues of GNOMON a year.

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

Subscription Rates:

Individual Members	£10.00
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0-10	£1.00 per copy
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Back numbers, not less than one year old, half these prices.

There will generally be a 10% discount to AAE members on all publications and advertising rates.

Practising teachers may claim their subscriptions as an allowance against income tax, thereby effectively reducing their contributions.

All communications (except those to the Editor) should be addressed to:
The Association for Astronomy Education,
The Royal Astronomical Society,
Burlington House, Piccadilly,
LONDON. W1V 0NL.

Editor: Alex Barnett, 43 Second Avenue, Wellingborough, Northants, NN8 3PX
email alexbarnett@dial.pipex.com. - for all enquiries concerning the Newsletter.
(Tel 01933 443628)

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Whole page	£120
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* These may be of any size which may conveniently be inserted into the newsletter. There may also be an additional charge for posting if the inserts are heavy.

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

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

FOR YOUR INFORMATION . . .

The BIG Event is an informal conference of BIG members and others interested in interactivity within science centres and museums. Last year, around 200 attended the event. It is held at Herstmonceux Science Centre, East Sussex (in the grounds of the old Royal Observatory). You can find out more about BIG from the internet link on the website below. (BIG stands for British Interactive Group)

This year's event is also at Herstmonceux and is held from July 23rd to July 26th. For further details of costs, programme and accommodation, contact Bridget Holligan at the Oxford Trust on 01865 728953.

BIG is very interested in hearing from mobile planetarium users as it feels that this is a group of people at the forefront of interactivity that doesn't normally spring to mind when you think about interactives. Sessions at the BIG Event include discussions on teaching and explaining methods, building interactives and networking. The key note speaker is from the Millennium Experience Company and other Millennium science Centres will also have a presence there.

http://www.shef.ac.uk/~lmu/tjc.html

The **Association for Science Education annual conference** is going to be held at Reading University next year from Thursday 7th to Saturday 9th January. It is being held in conjunction with a wider programme of conferences from Monday 4th January covering topics of interest to educators. For further information contact the conference office by fax on 01707 266532 or email mbrookman@ase.org.uk.

That **eclipse** is getting closer and closer. Many groups around the country and preparing packs and gadgets to help teachers prepare their classes. Watch this space.

The **British Association of Planetaria,** a subgroup of AAE had it annual meeting at Techniquest on 9th May. A great time was had by all thanks to the effort of the Techniquest team. A variety of ideas for use in Starlabs or portable planetaria were presented, along with discussions on copyright and legal issues for using images and music in shows. There was also discussion about the future of BAP which, for the time being will operate as a more formal sub-committee before deciding if it wants to become an independent organisation. The challenges of the British Planetarium community with regards to staffing and training were discussed and it is hoped to creative an FE type modular course to assist with the training and further development of planetarium staff skills in areas ranging from photography and slide preparation to marketing and promotion. If there are any AAE members who feel that they should be on the receiving end of the small informal news sheet and goings on in the British Planetarium Community, can they please send their name and address to Eva Hans, South Tyneside College Planetarium, St Georges Avenue, South Shields, Tyne and Wear, NE34 6ET.

There are three new large planetaria and some smaller ones going up in the next few years and not enough staff to run them currently exist. It will however be exciting times for resources in astronomy education and many schools find themselves within a convenient distance of a new science centre/planetarium and can thus utilise the resources and assistance there. AAE will probably be seeking to create a more formal resource centre structure using these new centres.

Any **news or events** that should be in this column should be sent to the Editor, address as front page announcement.

Here is a 'cry from the heart' sent by email to a group of teachers working in Italy. If you would like to write to GNOMON, we will publish your replies and pass them on.

Alan Pickwick

At the beginning of this school year, in October, I explained to my students of the first year of the physics course (14 years old) the meaning of the angle measuring the height of a celestial body; then I asked them to write down what they thought to be the height of the Sun at midday in the second half of June and in the second half of December. All of them answered that at midday in June the Sun is 90 high and 30% of them answered that it has the same height (90) also at midday in December. I do not live in Quito (Ecuador), nor in Kenya, but in a town in northern Italy the latitude of which is approximately 45 north. Their answers lead me to suspect that in some of them there is a total lack of connection, of communication with nature, with what is outside their own individuality. It looks like if they had no perception of the presence of what is perhaps the strongest presence of the world outside ourselves, the Sun

I sometimes have the feeling that some students study things in the same way as they look at TV: the world of young people is so rich of images and so poor of physical and natural reality that they perceive what they are studying as a image as well, they find it hard connecting it with the world outside of the window.

What would you all do to overcome such a problem? Which kind of didactic initiatives would you propose after discovering this limit? How could we use astronomy to help them feel that images that fill up TVs and the books they study are only a simplified representation of a reality that does exist outside the images themselves and that continuously changes? How could we let them feel the magic power of the Sun?

Ferruccio Jarach,
Via Piazza, 11,
26900 Lodi,
Italy
jarach@prof.it

QUERIES

Our Query Service has been very busy lately, Mike Dworetsky of ULO is doing an admirable job. You can reach "query" at
E-mail: query@ulo.ucl.ac.uk

Hello Stephen! Your question to "Ask an Astronomer" was: Why do Jupiter and Neptune have more than one moon whilst the other planets in our system have only one or none?

Answer: First of all, Stephen, the question as you have asked it has an error in it. Other planets besides Jupiter and Neptune have many moons. The number of known satellites orbiting around each of the nine planets is as follows:

Mercury:	0
Venus:	0
Earth:	1
Mars:	2
Jupiter:	16
Saturn:	18
Uranus:	17
Neptune:	8
Pluto:	1

So your question ought to have been, "Why do the four big planets have lots of moons and the five smaller planets have two, one, or none?" Before I answer, though, you may find out from an encyclopaedia that Uranus has 15 known moons, not 17. The reason for the difference is that two small moons were recently discovered at Palomar Observatory; in fact, the article officially giving details of the discovery was published in Nature magazine only last week.

There seem to be three ways for planets to get moons:

1. While planets were still forming out of the cloud of gas and dust surrounding the newly formed Sun, two large bodies could have collided. The result might be either a merger into a larger body (a planet), or a part of the colliding material could be knocked into orbit around the rest of the material, which would have formed a planet-moon system like the Earth and Moon. It is thought that the Moon may have formed as a result of a collision between the early Earth and something about the size of Mars, which melted together, leaving debris from the collision condensing in orbit around it to form the Moon. If so, the formation of the Moon can be thought of as an accident.

2. As they condensed from the solar dust cloud, the giant planets probably had smaller surrounding dust clouds of their own, which condensed into satellites like the large moons of Jupiter and Saturn. There is evidence for this in the fact that all four giant planets have rings of dust and ice, although only the rings of Saturn are large and dense enough to be easily visible from Earth. Some smaller moons can form this way.

3. Several of the moons of the outer planets appear to be asteroids or similar objects, possibly captured by the strong gravity of the giant planets. One way we can tell this is to compare views from spacecraft that showed close-ups of the moons of Mars with views of true asteroids photographed by Galileo and NEAR missions. They look similar. Also, the orbits of some of the smaller moons are backwards, or retrograde, which can't be due to a spinning dust cloud, but which is only possible for captures.

Although Mars isn't a giant planet, and is smaller than the Earth, it can capture asteroids fairly easily because it is much closer to the asteroid zone than the other three inner planets and has many more opportunities to catch one. At the moment, Mars is orbited by two asteroid-like moons called Phobos and Deimos.

Pluto is the smallest planet. No one is quite sure how the satellite of Pluto got there, but we are glad it did, because it has made it possible to get information about Pluto which could not be obtained without it. It was probably captured but the details are not known.

So moons can come into being in three ways: forming by collisions between large planet-like objects, forming through the condensation of a dust cloud around a giant planet, or by being captured by the gravity of a planet. The answer to your question is that the giant planets are much better at the second two methods of formation of moons while the first method only rarely produces a moon.

I hope you can get some books from the library and read more about the interesting discoveries that have been made about the other planets. And you can use the Internet to surf to some of the latest images from Mars and Jupiter:

http://mars.jpl.nasa.gov/mgs/ for the Mars Global Surveyor

http://www.jpl.nasa.gov/galileo/for the Galileo mission to Jupiter

There are many other Web sites about the exploration of the solar system; I hope these will get you started on your explorations, Stephen. Good luck!

★ ★ ★ ★

Dear Sir or Madam,
I'm doing a career report in school, and I have chosen the topic of Astronomers because I thought it would be something that I would be interested in as my own future career. I was wondering if you could be able to give me any information or advice on becoming an astronomer. Thank you for your time.

Kristin

Hello Kristin,

Your e-mail gives no clue as to where you are located or what age you are so my answer has to be as general as possible. The best advice to give anyone who wants to be an astronomer is, do it because you love the subject and be prepared to work very hard. There is little point in doing it for the money because most astronomers are either academics or employed by government bodies and the scope for earning high salaries is not very good. The other advice is to get as much education in mathematics and physics as you can absorb because it is essential to be good at both subjects in order to do astronomy. The best preparation is to do a University

degree in Astronomy, Astrophysics, or Physics. It normally takes several years of study and research after a first degree before the aspiring astronomer can be awarded a doctorate (PhD) which is the entry level qualification for research.

However, a possible alternative if you think you might like teaching rather than research is to look into training as a planetarium lecturer or educator.

There is an American Web Site where some students have set up an Ask an Astronomer service; they have several articles on aspects of careers:

http://www.ucolick.org/

Go to the Ask an Astronomer page and in the Search Answers box enter: career in astronomy This will give you several related answers they have given to similar questions. Except for the obvious American orientation, the answers I read there are not very different from those we would give in Britain.

I have had only one other question on careers so far, from someone who wanted to know about what University to attend for a good astronomy degree course. My full answer is given below, and my signature is at the end. Best wishes for success in your project.

★ ★ ★ ★

Dear Mr Brown,

On Thu, 2 Apr 1998, you wrote:

I aspire to be a professional astronomer although I don't know which university course I should do. Due to illness I have only 5 GCSEs-English, Eng Lit, Geography, Art and Maths (4 at grade A and one at B), and I am now studying for Physics, Maths, Further Maths, History and General Studies at A Level. I was hoping you could point me in the right direction; particularly over what you consider to be a 'good' astronomical university and what sort of course would be best suited to my qualifications. Thankyou so much for your time!

A good place to start researching this is in the magazine Astronomy Now. Each October, they devote a special issue to UK Astronomy and Astrophysics degree courses. Try to find past issues going back two or three years in a library. In the UK an Astronomy or Astrophysics degree is a very reasonable way to train for entry to a research degree course, which is the usual path taken by professional astronomers. Doing a physics degree is also possible.

You need to ask yourself whether you want to stay near home or live well away from home; what sort of A-levels you are likely to get; and so forth. Do you think you would enjoy the hustle and opportunities of big cities, or would you be more content living a quiet country life in a small university town? This will help to narrow your choices. Only a few universities offer what I would regard as 'genuine' astronomy degrees in the UK: places like UCL, Newcastle, Leicester, Glasgow, St Andrews, Manchester, Birmingham, and Sussex come to mind, as do Hertfordshire and Central Lancashire from 'new' universities. (this list is not complete) The better universities require very strong A-levels. The typical entrant at UCL, where I work, has 2Bs and an A in relevant subjects (which General Studies is not—so devote all your efforts to the other subjects).

Degrees in astrophysics are very similar but an astronomy degree should have the distinction of being strong in observational and practical work, with a good observatory a must. Still others offer physics degrees with some astronomy lecture courses. The latter is what you are likely to get at Oxford and Cambridge.

You might also look at the research ratings of the departments because this could be a guide to the number of active astronomers working in the department. A weak research department should probably be avoided if your aim is to train for professional astronomy. Check for Web pages also, as these can give you the most recent information and let you look for 'home pages' of staff.

Write to each of the departments which look likely to fill your needs, and ask for details of the course offerings. They should all be able to provide you with brochures. Also, ask your physics tutors for advice, especially if you can find one interested in astronomy.

Finally, at the end of it all, please remember that there are actually comparatively few professional places in astronomy for longer-term careers, which means that you should do your very best if you want to have any chance at all, but be prepared to consider doing something else at the end of the degree course!

Best of luck - maybe I will see you here some day at an interview - who knows?

Mike Dworetsky,
University of London Observatory
for AAE Query-Ask an Astronomer

★ ★ ★ ★

To: UK teachers

I need some help, about application meteor for communication Thanks before for your information.

Sincerely yours,
Nur Hasan Murtiaji

Dear Mr. Murtiaji

Thank you for writing to the AAE query service. Your question can be answered in a variety of ways. There is a lot of information on the World Wide Web (WWW), so the easiest way to offer what you want is to send you to do a Net search with a browser. I tried the AltaVista search engine and asked for

+meteors +radio
and
+meteors +communication

(+means include this word in the search)

Both searches gave useful information which may be exactly what you are looking for. Use your computer's browser to look at:

http://www.qsl.net/k0sm/ms.htm

which discusses amateur communication via ionisation trails. Also,

http://www.serve.com/meteors/faq3.html

is the American Meteor Society FAQ on radio meteors.

Both of these give a lot of information and references. See, for example,

Lynch, J.L., A Different Way to Observe the Perseids. Sky & Telescope, August 1992, pp. 222-225.

Mason, J., Tuning in to meteor showers. Astronomy Now, February 1994.

Black, W.H., Observing Meteors by Radio. Sky & Telescope, July 1983, pp.61-62.

Pillon, K., Meteor astronomy at home (Computer Adventures). Popular Science, May 1984, pp. 80.

If this is for a group project, best wishes for success. With a minimum of equipment it should be possible to detect meteors hundreds of km away.

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On Wed, 1 Apr 1998, Bob Smith wrote:

Is the darkness between the Stars & Galaxies the edge of time and that nothing exists beyond this at the limit of 15-20 Billion Light Years since the Big Bang or given Redshift Velocities of objects/Galaxies in their evolution could they be beyond this distance but there has not been enough time for their light to reach us? Thank you.

You have asked a lot of questions! Let me try to break it into little bites and explain the answers to each part.

1. *Is the darkness between the stars and galaxies the edge of time, and nothing lies beyond that limit?*

When we look deep into space with very sensitive large telescopes and radio telescopes, we are looking outwards in distance and also back in time, because of the finite speed of light (about 300,000 km/sec). We have observed that the Universe is expanding, which implies that there was a time when everything was together in one place (call it time = 0).The early Universe was extremely hot, and it would have cooled as it began expanding. At some point, this cooling would have proceeded to the point where hydrogen ions and electrons recombined to make neutral hydrogen atoms. At this moment the Universe would have suddenly gone from being opaque to light to being transparent. This would happen at a temperature of about 4000 Kelvin. In 1965, astronomers discovered microwave radiation coming from all directions which was identified as this 'black body' radiation. It proved to have a temperature of 2.8 Kelvin. (The freezing point of water is 273 K; a hot kitchen oven might be at 500 K; glowing iron melts at 1711 K.)

We interpret this background as being the red-shifted light of the Universe from the 'era of recombination'. So, although we do not see visible light, we do see 'microwave light', between the stars and galaxies.

Because we cannot see beyond the opaque hydrogen gas of the early Universe, we cannot see literally to the edge of time except through theoretical models of the earliest Universe. For a long time after the gas 'cleared', no stars or galaxies formed. The Hubble Space Telescope has succeeded in looking far enough out in space (and back in time) to observe what may be the first galaxies, seething with bursts of star formation. These are so very faint that, in ordinary ground-based observations, the sky where they are seen looks completely dark. But this is only because our instruments had not been sensitive enough to see them.

2. *Could there be galaxies beyond the distance of 15-20 billion light years, so that not enough time has elapsed for their light to reach us?*

No. It is difficult for the imagination to grasp, but the Universe is not static or Euclidean. What you are asking about could only happen if the Universe contained no matter, was infinite in time and space and did not expand. Since we can see the Universal cosmic microwave background, which we are confident represents the era of recombination of hydrogen, we know that we are already seeing beyond the time when the first galaxies formed. These concepts are very difficult to explain neatly without use of diagrams and mathematics. People tend to think of things in everyday terms of time and distance, which works fine on Earth, but this fails to describe what is happening on immense cosmic scales of time and space.

For more information, you might try the following Web sites, from astronomy course teachers, NASA, etc:

http://www.missouri.edu/~physwww/handout_10.html

http://www2.ari.net/home/odenwald/qadir/cosm.html

http://www.pbs.org/wnet/hawking/html/home.html

http://image.gsfc.nasa.gov/poetry/astro/q1591.html

just for starters, or try your own Net search on the keywords

+cosmology +universe +"Big Bang" -creationism

This ought to keep you busy for a while!

Best wishes,

★ ★ ★ ★

AND FINALLY

On Wed, 1 Apr 1998, Stephen Bailey wrote:

I wonder if you can help me, I am trying to track down the exact wording and provenance of half-remembered quote from, I think, an Astronomer Royal (possibly Flamsteed): "Of meridians and parallels man has made a net and, casting this net upon the heavens, made them his own"

I thought I remembered it from a trip to the old Royal Observatory in Greenwich, but they have never come across it. If you can help I should be very grateful, it is far too good a saying for me to have made up!

This one has Query stumped, so far! I have some feelers out to colleagues who might recognise this and if I find out who said it I will let you know.

ANY IDEAS ANYONE?

Query

for the AAE Ask an Astronomer service

CURRICULUM CORNER

EXPLORING MARS

Mars is once again popular with the masses, thanks to the Pathfinder probe which beamed back those stunning images in the Summer of 1997. Anxious to capitalise on this interest, myself and Kathy Michaels, the Director of the Maryvale Schools planetarium in Buffalo, New York decided to ask a small, select group of pupils in the middle school to design a Mars base from the ground up. To begin with, there were only perhaps 10 children involved, but within weeks the project had taken on a life of its own, and this number had grown to over 100. I think we've created a monster!

The project is set 100 years into the future, so we've called it Mars 2098. The logo is the Greek sign for Mars, a circle with an arrow coming off the perimeter. We told the kids the base will be built inside a three-mile wide crater close to the equator. (We'll find a real one on a Mars map in the right location). They decided the base should be large enough to hold 1,800 people (equivalent to the number of pupils in their school). To make it more tangible, we had them build a crater about four feet wide from cardboard and paper mache surrounding a wooden base. It was then painted red.

Once the kids realised what we were about they really got into the project. It challenges them to think about literally every aspect of modern day life which they (and adults!) take for granted. The great thing about this from the viewpoint of curriculum needs is that the wide variety of tasks they have to perform make Mars 2098 an ideal multi-disciplinary exercise.

Here is a selection from a very long list:

How are we going to get the colonists there in the first place?

What is the most efficient propulsion system and route to take?

Calculate how much living space and air an average person needs.

How can we make air?

What rubbish can be recycled and how?

What do we do with the stuff that can't be recycled?

How to design efficient living accommodations in a limited space.

Where to get the energy the base will run on (solar, geothermal, nuclear, wind etc.).

Design a communications system for use within the colony and for keeping in touch with Earth (which requires them to know when the Sun gets in the way and how to avoid that problem).

How to form a government and elect the leaders.

How to explore the Martian landscape.

How much food and water does an average person need?

What are the most nutritious foods and how can they be grown on Mars?

Design an education system for the children.

Design a Martian calendar.

How can we move people around the colony efficiently?

What leisure activities will be offered?

and so on, ad infinitum, almost!

One book in particular I found to be highly useful in our research. It is The Case for Mars, by Bob Zubrin. It caused a stir in NASA a few years ago with its exciting, radical approach to getting the first small group of astronauts to the planet. Almost every page has something useful we needed to know.

There is scope to invite into the classroom experts in various fields, such as waste disposal, hydroponics etc., who can give the children a greater insight into these topics than they perhaps would get from just reading a few paragraphs in a book.

We divided up the base into units and assigned each pupil a specific role. They needed to research their given topic, write a few hundred words about it and coordinate their findings with chosen team leaders. As I write, we are still working on the nitty-gritty, but hope to have it all finished in time to present to the rest of the school in May or June as part of Maryvale's annual Celebration of Success Day. The crater will be the centre-piece, and the pupils' project notes will be on display, too.

A paper about this project may be presented at the International Planetarium Society's conference in London in June, so look out for it if you are attending.

Before we began Mars 2098, the pupils clearly didn't know a great deal about the planet, but during their research they have garnered much useful information, giving them both a greater appreciation of the Red Planet and of the complexity of modern society. I recommend this idea to other educators. Just sit back and watch it bloom!

Steve Tidey
Assistant Director, Maryvale Schools Planetrium, Buffalo, NY

Several word games with an astronomical feel for those sunny afternoons

ATOMIC COMPOSITION OF CONSTELLATIONS

I expect that you didnít know that some constellations have a specific atomic composition. Take PAVO for example, it is made of protactinium plus vanadium and oxygen. How do I know? Well, the symbols for these elements are, in order, Pa, V, O, thus PA+V+O = PAVO.

It is often easier to start with the reverse. In the first six cases below, identify the constellation that has the given atomic composition. Then see if you can do the reverse with the remaining half dozen.

Boron plus Oxygen plus Oxygen plus Tellurium plus Sulphur.
Chromium plus Astatine plus Erbium
Lutetium plus Plutonium plus Sulphur
Tantalum plus Uranium plus Ruthenium plus Sulphur
Lanthanum plus Carbon plus Erbium plus Tantalum
Carbon plus Argon plus Iodine plus Sodium
CIRCINUM
LIBRA
MONOCEROS
OCTANS
PISCES
PUPPIS

Using the word CLUSTER, how many words of four or more letters can you make? (there are over 30)

Using the word PLANETS can you make over 60 words of four letters or more?

REVIEWS

QUARKS, LEPTONS AND THE BIG BANG, by Jonathan Allday. 315 Pages. Price £12.95.

It takes a brave person to write a "popular" book on this type of subject.

It is obvious that the writer was conscious of this and from time to time puts in little quotes to ensure the reader is always reminded of Quantum weirdness keeping in mind Bohr's famous quote, 'Anyone who is not shocked by Quantum theory has not understood it.'

Einstein described the difficulty very well:- . . . either he succeeds in being intelligible by concealing the core of the problem . . . or he give such an expert account that the reader is discouraged from reading further.' Einstein, of course, had Relativity in mind but the non-intuitive nature of quantum theory engenders the same problem.

This is a mathematical subject and the writer has steered a middle course. He does not make the mistake of banning all mathematical equations. The usefulness of a very famous recent book was ruined because the equally famous author took the advice given to him that the sales would fall off by X per cent for each equation included.

This book is described as being between the popular level and pre-university so some understanding of physics and maths is assumed. Never-the-less the writer steers clear of the very advanced maths of the experts. The equations used are understandable. This makes a difference and many things fall into place when numbers can be applied to them. A good example of this is the explanation of the reason for baryon numbers in units of 1/3 instead of 1's.

The author's description of his book is about right: More technical than a popular book on the subject, less technical than a textbook. The first 160 pages inform the reader in detail of the nature of particles. Then the various experimental techniques are described for dealing with these incredibly tiny pieces of matter and the equipment used to glean information from these experiments.

Then follows modern ideas on the possible unification of all the four forces: The Grand Unification.

Finally there is about 100 pages on how all this is connected with astronomy from The Big Bang up to the present day.

Just one small quibble. Near the beginning of the book the definition of an atom uses Bohr's 1913 model which in quantum terms is not correct. John Gibbons described it as "a hotchpotch"; although it works well for chemistry.

The good index and detailed contents list at the front makes it very easy to refer back. In addition there is a 12 page detailed glossary and at the end of each chapter there is an ample summary with extensive notes.

Some of the book on my bookshelves are in pristine condition; others are dog-eared and well thumbed. This book, in time, will fall into the latter category. I recommend it to anyone interested in this absorbing subject.

Frank Tobin

SAD NEWS

It is with regret that we heard recently of the death of a long-term member and supporter of the AAE, Mr Edward Robert Wood of Tachbrook Street, London.

Our thoughts are with his family and friends.

Sky Diary Summer 1998

NIGHT SKY FOR THE THIRD QUARTER OF 1998

The map is part of the sky looking 10° west of south at midnight on August 5th (all times are GMT). The Sun sets at about 20^h30^{min} on July 1, and just before 18^h by September 30. The Autumn Equinox is on the morning of September 23. At that moment, sidereal time (right ascension on the meridian) and GMT are the same, the sidereal clock having "gained" exactly 24 hours since the 1997 Autumn Equinox.

High in the night sky throughout the quarter is the trio of bright stars often called the "Summer Triangle", an approximately isosceles triangle of stars linking different constellations. Vega, the northwest point of the triangle and the brightest, is in Lyra. Deneb, the northeast point, is in Cygnus, and Altair, the southern point, in Aquila. The Triangle appears to the right of centre in the chart, extending from roughly one third of the distance from the top of the chart to one third of the distance from the bottom.

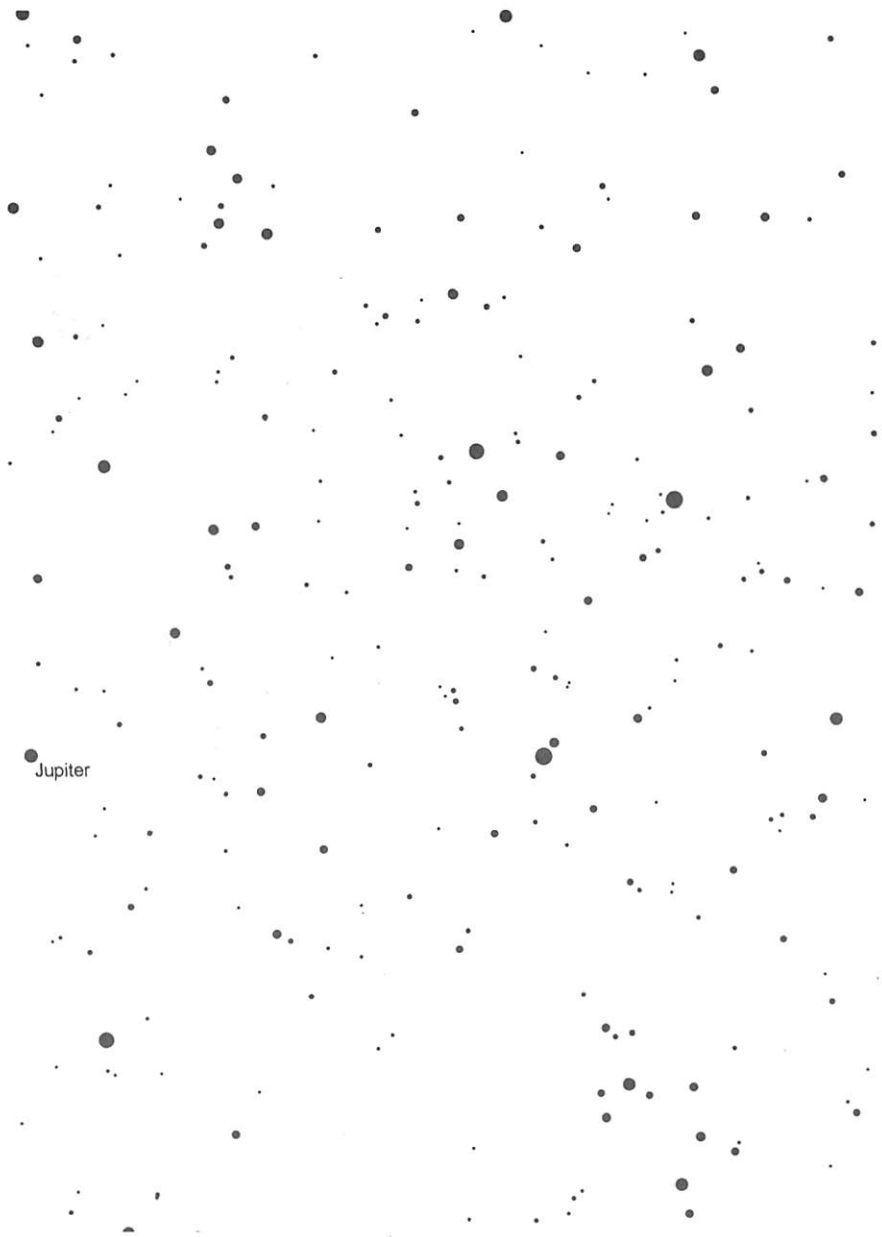
Cygnus, the Swan, is sometimes called the "Northern Cross", and it is certainly more crucifix-shaped than the Southern Cross, Crux, which is really a diamond shape. It is worth binocular examination on a very dark (moonless) night to try and spot the elusive North America nebula, just to the east of Deneb, which is comparatively easy to catch on a simple colour photograph. The head of the Swan (or the base of the cross) is Albireo, a wide double of glorious colour contrast that can be made out in a good pair of rigidly mounted binoculars.

The Triangle is useful for finding two small constellations that (for a change) look like their names, Delphinus, the Dolphin leaping joyfully below the eastern arm of the cross, to the north east of Altair, and Sagitta the Arrow, between Albireo and Altair. Sagitta is almost the smallest constellation in the sky.

Sky Diary *cont*

The faint star on the chart very close to Vega at about the 10 o'clock position (a position angle of about 60° to Vega) is epsilon Lyrae, the famous wide double star. It can be seen in binoculars (the latest edition of *Norton's Star Atlas* describes it as a "naked eye pair", but at distance 208" and magnitudes of about 4.6 each that must be a most optimistic description!). It is famous because in an 80mm telescope or larger, each component is found to be a double star separated by 2.6" and 2.3" respectively.

The line from Deneb through Altair points down to Sagittarius, which is the southernmost constellation of the zodiac so is best seen from southern latitudes of Britain. It appears in the bottom right corner of the chart, and (with a bit of imagination) can be seen as a "Teapot". The top of this teapot is a little (upside down) dipper of six stars which may also help in recognising the group.



Mercury reaches western elongation (18°) on August 31, and will be some 10° above the horizon (from southern Britain). Venus will be very close and to the east (slightly closer to the Sun) in the dawn sky. Mars, Saturn and Jupiter will also be spread along the ecliptic at this time, clearly marking its path through the stars.

Jupiter reaches opposition on September 16, and will be very obvious in Pisces to the south of the Great Square of Pegasus, roughly where Saturn was two years ago, and now getting much more favourably placed for northern observers than it has been for several years. Because Jupiter takes about 12 years to orbit the Sun, it advances about one zodiacal constellation each year (bearing in mind that these constellations are by no means of equal extent along the zodiac), so next year it will be close to where Saturn is during this Summer, on the Pisces/Aries border. Jupiter will eventually overtake Saturn in 2000 June, unfortunately at about the time both planets are at conjunction.

Three eclipses, two of the Moon and one of the Sun take place as the Sun nears the position of the Moon's ascending node, which is about 40° west of the Autumn Equinox at these dates. Both lunar eclipses are unexciting, being both penumbral and partial, and only the first (August 8) is visible from Britain. The solar eclipse is annular, and will be seen only in the Antipodes.

Moon Phases

Month	New Moon	1st Quarter	Full Moon	Last Quarter
July	23	31	9	16
August	22	30	8	14
September	20	28	6	13

Richard Knox
Penzance Peripatetic Planetarium

Caption to star chart: A part of the sky looking south in mid-August, from the horizon to the pole. Polaris is at the top of the chart, just right of centre. In the centre of the chart is the "Summer Triangle", with the Great Square of Pegasus to the east. From the top corner of the Square (as shown) the curve of Andromeda extends northwards along the left edge of the chart. The west side of the Square points down to Fomalhaut, one of the furthest south stars easily seen from Britain, near the bottom left corner of the chart.