

Gnomon

Newsletter of the Association of Astronomy Education

Vol.31 No.4

ISSN 0952 326X

Summer 2012

All Change at the AAE

At the Annual Business Meeting held on the 7th July 2012 it was resolved to make some sizeable changes.

This will be the final paper edition of Gnomon. With the membership dwindling and the cost of postage rising, in future Gnomon will be published electronically. It is intended that there will be four editions per year.

The members subscription has been set to zero. As almost all the cost of running AAE has been in the printing and postage of Gnomon, the subscription revenue, though welcome, is not essential.

Those of you who pay by standing order (and others) could cancel but perhaps you would consider continuing your payment as a donation, which could be Gift Aided. I enclose a Gift Aid form for you to sign if you so wish.

The Council intends to keep AAE going and it will be possible for new members to join by filling in a form on the web site.

I will enter your details into the web site membership system and advise you of your logon name and password in due course.

Please check that your email ad-

dress is correct as shown on the A4 mailing sheet as this will be the means of communication with you in the future.

If you absolutely do not have an email address, it might be possible to post Gnomon to you. Please let me know if you are in this situation.

This change gives the opportunity to form an active Facebook group which could accumulate many more people than would ever consider joining AAE. This could be useful in securing our influence in the future.

Alan Pickwick. Honorary Treasurer and Membership Secretary.

SpaceX Returns from the ISS

At the end of May the SpaceX spacecraft Dragon successfully splashed down in the Pacific after a 10-day trip to the International Space Station.

It was launched from Cape Canaveral in Florida on a Falcon 9 rocket. The Dragon spacecraft approached

The ISS crew put about 1,400 pounds of completed experiments and redundant equipment inside the Dragon for return to Earth.

The successful recovery of the capsule and its contents triggers a £1bn contract for 12 further re-supply trips.

As developments continue the cost

ESERO Conference

The UK Space Education Office (ESERO-UK) is holding a conference for organisations throughout the UK that provide support to teachers and students in the use of Space as a context for enriching teaching and learning in schools. Teachers are also welcome to attend.

Celebrating the use of Space to enrich teaching and learning in the UK the conference will be held on the 13th and 14th September 2012 at the National STEM Centre, University of York.

Some of the headline talks are:

- Can 'Enrichment' resources change practice in schools?
- STEM landscape in schools
- IOP work and resource provision for schools
- Delegates Soapbox Session
- What do teachers want that will help teaching and learning in the classroom?
- The changing curriculum in England.
- What support and funding is available to promote activities in schools?

Book now on the web site.

www.spacex.com

www.esero.org.uk



the Space Station and was docked using the station's robotic arm.

The spacecraft carried 1200 pounds of non-critical cargo for the astronauts and cosmonauts living on the station.

of taking material to orbit could fall from \$10000 per pound using the Shuttle to as little as \$1000 per pound.

MESSENGER Mission Completes 1000th Orbit of Mercury

MESSENGER Mission News reported that in June MESSENGER successfully completed its 1000th orbit of the planet. It is now in the 8-hour orbit from which it will operate for the next year.

Mercury's Oddly Offset Magnetic Field

Recent results show that Mercury's magnetic field is not symmetrical. The field lines are swept into space by the Solar Wind.

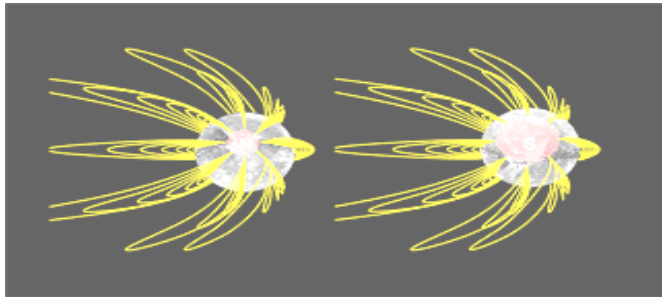


Image Courtesy of NASA

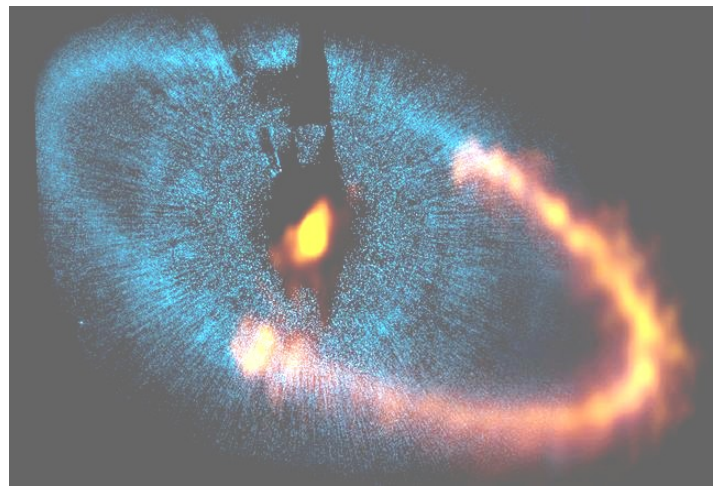
Illustrative magnetic lines of force (yellow lines) for two views of Mercury. The polar region (red shading) within which the local magnetic field opens to the solar wind, and is not connected to the opposite hemisphere of the planet, is four times larger in the south (S) than in the north (N). The magnetic field offset strongly enhances the exposure of the surface at high southern latitudes to bombardment by charged particles in the solar wind.

<http://messenger.jhuapl.edu>

ALMA Progress

The ALMA radio telescope array has produced its first images. It now has 41 of the 66 dishes in place and connected to the computer system.

This new picture shows the dust ring around the bright star Fomalhaut. The underlying blue picture shows an earlier image obtained by the NASA/ESA Hubble Space Telescope. The new ALMA image has given astronomers a major breakthrough in understanding a nearby planetary system and provided valuable clues about how such systems form and evolve. Note that ALMA has so far only observed a part of the ring.



Microwave image courtesy of ALMA (ESO/NAOJ/NRAO) and visible light image NASA/ESA Hubble Space Telescope

www.almaobservatory.org

Kepler Progress

As of July 2012 the counts are:

Confirmed Planets: 74

Planet Candidates: 2321

Eclipsing Binary Stars: 2165

Kepler uses the transit method to detect extrasolar planets. When Venus passed across the disc of the Sun recently, a very small dip in the Sun's brightness was observed. Kepler is continuously observing a small patch of the sky in the constellation of Cygnus. The patch is equivalent to the area of your hand held at arm's length. There it simultaneously monitors the brightnesses of more than 100,000 stars, searching for transits.

Once detected, the planet's orbital size can be calculated from the period (how long it takes the planet to orbit once around the star) and the mass of the star using Kepler's Third Law of planetary motion. The size of the planet is found from the depth of the transit (how much the brightness of the star drops) and the size of the star. From the orbital size and the temperature of the star, the planet's characteristic temperature can be calculated. From this the question of whether or not the planet is habitable (not necessarily inhabited) can be answered.

www.nasa.gov/kepler

Subscription Rates:

Individual Members.....£0.00
Retired Members.....£0.00
Corporate Members
(e.g. schools, colleges etc.).....£0.00
Members receive yearly four issues of *Gnomon*. Corporate Members will receive three copies of each issue. A £2 discount is made on all annual subscriptions paid by direct debit.

Extra Copies:

0 - 10 £1.00 per copy
11 - 50 £0.75 per copy
51 + £0.50 per copy
(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, effectively reducing their contributions.

All communications (except those to the Editor) should be addressed to:

Association for Astronomy Education
The Royal Astronomical Society
Burlington House, Piccadilly
LONDON W1J 0BQ

www.aae.org.uk

For all enquiries concerning the newsletter, contact the Editor:

Alan C Pickwick
19 Edale Grove
Sale, M33 4RG

Alan_C_Pickwick@btinternet.com
Telephone: 0161 973 6796

Any photographs sent to the Editor by email (preferred) should be sent in a common format (TIF or JPEG) with resolution not less than 300 dpi © Material from *Gnomon* may be used by members in scholastic applications. Publication elsewhere *must* have the written permission of the AAE or the authors.

Advertising Charges:

Whole page £120
Half page £60
Quarter page £30
Inserts £75

(Inserts may be of any size which may conveniently be inserted in the newsletter. Heavy items may incur an additional charge for postage.) A 25% reduction is made for advertising in all four issues.

Publication Dates:

These are at the equinoxes and the solstices, that is four times a year. Copy deadlines are four weeks before these dates.

Using Floodlights for Spectra

Relatively inexpensive light sources showing a wide variety of spectra are to be found in security floodlights.

Recently, I had a request for information from Ian Robinson, Head of Physics, Prior Pursglove College. He has bought some samples and has kindly agreed to share some of his spectra.

The floodlights came from CPC (www.cpc.co.uk). They will sell to anybody of good repute with money!

- * High Pressure Sodium (SON) Flood LA02534 £40
- * Metal Halide (MH) Flood LA03364 £40
- * Low Energy Lamp Flood LA02518 £35
- * LED Flood LA02534 £10

Low pressure sodium (SOX) lamps seem now to be out of production but a look on EBay shows quite a few small streetlights for sale. You could approach your local council Street lighting Department and see if they could give you a variety of small fittings.

The SON lamps show a sodium spectrum with a very large absorption band where the D-lines should be! This is how they create a less-yellow colour.

The MH lamps show a mercury spectrum and is usually a point source that casts sharp shadows.

The low energy lamps look like domestic filament lamps but do it with a complex mix of bands and lines from the mercury vapour and the phosphor.

The LED lamps show bands from the semiconductor and bands from the phosphors.

Ian took the spectra using a Red Tide USB 650 spectrometer which he strongly recommends. See the web site at www.oceanoptics.com. There are dealers in Europe. Cost about \$1000.

The spectra to the right are in the order mentioned above:

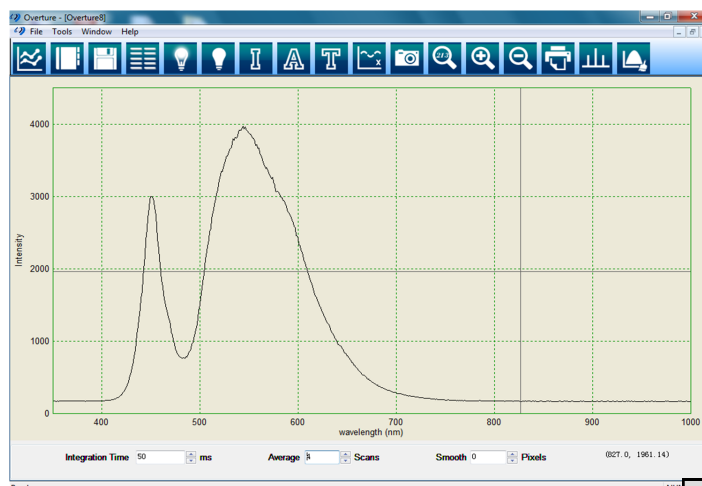
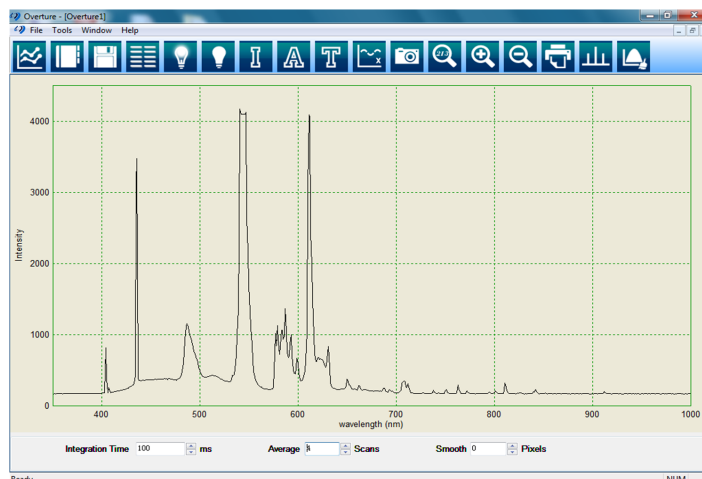
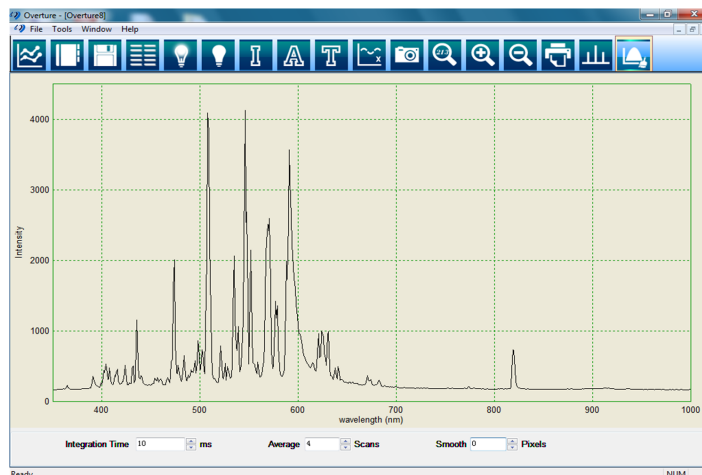
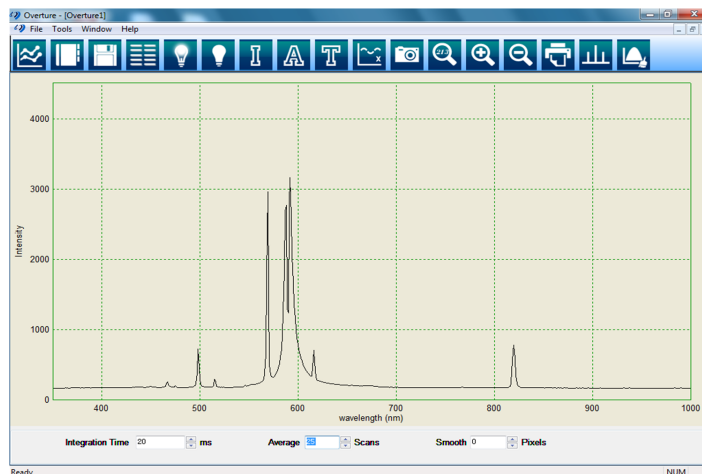
- * High Pressure Sodium (SON)
- * Metal Halide (MH)
- * Low Energy Lamp (Compact Fluorescent)
- * White LED.

One can observe spectra using the conventional school spectroscope and diffraction grating. There are a number of hand-held spectroscopes that give very good results. However very few are calibrated:

Direct Vision Handheld Spectroscope D2-3210.05 £56.00 www.djb.co.uk/ppl_spectroscope.html

Pocket Diffraction Spectroscope B8A81802 £49.62 www.philipharris.co.uk/product/B8A81802

Another USB Spectrophotometer & Spectrometer D3-1020.00, £399.00, is available from http://www.djb.co.uk/ppl_spectrometer.html but I have no experience of it in use.



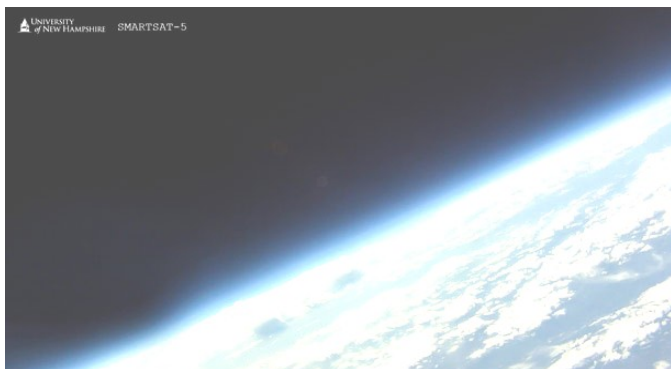
Use Balloon and Rocket Flights to Enthuse your STEM groups

In the UK we may not have access to the amazing facilities described below but we can still make water rockets and simple chemical rockets. Even fastening a small camera to a kite or tethered to bunch of helium balloons can be inspirational.

American High School Snaps High-altitude Balloon as it Shreds

In America it is possible to fly small weather balloons to carry scientific payloads to heights of 30 kilometres. Experiments with balloons are relatively inexpensive and don't take vast amounts of time so school children can contribute

As part of Project SMART, a team of high school students along with mentors from the University of New Hampshire recently sent such a balloon up to 32.2 kilometres! While that's not technically into space (which begins officially at a height of 100 km), it's still high enough that the sky is black, and the view of Earth breath-taking.



The Earth from 32.2 km. Photograph courtesy: University of New Hampshire.



Balloon Shreds at 32.2 km. Photograph courtesy: University of New Hampshire.

On board was a Geiger counter to measure cosmic rays as well as a Styrofoam dish-shaped re-entry vehicle which returned the package safely to the ground. It is thought to be the first time that's been done in the small-balloon community.

The camera they flew up with their experiment happened to catch the balloon just as it burst! The balloons are designed to burst once they get to maximum altitude. The payload drops back to Earth and can be recovered otherwise the balloon would stay afloat for a long time and the experiment lost.

Water Rockets

An Australian Web Site with great construction details:
www.aircommandrockets.com

The 2013 NPL Water Rocket Challenge will be held on Wednesday 19 June at the NPL Sports Club, Queens Road, Teddington - www.npl.co.uk

There is a detailed guide at resource.npl.co.uk/docs/educate_explore/water_rockets/wr_booklet_screen.pdf

Not all water rockets are small:



Image courtesy of teddingtontown.co.uk

For ready-made items, search Amazon.

Chemical Rockets

More expensive than water rockets. A wide range can be purchased from The Model Rocket Shop - www.modelrockets.co.uk

Air Blast Rockets

Made popular by Gary Williams of the Institute of Physics. The launcher comprises a series of standard plastic water pipes that act as an air reservoir. The air is compressed using a tyre pump. It is released using a quarter-turn valve. The resulting air blast drives a cardboard tube into the sky! Details on www.talkphysics.org.

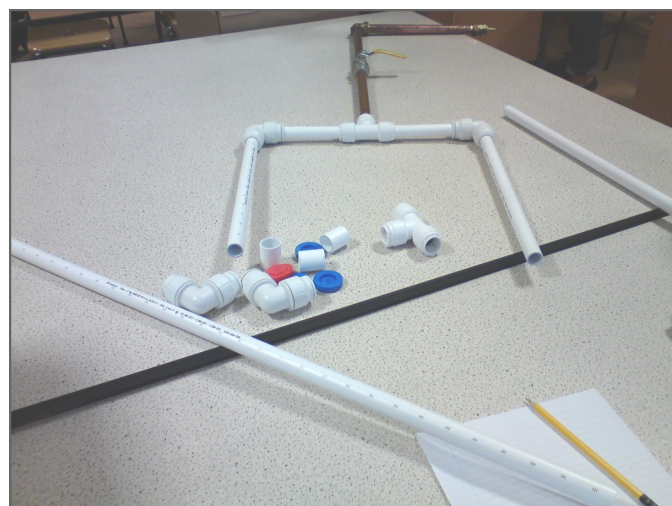


Image courtesy of blog.mrmackenzie.co.uk

Saturday Morning Science

From the University of Missouri comes a series of recorded lectures for teenagers. Here are some Earth and Space related titles:

- Space: A personal perspective from low Earth orbit
 - Once around the orbit
 - Conservation when seas are rising
 - The New Madrid seismic zone: what can it teach us about earthquakes?
 - Space bugs, vaccines, and microbiology research in space flight
 - Actually, it IS rocket science: space flight explained
 - Deep-sea hydrothermal vents: new technologies, new discoveries
-
- How many things can you keep in mind?
 - How game theory explains stupid behaviour

satscience.missouri.edu/multimedia.php

Amateur Astronomers Boost ESA's Asteroid Hunt

A partnership with the Faulkes Telescope Project promises to boost the ESA's space hazards research while helping students to discover potentially dangerous space rocks.



Faulkes Telescope, Hawaii

ESA's Space Situational Awareness (SSA) programme is keeping watch over space hazards, including disruptive space weather, debris objects in Earth orbit and asteroids that pass close enough to cause concern.

The asteroids – near-Earth objects or NEOs since they cross Earth's orbit – are a particular problem.

Any attempt to survey and catalogue hazardous asteroids faces a number of difficulties. The asteroids are often jet black or at least very dark and they're often spotted only once and then disappear before the discovery can be confirmed.

ESA is turning to amateur astronomers to 'Crowdsource'

observations as part of Europe's contribution to the global asteroid hunt. These efforts will add to the follow-up observations already done at ESA's Optical Ground Station on Tenerife in the Canary Islands.



This summer the UK's Faulkes Telescope Project will become the latest team to formally support the SSA programme. Spain's La Sagra Sky Survey, operated by the Observatorio Astronomico de Mallorca, began helping SSA earlier this year.

"The wider astronomy community offers a wealth of expertise and enthusiasm, and they have the time and patience to verify new sightings; this helps tremendously," says Detlef Koschny, Head of NEO activity at ESA's SSA programme office.

"In return, we share observing time at ESA's own Optical Ground Station in Tenerife and provide advice, support and professional validation. We'll assist them in any way we can."

The Faulkes Telescope Project runs both educational and research programmes, based at the University of Glamorgan in the UK.

The project has a strong record in public education and science outreach, and is a partner of the US-based Las Cumbres Observatory Global Telescope network, which owns and operates two telescopes. Faulkes supports hundreds of schools across Europe.

"Our new cooperation with ESA is a great opportunity. Use of the 2 metre diameter telescopes in Hawaii and Siding Spring, Australia, will greatly enhance asteroid-spotting for the SSA programme, enabling fainter object detection and tracking from a global telescope network," says Nick Howes, Pro-Am Programme Manager at the Faulkes Telescope.

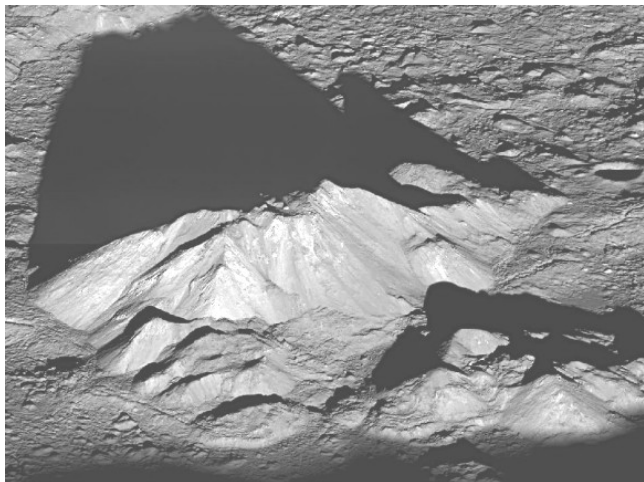
"For European students, collaborating on exciting ESA activities and possibly detecting new NEOs is very appealing as it's engagement with one of the world's great space agencies doing critical scientific work."

ESA's SSA programme is developing services and infrastructure to enable Europe to observe NEOs, predict their orbits, produce impact warnings and be involved in possible mitigation measures and civil response. It will also provide services to monitor man-made debris objects in orbit that can pose hazards to satellites and to monitor the effects of space weather phenomena on space and ground assets.

Adapted from an ESA Press Release.

Recent Space Research Relating to the GCSE Astronomy Syllabus

Tycho Crater



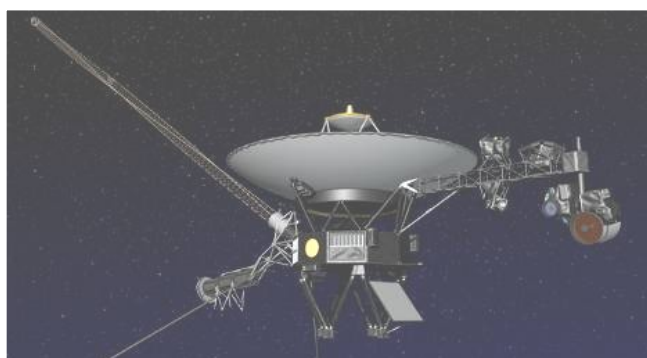
Like the Graben discussed in the last issue of Gnomon, Tycho Crater also provides evidence of relatively recent volcanic activity on the Moon.

The central peak of Tycho crater contains features that are volcanic in origin, indicating that the Moon was geologically active during the crater's formation 110 million years ago.

Vents, lava channels, and solidified flows of inner crustal material found within Tycho Crater were made as recently as 100 million years ago — after the creation of the crater itself.

It has also been speculated that this could indicate that there was pre-existing volcanic activity within the Moon at the site of the Tycho impact.

Voyager 1



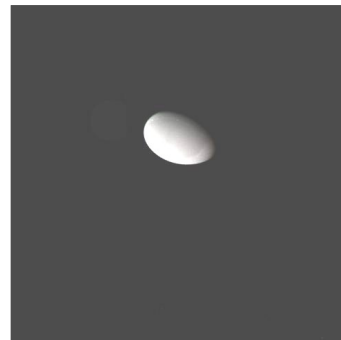
The data making the 120 astronomical unit journey from Voyager 1 satellite, (which was launched in 1977), show that the spacecraft has encountered a region in space where the intensity of charged particles from beyond our solar system has markedly increased. This implies that the mission is now close to the heliopause, the plasma boundary which is accepted by many astronomers to be the edge of the Sun's sphere of influence.

The GCSE textbook does not explicitly define the dimensions of the solar system, but does imply on page 31

that the long period comets in the Oort cloud, originating at a distance of 50,000 astronomical units from the Sun, are at its "outer reaches".

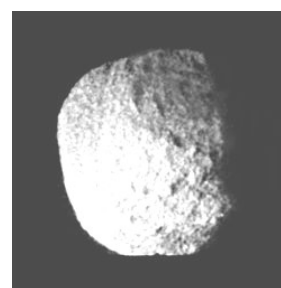
The significant difference between these two estimates of the solar system boundary, (they differ by a factor of more than 400), suggests that care should be taken to emphasise the assumptions that lie behind them when they are quoted to students.

Methone



The Cassini satellite mission has recently captured its best image to date of Methone a tiny, egg-shaped moon of Saturn, which is only 3 km across. Methone, which was discovered by Cassini in 2004, orbits between the moons Mimas and Enceladus, at a distance of 194,000 km from Saturn, and it is remarkably regular and smooth. No craters are visible in this image, (implying that the object has a very young surface), and Methone is far too small for gravity to pull it into hydrostatic equilibrium.

The GCSE textbook covers moons on page 28, where it points out that Neptune's moon Proteus, (which has a diameter of 420 km), is the largest irregular Moon in the solar system, and that it is just one of a number of small inner moons around this planet.



One scenario suggested to account for these small irregular moons of Neptune is that they are the result of debris from a collision. It would appear that alternative mechanisms must be at work at Saturn to account for the unblemished characteristics of Methone, which certainly does not appear to be the direct result of a collision.

GCSE Astronomy – A Guide for Pupils and Teachers by Nigel Marshall. Mickledore Publishing: 4th revised edition (1 Sept 2009) ISBN(13) 978-0-9536345-7-6

Dr Stuart Eves
Lead Mission Concepts Engineer
Surrey Satellite Technology

GCSE Astronomy: A Guide for Pupils and Teachers by Nigel Marshall. Mickledore Publishing; 4th Revised edition (1 Sep 2009) ISBN-13: 978-0953634576. £12.95.

For your Library

"The Universe Rock Series" by Raman Prinja
"Spacecraft and the Journey Into Space"
"To the Planets and Beyond"
"Stars and the Dust That Made Us"
"Galaxies and the Runaway Universe"
QED Publishing, a division of Quarto Publishing plc
Paperback £5.99. Hardcover £10.99.
Publication in late 2012.

A very well produced set of books in A4 format that cover Earth and Space. Suitable for age 10 years into teenage years. The books follow a standard pattern. Turning the pages reveals double page spreads with good graphics and a well thought out text boxes. After a few pages of information these is a practical task to perform and a summary of what has been learned.

Spacecraft and the Journey Into Space covers rockets, planetary missions and space telescopes. The practical tasks include making a rainbow using water in a washing-up bowl and measuring how much taller you are after a good night's sleep (astronauts in space).

To the Planets and Beyond covers the planets and moons as well as the question of life beyond Earth. The practical tasks include making a baking-powder volcano and a paper-cup sundial.

Stars and the Dust That Made Us covers the evolution of stars and has a delightful demonstration of scintillation again using a washing-up bowl.

Galaxies and the Runaway Universe covers the evolution of the Universe and has a nice demonstration of material whirling about to form a spiral galaxy. The expanding Universe demonstration with a balloon covered in spots drawn on with a felt-tip pen is the only mistake I could find. The spots should be pieces of cotton wool. The space between the clusters of galaxies expands but the galaxies do not get bigger.

Each book ends with a top-ten facts page and a glossary. Recommended.

Alan C Pickwick

"The Construction of the Heavens: William Herschel's Cosmology" by Michael Hoskin. Cambridge University Press ISBN-13 978-1107018389. £61.75 Hardcover.

This is a comprehensive history of the work of William Herschel. Over 50 years the author has published four books and many articles on Herschel. In this book the author has reproduced many of Herschel's original papers.

Hoskin starts with a brief review of the first half of Herschel's life (1738-1822) from his birth in Hanover to the point where George III appoints him as Astronomer to the King - a professional astronomer.

In the second chapter Herschel's study of the distances to the stars, the variability of the brightness of stars and the motion of the solar system as derived from the proper mo-

tion of stars are analysed.

In the next three chapters Herschel's work to understand the nebulous patches of light he could see through his telescopes is analysed. The increasing power of the telescopes is illustrated with reproductions of the engravings of the 20-ft and then the 40-ft reflector. With these improvements Herschel realises that some nebulae are clusters of stars and some are truly nebulous clouds.

At the end of the fifth chapter the author lists the topics that Herschel was working on in the early 1800s: The scale of the universe (not much progress); the origins of the nebulae (an understanding that stars and gas clouds are linked); the fate of globular clusters (an understanding of the action of gravity on their evolution); and the rotation of stars (caused by the collapse of an irregular cloud of matter). The author also reminds us that Herschel thought that geology pointed to an age of the Earth of thousands of centuries and that light from the most distant nebulae had travelled for perhaps two million years.

The second half of the book comprises eight of Herschel's key papers on cosmology, representing his progress between 1783 and 1814. They are fully annotated with historical notes and modern astrophysical explanations and make an excellent basis of study for undergraduate and postgraduate students in the history of science and in astronomy.

Whilst being very detailed, the book is a compelling read for anyone interested in the development of observation and theory over Herschel's lifetime. Unfortunately, at over £60 it is not likely to find its way into many personal libraries but would be an excellent book to borrow from a public library.

Alan C Pickwick

"Haunted Observatory: Curiosities from the Astronomer's Cabinet" by Richard Baum. Prometheus Books. ISBN-13: 978-1591025122. £21.21 Hardcover.

The author covers a wide range of ghosts that haunt the developments of astronomy. These are not metaphysical ghosts but both ideas and observations that are an important part of the development of our understanding. Some were the beginnings of the truth when equipment was being used at its limits and some were wishful thinking!

The Mountains of Venus, a City in the Moon, ghostly rings around Uranus and Neptune, bright inexplicable objects seen near the Sun are examples. An allusion Coleridge's poem "The Ancient Mariner" to a "Star dogged Moon" is explored.

The book is very readable. It is not an introduction to astronomy but a very satisfying walk through the last two hundred years of telescopic astronomy.

The book ends with a massive set of references for those who want to take any of the topics further.

Alan C Pickwick

What Can I See Tonight?

Welcome to "What Can I See Tonight?", a feature designed to answer that question and to give a few simple observing tasks for homework.

The descriptions are set for one hour after Sunset in the middle of each month. In the winter this will be just as the pupils arrive home. Specific events are given their date in the month.

The Moon is best observed when the terminator, the line between the Sunlit and shadowed parts, is in the centre of its face. The craters on the terminator show up spectacularly well when observed with even the most inexpensive binoculars. It is time to get that telescope down from the top of the wardrobe or from under the bed, where it has been collecting dust!

Meteor showers are generally disappointing unless there is no Moon. Even then you might have to wait several minutes to see an event. Good for the enthusiasts. Best observed from a garden chair or a sun-bed!

July. Observe at 22:30

- * Mars and Saturn are low in the South-West
- * Cygnus the Swan is high in the East
- * Capella low in the North
- * The Summer Triangle is high in the South-East. Vega is at the top and Deneb to the left. Albireo is at the head of the Swan. In a small telescope Albireo is a stunning double star with one star yellow like the Sun and the other sapphire blue
- * Arcturus is high above Saturn
- * Ursa Major is high in the West

Interesting Events

- * 28 Delta Aquarid meteor shower - best to look after the Moon sets

The Moon

- * 26 First Quarter. Sets at 23:00 (Best for observing detail)

August. Observe at 21:30

- * Capella is low in the North
- * Arcturus is quite high in West
- * The Summer Triangle is high in the South-East
- * Ursa Major is high in the North-West
- * The W of Cassiopeia is in the North-East
- * Cygnus the Swan is high in the South-East

Interesting Events

- * 13 Perseid meteor shower peaks

The Moon

- * 2 Full. Low in the South-East
- * 9 Last Quarter. Rises at 23:00 (Best for observing detail)
- * 24 First Quarter. Sets at 22:30 (Best for observing detail)

September. Observe at 20:30

- * Jupiter is very low in the East
- * The Summer Triangle is high in the South
- * Cygnus the Swan is high in the South-East
- * The W of Cassiopeia is high in the North-East
- * The Andromeda Galaxy is quite high, just North of East. It is the only truly distant object that can be seen with the naked eye in the Northern Hemisphere. It is 2.5 million light years away. The most distant star that can be seen with the naked eye is about 15000 light years away. The light having started out at the end of the last Ice Age.
- * Arcturus is low in the West and with its soft orange colour it is easily mistakable for a planet.
- * Capella is low in the North

Interesting Events

- * 22 The Autumn Equinox. Equal night and day

The Moon

- * 8 Last Quarter. Rises at 23:00 (Best for observing detail)
- * 22 First Quarter. Sets at 22:00 (Best for observing detail)

Moon formation:

Was it a 'hit and run' accident?

New computer simulations suggest a large, fast-moving body impacted the Earth to create the Moon. What is certain is that some sort of impact from another body freed material from the young Earth and the resulting debris coalesced into today's Moon. In a report published in *Icarus*, researchers suggest that the crash happened with a much larger, faster body than previously thought.

In recent years, the best guess for how the Moon formed has been that a relatively slowly moving, Mars-sized body called Theia crashed into the very young Earth. That would have heated both of them up and released a vast cloud of molten material, much of which cooled and clumped together to give rise to the Moon. If so, the Moon would be made up of material from both the Earth and from Theia, which should be somewhat different from one another.

What complicates that story is a number of observations of isotopic compositions taken from the Earth and from lunar samples. The ratio of the Earth's and the Moon's oxygen isotopes is nearly identical. Confounding the issue further, a report in *Nature Geosciences* concludes that a fresh analysis of lunar samples taken by the Apollo missions shows that the Moon and the Earth shared an uncannily similar isotope ratio of the metal titanium. That points to the Moon being cleaved from the Earth.

Now, Andreas Reufer, of Bern has run computer simulations that suggest another possibility: that a far larger and faster-moving body made an even more glancing blow with the young Earth. The research group said that the body would have lost only a small amount of material and most of it would have continued on after the "hit-and-run".

Adapted from various press releases