Gnomon

Newsletter of the Association of Astronomy Education

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Another Funding Crisis for UK Astronomy

Readers may have seen articles in the national press, or on television, about a new funding crisis in UK astronomy. I have been asked to give a brief summary of what is actually going on, though frankly these days I cannot be sure that the correct information is reaching us at AAE - or anywhere else.

During 2006 plans were announced to merge the Particle Physics and Astronomy Research Council with the Council for the Central Laboratory of the Research Council, to form a new council called the Science and Technology Facilities Council (STFC) to deal with "big" facilities such as observatories, satellites, light sources, particle accelerators and the science communities that use them. The new council began work at the start of April 2007. Everything seemed to be running smoothly until November, when STFC announced a big reduction in support for astronomy and other science activities).

By January 2008, it was clear that there are three major cuts imposed on UK Astronomy: sudden withdrawal from the 8-metre Gemini telescope project in the Northern Hemisphere, 25% cuts in responsive research grants to investigators, and withdrawal of support for national and international projects like the Merlin radio telescope interferometer, Liverpool Telescope, UK Infrared Telescope, Solar-Terrestrial Physics (e.g., EISCAT), the Isaac Newton Telescope and William Herschel Telescope, and staff redundancies of about 50% at the Astronomy Technology Centre in Edinburgh. Various physics facilities are also affected: withdrawal from the International Linear Collider project, and cuts at some central laboratory facilities.

Reviews are also planned of activities such as dark matter searches, gravitational wave experiments and cosmic microwave background data. Cuts in administrative costs at STFC Headquarters are, as I understand it, minimal. Prof. Paul Crowther at University of Sheffield has been keeping track of all the latest on this situation, with details at:

//pacrowther.staff.shef.ac.uk/stfc.html

All these cuts have an origin in a weak funding allocation for physics and astronomy in the most recent Government Comprehensive Spending Review. The overall science budget is heavily weighted towards medical research. It failed to take into account some major cost items for new central facilities in the UK, and the result is an £80 million shortfall in funding over the next three years.

I would not for one minute suggest that you advise a 16-year old to abandon hope of doing astronomy or astrophysics at University because of these problems, but it is very likely that after doing a course and a PhD they could find it significantly harder to get a post in the UK. However, today's 16-18-year old may well be able to ride out the storm by the time they get to that stage. We do not know what will happen after 2011.

Mike Dworetsky UCL

Furthest yet?

The NASA/ESA Hubble Space Telescope, with a boost from a natural "zoom lens", has found the strongest evidence so far for a galaxy with a redshift of about 7.6. It is likely to be one of the youngest and brightest galaxies ever seen, which would have been formed right after the cosmic "dark ages" 13 billion years ago - a mere 700 million years after the beginning of our Universe. Detailed images from Hubble's Near Infrared Camera and Multi-Object Spectrometer (NICMOS) reveal an infant galaxy, dubbed A1689-ZD1, undergoing a firestorm of star birth as it comes out of the dark ages. This was a time a time shortly after the Big Bang, but before the first stars completed the reheating of the cold, dark Universe. Images from NASA's Spitzer Space Telescope's Infrared Array Camera provided strong additional evidence that it was a young star-forming galaxy in the dark ages.

The new images promise insight into the formative years of galaxy birth and evolution and yield information on the types of objects that may have contributed to ending the dark ages. Current theory holds that the dark ages began about 400,000 years after the Big Bang, as matter in the expanding Universe cooled and formed clouds of ☞

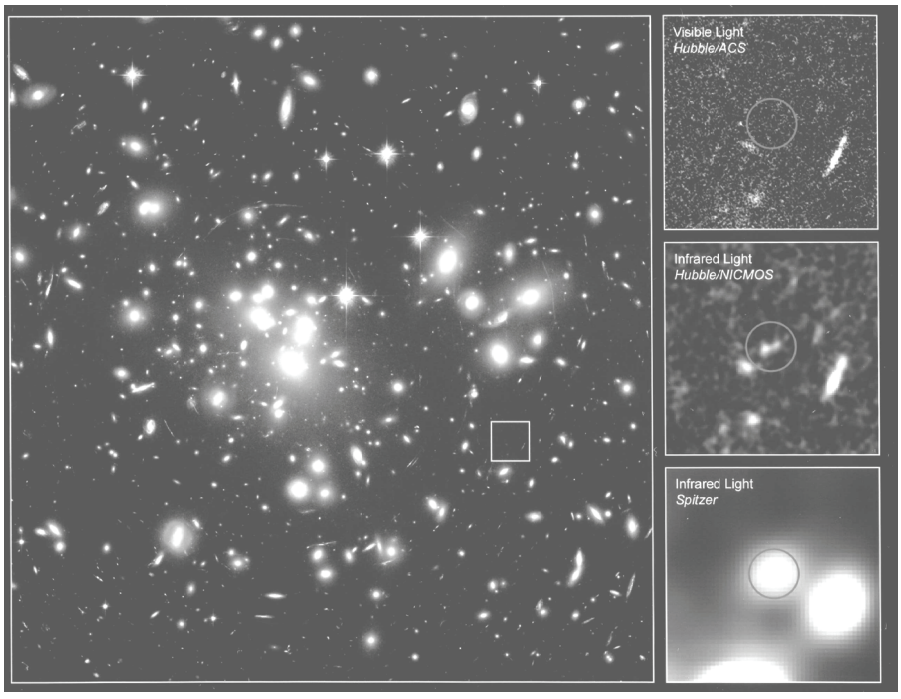

Photo: NASA, ESA. L. Bradley (JHU); R. Bouwens (USC), H. Ford (JHU) and G. Illingworth (UCSC)

Your newsletter: urgent action required

For some of you who find it hard to get to meetings, *Gnomon* is the only contact with the AAE. So it is doubly important that the articles are useful, the news is up to date and the exchange of ideas and/or teaching materials is good.

However, surprisingly, this issue had severe problems of shortage of copy very close to the deadline! Surely there is no lack of exciting things going on out there? Perhaps you are all so busy that you have not got the time to send in a few words? Perhaps you feel that no-one will want to read about your ideas and activities – but this would be wrong. This is your forum to read about everyone else's brilliant ideas *and to share your own with us*. When I was at school (a very long time ago now) I was told that I would get out of an activity only whatever I had put into it. The same must be true of an organisation like the AAE which was set up to share aims, ideas and activities.

So come on all of you! Surely someone out there has a nice photo of Comet P/Holmes, or of the Moon, or of a trip to a planetarium or science centre. Or perhaps your students might like to write about their observations/ coursework trial and tribulations/interests/ambitions. Whatever you send will have a seriously large chance of making it into print and will be enjoyed by other readers.

As they say –"Use it or lose it"!

Anne Urquhart-Potts
AAE Secretary

Offer from Down Under for science link

Thank you Anne for that call to arms. Here is an example of what you can usefully use your newsletter for. Eric Jackson, whose musings on us upside downers is on page 5, writes:

I have a number of schools that are interested in exchanging observations with schools in the Northern Hemisphere. Could anyone who is interested please e.mail me at **jacksone.j#xtra.co.nz**

Editor

New resources for learning astronomy

The Royal Astronomical Society has recently launched its new Education Resources Database, designed to help teachers and students find the very best resources in astronomy and geophysics.

Advancing Astronomy and Geophysics

Each resource listed in the Database carries the RAS "kite-mark" to show that it has been checked for accuracy by professional astronomers and for effectiveness in the classroom by practising science teachers. Furthermore, all resources are listed by astronomical or geophysical topic and also by UK qualification. For example, users can quickly find all resources to support the section on the Expanding Universe in the Edexcel 360° Science GCSE with just a couple of clicks, as the sample search results show.

All UK qualifications containing sections on astronomy or geophysics are supported, with new resources added regularly. The RAS Education Resources Database can be found at **www.ras.org.uk/resources**

Julien King
Chair of Education Committee, Royal Astronomical Society

Get ready for the 2008 AGM

This year the AAE will hold its AGM at Burlington House, long-standing and newly-refurbished London home of the Royal Astronomical Society (RAS). The meeting will run from 10 am to 5 pm on Saturday 28th June. All members are warmly invited to attend.

At the AGM there will be speakers on a range of topics, from cutting-edge astrophysics and cosmology to techniques for teaching astronomy in primary schools. We will also open the meeting to local or visiting teachers, so expect a lively discussion on the burning issues of the science curriculum!

Nearer the time, we will circulate registration details but for now please contact Robert Massey via **rm#ras.org.uk** if you have any questions about the day, wish to reserve your place, or are interested in giving a presentation. Further details will soon appear on **www.ras.org.uk**

☞ Furthest yet? *(cont. from page 1)*

cold hydrogen. These cold clouds pervaded the Universe like a thick fog. At some point during this era, stars and galaxies started to form. Their collective light heated and cleared the fog of cold hydrogen, and ended the dark ages about a billion years after the Big Bang.

A relatively nearby (roughly 2.2 billion light-years away!) massive cluster of galaxies, Abell 1689, acts as a gravitational lens, amplifying the light from the more distant galaxies directly behind it, and increasing its brightness by nearly 10 times - bright enough for Hubble and Spitzer to detect.

Spitzer's images show that the galaxy's mass is equivalent to several billions of stars like our Sun, just a tiny fraction of the mass of the Milky Way. This is typical of galaxies in the early Universe.

The galaxy is an ideal target for Hubble's successor, the James Webb Space Telescope, planned to be launched in 2013 because even with the magnification from the gravitational lens, Hubble's sharp "eye" can see only knots of the brightest, heftiest stars in the galaxy. Hubble cannot pinpoint fainter, lower-mass stars, individual stars, or the material surrounding the star-birth region. The James Webb infrared observatory will have a mirror about seven times the area of Hubble's primary mirror and will collect more light from faint galaxies. It should also be able to view even more remote galaxies whose light has been stretched deep into infrared wavelengths that are out of the reach of NICMOS.

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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:
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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

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Observations

Funding cuts: what can we do?

In the last decade, astronomers have become accustomed to modest growth in the UK research budget, albeit on a smaller scale than that enjoyed by other areas of science. At first sight, this was set to continue when the Government announced the 2008-11 allocation for the Science and Technology Facilities Council (the body that emerged from the merger of PPARC and CCLRC) as part of the Comprehensive Spending Review.

But it was soon clear that the combination of inflation, funding Full Economic Costing of research and the running costs of new facilities meant that the purported 14% increase over three years became a substantial real terms cut. Even if the STFC chose only to fund current research programmes, there would be a shortfall of £80 million over the three years to 2011.

In November came the first sign of the impact with the announcement that the UK was to withdraw from the Gemini Observatory (hastily issued after a leak from a US member of the Observatory board), despite our long-standing membership and £35 million of capital investment to date. This will eventually save the UK around £4 million a year, but will greatly hinder the ability of British astronomers to compete with their peers overseas.

Sadly the Gemini news was just the beginning. In the second week of December, RAS President Professor Michael Rowan-Robinson received details of the STFC delivery plan from a reliable source and the official announcement came later that week. The cuts were as savage as predicted – for example participation in Gemini South, all UK involvement in ground-based solar-terrestrial physics facilities and a 50% cut to the Astronomy Technology Centre in Edinburgh. Projects that may be cut in full or in part include the Dark Energy Survey, the Zeppelin 3 search for dark matter and the MERLIN radio interferometer. 25% of new research grants are at risk too.

By now scientists working in the areas affected – including astronomy, solar-terrestrial and particle physics – were expressing their anger at the proposals. The RAS issued press statements and gave interviews and this bad news story had three successive weeks of coverage in outlets from the BBC to the broadsheet newspapers. And graduate student William Vazquez organised an online petition that attracted nearly 17500 signatures – surely a record for a science cuts issue.

There are some signs that our protests and lobbying are working. STFC has moved to a position where it will negotiate access to the Hawaii Gemini Telescope – so UK scientists should still have access to a major observatory in the northern hemisphere. The House of Commons Select Committee on Innovation, Universities and Skills heard evidence from Professor Rowan-Robinson in late January. And the Government has announced a review of the health of physics by Professor Bill Wakeham, Vice-Chancellor of Southampton University. But for all these moves there is still no sign of additional funding to address the crisis – the worst set of cuts for many years.

AAE members can help make our case to the Government. Contacting your MP by e-mail, letter of fax can be very effective. The RAS website explains how to get in touch with your local representatives and outlines some of the points you may wish to make.

See 💻 **www.ras.org.uk** for further details.

Robert Massey

(Adapted from an article that first appeared in *Astronomy and Geophysics*)

RAS Schools' Newspaper Competition 2008 – The Dark Side of the Sun..?

This year's Royal Astronomical Society Newspaper Competition for schools invites students to explore the many effects which the Sun has on our planet, in conjunction with the continuing International Heliophysical Year.

The competition is open to school or college students aged between 7 and 19. Younger students (Key Stage 2 and 3 - ages 7-14 years) are asked to produce a small newspaper explaining the various effects which the Sun has on the Earth, suitable for the general public. Older students (Key Stage 4 and 5 - ages 14 to 19 years) should produce an article suitable for a scientific magazine, which evaluates the evidence linking the Sun to recent global warming.

The competition is clearly linked to the Science curriculum at all Key Stages, as well as providing an excellent enrichment opportunity for students studying GCSE Science or AS/A Level Physics. Although the competition has a scientific topic, it is designed to be cross-curricular, with many schools allowing students to work on their entries in both their Science and English lessons.

Wining students receive equipment to get them started in observing the night sky and their school receives a telescope. Winning schools are often visited by a Fellow of the Royal Astronomical Society, to present their prizes formally.

Students have the remainder of the academic year to complete their entries, with the closing date being the 28th July 2008. Full details of the competition are provided on the flyer which is enclosed with this edition of Gnomon, further copies of which can be downloaded by following the Education link at 💻 **www.ras.org.uk**

Julien King

Chairman of Education Committee

W(h)ither Pluto?

Ruth Jarmin, Director of Education at Stranmillis Teacher Training College asked to what extent children and young people have gained a "reasonable lay understanding of the issues relating to the change in the status of Pluto. (Not after formal instruction, for example, a science course, when much more than a lay understanding would be expected). This was Mike Dworetsky's reply:

I have not had much to do with school discussion Pluto's reclassification, but I have the perspective of being one of the IAU members who debated and voted on the general question at Prague in August 2006.

Early discoveries about Pluto began with the declaration that it was the predicted ninth planet. But it turned out to be too faint for that and, as time went on, smaller and smaller limits on size and mass were found for it. The question of reclassifying Pluto as a dwarf planet arose after detailed observations of eclipses and transits of its larger satellite (Charon) showed that Pluto was far smaller then our own Moon, and of low density, a mixture of ice and rock, like many moons of the outer planets.

The problem became a more serious one in 2005 when advances in technology and serious search efforts found more examples of Pluto-like objects in the Kuiper Belt, at greater distances than Pluto. The whole problem eventually had to be confronted officially, because one of these objects turned out to be larger than Pluto.

So the question arose, is this new object also a planet, or something else? And if it is bigger than Pluto, and it is not a true planet, should not Pluto really be reclassified also?

A bit of history here: the IAU officially names minor bodies in the Solar System, usually after a suggestion by the discoverer. But the IAU has *(Continued on page 5)* ☞

Earth-like planets may abound

Rocky planets are likely to be found around up to 60% of Sun-like stars, according to two different teams of astronomers presenting papers to a major conference in February.

The papers, presented to the annual conference of the American Association for the Advancement of Science in Boston (Massachusetts, not Lincolnshire), offer observational evidence from the Spitzer Space Telescope which discovered huge amounts of dust around many solar-mass stars. This is interpreted as having been formed from the collision of young rocky planets and planetoids in the early stages of development. Sun-like stars are particularly important targets for observation as the lifetime of stars with such mass is long enough for the potential development of living organisms (by contrast, particularly massive stars may last just a few million years).

The question "Do aliens exist?" is one that I am asked time and again by enthusiastic students of all ages in the course of my mobile planetarium presentations. This is usually followed by much tittering on the part of other children, but I always treat it as equally as valid a question as the many other fascinating questions the children ask. Recent computer modelling has suggested that stable planetary systems may even form in multiple star systems (despite the seemingly chaotic gravitational influences one might envisage), so the chances of finding Earth-like worlds seem only to increase as astronomers improve their understanding of the dynamics of our galaxy. A particular idea I stress to children when answering the "aliens question" is that of the Goldilocks scenario, as this links in with the familiar tale of Goldilocks and the Three Bears as well as the important concept of the three states of matter.

It is all very well finding rocky planets, I tell the children, but there is little likelihood of finding alien lifeforms if there is no liquid water on them. Reminding them that their bodies are composed mostly of water, I point out that (as far as we know) liquid water is essential to life. When Goldilocks trespassed into the Three Bears' house (risking an ASBO in the process), she found that Daddy Bear's porridge was too hot.

Similarly, many exoplanets discovered so far (an exoplanet being the term used for any planet discovered beyond our solar system) are too close to their parent star for liquid water to exist - it would have boiled off years ago, leaving it parched (like Mercury). Goldilocks found Mummy Bear's porridge to be much too cold, just as many other exoplanets are found to be far too cold for liquid water to exist - it would be frozen solid ice.

"So what about Gliese 581C?" another pupil might interject, "isn't that supposed to have liquid water on it?" This is the so-called "Goldilocks scenario". "Aha", I say, then remind them about the excitement generated last year with the announcement of the discovery of the most Earth-like world yet, orbiting a star some 42 light-years away. "The trouble is, further observations by other astronomers and a re-evaluation of the data led to the little-known announcement a few months later that Gliese 581C actually turns out to be too cold for liquid water to exist, after all".

This provokes groans of disappointment as children almost universally wish for aliens to exist (even if they don't want them to visit us!). Depending on the age of the children involved who come into the Space Odyssey planetarium (who range from pre-school children to A-level astrophysicists!), I often try to impress on them the awesome sense of scale involved with inter-stellar travel, not only to explain how incredibly difficult it will be for humans to head out to explore the Galaxy, but also to reassure the students that it is equally difficult for aliens to come to Earth, laser-zap guns a-blazing!

So, the announcements in Boston this year offer astronomy educators yet another opportunity to engage with students in the philosophical side of our art. Of course it is important to teach various facts and figures about the mechanics of our Solar System (and these in themselves often produce wide eyes and gasps of wonder, e.g. the dramatic size of the Sun compared with the Earth). I find it is also very enjoyable and inspirational to lead children to think of the more abstract and philosophical lines of thought that gazing up into and observing the heavens can bring. By emphasising how our understanding is evolving and improving all the time, it may well be that some of our young audience members will become the astrophysicists of the future, helping in turn to further our comprehension of the Universe around us.

Simon Ould
www.spaceodyssey.co.uk

Thomas Harriot 1560-1621: Unsung Hero of English Astronomy

Who made and recorded the first lunar observations using a telescope? If you think it was Galileo you are almost certainly wrong. The honour properly belongs to the man whose portrait you see here - an Englishman, Thomas Harriot, on 26th July, 1609, at Syon House, near Isleworth.

Harriot's public relations record has to be the worst in history. He made ground-breaking observations of sunspots. He calculated the periods of Jupiter's moons. His achievements were astonishing in a number of fields, including pure mathematics and anthropology. Moreover, the times he lived through were most interesting. His patron was Henry Percy, known as the "Wizard Earl", 9th Earl of Northumberland. He had influential friends like Walter Raleigh, whose navigational tutor he was and with whom he sailed on pioneering voyages to America. He was on the fringe of the Gunpowder Plot: yet very few people have heard of him.

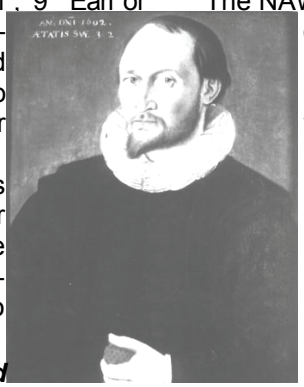
2009 will mark the 400th anniversary of Harriot's observations of the Moon and should be the year to banish this anonymity once and for all. The same month next year also sees the 40th anniversary of the Apollo 11 Moon landing. 2009 is also to be the first International Year of Astronomy.

National Astronomy Weeks have taken place since 1981 whenever there has been an astronomical event likely to catch the public interest. The last one was in 2003 at the time of Mars' closest opposition to Earth for 60,000 years. The next was scheduled to take place in 2009 with the intention of commemorating Harriot's lunar observations and will now do so within the exciting context of a year of national and international celebration of astronomical achievement. That year could make Harriot's name as well known as that of Galileo, in the UK if not elsewhere.

The NAW initiative is called Telescope 400 and will focus on the Thomas Harriot's achievements, particularly in relation to his historic observations of the Moon. The quarter centenary on July 26th itself will be celebrated at Syon Park and there is a Moon Observation week at the end of March – beginning of April when the Moon will be at its best altitude for the year. Over the next month or so a website will be launched to support this project.

At the very least, we should all expect to hear a lot more about Thomas Harriot over the next couple of years.

Teresa Grafton



The original of this portrait of Thomas Harriot (1602) is in Trinity College Oxford

Curriculum Corner

Upside down in the north

Here is just a selection of phenomena that are astronomically based and which Northern Hemisphere residents probably have never thought about that those living in the Southern Hemisphere have to deal with.

● The South Pole is more important to us up here in New Zealand than the North Pole. There is no "top" or "bottom" in space so it is just as correct to show the South Pole at the "top".

● As we go south it gets colder. Going north gets warmer.

● Did you know that the Bible is written from a Northern Hemisphere perspective? See Job Chapter 9 verse 9. He (God) is the maker of the Bear and Orion, the Pleiades and the constellations of the south. Southern Hemisphere viewers can't see the Bear, but we can see Orion, the Pleiades and the constellations of the *north* that are far enough south.

● What you call the “Far East” is our near west. Our “Far East” is the UK, which makes the USA our “Middle East”.

● Clocks go "clockwise " because they were developed in the Northern Hemisphere where the Sun goes "clockwise" across the sky.

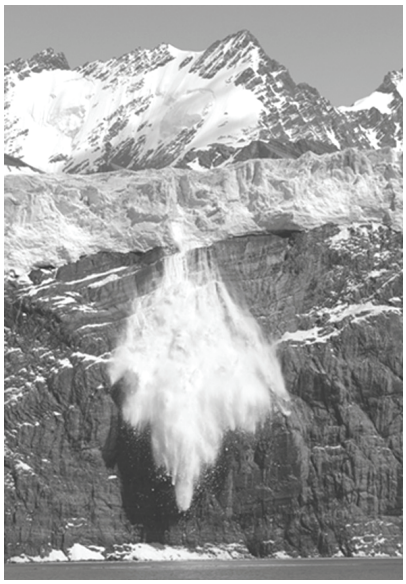
● In the Southern Hemisphere east is on the right as we look North to the Sun as it goes "anticlockwise" across the sky.

● Anyone visiting from the Northern Hemisphere says that constellations of the Zodiac and the Moon are "upside down" which is confusing for them. They are "right side up" to us.

● Our school year runs according to a calendar year unlike Northern Hemisphere schools - that does not seem to make sense to us! Christmas is a time for summer vacations. Christmas cards with snow scenes make no sense.

Eric Jackson

(Please see the news item on page 2, column 1 Ed.)



Well, Eric, this was taken on last Christmas Day, and shows a snow avalanche pouring down the cliffs. Now the location was close to latitude 54°, which is about the same as Newcastle upon Tyne where we love our snow and robins and sledges and chestnuts roasting on an open fire, Jack Frost picking at our noses etc. etc. However, this was taken at latitude 54° south!! Ed

Measuring the altitude of the Sun

This activity is best done following the winter or summer solstice. The only materials required are a 3-metre length of paper, about the same length of string, and a protractor.

At or near solar noon, have a volunteer stand on the end of the paper in the sunshine, and looking at their shadow. Draw around their shadow, including their shoes. Record their name, time and date.

Run a string from the top of their head to the top of the shadow of their head. Use a protractor to measure the angle where the string meets the paper and record the angle.

Measuring the altitude of the Sun: does it suggest a way of measuring the height of a tree or even a building? This experiment offers many possibilities!

Points to observe are: is there any difference between the angles measured for the shortest and tallest students in the class?

● Does the angle change if the activity is done at other times of day (say between 9 a.m. and 3 p.m.)?

● Repeat the activity and measurements with the same student at the same time of the day once a week for a month. Record each measurement and compare them.

● From the angles recorded decide if these indicate whether the sun is increasing or decreasing in apparent height?

● Is there any noticeable relationship between the height of the sun, the length of the shadow and the season?

● Is there any difference if the activity is done at another time of the year?

Eric Jackson

☞ ***W(h)ither Pluto?*** *(continued from page 3)*

no official way to decide the name of a major planet. So the IAU had to make a decision on whether the new object was a planet or not. If not, the discoverer could suggest a name and it would go through the committee. If it was a planet, the discoverer could name it anything he wanted. The overwhelming majority of astronomers thought it was not a planet. So a new category of Solar System body was defined, the dwarf planet, to distinguish these objects from the larger rocky planets like Earth, and the gas giants, like Jupiter.

It was not the first time astronomers have changed the definition of planet. About 150 years ago, the first four asteroids discovered (Ceres, Pallas, Juno, and Vesta) were listed as planets in textbooks and articles. Then astronomers discovered more and more objects similar though smaller, and a decision was made to call them minor planets (or asteroids).

So the astronomers were not out to "get" Pluto; it is just that our knowledge had advanced to the point where it was becoming clear that Pluto is not really a planet the way Mars and Uranus are planets. It was an early discovery of a new type of object, which needed a class all of its own.

Mike Dworetsky

For your Library

David Levy's Guide to Observing Meteor Showers. David H. Levy. ISBN 9780521696913. £18.99 (paperback). 128pp. Illustrated. Cambridge University Press

Meteor observation is one of the more "amateur" ends of astronomical studies, with very little special requirements needed other than rather more of the usual midnight stamina that comes with the territory.

But data on meteor shower performances would be non-existent without the many amateurs who get hooked. It is also a specific part of the subject of astronomy that is of great interest to the young, and watching for meteors is a good way to catch a young student's enthusiasm. In view of this, it is surprising that the subject is not so well served in the literature as the many other aspects of astronomy.

So a hearty welcome to the new book by David Levy, better known of course for his study and discoveries of comets, including his share in the famous Jupiter bombardment by comet Shoemaker-Levy 9 in 1994.

David Levy was himself inspired into entering the astronomical field by his first sight of a meteor when at a much more tender age. The first chapter of this book recounts that story. He goes on to explain that meteors are not objects, they are *events* caused by the destruction of a tiny particle of matter, a meteoroid, hardly bigger than a grain of dust, entering the Earth's atmosphere. The extreme velocity causes friction to heat the air surrounding to incandescence, finally destroying the particle in a momentary blaze of glory.

Most meteoroids start life as a component of the tail of a comet, but there are other tiny particles in space left over from previous catastrophes, especially in the era of the formation of the Solar System itself. Those resulting from comets tend to follow the same orbital paths but drifting away from the main body of the comet over time, almost like leaving a gritty trail through space in a giant ellipse round the Sun. Where these trails intersect with the orbit of the Earth, then at the time of year the Earth itself reaches that point, the meteoroids are most likely to enter the atmosphere and create so-called meteor showers.

One of the characteristics of these regular showers is that, since the particles are following a broadly similar path round the Sun, they are approaching the Earth from the same direction. As some of them enter the Earth's atmosphere, they appear to radiate from a single small area of sky. This is due entirely to the effects of perspective: the parallel lines of telegraph poles that used to run alongside railway lines similarly appear to the passenger to radiate in all directions as a train run along the track. Meteors are about 40 miles or so above the surface of the Earth, far enough to appear to emanate from a point called the *radiant* which can conveniently be described by naming it from the constellation, or even star where it appears to be.

Levy describes the range of meteoroids, dividing them into micrometeoroids and Brownlee particles, the latter being so fine the cloud they cause in the atmosphere is responsible for the zodiacal light and *gegenschein* . At the other end of the scale are the larger chunks of rock that cause a spectacular blazing trail of a fireball across the sky. These can break up or explode, and these are *bolides*. The larger bodies can survive their fall to Earth and await a discoverer of the resulting *meteorite*.

The book discusses some of the pleasures and pains of meteor shower observing, and the techniques for people on their own, or in groups. The techniques for various sizes and abilities of observing teams are described, and other chapters describe recording and photographing the events, and processing the data afterwards.

About half the book is a chronological description of the many meteor events to be named. (Where they are not, as in some of the illustrations, he just refers to an "end of January meteor"). This includes some fascinating asides, for example did you realise that the Quadrantids are named after a constellation that no longer exists? David Levy gives the full description of where it was, and by whom the shower was so-named.

Some are fairly obscure, he admits, and may not be recognised, even by some specialists who study meteors. Omicron Draconids, gamma Velids and August Pavonids, are some examples.

This is a thorough, and most readable book. It could be an important aid to anyone waiting to inspire youngsters, as the author was in his turn first inspired on 1956, July 4.

Richard Knox

Digital SLR Astrophotography. Michael A. Covington. ISBN 9780521700818. £21.99. (paperback) 219pp. Illustrated. Cambridge University Press.

Digital photography has only relatively recently finally ousted film as the medium preferred by the *cognoscenti.* The digital single lens reflex camera seemed a throwback to the days of film, or at least a chance for keen photographers to indulge in some nostalgia. But in fact for those of us who have tried to use a top class digital camera without even a viewfinder, struggling to see anything on an LCD screen on a perfectly normal bright day, the SLR seems a common sense necessity. So it was not long before the Canons and Nikons etc. re-emerged from the museums to resume their place as the serious photographer's digital camera. As the author of this book points out, the story is still very much ongoing, especially to the very specialised application to astrophotography, so he can, with some justification, describe the digital SLR revolution as still in progress. So the book is not intended to be a complete guide to the subject, he says. Well, he has done a thorough job, just the same.

For students, this book has the additional bonus of being a useful technical guide to the digital camera in all its aspects, not just for the sky at night.

The book describes the special requirements and problems for the camera being used for astrophotography, such as shutter vibration, auto focus mechanisms, and so on, and later chapters go into plenty of detail on how to overcome these problems.

The book also covers the practical problems of any type of astrophotography, such as mounts, guiding, and correcting guiding errors. There are detailed discussions on the choice and use of exposure processing software, including such practical considerations as the use of freeware! In addition, the more specialised astronomical techniques, such as stacking, are examined.

The quality of amateur astronomical photography has been stepped up many notches by the use of CCDs in all their camera forms. The particular advantage of the digital single lens reflex camera must be its useful role for all other subjects. Not least is the ability it gives the impoverished amateur to emulate the professional by taking hundreds (if necessary) of exposures to get one right without costing the Earth in wasted film and time. The digital camera has brought seriously good quality photographs within the reach of many more people than was previously possible, and it could be argued that the digital SLR is the best tool the amateur, and maybe even the professional photographer has ever had. Michael Covington makes the case very well.

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Galileo and Darwin 2009: A Universe for Life?

The year 2009 offers a unique opportunity to celebrate some of the greatest achievements of mankind in unravelling the secrets of Nature. It will be 400 years since Galileo extended the human senses opening a wider window to the Universe; it will be 200 years since Charles Darwin's birth and 150 years since the publication of *The Origin of Species by Means of Natural Selection*. It will also mark the 40th anniversary of the first human steps on the lunar landscapes.

Galileo and Darwin 2009 is a journey exploring different possibilities of bring together astronomy and biology. The underlying theme is the universality of evolution, both environmental and biological, It also implies an evolution in the human perception and understanding of the Universe, which leads to the following ideas for discussion.

Our senses clearly suggest that the Earth is a flat environment at the centre of a Universe that rotates around it. The Copernican model (proposed initially by Aristarchus nearly 2000 years earlier) told us that it was the Sun, not the Earth, at the centre of a system of planets. This model was taken forward by the visionary Giordano Bruno, who predicted a Universe with an infinite number of worlds like the Earth. For this he was tortured for seven years and burnt at the stake in 1600 by the Italian inquisition. In the years that followed, Galileo's telescopic observations came with a clear proof that Copernicus was indeed right, but even so, he was threatened and his discoveries were still censored. Why was this model so difficult to accept and its supporters persecuted so violently in Europe?

The universality of evolution had its first and most important impact on society with the publication of the *Origin of Species by Means of Natural Selection* by Charles Darwin in 1859. An impact that ever since, has been at the root of heated discussion and violent debate mainly in the western world. Once again, why is it that these ideas, so well supported by evidence, are apparently so difficult to accept?

Only five years later, in 1864, the universality of evolution was implicit in a publication by Huggins and Miller during the development of spectroscopic techniques that gave birth to astrophysics, where they wrote: "….a community of matter appears to exist throughout the visible universe for the stars contain many of the elements that exist in the Sun and Earth. It is remarkable that the (chemical) elements most widely diffused through the host of stars are some of those most closely connected with the constitution of living organisms of our globe, including hydrogen, sodium, magnesium and iron. May it not be that at least the brighter stars are like our Sun, the upholding and energising centres of systems of worlds adapted to be the abode of living beings?"

The quote has strong links to the ideas of Giordano Bruno, now expanding the Copernican principle by their discovery that the chemistry of life appears everywhere in the Universe, suggesting an evolutionary process from simple inorganic chemistry to the complexity of primordial life and beyond. Would Darwinian processes be applicable on a cosmic scale?

Primitive bacterial life appeared the very young Earth. But for most of the Earth's history, life remained bacterial. The environmental conditions required for the evolution of complex life were the result of an amazing chain of chance events, coincidences and processes in which life itself played a fundamental role. The main conditions conducive to evolution were:

- the right class of star at the right distance from the planet;
- a rocky planet an with iron outer core molten by radioactive decay that has a magnetic field acting as a shield against cosmic radiation;
- multiple cataclysmic collisions during the early stages of the life of the planet that produced an accumulation of water (by cometary impacts) and a massive collision that produced a large satellite that in turn produced tides and created pockets of primordial soup;
- a stable, tilted polar axis giving long-term weather stability
- primordial photosynthesis that produced an oxygen rich atmosphere that was essential for the conservation of liquid water, for biochemical evolution and complex cell structures;
- plate tectonics, that led to diverse continents, stimulating the Darwinian processes and diversity of species;
- massive periodic biological extinctions that became important for the emergence of intelligent mammals and eventually, a technological civilisation.

Lack of space prevents elaboration on these points, but they are useful to establish themes for discussion. For example, are these conditions essential for the Darwinian processes to produce complex life and intelligence? Could complex life evolve under different circumstances? If so, given the fact that there is extrapolated evidence for billions of solar systems in our galaxy, can we expect more technological civilisations similar to ours? Would they necessarily be similar to ours? Is Darwinian natural selection of living species a universal process?

Following what happened on Earth, bacterial life may be very abundant in the Universe. However, the conditions for further evolution and operation of Darwinian processes seem almost impossible to replicate elsewhere. Is our very presence a violation to the Copernican principle? Do we occupy a unique, privileged position in the Universe after all?

At the moment of this publication, the ideas for possible events during 2009 are still taking shape. There are obvious links to philosophy and religion that could result in engaging public activities such as: exhibitions, lectures, debates, café-scientifiques, essays, TV programmes, etc. all within the framework of IYA2009 and Darwin 2009.

Galileo and Darwin 2009 will be published in more detail elsewhere.

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Sky Diary Winter 2008

Starting with the inner planets during April we will not be seeing much. Mercury is unfavourably placed and Venus is too close to the Sun for any easy viewing. It is a more exciting time for the outer planets though. Mars will be moving rapidly through the constellation of Gemini and will have a reasonable presence at 0.8 magnitude. Jupiter is at last a prominent morning object visible for a couple of hours prior to sunrise in a south-easterly direction. With a standard pair of binoculars and a steady hand you will be able to see the Galilean moons as they dance around the planet's equator. If you can get a look through larger binoculars or through a quality telescope the planet will reveal its dark equatorial belts. Saturn at 0.3 magnitude is steadily moving through Leo and will be seen high each evening in the South.

The Lyrid meteor shower produces swift and brilliant meteors that originate from the tail of comet Thatcher 18611. At a usual rate of 10 per hour the storm is visible from the 20th to the 23rd. The best time to catch these "shooting stars" with be at the peak on the morning of the 21st.

April provides us with a reasonably close meeting☞ 7

☞ of the Moon with both Mars and Saturn. During the evening of the 11th a fantastic sight will be Mars and the Moon embraced by the twins of Gemini setting as the night progresses. As the Sun sets on the 15th and the night sky appears, the Moon will come into view near both Saturn and the star Regulus in Leo.

Moon phases for the second quarter of 2008

	New Moon	First Quarter	Full Moon	Last Quarter
April	**5**	**12**	**20**	**28**
May	**6**	**12**	**20**	**28**
June	**3**	**10**	**18**	**26**

Leo would be a nice constellation to concentrate on this month if you have a telescope or pair of large binoculars. Contained within its boundaries are many interesting galaxies of which a grand total of six are only 9th magnitude. M65 and M66 are positioned just under the rear leg of the lion. M66 is a little larger showing us just a little more of its spiral arms. NGC 2903 was just missed by Charles Messier but is well worth hunting out at the end of the Leo's head. M95, M96 and M105 are under the lion's body. Barred spiral galaxy M95 was one of the galaxies in the key project of the Hubble Space Telescope for the determination of the Hubble constant.

Moving on now into May we find Mercury becomes visible from the first week onwards. It will be seen as a 0.5 magnitude object chasing hastily after the Sun each evening. On the 3rd it will be very near the Pleiades, and by the middle of the month will be easier to see after sunset. Venus is still busy and out of sight this month. Mars will now be passing through the constellation of Cancer and will be easy to pick out as there will be no bright stars close. The big photo opportunity of the month is on the 23rd. On this date Mars will spend the evening dancing through the beehive cluster until it sets around midnight. Jupiter will be moving through Sagittarius at a very bright 2.4 magnitude during May in the south from around 2 am until sunrise. Saturn, still in Leo, is the one to watch this month as it is visible all night so is perfect for telescopic observing.

If you like meteor storms then cross your fingers for a clear night on the 5th of May as the Earth passes through the debris left by the comet P/Halley. This shower is known as the Eta Aquarids and is active from the 1st until the 8th. During the peak though expect a rate of up to 35 meteors an hour on a night with no moonlight to interfere.

Now on for a great photo opportunity on the 27th. If you stay up very late, you will be able to see Neptune pass less than half a degree from the Moon. Mars and the Moon again pass close on the 10th with the Moon and Saturn passing close on the 12th.

We all know and love Ursa Major and this may well be a great constellation to investigate during May. Look for the easy visual double of Alcor and Mizar in the Plough. Mizar will then reveal itself as a double star in a small telescope. M97 the Owl Nebula is also nice to see on a clear night. It is a faint planetary nebula and can just be made out with binoculars.

Rising and setting times (UT): lat.52°N; long.3°W

	April 15		May 15		June 15	
	Rise	Set	Rise	Set	Rise	Set
Sun	05h 14m	19h 10m	04h 17m	19h 59m	03h 51m	20h 33m
Mercury	05h 19m	19h 02m	05h 06m	22h 10m	03h 43m	19h 08m
Venus	05h 01m	17h 40m	04h 09m	19h 16m	03h 58m	20h 42m
Mars	09h 26m	02h 20m	08h 57m	01h 04m	08h 39m	23h 37m
Jupiter	02h 08m	10h 10m	00h 13m	08h 17m	22h 01m	06h 04m
Saturn	13h 44m	04h 05m	11h 45m	02h 06m	09h 52m	00h 07m
Uranus	04h 22m	15h 43m	02h 27m	13h 52m	00h 26m	11h 54m
Neptune	03h 31m	13h 10m	01h 34m	11h 15m	23h 29m	09h 12m
Moon*	13h 48m	03h 35m	15h 22m	02h 18m	18h 03m	01h 19m

**** Moon rise and set times are for the stated venue only, but other locations in the UK and other dates can be estimated from these and the Moon phase table***

Finally for this edition of *Sky Diary* we come to June. Mercury best during May and becomes harder to see in the light of the dawn. Venus is again out of sight. Mars can be seen for a few hours after sunset in the west. Jupiter is a morning object very low in the south. Saturn in June sets just after midnight but continues in Leo brightly at 0.7 magnitude.

The Sun this month moves through Taurus and into Gemini and the Summer Solstice is at 23:54 UT on the 20th. Don't forget that with the right equipment the Sun is an amazing sight through a telescope. I would advise speaking to your local astronomical society for advice and contact experienced solar observers with quality equipment.

James O'Neill

This small group of galaxies consists of the Messier objects M65 (lower right), and M66 (lower left), with the edge-on spiral galaxy NGC3628 (upper left). The bright star is 7.11 magnitude Hipparchos 55262 three galaxies form the "Leo Triplet", visible in the same low power field of a telescope. They are at a distance of 35 million light-years or more. These images were taken at the Burrell Schmidt telescope of Case Western Reserve University's Warner and Swasey Observatory located on Kitt Peak, near Tucson, Arizona. The image field is about 40.6x50.8 arc minutes.

REU program/NOAA/AURA/NSF