Gnomon

Newsletter of the Association of Astronomy Education

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AAE Annual General Meeting Liverpool September 2011

This event is open to all AAE and will be held as part of the BAP Conference which takes place on Friday 9th and Saturday 10th September 2011. AAE members are invited to participate in the whole weekend by registration but the Saturday events are free to teachers. There will be a programme of workshops, sessions and talks plus a chance to visit the planetarium.

Venue: World Museum Liverpool, L3 8EN

The registration fees are £30 for AAE members attending the conference and AGM. Teachers can attend free on Saturday.

Registration will be online—see the AAE website soon for details.

The AAE's Annual Business Meeting will also be part of Saturday's proceedings. This is your chance to have a say in the running of the AAE. Elections for Council will take place at this meeting—nominations for Council positions should be sent to the AAE Secretary or Gnomon editor prior to the meeting. Please also send items for the agenda.

Anne Urquhart-Potts

The Lunar Eclipse of June 15th

Did you manage to see the eclipse? We were seriously clouded out in our part of Cornwall but others around Europe have had fantastic views. The Moon rose around 21.20 BST already totally eclipsed as seen from the UK. The total phase ended at 22.03 BST.

This photograph was taken from the Czech Republic by Wespecz who says: I've taken this by a simple digital camera on the night mode located behind a simple binocular and fixed by books, so don't expect miracles here"!

There are more photos of the eclipse on page 2.

Anne Urquhart-Potts

Goodbye to Spirit Rover on Mars

NASA has announced the end of operational planning activities for the Mars rover "Spirit". Its twin, Exploration Rover "Opportunity", is now a single-rover operation. Spirit's last communication was on March 22, 2010 as the Martian winter approached and the rover's solar-energy supply declined. The two intrepid rovers landed on Mars in January 2004 and have lasted well beyond their life expectancy of about three months. This marks the completion of one of the most successful missions of inter-planetary exploration ever launched.

NASA has checked frequently in recent months for a possible reawakening of Spirit as solar energy available to the rover increased during the Martian spring. A series of additional re-contact attempts that were designed for various possible combinations of recoverable conditions ended on May 25th 2011 .

During its seven years on the Martian surface, Spirit has driven 7.73 km and has taken thousands of images of the Martian surface It ground the surfaces off 15 rock targets and scoured 92 targets with a brush to prepare the targets for a spectrometer and a microscopic imager. It discovered white soil that was nearly pure silica.

(Photo from the NASA's JPL website).

The Ancient Night - no more

The Daily Telegraph of May 10th 2011 carried an article by Charles Spencer, welcoming the proposed changes at Stonehenge (re-routing of a nearby road and removal of the visitor centre) and describing the inadequate facilities that people currently find as they arrive from all over the world to marvel at what is arguably Europe's most famous ancient site.

Stonehenge is, with the possible exception of the Great Pyramid, also the world's best known astronomically aligned monument. I wrote to the Telegraph, and my letter was published on May 12th, pointing out that it is not only during the day that the area has been despoiled.

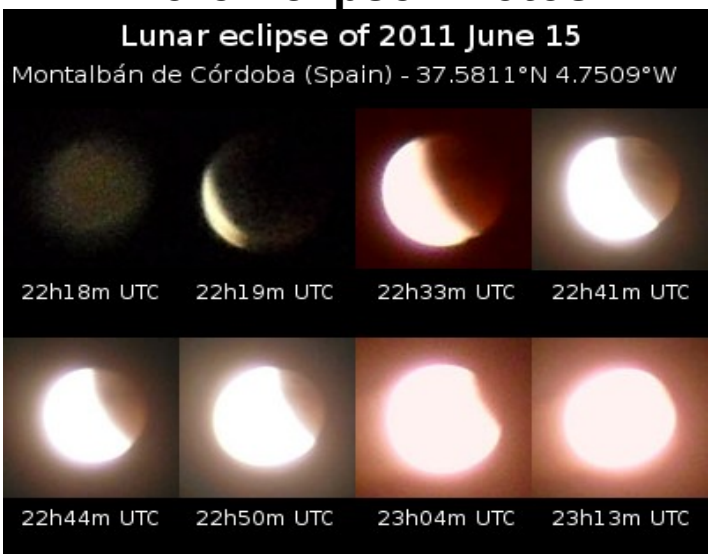
Drive along the A345 road at night, past Durrington, three kilometres to the east of Stonehenge, and you will not see the ancient stars that have arched over the monument

for the last 4000 years, ever since it was a circular ditch. Instead, the night sky is filled with massive light spill from a golf driving range – yes, a golf driving range – situated just east of the ancient stones. Amazingly, somebody at Wiltshire County Council gave permission for this destruction of the nocturnal environment over Stonehenge; and the awful irony is that such golf ranges do not need any large-scale lighting, as the technology exists for the users to see the balls in flight without the use of 'scatter-gun' floodlights.

UNESCO has called the Avebury-Stonehenge-Woodhenge-Durrington tract of Wiltshire a 'landscape without parallel' If you think that the stars over Stonehenge are worth fighting for, please contact: Wiltshire County Council's Community and Environment Department, 165 Bradley Road, Trowbridge BA14 0RD.

Bob Mizon
Coordinator
BAA Campaign for Dark Skies

More Eclipse Photos



Photos from Montalbán de Córdoba, Spain taken by Hameryko

Did any AAE members manage to capture images of this event? Please send your best ones to Gnomon for the September issue! **Ed**

The New Look AAE Website

Please have a look at our new web site at:

www.aae.org.uk

We need your help to check, in particular the details on the "Astronomy Centres to Visit" and the "Astronomy Web Links" pages. It is important that these are correct. Feel free to suggest additions, deletions and corrections. Please use the "Contact Us" page to send your responses to the Webmaster.

Also there is an "Amazon Box" on the lower left of the home page which runs through any given list of books of our choice. So we need to compile a list of the best 10 or twenty Astronomy Education books. We could have more than one box, dividing the list into Primary, Secondary, Outreach GCSE etc. Please send the titles of your favourites in any category (again through the "Contact Us" page).

Please also try out the Search Engine, send a question to the "Ask An Astronomer" and generally check the workings of the site.

Alan C Pickwick.

By searching the links, I noted the deadline of the EAAE's competition "Catch a Star" is looming - see page 6 for more details. **Ed**

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

Edwin Hubble - Part 2

This follows on from Ian Morison's article about Hubble's earlier life (last issue).

Before we can discuss what was perhaps the greatest discovery of the last century, we need to learn about two highly significant sets of observations. The first were made by Henrietta Leavitt whilst working at the Harvard College Observatory where she became head of the photographic photometry department. Her group studied images of stars to determine their magnitude using a photographic measurement system developed by Miss Leavitt that covered a 17 magnitude brightness range.

Many of the plates measured by Leavitt were taken at Harvard Observatory's southern station in Arequipa, Peru from which the Magellanic Clouds could be observed and she spent much time searching the plates taken there for variable stars. She discovered many variable stars within them including 25 Cepheid variable stars. These stars are amongst some of the brightest; between 1000 and 100,000 times that of our Sun and are named after the star Delta Cepheus which was discovered to be variable by the British astronomer John Goodricke in 1784. These stars pulsate regularly, rising rapidly to a peak brightness and then falling more slowly. As they are very bright they can be seen at great distances. Leavitt determined the periods of 25 Cepheid variables in the Small Magellanic Cloud (SMC) and in 1912 announced what has since become known as the Period-Luminosity relation. She stated:

"A straight line can be readily drawn among each of the two series of points corresponding to maxima and minima (of the brightnesses of Cepheid variables), thus showing that there is a simple relation between the brightness of the variable and their periods."

As the SMC was at some considerable distance from Earth and was relatively small, Leavitt also realized that: "as the variables are probably nearly the same distance from the Earth, their periods are apparently associated with their actual emission of light, as determined by their mass, density, and surface brightness."

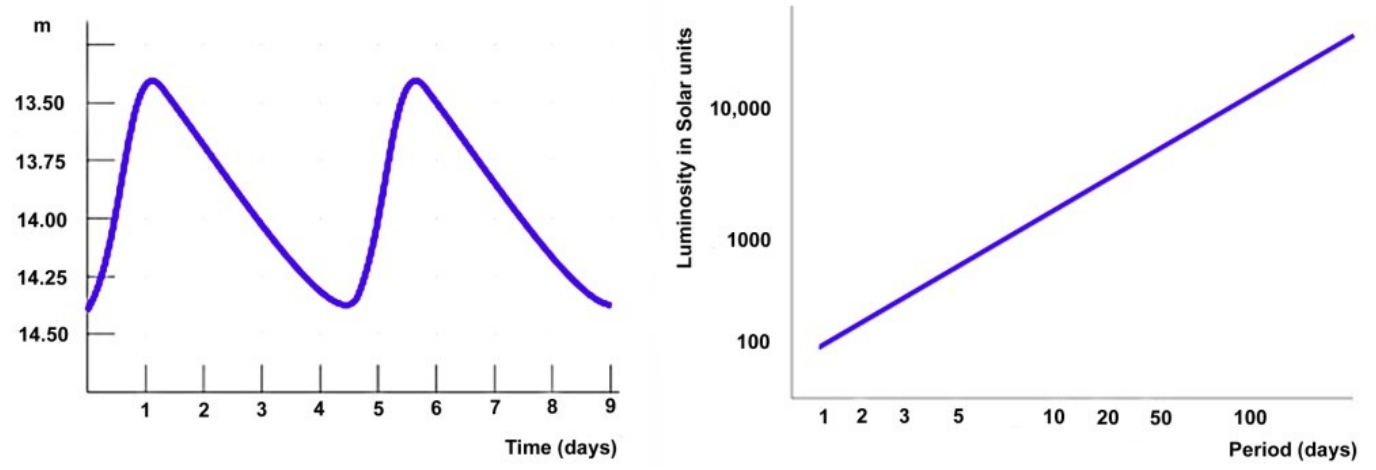
Henrietta Swan Leavitt 1868-1921

square law) that it would be 100 times further away than the LMC, that is 100 x 51.2 Kpc giving a distance of 5,100 Kpc (16,600,000 light years). Cepheid stars are therefore the ideal standard candle to measure the distance of clusters and other galaxies. As we do not the precise location of the Cepheid variable within the cluster or galaxy there will be a small uncertainty but this error is typically small enough to be irrelevant.

There had long been arguments as to whether the "White Nebulae" were within or beyond out own Milky Way galaxy. In 1912 Vesto Slipher at the Lowell Observatory published his observations of the spectral lines in M31, the Great Nebula in Andromeda, and found that they showed a shift towards the blue. Assuming that this was due to the Doppler shift this indicated that Andromeda was moving towards us at a speed of 300 km/sec - greater than any previously observed. Slipher wrote:

"The magnitude of this velocity, which is the greatest hitherto observed, raises the question whether the velocity-like displacement might not be due to some other cause (than the Doppler shift), but I believe we have at present no other interpretation for it" .

Three years later he reported on the spectral shifts in the lines of a further 14 galaxies, all but three of which were receding from us at high speeds. This was perhaps an indication that these objects were not part of our own galaxy as the measured Doppler shifts of known objects within our galaxy were far less. But an opposing view was promoted by Harlow Shapely who had used Cepheid variables to measure the size of the galaxy and the place of our Sun within it. As a result, he was a highly respected astronomer so many accepted his word that the nebulae were nearby. His key point was that novae were observed in these objects and, if they were at great distances they would have to be unimaginably bright. [Actually they were, as they were supernovae!]



A Cepheid variable Light Curve and period -luminosity relation.

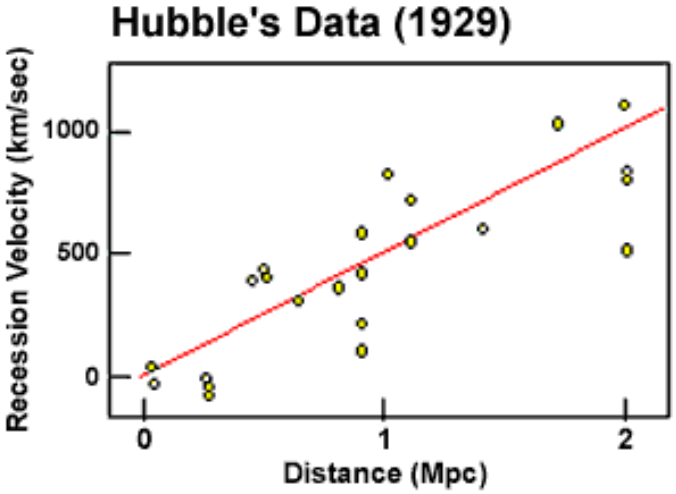
The relationship between a Cepheid variable's luminosity and period is quite precise: a three-day period Cepheid corresponds to a luminosity of about 800 times the Sun whilst a thirty-day period Cepheid is 10,000 times as bright as the Sun. So that if, for example, we might measure the period of a Cepheid variable in a distant galaxy and observe that it is 10,000 times fainter than a Cepheid variable having the same period, in the Large Magellanic Cloud (LMC). We can then deduce (from the inverse

☞ *(cont. on p4)*

☞ *(cont. from p3)* What was needed was the measurement of the distance to one of these "White Nebulae". Hubble knew that if he could locate a Cepheid variable in one and measure the period of its oscillation, he could compare its brightness with one of similar period that had been observed in the SMC. If, say, it appeared 100 times fainter, he would know that it would lie at a distance 10 times further away than the SMC whose distance was known. The Andromeda Nebula, M31, was the obvious target and finally, on an image taken on the 9th October 1923 he found one and was thus able to calculate that Andromeda lay at a distance of 860,000 light years - well beyond the extent of our own galaxy, then thought to be about 300,000 years in diameter.

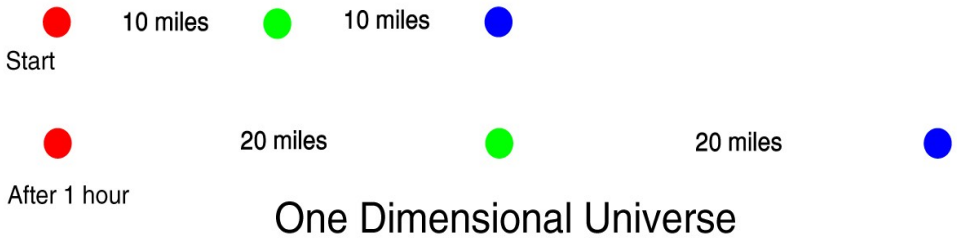
[You will note that these values are about three times smaller than those currently accepted. There are two main types of Cepheid variable and those observed in Andromeda were several times brighter than those observed by Henrietta Leavitt in the SMC. This reduces the calculated distance].

His discovery, announced on December 30th 1924, profoundly changed our understanding of the Universe. Hubble then went on to measure the distances to the galaxies whose redshifts had been measured by Vesto Slipher and



combined his distance measurements with Slipher's velocity measurements to make what was perhaps the single most important discovery of the last century.

Hubble found that the more distant galaxies had greater velocities of recession and (roughly in the original data) the greater the distance the greater the velocity. This has become known as Hubble's Law: the velocity of recession being proportional to the distance. Why was this so important? Imagine the very simple one dimensional universe shown below.



One Dimensional Universe

Initially the three components are 10 miles apart as shown in the above plot. Let this universe expand uniformly by a factor of two in one hour. As seen from the left hand component, the middle components will have appeared to have moved 10 miles in one hour whilst the right hand component will have appeared to move 20 miles - the apparent recession velocity is proportional to the distance.

The speed of recession and distance were directly proportional and related by "Hubble's Constant" or H_0. The value that is derived from his original data was about 500 km/s/Mpc. The use of the word "constant" is perhaps misleading. It would only be a real constant if the universe expanded linearly throughout the whole of its existence. It has not - which is why the subscript is used. H_0 is the *current* value of Hubble's Constant!

If one makes the simple assumption that the universe has expanded at a uniform rate throughout its existence, then it is possible to backtrack in time until the universe would have had no size - its origin - and hence estimate the age, known as the Hubble Age, of the Universe. This is very simply given by $1/H_0$ and, using 500 km/s/Mpc, one derives an age of about 2000 million years:

$1/H_0$ = 1 Mpc / 500 km/s
= 3.26 million light years/ 500 km/s
= $3.26 \times 10^6 \times 365 \times 24 \times 3600 \times 3 \times 10^5$ s / 500
= $3.26 \times 10^6 \times 3 \times 10^5$ years / 500
= 1.96×10^9 years
= ~ 2 Billion years

This is obviously incorrect; the distance calibration data Hubble used was incorrect and, in addition, he was actually observing a brighter class of Cepheid variable which led him to significantly underestimate the distance to the galaxies.

Hubble also devised the most commonly used system for classifying galaxies, grouping them according to their appearance in photographic images. He arranged the different groups of galaxies in what became known as the Hubble sequence. They fell into 3 groups: elliptical, spiral (which were sub-divided into normal and barred spirals) and irregular galaxies.

The dome of the 200 inch telescope at Mount Palomar open for observing

After the war he supported the construction of the gigantic 200-inch telescope on Mount Palomar, south of Mount Wilson, which helped put him on the cover of Time magazine in 1948. He was honoured with making its first observation - that of NGC 2661, the Cometary Nebula, that he had first studied in 1914. Sadly, in 1953, shortly after the 200-inch was completed, Hubble died of a heart attack. Up to the time of his death, astronomers were not able to be considered for the Nobel Prize. This was remedied shortly afterwards but as it is never awarded posthumously he never became a Nobel Laureate – an honour that he so richly deserved.

Ian Morison,

(Gresham Professor of Astronomy)

Letter from Down Under

The Instrumentation Science Group at the Australian Astronomical Observatory (AAO), in collaboration with colleagues from Sydney University and Macquarie University has been very busy of late. The people tasked with developing the next generation of technology to enable us to see faster and deeper into the universe have tested not just one but three new prototypes using so-called "photonic" devices on the Anglo-Australian Telescope (AAT) in the space of just one week!

The first of these is called GNOSIS, and is designed to suppress the OH molecular airglow which makes the sky so bright at near-infrared wavelengths (1.0–1.7 □m). GNOSIS consists of a special type of optical fibre, in which the density of material in its core has been specially modulated using a laser. While most wavelengths of light pass through the optical fibre unimpeded, certain wavelengths (in particular those corresponding to the strong OH airglow) are reflected back along the fibre. When the fibre is fed into a near-infrared spectrograph such as the IRIS2 instrument at the AAT, the usual forest of OH emission lines is completely suppressed, making it possible at last to distinguish the weak red-shifted optical emission lines of very distant galaxies. The integration of GNOSIS within an optical fibre makes it possible to feed IRIS2 even when it is not mounted directly on the AAT (see photo). After further testing and refinement of these fibres with IRIS2, GNOSIS will eventually go into service with the GNIRS near-infrared spectrograph on the Gemini North 8m telescope in Hawaii.

The second piece of innovative technology put through its paces is known as an Integrated Photonic Spectrograph (IPS). As telescopes become bigger and bigger, the size and cost of instruments which analyse the light collected scale up in proportion, to the point where some of the instruments envisaged for the coming generation of Extremely Large Telescopes (with mirrors 20m or more in diameter) are the size of a large room and cost tens of millions of dollars each! Put simply, such instruments are unwieldy and unaffordable, so a way must be found to bring them down to size. The IPS is a "spectrograph on a chip", making it possible to fit the entire instrument within a suitcase. For years the telecommunications industry has been developing such devices as near-infrared wavelength division multiplexers, but their needs and tolerances are somewhat different from those of astronomers. However commercialisation has made such devices relatively cheap to fabricate and with relatively minor modification they show some promise as efficient miniature astronomical spectrographs.

The third photonic device known as "Dragonfly" combines the power of optical fibres with the techniques of optical interferometry. An optical interferometer takes the light beams from two or more apertures in a mask and uses the fringe pattern produced when any two light beams interfere with each other to resolve structure in an astronomical source at a level much finer than the blurring effect of the Earth's atmosphere would normally permit. The method of aperture masking interferometry has been employed by Dr Peter Tuthill in a rather crude fashion on the Keck 10m telescope in Hawaii – his apertures consist of several holes cut in a wooden mask which is suspended directly in front of the Keck's secondary mirror! This setup has allowed him to see amazing dusty "pinwheel" structures around luminous stars known as Wolf-Rayet stars. See:
http://www.physics.usyd.edu.au/~gekko/pinwheel.html
for a movie of these rotating pinwheels.

The GNOSIS optical fibre runs from the Cassegrain feed of the AAT at top, down to the IRIS2 instrument below which is wrapped Christo-like in bubble-wrap to prevent the delicate optical fibre from snagging on IRIS2 as the telescope tracks the target of interest (Image credit: Anthony Horton, AAO)

The input of the Dragonfly instrument consists of an array of small lenses (much like the facets of insect eyes, hence the name) which feeds the light from each lens into its own optical fibre, which can then reformat the image into whatever pattern is required for optical interferometry. Future versions will replace the optical fibres with optical waveguides etched into glass or crystal using pulsed ultrafast lasers. The demands placed on the builders to get the light beams to interfere in just the right way are already pushing the boundaries of modern metrology (precision measurement). One of the most exciting potential applications for Dragonfly is to image Jupiter-size planets at Saturn-like distances around stars up to 500 light years away, a regime in which traditional coronagraphic searches are completely blind.

All these potentially revolutionary developments highlight the importance of access to a sizable telescope like the AAT as a "test-bed" for debugging and refinement, before deploying them on bigger telescopes elsewhere. At the same time however they give the AAT wholly unique capabilities which bolster the telescope's proud scientific record of achievement, and make the AAO such an exciting place to work.

Stuart Ryder

For your Library

Fred Hoyle: A Life in Science by Simon Mitton. ISBN9780521189477, £19.99 (US$36.99) Cambridge University Press. Paperback.

I can honestly say that reading this beautifully written book has been both enjoyable and illuminating. Fred Hoyle was one of the greatest British astronomers of the last century and this book gives a fascinating account of his somewhat turbulent life. I was amazed at the depth of detail that Mitton has unearthed including a wonderful account of his childhood leading up to the start of his academic career at the University of Cambridge and I doubt that any other writer could have given such a thorough account of his life and scientific achievements.

We learn of Hoyle's wartime work and I realised how this had been such a formative time in his career as he spent many evenings discussing astronomical topics with colleagues Hermann Bondi and Tommy Gold, two scientists who would be later linked with him in their ideas on cosmology.

Over his career, Hoyle made major contributions across a very wide range of scientific topics, returning to them as new observational results enabled him to apply his highly intuitive ideas. This means that a purely time-line biography would be very disjointed, so Mitton has wisely assembled the topics (most notably those relating to stellar evolution and cosmology) in chapters that are, in effect, in parallel.

Hoyle's major contribution to the theory of stellar evolution and the synthesis of elements in stars is well recounted. Many astronomers feel that he should have been awarded the Nobel Prize for this work, most notably for the prediction of an excited state of the Carbon 12 nucleus. He had realised that there had to be one to account for the fact that Carbon is so common: "since we are surrounded by Carbon in the natural world and we ourselves are carbon based life, the stars must have discovered a highly effective way of making it, and I am going to look for it" he wrote. This may have been the first use of the anthropic principle in astronomy. He pestered William Fowler's group at the Kellogg Laboratory to search for it, and his name was first on the paper that showed his existence. Fowler was later awarded the Noble Prize whilst Hoyle was not. Could this have been as a result of Hoyle's unwise interview in which he implied that the Nobel Prize Committee were wrong in not giving Jocelyn Bell one for her role in the discovery of Pulsars? The pinnacle of this part of Hoyle's work was the publication of a paper known as B^2FH that stretched to 108 pages. This epic work, a collaboration with Geoffrey and Margaret Burbidge and William Fowler, laid bare the processes of nucleosynthesis in stars. Ironically, they could not explain how the lightest elements, such as lithium, could be made in stars and Hoyle found out how they could have been made in a "Big Bang" origin to the universe – an event that he did not believe in!

But most amateur astronomers will know of Hoyle as one of the originators of the "Steady State" or "Continuous Creation" theory of cosmology along with Hermann Bondi and Tommy Gold. I learnt that the three had together viewed a classic horror film "Dead of Night" which features a recurrent nightmare and that, soon after, Gold hit upon the idea that the universe, like the film, might have no beginning or end. Bondi and Gold produced a paper on the "Steady State Theory" of the universe whilst Hoyle added a C term to Einstein's equations to provide for the continuous creation of matter. This would allow new galaxies to form in the space between the galaxies as they were carried apart by the expansion of space so keeping the overall view of the universe constant. My own understanding of how this theory arose was greatly enhanced by the chapters relating to this and I came to understand that his disagreements (to put it mildly) with Martin Ryle over the observational tests that were carried out to distinguish between the Big Bang or Steady State universes were perhaps more the fault of Ryle than Hoyle. This for me, as a radio astronomer, was a real high point in the book.

We at the Jodrell Bank Observatory should be thankful for another aspect of Hoyle's career, well covered in the book, when he played a major role in obtaining funding for UK astronomy. Early on, he helped make the case for a £50,000 grant to Bernard Lovell to build a long baseline interferometer linked to the 76m telescope at Jodrell Bank. This led to the discovery of quasars, so it was an excellent investment! Later he was responsible for the funding of the Anglo-Australian Telescope, an interferometer for Ryle's group at Cambridge and a major upgrade for Jodrell Bank's 76m radio telescope (whose first use provided the data for your editor's PhD!).

Mitton tells us of another of Hoyle's great legacies, the Institute of Theoretical Astronomy at Cambridge and how, the decision to combine it with the Astronomy Department and rename it the Institute of Astronomy - of which Hoyle was not made director - led to him resigning his Plumian Chair of Astronomy. In one sense, Cambridge's loss was Manchester's gain as he accepted an honorary chair at Manchester where, as a young assistant lecturer, I was able to attend some of his lectures.

As I have been writing this review a slim, red bound book with yellowing pages has been at my side. It's a 1950 edition (sadly not the first) of Fred Hoyle's first book "The Nature of the Universe". As Mitton describes, it was the transcript of a series of brilliant lectures (not the Reith lectures as I had thought) that Hoyle had given on the BBC and which had helped make him Britain's best known astronomer. I read this when at high-school and it inspired me to become an astronomer so I, personally, have much to thank Fred Hoyle for. But I would also like to thank Simon Mitton for making Hoyle's life and work come alive in his book – one that I cannot recommend too highly.

Ian Morison
Gresham Professor of Astronomy

New SETI Search

This March, the University of California, Berkeley, SETI led a collaboration that includes scientists from the SETI Institute and the National Radio Astronomy Observatory in a new effort to search for evidence of extraterrestrial intelligence on habitable planets. This experiment used the largest fully steerable radio telescope on the planet, the Robert C. Byrd Green Bank Telescope.

The current telescope was built following the collapse of the previous Green Bank telescope, a 90.44m Paraboloid. This collapsed in November 1988 due to the sudden loss of a plate in the box girder assembly.

The search targeted 86 exoplanet candidates found by the Kepler Mission. A rough analysis of the 60 terabytes worth of data is being conducted before it is sent out to SETI@home users for more detailed analysis.

EAAE Competition “Catch A Star” Deadline soon

Catch a Star is a contest that has been held as a result of the collaboration between the European Association for Astronomy Education (EAAE) and European Southern Observatory (ESO).
"Catch a Star!" includes more than one competition, so there is something for everyone. The idea of the program is to encourage students to work together, to learn about astronomy and discover things for themselves by researching information.

The goal of the European Astronomy Contest "Catch a Star" is to stimulate the creativity and independent work of students, to strengthen and expand their astronomical knowledge and skills, and to help the spread of information technologies in the educational process.

All students that have studied in European Countries during the current year and who have a strong interest in astronomy and information technology are invited to participate.

The contest includes developing and presenting astronomy projects online. The deadline is Monday, 1st July 2011, at 17:00 Central European Time. After the deadline all projects will be publicized on the project's webpage.

What do I need to do?

Write a report, in English, about an astronomical topic of your own choice (this could be a specific astronomical object, phenomenon, observation, scientific problem, theory, and so on). You may also wish to include practical activities such as your own observations, or experiments.

More details on the EAAE link on the AAE’s website.

Curriculum Corner

TIMING SUNLIGHT

Required: Stop watch.

While talking to the group outside ask if someone has a stopwatch function, or a large second hand on their watch and can time 8 minutes for you from the time that you clap your hands.

Get them to tell you when to start. Clap your hands once.

Tell the time keeper to let you know when 7 minutes and 40 seconds has past so that the group can count down the last 20 seconds when everyone will clap their hands once.

Tell the group that in 8 minutes time something amazing is going to happen.

Continue on with another activity in the meantime.

Ask the timekeeper occasionally how much time has passed or how much is left of the 8 minutes.

Get the group to count down the last 20 seconds and everyone claps their hands once.

Get the students to look around and tell you some things that they can see.

Accept 4 or 5 then ask, “Why can you see them”? Several answers will be given, such as, “Because they are there”. “It’s daylight”. Seek several explanations.

If an answer is given including light ask where the light came from.—“The sun”. “How long did the light take to get here from the sun”? “8 minutes”.

Tell the group. “The light arriving around us now left the Sun just over 8 minutes ago and has travelled 150,000,000 kilometres to get here. That is at the speed of light (300,000 kilometres per second).

That light has come from our nearest star, the Sun.

The next nearest star that we can see in the Northern Hemisphere is Sirius. The light we see from Sirius tonight has taken 9 years to get here. The light left Sirius when you were 9 years younger than you are now, and the light leaving Sirius tonight won’t arrive here until another 9 years!

The nearest star in the Southern Hemisphere is Alpha Centauri, the outer Pointer to the Southern Cross. Its light takes 4 years to travel to Earth.

Eric Jackson

Nearest The Sun

Which human being has been nearest the Sun? Well, I think we’re safe in assuming that it probably wasn’t Icarus! According to the ancient Greek story, Icarus pridefully flew too close to the Sun, at which point the wax in his wings supposedly melted, but there’s not much physics to support that story.

You might assume the correct answer to the question is “an astronaut”, and you’d be right…..at least in recent history. You might also assume it was an Apollo astronaut, since they travelled further from the Earth than any other manned missions to date, and you’d still be right.

But it isn’t quite as clear cut as you might think – for example, if the Apollo astronauts had travelled to the Moon when its near side was wholly illuminated at Full Moon, then they’d have been travelling further away from the Sun, not towards it, during their missions.

Also the Earth’s orbit round the Sun isn’t fixed; it gets perturbed by gravitational effects in regular ways that were first calculated by a Serbian mathematician called Milutin Milankovitch about 100 years ago. These Milankovitch cycles have attracted increasing interest over recent years, as scientists investigating the way that the Earth’s climate has changed periodically in the past have discovered the same periodicities in their temperature data as Milankovitch discovered in his orbital calculations.

Milankovitch discovered various cycles, but the two that are of particular interest are the variations in Earth’s orbital eccentricity, and the way in which the orientation of the orbit rotates in space over a 21,000 year period. In the September issue we look at how this affects the Earth-Sun distance in the past. Could people have been nearer in the past than today? What do you think? Send us your comments (or wait until September for more on this intriguing question).

Stuart Eves

Should there be an A-Level in Astronomy?

I would be interested to know whether Gnomon has ever included a debate on the possibility of creating either an AS or A level in Astronomy. Whilst I fully support the objective of including astronomical topics in other subjects, I think there is also merit in teaching Astronomy as a subject in it's own right.

Stuart Eves

The Editor writes:

We have at various times in our history debated this point, but the situation is always changing and perhaps this is a good time for a fresh debate. What do you think? Please write in with your views.

Sky Diary Summer 2011

From July to September there are plenty of interesting things going on in the night sky. I hope you were able to glimpse the lunar eclipse on June 15th. We don't have anything as spectacular this quarter but the Moon is always there as a very pleasurable object to observe and photograph.

Mercury is always a tough planet to observe. Your only chance to do so with any success is during early to mid-July. Looking towards the west just after sunset, if you have a low horizon, through the glow of twilight (a tall order, me-thinks). The very best day is on July 20th when Mercury is at its greatest elongation east of the Sun (27^0). Good luck!

Venus is simply not worth trying for. This beautiful "Morning Star" is practically impossible to see at the moment and is heading off behind the Sun. Only during the final quarter of 2011 will we see the return of this most tantalising planet.

Moon phases for the second quarter of 2011

	New Moon	First Quarter	Full Moon	Last Quarter
July	**1 and 30**	**8**	**15**	**23**
August	**29**	**6**	**13**	**21**
September	**27**	**4**	**12**	**20**

Unfortunately Mars is a very early morning riser at around 02:30 in July moving to 01:30 by September. However there is plenty to watch and during the summer holidays you have the excuse to stay up late and get some observing time in. In July you can use the red star Aldebaran in Taurus as a marker to find Mars as it passes about 5 degrees North of the star. On the July 27th, August 25th and September 23rd the Moon nears Mars for some nice photo opportunities. The big event though is on August 6th and 7th when Mars just misses M35 which is a bright star cluster in Gemini. Mars is low in the east during this close conjunction and through a telescope this will look fantastic.

Jupiter just gets better and better as an object to observe during this quarter. At the start of July this bright planet is rises in the east around 02:00 in the morning and rises by an hour earlier every 30 days. So by the end of September it is a late evening object and something you are realistically going to be able to observe. Jupiter outshines all of the stars around it. Even with binoculars you can see the disc with its variations in colours. With a telescope you can, with good seeing, view the dark and light cloud bands. Jupiter's four Galilean moons are usually seen, unless one or two of them are hiding behind this large gaseous planet.

Saturn is always fun to observe with its lustrous rings and bright moon Titan. Other moons of Saturn can be seen with a good telescope but Titan is visible through bin-oculars or a small telescope. It circles Saturn anticlockwise twice during a month. Saturn can be found to the south of west at dusk during July, setting only a couple of hours later. Within a few weeks it will start setting with the Sun and be out of sight until late Autumn. The rings have a tilt of only 7.5^0 in July but this will widen throughout the rest of the year. A white spot appeared last year in Saturn's North Tropical Zone and has spread around the planet.

Rising and setting times (BST): lat.52°N; long.0°W

	July 15		August 15		Sept 15	
	Rise	Set	Rise	Set	Rise	Set
Sun	04:58	21:14	05:43	20:25	06:34	19:16
Mercury	07:27	22:18	06.23	19:56	05:22	19:06
Venus	04:11	20:46	05:38	20:31	07:18	19:36
Mars	02:17	18:48	01:40	10:01	01:19	17:29
Jupiter	00:36	15:00	22:40	13:14	20:39	11:11
Saturn	12:21	00:04	10:32	22:05	08:49	20:08
Uranus	23:35	11:56	21:32	08:51	19:29	07:43
Neptune	22:36	08:42	20:32	06:35	18:29	04:29
Moon	21:06	05:11	20:36	07:43	19:49	10:00

Data for other venues and dates can be estimated from this (and the Moon phase) table.

Uranus (in Pisces) and Neptune (in Aquarius) are available for observation and become more favourable as the summer months pass. They will get higher in the sky and become visible earlier in the evening. Neptune is at opposition on August 22nd.

As the Earth orbits the Sun it often passes through the debris of passing comets and these minute pieces of dust burn up in our atmosphere and give us meteor showers. One of the most anticipated and most observed meteor showers of the year are the Perseids. This shower peaks on August 12th and 13th although a few meteors may start to be visible at the end of July. Unfortunately the Full Moon at this time will mean only the brightest of shooting-stars will be seen. To watch them you need a comfortable seat. I like to use a sun-lounger, facing north. The Moon will then be behind you and hopefully you will see meteors come from behind you and over your head. The peak of another shower, the Delta Aquarids, occurs on July 29th.

Finally why not keep an eye out for some "Noctilucent clouds"? These are high-altitude clouds that only form on rare occasions are usually seen during the summer months, close to the Summer Solstice. They form in the upper atmosphere (60 miles high) and late at night they reflect sunlight from the well set Sun, creating these night-shining clouds. If you do spot any please take a photo and send them into Gnomon. You can also report them at:

www.kersland.plus.com.

which is the British astronomical Association's Noctilucent Cloud homepage. A basic introduction to observing and reporting the Clouds can be found here.

James O'Neill