



November 2008

ARMAGH PLANETARIUM

ASTRONOTES

Incorporating **FRIENDS' NEWSLETTER**

An astronaut's odyssey

This month's night sky

Astronomers of the sea

The Ultimate Project?

The scent of Space

From the sea to the sky

By Colin Johnston, Science Communicator

Recently the crew of Space Shuttle mission STS-124 toured Northern Ireland talking to audiences at schools. This unique series of events is hoped to promote interest in science and mathematics among students and perhaps tempt some into scientific and technical careers. On 10 September I was privileged to listen to the presentation by Col. Ronald J. Garan, Jr. at St. Colman's College, Newry. Speaking in a sports hall packed with about 250 teenage boys, Garan began by telling the audience that he hoped to show that science was a subject worth specialising in.

STS-124 launched on 31 May this year and returned on 14 June. Its primary objective was to deliver and install the Japanese Kibo laboratory to the International Space Station (ISS). During the mission, Garan and his fellow crew members travelled 5.7 million miles (about 8 million km) as they orbited Earth. This was Garan's only spaceflight to date.

“he spent time living and working in Aquarius, a laboratory under the Atlantic”

Born in 1961, Ron Garan dreamt of becoming an astronaut since he was six, younger than most his audience. He held to this ambition throughout his schooldays, concentrating on science and “math”. Later as an officer in the USAF he flew with a fighter squadron before becoming a test pilot. Comparatively few astronauts are recruited every 4-5 years and there is fierce competition for the scarce posts but in 2000 he was accepted for NASA astronaut training on his second application (many candidates make five or six applications). His training included flying fast jets, time in water tanks to simulate space-walking, virtual reality techniques and a ten day



Image Credit: NASA

Have spacesuit, will travel Ronald J. Garan, Jr. wearing not an actual spacesuit but the Advanced Crew Escape Suit worn during the shuttle's ascent and descent.

survival training and team-building exercise in the wilds of Alaska. Part of his training was spent living and working in Aquarius, an undersea laboratory 20m (62ft) beneath the Atlantic waves. This was part of a project called NEEMO (NASA Extreme Environment Mission Operations), which hopes to prepare astronauts for living and work-



Image Credit: NASA

We all live in a NASA submarine Crew members for the ninth NEEMO mission prepare for a night dive. Ron Garan is at front right. His companions are astronauts Dafydd R. Williams (back right), Nicole P. Stott (front left) and University of Cincinnati medical doctor Tim Broderick (back left)..

ing in space. As a small, high-technology habitat in a hostile environment, Aquarius is reasonable facsimile of a space station. During his time as an aquanaut, Garan was involved a telemedicine experiment in which a surgeon in Canada performed simulated surgery over a video link using robotic instruments. Col. Garan also became acquainted with a 400lb grouper which regularly peered in through the habitat's window!

“Earth’s atmosphere appeared only half the width of Garan’s little finger”

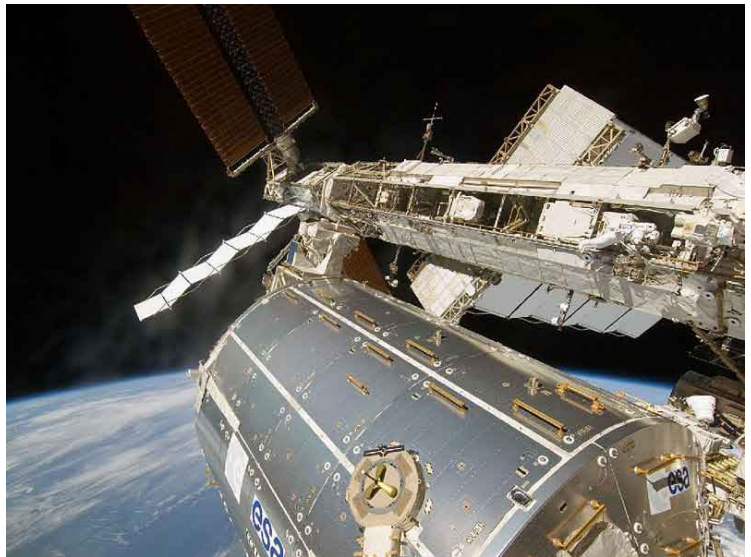
The crew of STS-124 spent four days confined together before making the “long ride” to the launch pad where Discovery sat waiting. Usually swarming with technicians, the pad seemed virtually empty on the launch day said Garan. He showed the audience video footage from his 4.5 million lb (2040 tonne) spacecraft as it rose skyward on 7 million lb (31MN) of rocket thrust. Within 8 minutes from take off, Discovery reached its orbital speed of 17 500 mph (7.8 km/s). The orbiter approached the ISS slowly so that its exterior could be examined for damage

received in the ascent. During the approach the Orbiter was flipped over to allow its belly to be inspected for missing heatshield tiles. The colonel’s video of this approach was accompanied by Strauss’ ‘Blue Danube Waltz’ on the soundtrack. I got the impression that this homage to ‘2001: A Space Odyssey’ went unrecognised by the boys in the audience. After docking the crew’s arrival was announced by the ringing of a naval bell on board the space station. They were welcomed

by the ISS’s crew and given a few minutes “to become acquainted with the ISS”.

Garan and his colleagues set to work. He prepared for his first spacewalk or extra-vehicular activity (EVA) by breathing pure oxygen overnight. This is necessary as the spacesuit cannot be pressured to standard atmospheric pressure, so rather than being filled with air (which is mainly nitrogen), pure oxygen at a lower pressure is used instead. After donning the bulky spacesuit Col. Garan left the ISS’s airlock for the utter void of space. He was carried across the 150ft (46 m) from the airlock to Discovery’s payload bay on the tip of the ISS’s own robot arm, a period he described as “one hour with Earth above me”. This gave him an “impression of Earth as a planet”.

He stressed how from his vantage point our planet’s atmosphere appeared only half the width of his little finger, nor could he see the borders running across the continents. Like many, if not all space travellers, he was impressed by Earth’s beauty and how it was an “oasis” in the “harshness of space”. He told the audience that he believes we all have a responsibility to look after Earth



Man and Machine Ron Garan (just visible at the right) is dwarfed by both the ISS and the Earth below. The ESA Columbus laboratory is visible in the foreground. This spectacular picture was taken during his final 6½ hour EVA.

Joining the 32 000lb (14.5 tonne) Kibo module to the ISS was relatively easy, Garan was impressed by how smoothly the components joined together. After being mated with the ISS, Kibo was just an empty shell to be filled with heavy equipment racks, before they did this the crew enjoyed the freedom to move around its interior, so uncluttered compared to the 'busy' remainder of the station.

“stupid astronaut tricks are a lot of fun”

Discovery stayed at the ISS for a week in which Garan made three spacewalks, the final one being to replace a giant nitrogen tank. Once undocked the Orbiter spent several days being prepared for its return to Earth. This was a relatively leisurely time for the crew who clearly enjoyed

the chance to play in microgravity. Garan found these “stupid astronaut tricks” to be “a lot of fun”. The mission ended with the shuttle’s fiery reentry to the atmosphere and standard dramatically deep descent to the runway in Florida. The colonel took questions from the audience on everyday life in microgravity, the possibility of colonizing Mars and finding life there and the future of space travel. He believes that space activities in low Earth orbit will eventually become entirely privatized, while NASA will concentrate on exploratory missions to the Moon and beyond.

An inspirational speaker with interesting things to say, Col. Garan held his young audience in fascination. Hopefully many will remember and apply his message that through hard work and study you can achieve your dreams.

The Sky in November

By Tracy McConnell, Education Support Officer

Welcome back to the “Night Sky Guide” for November. We’re getting into the winter months now so you will be experiencing longer nights, with the sun setting earlier, giving you more time to enjoy the wonders of the night sky. Unfortunately, the clear nights at this time of year are usually bitterly cold, so be prepared for this weather with some warm clothes and a hot drink. My guide is based on the stars expected around 11:00pm on 15 November, but I will let you know about some other sights visible during the rest of the month.

Last month we were looking at the signs of the Zodiac and we covered Capricornus, Aquarius, Pisces, Aries and Taurus.

Capricornus will have set in the SW at around 9pm and by 11pm Aquarius is setting in the SW too. Pisces is mid-sky SSW and Aries is high in the south while Taurus is mid-sky in a SE direction. We finished with Taurus last month and it is still very prominent this month so I’ll be mention-

ing it later again. This month’s new Zodiac sign is Gemini (the Twins). Cancer the Crab is also starting to appear in the East but we’ll look at it next month.

Gemini is an interesting pattern which is in the middle of the eastern sky at this time, but it’s probably hard to see with the moon almost full.

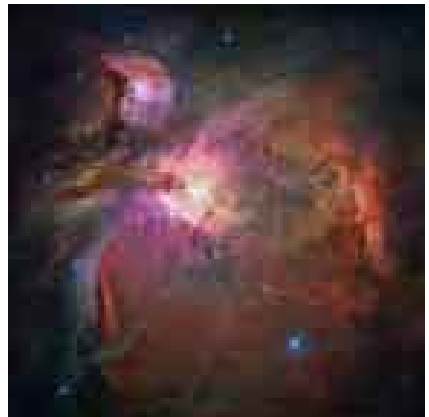


Image Credit: ESA and NASA

The Orion Nebula imaged in visible light

As a stick diagram, Gemini looks like two stick men, so it's easy to see. The two bright stars at the heads of these men are Pollux and Castor. In the July edition I covered the mythology behind Cygnus the swan, where the god Zeus posed as a swan in order to romance a beautiful woman named Leda. She later produced two eggs from which hatched twin girls and twin boys. The boys were Castor and Pollux, the Gemini twins.

“Castor is actually a six-star system”

The star Castor is very interesting to look at, as it's a multiple star. Through a small telescope you can identify up to 3 components, but with the aid of a larger telescope we find that each of these components is a binary system of 2 stars. This means that Castor is actually a 6 star system.



The horsehead Nebula A cloud of cold and dark dust silhouetted against the nebula in the background.

Facing SE in the middle of the sky is a famous and easily spotted pattern of three bright stars in a row. These three stars are part of a constellation called Orion and they are commonly called Orion's Belt". Orion's shape is quite easy to find. Above the belt are two stars in the place of his shoulders. The left hand star is a red giant star called Betelgeuse. Below the belt are another two stars representing Orion's knees. The right hand star is bright white and is called Rigel. If you look closely you can see the stars representing Orion's upraised sword or club on the left side and a protective shield on the right side.

There are some stunning objects in this constellation that are easy to find. About halfway

between Orion's belt and his knees is M42, the Orion nebula. This is one of the brightest nebulae in the night sky and it is about 1600 light years (490 parsecs) away. The famous Horsehead nebula is also found in Orion, just below the left-most star in Orion's belt, and its located approximately 1500 light years (460 parsecs) away from Earth.

“The Leonid Meteor Shower will reach its peak activity on the 17th and 18th”

In Greek mythology Orion was a great hunter and he had a big ego. He often boasted that he could defeat any animal. In one of the myths about his demise, Zeus decided to punish Orion for his boasting to teach him a lesson. He sent a tiny poisonous scorpion (Scorpius, a sign of the zodiac, not visible until May) to sting Orion on the ankle while he was battling Taurus the bull. There is another celestial fireworks show due around the 17 and 18 November. The Leonid meteor shower will be peaking around that time. There are still plenty of other constellations from the previous months visible at this time. Cassiopeia, Cepheus, Andromeda, Perseus and Pegasus are in the high western sky. Cetus the sea monster is low south. Cygnus the swan and Lyra the harp are WNW.

Finally some of the “wandering stars”, otherwise known as the planets will pop up at various times of the night. Around 6pm, as the sun is setting, Jupiter and Venus are in the SW. Venus is very low on the horizon and sets just after 6pm. Jupiter will set at around 7pm. Saturn will be rising in the East at about 2am. All of these will just look like bright stars.

Enjoy your stargazing and I'll see you next month.

Moon Phases, Nov 2008

Thurs 6 Nov	First Quarter
Thurs 13 Nov	FULL MOON
Wed 19 Nov	Last Quarter
Wed 27 Nov	NEW MOON

The Astronomers of the Seas

By Orla O'Donnell, Education Support Officer

For generations human beings have looked to the stars for religious guidance, story telling and, more practically, navigation. The earliest travellers used the stars to navigate the vast oceans and recent studies have revealed that we are not the only mammals to do so. The cute, and what turns out to be the very clever, seal also uses the stars to aid navigation.

From the earliest human society the stars have been used as a method to navigate the vast and treacherous oceans. The Polynesian people from 4000 BC used the stars linking them with their destination on the horizon to navigate thousands of kilometres of the Pacific Ocean. These ancient Polynesian voyagers colonized hundreds of islands across the Pacific by dividing the sky up into what they called 'star paths'. They put such importance into navigation by stars that each boat would carry one or more men that were experts in using the stars as a guide.

The technique of using stars as a tool for navigation was used also to great success by the ancient Phoenicians too. The Phoenicians were

a maritime society whose home land of Canaan was located on the coastal regions of modern day Lebanon, Syria and Israel. The Phoenicians picked out the stars and constellations to navigate the Mediterranean, Red sea and the Indian Ocean. They even circumnavigated Africa around 590 BC.

“Seals developed the skill of following stars to lead them to food ”

Today lost travellers can still look to the stars to find their position when modern technology fails them. Even though modern GPS systems have made celestial navigation seem old hat, professional seafarers, such as the British merchant navy still teach the techniques to the young cadets as a back up should technology fail.

As far back as humans have been attempting to sail out and venture across the oceans they have used the stars as their guides. However, it seems that we humans are not the only mammals to harness the navigational powers of the stars. A ground breaking study conducted by a European research team headed by Dr Guido Dehnhardt of the University of Rostock in Germany has discovered that seals may have evolved the same skills.

Scientists constructed a modified planetarium around a tank housing seals in the University of Southern Denmark in Odense. They used lasers to initially guide the seal to a particularly bright star. The planetarium's sky was then moved around and the seals were still able to navigate themselves again to the same bright star with an accuracy of 100 %. The scientists believe that seals developed the skill of following stars to lead them to foraging grounds to find food. The seals follow the stars during dawn and dusk



Image Credit: artwork by John Webber via wikimedia.org

Polynesian sailors Their craft is a two-hulled canoe.

Image Credit: Andreas Trepte, Mainzburg.



An astronomer relaxes after a night's observing The news that seals enjoy stargazing and even visit planetaria means that we can broaden our customer base. Raw herring may soon be available in the Voyageur Cafe.

when they can see both land and the stars, using the stars to guide them to their desired point. The technique that seals use is actually similar that to the 'Star Paths' method of the Polynesian sailors mentioned earlier. Other mammals such as sea lions and whales rise above the water to orientate themselves but further study is needed to ascertain if they too use the stars for orientation.

It is fascinating the power and importance that the stars have on all life on Earth and what some see just as pretty lights in the night sky are in fact a vital tool for survival. Who would have guessed that these cute mammals share so much with human beings? So if you were thinking of getting a seal coat for Christmas, here is another reason to reconsider: you will be wearing the skin of a fellow stargazer!

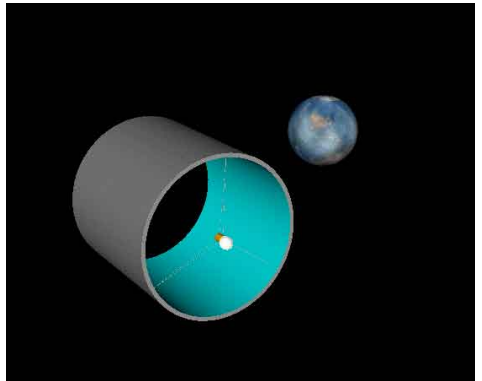
Spaceship of the mind

by Colin Johnston, Science Communicator

In our December 2007 and January 2008 issues, Astronotes featured a couple of articles on the feasibility of interstellar travel, that is, actually flying between the stars. Since the distances are vast beyond conception, and building a spaceship capable of moving at close to the speed of light will require millennia of technical development (and indeed may not be possible ever) it looks as though journey times to even the closest stars will take many decades at the very best.

One option that was briefly mentioned was the so-called Generation Ship concept. This is the idea that if the journey takes centuries then the starship should be vast, a veritable space-going city capable of sustaining human life for a colossal span of time. A young crew would settle on board, press the ignition button and set off. The crew would live out their lives, have children, grandchildren and so until their descendants arrive at the destination star. Such interstellar communities have featured in some classic science fiction novels, but could this ever become reality? Futurists Steve Kilston

and Sven and Nancy Grenander have recently announced that they are studying the feasibility of this incredible endeavour (note this is apparently entirely a spare-time study, as far as I can



Thinking big: the 2km long Ultimate Project starship, shown here arriving at an Earth-like planet, would be huge by human spaceflight standards, weighing as much as 16 Great Pyramids. It is still dwarfed by its science fiction predecessors such as Arthur C. Clarke's 50km Rama (and its sister ships) and Greg Bear's Thistledown from 'Eon' and its sequels which is 290 km long (and a lot bigger inside!)

Image Credit: Steve Kilston (reproduced with permission).

Targets for colonisation?

This chart shows stars inside a 13 light year radius of the Sun (at centre). There are 32 stars in this volume including the Sun. Only two of them are G class stars like our own Sun, these are Tau Ceti and Alpha Centauri A. The majority of the stars in this volume are dim red dwarfs, invisible to the unaided eye. Currently Epsilon Eridani is the closest known star with a planetary system

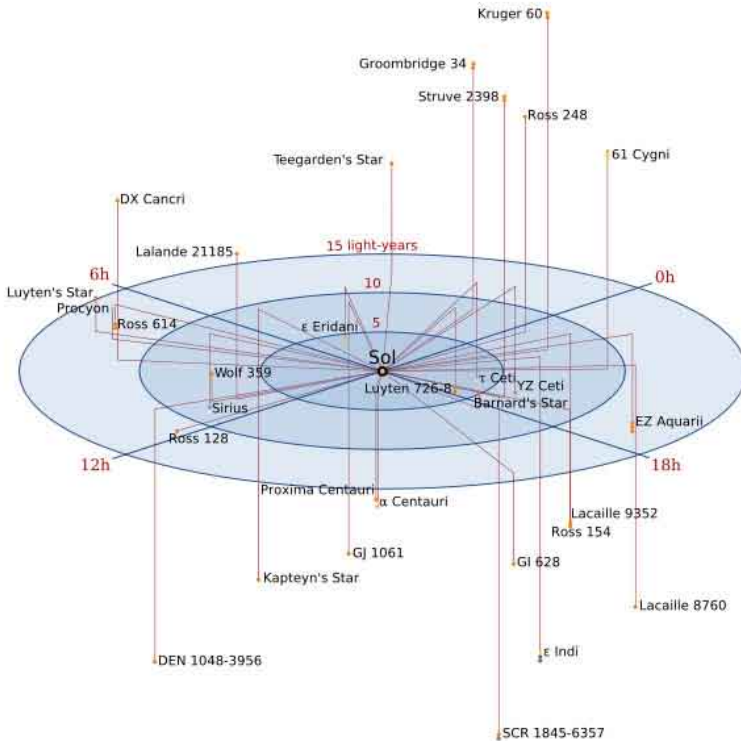


Image Credit: Inductiveload

see they are not funded by any government or private body). They call this study 'The Ultimate Project' and this title is by no means hyperbole.

The team believes that if research starts now that in five hundred years time we could build a starship. They assume new technology will become available but no new laws of physics will be discovered (no Star Trek-style warp drive alas). This gargantuan craft would have a hollow cylindrical hull about two kilometres (1.24 miles) long and two kilometres in diameter. The occupants would live in ten or more decks with 'artificial gravity' equivalent to gravity at the Earth's surface induced by the 100 million tonne vehicle's spin. Propelled by an engine running on deuterium/helium-3 fusion (like the British Interplanetary Society's Daedalus concept), this miniature world would take perhaps 10 000 years to travel between stars to a known habitable world. Throughout that time the ship would maintain a population (crew seems the wrong word) of

a million people. Kilston and the Grenanders note that Iceland currently has a population of 310 000 in a pleasant and stable (but recently insolvent) society to counter objections that the starship's population is too small. On arrival the ship's passengers would settle on their new world. Eventually their descendents would build more starships to trek to more planets, and gradually the human race would spread across the Milky Way...

The team is seeking additional collaborators to assist with the 'Ultimate Project'. The team correctly notes that this project "offers a huge assortment of challenges in almost all areas of human experience and understanding". Besides the staggering engineering involved in the starship's propulsion system, which will occupy physicists and engineers aplenty, they are other specialities that are needed. I would venture to suggest that we have more ideas on how to build the engines for such a craft than we know how to create a self-contained artificial ecology that

can last 10 000 years. Ecologists, biologists and geneticists will have to do their work very well lest after a few millennia the starving interstellar pioneers are forced to subsist on rations of Soylent Green (see the 1973 movie!). Sociologists, economists and historians would have a lot to add to discussions about the feasibility of a stable society and institutions persisting continuously for a hundred centuries – a period far longer than written history. It is easy to see the starship's occupants lapsing into anarchy and barbarism or alternatively being held under the iron heel of a totalitarian regime. Drafting a constitution for the space travellers to live by is part of the project.

I have severe doubts that this grandiose future vision will be realised but I think never the less

that performing the study is still a useful enterprise. The history of science and technology is full of incidents where dedicated researchers intending to investigate in one specialized field, discovered something else entirely – something much more important than their original goal. For example, the cosmic microwave background was discovered by scientists commissioning a satellite communication antenna, plastics were discovered through a chemical lab mishap and so on. The Ultimate Project may lead to a starship or it may not, yet it may still uncover important insights into the unexpected to enrich our lives. Either way it should be a lot of fun.

(You can read more about this project at: <http://tup.theultimateproject.org:8080/confluence/display/proj/The+Ultimate+Project>)

The odour out of space

By Nigel Farrell Education Support Officer

On a recent journey to work I became rather intrigued by an interview on Radio Ulster with a chap called Steve Pearce. Steve runs a company called Omega Ingredients which is based in a small village in England near the town of Ipswich. Normally Steve is not connected to the world of astronomy or space technology, as in his day to day role he is one of the world's most foremost experts on smells. Ordinarily, he is tasked with creating smells and flavours for foodstuffs, and he can create an extensive assortment of aromas in his laboratory, from those for the food and beverage industries, to products which make you or your car smell pleasant. Occasionally though Steve is asked to produce some even more exotic smells which range from the curious to the downright bizarre. This has lately included being asked by a museum to recreate the smell of the hair of the Egyptian Queen Cleopatra.

What has all this got to do with space? Well, recently NASA has heard of Steve's work and has asked him to recreate the smell of outer space in order to add a whiff of realism to their training sessions. Steve, as you might imagine,



Image Credit: NASA

'Make mine well done' Astronauts on space walks report space smells like hot metal or fried steak

was rather taken aback when this request was forwarded to him, and told the BBC "What they want is for me to make the smell of space, so they can make their training exercises with astronauts more realistic, so when they are pretending to do a space walk by floating in a swimming pool, it will smell of outer space."

Our sense of smell is the only one of the five senses which is directly wired to our brains, thus,

familiar smells, can, it is often said, bring back memories of past experiences. Curiously, no one fully understands how our sense of smell operates but it is says Pearce, the most powerful and underrated of all our senses and one which he thinks we are in danger of overlooking.

“Our sense of smell is the most powerful and underrated of all our senses”

Describing his latest task however, Pearce explains, “What I will do is try and re-create those particular odours. I’ll let NASA have samples and we’ll fine tune it until I’ve got what they want.”

To complete this assignment NASA has asked some of its astronauts who have completed space walks to describe what the smells they experienced were like. Apparently the most popular replies have said that the odour is not unpleasant, sweet and metallic, with many interviewees revealing that it resembles the smell of fried steak or hot metal.

What intrigued me most concerned the fact that space is a vacuum and it seemed strange to me that a vacuum would have a smell, but, accord-

ing to astronaut and International Space Station Science Officer Don Pettit, space has a very definite smell. Pettit had the job of opening the airlock on the ISS for two of his crewmates who had been outside on space walks. He noted that each time he reopened the airlock to welcome back the crewmembers he noticed a peculiar odour. He thought, at first, that the smell had come from the air ducts in the airlock compartment, but then he noticed that the smell was also detectable on the astronaut’s suits, helmets, gloves and tools, he also noted that the odour seemed to be more pronounced on fabrics than on other surfaces.

Pettit says the smell was hard to explain but described it as, “metallic; a rather sweet metallic sensation”, and went on to say how it had conjured up memories of summers spent in use of an arc welding torch, helping to repair heavy equipment for a small logging firm, “It reminded me of pleasant sweet smelling welding fumes... That is the smell of space”.

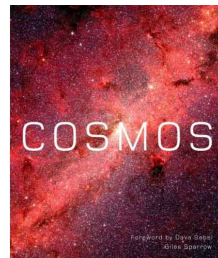
(Editor’s note: Nigel’s article reminds me that most of the Apollo astronauts who landed on the Moon reported a pungent smell reminiscent of spent gunpowder in the Lunar Module’s cabin. Almost certainly this was the scent of moondust!)

Astronomy books

Book reviews by Colin Johnston, Science Communicator

Even in today’s world of wide-screen multi-media, reading a good book is still the best way to learn about anything. Thanks to their visual appeal astronomy and space exploration are particularly well-served among the mainly high-illustrated books. Here are my pick of recent space and astronomy books.

Peter Grego’s ‘Need to Know? Universe’ is a handy-sized guide to celestial objects and theories of their formation. It does not pretend to be an observer’s guide; there are no star charts and experienced astronomers will not find anything that is surprising but it is meant to be a book for



Coffee table book This work gives a whole new meaning to the term, all you need to do is screw four legs on to this volum and you will have a **small but serviceable coffee table!** . beginners. As a colourful and concise paperback introduction to the Universe it is ideal and at less than £10 it's a bargain!

First published in 1980, Carl Sagan's 'Cosmos' is still a classic of science writing for everyone and the original hardback edition was also notable for its gorgeous colour illustrations. Two new books borrow the title. Both are almost entirely unrelated to Sagan's book (and neither pretends to be a relation) but are similar in that they are filled with glorious pictures. The chunky paperback 'Cosmos' by Mary K Bauman and her collaborators is essentially a picture book of stunning images. Mainly taken over the past couple of decades by high-technology observatories and spacecraft including the current Mars missions and the Cassini probe, the pictures are a visual treat with extensive explanatory captions. It is a delightful book to dip into and marvel.

The other new 'Cosmos' is Giles Sparrow's mighty tome. This is a HUGE book and is another magnificent picture book but there also is a substantial and up to date text too. I highly recommend this book with the single caveat that it is so big that it cannot be comfortably held, making it difficult to browse through into. You will need to lay this one out on a desk.

Much easier to handle is Professor Benacchio's 'Great Atlas of the Universe' is a compact hardback, aimed at a slightly higher level than the previous books. It covers all of astronomy (minus practical data for observers) with extensive use of large colour images. To add to the pictures' impact and fit so many into a book only 20cm square the publishers have taken an unusual space-saving tactic by making extensive use of large fold-out sections. It is an interesting approach but after a while you do start to wonder why they didn't just use bigger pages! The text is authoritative and again it is a great introduction to astronomy for the beginner.

If you are looking for star charts and moon maps together with practical advice for observing in a pocket-sized soft-back package you should go for 'Collin's Stars and Planets' by well-known astronomer populizers Ian Ridpath and Wil Tirion. An alphabetical listing of constellations and their most interesting sights builds up to complete coverage of the whole sky (including the southern hemisphere). This is followed by an extensive and up to date section on solar system

objects. The book is rounded off by a section on choosing the most suitable telescope.

If you want to introduce someone to the wonders of the Universe by giving them a nice present I would recommend any of these books.

*'Need to Know? Universe' by Peter Grego, Collins, 2006, ISBN-13 9780007214389

*'Cosmos' by Mary K Bauman et al, Duncan Baird, 2007, ISBN-9781844835188

'Cosmos' by Giles Sparrow, Quercus, 2007, ISBN-10: 1847241255 ,ISBN-13: 978-1847241252

*'The Great Atlas of the Universe' by L. Benacchio, David & Charles, 2007, ISBN-13 978-0-7153-2680-0

*'Collin's Stars and Planets' by Ian Ridpath and Wil Tirion, Collins, 2007, ISBN 978-0-00-725120-9

*The above titles are available from www.astro-sales.biz (tel +44 28 37523689)



Image Credit: Gary Thompson

Astronomical enigma Astronotes reader Gary Thompson spotted this puzzling shopfront in Edinburgh. Why is there a huge painting of songstress Karen Carpenter and astronomer Carl Sagan in the window? Both are deceased and much missed and the Carpenters did a cover version of "Calling Occupants of Interplanetary Craft", while Sagan was a proponent of SETI, but otherwise I cannot see a connection. For that matter what does the shop sell?

Image of the Month

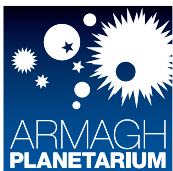


Image Credit: NASA, Kim Shiflett

Fitting the engines to a Space Shuttle Orbiter is not a simple task. Here we see technicians installing one of three Space Shuttle Main Engines (SSMEs) to Atlantis for its planned but now postponed mission to repair the Hubble Space Telescope.

Developed in the early 1970s, the SSME design still represents the pinnacle of liquid fuel rocket engine technology. There have been bigger engines of higher thrust (the Saturn 5's F1 comes to mind) but for its weight, the SSME's performance is superlative. Most importantly, every other rocket engine is designed to be used once and discarded. The SSME is the only large liquid fuel motor that can be used over and over again. Sadly this

reusability relies on extensive and costly technical support. Each engine (originally intended to fly ten times before major servicing) must be disassembled and rebuilt after every mission. This is so costly that it would probably be cheaper to discard the engine after every flight. The engine is amazing technology that has never lived up to expectations. The same can be said about the whole Space Shuttle system. This does not reflect badly on the engineers behind the project, space travel is still hugely complex and difficult to accomplish despite the internet pundits who say otherwise. One day travel into orbit will be as routine as air travel but that day still lies in the unforeseen future. (Caption by Colin Johnston, Science Communicator)



www.armaghplanet.com

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Tel: 02837 523689 Email: cj@armaghplanet.com

Editor: Colin Johnston
Assistant Editor: Alyson Kerr
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