NEWSLETTER

Dec 2015 - Feb 2016 Issue 173

Double Rainbow captured in London by Peter Crabb

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Editorial John Richards

Christmas is almost upon us again, and the dark skies should be a huge bonus for us 'astronomers', giving us hours of dark skies and beautiful sights to behold. Alas, living in Wales, as we do, imparts certain 'disadvantages' to us. From a positional sense, Wales has the 'benefit' of being among the first to sample all the Atlantic weather fronts have to offer: Clouds, wind and rain, with little likelihood of seeing any passing Geminid meteors. So why not cuddle up with a nice bottle of wine/cider/mineral water/coco (delete as applicable) and savour the astronomical delights we have to offer, in this, the last issue of 2015.

Kayleigh has supplied another excellent article on British Astronaut, Tim Peake, who will imminently be launched atop a Soyuz rocket for his six month stay aboard the International Space Station. We continue with a brief history of spaceflight since the Society was formed. Also, our Vice Chairman, Phil Wallace, discusses why we DID land on the Moon in 1969. Along with the usual 'Behind the scenes' information from Dave and the quarterly sky review from Hugh Lang, the issue promises to be a Christmas 'cracker'

Wishing you clear and dark skies - John

Contact Details

Have you changed your email address or other contact details recently? If so, you could be missing out on receiving important Society information. Please keep us up to date with any changes. Send your revised details to either our Membership Secretary (membership.secretary@cardiff-astronomical-society.co.uk) or Secretary (secretary@cardiff-astronomical-society.co.uk).

Publication Dates

The CAS newsletter is published at the first Society meeting of September, December, March & June. The deadline for submissions is 4 weeks before the publication date, and is 7th Feburary for issue 174.

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Behind the scenes Dave Powell

The September star party was ok. If I'm honest the sky while looking good earlier in the evening changed, when high, thin patchy stuff rolled in from the west; still planet Saturn although low down proved a popular turn in the observatory telescope. Later under poor seeing conditions we looked at M31 and its close companion M32. We had about 20 members of society and several said this was the first time they had seen the smaller galaxy. My guess is that most had seen it before without knowing. Another member brought along his 4.75mm Skywatcher on an EQ5 mount. This beauty is computer controlled and being a long focus refractor the views of the double double in Lyra were spectacular. The brighter stars were visible and one in particular, Capella, low down in the east reminded everyone that winter is on its way. Later in the season this star will blaze high overhead. I managed to explain how the three Messier open clusters will look M36,M37,M38, when Capella gains altitude, so we look forward to winter with some excitement. It's nice to note the camaraderie that's forming at these meetings, helped along no doubt by our new found ability to offer tea,coffee and hot chocolate. Now all we need to do is remember the milk!

My thanks to Kath Compton and Jim Hennessy for organising the 40th anniversary dinner. Held on Friday September 11th at the Cardiff and County Club, Westgate Street Cardiff. The venue was magnificent. The building is over 100 years old and I must have passed it countless times over the years never knowing the place existed. When we arrived we were greeted by a young lady playing a harp. Now I am the first to admit this was not my kind of music, but somehow it lent itself to the overall ambience and turned out to be thoroughly enjoyable.

The dining room was elegant and the meal fantastic. We met old friends such as Steve Godfrey and his wife Carol who travelled from their home in Dorset to be with us. Steve was our very first Treasurer way back in 1975. Unfortunately, two other friends were unable to be with us due to ill health, and we wish both Mike Painter, and Mike Disney speedy recoveries. All in all a splendid evening and one that I will remember with affection.

Observatory Manager Bob Love has decided to step down from the post. Bob has devoted so much time and energy to looking after our observatory that his own is still only half built! He has made sure all the major work we needed is complete and fingers crossed whoever takes over will have little to do.

I wish him well, and know he will still attend the majority of observing sessions. Bob is someone who comes along once in a while and throws himself into the project. Without all the hard work and no small expertise on his part the observatory would not be in the fine shape it is. Let's hope his observatory works as well as ours.

The October star party started well. We opened the observatory under a cloudless sky that lasted about 45 minutes, afterwhich every cloud in the northern hemisphere decided to join the party. We managed to view M52 and M31 before it all got too much, and we went home.

Andy Thompson has also called time as a member of committee due to his wife Lorraine ill health. Andy has done us proud at a time when we needed stability and loyalty. Here's hoping Lorraine is well enough to attend meetings soon.

After my talk about the Penylan telescope and the whereabouts of the surviving pieces I am grateful to Andy Thompson and Spencer Grennan who took up the challenge and went to the "Cardiff Story Museum". Yes, they do have the mirrors etc. but not on display. It seems because of cuts to this service, space has been taken up by moving stuff from one floor of the central library into the museum, resulting in the Cardiff Story having less space. Will they ever see the light of day?.

I have spent a tremendous amount of time sorting out our membership database and membership cards. It's in better shape than it was. If you have renewed or joined recently then when you attend meetings pick up your membership card. Also any database is only as good as the information it holds, so if you have changed your email address, please remember to let me know as well.

The November star party took place on the wildest of weather

nights. In fact, I did think 'who in their right mind' would risk driving to the site in such a storm. They would be mad. So I set off for Dyffryn, knowing Bob Love would be there, but assumed within 10 minutes the two of us would decide to go home. When I arrived, Chris Hughes, was already downloading the data from our meteor camera to send to UK Mon. For a brief moment the crescent Moon appeared, but we rightly decided not to open the roof of the observatory because we had not informed the nearby airport to lookout for a flying roof.

Then a moment this Society was made for happened. A dad who had been to Dyffryn with his family back in the summer and looked through a solar scope brought his 12 year old son and his two mates. We gave them a tour of the observatory and they were thrilled to see the scope. Lots of WOW's and I think the word "Brill" were used a few times. These three lads were captivated by what we had at our disposal. We then took them into the Cory Centre where with the aid of a laptop we gave a talk about the night sky. Dad, and three happy lads went home really pleased they had risked the journey and that we had been on hand to entertain. Surely a night to be proud of and just shows what we can achieve if we put our minds to it.

Stargazing evening - Brecon October 17th

Brecon Mountain Centre hosted this public event, Theresa kept up her remarkable ability to organise these events. Saturday October 17th was no different, as it coincided with a big sporting event, this time Wales were playing South Africa in the rugby World Cup. The game started just as Bob,Hugh, and myself were heading up the A470 in complete silence. On arrival we were greeted by Andrea who would be in charge of the centre. "Why so glum boys?", she asked. "We wanted to watch the match", we cried in unison. "Oh well, if that's all that's troubling you watch it over the internet." She then set everything up, made us a mug of tea each and left us in a room happy. 30 minutes to go and the inevitable happened. Theresa and the other volunteers turned up and started making noise, and for some reason or other began setting up the merchandise stand. All very laudable but the match was still on!

Then the questions: Theresa asked me where are the display boards?. A cold sweat broke out all over my body.

"Would these be the display boards you asked me to remind Bob to pick up?", I asked.

"Yes, the ones the society paid £300 to replace the old tatty ones and that Owen and I spent many hours getting just right for this evening"

Just as I tried to think of who I could blame for this, South Africa scored what turned out to be the winning try and the three of us began to sob. This cut no ice with Theresa, so we went to the car to bring in the telescopes. Could things get any worse? Well yes, because Bob forgot to pack the 12 volt battery that drives the 12" Dobsonian. Well that was it, like three naughty schoolboys we sat through a lecture about how people had paid good money (£8 per head) to attend the evening and they would expect a professional show. Could be worse I suppose. Then it got worse. Someone went outside,saw the crescent Moon, and only went and told Theresa. So we all had to focus on the Moon and show the punters as they began to arrive. Mercifully after a few minutes the clouds rolled in once more and we regrouped inside. I gave the first talk, then we broke to allow the distribution of the soup. Once we got all 60 people back inside Phil took over and gave a splendid talk about the Apollo Space programme. What amazed me the most was people had come from Milton Keynes, and Birmingham to hear us.

On the plus side we had two new volunteers, they looked very much like rabbits caught in car headlights, but by the end of the evening they said they had enjoyed themselves.

It was time to pack everything away. Andrea said there had been no complaints. We said our farewells and set off home, another job well done.

PS Good news, the tractor driver appears to have found his way out of the field in time to watch the match.(see newsletter 172)

Telescope Workshop

We were invited to put this event on at National Museum of Wales and with our unerring knack for organising events to coincide with important sporting events, Saturday October 31st, was the perfect time. After all, who wants to watch the Rugby World Cup final anyway?

So at the unearthly hour of 9 am I arrived to find a hive of activity. All the volunteers turned up even earlier, but I can't be responsible for them!

Between us all we set up our merchandise tables, a life size cut out of Buzz Aldrin (don't ask), several different types of telescope, and helped our friendly trader" Nipon Optics" to set up their stand.

Three of us decided to put up the new 'all singing all dancing' display boards that some of you may remember we purchased at great expense because the old ones were hard to erect and fell down if someone so much as breathed on them. So without the aid of the manual, or safety net we completed the job in record time, only to see them fall down in a heap. At this point Theresa decided we needed a supervisor, and shortly afterwards the job was completed.

Our Junior Representative, Kayleigh, turned up with a bottle of fairy liquid, three yellow balloons, an assortment of colouring agents, several small glass containers, and various other bits and bobs. I had no idea what she was doing with all this, but the kids loved it and every time I looked over she seemed to be rubbing balloons into her hair! I decided it was none of my business, and left her to it.

The star attraction however was the appearance of Darth Vader. Now if I had known what Spencer was going to do before he did it I would have said "NO NO NO!". But I have to admit he outshone Buzz and the kids loved him, and of course his light sabre.

From 10 am until we clocked off at 4 pm we had a steady stream of visitors to the telescopes. We had hung models of Saturn and the Moon from the top gallery and these made great objects to show the power of the scopes. Over 1,500 people attended and the majority came over to see us. Some wanted photos of family members with

Buzz or Spencer,(sorry Darth),others purchased stuff, or sought advice on the best telescope or pair of Binoculars to ask Father Christmas for.

We were a big team, far too many to mention and they were all needed. Everyone was kept busy for most of the time, but it was fun. We all had a laugh, and at the end of the day we were all glad we did it.

Most of us were home in time to watch the second half of the game, but I won't tell if you don't.

The Sky January - March 2016

Robert Lang

The planets

Mercury is more difficult to locate as the planet is never more than a maximum of between 17 - 28 degrees away from the Sun as seen from Earth. The variation in its distance is due to the highly eccentric orbit, therefore observing this planet can only take place around 45 minutes after sunset, or 45 minutes before sunrise. The planet usually makes six appearances, three in the morning and three in the evening sky every year. Because of the planets proximity to the sun, plus its rapid orbital speed, the planets visual magnitude varies rapidly throughout its apparition. Mercury puts a appearance just before sunrise at the start of February, but to all intents and purposes is a very poor show for observers in the Northern hemisphere. We have to wait till until April before the planet puts on a reasonable apparition in the evening skies.

Venus is a very bright morning object (magnitude -4.4) entering the constellation of Libra. On 9th January Venus is in conjunction with Saturn separated by around 5.5 minutes of arc (0.8 degrees) By the middle of the month Venus will rise some two and a quarter hours before the Sun (In the south-south east,) the planet now reaches its highest position in the sky for this apparition. On the 23/24 January the planet passes 2 degrees north of the lagoon nebulae (M8) then moves past the teapot asterism of Sagittarius and then on the 29th

passes 1.4 degrees north of the globular cluster M22. On February 6th Venus now at magnitude -3.9, the Moon and Mercury (mag 0.0) will form an equilateral triangle. Venus is now moving at its fastest apparent rate of motion for this apparition. By the end of the month of February Venus's elongation has reduced to 25 degrees and appears slightly gibbous through a telescope (90% illumination) having a apparent disk diameter of 13 seconds of arc, though now the planet will be becoming quite difficult to find in the morning twilight sky. By mid March Venus now residing in the constellation of Aquarius will have disappeared into the brightening east south east twilight sky.

Mars starts the year as a morning object, at a solar elongation of around 70 degrees West with a visual magnitude of around 1.0 and can be found in the constellation of Virgo. On January 17th the planet passes into the constellation of Libra. The planet reaches western quadrature (90 degrees from the Sun.) on 7th February. Mars will be observed to have a visual magnitude of around 0.7 and a disk diameter of some 7 seconds of arc, increasing in magnitude to 0.5 and apparent size to 10 seconds of arc by early March. The Planet is now again large enough to show appreciable surface detail to telescopic observation. On 26th March the planet at mag -0.4 and passes 2.6 degrees North of the globular cluster M80. With a low magnification wide field eyepiece you should be able to observe both in the same field. On the 31st of March Mars enters the rather barren constellation of Ophiuchus.

On 8th January **Jupiter** is stationary prior to beginning to retrograde in the constellation of Leo, with a magnitude of -2.2 and apparent visual diameter of 40 seconds of arc. By 19th February the planet will be in the late evening sky and will have brightened to magnitude -2.5, with an apparent visual diameter of 43 seconds of arc. On 8th March Jupiter will have increased to its maximum magnitude of -2.5 and visual diameter of 44.4 seconds of arc. The planet is now at opposition, making its closest approach to Earth, rising in the eastern sky as the sun sets and observable throughout the spring night. Obviously this is a good time to get our your telescopes out and observe this planet.

Saturn, having just passed solar conjunction in Ophiuchus will be very close to the Sun and is also at its most distant point from the Earth (11.03 Au.) By mid January the planet will have re-appeared in the morning twilight sky. Currently Saturn's ring system is tilted so that we observe the Northern hemisphere of the planet at an angle of 26 degrees. The globe diameter is 18.4 seconds of arc and the ring diameter is 41.7 seconds of arc. On the morning of 9th January at 03:57 UTC there will be a very close conjunction between Saturn at magnitude 0.6 and Venus (magnitude -3.9) the planets been separated by around 0.1 degrees. Saturn remains in the constellation of Ophiuchus throughout the year. By the end of March Saturn rises around 02:00 UTC.

Uranus starts the year still residing in the constellation of Pisces. The planet cumulates at 18:18 UTC (at magnitude 5.8) and be observable until 22:20 UTC. Uranus slightly brightens by around 0.1 magnitudes over this coming month but at the same time sets ever earlier into the evening sky. By the middle of February the planet will have disappeared from the evening sky and will reappear in the evening sky some time around mid July 2016.

Neptune (magnitude 7.9) is currently residing in the constellation of Aquarius and may just be visible for the first week or so of January, but will certainly have sunk below the horizon by mid month, to return to our evening skies some time in July 2016.

Constellations

This time of year is the coldest and probably (for me at any rate!) the most difficult time to extract one's self from the comfort of a warm house, into a cold back garden or observing site to marvel at the wonders of the sky; whether it's just stars or faint nebulae or galaxies. But this time of the year, with all its personal discomforts can also bring several real observational benefits. Early evening darkness, very dark skies, and even though cold enough to freeze your bit's off, the added benefit of the celestial canvas been painted with myriads of crystal clear steady points of light, a sign of a steady atmosphere and therefore good seeing (photometric skies) for the more serious astronomers amongst us.

If we look toward the north east we will come across the great bear, Ursa Major with the bowl and pointers been uppermost and pointing to the west. Drawing an imaginary line from the bowl one will come across a fairly sparse region of the sky but one star will stand out from the others around it. This is **Polaris,** the 'Pole Star', which stays almost, but not quite, static at that point in the sky over the entire year with all other constellations revolving around it. Polaris is part of the constellation of the little bear 'Ursa Minor'. Wrapping itself around the north of Ursa Minor and its tail between the eastern side of Ursa Major resides a fairly long but faint constellation of Draco the dragon. The stars of this constellation are quite faint, so one needs the skies to be dark and clear to discern them. The distinctive cross shape of Cygnus the swan is sinking towards the north western horizon. Above Cygnus is the House of Cepheus. To the East side of Cepheus is a fairly sparse area of sky, but in actual fact its home to Camelopardaus the giraffe, the constellation not easily discerned unless the skies are clear and dark. To the west side of the giraffe resides the distinctive 'W' shape of Cassiopea, which cannot be missed, and if you draw a imaginary line between the highest two stars in the W shape, towards Ursa major, and a line from the pole star roughly due south, the lines will intersect the constellation of Camelopardaus. Another easily overlooked constellation residing to the north east next to the giraffe and just below Ursa major is Lynx, though its really nothing more than a few insignificant stars forming this constellation now stretching down to the northeastern horizon. Moving back to the distinctive W shape of Cassiopea, using the middle and lower base star and then drawing an imaginary line southwards, we arrive at the constellation of **Perseus**. If the skies are dark enough you may also see (intersecting that imaginary line,) a faint patch of light which comprises of two clusters of stars; this is Caldwell 19, the Double Cluster. Looking To the east side of Perseus a bright star will stand out, **Capella.** It's the brightest star in the constellation of Auriga and also look out for 3 open clusters contained within this constellation; **M36**,**M37** and **M38**. Moving more or less due east, close to the horizon **Cancer** the Crab is making an appearance, along with another fine cluster, **M44 The Beehive.** Now moving along the

ecliptic plane, we arrive at **Gemini** the twins and viewing from Cardiff two star stand out from this constellation. Pollux and Castor are easily spotted in a light polluted sky within the borders of Gemini along with Planetary Nebula **NGC2392** and Open Cluster **M35**. Below Gemini, just south of due east the constellation of **Canis Minor**, the small hunting dog has just appeared, containing the bright star **Procyon**. Looking to the south east the well known constellation of **Orion** stands. It's difficult to miss even in the brightest of light polluted skies, with the bright red star **Betelgeuse** and the blue white star Rigel, the belt consisting of three bright stars and sword comprising of **M42**, **M43** and the **Trapezium** within its boundaries. Using the three stars comprising the belt of Orion and looking upwards we arrive at the red star **Aldebaran**, the eye of **Taurus** the bull. Within the boundaries of Taurus resides the Famous Crab Pulsar which is buried amongst the supernovae remnants that comprise **M1**, more commonly known as the **Crab Nebulae**. Continuing the line upwards we arrive at faint patch of light known as the **Pleiades** (**M45**.)

We are now facing southward. To the right of the Pleiades now on the ecliptic is the constellation of **Aries** the Ram and to the west side of Aries is **Pisces** the Fish, now moving toward the western horizon, while **Aquarius** the water carrier is setting in the west. High in the south western sky progressing toward the horizon is the great square of **Pegasus**. The square is distinctive as it is fairly sparse of stars. To the north eastern side of the square resides the constellation of **Andromeda** with the Galaxy **M31**. It's bright enough to see with the naked eye and covers an area of over 3 degrees, that's six moon diameters! Just below Andromeda resides the constellation of **Triangulum**, not a very distinctive constellation, but just look northwards and we arrive at **M33,** a face on spiral galaxy. It can be observed with the naked eye from a dark site but through a telescope is spectacular.

Skirting the South Eastern horizon below Orion is the constellation of **Lepus**. Below **Rigel** winding southward is the constellation of the river **Eridanus** and in the low south west we arrive at the constellation of the **Cetus** the whale. While in the far south west Aquarius is setting.

Moving on a month to January the constellations will have shifted by two sidereal hours. **Leo** is starting to rise in the east. The asterism of the sickle (Head of Leo) risen and the constellation of **Cancer** will be visible to the West. **Aquarius** will have set with the great square now setting in the West. **Orion** is almost due south; to the south east the bright star **Sirius** in Canis Major has risen to accompany Orion. Cetus is now starting to sink below the southwest horizon. By Mid February only the tail of Cetus will be visible in the south west, Sirius will be due south while the spring constellations will be making an appearance with **Coma Berenices** rising in the North east. Leo is now well above the eastern horizon and **Hydra** has risen in the south east. By mid March **Bootes** will be rising in the north east, **Virgo** rising in the east while Andromeda, Triangulum and Aries will setting in the west.

CORRECTION

It has been brought to my attention that an error crept into the last edition of the newsletter. The error related to the ownership of the image on the front cover. I incorrectly attributed the image to Grahame Carter, when in fact the image was taken, and owned by, Ed Cloutman . I apologise for the inaccuracy.

FOR SALE

A 12 inch Dobsonian telescope with David Hinds mirror. It was made by a firm called "Dark Star" in Mid Wales. Unfortunately, they are no longer trading. The mirror most likely needs a re-silver. It hasn't been used extensively, and Kevin is primarily selling the scope to create additional space. It was primarily purchased for deep sky work. Pictures on request. He is open to offers, but is looking for at least £100. If you're interested, or need further information, Kevin can be contacted by email @ bluespower1@sky.com or you can contact him on 0781 804 5181

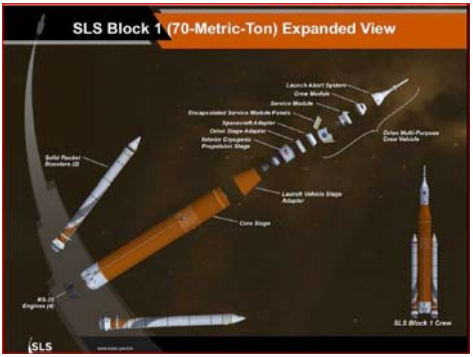
Spaceflight Roundup John Richards

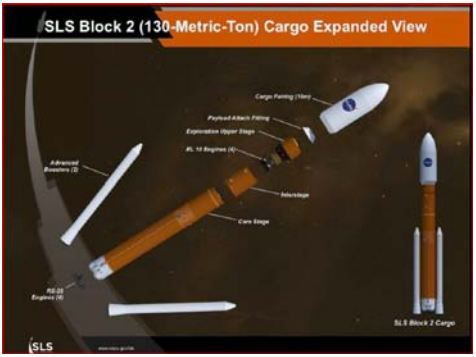
On October 16th Scott Kelly became the US astronaut to spend the most time in space. On that day, he began his 383rd day living in space, beating the previous US record held by Mike Fincke. Additionally, on 29th October, Scott broke Michael Alegria's 215 day record, and now holds the record for the longest single spaceflight by an American. Scott Kelly and Mikhail Kornienko are now well into their year long mission aboard the **ISS**, investigating, among other things, the effect of long term weightlessness on the human body. They launched from Baikonur in March 2015, and will return to Earth in Spring 2016. While Scott's record is impressive, it pales, when compared to Gennady Padalka's 879 days in space. His latest return to Earth was on 12th September 2015 (see issue 172).

Scott, Mikhail and Sergey will soon be joined by British astronaut **Tim Peake,** who with Yuri Malenchenko and Timothy Kopora will start Expedition 46. Tim is now making final preparations for flight, and was seen extensively on British television in early November, drumming up enthusiasm for the mission. For further details of work Tim and the other members of Expedition 46 will be doing see the article written by Kayleigh Churchill, later in this edition.

On October 22nd, NASA released the mock ups for the configuration of the new **SLS**, destined to take astronauts beyond Earth orbit, to asteroids and eventually to Mars. Two configurations were shown. NASA is hoping the highly flexible configuration, (sharing as it does the same basic core-stage), will allow for different crew and cargo flights, while at the same time promoting efficiency and cost savings.

The 'Block 1' (or 70T) vehicle is the crewed version carrying up to 4





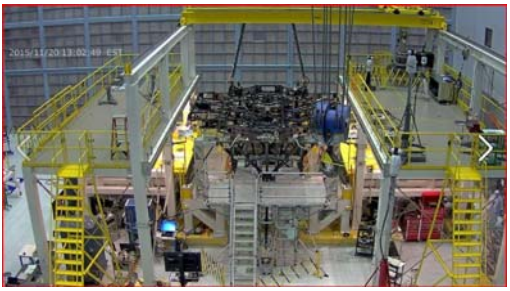
astronauts (in the Orion Multi-Purpose Crew Vehicle), or up to 70 tonnes into orbit. The 'Block 2' (or 130T) vehicle is primarily the vehicle that will launch heavy cargo (up to 130 tonnes) into space. The two-stage vehicle will be the largest rocket ever built.

Elsewhere in the Solar System, NASA engineers are planning the final Enceladus flybys **Cassini** will perform, before the end of its mission. They will sample the jets emanating from the surface of Enceladus. The closest of these occurred on 28th October, when Cassini flew within 49,000 metres of the surface of Enceladus' south polar region. Due to the speed of the Cassini probe, relative to Enceladus, (more than 8km a second), the sampling took fractions of a second, but is Cassini's deepest-ever dive into the plume of icy spray that is ejected from fractures in the south polar region. The encounter will allow Cassini to obtain the most accurate measurements yet of the plume's composition, and might offer insights into the ocean world beneath the ice. It will NOT though be able to detect life, as some excited journalists have speculated.

Between 22nd October - 3rd November mission controllers at John Hopkins University successfully carried out 4 course corrections of the **New Horizons** probe to ensure it meets with Kuiper belt object 2014 MU69, on its scheduled date of 1st January 2019. The first and fourth burns were between 16 and 20 minutes long. Currently, the extended mission hasn't actually been officially endorsed or even approved by NASA, but the course adjustments 'preserve the option' of venturing to the Kuiper Belt object in 3 years time. The

New Horizons team will present their proposal to NASA in early 2016. Currently, 2014 MU69 is about 1 billion miles beyond Pluto. New Horizons is now about 100 million miles beyond Pluto and is travelling at approximately 32,000 miles an hour. At the same time as it hurtles into deep space, toward its proposed Kuiper belt rendezvous, New Horizons continues to return startling information that has shed an exciting new light on the outer Solar System. Long thought to be a cold and dead environment, it turns out the outer Solar System is an active area, full of dynamic activity including ice volcanoes, complex hydrocarbon 'rain', and the atmosphere of Pluto venting into space.

NASA announced, on 18th November, the James Web Space Telescope (**JWST**), is being prepared to have its 18 hexagonal gold



plated mirrors mounted to the telescope. Each hexagonal mirror takes around 16 hours to install, and is, in the words of Adam Carpenter,a Mechanical Integration engineer at Goodard Space Flight Centre, a "somewhat delicate operation". The JWST is currently scheduled to be launched on top of an Ariane 5 rocket from French Guinea in late 2018. This mirror placement is absolutely critical, as due to the telescope's orbit (1 million miles from Earth), there is no opportunity of a rescue mission (like the Shuttle did for Hubble), should any serious issue be found with the telescope.

In a busy month for NASA, on 20th November, NASA issued a 1st "mission work order" to **SpaceX**, to launch astronauts from US soil. The mission, provisionally pencilled in for late 2017, will involve a Falcon 9 rocket, including a crewed Dragon spacecraft, carrying up to 4 NASA (sponsored) passengers along with around 220 pounds of pressurised cargo. NASA is hoping that SpaceX and Boeing (who received their 1st crewed mission order in May) will reestablish an American capability to launch astronauts into space, lost when the last shuttle mission flew in 2011.

Did we really land on the Moon?

Phil Wallace

20th July 1969. Neil Armstrong and Buzz Aldrin step out of the Lunar Module *Eagle* and on to the Moon's surface. On Earth, the Americans celebrated and the Soviets commiserated. It has been called "the day the whole world looked up." A single event that brought an end to the '60's Space Race and fulfilled the seemingly impossible wish of President Kennedy. And yet, according to some theorists, this historic event witnessed by billions, *never happened*.

It's perhaps the most famous conspiracy theory in history (alongside, ironically, the JFK assassination) and it has spread and grown and changed in the forty-three years since the moon landing happened. It all began with Bill Kaysing's self-published book *We Never Went to the Moon: America's Thirty Billion Dollar Swindle.* The cause was taken up by the Flat Earth Society, who accused NASA of faking it at Hollywood, sponsored by Walt Disney, filmed by Stanley Kubrick and scripted by Arthur C. Clarke. If only that were true, it would probably be cooler than the reality.

Today, the theories take two forms: that the landings did not happen at all and NASA lied to the world, and that the landings *did* happen, but not as NASA showed them. The first case is more common and the most entertaining to debunk, so we'll focus on that for this article. Most of the "evidence" comes from looking at NASA photographs, videos and other data, so let's look at some of the claims.

"There are no stars in any of the Moon photographs." This is a good one, but it is easily dealt with. Although there is no atmosphere on the Moon, the landings all took place during the lunar daytime, when the Sun is high in the sky. And like on Earth, light from the Sun and reflected from the lunar surface washes out the stars. You get the same effect when looking at pictures of the ISS or Space Shuttle taken in space.

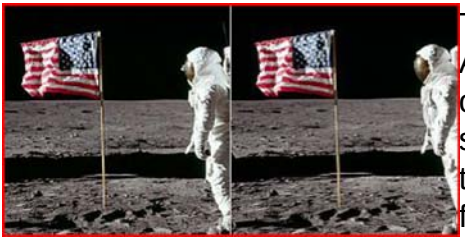
"*If Neil Armstrong was the first man on the Moon, who held the TV camera to record it?"* This is a less than brilliant "problem." The

Lunar Module had a TV camera mounted on its lower section for exactly this purpose; to film the historic moment and allow all Mankind to share the experience.

"The spacecraft would have passed through the Van Allen Belts and given the astronauts a fatal dose of radiation." The orbital transfer trajectory was chosen to limit radiation exposure, but according to Dr. James van Allen, the discoverer of the radiation belts, has said publicly that the total dose was about the same as a nuclear power plant worker receives in a year. In fact, the radiation doses are good evidence that the missions did occur. Of the 36 astronauts to fly to the Moon, 33 of them have (or had) developed cataracts consist with exposure to cosmic rays.

"*Camera film would have been fogged by the radiation."* Film was deliberately kept in metal containers to prevent this effect. Also, film from Soviet probes of the era was not fogged either.

"The US Flag flutters in the breeze of the studio used." The famous argument. The flag appears to flutter, and shake and so on, as it only could if there was a breeze and hence an atmosphere. However, the flags were held on a inverted L-shaped rod, with a plastic wire through the top of the flag to hold it up. Without any atmosphere, the flags would fall down due to gravity. Finally, the "flutter" is the same from one photo to the next:



The image on the left is of Buzz Aldrin saluting the flag. The photo on the right is taken several seconds later; Aldrin has turned towards Armstrong to see if he has finished taking the picture. And the flag flutter remains the same, as we would expect from an airless lunar surface.

"There is no dust scatter or blast crater below the LM Descent Stage." Nor should there be. The descent engine was throttled back almost to zero for the last stage of the landing; it only had to balance the lander's weight, which was reduced by the 1/6th gravity and nearly exhausted propellant tanks. In fact, the pressure exerted by the engine at landing was only 1.5 PSI, about the same as average

human blood pressure or 1/10th atmospheric pressure.

"The ascent stage shows no rocket flame when returning the command module." The ascent stage, like the Saturn-V upper stages, used hypergolic propellants that burn very hot and very efficiently, giving a nearly transparent flame, which would be difficult to see in the reflected sunlight.

"The Moon lander weighed 17 tonnes yet makes not imprint on the dust, but footprints can be clearly seen." Once down, the lander weighed less than 3 tonnes having expended most of its propellant. The astronauts weighed less but exerted more pressure. This is because their boots are much smaller than the lander footprints.

Ultimately, there is a very good argument that we did land on the Moon. Over 400,000 people worked on or were involved with the Apollo program. In more than forty years, *somebody* would have spilled the beans if it were a hoax. In fact, it's actually easier to go to the Moon than fake it convincingly and keep it secret for forty years.

From 'New Hope' to New Horizons (part 2)

The 2nd decade of space exploration started brightly. On 24th January **1986** NASA's Voyager 2 probe passed within approximately 50,000 miles of the cloud tops of Uranus. During its pass of the planet, Voyager 2 measured Uranus' atmospheric content, took pictures of its 5 largest moons, discovered 10 more, and examined its gossamer style ring structure. Another triumph for NASA.

The 1st shuttle mission of 86 was in fact a delayed flight scheduled from December the previous year. It's main claim to fame is that its the 1st flight of current NASA administrator, Charlie Bolden. The 2nd flight held much promise. There was a feeling that the shuttle program had become routine. People were losing interest. TV networks had long stopped showing launches lives, and news stations rarely carried shuttle stories. In one sense, NASA's stated aim, of making space flight routine, had succeeded. In 1984, in an attempt to inject new interest into the space program, President Reagan, in one of his more lucid moments, announced the

"Teacher In Space Project". NORMAL teachers would train as astronauts, venture into space, teach, educate and inspire and then return to the classroom to continue their work. 40,000 applied. In 1985, Christa McAuliffe was chosen. On 28th January 1986, she along with 6 other astronauts were strapped into the Space Shuttle **Challenger** on that fateful trip. The weather was bitterly cold (-3 C), and the launch had been postponed a number of times, due to a variety of reasons. NASA then, fatefully, approved the launch, despite objections from some engineers who feared the low temperatures were worryingly close to the operational constraints of the craft. After what appeared at first to be a faultless launch, and at

T+73 seconds, just as the Shuttle reached the point of maximum pressure and stress on the vehicle (a point called MAX-Q), the shuttle exploded, killing all 7 astronauts aboard. There has been speculation that some of the astronauts might have been, at least partially, conscious during the descent. It is not a thought I like to think about. Much hand-wringing and blaming was to follow. For the next 25 years, every shuttle flight I watched on television, the internet, or had the privilege to witness in person, when I heard the NASA commentator say "Go at throttle up", my heart was always in my throat, and I had a palpable sense of relief when this time passes without incident.

The Challenger disaster grounded the US space fleet for nearly 3 years. The report, released in August of 86, highlighted a catalogue of issues. The cause of the disaster was the failure of an 'O' ring on the Solid Rocket Booster (SRB). The underlying decision to launch was also criticised, as was the unrealistic launch schedule, but an endemic failure of culture was identified at NASA. The report said the Challenger explosion was "a disaster waiting to happen"

Less than a month later, the Russians launched the first module of the space station MIR, which began our near permanent habitation of space. On 11th March the ESA probe, Giotto flew within 400 miles

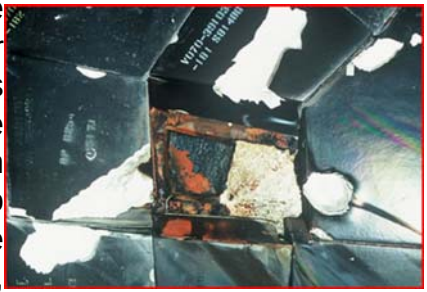
of **Halley's comet,** our closest approach to date of such an object. The mission was a forerunner of ESA journeys in the future. In 1986 the British Government passed into law the '1986 Outer Space Act'. It's aim was to ensure the the UK had laws based on the obligations it had signed up to, but it also rejected the idea of **UK manned spaceflight,** or more accurately committing the UK government to spend any money on it. That decision was only reversed over 30 years later, when the UK Space Agency was formed in 2011, and will culminate in Tim Peake visiting the ISS in December.

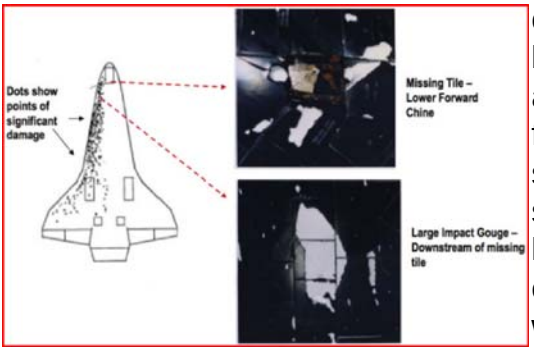
1987 saw Yuru Romanenko break the space endurance record when, as part of the 2nd long duration experiment he remained in orbit for 326 days aboard the MIR space station. Sally Ride, the 1st woman astronaut proposed sending astronauts to Mars by 2003. Almost 30 years later, while the names are different, the message remains the same. Maybe in another 30 years? 1987 also saw the 1st launch of the Energia heavy lift launch vehicle. The rocket, capable of launching 100 tonnes into low Earth orbit, only flew twice and was ultimately deemed an expensive failure.

The Soviet Union's problems with Mars missions resurfaced in **1988**, when Fobos 1 and 2 failed to reach the red planet. Fobos 1 failed while on route to Mars, and while Fobos 2 reached Martian orbit, and took some images of Phobos, contact was lost before the release of 2 landers. August saw the launch of Soyuz TM-6 carrying Afganistan's 1st, and so far only, cosmonaut, Abdul Mohmand. 2 interesting facts about this mission are that Abdul is believed to be the 1st Muslim to take a copy of the Quran into space, and by making a phone call home to Afganistan, Pashto became the 4th language spoken in

space. To cap a good year in space for the Soviet Union, November saw the launch of Energia and Buran, the Soviet version of the space Shuttle. In many respects, the Buran was more advanced than the US shuttle, as it could be flown in an automated mode, with no passengers. Due to the collapse of the Soviet Union, neither Buran or Energia flew again.

September saw the long awaited "Return to Flight" mission of the US Space Shuttle when STS-26 thundered into orbit. The mission, lasting 4 1/2 day was considered a success, launching a satellite and testing the enhancements made to the shuttle since its last flight. One of these enhancements was the Voice Control Unit (VCU), a device to recognise and respond to human speech. As you can imagine, no critical systems were controlled using the system, and some astronauts had issues using it, but this was the 1st time any such device had flown. One major issue though was that extensive damage was noted on the protective tiling of the shuttle. Even more extensive damage was noted on the next shuttle flight, a secret mission for the American military. Astronauts reported seeing white material on the windshield of the vehicle while in orbit. The crew used the Canadarm to take images of the underside of the craft, but these proved inconclusive, as the images returned to the ground were of poor quality. Mission controllers seemed unmoved, but understandably the astronauts were said to be furious. Thankfully, the shuttle returned to Earth safely, but NASA was horrified when they saw how extensive the damage really was. More than 700 tiles were damaged, and one tile was missing COMPLETELY. Atlantis is the most damaged re-entry vehicle ever to return to Earth successfully. It was of course a harbinger of things to come.





May **1989** saw the launch of first planetary spacecraft by a space shuttle, when the Space Shuttle Atlantis launched the Magellan spacecraft, during STS-30. In October, Galileo was launched from the Space Shuttle Atlantis, during STS-34. During August, NASA's Voyager 2 became the first spacecraft to observe the planet Neptune, its last planetary target. Passing about 3,000 miles above Neptune's north pole, Voyager 2 made its closest approach to any planet since leaving Earth 12 years previously. When it arrived, Voyager 2 gave us our first close-up views of the blue planet and its moons. Mission scientists expected the planet to be a blue, featureless ball, much like Uranus. Instead, they discovered a dynamic world, with a curious blue spot, dramatic cloud features, and the strongest winds observed in the Solar System. Five hours later, Voyager 2 passes about 25,000 miles from Neptune's largest moon, Triton and headed off into deep space. In November, the Cosmic Background Explorer was launched. Its mission was to map tiny variations in the Cosmic Microwave background, discovered by Arno Penzias and Robert Woodrow Wilson in 1964. Toward the end of the year, a new module was added to the MIR space station. Kvant-2 was launched on a Proton rocket, and the module provided better life support and an airlock.

Magallen in the shuttle, just prior to launch

1990 saw a simultaneous high and low in April when the Hubble Space Telescope was launched aboard the Space Shuttle Discovery. Initially hailed as a success the telescope was quickly found to contain a flawed primary mirror. It turned out the mirror was ground to a high precision, but the wrong shape! NASA was roundly criticised for not spotting the error at the time. It's hard to believe now, seeing the amazing images Hubble has produced over the subsequent decades, but initially, and for 3 years, it was more or less useless.

Before and after images from Hubble space Telescope

In late May, a new module was added to the MIR space Station. It was equipped with material processing furnaces, a camera for Earth resource experiments, as well as a number of astrophysics experiments. In August, Magellan arrived at Venus. It spends the next 4 years mapping the Venusian surface with cloud penetrating radar. During its 6 mapping cycles, as well as achieving almost 100% radar coverage of the surface,and also topographical data, it also measured the planet's gravitational field, to a very high level of accuracy. Earlier, in February, Galileo flew within 10,000 miles of Venus. It was the 1st of 3 gravity assists the probe would receive on its way to Jupiter.

In October, the Solar probe, Ulysses, was launched from the Space Shuttle Discovery. The primary mission of Ulysses was to study the Sun at all latitudes, including BOTH poles. Due to the velocity

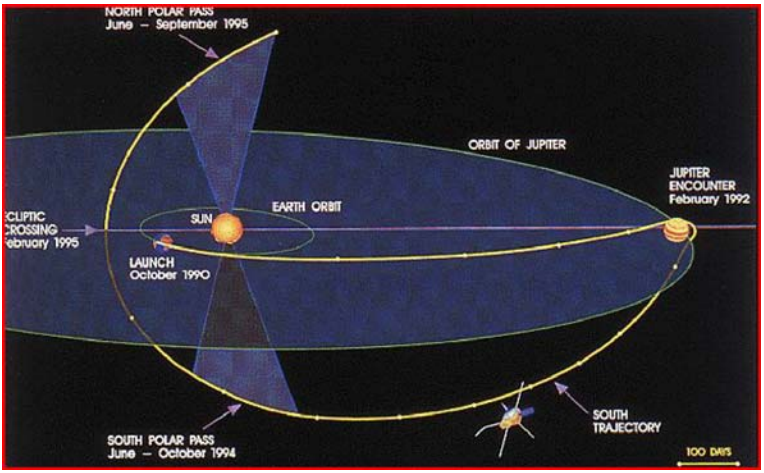
required to achieve this, the craft first started its mission by making the somewhat counter intuitive 18 month trip to the planet Jupiter.

Early in **1991**, the US Air Force conducted an interceptor test as part of Ronald Reagan's Strategic Defence Initiative, a plan to destroy Soviet nuclear rockets before they hit US soil. Another test was performed in May. May also saw the launch of Britain's first cosmonaut, Helen Sharman. She spent nearly 8 days in orbit aboard the MIR Space Station as part of 'Project Juno', a project funded by a private group to put a British person in space. After receiving 13,000 applications and a rigorous selection process, Helen was chosen and flew on the Soyuz TM-12. Also aboard was Sergei Krikalev, who was to start another 'long stay experiment. He stayed in orbit for 312 days, returning to Earth in early 1992.

In April, the Space Shuttle Atlantis launched the Compton Gamma Ray Observatory. It was the heaviest astrophysics payload ever flown at that time, at over 17 tonnes, and was the second part of NASA "Great Observatories" series. It had unprecedented instruments capable of analysing the electromagnetic spectrum from energies ranging from 30 keV to 30 GeV. It's subsequent 8 year mission helped astronomers determine how black holes trigger massive jets of X-rays and gamma rays, and detected gamma rays streaming from a variety of sources including black holes, exploding stars, and also from our own Sun. 1991 saw both the last official manned and unmanned space flights of the Soviet Union, when in October a Soyuz TM-13 flew to MIR, and in December saw the launch of a Proton rocket carrying a communications satellite.

¡*Compton GRO soon after launching from Atlantis*

1992 The Space Shuttle Endeavour made its maiden flight. and was a direct replacement for Challenger, lost 6 years previously. Its 1st consisted of retrieving and repair an Intelsat satellite, initially launched into the wrong orbit, and to verify procedures and techniques that would in future help build the International Space Station. On 8th Febraury, the Ulysses probe reached Jupiter and changed orbit to eventually allow it to study BOTH poles of the Sun. Giotto, on its supplemental mission after surviving its Halley's Comet encounter, flew within 120 miles of its 2nd comet, 26p Grigg-Skjellerup. After almost 14 years of analysing Venus, and having also played a part in observing Halley's Comet, when invisible from Earth, NASA deliberately de-orbited the Venus Orbiter probe into the Venusian atmosphere. Galileo continued its "long way round" trip to Jupiter with its 2nd gravity assist flyby of Earth.



The highlight of **1993** was without doubt the trip by the Space Shuttle Endeavour in December to repair the Hubble Space Telescope. From the 5th - 9th, the astronauts completed 5 spacewalks totalling almost 36 hours. To lessen stress on the astronauts, the spacewalks were split between 2 teams of 2. The 1st team consisted of Story Musgrave and Jeffrey Hoffman. They spent more than 22 hours

repairing Hubble in 3 spacewalks. The 2nd team consisted of Kathryn Thornton and Thomas Akers, who spent almost 14 hours in 2 spacewalks. During the 5 spacewalks (a record for 1 mission), the astronauts installed the Wide Field and Planetary Camera 2 (WFPC2), the Corrective Optics Space Telescope Axial Replacement (COSTAR), and new solar arrays and gyroscope. It was the 1st of 4 servicing missions, and revolutionised not only the capabilities of Hubble, but also its fair to say, astronomy itself.

The Mars voodoo struck again when the NASA probe Mars Observer failed after an 11 month journey and within 3 days of it planned orbital insertion to the Red Planet. On August 21st the probe was about to begin pressurising its fuel tanks in preparation for the orbital-insertion manoeuvre when its transmitters fell silent and the spacecraft was never heard from again. Again, in August Galileo, still on its way to Jupiter, flew past 243 Ida, the first asteroid found to have a natural satellite, orbiting around it. September sees, the first launch of the four stage Indian Polar Satellite Launch Vehicle (PSLV)

1994 January saw the launch of Clementine, a collaborative mission between NASA and the Strategic Defence Initiative Organisation. It's two phase mission was to test sensors and spacecraft systems, and to make scientific observations of the Moon, and the near-Earth asteroid 1620 Geographos. Experiments onboard included Ultraviolet/Visible high res cameras, a near infrared CCD camera, and a Bistatic Radar Experiment to detect the presence of water at the lunar poles. After 2 months observing the moon, a computer malfunction caused the probe's thrusters to fire for too long, which place it in the wrong orbit for the asteroid flyby. Scientists, being an ever resourceful bunch, decided to send

the probe through the Van Allen radiation belts, in order to test various systems on the craft. On 8th January a Soyuz TM-18 capsule carrying cosmonaut Valeri Polyakov launched to the Space Station Mir. Polyakov spends 437 days in space, returning home in Soyuz TM-20 the following year, setting the record for the longest time continuously spent in space by any human. It was only his second flight in space, having spent (a mere) 240 days in orbit during 1988. In February, Sergei Krikalev became the first Russian Cosmonaut to fly on aboard a US Space Shuttle when he flew aboard Discovery mission STS-60. In October, after 4 years of mapping the Venusian surface, the Magellan was deliberately de-orbited into the Venusian atmosphere. In November, Jospeh Tanner flew aboard the Space Shuttle Atlantis, during STS-66. Nothing unusual in that you might think. The item of note is that is his mother is Welsh (a Welsh speaker who hails from Llandewi Brefi), and among his belongings he took up with him to orbit was a Welsh flag!!

Valeri Polyakov after his successful landing

In February **1995** Eileen M. Collins became the first woman pilot to fly a Space Shuttle during STS-63. During the mission, the Space Shuttle Discovery travels to within 37 feet of the Russian Space Station Mir, in preparation for a future docking that occurs in June, during STS-71, when Space Shuttle Atlantis rendezvous with Russian space station Mir during a ten-day mission. Astronaut Norman Thagard is returned from Mir after setting a new American space endurance record of 115 days. In December, the Galileo spacecraft finally arrives at Jupiter. Early in the mission, a probe is dropped into the Jovian atmosphere. Galileo spends the next two years orbiting the giant gas planet and studying its moons. Ulysses passes over Solar north pole. During its extended mission it encountered a number of cometary tails, and made a second orbit around the sun during 1999 - 2004. **Next Issue 1996 - 2005**

Up-coming CAS Public Events

Date	Time	Event	Venue
15th Dec.	5:30pm - 7:30pm	Destination Space: The Launch	Techniquest, Cardiff
16th Jan.	10am - 4pm	Astronomy Day	National Museum of Wales

The BBC has confirmed another series of Stargazing live during the second week of January 2016. Check the web site for details of stargazing evening for members and the public at the observatory in Dyffryn Gardens

CAS Lectures December to February

Date	Title	Lecturer
10th Dec	The Star of Bethlehem.	Prof David Hughes,Sheffield University.
7th Jan	The Great Quasar Debate 1963-1986.	Prof Mike Edmunds,Cardiff University.
21st Jan	The Habitable Zone-A Defunct Idea? The Discovery of Water on Europa,Enceladus & Ganymede and its Potential for Life.	Dr Martin Griffiths,University of South Wales.
4th Feb	Telescopes through the Ages.	Dr Chris North,Cardiff University.
18th Feb	Time keeping on Mars.	Dr Nik Whitehead,Swansea Astronomical Society.

Observing Sessions

Date	Day	Time	Venue
11th or 12th Dec.	Fri or Sat	20:00 GMT	Dyffryn Gardens
18th or 19th Dec.	Fri or Sat	20:00 GMT	Mountain View Ranch
8th or 9th Jan.	Fri or Sat	20:00 GMT	Dyffryn Gardens
15th or 16th Jan.	Fri or Sat	20:00 GMT	Mountain View Ranch
5th or 6th Feb.	Fri or Sat	20:00 GMT	Dyffryn Gardens
12th or 13th Feb.	Fri or Sat	20:00 GMT	Mountain View Ranch
4th or 5th Mar.	Fri or Sat	20:00 GMT	Dyffryn Gardens

NOTE:- Where two dates are given we will attempt to hold the session on the first date, weather permitting, otherwise we will try again on the subsequent date. All dates are subject to weather conditions. For confirmation of any session please check on the CAS Web site or the CAS Observing line. 07817 723 883 for more information.

Mountain View Ranch was formerly Castle Heights Golf Club.

Almanac Compiled by John Richards

Sun Rise/Set & Twilight

Date	Astronomical Twilight Begins	Sun Rise	Sun Set	Astronomical Twilight Ends
1st December	05:53	07:54	16:07	18:09
08th December	06:01	08:05	16:04	18:07
15th December	06:07	08:11	16:03	18:07
22nd December	06:11	08:15	16:05	18:09
29th December	06:14	08:18	16:10	18:14
1st January	06:14	08:18	16:13	18:16
8th January	06:14	08:16	16:21	18:23
15th January	06:11	08:12	16:31	18:31
22nd January	06:07	08:05	16:42	18:40
29th January	06:00	07:56	16:54	18:50
1st Febraury	05:56	07:52	16:59	18:55
8th Febraury	05:47	07:40	17:12	19:06
15th February	05:35	07:28	17:25	19:17
22nd Februrary	05:23	07:14	17:38	19:29
29th February	05:08	06:59	17:50	19:41

Meteor Showers

Date	Meteor Shower	RA	DEC	ZHR
10/12/15	Puppids-Velids	9h00m	-48°	15
15/12/15	Geminids	7h28m	32°	75
23/12/15	Ursids	14h28m	78°	5
26/12/15	Puppids-Velids	9h20m	-65°	15
05/01/16	Quadrantids	15h28m	50°	80

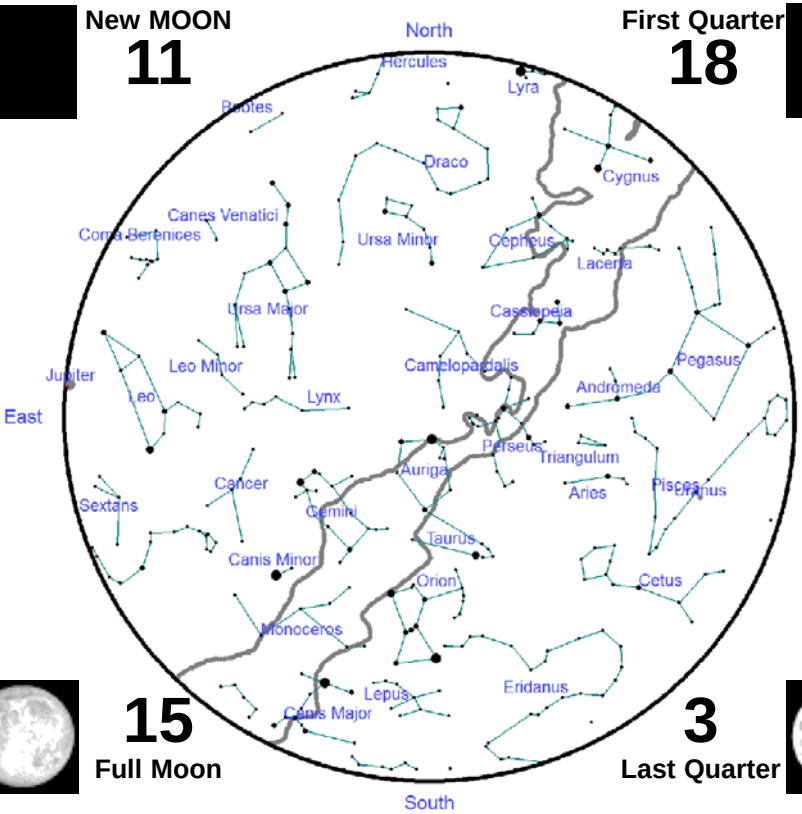
Observers Club Meetings & Dave's Star Parties

NOTE: Due to various other society commitments, there will **NOT** be an Observers Club Meeting or Star Party in January. Please check the web site for future dates for these events.

Almanac December

New MOON
11

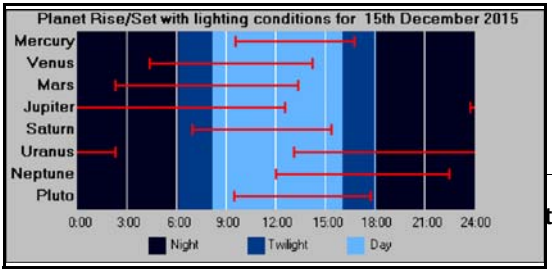
First Quarter
18



15
Full Moon

3
Last Quarter

	Constellation	R.A	Dec	Rises	Sets	Mag.
Mercury	Sagittarius	18h33m11s	-25°29'24"	09:32	16:46	-0.6
Venus	Libra	14h39m35s	-13°08'24"	04:21	14:11	-4.1
Mars	Virgo	13h12m08s	-06°02'25"	02:17	13:21	+1.4
Jupiter	Leo	11h33m38s	+04°06'49"	23:44	12:34	-2.1
Saturn	Ophiuchus	16h31m08s	-20°12'56"	06:54	15:21	+0.6
Uranus	Pisces	01h02m14s	+05°55'59"	13:05	02:14	+5.8
Neptune	Aquarius	22h47m20s	-08°33'19"	12:03	22:42	+8.0
Pluto (Dwarf)	Sagittarius	19h12m00s	-20°52'47"	09:39	17:57	+14.2



Planet Events

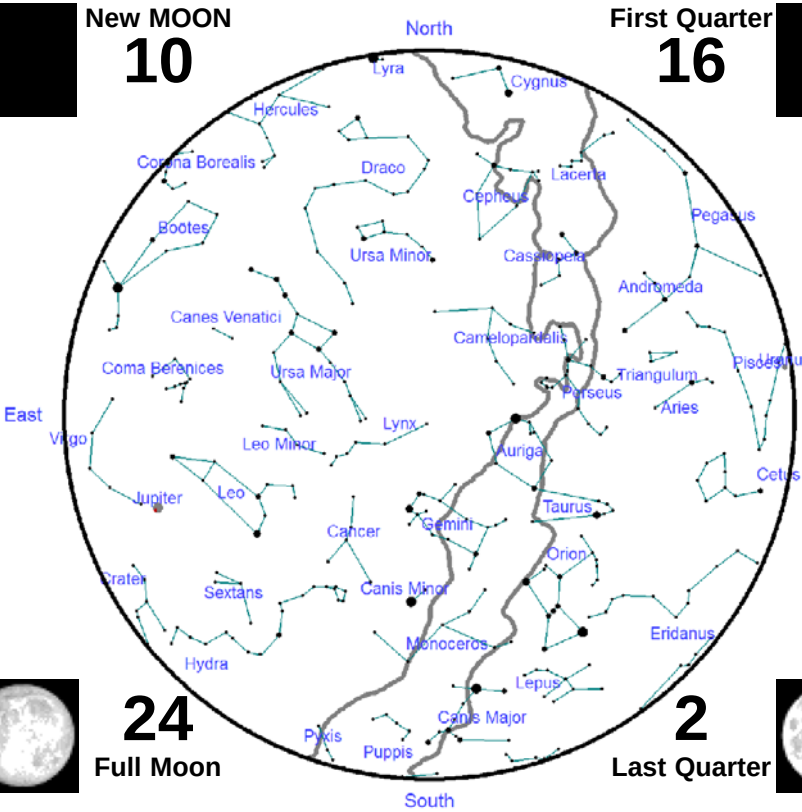
None

The data presented here is for the 15th December. Positional data is at 00:00 GMT/UT

Almanac January

New MOON
10

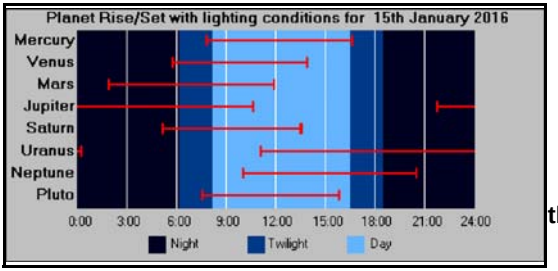
First Quarter
16



24
Full Moon

2
Last Quarter

	Constellation	R.A	Dec	Rises	Sets	Mag.
Mercury	Sagittarius	19h38m20s	-18°22'07"	07:48	16:37	+4.6
Venus	Ophiuchus	17h13m16s	-21°30'34"	05:43	13:53	-4.0
Mars	Virgo	14h17m30s	-12°10'07"	01:52	01:52	+1.1
Jupiter	Leo	11h36m58s	+03°54'40"	21:46	10:35	-2.3
Saturn	Ophiuchus	16h45m24s	-20°40'30"	05:09	13:30	+0.6
Uranus	Pisces	01h02m38s	+05°59'44"	11:03	00:13	+5.8
Neptune	Aquarius	22h53m58s	-07°56'30"	10:05	20:50	+8.0
Pluto (Dwarf)	Sagittarius	19h19m21s	-21°13'40"	07:47	16:00	+14.3



Planet Events

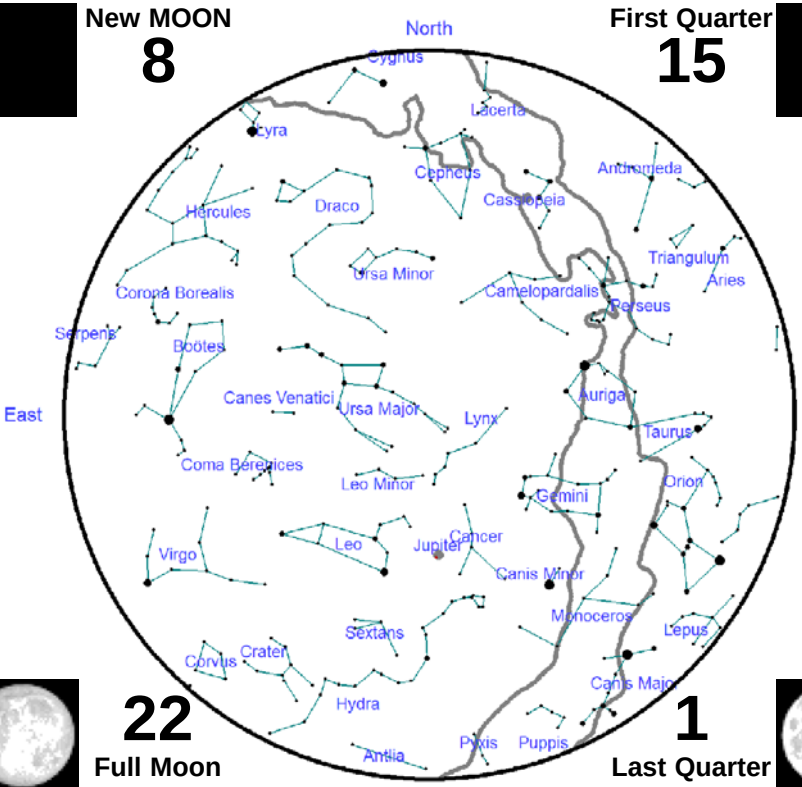
4th Earth at Perihelion (0.98 A.U.).
8th Mercury at Perihelion (0.31 A.U.).
14th Mercury at Inferior Conjunction.

The data presented here is for the 15th January positional data is at 00:00 GMT/UT

Almanac February

New MOON
8

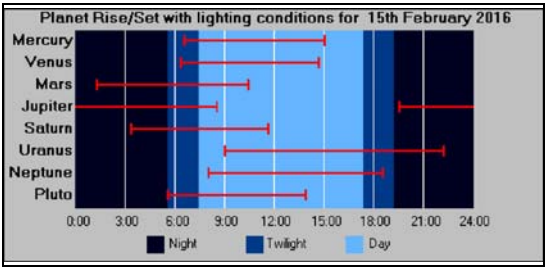
First Quarter
15



22
Full Moon

1
Last Quarter

	Constellation	R.A	Dec	Rises	Sets	Mag.
Mercury	Capricornus	20h14m45s	-20°22'20"	06:34	14:59	-0.1
Venus	Sagittarius	19h57m29s	-20°41'55"	06:19	14:40	-3.9
Mars	Libra	15h18m26s	-16°48'16"	01:17	10:25	+0.6
Jupiter	Leo	11h29m25s	+04°51'22"	19:32	08:30	-2.4
Saturn	Ophiuchus	16h56m12s	-20°56'08"	03:20	11:37	+0.5
Uranus	Pisces	01h05m58s	+06°21'22"	09:02	22:12	+5.9
Neptune	Aquarius	22h54m06s	-07°55'38"	08:03	18:48	+8.0
Pluto (Dwarf)	Sagittarius	19h19m27s	-21°13'34"	05:45	13:58	+14.3



Planet Events

21st Mercury at Aphelion (0.47 A.U.).
28th Neptune at Conjunction.

The data presented here is for the 15th February, positional data is at 00:00 GMT/UT

EXPOSE-R2: Life in space? Life on Mars?

On 15 December British European Space Agency astronaut Tim Peake will be launched on his mission to the International Space Station.

Astronaut Tim Peake will begin his five-month mission on the International Space Station in December 2015, becoming the first British ESA astronaut to visit the Station. He will be involved in many experiments aboard the ISS during this time. Research in space crosses many different subjects – the unique environment of the ISS offers a great opportunity to investigate novel materials, life in space, the human body, fluid physics, new technologies and many other things.

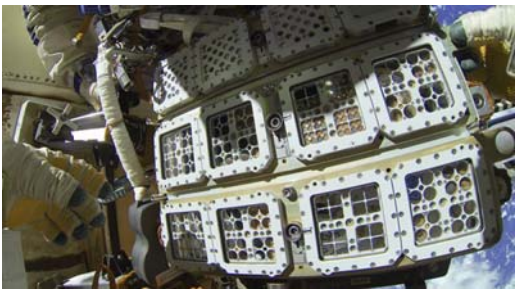
It is not only the weightlessness which scientists make use of: extreme radiation, vacuum, isolation and many other factors can be used to study physical and psychological effects in a new way. UK scientists are making important contributions to the truly international work on board the International Space Station. This work will improve life on Earth, for instance by developing new medical techniques, or strong, lightweight materials. It will also help space agencies to plan for future space missions, beyond the Earth's orbit and on to destinations such as the Moon or Mars.

Scientists have put organisms on the outside of the International Space Station to see if and how they'll survive in space and to investigate how their component molecules survive. Many factors such as radiation, lack of oxygen and extreme temperature

changes might make you think that life won't survive exposed to outer space. But if it does survive, looking at how, why and where will help us to understand the origins of life and where else to look for it beyond Earth.

Scientists trying to unravel the origins of life often study organisms in extreme conditions – the Arctic and Antarctic; the Atacama Desert; acidic rivers such as Rio Tinto in Andalucía; deep-sea thermal vents and so on – to learn more about the limits to life and how organisms adapt to different environmental conditions. This has implications for how life may have arisen and evolved on the early Earth, and on other places in the Solar System, such as Mars or the moons of Jupiter.

The unique orbital laboratory of the International Space Station (ISS) allows us access to another extreme environment – space – with a combination of conditions not present on Earth, and gives scientists the opportunity to study how organisms react in a highly controlled way. There are a number of aspects of being exposed to the space environment which have implications for our understanding of how and where life can survive: the different radiation conditions; the extreme vacuum; the extreme changes in temperature.



EXPOSE is a facility mounted outside the ISS dedicated to astrobiology, developed by ESA to allow exposure of chemical and biological samples to outer space. A combination of in situ measurements and laboratory analysis of samples returned from space is used.

EXPOSE R-2 is the third in a series, following successful missions launched in 2008 and 2009 – one mounted onto the exterior of the European Columbus module ('EXPOSE-E'), one mounted on the Russian Zevzda module ('EXPOSE-R').

EXPOSE-R2, also mounted outside the Russian module, will fly for 18 months (starting in August 2014 and ending in April 2015), and has two main experiments: BIOMEX and BOSS, both with significant involvement from Professor Charles Cockell, University of Edinburgh.

BIOMEX is studying whether life or its component biomolecules survive on the surface of Mars. There are many different compartments, each containing different organisms, such as bacteria, algae, fungi. Some of these will be protected by an artificial Mars soil, to a variety of depths, and some will even have a 'Martian' atmosphere, rich in carbon dioxide, whilst others will be left entirely exposed to space. This will help understand the habitability of the Martian surface and inform future exploration of the Red Planet.

BOSS (Biofilm Organisms Surfing Space) is studying biofilm and non-biofilm forming organisms, comparing how they respond to UV radiation. It is thought that biofilm forming organisms may be better able to withstand UV radiation; this experiment will test this idea, and try to answer why that may be the case. This will improve understanding of where and how microbes can thrive, with implications for better understanding biofilms, and microbial resistance, on Earth.