NWASNEWS

Volume22, Issue 4

December 2016

Newsletter for the Wiltshire, Swindon, Beckington Astronomical Societies and Salisbury Plain

MERRY CHRISTMAS and HAPPY NEW YEAR

Thankyou all for the number of submissions for this months newsletter, 6 members logs, trips to La Palma, images and information on star Atlases for the beginner.

So much that I was happy to only have to include a few of my images in this issue. Extra editing required, but worth it.

The super Moon (I hate that term, coming to mean any full Moon closer than 365,000km at apogee used in astrology the correct astronomical term is apogee syzygy Moon) was clouded out for most of us.

Again this knocked out the Leonid meteor shower, though I had recorded a few in the evening before and after the 17th of the month. This month we have another major meteor shower, the slow bright Geminids at a peak on the 14th/15th, just after another syzygy Moon, which will destroy most seeing. Much better will be the Urseid shower through late December.

The Moon on Christmas eve will be waning quarter Moon, only up after Midnight so no viewing Santa as he crosses the orb. Not even a Space Station to wave at around Christmas night.

But should his sleigh being bringing you new telescopes or equipment you are unfamiliar with remember we will have a viewing session early in the evening of the 30th December, staring around 6pm so we can help you setting up any new equipment.

We will also have a beginners setting up meeting on the January 3rd hall meeting. If you have any questions on setting up from binoculars to telescopes and imaging if you let me know on email beforehand I can ensure we have the right equipment at the demonstration to help you.

As Cassini takes its first plunge through the rings of Saturn tonight we have Andrew Lound at Wiltshire as our speaker, and his topic will be Saturn the Lord of the Rings (or could that be Flies-by)…

Andrew has been a returning speaker with an extremely entertaining style, and I am sure he will as informative as ever tonight.

We will have some seasonal snacks with our coffee after the meeting… enjoy your evening, and your astronomy over Christmas and throughout 2017.

Clear skies

Andy

The 26 hour old Moon on 30th November, Pete Glastonbury. This was nearly the apogee Moon, 404,000km away. Unlike the perigee the full (super yuch) Moon of 13h December...359,000km away.

Wiltshire Society Page

Wiltshire Astronomical Society
Web site: www.wasnet.org.uk
Meetings 2015/2016Season.
NEW VENUE the Pavilion, Rusty Lane, Seend
Meet 7.30 for 8.00pm start
2016

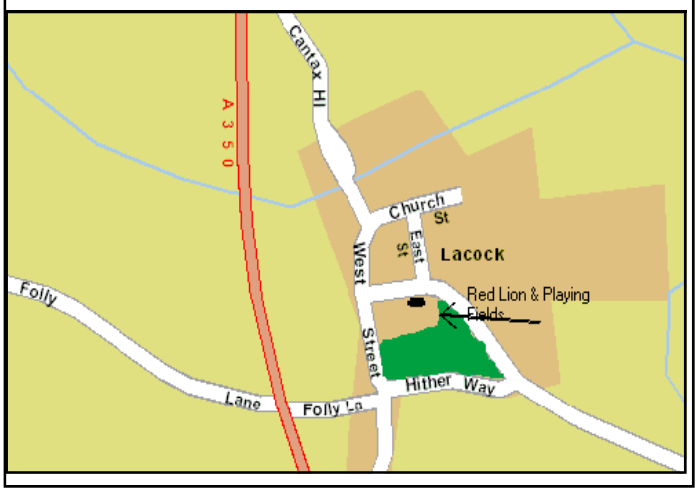
6 Dec	Andrew Lound, Saturn – Lord of the Rings
3 Jan	TBA (Probable beginners set up session)
7 Feb	Professor david Southwood, 10 Years of Space Science at the European Space Agency
7 Mar	Steve Tonkin, And yet it Moves!
4 Apr	Dr Chris North, Telescopes through the Ages
2 May	Martin Griffiths, Planetary Nebulae Marathon
6 Jun	Mark Radice, Observing from the Caribbean + AGM

Observing Sessions

The Wiltshire Astronomical Society's observing sessions are open, and we welcome visitors from other societies as well as members of the public to join us.
We will help you set up equipment (as often as you need this help), and let you test anything we have to help you in your choice of future astronomy purchases.

Please treat the lights and return to full working order before leaving. With enough care shown we may get the National Trust to do something with them!

PLEASE see our proposed changes to the observing sessions, contacting and other details. Back Page

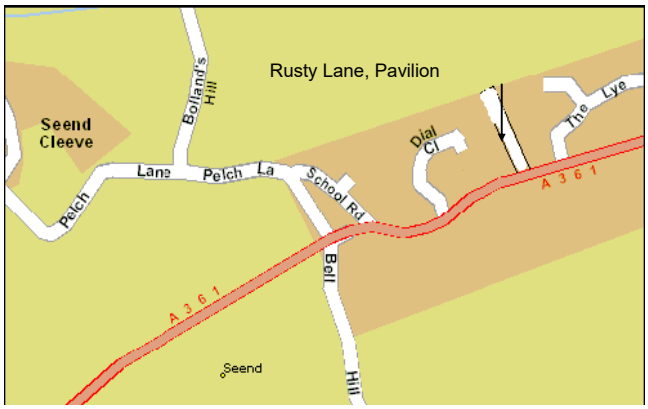


Our speaker tonight:
Andrew Lound
Saturn: The Lord of the Rings
http://www.andrewlound.com/
His biography is to the right.

Membership Meeting nights £1.00 for members £3 for visitors

Wiltshire AS Contacts

Andy Burns (Chairman, and Editor) Tel: 01249 654541, email: anglesburns@hotmail.com
Vice chair: Keith Bruton
Bob Johnston (Treasurer)
Philip Proven (Hall coordinator)
Peter Chappell (Speaker secretary)
Nick Howes (Technical Guru)
Observing Sessions coordinators: Jon Gale, Tony Vale
Contact via the web site details. This is to protect individuals from unsolicited mailings.



Andrew Lound has been presenting public lectures and staging exhibitions for over 30 years and has participated in over 2,300 events.

He regularly tours the UK with his Odyssey Class Dramatic Lectures and is invited back time and again due to popular demand. He has also worked in USA and in 2005 became the first western science speaker to tour Libya following the removal of sanctions.

He can be heard regularly on BBC radio WM where he is known as "The Urban Space man" or "WM's Titanic Expert..." His current projects include working with the California Institute of Technology JPL on promoting the Cassini Mission to Saturn and The Antoniadi Project – a space-probe to the Hellas Region on Mars. He is also developing new computer techniques for use in public lectures. Andrew is a man of many interests who specializes in space science and astronomy from both a current and historical perspective. Another main area of interest for Andrew is the Titanic. After many years of dedicated research he is now recognized as one of the worlds leading authorities on the subject.

Swindon Stargazers

Swindon's own astronomy group

The club meets once a month at Liddington Hall, Church Road, Liddington, Swindon, SN4 0HB at 7.30pm. See programme below.

Ad-hoc viewing sessions

Regular stargazing evenings are being organised near Swindon. To join these events please visit our website for further information.

Lately we have been stargazing at Blakehill Farm Nature Reserve near Cricklade, a very good spot with no distractions from car headlights.

We often meet regularly at a lay-by just outside the village of Uffcott, near Wroughton. Directions are also shown on the website link below.

When we use East Kennett, we meet at the public car park just below The Red Lion pub at Avebury; we usually hang on for 10 minutes and then move on to our viewing spot at East Kennett. Information about our evenings and viewing spots can be found here:

http://www.swindonstargazers.com/noticeboard/noticeboard06.htm

If you think you might be interested email the organiser Robin Wilkey (see website). With this you will then be emailed regarding the event, whether it is going ahead or whether it will be cancelled because of cloud etc.

We are a small keen group and I would ask you to note that you DO NOT have to own a telescope to take part, just turn up and have a great evening looking through other people's scopes. We are out there to share an interest and the hobby. There's nothing better than practical astronomy in the great cold British winter! And hot drinks are often available, you can also bring your own.

Enjoy astronomy at it's best!

Members of the Wiltshire Astronomical Society always welcome!

At Liddington Village Hall, Church Road, Liddington, SN4 0HB – 7.30pm onwards

The hall has easy access from Junction 15 of the M4, a map and directions can be found on our website at:

http://www.swindonstargazers.com/clubdiary/directions01.htm

Friday 16 Dec 2016

Programme: Christmas Social at The Village Inn, Liddington

Meeting Dates for 2017:

Friday 20 January 2017
Programme: Sally Russell - Astronomical Sketching

Friday 17 February 2017

Programme: David Boyd - Spectroscopy

Friday 17 March 2017

Programme: AGM plus Dr Bob Gatten - Using the Faulkes Telescope Project's remote telescopes, results so far

Friday 24 April 2017

Programme: Dr Pauline Norris - The Ancient Egyptians and their Astronomy

Friday 19 May 2017

Programme: Martin Griffiths - Contact with extraterrestrials, how will it affect us

Friday 16 June 2017

Programme: Paul Roche - Robotic Astronomy

---------SUMMER BREAK--------

Friday 15 September 2017

Programme: Prof. Richard Harrison MBE BSc Phs FRAS FinstP - Space Weather

Friday 20 October 2017

Programme: Steve Tonkin - Binocular Astronomy

Friday 17 November 2017

Programme: Mike Leggett: Exploration of Mars

Friday 15 December 2017

Programme: Christmas Social

Website:

http://www.swindonstargazers.com

Chairman: Peter Struve

Tel No: 01793 481547
Email: peter.struve@sky.com
Address: 3 Monkton Close, Park South, Swindon, SN3 2EU

Secretary: Dr Bob Gatten (PhD)
Tel Number: 07913 335475

Email: bob.gatten@ntlworld.com
Address: 17, Euclid Street,

Swindon, SN1 2JW

BECKINGTON ASTRONOMICAL SOCIETY

Society Details & Speakers programme can be found on our Web-site www.beckingtonas.org

General enquiries about the Society can be emailed to chair-man@beckingtonas.org.

Our Committee for 2016/2017 is

Steve Hill----------Chairman- 01761 435663

John Ball----------Vice Chairman- 01373 830419

…….john@abbeylands1.freeserve.co.uk

Sandy Whitton---- Secretary-07974-841239

……..sandy.whitton@blueyonder.co.uk

Jacky Collenette---Treasurer…collenettejacqueline@yahoo.co.uk

Mike Witt---------- Membership-……mjwitt@blueyonder.co.uk.

John Dolton------Committee…. member@jdolton.freeserve.co.uk

Meetings take place in Beckington Baptist Church Hall in Beck-ington Village near Frome.

See the location page for details of how to find us on our web-site……

Post Code for Sat Nav is BA11 6TB.

Our start time is 7.30pm.

Programme details for 2016/2017

2016

Nov 18th…. An Echo of Ingenuity……. Dick Cardy

2017

Jan 20th: Tales from the Dark Side (Pt. 2)……. Mike Witt

Feb 17th: A Very Victorian Scientist……. Andy Burns

Mar 17th: The Sun…….. Ron Westmaas

Apr 21st: Observing the Solar System……..… Mark Radice

May 19th: Imaging Colloquium `Open discussion bring your kit along`…… Steve Hill.

All are welcome to come along for a chat from beginners to ex-perts.

SALISBURY PLAIN OBSERVING GROUP

Where do you meet?

We meet at a variety of sites, including Pewsey Downs, Everleigh, Bratton Camp, Redhorn Hill and Whitesheet Hill. The sites are cold in winter so you will need warm clothing and a flask. We are always looking for good sites around the edge of the Plain.

Do I join?

No. We are not a club. We meet informally, so aside from contacting our friends to give a yes or no to meet-ing up, that's it.

I am a beginner—am I welcome?

Of course you are — whether you have a telescope, binoculars or just your eyes, there will be someone to observe with. We have a variety of equipment and are always happy for newcomers to look through.

So I just turn up?

Essentially yes, but please drop us an email as parking can be an issue at some of the meeting areas or at the pubs.

I am more experienced—what's in it for me?

If you have observing experience we prepare a monthly observing list chosen in rotation by the group. We pick some easy objects, some moderate and some tough ones. If you are experienced, why not share what you know?

Any ground rules for a session?

Common sense applies in the group; red light is essen-tial to preserve night vision; we park cars so you can leave when you wish and not disturb others with your headlights.

Contact Details

Our Website

www.spogastro.co.uk

Our Email

spogastro@googlemail.com

Twitter

http://twitter.com/SPOGAstro

Facebook

http://www.facebook.com/group.php?gid=119305144780224

Dimming stars, erupting plasma, and beautiful nebulae

By Marcus Woo

Boasting intricate patterns and translucent colors, planetary nebulae are among the most beautiful sights in the universe. How they got their shapes is complicated, but astronomers think they've solved part of the mystery—with giant blobs of plasma shooting through space at half a million miles per hour.

Planetary nebulae are shells of gas and dust blown off from a dying, giant star. Most nebulae aren't spherical, but can have multiple lobes extending from opposite sides—possibly generated by powerful jets erupting from the star.

Using the Hubble Space Telescope, astronomers discovered blobs of plasma that could form some of these lobes. "We're quite excited about this," says Raghvendra Sahai, an astronomer at NASA's Jet Propulsion Laboratory. "Nobody has really been able to come up with a good argument for why we have multipolar nebulae."

Sahai and his team discovered blobs launching from a red giant star 1,200 light years away, called V Hydrae. The plasma is 17,000 degrees Fahrenheit and spans 40 astronomical units—roughly the distance between the sun and Pluto. The blobs don't erupt continuously, but once every 8.5 years.

The launching pad of these blobs, the researchers propose, is a smaller, unseen star orbiting V Hydrae. The highly elliptical orbit brings the companion star through the outer layers of the red giant at closest approach. The companion's gravity pulls plasma from the red giant. The material settles into a disk as it spirals into the companion star, whose magnetic field channels the plasma out from its poles, hurling it into space. This happens once per orbit—every 8.5 years—at closest approach.

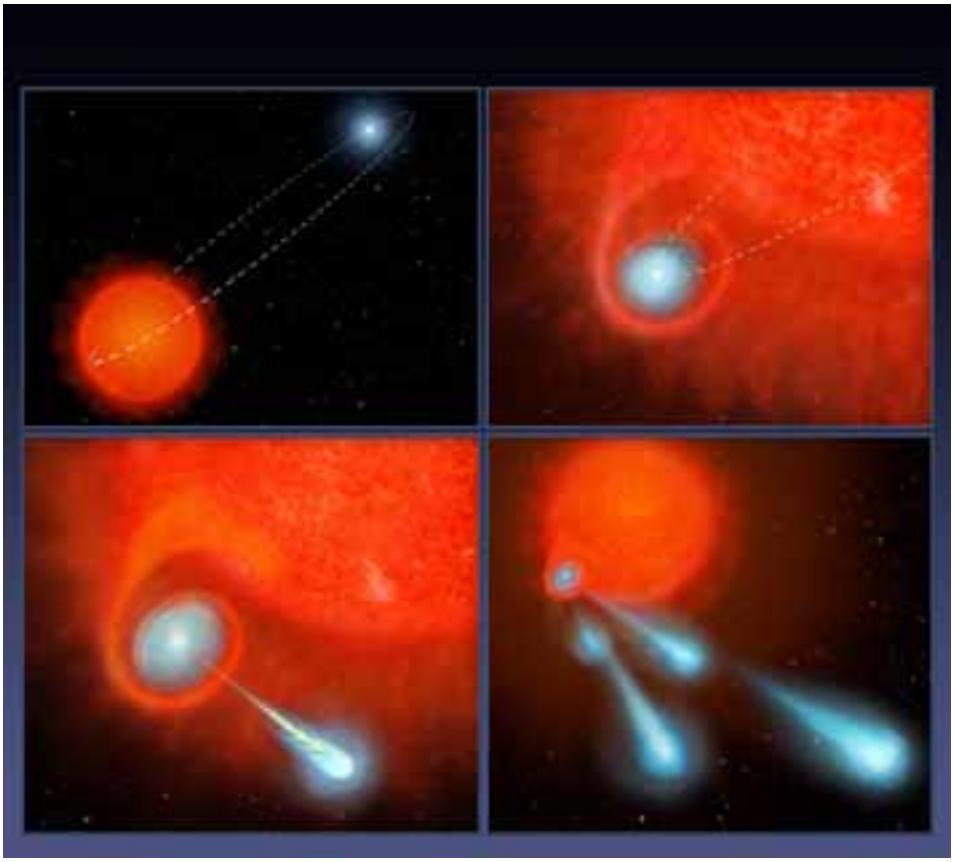
When the red giant exhausts its fuel, it will shrink and get very hot, producing ultraviolet radiation that will excite the shell of gas blown off from it in the past. This shell, with cavities carved in it by the cannon-balls that continue to be launched every 8.5 years, will thus become visible as a beautiful bipolar or multipolar planetary nebula.

The astronomers also discovered that the companion's disk appears to wobble, flinging the cannonballs in one direction during one orbit, and a slightly different one in the next. As a result, every other orbit, the flying blobs block starlight from the red giant, which explains why V Hydrae dims every 17 years.

For decades, amateur astronomers have been monitoring this variability, making V Hydrae one of the most well-studied stars.

Because the star fires plasma in the same few directions repeatedly, the blobs would create multiple lobes in the nebula—and a pretty sight for future astronomers.

If you'd like to teach kids about how our sun compares to other stars, please visit the NASA Space Place: http://spaceplace.nasa.gov/sun-compare/en/



This four-panel graphic illustrates how the binary-star system V Hydrae is launching balls of plasma into space. Image credit: NASA/ESA/STScI

Star Atlases for the uninitiated

So you have been bitten by the astronomy bug? You'll have taken the plunge and bought the shiny new binoculars or telescope, which are fighting to escape their wrapping and join you under the night sky. Outside it is clear and cool (preferably cold for maximum enjoyment), you look up and ah - it is not quite as easy as you first thought. There are limitless stars to see, but is that pattern Hercules, the Plough, and never mind Camelopardalis!

You need an atlas, preferably paper rather than electronic (just because I am biased) or that planisphere that the shop so helpfully sold you, but probably did not know how to use themselves. The initial steps around the night sky are tentative, but not really difficult if you apply yourself and are prepared to forgo warm evenings in.

I was in that position 10 years ago, when finding the Pleiades was a major achievement, but I purchased a series of atlases which are my constant companions in the observing field and are well thumbed, if not downright dog-eared.

Life's maxim really ought to be keep it simple, and nowhere is that philosophy more appropriate than under a clear sky, with a hard frost on the ground, in the middle of December. This was my introduction to use of a free map from Skymaps.com, a wonderful website where each month you can download a map giving the major constellations, deep sky objects to cut your teeth on, and planetary positions to get you started. Pop this map inside a waterproof plastic pocket and you have a wonderful low tech but informative navigation aid.

If you want to match the sky to your own observing date and time, then a planisphere is a wise investment. You can purchase a plastic coated Phillips one for around £8 or Astronomy Now have their version for around £3. The trick with these devices is imagining the small window is actually the entire sky overhead down to the horizon, which is the problem I had when much younger and no one around to show me. It takes a little skill to transfer the size of the constellations on the planisphere to their larger than life counterparts, but once you've achieved this then you can flip it over and then work out where the planets ought to be for a given date and time. Familiarity with the night sky is just the same as with your own locale - practice and remembering the landmarks.

Once you have mastered the planisphere and dispensed with your Skymap.com map (an unforgivable sin) then you need something a little more detailed. More knowledgeable readers are probably waiting for me to wax lyrically about Sky and Telescope's Pocket Sky Atlas, but I am not going to - yet. Instead, I suggest the Deep Sky Reiseatlas published by Oculum in Germany. Why this one? Simply because it is not over detailed, offers laminated pages which are a bonus in the UK, and has Telrad finder circles superimposed to help you locate deep sky objects. As a fringe benefit, you will learn the entirely necessary and useful fact that the German for "globular cluster" is "kugelsternhaufen". Buy this atlas through Amazon for around £20 and you will not be disappointed.

Alternatively, you could try the Bright Star Atlas from Willmann Bell. I do not have one myself (yet!) but having flicked through a copy at Kelling it looked good to me. The atlas offers stars down to magnitude 6.5, along with over 300 deep sky objects.

So to the Pocket Sky Atlas, or PSA to its groupies. I was introduced to this little book in 2007 on a damp observing field at Kelling Heath and was hooked. Consisting of some 80 maps reaching stars of magnitude 7.6, it has enough to keep you going for years. I have two copies, one for the field which has been criminally abused and suffered damp abuse as no book should, and a desk copy which rarely leaves my study. The drawback? Well its size is a blessing and a curse simultaneously, being a little over A5 in stature, so perfect for popping in the overcoat, but not easy reading for more mature eyes. Fortunately there is a compromise in the "Jumbo" PSA; exactly the same maps but reproduced at A4 rather than A5 size, with extra maps of the Scorpions tail and the "Steam" from the Teapot.

Going beyond the PSA or its Jumbo brother, takes you into esoteric atlas territory. Sky and Telescope produce the Sky Atlas 2000 in four flavours for indoor and outdoor use. Sized at A3, this chart reaches magnitude 8.5, with 2,700 deep sky objects.

The comparatively new "Interstellarum Deep Sky Atlas", published by Cambridge in the UK, is probably the best all round atlas for the larger aperture. Available in 2 editions, the water resistant Desk edition, and the lavish Field edition printed on waterproof paper, Interstellarum offers stars down to magnitude 9.5 and over 10,000 deep sky objects. This is my most used atlas, next to the PSA, and the one I am using in my Herschel 400 observing project.

If you still want more detail, then consider purchasing Willmann Bell's "Uranometria", now available in a single volume "Pole to Pole" version. Containing over 280,000 stars down to magnitude 9.75, it also has a companion guide giving brief biographical information to the deep sky objects therein.

If you decide to become more serious with your observing, then planning and logging software such as SkyTools or DeepSky Planner can give you references to pages in the atlases to speed up your observing

If star atlases give you the collecting bug, then you can hunt down the early versions of "Uranometria" for the northern and southern skies, the first volume having a good background to the history of star atlases.

For rarity value have a look for the Herald Bobroff atlas, or for the ultimate, seek out a copy of the three volume Millennium Star Atlas. This has stars down to magnitude 11. Following the International Year of Astronomy, you could have bought the 256 map "Great Atlas of the Sky", a lovely work, but a bit on the large size for the field.

So, there we are - a roundup of the atlases I currently own or have been able to see a copy of. There are more of course and every observer has their own favourite. Despite this being the age of the tablet and the smartphone with all the astronomical apps you can have, there is something still very appealing to me to not using these, but instead finding your way around the night sky, learning to navigate as so many have done before.

Jonathan Gale

Web Links

Skymaps

http://www.skymaps.com

Planispheres

http://www.philipsastronomy.com/?page_id=103

https://astronomynow.com/shop/product/the-astronomy-now-planisphere/?v=79cba1185463

Deep Sky Reisatlas

https://www.amazon.co.uk/Deep-Sky-Reiseatlas-Michael-Feiler/dp/3938469714

Bright Star Atlas

http://www.willbell.com/atlas/atlas1.htm

Pocket & Jumbo Sky Atlas, Sky Atlas 2000

http://www.shopatsky.com/pocket-sky-atlas

http://www.shopatsky.com/jumbo-pocket-sky-atlas

http://www.shopatsky.com/sky-atlas-2000-deluxe-laminated

Interstallarum Deep Sky Atlas

http://www.cambridge.org/gb/academic/subjects/astronomy/amateur-and-popular-astronomy/interstellarum-deep-sky-atlas-desk-edition?format=SP&isbn=9781107503380

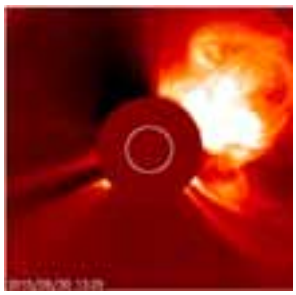
Uranometria

http://willbell.com/u2k/index.htm

SPACE NEWS

Sun Storm May Have Caused Flare-Up of Rosetta's Comet

By Nola Taylor Redd, Space.com Contributor | December 2, 2016 07:40am ET



The ESA/NASA Solar and Heliospheric Observatory spacecraft captured this image of a coronal mass ejection erupting on the sun on Sept. 30, 2015.

Credit: ESA/NASA/SOHO

Material from the sun may have caused Comet 67P/Churyumov-Gerasimenko to flare up nearly 100 times brighter than average in some parts of the visual spectrum, new research reports.

At about the same time that charged solar particles slammed into Comet 67P, the European Space Agency's (ESA) Rosetta spacecraft observed that the icy wanderer dramatically brightened. Initially, scientists assumed that unusual effect came from jets of material within the comet. However, newly released observations of 67P suggest that a burst of charged particles from the sun, known as a coronal mass ejection (CME), could have caused the change.

"The [brightening] was characterized by a substantial increase in the hydrogen, carbon and oxygen emission lines that increased by roughly 100 times their average brightness on the night of Oct. 5 and 6, 2015," John Noonan told Space.com. Noonan, who just completed his undergraduate degree at the University of Colorado at Boulder, presented the research at the Division for Planetary Sciences meeting in Pasadena, California, in October. [Photos: Europe's Rosetta Comet Mission in Pictures]

After reading a report of a CME that hit 67P at the same time, Noonan realized that the increased emissions from water, carbon dioxide and molecular oxygen observed by Rosetta's R-Alice instrument could all be explained by the collision of the comet with material jettisoned from the sun.

"This doesn't yet rule out that an outburst could have happened, but it looks possible that all of the emissions could have been caused by the CME impact," Noonan said.

A simulation reveals how the plasma of the solar wind should interact with Comet 67P/C-G.

Credit: Modelling and simulation: Technische Universität Braunschweig and Deutsches Zentrum für Luft- und Raumfahrt; Visualisation: Zuse-Institut Berlin

Colliding particles

Rosetta entered orbit around Comet 67P in August 2014, making detailed observations until the probe deliberately crashed into the icy body at the end of its mission in September 2016.

So Rosetta was tagging along when Comet 67P made its closest pass to the sun in August 2015. (Such "perihelion passages" occur once every 6.45 years - the time it takes the icy object to circle the sun.)

As 67P neared the sun, newly warmed jets began to release gas from the surface, building up the cloud of debris around the nucleus known as the coma. Jets continued to spout throughout Rosetta's observations as different regions of the comet rotated into sunlight. Such spouts were initially credited with the extreme brightening that took place in October 2015.

In addition to warming the comet, the sun also interacted with it through its solar wind, the constant rush of charged particles streaming into space in all directions. Occasionally, the sun also blows off the collections of plasma and charged particles known as CMEs. When CMEs collide with Earth, they can interact with the planet's magnetic field to create dazzling auroral displays; this interaction can also damage power grids and satellites.

Niklas Edberg, a scientist on the Rosetta Plasma Consortium Ion and Electron Spectrometer instrument on the spacecraft, and his colleagues recently reported that RPC/IES observed a CME impact on Rosetta at the same time as the bizarre brightening. The ESA/NASA Solar and Heliospheric Observatory (SOHO) spacecraft detected the CME as it left the sun on Sept. 30, 2015. [The Sun's Wrath: Worst Solar Storms in History]

According to Edberg, the CME compressed the plasma material around the comet. Because Rosetta was orbiting within the coma, the probe hadn't sampled any material streaming from the solar wind since the previous April, and wasn't expected to do so for several more months. When the CME slammed into the comet, however, the coma was compressed and Rosetta briefly tasted part of the solar wind once again.

"This suggests that the plasma environment had been compressed significantly, such that the solar wind ions could briefly reach the detector, and provides further evidence that these signatures in the cometary plasma

environment are indeed caused by a solar wind event, such as a CME," Edberg and his team wrote in their study, which was published in the journal Monthly Notices of the Royal Astronomical Society in September 2016.

Forces at play

For Noonan, the realization that a CME had impacted the comet at the same time of its unusual brightening had an illuminating effect.

"I read this [Edberg et al.] paper and realized that the substantial increase in electron density could account for the increased emissions from the coma that R-Alice observed, and set about testing what the density of the coma's water, carbon dioxide and molecular oxygen components would have to be to match what we saw," Noonan said.

Charged particles from the CME may have excited cometary material, causing it to release photons, he added. Some of the observed changes could be created only by interacting electrons, causing what Noonan called "unique fingerprints" that let the scientists know electrons were impacting the material. Of special importance was the transition of oxygen line in the spectra, a change that can only be caused by electrons.

"During the course of the CME, we saw this line increase in strength by roughly hundredfold," Noonan said.

The charged particles were unlikely to have come from the solar wind, which Noonan said would be blocked from ever penetrating this deep.

While CMEs have been observed around other comets, they have only been viewed remotely. From such great distances, only large-scale changes in the comets' comas and tails could be observed, Edberg said. Over the course of its two-year mission at Comet 67P, Rosetta's close orbit allowed it to observe other CMEs interacting with the comet, but Noonan said none were as noticeable as the event of Oct. 5-6, 2015.

"Prior to Rosetta, these electron impact emissions had never been observed around a comet, and it was these emissions that gave away that the CME might be a factor in causing them," Noonan said.

He cautioned that it isn't a given that the influx of charged particles caused the bizarre brightening, which still could be caused by the jets of material.

"At this point, we are still working to understand exactly what was the cause to see if it was the CME, and outburst, or both, that caused the emission," Noonan said.

Given the timing of the impact, however, it is unlikely that the flare-up was the result of gas released by jets alone.

"There are more forces at play than just a higher density of gas," Noonan said.

Follow Nola Taylor Redd on Twitter @NolaTRedd, Facebook or Google+. Follow us at @Spacedotcom,

Aliens Are Never the Answer

By Paul Sutter, The Ohio State University | November 22, 2016 02:30pm ET

The SETI Institute used its Alien Telescope Array in California to confirm an intriguing radio signal coming from the star HD 164595, located about 94 light-years from Earth.

Credit: SETI Institute

Paul Sutter is an astrophysicist at The Ohio State University and the chief scientist at COSI Science Center. Sutter is also host of Ask a Spaceman, RealSpace and COSI Science Now.

You may have heard in the news recently about weird or mysterious radio signals coming from outer space. It doesn't matter when you're reading this article — mysterious radio signals from outer space are almost always in the news.

About every six months or so, a flash of excitement and discussion ripples around the world as reports come in from some telescope or probe and the unexplained nature of its observations.

An unusually strong signal from a sun-like star. A repeated pattern that seems too precise to be natural. Bleeps and bloops from unknown sources with head-scratching signatures. Sure, there's a ton of stuff in space that could potentially maybe kind-of-sort-of create those signals, but could this … be it? Could this be the key piece of evidence that answers one of the ultimate existential questions? Are we alone?

No serious astronomer ever wants to rush out and blurt, "Hey, everyone! I've found aliens!" But at the same time, there's a strong desire to get your name in the history books. So when these signals pop up, you get lots of shrugging and hemming and hawing and "Look, we're pretty sure it's natural, but we can't rule out aliens," kind of talk. [Greetings, Earthlings! 8 Ways Aliens Could Contact Us]

Let me tell you a couple of stories.

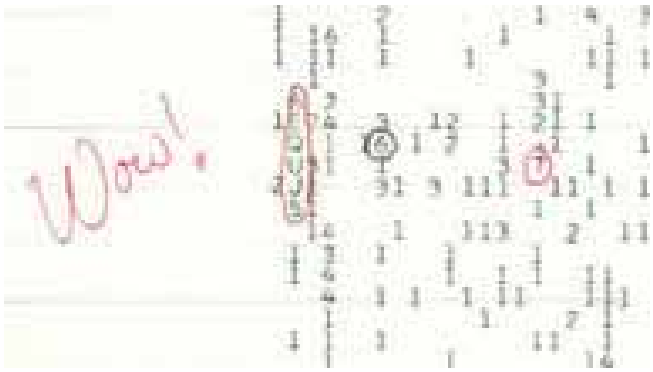
PULSARS

In the late 1960s, astrophysicist Jocelyn Bell Burnell was working with her adviser, Antony Hewish, with his fancy new radio telescope near Cambridge, England. After scanning a particular spot in the sky, they recorded an unusual signal: A source in the sky was sending frequent, repeated bursts, separated by an eerily precise 1.33 seconds.

The signal was so regular, so exact. Not knowing what to think of it, they cheekily named their source "LGM" — for "little green men." They didn't think they had found an advanced E.T. civilization, but … well, you never know. Better safe than sorry. Just in case.

The LGM hypothesis started to weaken when they found another source, and another, and another. And many others. Finally, the theorists woke up, started paying attention and figured it out: The signals were not caused by little green men, but rather little white neutron stars, wrapped in incredibly strong magnetic fields, beaming jets of radiation into space like a lighthouse. Today, we call them pulsars.

Wow!



A scan of a color copy of the original computer printout bearing the Wow! signal, taken several years after the signal's 1977 arrival.

Credit: The Ohio State University Radio Observatory and the North American AstroPhysical Observatory (NAAPO)

In 1977, astronomer Jerry Ehman was listening with his "Big Ear," a radio telescope operated by The Ohio State University. Finished with its scientific mission, the telescope was dedicated to SETI (search for extraterrestrial intelligence) observations. And one night, a huge, bright, continuous signal fell into the telescope's narrow field of view. For 72 seconds, the source shouted into the Big Ear at a peculiar frequency: 1,420 megaherz, the frequency that neutral hydrogen naturally emits

via a spin-flip transition of its electron. It was a very unmistakable frequency, a cosmological calling card.

Ehman was so impressed by the signal that he wrote "Wow!" on the printed output of the telescope, but unfortunately, no other telescope saw the signal, and it was never seen again. [Learn more about mysterious radio signals in this video]

Perytons

In 1998, the Parkes radio telescope in Australia started picking up an odd signal: Little "chirps" would occasionally hop from one frequency to another, lasting just a few milliseconds and coming from seemingly nowhere. Chirp, chirp, chirp; the little signals — called "perytons" — befuddled the telescope operators and astronomers across the world for decades.

That is, until 2015, when graduate student Emily Petroff and collaborators nailed the culprit: the microwave in the visitor center. You ever get impatient and open the microwave door before it's done? Yeah, their particular model didn't shut down very quickly and would leak a little bit of microwave radiation that the telescope picked up.

Aliens are never the answer

In all of these cases, and many more, speculation can overrun evidence — not necessarily by the astronomers involved, but almost always in the discussions surrounding the detections. The public is primed for alien transmissions: We talk to each other with radio, and if the SETI Institute or other groups pick up a weird radio signal, maybe it's aliens talking to us, we surmise.

Here's the thing: The hypothesis that aliens are causing a mysterious radio signal is almost always useless, because intelligent creatures can create almost any signal they want. Hear a *bleep-bleep-bloop*? Maybe aliens did it. Whoops! I meant *bloop-bloop-bleep*. Well, aliens could have done that, too. There's no predictive power in the "aliens did it" hypothesis. We can't ever disprove it. [Watch: Paul Sutter discusses the alien hypothesis]

When a natural astrophysical explanation is weak or not very convincing, there's often a temptation to wonder if aliens are behind it. After all, we can't rule out aliens! Exactly. We can't ever rule out aliens, because intelligent actors are capable of pretty much anything. We can't rule them out, so it's a scientifically useless position.

It's a very, very, *very* big leap to go from "We don't know what's causing this signal," to "Maybe aliens are causing this signal."

Astronomers love their radio telescopes because they get useful science done, but there are always all sorts of unexplained phenomena in the universe. That's kind of the reason astronomers remain employed — there's lots of stuff we simply don't understand. Signals, features, observations, the works. It's a big universe out there.

I'm not saying it's aliens, but it's not aliens.

Learn more by listening to the episode "Where do 'weird' radio signals come from?" on the Ask A Spaceman podcast, available on iTunes and on the Web at http://www.askaspaceman.com. Thanks to Kelly M. for the question that led to this piece! Ask your own question on Twitter using #AskASpaceman or by following Paul @PaulMattSutter and facebook.com/PaulMattSutter.

Original article on Live Science

‘Insufferable’ Moonwalker Buzz Aldrin Recovering From ‘Record Setting’ Antarctic Expedition Emergency Evacuation

5 Dec , 2016 by Ken Kremer

Buzz Aldrin – the second man to walk on the Moon – is recovering nicely today in a New Zealand hospital after an emergency medical evacuation cut short his record setting Antarctic expedition as the oldest man to reach the South Pole – which Team Buzz lightheartly noted would make him “insufferable” !

227 Stars Given Names By International Astronomical Union

Article Updated: 26 Nov , 2016

by Matt Williams

In May of 2016, the IAU Executive Committee approved of the creation of a special task force known as the Working Group on Star Names (WGSN). Composed of an international group of experts in astronomy, astronomical history, and cultural astronomy, the purpose of the WGSN is to formalize the names of stars that have been used colloquially for centuries.

This has involved sorting through the texts and traditions of many of the world’s cultures, seeking out unique names and standardizing their spelling. And after about six months, their labors have led to the creation of a new catalog of IAU star names, the first 227 of which were recently published on the IAU website.

This initiative grew out of the IAU’s Division C – Education, Outreach and Heritage group, which is responsible for engaging the public in all matters of astronomy. Their overall purpose is to establish IAU guidelines for the proposal and adoption of star names, to search historical and cultural literature for them, to adopt unique names that have scientific and historical value, and to publish and disseminate official IAU star name catalogs.

In this respect, the WGSN is breaking with standard astronomical practice. For many years, astronomers have named the stars they have been responsible for studying using an alphanumerical designation. These designations are seen as immensely practical, since star catalogs typically contain thousands, millions or even billions of objects. If there’s one thing the observable Universe has no shortage of, its stars!

However, many of these stars already have traditional names which may have fallen into disuse. The WGSN’s job, therefore, is to find commonly-used, traditional names

of stars and determine which ones shall be officially used. In addition to preserving humanity's astronomical heritage, this process is also intended to make sure that there is standardization in terms of naming and spelling, so as to prevent confusion.

What's more, with the discovery of exoplanets becoming a regular thing nowadays, the IAU hopes to engage the international astronomical community in naming these planets according to their stars traditional name (if they have one). As Eric Mamajek, the chair and organiser of the WGSN, explained their purpose:

"Since the IAU is already adopting names for exoplanets and their host stars, it has been seen as necessary to catalogue the names for stars in common use from the past, and to clarify which ones will be official from now on."

Artist's impression of a system of exoplanets orbiting a low mass, red dwarf star. Credit: NASA/JPL

For instance, it can certainly be said that HD 40307 g – an exoplanet candidate that orbits within the habitable zone of its K-type star some 42 light years away – has a pretty clunky name. But what if, upon searching through various historical sources, the WGSN found that this star was traditionally known as "mikiya" (eagle) to the Hausa people of northern Nigeria? Then this super-Earth could be named Mikiya g (or Mikiya Prime). Doesn't that sound cooler?

And this effort is hardly without precedent. As Mamajek explained, the IAU engaged in a very similar effort decades ago with respect to the constellations:

"A similar effort was conducted early in the history of the IAU, in the 1920s, when the 88 modern constellations were clarified from historical literature, and their boundaries, names, spellings, and abbreviations were delineated for common use in the international astronomical community. Many of these names are used today by astronomers for designations of variable stars, names for new dwarf galaxies and bright X-ray sources, and other astronomical objects."

Much like the constellations, the new star names are largely rooted in astronomical and cultural traditions of the Ancient Near East and Greece. Their names are rendered in Greek, Latin or Aabic, and have likely undergone little change since the Renaissance, a time where the production of star catalogs, atlases and globes experienced an explosion in growth.

Illustration of the red supergiant Betelgeuse, a traditionally-named star, as seen from a fictional orbiting world.
© Digital Drew.

Others, however, are more recent in origin, having been discovered and named in the 19th or 20th centuries. The IAU is looking to locate as many ancient names as possible, then incorporate them into an official IAU-approved database with more modern stars. These databases will be made available for use by astronomers, navigators and the general public.

In accordance with WGSN guildines, shorter, one-word names are preferred, as are those that have their roots in astronomical, cultural or natural world heritage. The 227 names that have been released include 209 recently approved names by the WGSN, plus the 18 stars that the IAU Executive Committee Working Group for Public Naming of Planets and Planetary Satellites approved of in December 2015.

Among those names that were approved are Proxima Centauri (which is orbited by the closest exoplanet to Earth, Proxima b), as well as Rigil Kentaurus (the ancient name for Alpha Centauri), Algieba (Gamma-1 Leonis), Hamal (Alpha Arietis), and Muscida (Omicron Ursae Majoris).

This number is expected to grow, as the WGSN continues to revive ancient stellar names and add new ones that are suggested by the international astronomical community.

Further Reading: IAU

CaSSIS sends first images from Mars orbit

UNIVERSITY OF BERN
30 November 2016 Astronomy Now

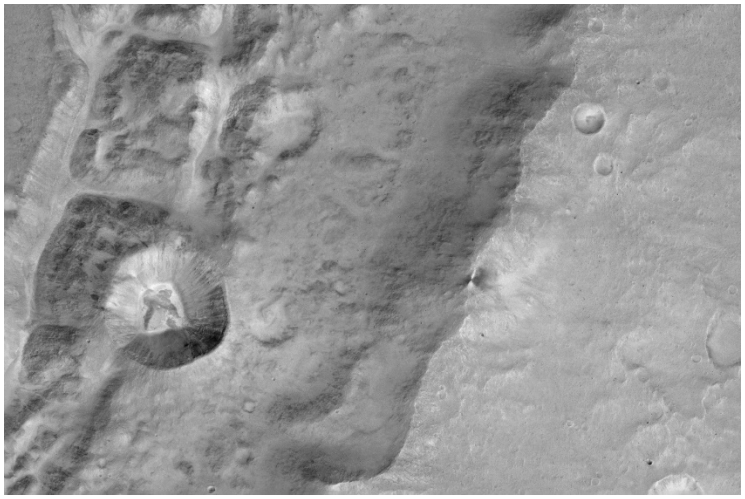


Image of a 1.4 kilometre-sized crater (left centre) on the rim of a much larger crater near the Martian equator. It was acquired at a resolution of 7.2 metres/pixel by the Colour and Stereo Surface Imaging System (CaSSIS) camera onboard ESA's ExoMars Trace Gas Orbiter. The images are very sharp and show the instrument is working extremely well at its nominal data acquisition rates. Click the picture for a full-size version. Image credit: © ESA/Roscosmos/ExoMars/CaSSIS/UniBE.The Mars Camera, CaSSIS, on ESA's ExoMars Trace Gas Orbiter captured its first high-resolution images of the Red Planet last week. The Bernese camera worked almost perfectly and has provided spectacular views of the surface.

CaSSIS (Colour and Stereo Surface Imaging System) has been developed by a team from the University of Bern led by Prof. Nicolas Thomas from the Center of Space and Habitability (CSH). It was launched with the European Space Agency's ExoMars Trace Gas Orbiter (TGO) on

14 March 2016. TGO entered orbit around Mars on 19 October. The onboard camera, CaSSIS, has returned its first images from orbit. “The first images we received are absolutely spectacular — and it was only meant to be a test,” says Nicolas Thomas.

Camera and spacecraft worked well in their first real test

TGO is currently in a highly elliptical orbit of just over 4 days duration. The spacecraft comes within 250 kilometres (155 miles) of the surface for a very short period but then goes out to over 100,000 kilometres (62,000 miles) from the planet. CaSSIS has imaged during two of these close approaches to test its capabilities and functions. The first approach occurred on 22 November.

“A lot of public attention has been on the failed landing of Schiaparelli, but TGO has been working really well so we have been extremely busy in the past month,” says Nicolas Thomas.

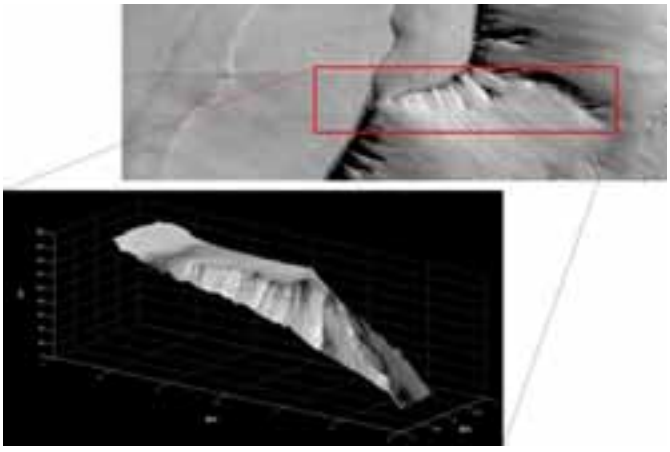
The Bern team has spent much of the time planning the observation sequences for the two close approaches. A total of 11 images were returned during the first fly-by. The spacecraft passed over a region called Hebes Chasma at its closest approach.

“We saw Hebes Chasma at 2.8 metres per pixel,” says Thomas. “That’s a bit like flying over Bern at 15,000 kilometres per hour (2.6 miles per second) and simultaneously getting sharp pictures of cars in Zurich.”

Other data have been acquired to improve the quality of the data after post-processing. The resulting image quality has impressed the entire team. “We were quite nervous but it looks as though almost everything functioned as we planned it. The resulting images are really sharp,” says Antoine Pommerol, co-investigator of CaSSIS at Center of Space and Habitability (CSH) of the University of Bern.

It’s only the beginning

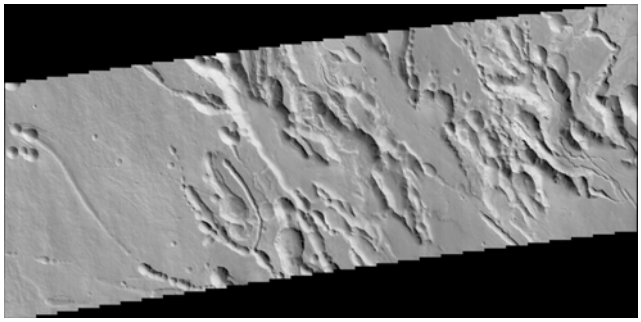
The colour and stereo capabilities of CaSSIS were also successfully tested. “The techniques for producing stereo from this type of data are still being developed but our Italian colleagues from the Astronomical Observatory of Padova (INAF), who are experts in this field, were able to produce a first result in just a couple of days in spite of it being very challenging,” says Thomas. A 3-D reconstruction of a region in Noctis Labyrinthus was produced from a stereo pair of images. This first analysis shows one of the steep-sided slopes characteristic of the region.



The first stereo reconstruction of a small area in Noctis Labyrinthus. The image gives an altitude map of the region with a resolution of less than 20 metres. Click the picture for a full-size version. Image credit: © ESA/Roscosmos/ExoMars/CaSSIS/UniBE.The test of colour was also successful. However, the first pass was over the region with the big volcanoes. The surfaces are covered with dust so there are few colour changes evident. “We will have to wait a little until something colourful passes under the spacecraft,” says Thomas. Until then, the pictures will be black and white.

In the next months, the team will be starting preparations for the prime mission. “The test was very successful but we have identified a couple of things that need to be improved in the onboard software and in the ground post-processing,” says Thomas. “It’s an incredibly exciting time.”

Eventually, TGO will use “aerobraking” (skimming into the atmosphere) to slow the spacecraft down and enter a roughly circular orbit 400 kilometres (250 miles) above the surface. This process will start in March 2017 and take around 9-12 months. The primary science phase will start around the end of 2017. CaSSIS will then enter nominal operations acquiring 12-20 high resolution stereo and colour images of selected targets per day.



A structure called Arsia Chasmata on the flanks of one of the large volcanoes, Arsia Mons. The width of the image is around 25 kilometres (16 miles). The formation is volcanic in origin and pit craters (possibly caused by subsidence) can be seen. Click the picture for a full-size version. Image credit: © ESA/Roscosmos/ExoMars/CaSSIS/UniBE.**High precision within milliseconds**

The imaging technique used by CaSSIS is called “push-frame.” It takes short exposures (framelets) at a very rapid rate and these images are put together on ground to produce the final product. For Hebes Chasma, the framelets were acquired with 700 microseconds exposure time at a rate of one framelet every 150 milliseconds. The high resolution imaging system is designed to complement the data acquired by the other instruments on TGO and other Mars orbiters while also enhancing our knowledge of the surface of Mars.

Dynamic Martian surface

It is now known that Mars is more dynamic than previously thought. Of particular interest to the 25-strong science team from 9 countries (including US and Russia) is the chance CaSSIS offers to study changes that occur over the day and over the Martian seasons. Further studies of possible liquid water on the surface will be one of the main aims. CaSSIS will also support the other instruments on TGO by trying to identify sources of trace gases, including methane which is a short-lived molecule seen in the Martian atmosphere first by ESA’s Mars Express spacecraft.

Icy moon Mimas dwarfed by Saturn's rings

NASA JET PROPULSION LAB

30 November 2016 Astronomy Now

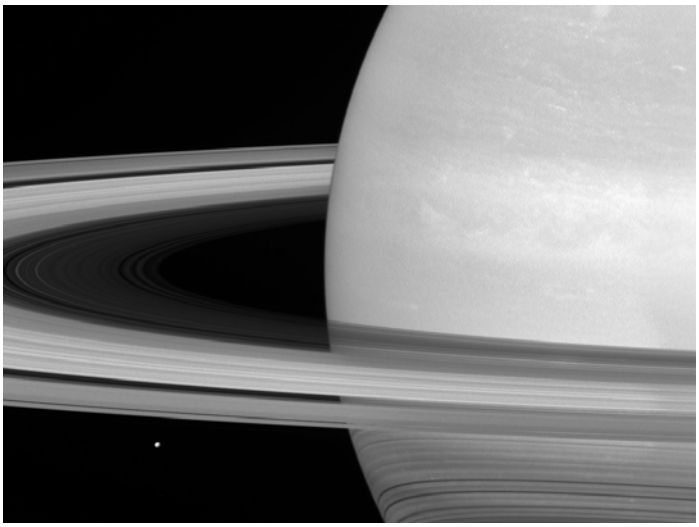


Image credit: NASA/JPL-Caltech/Space Science Institute.Saturn's icy moon Mimas (near lower left) appears tiny by comparison to the planet's rings, so it might seem that the rings would be far more massive, but this is not the case. Scientists think the rings are no more than a few times as massive as Mimas, or perhaps just a fraction of Mimas' mass. NASA's Cassini spacecraft is expected to determine the mass of Saturn's rings to within just a few hundredths of Mimas' mass as the mission winds down by tracking radio signals from the spacecraft as it flies close to the rings.

The rings, which are made of small, icy particles spread over a vast area, are extremely thin — generally no thicker than the height of a house. Thus, despite their giant proportions, the rings contain a surprisingly small amount of material.

Mimas is 246 miles (396 kilometres) wide.

This view looks toward the sunlit side of the rings from about 6 degrees above the ring plane. The image was taken in red light with the Cassini spacecraft's wide-angle camera on 21 July 2016.

The view was obtained at a distance of approximately 564,000 miles (907,000 kilometres) from Saturn and at a Sun-Saturn-spacecraft, or phase, angle of 31 degrees. Image scale is 34 miles (54 kilometres) per pixel.

Virgin Galactic's second spaceship aces first glide flight

December 5, 2016 Stephen Clark

Virgin Galactic's second SpaceShipTwo rocket plane, christened VSS Unity, glided to a runway landing after dropping from its carrier aircraft over California's Mojave Desert on Saturday. Credit: Virgin Galactic

Virgin Galactic's second SpaceShipTwo rocket plane glided to a runway landing after dropping from its carrier aircraft over California's Mojave Desert on Saturday.

With two pilots at the controls, the VSS Unity spaceship's first glide flight went well, returning Virgin Galactic's SpaceShipTwo vehicles to standalone sorties for the first time since a fatal accident on a test flight in October 2014 set back the company's plans to start commercial service with passengers on brief suborbital trips into space.

VSS Unity is Virgin Galactic's second rocket plane, and the first manufactured by a Virgin subsidiary named The Spaceship Company. Saturday's test came after a series of flights with the new SpaceShipTwo vehicle remaining attached to its huge carrier plane, dubbed WhiteKnightTwo.

Veteran test pilots Mark Stucky and Dave Mackay flew VSS Unity from its release from the WhiteKnightTwo carrier plane at an altitude of 50,000 feet to a smooth unpowered landing on a runway at the Mojave Air and Space Port in Mojave, California.

"As expected, for this first gliding test flight, VSS Unity was flying light and slow, achieving a maximum speed of approximately Mach 0.6 while gliding home from an altitude of 50,000 feet," Virgin Galactic said in a statement. "An initial look at the data as well as feedback from our two pilots indicate that today's flight went extremely well, but we'll take the time to properly and thoroughly analyze the vehicle's performance before clearing the vehicle for our next test."

Saturday's glide test was the fifth flight of VSS Unity since it first took to the skies in September.

"We're looking forward to getting back into the skies as soon as the engineers say we are ready to do so," Virgin Galactic said.

More glide flights are planned before Virgin Galactic officials give the green light to begin rocket-powered tests on VSS Unity.

"We have not yet reached the rocket powered phase of the test flight program — first we need to gather test flight data to confirm our analyses and calculations about how VSS Unity will perform in a wide variety of real-world flight conditions," the company said.

The glide flights will test the vehicle's performance at a range of weights, from a light load to a heavy spacecraft simulating a mission with full fuel tanks and passengers. The tests will also wring out VSS Unity's performance at different airspeeds and flight angles.

Pilots and engineers will also demonstrate SpaceShipTwo's abort modes during the glide flights, according to Virgin Galactic, part of Richard Branson's Virgin Group.

On full-up suborbital missions, SpaceShipTwo vehicles will drop from the bottom of its mothership at 50,000 feet, fire an aft-mounted hybrid rocket motor and accelerate past the speed of sound, heading for a peak altitude of more than 60 miles (100 kilometers), the internationally-recognized boundary of space.

Passengers aboard the rocket plane will experience several minutes of microgravity, and enjoy expansive views of Earth below the blackness of space.

During the next phase of the flight, the spaceship will reorient its twin tail booms to stabilize itself for re-entry, then glide to a runway landing like the space shuttle.

Virgin Galactic officials have set requirements VSS Unity needs to meet during the craft's glide flight test program before proceeding to rocket-powered tests. The company said it

will conduct as many flights as needed to meet the requirements.

The first SpaceShipTwo test vehicle, named VSS Enterprise, was on its fourth powered test flight when it broke apart shortly after igniting its rocket motor in October 2014. Co-pilot Michael Alsbury was killed in the accident — lead pilot Peter Siebold survived — 10 miles over the Mojave Desert.

National Transportation Safety Board investigators blamed the crash on Alsbury's premature unlocking of the craft's rotating tail booms.

The pilots did not send commands to deploy the re-entry feathering system, but strong aerodynamic forces in the lower, denser part of the atmosphere pushed the unlocked tail booms upward into their re-entry positions, leading to loss of control and the disintegration of the rocket plane.

VSS Unity has an electronic mechanism to prevent pilots from prematurely unlocking the feathering system.

Messier 27 – The Dumbbell Nebula


Article Updated: 21 Nov , 2016

by Tammy Plotner

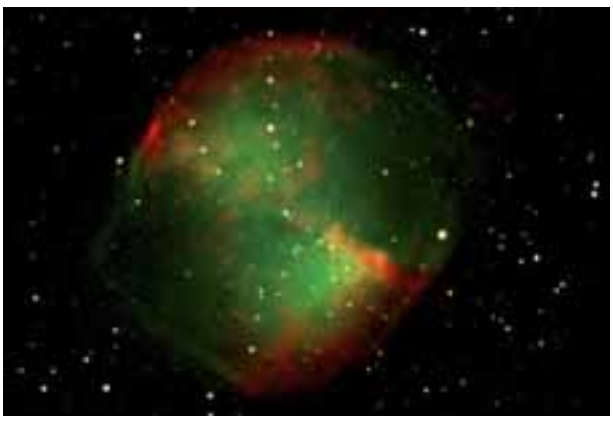
Welcome back to Messier Monday! In our ongoing tribute to the great Tammy Plotner, we take a look at the famous and easily-spotted Dumbbell Nebula. Enjoy!

Back in the 18th century, famed French astronomer Charles Messier noted the presence of several "nebulous objects" in the night sky. Having originally mistaken them for comets, he began compiling a list of them so that others would not make the same mistake he did. In time, this list would come to include 100 of the most fabulous objects in the night sky.

Known today as the Messier Catalog, this work has come to be viewed as one of the most important milestones in the study of Deep Space Objects. One of these is the famed Dumbbell Nebula – also known as Messier 27, the Apple Core Nebula, and NGC 6853. Because it of its brightness, it is easily viewed with binoculars and amateur telescopes, and was the first planetary Nebula to be discovered by Charles Messier.

Description:

This bright planetary nebula is located in the direction of the Vulpecula constellation, at a distance of about 1,360 light years from Earth. Located within the equatorial plane, this nebula is essentially a dying star that has been ejecting a shell of hot gas into space for roughly 48,000 years.



Picture of M27 processed and combined using IRAF and MaxIm DL. Credit: Wikipedia Commons/Mohamad Abbas

The star responsible is an extremely hot blueish subdwarf star, which emits primarily highly energetic radiation in the non-visible part of the electromagnetic spectrum. This energy is absorbed by exciting the nebula's gas, and then re-emitted by the nebula. Messier 27 particular green glow (hence the nickname "Apple Core Nebula") is due to the presence of doubly-ionized oxygen in its center, which emits green light at 5007 Angstroms.

For many years I quested to understand the distant and mysterious M27, but no one could answer my questions. I researched it, and learned that it was made up of doubly ionized oxygen. I had hoped that perhaps there was a spectral reason to what I viewed year after year – but still no answer.

Like all amateurs, I became the victim of "aperture fever" and I continued to study M27 with a 12″ telescope, never realizing the answer was right there – I just hadn't powered up enough. Several years later while studying at the Observatory, I was viewing through a friend's identical 12″ telescope and, as chance would have it, he was using about twice the magnification that I normally used on the "Dumbbell."

Imagine my total astonishment as I realized for the very first time that the faint central star had an even fainter companion that made it seem to wink! At smaller apertures or low power, this was not revealed. Still, the eye could "see" a movement within the nebula – the central, radiating star and its companion.

Image from a ground-based telescope at Westview Observatory in Cridersville, OH. Credit: Wikipedia Commons/ Charlemagne920

As W.G. Mathews of the University of California put it in his study "Dynamical Evolution of a Model Planetary Nebula":

"As the gas at the inner edge begins to ionize, the pressure throughout the nebula is equalized by a shock which moves outward through the neutral gas. Later, when about 1/10 of the nebular mass is ionized, a second shock is released from the ionized front, and this shock moves through the neutral shell reaching the outer edge. The density of the HI gas just behind the shock is quite large and the outward gas velocity increases within until it reaches a maximum of 40-80 km per second just behind the shock front. The projected appearance of the nebula during this stage has a double ring structure similar to many observed planetaries."

R.E. Lupu of John Hopkins has also made studies of motion as well, which they published in a study titled "Discovery of Lyman-alpha Pumped Molecular Hydrogen Emission in the Planetary Nebulae NGC 6853 and NGC 3132". As they indi-

cated, and found them to “have low surface brightness signatures in the visible and near infrared.”

But, movement or no movement, Messier 27 is known as one of the top “polluters” of the interstellar medium. As Joseph L. Hora (et al.) of the Harvard-Smithsonian Center for Astrophysics said in his 2008 study “Planetary Nebulae: Exposing the Top Polluters of the ISM“:

“The high mass loss rates of stars in their asymptotic giant branch (AGB) stage of evolution is one of the most important pathways for mass return from stars to the ISM. In the planetary nebulae (PNe) phase, the ejected material is illuminated and can be altered by the UV radiation from the central star. PNe therefore play a significant role in the ISM recycling process and in changing the environment around them…

“A key link in the recycling of material to the Interstellar Medium (ISM) is the phase of stellar evolution from Asymptotic Giant Branch (AGB) to white dwarf star. When stars are on the AGB, they begin to lose mass at a prodigious rate. The stars on the AGB are relatively cool, and their atmospheres are a fertile environment for the formation of dust and molecules. The material can include molecular hydrogen (H2), silicates, and carbon-rich dust. The star is fouling its immediate neighborhood with these noxious emissions. The star is burning clean hydrogen fuel, but unlike a “green” hydrogen vehicle that outputs nothing except water, the star produces ejecta of various types, some of which have properties similar to that of soot from a gas-burning automobile. A significant fraction of the material returned to the ISM goes through the AGB – PNe pathway, making these stars one of the major sources of pollution of the ISM.
“However, these stars are not done with their stellar ejecta yet. Before the slow, massive AGB wind can escape, the star begins a rapid evolution where it contracts and its surface temperature increases. The star starts ejecting a less massive but high velocity wind that crashes into the existing circumstellar material, which can create a shock and a higher density shell. As the stellar temperature increases, the UV flux increases and it ionizes the gas surrounding the central star, and can excite emission from molecules, heat the dust, and even begin to break apart the molecules and dust grains. The objects are then visible as planetary nebulae, exposing their long history of spewing material into the ISM, and further processing the ejecta. There are even reports that the central stars of some PNe may be engaging in nucleosynthesis for purposes of self-enrichment, which can be traced by monitoring the elemental abundances in the nebulae. Clearly, we must assess and understand the processes going on in these objects in order to understand their impact on the ISM, and their influence on future generations of stars.”

Messier 27 and the Summer Triangle. Credit: Wikisky

History of Observation:

So, chances are on July 12th, 1764, when Charles Messier discovered this new and fascinating class of objects, he didn’t really have a clue as to how important his observation would be. From his notes of that night, he reports:

“I have worked on the research of the nebulae, and I have discovered one in the constellation Vulpecula, between the two forepaws, and very near the star of fifth magnitude, the fourteenth of that constellation, according to the catalog of Flamsteed: One sees it well in an ordinary refractor of three feet and a half. I have examined it with a Gregorian telescope which magnified 104 times: it appears in an oval shape; it doesn’t contain any star; its diameter is about 4 minutes of arc. I have compared that nebula with the neighboring star which I have mentioned above [14 Vul]; its right ascension has been concluded at 297d 21' 41", and its declination 22d 4' 0" north.”

Of course, Sir William Herschel’s own curiosity would get the better of him and although he would never publish his own findings on an object previously cataloged by Messier, he did keep his own private notes. Here is an excerpt from just one of his many observations:

“1782, Sept. 30. My sister discovered this nebula this evening in sweeping for comets; on comparing its place with Messier’s nebulae we find it is his 27. It is very curious with a compound piece; the shape of it though oval as M. [Messier] calls it, is rather divided in two; it is situated among a number of small [faint] stars, but with this compound piece no star is visible in it. I can only make it bear 278. It vanishes with higher powers on account of its feeble light. With 278 the division between the two patches is stronger, because the intermediate faint light vanishes more.”

So where did Messier 27 get its famous moniker? From Sir John Herschel, who wrote: “A most extraordinary object; very bright; an unresolved nebula, shaped something like an hourglass, filled into an oval outline with a much less dense nebulosity. The central mass may be compared to a vertebra or a dumb-bell. The southern head is denser than the northern. One or two stars seen in it.”

It would be several years, and several more historical astronomers, before the true nature of Messier 27 would even be hinted at. At one level, they understood it to be a nebula – but it wasn’t until 1864 when William Huggins came along and began to decode the mystery:

“It is obvious that the nebulae 37 H IV (NGC 3242), Struve 6 (NGC 6572), 73 H IV (NGC 6826), 1 H IV (NGC 7009), 57 M, 18 H. IV (NGC 7662) and 27 M. can no longer be regarded as aggregations of suns after the order to which our own sun and the fixed stars belong. We have with these objects to do no longer with a special modification only of our own type of suns, but find ourselves in the presence of objects possessing a distinct and peculiar plan of structure. In place of an incandescent solid or liquid body transmitting light of all refrangibilities through an atmosphere which intercepts by absorption a certain number of them, such as our sun appears to be, we must probably regard these objects, or at least their photosurfaces, as enormous masses of luminous gas or vapour. For it is alone from matter in the gaseous state that light consisting of certain definite refrangibilities only, as is the case with the light of these nebulae, is known to be emitted.”

Whether or not you enjoy M27 as one of the most superb planetary nebula in the night sky (or as a science object) you will 100% agree with the words of of Burnham: “The observer who spends a few moments in quiet contemplation of this

nebula will be made aware of direct contact with cosmic things; even the radiation reaching us from the celestial depths is of a type unknown on Earth…"

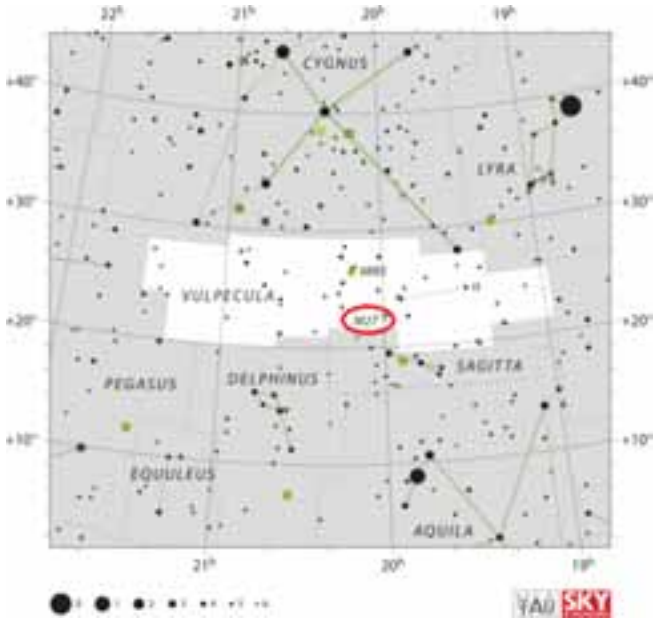
Locating Messier 27:

When you first begin, Messier 27 will seem like such an elusive target – but with a few simple sky "tricks", it won't be long until you'll be finding this spectacular planetary nebula under just about any sky conditions. The hardest part is simply sorting out all the stars in the area to know the right ones to aim at!

The way I found easiest to teach others was to start BIG. The cruciform patterns of the Cygnus and Aquila constellations are easy to recognize and can be seen from even urban locations. Once you've identified these two constellations, you're going smaller by locating Lyra and the tiny kite-shape of Delphinus.

Now you've circled the area and the hunt for Vulpecula the Fox begins! What's that you say? You can't distinguish Vulpecula's primary stars from the rest of the field? You're right. They don't stand out like they should, and being tempted to simply aim halfway between Albeireo (Beta Cygni) and Alpha Delphini is too much of a span to be accurate. So what are we going to do? Here's where some patience comes into play.

If you give yourself time, you'll begin to notice the stars of Sagitta are ever so slightly brighter than the rest of the field stars around it, and it won't be long until you pick out that arrow pattern. In your mind, measure the distance between Delta and Gamma (the 8 and Y shape on a starfinder map) and then just aim your binoculars or finderscope exactly that same distance due north of Gamma.



The location of M27 in the constellation Vulpecula. Credit: IAU/ Sky & Telescope magazine (Roger Sinnott & Rick Fienberg)

You'll find M27 every time! In average binoculars it will appear as a fuzzy, out of focus large star in a stellar field. In the finderscope, it may not appear at all… But in a telescope? Be prepared to be blown away! And here are the quick facts on the Dumbbell Nebula to help get you started:

Object Name: Messier 27
Alternative Designations: M27, NGC 6853, The Dumbbell Nebula
Object Type: Planetary Nebula
Constellation: Vulpecula
Right Ascension: 19 : 59.6 (h:m)
Declination: +22 : 43 (deg:m)
Distance: 1.25 (kly)
Visual Brightness: 7.4 (mag)
Apparent Dimension: 8.0×5.7 (arc min)

We have written many interesting articles about Messier Objects here at Universe Today. Here's Tammy Plotner's Introduction to the Messier Objects, , M1 – The Crab Nebula, M8 – The Lagoon Nebula, and David Dickison's articles on the 2013 and 2014 Messier Marathons.

MEMBERS VIEWING LOGS and IMAGES

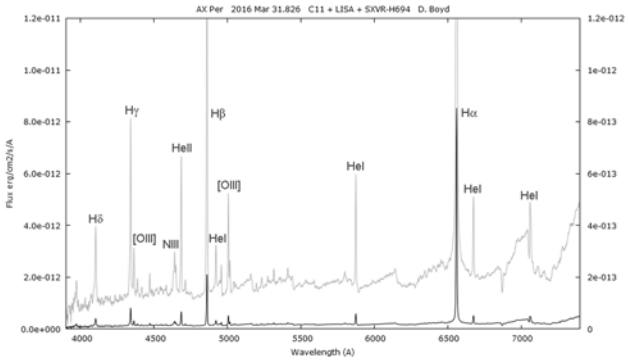
Log November 2016

Tony Vale

During November I made 70 observations of variable stars, bringing my cumulative total to 1012.My 1000th observation was of AX Persei which I recorded at a magnitude of 12.2 on 29th November. AX Persei is a symbiotic star. Williamina Fleming drew attention to the unusual spectrum of Z Andromeda, later to become the prototype symbiotic star, in 1901 but the term "symbiotic" was first used much later, in 1941 by Paul Merrill. The spectra of these stars were puzzling to Fleming because she was familiar with the spectra of cool red stars, white hot stars and planetary nebulae but these spectra sometimes showed all three. It later became clear that this was because all three components are actually present.

AX Persei is an eclipsing binary with a cool red giant and a hot white dwarf with an orbital period of 680 days. The giant star is losing mass at a great rate. Some of this is captured by the white dwarf and some of it is ionised by the UV radiation from the white dwarf giving rise to strong emission lines of hydrogen and helium.

Below is a spectrum of AX Persei taken earlier this year by David Boyd of the BAA. The fainter line is simply a scaling up of the solid line to enhance the detail. The hydrogen and helium emission lines can be seen clearly . There is also an underlying spectrum rising from left to right (blue to red) indicating a higher flux of red light compared to blue as is to be expected from a cool red giant star. The white dwarf is so hot that most of its light is in the ultra violet, outside the visible range so there is a minimal impact on this spectrum.



A strong outburst of V404 Cygni occurred in 2015. Although this object is on my list of targets it has proved elusive so far and I only have negative observations of it. It is frequently categorised as a nova but is in fact another binary system, this time with a black hole primary and a main sequence secondary, a little smaller than the sun. The two components are very close to each other and complete an orbit in only 6 days or so. The secondary is being stripped of material which is falling into the black hole via an accretion disc. Outbursts

may be caused by a lower accretion rate onto the black hole compared to the mass transfer rate from the secondary resulting in a piling up of material in the disc and extreme heating and x-ray emission. The 2015 outburst was unusual in that the visible magnitude reached around 12 on several occasions making it an easy object for amateur visual observers (such as yours truly) providing it could be caught during an outburst but unfortunately I kept missing it – once by only a couple of hours ! Its currently around magnitude 18, well outside my range but it can change rapidly so I'll keep watching. Its about 7,000 ly away.

During November the Blazar CTA 102 went into outburst reaching around magnitude 12 so I'm hoping to catch it over the next few nights. Quasars are distant galaxies with active supermassive black holes at the centre. Material is being ejected at very high speed from the magnetic poles of the black hole and these jets beam radiation (which is strong in radio frequencies) in the direction of travel. When the jets are directed towards us we see highly luminous objects which are called Blazars. CTA 102 became famous in the mid 60s because its radio signal was thought by some to be evidence of an extra terrestrial civilization.

VIEWING LOGS FROM PETER CHAPPELL

Viewing Log for 31st of October

For a change I actually had a free night with clear skies AND the moon was new, so I would have no light pollution from the sky at all J. I had found October for a month to be hard to get out and do any viewing, it did not help going to Canada for a week during the month, weather was not on myside or when I was free the moon was near full (time when I do not go out unless the moon is the target which is rare for me!).

I arrived at my usual viewing spot at Uffcott and had my telescope set up and ready to use by 19:57, I would be using a Pentax WX 14 mm eye piece to go with the Meade eight inch GOTO telescope. What to view now as I have completed both the Herschel 400 and Messier list back in late summer? Next list to view is the Caldwell list of 109 objects, a substitute to the Messier list? When I went along to the last WAS viewing session at Lacock I started to view the objects but found them to be very disappointing Caldwell (C) 2-5, the high thin cloud might not have helped so I thought I would try again at a later date. Before I started on the list I had a go at the planet Mars, it was just above the hedge and gave no real details of its surface! After that I had a look at Uranus and Neptune the Ice Giant planets, both of these only gave colour and no surface details, would probably need a much larger scope to get any?

So now on to the Caldwell list, this list is named after Patrick Moore, Caldwell being his middle name, he could not use Moore (M) as Messier had already used this letter! An American magazine wanted a list of objects to view so Patrick came up with this list in December 1995 as an extra to the Messier list? The list goes by declination with C 1 being the most northerly and C 109 most southerly, from the UK you can only get to C 69 (Bug Nebula). C 1 is an Open Cluster (O C) which is dim and sparse to view in Cepheus.
C 2, a Planetary Nebula (P N) also in Cepheus I could not make out so I will have to come back this is on another night and hopefully bag it! C 3 is a Barred Spiral Galaxy (B S G) in Draco, this turned out be a Faint Fuzzy Blob (F F B) just like C 4, the Iris Nebula (O C and Nebula) and C 5 (Spiral Galaxy (S G)). The first real gem was C 6 (Cat's Eye Nebula) a P N which looked like an out of focus star also in Draco. C 7 is an S G which looked like a Faint Blob to view. C 8 is an O C in Cassiopeia which is large and sparse to look at. The Cave Nebula also known as C 9 is a Bright Nebula to look at but to the eye was really F F B! C 10 was a nice O C to look at which could easy be in the Messier list? C 11 is an Emission Nebula also sitting in Cassiopeia, to the eye it was another F F B, the same could be said about C 12, an S G in Cepheus! Now we would be coming on to some nice objects to view, first up was C 13 the Owl Cluster always good to view! Probably the best object in his list for us in the UK is the Double Cluster in C 14; I had to change to a 50 mm eye piece to get both clusters in the telescope. C 15, the Blinking Planetary was like C 6 an out of focus star. A constellation I never really looked at contained the next object in C 16 (in Lacerta) an O C which was fair to look at, could not say anymore about this object really? C 17 and 18 are both Dwarf Spheroidal Galaxies and part of the Andromeda group of Galaxies, as usual with galaxies they were both F F B to look at! Staying within the arms of the Milky Way which goes from Cassiopeia to Cygnus and beyond my final two objects for the evening where found in Cygnus, C 19 is the Cocoon Nebula yet another O C with Nebula; this was an F F B to view. As for C 20 the North American Nebula I could not make it out at all, think I might be looking thru the Nebula as the magnification could be too great? Next time I do this list I will try again as it could be the viewing of the sky maybe?

It was now 21:35 and time to pack up as dew was covered the telescope and I was not wearing my winter viewing clothing and starting to feel the cool weather.

Clear skies.

Peter Chappell

Viewing Log for 4th of November

Yet another free night with clear skies so I thought I would have another viewing session, the previous one was only four nights ago which seems very close for me and viewing sessions?

I went along to my usual site at Uffcott and had the equipment set up and ready to go by 21:03, being a Friday night I hope not to have much traffic go by and ruin my night vision. If your eyes do see white light it can take around 20 minutes to get them back to seeing in the dark again? I would be carrying on with my Caldwell (C) list which I started last Monday. First objects to look at was Uranus and Neptune the two ice giants of the solar system, all I can see with these two objects is a steady point of light namely blue/green and blue!

My first target was C 20, the North American Nebula which I could not pick out last time! This Emission Nebula (E N) still would not give its self away, I think I must be looking thru the nebula probably need a wide field scope of around f6 and not the f10 scope I am using tonight? C 21 an Irregular galaxy (I G) is in Canes Venatici and below the horizon at the moment (the Caldwell list is done by declination with C1 the most northerly and C 109 the most southerly) so I will have to come back to this object later in the year or stay up later in the night! C 22 a Planetary Nebula (P N) is known as the Blue Snowball and has a blueish colour to it; it looks similar to M 57 (Ring Nebula in Lyra). It was not long before I got back to my non favourite Spiral Galaxy (S G) in C 23, the galaxy looked like a Faint Fuzzy Blob (F F B) which if you have read my reports before you know I do not get much if any detail from them! C 24 known as Perseus A is an I G and I was not sure if I could locate it? So this one I will have to come back to at a later date and hopefully bag it then? C 25 in the constellation of Lynx is the first Globular Cluster (G C) on this list, like most G C's it looks like a Fuzzy Blob (F B) to look at. C 26 is also in Canes Venatici so I cannot look at it tonight. C 27 the Crescent Nebula is an E N which I could not make out, so will have to try later on maybe with a slower scope? C 28 is a loose Open Cluster (O C) which looked better with a 40 mm eye piece instead of the 14 mm I normally use. C 29 in Canes Venatici so miss that one and bag C 30 instead, this S G had a bright core which made a nice

change for these galaxies J. The Flaming Star Nebula in Auriga is an Emission and Reflection Nebula around the star AE Aurigae, all I could see was a F F B in the sky! C 32 in Canes Venatici, as before! C 33 and 34 are the Veil Nebula in Cygnus, again I think my scope went thru this Supernova Remnant and might need a slower scope to view it? My final object of the night was C 37 in Vulpecula; this O C was similar to C 28 and best viewed with a 40 mm eye piece. By now Orion had cleared the eastern horizon so I had a quick look at M42 before packing up my gear at 22:18. This was the first time I had all of my winter gear on as my equipment had a frost covering it which would need to be dried out at home before putting away.

Clear skies.

Peter Chappell

Viewing Log for 7th of November

A half moon is about my limit for viewing the night sky as after that a lot of objects get washed out by the bright moonlight! As I had another free night and it was clear I thought I would have ago and see what I can view?

Turned up to my usual viewing spot at Uffcott and had my Meade LX 90 set up and ready to view by 20:22, again using a 14 mm Pentax WX eye piece giving me a magnification of about 143. Hopefully would not see much traffic, when I viewed here last Friday I only had one car go pass me in nearly two hours in the dark, let's hope for the same tonight! In the end two cars did go by me this evening.

First object on the Caldwell (C) list I could view tonight would be C 41, this is a large Open Cluster in Taurus, it looked better thru my finder scope as I could not fit all of it in my eye piece, it is also known as the Hyades a rival to the Pleiades (M 45) in the same constellation. C 42 is a Globular Cluster (G C) which looked like a Fuzzy Blob to view even with a half-moon nearby, maybe with no moon around this might be interesting to look at? C 43 is a Spiral Galaxy (S G) which had a bright dense core, also in Pegasus is C 44 a Barred Spiral Galaxy, this Faint Fuzzy Blob (F F B) was hard to make out! C 47 is a G C in Delphinus (a constellation I never really look at) was fairly bright even with a half-moon nearby! I was not sure if I could see C 51 an Irregular galaxy in Cetus, so I will have to come back to this one later on. C 55 is known as the Saturn Nebula, this Planetary Nebula (P N) looked good even within 5 ° of the moon J. The next P N was a F F B to look at in C 56, C 62 a S G was also a F F B to look at! C 63, the Helix Nebula is one of the nearest and brightest P N's to Earth?

C 63 looked like a large fuzzy patch to view, again better to look at on a moonless night? My final object on the Caldwell list for the evening was C 65, the Silver Coin Galaxy in Sculptor (yet another constellation I do not look at) a S G which as usual was a F F B to look at!

Had a quick look at Uranus, looked bright even with the moon nearby and finally Neptune before packing my gear up at 22:00. When I looked at the ground I could see my shadow very clearly do it will be a couple of weeks before I get my gear out again for viewing, assuming the sky is clear and I have a free evening?

Peter Chappell

Viewing Log for 28th of November

Yet another free evening and the sky was clear, so for the fourth time in November I would be going out and doing some viewing J.

As usual I went along to my usual viewing spot at Uffcott but this time I took out my Skywatcher EQ 3-2 Pro Mount instead of the Meade telescope. This EQ 3 mount also has GOTO installed so the only real different is the set-up of the kit and the hand controller. When I fired up the mount, the hand controller showed a date of 25th of March 2016, so it was just over eight months since this equipment last saw light! I had everything set up and ready to start by 19:45, with the EQ 3 mount I had attached a William Optics 80 mm refractor at f5.6 and a Televue 13 mm eye piece. Hopefully this time I would be able to see some of the Caldwell (C) objects I missed with the Meade?

My first object was Mars setting low on the south western horizon, Mars was out of view of the eye piece so I had to do some slight adjustment to be able to view it, no detail just a red object in the sky. Next target was Uranus but I could not find this planet at all, wondered if the set up was wrong? Turns out the mount were about 4 degrees below what it should be! So start again and this time get Polaris in the sites! After doing the set up again I was ready at 20:12.

Started off with Mars followed by Uranus and both of these objects were in the eye piece! Next object was Neptune before heading off to carry on the Caldwell list. First object was C20, the North American Nebula, unfortunately I could not find it, and so I tried a Deep Sky Filter to see if this would find it? I think I saw a faint glow but was not totally sure, so I have not claimed it just yet? The same was for the Crescent Nebula (C27), wondered if I need more light coming into my eyes? Might have to try with the 98 mm or 127 mm refractor at a later date?

So what do I look at with wide angle equipment set up? Open clusters (O C) maybe? First target was C13, the Owl Cluster in Cassiopeia, this cluster looked good but not that bright could make out the two bright stars that give this cluster its eyes! The Double Cluster (C14) looked just brilliant, might have been the best I have seen this O C? To get the Hyades in the eye piece I needed to change the 13 mm eye piece for the 31 mm Nagler as it was too large to view. M45, the Pleiades O C also in Taurus looked good. Tried M31 in Andromeda and probably for the first time I could see this entire large galaxy which is heading towards us at great speed. I was surprised I could see M44, the Beehive O C in Cancer, this cluster had just cleared some trees on the eastern horizon, yes winter is truly on its way if I can see this and not too late in the evening either! Final object of the evening was the Christmas Tree (AKA the Cone Nebula) cluster in Monoceros, unfortunately as before with Emission Nebulas namely C20, and C27, I could not make it out?

Time was now 21:36 and I was starting to get a bot cold, there was a nice layer of frost covering my equipment and car so I knew I would have to let all this dry over night before I could put them away correctly.

Home for a nice warm coffee.

Clear skies for 2017, hopefully?

Peter Chappell

From "Lyla", the Society's four-legged member - the real 'Black Dog'.

La Isla Bonita – under pristine skies,

Mike and I have just spent a relaxing 10 days on the beautiful island of La Palma (known locally as "La Isla Bonita"- the beautiful island) in the Canary Islands. Many people have never heard of it, and couldn't tell you where it is, Indeed, my friends on the island tell me some people arrive there thinking they are in Las Palmas, Gran Canaria and some even think they are in Palma de Mallorca!

Figure 1 The Canary islands Archipelago (Google Maps)

However, all of you astronomers will have heard of La Palma, as it is the home of the *Observatrio Roque de las Muchachos* (Rock of the Brothers) (ORM). This is because the island has some of the best astronomical viewing conditions anywhere in the World.

Figure 2 GRANTECAN & the Galileo telescopes at ORM

Many major telescopes, including, what is currently the largest, The Gran Telescopio de Canarias (GRANTECAN), a slightly bigger version of the Keck telescopes on Hawaii, with a 10.4 metre segmented mirror, as opposed to the 10 metre mirrors of the Kecks. Britain's premier instruments, the William Herschel Telescope (WHT) and the Isaac Newton Telescope (INT) are also sited there.

Figure 3 The Isaac Newton Group of Telescopes at ORM (ING)

Why La Palma? Well the island is smaller than the Isle of Wight, but taller than Ben Nevis. It even has its own rainforest! Like most of the Canaries, tourism plays a large part in its economy, but unlike the larger Canary islands, such as Tenerife, Gran Canaria or Lanzarote, on La Palma, tourism is on a small scale, deliberately so, because that's the way everybody wants it. It is like the Canaries used to be. For one thing, there is enough water for everyone, visitors and locals alike, no need for desalination plants producing undrinkable water only fit to shower in, no 'tea like mum makes' or embarrassing drunks in union jack shorts.

We did not get up to see the telescopes this trip, although we had hoped to. This was mainly a trip to start looking at property there – the old man and I want to retire there, but we took the binoculars with us. We were treated as ever to some absolutely pristine skies. Whilst most of you here in Britain were clouded out, freezing to death or struggling with light pollution, La Palma offers clear skies just about every night. Very little street lighting and even that is very strictly controlled to make sure its "sky friendly". There is no heavy industry allowed that might pollute the skies and aeroplanes are not allowed to overfly the island – by law. The locals are extremely proud that their little island is home of one of the World's premier astronomical sites. Even the tourists are encouraged to take a look through a telescope, in addition to ORM there are *miradors astronomicos* (astronomy viewpoints) are dotted throughout the island as shown on this board in Puerto Naos, one of the few tourist areas in La Palma.

Figure 4 Location board of observing sites on La Palma in Puerto Naos.

This brings me on to the main topic of this piece. Just before we left for La Palma, some potentially exciting news broke. At the end of this decade and the early part of next, some exciting new telescopes are scheduled to come on stream. In 2018 the long-awaited replacement for the venerable Hubble Space Telescope (HST), the James Webb Space Telescope (JWST) is due to launch. Personally, I'm not holding my breath for this one, given its previous tortuous history. On the ground two new enormous new telescopes are due to come into service, three times the size of anything we currently have available.

Slightly the larger of the two is the European Extremely Large Telescope (E-ELT). This is scheduled to be built at the European Southern Observatory (ESO) at La Scilla in the Atacama Desert of Northern Chile. It will have a segmented mirror of 39.3 metres (129 feet) in diameter. It will have an angular resolution of 0.001-0.65 arcsec, a collecting area of 978 m^3, adaptive optics and a Nasmyth mount. It will probably eventually be named, probably after some Italian or German scientist, as is usual for European projects (what about the Brits!), and is scheduled for first light in 2024.

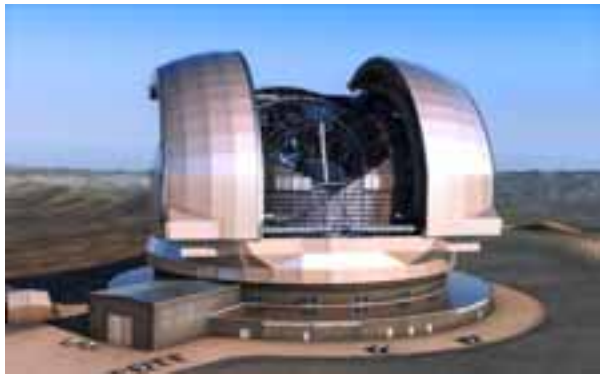


Figure 5 Artists impression of E-ELT (ESO)

The second of these monsters will be the Thirty Metre (sorry, Meter – it's manly American) Telescope (TMT), which is a Ritchey-Chrétien type telescope. It will also have a segmented mirror of 30 metres (98 feet), a collection area of 655 $m^3$and an altazimuth mount. The TMT was always intended to go to Mauna Kea in Hawaii, alongside the Kecks. Alas, there is a snag. The dome – somehow the word seems inadequate – to house this beast will be the size of an 18-story building. A permit to build was granted by the authorities in April 2013 and construction was due to start in October 2014. However, to some native Hawaiians, Mauna Kea is their sacred mountain and they have long protested that the telescopes on the top of the mountain are a 'desecration.' The fact that it is the best astronomical viewing site in the northern hemisphere means nothing to them. They were promised that TMT would be the last telescope that would ever be built there (Yeah, Right!) and that two older telescopes at the site would be de-commissioned. When construction was due to start they laid down in front of the bulldozers. Construction was deferred twice, but the protesters would not be budged. Then to cap it all, the Hawaii State Appeal Court ruled on the 24th June 2015 that when the original building permits were issued, 'due process' was not followed and the permits were duly cancelled.

Figure 6 Artists impression of the TMT (TMT)

Of course, other segments of the TMT project, including the telescope itself, have proceeded on schedule and the nightmare scenario of having a huge 'state of the art telescope' with nowhere to put it looms large. You cannot just stick it on tripod in your back garden! So in early 2016 the International Observatory Board (IOB), the committee running the project, reluctantly decided to look at alternative sites. A shortlist of eight possible alternative sites was drawn up

Roque de los Muchachos, la Palma, Canary islands, Spain;

Cerro Amazones, Antofagasta region, Chile;

Cerro Tolanchar, Antofagasta region, Chile;

Cerro Tolar, Antofagasta region, Chile;

San Pedro Mátir, Baja California

Hanie, Jammu and Kashmir, India.

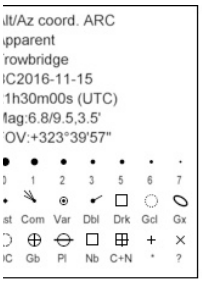
The astronomical community quickly pointed out that to have both of these massive instruments in the Southern Hemisphere made no sense – some 40% of the sky would be invisible to both of them. The sites in South America and India were also 'virgin' sites, with none of the infrastructure needed to support them, such as roads, IT and accommodation for personnel etc., all of which would have to be built, thus adding to the cost – ORM already has these. ORM is at a lower elevation than Mauna Kea (2,423m – 7,949ft. as opposed to 4,207m - 13,802ft.) and there was some concern that the performance of the TMT would be compromised by the increased atmospheric absorbtion, however, this is only marginal and ORM does not have not have a problem that afflicts Mauna Kea, the altitude makes living there very difficult due to the thin atmosphere and the consequently reduced partial pressure of oxygen and hypoxia is a concern for some of the scientist visiting (even in these days where you can observe from the comfort of your office, some astronomers still would rather be at the telescope). In any event the IOB determined that all of the alternative sites would allow TMT to carry out its declared scientific objectives.

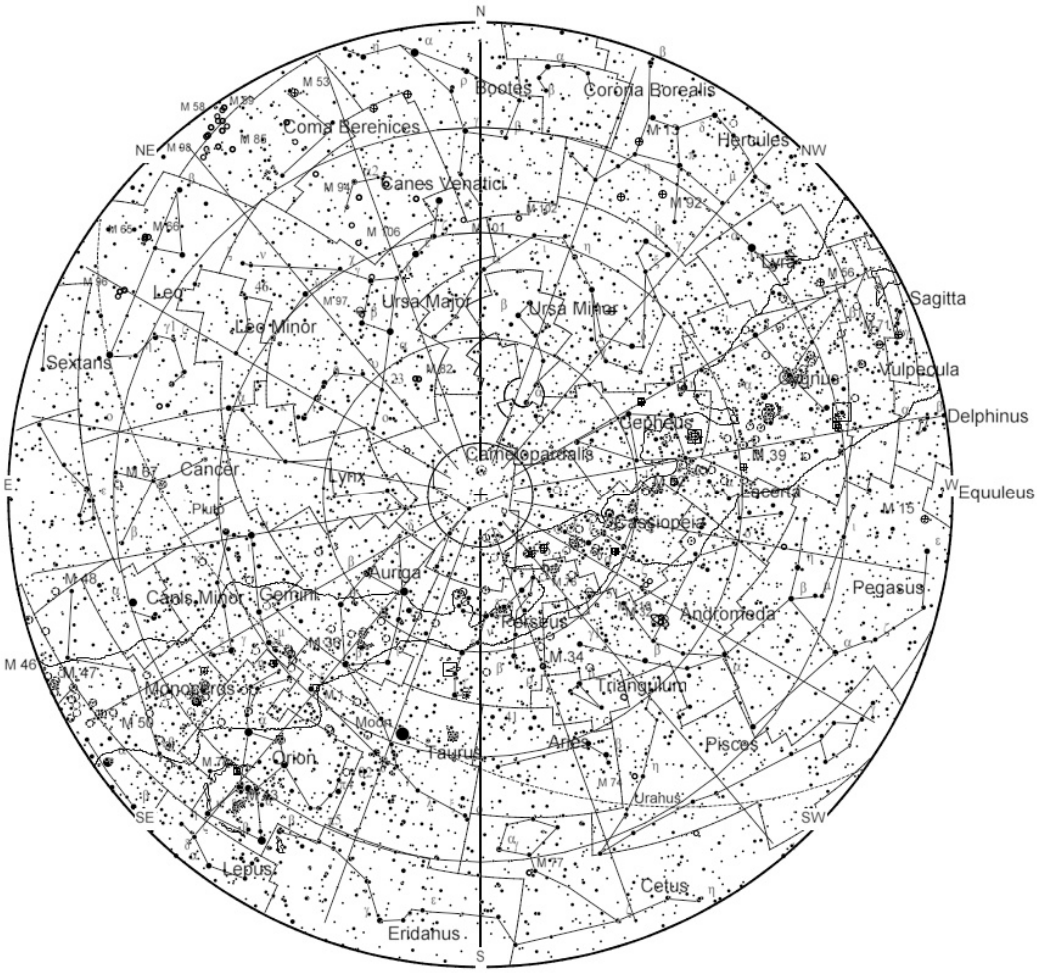
So it was announced in November 2016 that ORM had been chosen as the alternative site. The primary site remains Mauna Kea and a final decision by the Hawaii Supreme Court is awaited, but this has to be made soon, the IOB has stated that early in 2017, they will have to make the decision and press ahead with construction of the dome. I suspect this is mainly to put pressure on the Hawaiians to ask themselves the question 'do you really want to throw away a $1.4 Billion investment for a few idiots that want to live in the Stone Age'?

I really hope this project comes to La Palma, the Spanish dealt with the problem of 'revolting peasants' in the 16th Century – they simply slaughtered all the natives! Whilst I doubt that this would be approved practice in these 'politically correct' days, there is no doubt it was very effective! There are no dissenting voices on La Palma – they would welcome TMT. $1.4 Billion- bring it on!

Hi Andy,
Jonathan Gale has suggested that I send you the attached photo of the moon taken through my birdwatching scope at about 0700 on 16th November.
Best Wishes John Osborne

WHATS UP, DECEMBER 2016





December 11 - **Mercury at Greatest Eastern Elongation.** The planet Mercury reaches greatest eastern elongation of 20.8 degrees from the Sun. This is the best time to view Mercury since it will be at its highest point above the horizon in the evening sky. Look for the planet low in the western sky just after sunset.

December 13, 14 - **Geminids Meteor Shower.** The Geminids is the king of the meteor showers. It is considered by many to be the best shower in the heavens, producing up to 120 multicolored meteors per hour at its peak. It is produced by debris left behind by an asteroid known as 3200 Phaethon, which was discovered in 1982. The shower runs annually from December 7-17. It peaks this year on the night of the 13th and morning of the 14th. The nearly full moon will block out many of the fainter meteors this year, but the Geminids are so bright and numerous that it could still be a good show. Best viewing will be from a dark location after midnight. Meteors will radiate from the constellation Gemini, but can appear anywhere in the sky.

December 14 - **Full Moon, Supermoon.** The Moon will be located on the opposite side of the Earth as the Sun and its face will be will be fully illuminated. This phase occurs at 00:06 UTC. This full moon was known by early Native American tribes as the Full Cold Moon because this is the time of year when the cold winter air settles in and the nights become long and dark. This moon has also been known as the Full Long Nights Moon and the Moon Before Yule. This is also the last of three supermoons for 2016. The Moon will be at its closest approach to the Earth and may look slightly larger and brighter than usual.

December 21 - **December Solstice.** The December solstice occurs at 10:44 UTC. The South Pole of the earth will be tilted toward the Sun, which will have reached its southernmost position in the sky and will be directly over the Tropic of Capricorn at 23.44 degrees south latitude. This is the first day of winter (winter solstice) in the Northern Hemisphere and the first day of summer (summer solstice) in the Southern Hemisphere.

December 21, 22 - **Ursids Meteor Shower.** The Ursids is a minor meteor shower producing about 5-10 meteors per hour. It is produced by dust grains left behind by comet Tuttle, which was first discovered in 1790. The shower runs annually from December 17-25. It peaks this year on the the night of the 21st and morning of the 22nd. The second quarter moon will block many of the fainter meteors. But if you are patient, you might still be able to catch a few of the brighter ones. Best viewing will be just after midnight from a dark location far away from city lights. Meteors will radiate from the constellation Ursa Minor, but can appear anywhere in the sky.

December 29 - **New Moon.** The Moon will located on the same side of the Earth as the Sun and will not be visible in the night sky. This phase occurs at 06:53 UTC. This is the best time of the month to observe faint objects such as galaxies and star clusters because there is no moonlight to interfere.

THE GEMINIDS METEOR SHOWER

by David Dickinson

One of the best yearly meteor showers contends with the nearly Full Moon this year, but don't despair; you may yet catch the Geminids.

The Geminid meteor shower peaks next week on the evening of Tuesday night into Wednesday morning, December 13th/14th. The Geminids are always worth keeping an eye on in early through mid-December. As an added bonus, the radiant also clears the northeastern horizon in the late evening as seen from mid-northern latitudes. The Geminids are therefore also exceptional among meteor showers for displaying early evening activity.

The Geminid radiant, looking east around 11 PM local on the evening of December 13th. Note the nearby Moon in the same constellation. Image credit: Stellarium.

First, though, here is the low down of the specifics for the 2016 Geminids: the Geminid meteors are expected to peak on December 13th/14th at midnight Universal Time (UT), favoring Western Europe. The shower is active for a two week period from December 4th to December 17th and can vary with a Zenithal Hourly Rate (ZHR) of 50 to 80 meteors per hour, to short outbursts briefly topping 200 per hour. In 2016, the Geminids are expected to produce a maximum ideal ZHR of 120 meteors per hour. The radiant of the Geminids is located at right ascension 7 hours 48 minutes, declination 32 degrees north at the time of the peak, in the constellation of Gemini.

The Moon is a 98% illuminated waning gibbous just 20 degrees from the radiant at the peak of the Geminids, making 2016 an **unfavorable year** for this shower. In previous years, the Geminids produced short outbursts topping 200 per hour, as last occurred in 2014.

The Geminid meteors strike the Earth at a relatively slow velocity of 35 kilometers per second, and produce many fireballs with an *r* vaule of 2.6. The source of the Geminid meteors is actually an asteroid: 3200 Phaethon.

The orientation of the radiant versus the Sun, Moon and Earth's shadow just past midnight Universal Time on the evening of December 13th/14th. (Created using Orbitron).

A moderate shower in the late 20th century, the Geminids have increased in intensity during the opening decade and a half of the 21st century, surpassing the Perseids for the title of the top annual meteor shower.

The orbit of 3200 Phaethon. Image credit: NASA JPL.

The Geminid shower seems to have breached the background sporadic rate around the mid-19th century. Astronomers A.C. Twining and R.P. Greg observing from either side of the pond in the United States and the United Kingdom both first independently noted the shower in 1862.

Orbiting the Sun once every 524 days, 3200 Phaethon wasn't identified as the source of the Geminids until 1983. The asteroid is still a bit of a mystery; reaching perihelion just 0.14 astronomical units (AU) from the Sun, (interior to Mercury's orbit) 3200 Phaethon is routinely baked by the Sun. Is it an inactive comet nucleus? Or a 'rock comet' in a transitional state?

Observing meteors is as simple as setting out in a lawn chair, laying back and watching with nothing more technical than a good ole' Mk-1 pair of human eyeballs. Our advice for 2016 is to start watching early, like say this weekend, before the Moon reaches Full on Wednesday, December 14th. This will enable you to watch for the Geminids after morning moonset under dark skies pre-peak, and before moonrise on evenings post-peak.

Two other minor showers are also active next week: the Coma Bernicids peaking on December 15th, and the Leo Minorids peaking on December 19th. If you can trace a suspect meteor back to the vicinity of the Gemini 'twin' stars of Castor and Pollux, then you've most likely spied a Geminid and not an impostor.

And speaking of the Moon, next week's Full Moon is not only known as the Full Cold Moon (For obvious reasons) from Algonquin native American lore, but is also the closest Full Moon to the December 21st, northward solstice. This means that next week's Full Moon rides highest in the sky for 2016, passing straight overhead for locales sited along latitude 17 degrees north, including Guatemala City and Mumbai, India.

A 2015 Geminid over Sariska Palace in Rajastan, India. Image credit and copyright: Abhinav Singhai.

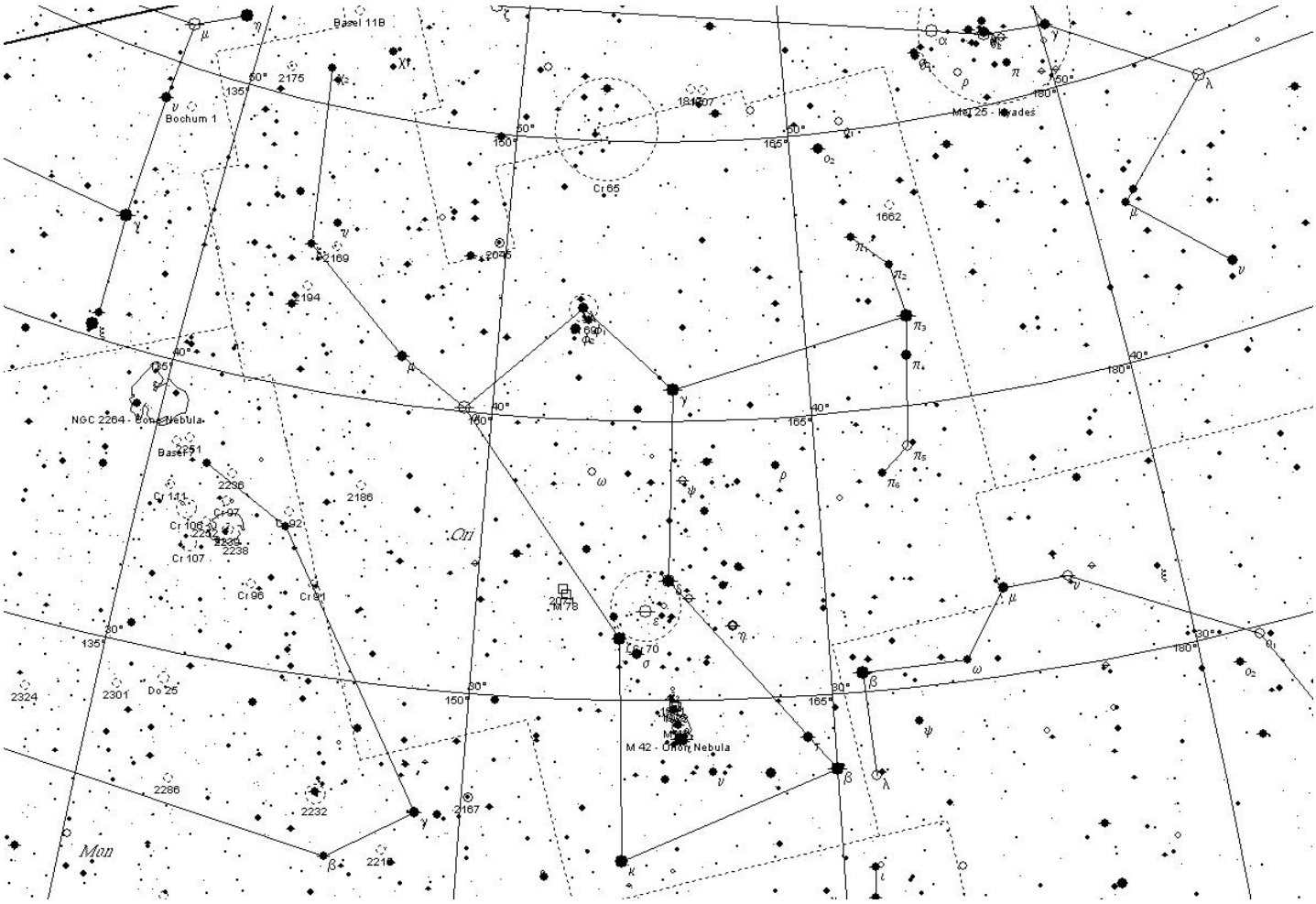
Photographing the Geminids is also as simple as setting a camera on a tripod and taking wide-field exposures of the sky. We like to use an intervalometer to take automated sequences about 30 seconds to 3 minutes in length. Said Full Moon will most likely necessitate shorter exposures in 2016. Keep a fresh set of backup batteries handy in a warm pocket, as the cold December night will drain camera batteries in a pinch.

Looking to contribute some meaningful scientific observations? Report those meteor counts to the International Meteor Organization.

Our humble meteor imaging rig. Credit: Dave Dickinson.

And although the Geminids might be a bust in 2016, another moderate shower, the Ursids has much better prospects right around the solstice…

CONSTELLATIONS OF THE MONTH: ORION



Orion is the master of the winter skies. He lords over the heavens from late fall to early spring, with his hunting dog Sirius trailing at his feet.

The mythic tales of Orion go as far back as the Hittites, who flourished from the Second Millenium BC to around 1200 BC.

One story from this culture gives an interesting account of Orion's death. Here he is called Aqhat, and was a handsome and famous hunter. The Battle-Goddess Anat fell in love with Aqhat, but when he refused to lend her his bow, she sent another man to steal it. This chap bungled the job, and wound up killing Aqhat and dropping the bow into the sea. This is said to explain the astronomical fact that Orion and the Bow (an older version of the constellation) drops below the horizon for two months every spring.

Like all myths borrowed from several sources over a great length of time, the Greek stories offer many variations. Generally speaking, Orion was known as the "dweller of the mountain", and was famous for his prowess both as a hunter and as a lover. But when he boasted that he would eventually rid the earth of all the wild animals, his doom may have been sealed.

It might have been the Earth Goddess herself who sent the deadly scorpion to Orion. Or possibly Apollo, concerned that Orion had designs on his sister, Artemis. Thus Apollo may have told the Earth Goddess of Orion's boast. In any case, it seems clear that it was the Earth Goddess who sent the scorpion on its mission.

Some stories have the scorpion killing Orion with its sting. However the general consensus is that he engaged the scorpion in battle but quickly realised its armour was impervious to any mortal's attack. Orion then jumped into the sea and swam toward Delos. But Apollo had witnessed Orion's struggle with the scorpion and would not let him escape so easily. He challenged his sister Artemis, who was an excellent shot, if she could hit that small black object far away in the sea, the head -- he told her -- of an infamous and treacherous villan. Artemis struck the object with her first shot. She then swam out to retrieve her victim's corpse, and discovered she had killed Orion. Artemis implored the gods to restore his life, but Zeus objected. So she put Orion's image in the heavens.

In his eternal hunting, Orion is careful to keep well ahead of the scorpion. In fact Orion has disappeared over the horizon by the time Scorpio rises in the east, as it becomes his turn to rule the evening sky.

Finding Orion should be no problem. Its stars are some of the most familiar in all the heavens. Question: can you name the three stars that make up Orion's Belt. (Answer below.)

Above the belt, slightly to the left, is *Betelgeuse, alpha Orionis.*

Betelgeuse, the right arm of Orion (or "armpit" as the name suggests), glows with a dull red. Although labelled *alpha Orionis*, it is less bright than *beta Orionis* (Rigel), in the opposite corner of the constellation, to the southwest. Yet if slightly less bright, it is much larger, estimated at around 250 Suns. If one were to replace our Sun with Betelgeuse, its size would completely engulf the Earth and extend as far as Mars.

As the brightest star in Orion, *Rigel* ranks as the seventh brightest star in all the heavens, just behind Capella. It is a visual binary; its companion is much fainter, but quite visible if you are persistent enough (PA 202º, 9.4").

The other corners of the constellation are formed by *Bellatrix (gamma Orionis)* and *Saiph (kappa Orionis)*. It was once thought that all women born under the sign of Bellatrix would be fortunate and have the gift of speech. The star's name is often translated as Female Warrior or Amazon, and another name sometimes seen is "Amazon Star".

The constellation's main feature is of course the three stars which form the "belt" across the middle of Orion: from west to east *Mintaka, Alnilam,* and *Alnitak*. Even the Bible makes reference to this famous group. God, while pointing out how all-powerful he was, is purported to have asked Job if he

(Job) was able to "loose the bands of Orion" (*Job* 38.31).

The last of these stars is also known as *zeta Orionis*, and is a well known triple star system. The primary is a blue-white star, and its companion (165º, 2.3") is a dull red. Close by, just to the south, is the renowned Horsehead Nebula, a so-called dark nebula that is not visible in scopes but quite spectacular in long-exposure photographs.

Binary stars in Orion:

There are many double stars in this constellation visible in small telescopes. Below are several selected from a wide list.

Beta Orionis (Rigel) has a 10.4 visual magnitude companion at 202º and a wide 9.5" separation. This is a fixed system.

Lambda Orionis (between Betelgeuse and Bellatrix) is another fixed binary, with a 5.5 companion at PA 43º and 4.4" away.

Theta[1] is a complex system of fixed stars. The four brightest form The Trapezium, an outstanding multiple system for small telescopes. AB is at a position angle of 32º and separation 8.8", AC: PA 132º, 12.7", and AD: PA 96º, 21.5".

Theta[2] is also a fine binary, a triple system to the south-east of The Trapezium. Component B is a binocular object: 6.4 magnitude at a position angle of 92º and separation 52.5". Component C (8.5) is even wider: PA 98º and separation 128.72".

Sigma Orionis is one of the few orbiting binaries found in Orion. Component B has an orbit of 158 years and is one of the few components that traces a not-quite-perfect circle. That's to say, we see it nearly face on, as a wheel spinning around its hub.

The separation never changes much from its current distance of only 0.2". Its 2000.0 position angle is 132º.

Much easier to resolve is component E, with a visual magnitude of 6.7, this is a binocular object at a position angle of 61º and separtion of 42".

Zeta Orionis (1.9, 4.0) has a very slow orbit of 1509 years, and is currently at 165º and 2.3" separation.

Variable stars in Orion:

A dozen stars in this constellation are visible in small scopes, but most of them are of the EA type of eclipsing binaries, which change very little. These include two stars of the Trapezium (theta 1A and 1B).

EA variables are old stars, nearing the end of their evolutionary process. The companion has grown to the size of a subgiant, perhaps equal in size to its primary. But their luminosities are quite different; thus, as the dimmer companion revolves around its primary, variations in the total brightness occur.

The maximum brightness occurs of course when the two are not eclipsed, with each one adding its luminosity to the total output. Two minima also occur: the principal minimum is when the companion blocks out the primary; while a secondary minimum occurs when the companion is eclipsed by the primary.

The only interesting Mira-type regular variable is *U Orionis*, which usually has a brightness of 4.8 but every 368.3 days it drops down to 13. In 2000 the minimum is scheduled to occur on 5 December.

Deep Sky Objects in Orion:

M42, The Orion Nebula is perhaps the most photographed deep sky object in the heavens, a vast nebula of gas and dust exquisitely lit by surrounding stars.

This is a celestial nursery; soon (that's to say, in several hundred million years) young stars will appear from this wealth of cosmic matter.

Inside the nebula is the fascinating four-star system known as *The Trapezium*: theta 1A, 1B, 1C, and 1D - four stars held together by common gravity (actually at least two other stars are part of this complex system.) They are visible in medium sized telescopes and, with the nebula, form one of the most beautiful binary systems in the heavens.

M43 (NGC 1982) is a detached part of the Orion Nebula, with a ninth magnitude central star. A dark lane of gas separates M43 from M42, although the two are actually part of the same vast cloud.

M78 (NGC 2068) is a faint reflection nebula NE of Alnitak (zeta Ori), that looks best in long-exposure photographs.

The Horsehead Nebula is an intriguing and devilishly difficult dark nebula found just between zeta Orionis and sigma Orionis, visible in medium to large telescopes given the right sky conditions. An H-Beta filter is also helpful.

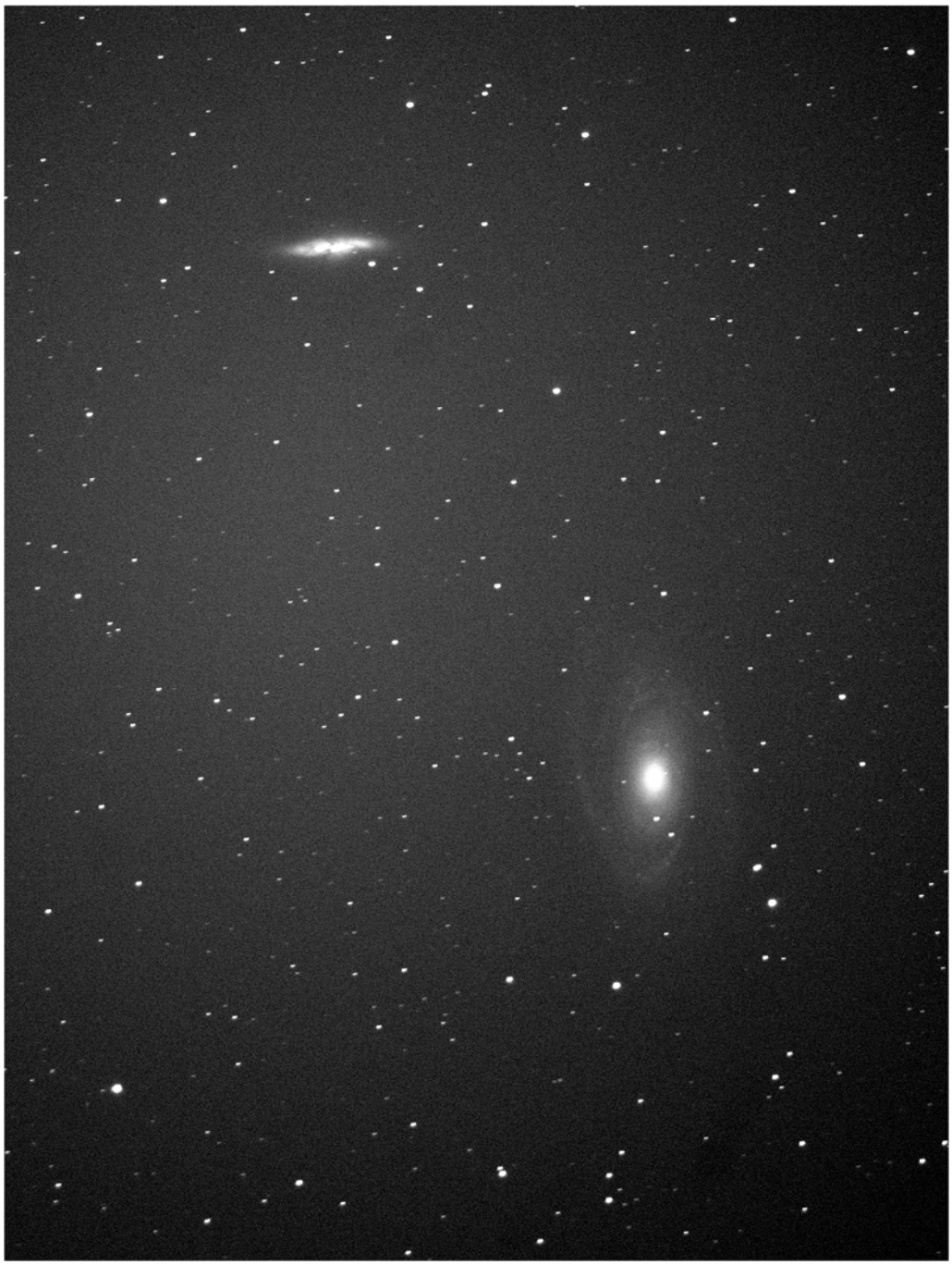
Upcoming Local Astronomy Events.

Our programme for next year is to start as follows:

Fri 6 Jan 17	7.30 pm	Elwin	Dr Hendrik van Eerten	Understanding Cosmic Explosions: gamma-ray bursts and other violent phenomena in astrophysics	University of Bath
Fri 3 Feb 17	7.30 pm	Elwin	Prof Graham Machin	Mercury rising - measuring temperature through time	NPL
Fri 3 Mar 17	7.30 pm	Elwin	Prof Carole Mundell	TBD	University of Bath
Sat 4 Mar 17	Morning	Duncan	WHS AGM		

Hope to see you there!

Tony Symes



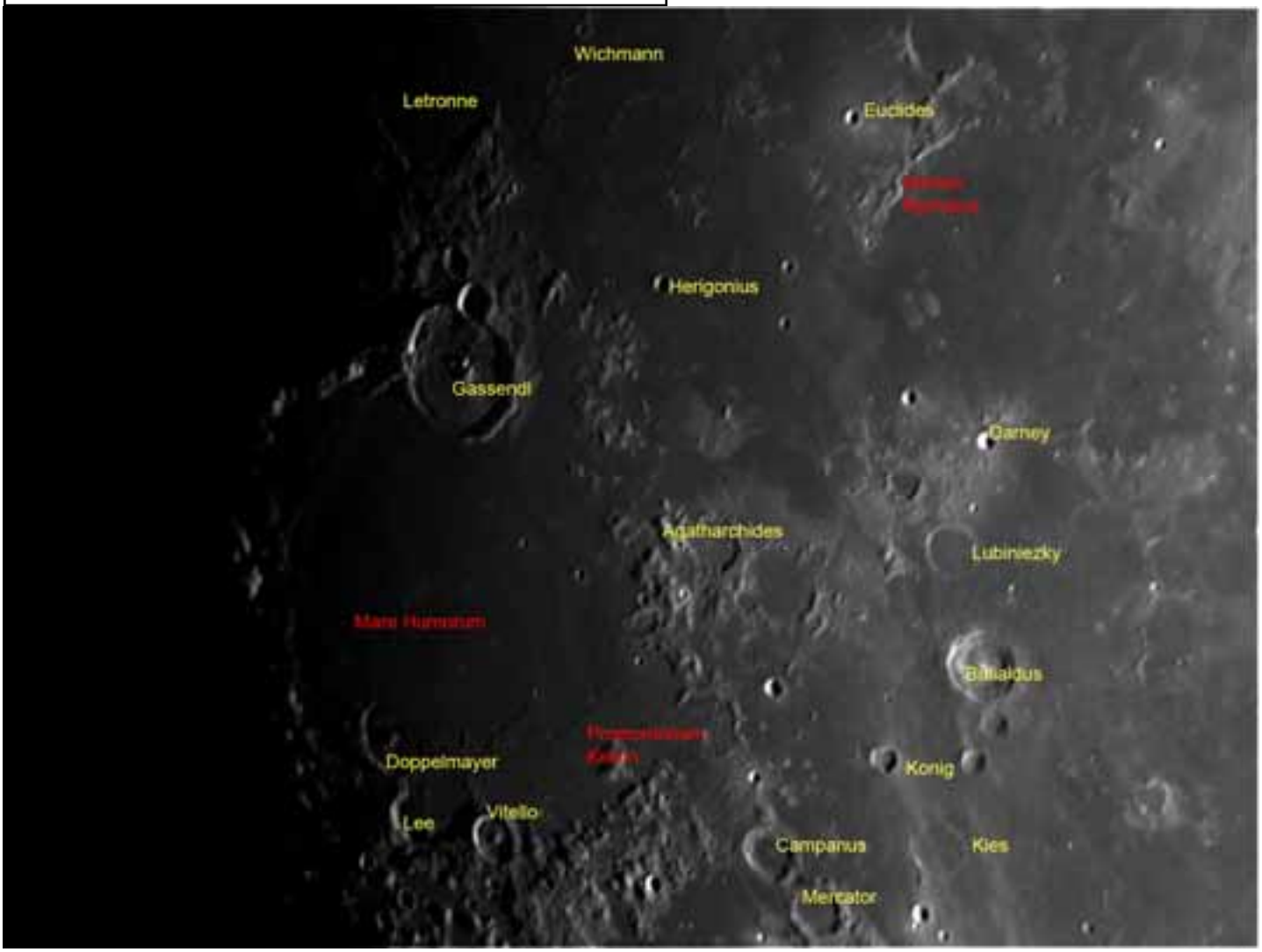
M81 Bodes galaxy and the Cigar galaxy M82, two galaxies that have moved close to each other in the last billion years, ripping the central core of the smaller Cigar galaxy into turmoil, exposing and feeding its central black hole.

ISS PASSES For November - mid December2016 From Heavens Above website maintained by Chris Peat

Date	Brightness	Start	Highest point		End					
	(mag)	Time	Alt.	Az.	Time	Alt.	Az.	Time	Alt.	Az.
05 Dec	-2.9	18:00:38	10°	SW	18:03:49	48°	SSE	18:04:10	45°	SE
06 Dec	-2.2	17:08:57	10°	SW	17:11:58	33°	SSE	17:14:17	15°	E
06 Dec	-1.6	18:44:58	10°	W	18:46:58	34°	WSW	18:46:58	34°	WSW
07 Dec	-3.3	17:53:01	10°	WSW	17:56:18	72°	SSE	17:57:03	49°	E
07 Dec	0.2	19:29:30	10°	W	19:29:43	12°	W	19:29:43	12°	W
08 Dec	-2.9	17:01:07	10°	WSW	17:04:21	54°	SSE	17:07:06	13°	E
08 Dec	-2.0	18:37:29	10°	W	18:39:46	41°	W	18:39:46	41°	W
09 Dec	-3.4	17:45:28	10°	W	17:48:47	90°	NNW	17:49:49	41°	E
09 Dec	0.0	19:22:00	10°	W	19:22:30	14°	W	19:22:30	14°	W
10 Dec	-3.2	16:53:28	10°	WSW	16:56:46	78°	SSE	16:59:53	11°	E
10 Dec	-2.5	18:29:58	10°	W	18:32:33	51°	W	18:32:33	51°	W
11 Dec	-3.4	17:37:56	10°	W	17:41:14	85°	N	17:42:37	33°	E
11 Dec	-0.3	19:14:27	10°	W	19:15:17	16°	W	19:15:17	16°	W
12 Dec	-3.3	16:45:52	10°	W	16:49:11	87°	N	16:52:30	10°	E
12 Dec	-3.0	18:22:24	10°	W	18:25:23	65°	WSW	18:25:23	65°	WSW
13 Dec	-3.3	17:30:20	10°	W	17:33:39	87°	S	17:35:32	24°	ESE
13 Dec	-0.6	19:06:56	10°	W	19:08:13	20°	W	19:08:13	20°	W
14 Dec	-3.3	16:38:15	10°	W	16:41:34	86°	N	16:44:53	10°	E
14 Dec	-2.6	18:14:47	10°	W	18:17:59	48°	SSW	18:18:27	44°	S
15 Dec	-3.0	17:22:41	10°	W	17:25:58	65°	SSW	17:28:48	13°	ESE
15 Dec	-0.7	18:59:35	10°	W	19:01:30	19°	SW	19:01:30	19°	SW
16 Dec	-1.5	18:07:13	10°	W	18:10:08	29°	SSW	18:12:00	17°	SSE
17 Dec	-2.1	17:15:01	10°	W	17:18:10	42°	SSW	17:21:18	10°	SE
17 Dec	-0.1	18:53:13	10°	WSW	18:53:59	11°	SW	18:54:46	10°	SSW
18 Dec	-0.4	17:59:55	10°	W	18:02:08	17°	SW	18:04:20	10°	S
19 Dec	-0.9	17:07:25	10°	W	17:10:12	25°	SSW	17:12:58	10°	SSE
21 Dec	0.0	17:00:14	10°	WSW	17:02:05	14°	SW	17:03:57	10°	S
29 Dec	0.5	06:52:26	10°	SE	06:52:48	10°	SE	06:53:11	10°	SE
31 Dec	-0.5	06:42:00	10°	S	06:44:23	19°	SE	06:46:47	10°	E
01 Jan	-0.2	05:50:59	10°	SSE	05:52:21	12°	SE	05:53:43	10°	ESE
01 Jan	-2.2	07:25:05	10°	SW	07:28:14	46°	SSE	07:31:23	10°	E
02 Jan	-1.6	06:33:05	10°	SW	06:36:02	32°	SSE	06:39:00	10°	E
03 Jan	-1.1	05:42:50	19°	S	05:43:54	22°	SE	05:46:28	10°	E
03 Jan	-3.1	07:16:45	10°	WSW	07:20:00	70°	SSE	07:23:16	10°	E
04 Jan	0.0	04:53:05	12°	ESE	04:53:05	12°	ESE	04:53:37	10°	ESE
04 Jan	-2.7	06:25:46	20°	SW	06:27:44	52°	SSE	06:30:56	10°	E
05 Jan	-1.9	05:35:50	35°	SE	05:35:50	35°	SE	05:38:32	10°	E
05 Jan	-3.4	07:08:31	10°	W	07:11:48	89°	S	07:15:05	10°	E
06 Jan	0.2	04:45:46	11°	E	04:45:46	11°	E	04:46:02	10°	E
06 Jan	-3.3	06:18:26	40°	WSW	06:19:27	76°	SSE	06:22:43	10°	E
07 Jan	-1.7	05:28:16	34°	E	05:28:16	34°	E	05:30:21	10°	E
07 Jan	-3.4	07:00:55	15°	W	07:03:34	84°	N	07:06:51	10°	E
08 Jan	-3.5	06:10:41	61°	W	06:11:11	88°	N	06:14:27	10°	E
09 Jan	-1.2	05:20:23	28°	E	05:20:23	28°	E	05:22:04	10°	E
09 Jan	-3.4	06:53:02	19°	W	06:55:17	88°	S	06:58:33	10°	E
10 Jan	-3.5	06:02:42	78°	WNW	06:02:52	85°	N	06:06:09	10°	E
11 Jan	-0.9	05:12:21	23°	E	05:12:21	23°	E	05:13:44	10°	E
11 Jan	-3.2	06:45:00	22°	W	06:46:55	68°	SSW	06:50:10	10°	ESE
12 Jan	-3.4	05:54:38	81°	SE	05:54:38	81°	SE	05:57:47	10°	ESE
12 Jan	-2.0	07:27:50	10°	W	07:30:45	30°	SSW	07:33:40	10°	SE

Nothing on Christmas Eve...

END IMAGES, OBSERVING AND OUTREACH



.The Mare Humorium part of the Moon with named featured. Imaged using DMK webcam on Televue 127mm with 5x powermate. Andy Burns

Date	Moon Phase	Observing Topic
2016		
Tuesday 13th / Wednesday 14th December	*Full*	*Geminids meteors*
Friday December 30th	Waxing crescent (Sets 6 pm)	Deep Sky & Lunar targets (Xmas session, meet at 6pm)
2017		
Friday 27th January	New Moon	Deep Sky
Friday 24th February	Waning crescent (sets 3pm)	Deep Sky
Friday 24th March	Waning crescent (sets around 2pm)	Deep Sky
Friday 28th April	Waxing crescent (sets 11pm)	Deep Sky & Lunar targets
Friday 26th May	Waxing crescent (sets around 10pm)	Deep Sky & Lunar targets

OUTREACH ACTIVITIES

Early January 2017? Star Gazing Live

Still awaiting clear Thursday to tie in with Chippenham Scouts.

January 26th Lacock Positives Photographic Society Talk.

Paragon School, Bath February 7th or 14th depending on weather.