NWASNEWS

Volume25, Issue 4

December 2019

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Seasons Greeting to you all

Forgot at the last meeting that December brings the festive cheer, and the need for suitable vitals at the meeting. But we should be ready. So happy Christmas to you all.

We will not be joined by our stalwart member Philip Proven, I'm afraid his heart pacemaker is again causing problems due to infection and he is now having a replacement fitted. He claims he is well despite that, but will not be with us until the new year. I sure you are all happy for me to pass on our best wishes for a speedy recovery.

We had a great turn out with many solar viewing types available at the Monday transit of Mercury viewing session with many members of the public coming along for a view through the telescopes.

Great so many of you were happy to share the experience.

Don't forget our Christmas viewing session on Friday 27th, and it starts at 6:30 pm so families are very welcome (weather permitting).

Clear skies Andy Burns.

From Peter Chappell visit to try out imaging and processing with Chris Brooks at my observatory last Friday.

We were trying first light through the Optolong L enhance filter and really helps picking up other wise faint hydrogen clouds that are in an excited state (from starbirth etc).

Not suitable for all subjects and it does demand long or multiple exposures.. Here high ISO is visible as grain.

Canon D600 APS-C size imaging chip.

Andy

Wiltshire Society Page

Wiltshire Astronomical Society

Web site: www.wasnet.org.uk

Facebook members page: https://www.facebook.com/groups/wiltshire.astro.society/

Meetings 2018/2019Season.

NEW VENUE the Pavilion, Rusty Lane, Seend

Meet 7.30 for 8.00pm start

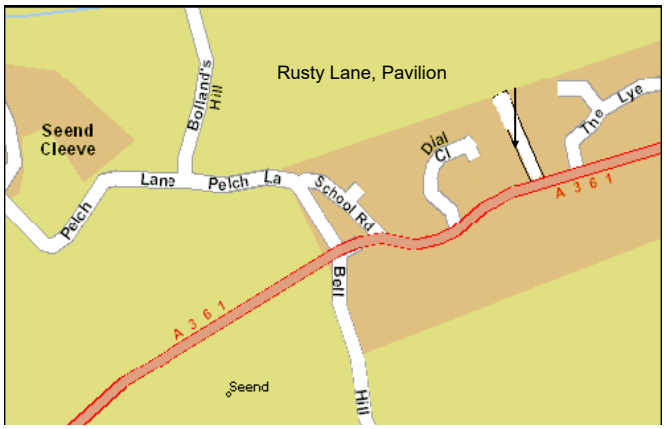
Membership Meeting nights £1.00 for members £3 for visitors

Wiltshire AS Contacts

Andy Burns Chair, anglesburns@hotmail.com
Andy Burns Outreach and newsletter editor.
Bob Johnston (Treasurer) Debbie Croker (vice Treasurer)
Philip Proven (Hall coordinator) Dave Buckle (Teas)
Peter Chappell (Speaker secretary)
Nick Howes (Technical Guru)
Observing Sessions coordinators: Chris Brooks, Jon Gale,
Web coordinator: Sam Franklin
Contact via the web site details.

NEW SEASON 2019/2020

3rd Dec Dr Dirk Froebrich 'Making Stars and Planets – The Hoys-Caps Citizen Science Project'.
2020
7th Jan Open Forum/Beginners Meeting.
4th Feb Jon Gale 'Observing the Herschel 400'.
3rd Mar Dr Lilian Hobbs 'Armchair Messier Marathon'.
7th Apr Pete Williamson 'The Moon and Moons of the Solar System'.
5th May Martin Griffiths 'The Habitable Zone – What is it and How is it determined'.
2nd Jun Paul Money 'Triumphs of Voyager (part 2) – Where no probe has gone before'.



Dr Dirk Froebrich

After completing his degree in Physics at the Universität Leipzig in Germany, Dr Dirk Froebrich went on to study for his PhD at the Universität Jena. From Germany, he moved to a researcher position at the Dublin Institute for Advanced Studies and was appointed Lecturer in Astronomy/Astrophysics at the University of Kent in 2009.

Research interests

Dr Dirk Froebrich's main research areas are young protostars and their outflows, structure and properties of molecular clouds and the formation and evolution of star clusters.
More detailed information on Dirk's research can be found at the research website link above.

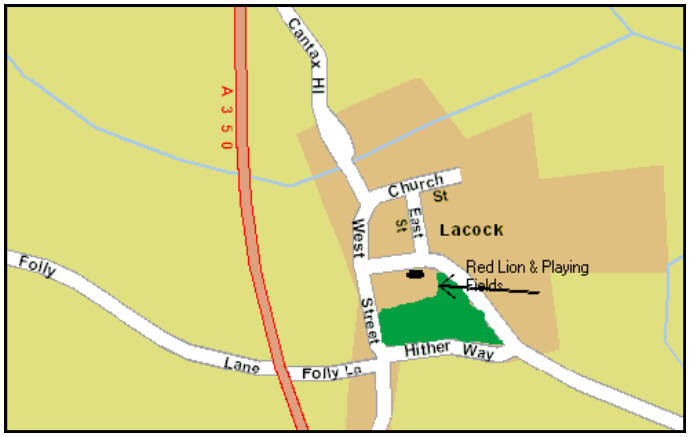
Teaching

Dirk teaches on a range of astrophysics and astronomy modules including atomic physics, cosmology and the interstellar medium, and the multiwavelength universe and exoplanets.

Publications

Showing 5 of 87 total publications in the Kent Academic Repository

Observing Sessions see back page



Members for sale/wanted

Hi Andy. I tried to put my for sale stuff on the web page but was unavailable.

Briefly this is. For sale. I EQ6pro. Go to equatorial mount (hardly used)wth controls. 1 Sealy Power Products Road Start. battery. Model RS102 v2. All for £860.00. Inspection anytime just across Rusty Lane in my garage. Phone 01380828407/ philipproven@gmail.com

Please advise if you can put in NL or not

As ever Philip Proven
.

Swindon's own astronomy group

December meeting

For December we have our Christmas social and this year we are going to The Cross Keys in Wanborough for a traditional Christmas feast.

We reconvene on January 17th when Ian Smith will be presenting a presentation on ' Imaging Planetary Nebula', the first of two sessions on astrophotography next year.

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.

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 below). 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!

Meetings 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

Meeting Dates for 2019

Friday 13 December 2019
Programme: Christmas Social

Meeting Dates for 2020

Friday 7 January
Programme: Ian Smith: Imaging Planetary Nebula

Friday 21 February
Programme: Dr Jane Clark: Orbits in the Solar System

Friday 7 March
Programme: AGM / Bob Gatton: The Red Planet

Friday 17 April
Programme: Gary Poyner - Variable Stars around the Perseus Double Cluster

Friday 15 May
Programme: Mike Foulkes: Herschel's Planet

Friday 19 June
Programme: Graham Bryant - Pluto from Myth to Discovery

Website:

http://www.swindonstargazers.com

Chairman: Robin Wilkey

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dark sky wales
dywyllwch awyr cymru

The Night Sky in December 2019

Winter is well advanced now and the beautiful constellations of Orion, Auriga, Taurus and Gemini are available in the evenings. The winter Milky Way holds some spectacular objects too.
Moon in December
New: 26th December
First quarter: 4thDecember
Full: 12th December
Last Quarter: 19thDecember
Planets in December
Mercury: is a morning object by mid month but rapidly fades back toward the Sun by months end.
Venus: is an evening object in the constellation of Sagittarius but remains low on the horizon, setting by 20:00 throughout December.
Mars: is an early morning object in the constellation of Libra, rising at 03:00 by mid month and shining feebly at magnitude 1.6
Jupiter: is in conjunction with the Sun in late December and not well placed for observing this month
Saturn: is rapidly fading in the evening twilight and sets by 19:30 by mid month.Eraly evening observers can still see the rings and satellites.
Uranus: is in the constellation of Aries and fading to magnitude 5.9. it can be seen as a small disk in a moderate telescope.
Neptune: can be found in Aquarius but it shines feebly at magnitude 7.9
Meteor showers in December
The best shower of the month is the Geminids, which peak on the evening/morning of the 13/14th December. With a ZHR of 40 meteors they are worth looking out for and leave brilliant yellowish trains as they zip across the sky. The just past full Moon will spoil some of the later meteors, but they are still worth waiting for. The Geminids are associated with the near earth object 3200 Phaeton, possibly a spent comet.
The second shower is the Ursids which have a low ZHR of about 10. They peak on the evening of the 23rd December. The shower is associated with the comet 8P Tuttle, first discovered in 1790. The Ursids have occasional storms; in 1945 and in 1986 there were events where over 50 meteors per hour were witnessed but 2019 does not look likely to have such an event.
Interesting Events in December
On the evening of the 29th December the moon is just one degree from the planet Venus in the evening sky
Variable star Mira in the constellation of Cetus remains close to maximum brightness and is well worth looking at as a lovely orange red giant star.
Comets in December
There are no bright comets reported for observation this month.
Constellation of the Month: Taurus
The stellar grouping that forms the constellation of Taurus is one of the most easily recognizable associations in the sky. The wide "V" shape of the head of the bull, and its prominent star Aldebaran plus the beautiful cluster of the Pleiades makes Taurus one of the marvels of the night sky. The constellation dates from antiquity, and has been recognized as a heavenly bull by practically every civilization on the face of the Earth; indeed, it is one of few constellations that actually look like the beasts they represent! In Greek mythology the constellation represents the Bull that Zeus became to run off with the nymph Europa. Only the head and shoulders of the bull are depicted in the sky and originate with this tale as the bull bore Europa across a river, making the body invisible.
The constellations of Taurus and Auriga are fused together into a large pattern in the sky which tells the tale of Hu Gadarn, the first man to link oxen to the plough. The entire assembly starts with Bootes the herdsman, that role now taken by Hu Gadarn, moves in a line through Ursa Major and comes down through Auriga to Taurus the oxen. If Hu is handling the plough, then it is easy to see why the seven stars of Ursa Major are so named in British tradition, although why Auriga is seen as the link to the oxen is now lost. On a dark winter's night, Taurus dwells high in the sky as seen from Britain, and contains several objects of note.
By far the greatest deep sky object is the Pleiades, a jewel like cluster of seven stars that glitter like diamonds. The cluster actually contains over 200 stars, but only the brightest ones are visible the unaided eye. The cluster represents the seven daughters of Atlas, the giant who held the heavens from the Earth in Greek mythology. The cluster itself in mentioned in the literature of almost every culture and the Chinese made the first recorded observation in 2357 BCE, although it is possible that Babylonian scripts could go back further. The cluster is even mentioned in the King James Bible in the book of Job, chapter 38 vs 31.
The central star of the cluster, Alcyone, is the brightest object, ruling impassively over her blue supergiant sisters. The cluster is commonly believed to be only a few million years old, recently formed on the astronomical timescale, and this is borne out by the presence of shrouds of gas and dust that surround the stars with a blue nebulous glow. The poet Tennyson referred to the ethereal beauty of this group in *Locksley Hall*, quoting:
Many a night from yonder ivied casement
ere I went to rest,
did I look on great Orion sloping
slowly to the west.
Many a night I watched the Pleiad's rising
through the mellow shade,
Glitter like a swarm of fireflies
Tangled in a silver braid.
To those fortunate enough to own a telescope large enough to show this nebula visually, the description above fits the asterism like the proverbial glove. The Pleiades lie about 420 light years away and are best seen with either a low power ocular, or even better, a pair of binoculars, which capture this fantastic group in one field. Close to Alcyone is a marvellous triple star that is readily apparent in a small telescope, whilst scattered around the field is an amazing assortment of bright stars and doubles. The Pleiades are a truly arresting sight, certainly one of nature's visual successes
Not to be overlooked is the other major cluster of the constellation, the Hyades. This is the "V" shaped group of stars that make up the familiar outline of Taurus, and is remarkable in that it is the second closest star cluster to Earth, and hence is a stellar laboratory for cluster theories. The Hyades are approximately 130 light years away, and like the Pleiades, are best seen with binoculars; revealing a wonderful group of stars ranging from 5th to 10th magnitude. Theta Tauri is a naked eye double; both components are a glorious yellow in colour, whilst most of the other stars of the cluster are white. The primary star, Aldebaran, is not a component of the Hyades it lies 55 light years away, with the cluster making a pretty backdrop for this K type giant star, 45 times the diameter of our Sun.
The object that initiated Messier's catalogue is to be found just above the star marking the southern horn of the bull. The Crab nebulae, so called by Lord Rosse was first seen by Messier in 1758, but had been seen by other observers prior to that time. Little did they suspect the impact this object was to have on the future of astronomy, as it was the first confirmed remnant of a supernova, plus the first visually detected Pulsar in our universe. The Crab nebula is an eighth magnitude smudge of blue white light in a small telescope, with a distinct "S" shape. Binoculars will be rather hard put to pick it up as it has a low surface brightness for an 8th magnitude object. Observers with larger telescopes may well be able to discern the filaments around the periphery of the nebulae, plus the few stars that appear to be imbedded in the gas, although these are only field stars.
The Crab is the remnant of a star that was seen to explode in the year 1054 A.D. and has a well-documented history in the

annals of both the Chinese and the American Indians, although no sighting was made or recorded in Europe, presumably due to prevailing superstitions of the time or the loss of any records that were made. It was an incredibly bright object, visible in the daytime sky for over 3 weeks, and visible at night for over a year. Today, astronomers ponder over this marvel of nature that has taught us so much about the universe we live in.

In the eastern portion of the constellation, close to the border with Auriga and lying amongst the stars of the Milky Way is an enigmatic object that is invisible to amateurs, but may be glimpsed with a long exposure photograph. This is another supernova remnant, termed S.147, and is a wreath like vapour of gas that is difficult to separate from the background Milky Way. It appears to have originated over 50,000 years ago, but no pulsar has yet been detected in this part of the sky, only a faint source of radio emission. Perhaps age has caused the pulsar to become inactive or fade away.

There are several other objects to scan within Taurus, notably two star clusters, NGC 1647 and NGC 1746, which both lie between the horns of the bull. NGC 1647 lies just a short way in a direct line from the lower arm of the "V" of the Hyades and is a 7th magnitude group of some 25 stars in a nice compressed field which can be glimpsed with binoculars. NGC 1746 lies nearer the ends of the horns of the bull and is a more scattered group containing about 50 stars of 8th magnitude upwards. Both groups are visible in small telescopes and are a pleasing sight. Another two star clusters of note can be found together in the same low power field, and are NGC 1807 and NGC 1817 respectively. The richer of the two is NGC 1817, which contains over 50 faint stars, whilst NGC 1807 is a small unremarkable group of 15 stars in a compact group.

BECKINGTON ASTRONOMICAL SOCIETY

Society Details & Speakers programme can be found on our Website www.beckingtonas.org

General enquiries about the Society can be emailed to chairman@beckingtonas.org.

Our Committee for 2016/2017 is

Chairman: Steve Hill (email chairman@beckingtonas.org)
Treasurer: John Ball
Secretary: Sandy Whitton
Ordinary Member: Mike Witt

People can find out more about us at www.beckingtonas.org

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

See the location page for details of how to find us on our website……

Post Code for Sat Nav is BA11 6TB.

Our start time is 7.30pm

Date	Title	Speaker
6th December	Social Evening/Member Talks/Quiz/Nosh	
17th January	*The Herschel 400*	Jonathan Gale
21st February	*Asterisms: Jewels of the Starry Sky*	Bob Mizon
20th March	*TBA*	Steve Hill
17th April	*Planetarium in the Bedroom*	Lilian Hobbs
15th May	*It's Not Rocket Science*	Martin Budzynski
19th June	Annual General Meeting *Member Talks*	

STAR QUEST ASTRONOMY CLUB

This young astronomy club meets at the Sutton Veny Village Hall.
Second Thursday of the Month.

Hunting Outbursting Young Stars with the Centre of Astrophysics and Planetary Sciences (HOYS-CAPS)

Dr Dirk Froebrich -- df@star.kent.ac.uk

HOYS-CAPS is a new citizen science project run by the University of Kent. It aims to engage amateur astronomers in the search for and characterisation of highly variable young stellar objects. This article briefly summarises the science goals of the project and the requirements for participation. More detailed information can be obtained from Dirk Froebrich or on the project webpage, which also showcases first results and images:

http://astro.kent.ac.uk/~df/hoyscaps/index.html

Science Goals

Understanding the mass accretion process onto the young stellar objects is one of the fundamental problems in star formation. In particular, the variation of accretion rates on timescales of several years is not well understood. Observed mass accretion rates of young stars tend to be much lower than predicted by theory. One solution for this problem is that young stars undergo rare and short, but intense bursts of increased accretion activity during which a large fraction of their total mass is accumulated. These burst can be observed as increases in luminosity by up to (or even in excess of) a factor of 100. Recent works have shown the most intense of these, the FU-Ori type bursts, are very rare and only happen every 5-50 thousand years for a particular young star. It is still not clear how long these busts last -- some known bursts have lasted for more than 100 years.

Our goal is to measure the occurrence rate of these bursts more accurately than the current order of magnitude estimate. This is important as it will allow us to accurately determine what fraction of the total mass young stars accrete during these bursts. Due to their intensity and thus vastly increased output of energetic radiation, these bursts have a severe impact on the chemistry and distribution of the material in the stellar accretion disks. Thus they are ultimately a great influence on the formation of planetary systems in these disks.

To identify these rare events we plan to photometrically monitor a number of nearby young clusters and to search for new, highly variable objects. Using clusters of young stars has the advantage that we know the distance and ages of all objects, as well as the total number of the monitored stars -- all vital for the scientific analysis. The envisaged long term monitoring will not just identify outbursting objects, but also other, rare events such as occultations of objects by their accretion discs (such as in KH 15D or V* V582 Mon) which can be used to study these discs in great detail.

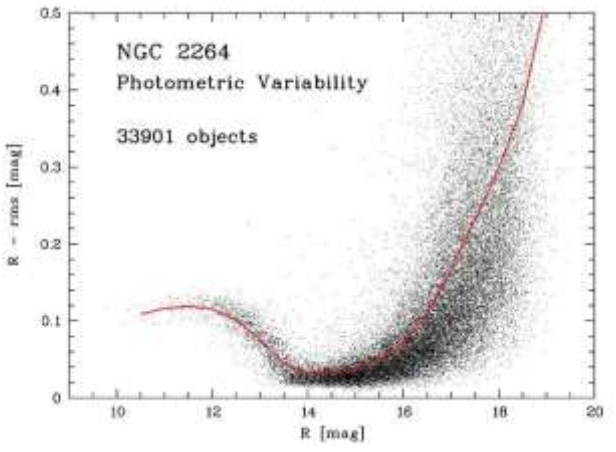
Participating in the Observations

Our main aim is to find highly variable or outbursting objects, hence there are no particularly high requirements for the image quality. Nevertheless, to increase the usefulness and accuracy of the brightness measurements, all images should be subject to a bias and flatfield correction. This removes most of the systematic noise in the images and greatly improves the detectability of brightness variations, in particular for fainter objects. The project website has some detailed notes of the required data reduction procedures, and we are also able to run a workshop for small groups of interested participants should this be of interest.

There are no other stringent requirements for the images. Any image is useful and much appreciated. The website lists a number of target clusters/regions -- which will be extended should more participants join the project. Please centre your images on the provided coordinates to maximise the number of monitored stars. The field of view, filter used and integration times do not matter. Based on our experience in the first observing season, and the subsequent data analysis, the best 'strategy' seems to be if every observer concentrates his/her efforts on a small number of targets and spends a larger integration time on target to monitor fainter cluster members. Images can be taken at any time, ideally one every few weeks, but even a single image is helpful. When you have done the data reduction of your images (dark current and flatfield corrections) you can upload your final images to our Dropbox account (details on request). We will then perform photometry of your images as soon as possible and check if there are new, highly variable stars in the image. We have started to develop software which automatically analyses the lightcurves for all stars in all images, hence the processing will eventually be done very quickly. Should any new potentially erupting objects be detected, we aim to perform follow up observations with a number of telescopes to verify their nature. Currently we will be able to quickly get access to the St. Andrews Observatory, the Liverpool Telescope, the Thuringian State Observatory in Germany and the newly constructed Beacon Observatory at the University of Kent.

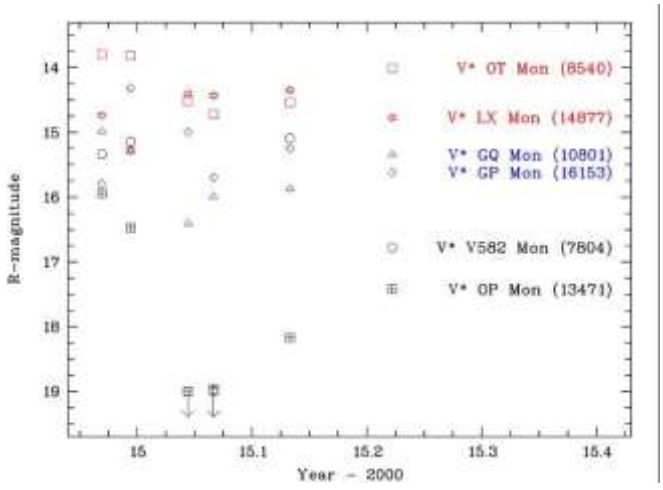
Data Analysis and first Results

During the first observing season we have gathered 42 images of seven individual targets. We have analysed the six different RGB images of NGC2264 (Christmas Tree Cluster) in some detail. We attached an accurate coordinate system to every image using the astrometry.net software and then co-added all images with the Montage software package. This deep image was used to detect stars using the SourceExtractor software and photometry of all stars has subsequently been performed in each of the individual images. Using the assumption that on average all the stars in the image are not variable, the fluxes of all images are set equal and stars who are much more variable than the typical stars of the same brightness are selected. This procedure easily recovers many of the known and obvious variable stars in the images. Finally, the magnitudes of the stars are calibrated using the photometry from the Sloan Digitized Sky Survey.



In Fig.1 we show the typical variability of the stars in NGC2264 as a function of their R-band magnitude. Bright stars vary by about 0.1mag (or 10%), which is due to saturation and non-linearity in the detector which varies with the observing conditions such as the seeing and transparency of the atmosphere. For a range of magnitudes (R=13.5--15.5) the typical variability (or accuracy of the photometry) is better than 0.05mag (or 5%). The faintest objects detected in the images are about R=18mag.

The Christmas Tree in NGC2264, the Cone is top right (Andy Burns)



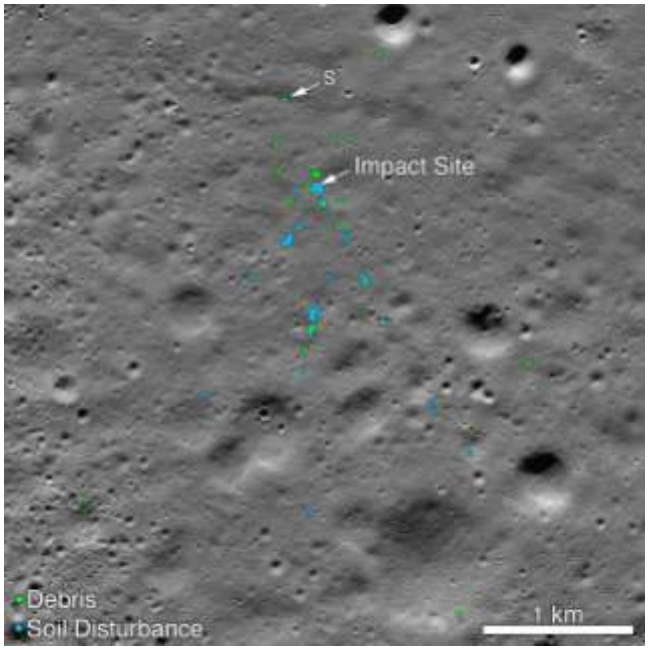
In Fig.2 we show the R-band magnitudes as a function of time of six of the selected and well known highly variable objects. All of them vary by at least one magnitude and two of them completely disappear below the detection limit in at least one of the images. Hence some of the stars change their flux by almost a factor of 100.

SPACE NEWS FOR December 2019

Our Facebook page carries a lot of these news items throughout the month.

Found! NASA Spots Crash Site and Debris from India's Lost Moon Lander

By Meghan Bartels 9 hours ago Spaceflight



NASA's Lunar Reconnaissance Orbiter spotted debris, marked in green, and soil disturbance, marked in blue, caused by the hard impact of India's Chandrayaan-2 spacecraft on Sept. 6, 2019.
(Image: © NASA/GSFC/Arizona State University)

Scientists and amateurs alike have spent months combing through images from NASA's Lunar Reconnaissance Orbiter looking for the remains of India's moon lander — and that search has paid off.

Today (Dec. 2), the team that runs the Lunar Reconnaissance Orbiter Camera (LROC) instrument released images taken on Nov. 11 that show how the spacecraft has changed the surface of the moon. Imaging experts have spotted extensive evidence of the crash, including both debris from the craft and places where the collision seems to have stirred up the moon's regolith.

India's Chandrayaan-2 mission to the moon included a lander called Vikram, which was meant to gently land on the lunar surface near the south pole on Sept. 6. But near the end of the touchdown maneuver, Vikram went silent. India's space agency said it spotted the lander soon after, via the orbiter component of the mission, but the agency has not released those images, and NASA's long-standing Lunar Reconnaissance Orbiter hadn't had the same luck.

Related: India's Chandrayaan-2 Mission to the Moon in Photos

Now, that last part has changed. The NASA spacecraft's first pass over the impact site occurred on Sept. 17, and the LROC team published the resulting image later that month, even though they didn't think they had found any sign of the crash. But in that image, someone named Shanmuga Subramanian spotted one extraordinarily bright pixel and reached out to the LROC team, according to a NASA statement released today.

An image combining before and after photographs of the Vikram impact site highlights the dark inner and light outer materials splaying out from the impact. (The straight diagonal lines are imaging artifacts, not features on the moon.) (Image credit: NASA/GSFC/Arizona State University)

That tipoff, plus images with better lighting and resolution taken in mid-October and on Nov. 11, gave LROC special-

ists the details they needed to map the full scope of the surface changes caused by the hard landing. Newly released images show the impact crater itself, dark ejecta rays and light lines marking the debris field.
According to the statement, the largest pieces of debris are each about 4.5 feet (1.5 meters) across. Vikram measured 8.3 feet (2.5 m) in its longest dimension, according to materials released by India's space agency before the landing attempt.

Japanese Asteroid Probe Tests Ion Engine for Journey Home to Earth

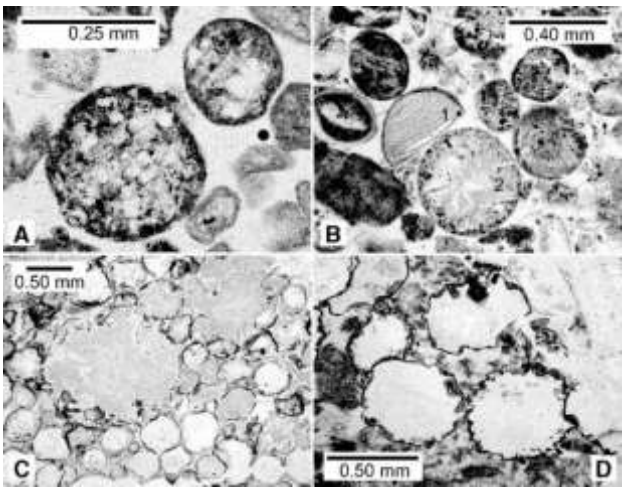
By Leonard David 9 hours ago Spaceflight
Hayabusa2 will fire up its ion engine in earnest on Dec. 3.
A Japanese asteroid probe is getting fired up for its return to Earth.
A recent test of the ion engine that powers Japan's Hayabusa2 spacecraft went well, clearing the hardware for full-on operations soon, mission team members announced late last week.
"This trial run has not had any problems, and the preparations for the ion engine operation during the cruise phase of the return journey are complete," the official Twitter account of the Hayabusa2 mission stated on Nov. 28.
Ion-engine operation for the return cruise to Earth will start on Tuesday (Dec. 3), a key date for the Hayabusa2 mission.
"We are finally beginning full-scale return operations," Hayabusa2 team members said in another Nov. 28 tweet. "Incidentally, December 3 is also the 5th anniversary of the launch of Hayabusa2!"
Hayabusa2 left the near-Earth asteroid Ryugu on Nov. 13, 2019, utilizing chemical propulsion thrusters for the spacecraft's orbit control.
The probe had been studying Ryugu up close since June 2018. During its time at the asteroid, Hayabusa2 dropped several smaller probes onto Ryugu's rubbly surface and collected multiple samples, which will be returned to Earth in December 2020.
The Japan Aerospace Exploration Agency (JAXA) is currently working with the Australian government to support the recovery of the Hayabusa2 reentry capsule in late 2020 at the Woomera Prohibited Area, located in the outback desert of South Australia.
The Hayabusa2 spacecraft itself will cruise past Earth and potentially explore another asteroid target, if JAXA approves an extended mission.
Watch Japan's Hayabusa2 Grab a Piece of an Asteroid in This Incredible Video!
Shadow Selfie! Japanese Asteroid Probe Snaps Amazing Post-Landing Pic

Japan's Hopping Rovers Capture Amazing Views of Asteroid Ryugu (Video)

Leonard David is author of the recently released book, "Moon Rush: The New Space Race" published by National Geographic in May 2019. A longtime writer for Space.com, David has been reporting on the space industry for more than five decades. Follow us on Twitter @Spacedotcom or Facebook.

Giant Meteor Impacts Might Have Triggered Early Earth's Plate Tectonics

Plate tectonics have played a vital role in the geological evolution of our planet. In addition, many scientists believe that Earth's geologically activity may have played an important role in the evolution of life – and could even be essential for a planet's habitability. For this reason, scientists have long sought to determine how and when Earth's surface changed from molten, viscous rock to a solid crust that is constantly resurfacing.
Despite the best efforts of Earth scientists, this remains one of the biggest unanswered questions about our planet. According to a new study by a team of geologists from Australia and the US, it is possible that the transition was triggered by extraterrestrial objects impacting Earth's surface. These results could have significant implications for the study of extrasolar planets and the search for life beyond Earth.



Spherules in the Barberton greenstone belt in the Kaapvaal craton, South Africa. Credit: Lowe et al., 2014.

For the sake of their study, the international team considered looking beyond Earth for possible explanations of how tectonic activity began. As Craig O'Neill – the director of the Macquarie University Planetary Research Centre in Sydney, Australia and the lead author on the paper, said:

"We tend to think of the Earth as an isolated system, where only internal processes matter. Increasingly, though, we're seeing the effect of solar system dynamics on how the Earth behaves."

According to the most widely accepted theory of planet formation, the Earth formed roughly 4.6 billion years ago from material accreted from the Solar Nebula. Based on modeling studies and comparisons with lunar impacts, astronomers and geologists have theorized that Earth experienced a number of massive impacts for hundreds of millions of years afterward.
The most notable of these is believed to have taken place about 100 million years later and caused the formation of the Earth-Moon system (aka. the Giant Impact Hypothesis). Although these impacts tapered off over time, they left behind evidence in the form of spherule beds – round particles that formed from rock vaporizing and condensing.

Roughly 3.2 billion years ago, during the Archaean Era, planet Earth began to experience tectonic activity. Credit: ocean.si.edu

For the sake of their study, the team considered the distinctive layers of spherule beds that have been discovered in the Pilbara craton in Australia and the Kaapvaal craton in South Africa. These beds are the result of periods of intense bombardment from extraterrestrial objects that took place roughly 3.2 billion years ago – during the Archaean Epoch (ca. 4 to 2.5 billion years ago).
Interestingly, this is about the same time that the first evidence plate tectonics appears in the geological record.
O'Neill and his colleagues decided to investigate this coincidence to see if there was a possible connection. As O'Neill explained:

"Modelling studies of the earliest Earth suggest that very large impacts – more than 300 km in diameter – could generate a significant thermal anomaly in the mantle."

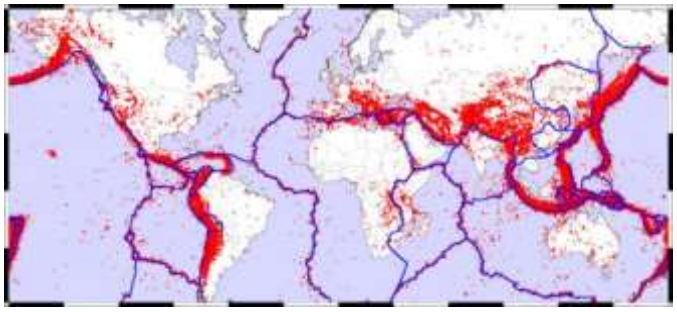
Such impacts, according to O'Neill and his team, appears to have altered the mantle's buoyancy to the point that upwellings would occur that could directly drive plate tectonics. However, the sparse evidence that dates to the Archaean suggests that mostly smaller impacts measuring than less than 100 km (62 mi) in diameter occurred during this period.

Ridges in the ancient Dresser Formation in the Pilbara Craton of Western Australia. Credit: Kathleen Campbell

To determine if impacts of this size were large and frequent enough to have initiated global tectonic activity, O'Neill and his team took a two-pronged approach. On the one hand, they used existing techniques to expand the impact record of the Middle Archaean (ca. 3.3 to 2.9 billion years ago). Next, they developed numerical simulations to model the thermal effects that these impacts would have on Earth's lithosphere. What they found was that during the Middle Archaean, 100 km-wide impactors would have been capable of weakening Earth's crust. Not surprising, since the Chixculub impact that caused the Cretaceous–Paleogene extinction (and killed off the dinosaurs), measured 70 km (43.5 mi). Assuming that Earth's exterior was already primed for subduction, O'Neill and his team concluded such an impact would have been sufficient:

Had the Earth's lithosphere been a uniform thickness at the time, according to O'Neill, the impact would have had little effect. But during the Middle Archean, cooling had caused Earth's mantle to become thicker in some spots and thinner in others. If an impact were to take place in a thin spot, it could add to the buoyancy differences already caused by the thickening and thinning process and trigger tectonic activity. Said O'Neill:

"Our work shows there is a physical link between impact history and tectonic response at around the time when plate tectonics was suggested to have started. Processes that are fairly marginal today – such as impacting, or, to a lesser extent, volcanism, actively drove tectonic systems on the early Earth. By examining the implications of these processes, we can start exploring how the modern habitable Earth came to be."



Map of the Earth showing fault lines (blue) and zones of volcanic activity (red). Credit: zmescience.com

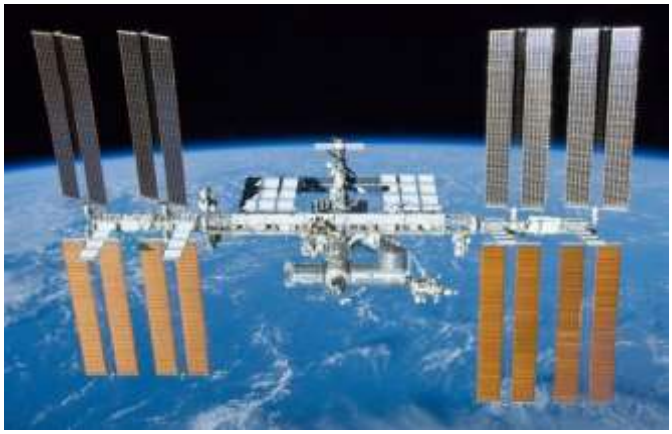
These results could have far-reaching implications for Earth sciences and the study of extrasolar planets. On Earth, a lot of significant developments have been traced to the Middle Archaean, including the rise of photosynthetic organisms and the earliest oxygen gas in our atmosphere. Understanding ancient impacts and how they affected terrestrial evolution can therefore help us to learn more about the origins of life on Earth.

Similarly, understanding how geological activity began on Earth could help us locate potentially-habitable planets. So far, the vast majority of terrestrial exoplanets that have been discovered were found to be "stagnant lid planets", where no plate activity takes place. If the difference between habitable and uninhabitable is an impact that can trigger plate activity, that could help narrow the search!

The study, titled "The role of impacts on Archaean tectonics", recently appeared in the scientific journal *Geology*.

Further Reading: GSA, GeoScienceWorld

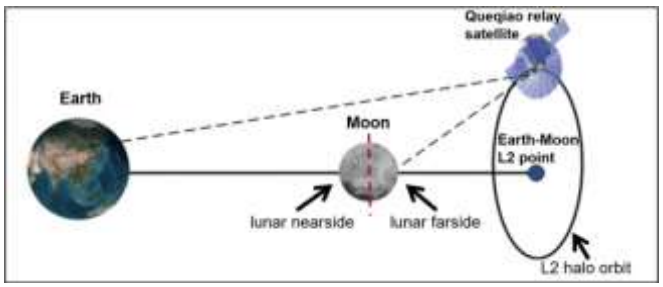
Cancer Seems to Have Trouble Spreading in Microgravity



There are a number of health risks that come with going to space. Aside from the increased exposure to solar radiation and cosmic rays, there are the notable effects that microgravity can have on human physiology. As Scott Kelly can attest, these go beyond muscle and bone degeneration and include diminished organ function, eyesight, and even changes at the genetic level.

Interestingly enough, there are also a number of potential medical benefits to microgravity. Since 2014, Dr. Joshua Choi, a senior lecturer in biomedical engineering at the University of Technology Sydney, has been investigating how microgravity affects medicine and cells in the human body. Early next year, he and his research team will be traveling to the ISS to test a new method for treating cancer that relies on microgravity.

There's Now an Operational Radio Telescope on the Far Side of the Moon



The *Chang'e-4* mission, the fourth installment in the Chinese Lunar Exploration Program, has made some significant achievements since it launched in December of 2018. In January of 2019, the mission lander and its *Yutu 2* (Jade Rabbit 2) rover became the first robotic explorers to achieve a soft landing on the far side of the Moon. Around the same time, it became the first mission to grow plants on the Moon (with mixed results).

In the latest development, the Netherlands-China Low Frequency Explorer (NCLE) commenced operations after a year of orbiting the Moon. This instrument was mounted on the

Queqiao communications satellite and consists of three 5-meter (16.4 ft) long monopole antennas that are sensitive to radio frequencies in the 80 kHz – 80 MHz range. With this instrument now active, *Chang'e-4* has now entered into the next phase of its mission.

Interstellar Comet Borisov is About to Make its Closest Approach to Earth

On August 30th, 2019, astronomers with NASA, the ESA, and the International Scientific Optical Network (ISON) announced the detection of the interstellar comet C/2019 Q4 (2I/Borisov). News of the object was met with a great deal of excitement since it was only the second interstellar object to be detected by astronomers – the first being the mysterious object known as 'Oumuamua (which astronomers are still unsure about)!

After a lot of waiting and several follow-up observations, 2I/Borisov is about to make its closest approach to Earth. To mark the occasion, a team of astronomers and physicists from Yale University captured a close-up image of the comet that is the clearest yet! This image shows the comet forming a tail as it gets closer to the Sun and even allowed astronomers to measure how long it has grown.

The image was captured last Sunday (Nov. 24th) using the Keck I Telescope's Low-Resolution Imaging Spectrometer, located at the W.M. Keck Observatory in Manua Kea, Hawaii. The team was led by Peier van Dokkum, the Sol Goldman Family Professor of Astronomy at Yale, and Professor Gregory Laughlin, with the assistance of Shany Danieli and Cheng-Han Hsieh (a PhD student and undergrad, respectively).

Image of 2I/Borisov, taken on Sept 9/10th as it approached the Sun. Credit: Gemini Observatory/NSF/AURA

Based on the image they captured, van Dokkum and his colleagues estimate that the comet's tail extends for a distance of almost 160,000 km (100,000 mi). For comparison, Earth measures 12,742 km (7917.5 mi) in diameter, which makes 2I/Borisov's tail 14 times the size of Earth. To put that in perspective, the team superimposed an image of Earth next to the comet to illustrate the difference in size.

"It's humbling to realize how small Earth is next to this visitor from another solar system," van Dokkum said.

It is important to note, however, that the solid nucleus of the comet measures only 1.6 km (one mile) in diameter. As with all comets, frozen material in the core (volatile materials like frozen water, carbon dioxide, etc.) began to sublimate as it got closer to the Sun. This sublimated material, mixed with dust from the surface, then formed a gaseous envelope that became stretched out into a tail.

Since it was first detected entering the Solar System this past summer, astronomers have been able to capture images of 2I/Borisov on two occasions. The first image (shown above), which captured 2I/Borisov's pronounced tail and confirmed that it is actually a comet, was taken by astronomers using the Gemini North Telescope's Gemini Multi-Object Spectrograph on the night of September 9-10th.

A Hubble image of comet 2I/Borisov speeding through our Solar System. Credit: NASA/ESA/D. Jewitt (UCLA)

The next image (shown above) was captured on Oct. 12th by a team from the University of California, Los Angeles (UCLA) using the Hubble Space Telescope. At the time, 2I/Borisov was within 418 million km (260 million mi) of Earth. The images showed the progression of 2I/Borisov's sublimation and the formation of its tail, which was already becoming rather long at this point.

2I/Borisov will be reaching the closest point in its orbit to the Sun (perihelion) on December 8th, where it will be near the inner edge of the asteroid belt. When it makes its closest approach to Earth (in late December) it will pass us at a distance of over 300 million km (190 million mi) – a little over to 2 AUs (or twice the distance between Earth and the Sun).

It will be passing beyond the orbit of Mars at this point, which means that it will pose no threat to Earth. This in spite of the fact that astronomers recently detected traces of cyanide in the comet. So as Douglas Adams would say, "Don't Panic!"

This comet and its predecessor, 'Oumuamua, have raised awareness about the presence of interstellar objects in our system and how regularly they pass through. In the coming years, space agencies around the world hope to be able to mount missions to intercept and study one of them. These include the ESA's proposed Comet Interceptor mission, which is scheduled for launch sometime in 2028.

Astronomers Are About to Detect the Light from the Very First Stars in the Universe

A team of scientists working with the Murchison Widefield Array (WMA) radio telescope are trying to find the signal from the Universe's first stars. Those first stars formed after the Universe's Dark Ages. To find their first light, the researchers are looking for the signal from neutral hydrogen, the gas that dominated the Universe after the Dark Ages.

It took a while for the first stars to form. After the Big Bang, the universe was extremely hot; too hot for atoms to form. Without atoms, there could be no stars. It wasn't until about 377,000 years after the Big Bang that the Universe had expanded and cooled enough for atoms to form, mostly neutral hydrogen with a little helium. (And traces of lithium.) After that, the earliest stars started to form, during the Epoch of Reionization.

To find the elusive signal from that neutral hydrogen, the MWA was reconfigured. The MWA is in remote Western Australia, and it had 2048 radio antennas arranged into 128 "tiles" when it began operation in 2013. To hunt for the elusive neutral hydrogen signal, the number of tiles was doubled to 256, and the entire array was rearranged. All the data from these receivers is fed into a supercomputer called the Correlator.

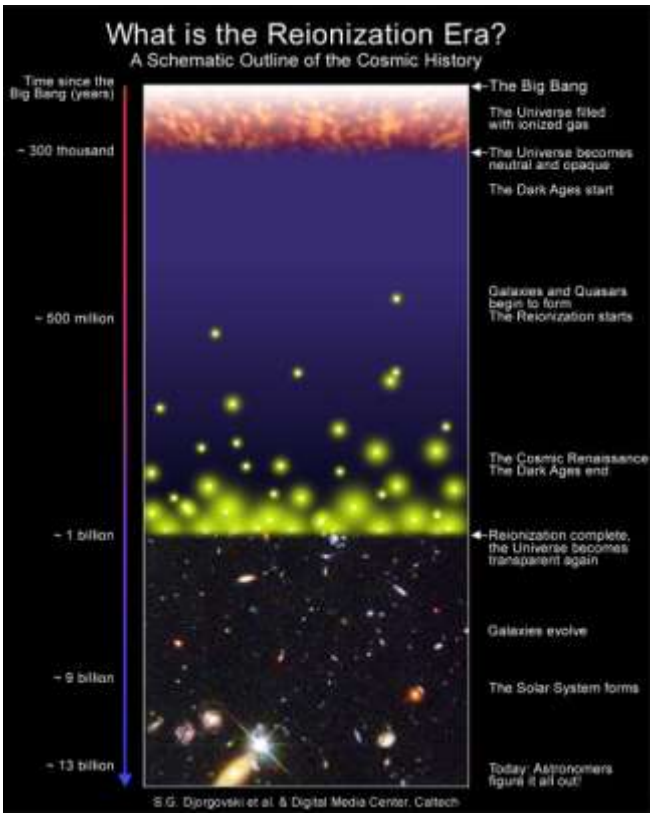
The Murchison Widefield Array consists of 256 tiles of receivers. Image Credit: MWA Collaboration/Curtin University.

A new paper to be published in the Astrophysical Journal presents the results from the first analysis of data from the newly configured array. The paper is titled "First Season MWA Phase II EoR Power Spectrum Results at Redshift 7." The lead researcher is Wenyang Li, a PhD student at Brown University.

This research was aimed at understanding the strength of the signal from the neutral hydrogen. The analysis set the lowest limit yet for that signal, a key result in the search for the faint signal itself.

"We can say with confidence that if the neutral hydrogen signal was any stronger than the limit we set in the paper, then the telescope would have detected it," said Jonathan Pober, an assistant professor of physics at Brown University and corresponding author on the new paper. "These findings can help us to further constrain the timing of when the cosmic dark ages ended and the first stars emerged."

Despite what looks like a detailed timeline of events in the early Universe, there are significant gaps in our understanding. We know that following the Dark Ages, the Epoch of Reionization began. That's when the formation of atoms led to the appearance of the first structures in the Universe, like stars, dwarf galaxies, and quasars. As those objects formed, their light spread through the Universe, re-ionizing the neutral hydrogen. After that, the neutral hydrogen disappeared from interstellar space.



Graphical representation of the history of the universe, by Djorgovski et al, (Caltech).

Scientists want to know how the neutral hydrogen changed as the Dark Ages gave way to the Epoch of Reionization, and the Epoch of Reionization unfolded. The first stars to form in the Universe were building blocks of the structure we see today, and to understand them, scientists need to find the signal from that early neutral hydrogen.

But that's not easy. The signal is faint, and it takes extremely sensitive detectors to find it. Though the neutral hydrogen initially emitted its radiation at a 21 cm wavelength, the signal has been stretched due to the expansion of the Universe. It's now about 2 meters. That 2 meter signal is now easily lost among a host of other signals like it, both natural and human-caused. That's why the MWA is in remote Australia, to isolate it from as much radio noise as possible.

"All of these other sources are many orders of magnitude stronger than the signal we're trying to detect," Pober said. "Even an FM radio signal that's reflected off an airplane that happens to be passing above the telescope is enough to contaminate the data."

This is where the processing power of the Correlator supercomputer comes in. It has the power to discard contaminating signals, and also to account for the nature of the MWA itself.

A diagram of the evolution of the universe from the big bang to the present, with two epochs of reionization. Credit: NASA, ESA, and A. Feild (STScI)

"If we look at different radio frequencies or wavelengths, the telescope behaves a little differently," Pober said. "Correcting for the telescope response is absolutely critical for then doing the separation of astrophysical contaminants and the signal of interest."

The reconfiguration of the array, the data analysis techniques, the power of the supercomputer, and the hard work of researchers produced results. The paper presents a new upper limit for the signal from the neutral hydrogen. This is the second time that scientists working with the MWA have released a new, more finely-tuned limit. With continued progress, scientists hope to find the elusive signal itself.

"This analysis demonstrates that the phase two upgrade had a lot of its desired effects and that the new analysis techniques will improve future analyses," Pober said. "The fact that MWA has now published back-to-back the two best limits on the signal gives momentum to the idea that this experiment and its approach has a lot of promise."

Finally! Scientists Find a Place on Earth with Liquid Water But No Life

In recent years research into extremophiles has captured the interest of astrobiologists. The discovery of lifeforms in some of Earth's most extreme environments has helped shape our thinking about extraterrestrial life. Life on other worlds may not need the kind of temperate, balanced environment that most life on Earth is adapted to.

The search for life and habitability on other planets and moons is focused on liquid water. (And in one case, liquid hydrocarbons.) Cells need liquid to carry out their functions; it's axiomatic.

It's also axiomatic that everywhere on Earth that you find water, you find life. In thermal vents on the sea-floor, deep down in caves, in fresh lava, and on glaciers. There's even life that relies on the radioactive decay of uranium to survive. It looked like life was everywhere on Earth, wherever there was water.

Until now.

A new study from French and Spanish scientists focuses on a place on Earth where liquid water is abundant, but life is absent. The area is called Dallol, and it's a geothermal field in Ethiopia. It features hot, acidic, hypersaline ponds. The new study is published in Nature and is titled "Hyperdiverse archaea near life limits at the polyextreme geothermal Dallol area."

"…we have verified that there's no microbial life in these salty, hot and hyperacid pools or in the adjacent magnesium-rich brine lakes."

Purificación Lopez Garcia, French National Centre for Scientific Research, Team Lead.

The Dallol area has been studied by scientists before, and those studies indicated the presence of life. But this new work overturns those results, and presents the case for an environment so extreme, even extremophiles can't live there.

In May 2019, Nature published a study titled "Ultra-small microorganisms in the polyextreme conditions of the Dallol volcano, Northern Afar, Ethiopia." In the introduction it says "Here we report for the first time evidence of life existing with these hot springs using a combination of morphological and molecular analyses." The researchers said that there was evidence of life "entombed within mineral deposits," and that the life-forms were members of the Order Nanohaloarchaea, organisms found in other hypersaline environments.

But this new study comes to a different conclusion: there is no life in the multi-extreme ponds at Dallol.

"After analysing many more samples than in previous works, with adequate controls so as not to contaminate them and a well-calibrated methodology, we have verified that there's no microbial life in these salty, hot and hyperacid pools or in the adjacent magnesium-rich brine lakes," said lead researcher Puri López García in a press release.

Lopez Garcia says that previous studies may have found microscopic structures that looked like cells under a microscope. But their analysis shows that their biological nature doesn't hold up under intense scientific scrutiny. "In other studies, apart from the possible contamination of samples with archaea from adjacent lands, these mineral particles may have been interpreted as fossilized cells, when in reality they form spontaneously in the brines even though there is no life."

The Dallol landscape is a region of intense hydrothermal activity. There's a volcanic crater full of salt, where the intense heat boils the water, and where toxic gases emanate. Dallol itself is located in the Danakil Depression in the Afar Triangle. It's a remote area known for its otherworldly land-forms and colors.

The otherworldly landscape of Dallol. The colors change due to the variable oxidation of inorganic iron. Image Credit: By Kotopoulou Electra – Own work, CC BY-SA 4.0, https://commons.wikimedia.org/w/index.php?curid=74975209

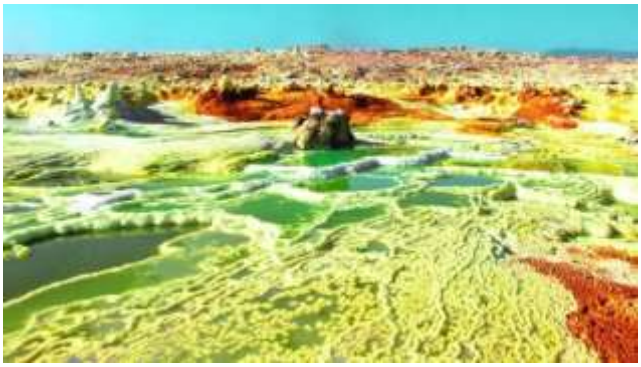
Dallol's hydrothermal springs discharge high temperature water that reaches 108 °C (226 °F.) It's anoxic, hypersaline, and hyper-acidic. In this environment, according to Lopez Garcia, some silica-rich Dallol mineral precipitates may look like microbial cells under a microscope.

"We would not expect to find life forms in similar environments on other planets, at least not based on a biochemistry similar to terrestrial biochemistry."

PURIFICACIÓN LOPEZ GARCIA, FRENCH NATIONAL CENTRE FOR SCIENTIFIC RESEARCH, TEAM LEAD.

The surrounding area contains an abundant diversity of primitive salt-loving organisms, but the pools themselves do not. "What does exist is a great diversity of halophilic archaea in the desert and the saline canyons around the hydrothermal site," Lopez Garcia, a biologist, explains, "but neither in the hyperacid and hypersaline pools themselves, nor in the so-called Black and Yellow lakes of Dallol, where magnesium abounds. And all this despite the fact that microbial dispersion in this area, due to the wind and to human visitors, is intense."

We get excited when we detect water on another world, which so far hasn't happened often. But this study shows that the presence of water, though tantalizing and worth pursuing scientifically, guarantees nothing. In fact, it shows that environments like this can present microscopic structures that appear biotic in origin, but aren't. It shows that liquid water environments can be sterile.



Hydrothermal chimneys, salt pillars and terraces of Dallol, Ethiopia. Image Credit: By Electra Kotopoulou – Own work, CC BY-SA 4.0, https://commons.wikimedia.org/w/index.php?curid=74988059

"In addition, our study presents evidence that there are places on the Earth's surface, such as the Dallol pools, which are sterile even though they contain liquid water," stresses Lopez Garcia.

The Dallol pools are a quadruple-threat when it comes to life. The combination of high temperatures, high acidity, and hyper-salinity creates a barrier to living organisms. In other ponds, there's an abundance of chaotropic magnesium salts. Chaotropic agents disrupt the hydrogen bonding between water molecules and also denatures biomolecules.

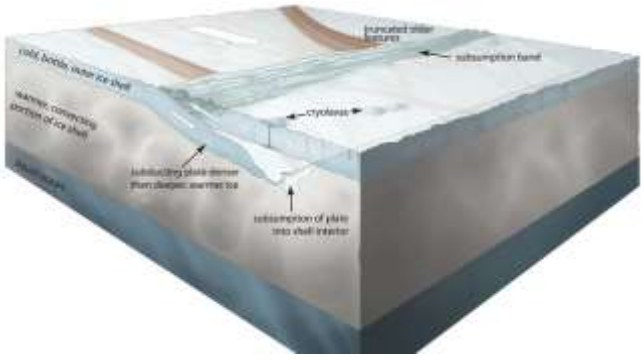
Assuming that life on other worlds has a similar biochemistry to Earth life, then nothing could survive in this type of environment. "We would not expect to find life forms in similar environments on other planets, at least not based on a biochemistry similar to terrestrial biochemistry," points out Lopez Garcia.

Water Vapor Was Just Found on Europa, More Evidence There's Liquid Water Beneath All that Ice

What's been long-suspected has now been confirmed: Jupiter's moon Europa has water. As we've learned more about the outer Solar System in recent years, Europa has become a high-priority target in the search for life. With this discovery, NASA has just painted a big red bulls-eye on Jupiter's smallest Galilean moon. "While scientists have not yet detected liquid water directly, we've found the next best thing: water in vapor form."

Lucas Paganini, NASA Planetary Scientist, Research Lead.

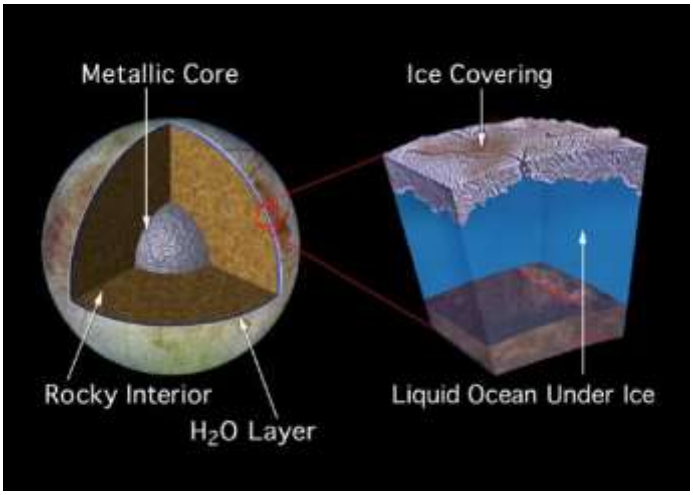
Prior to this discovery, scientists already had some evidence that Europa has the potential to harbor life. The moon has the smoothest surface of any object in the Solar System, which led scientists to hypothesize that it had liquid water in a subsurface ocean, kept above freezing by tidal flexing from Jupiter. That tidal flexing not only keeps the water in liquid form, it creates ice plate movement similar to tectonic plates on Earth, according to the hypothesis.



Scientists have found evidence of plate tectonics on Jupiter's moon Europa. This conceptual illustration of the subduction process (where one plate is forced under another) shows how a cold, brittle, outer portion of Europa's 20-30 kilometer-thick (roughly 10-20 mile) ice shell moved into the warmer shell interior and was ultimately subsumed. A low-relief subsumption band was created at the surface in the overriding plate, alongside which cryolavas may have erupted. Image credit: Noah Kroese, I.NK

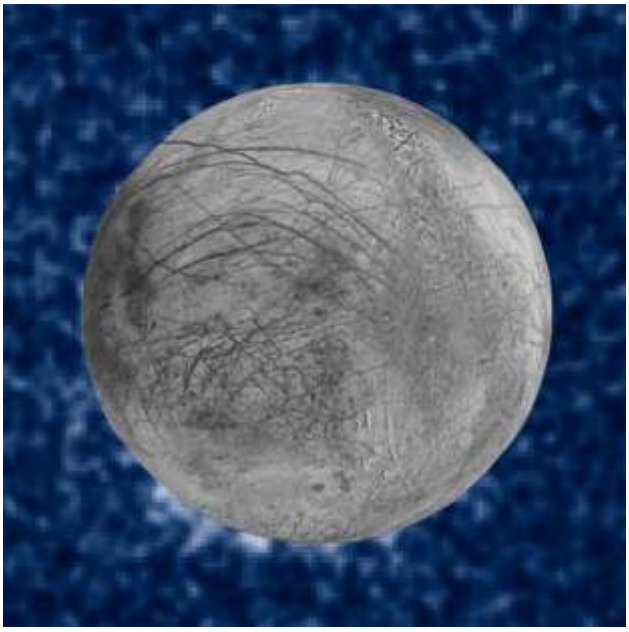
More evidence came from studying the brown splotches on Europa's surface. Scientists hypothesized that those are chemicals from the subsurface ocean which have made their way to the surface. This shows that the sea floor might be interacting with the surface, an important consideration when thinking about habitability.

The discovery of liquid plumes raised the excitement level about Europa's potential habitability.



Artist's impression of Europa's interior, based on data obtained by Galileo space probes Credit: NASA

In 2012 the Hubble captured an image of Europa showing what many interpreted as a plume of water vapor coming out of a crack in the frozen surface, shooting up to about 200 km (120 miles) high. (For comparison, Mt. Everest is only 8.8 km high.) In 2016, there was more evidence from Hubble that suggested plumes.



This composite image shows suspected plumes of water vapour erupting at the 7 o'clock position off the limb of Jupiter's moon Europa. The plumes, photographed by Hubble's Imaging Spectrograph, were seen in silhouette as the moon passed in front of Jupiter. Hubble's ultraviolet sensitivity allowed for the features, rising over 160 kilometres above Europa's icy surface, to be discerned. The water is believed to come from a subsurface ocean on Europa. The Hubble data were taken on January 26, 2014. The image of Europa, superimposed on the Hubble data, is assembled from data from the Galileo and Voyager missions. Image Credit: NASA, ESA, W. Sparks (STScI), and the USGS Astrogeology Science Center

NASA's Galileo spacecraft detected perturbations in Jupiter's magnetic field near Europa during that spacecraft's time at Jupiter, from 1995 to 2003. Scientists attributed those perturbations to a salty ocean that might exist under the moon's frozen surface, since a salty ocean can conduct electricity. Also, the Galileo spacecraft came as close as 206 km (128 mi) to Europa's surface in 1997 and some researchers suggest it actually flew through a plume.

But in all that data, there was no definitive discovery of water. Now that's changed.

"This first direct identification of water vapor on Europa is a critical confirmation of our original detections of atomic species…"

Lorenz Roth, Astronomer and physicist, KTH Royal Institute of Technology in Stockholm, co-author.

A team of scientists led by Lucas Paganini, a NASA planetary scientist, have published a paper announcing the discovery of water at Europa. The paper is titled "A measurement of water vapour amid a largely quiescent environment on Europa." It's published on November 18th in the journal Nature.

In a press release, Paganini said, "Essential chemical elements (carbon, hydrogen, oxygen, nitrogen, phosphorus, and sulfur) and sources of energy, two of three requirements for life, are found all over the solar system. But the third — liquid water — is somewhat hard to find beyond Earth. While scientists have not yet detected liquid water directly, we've found the next best thing: water in vapor form."

This artist's illustration shows what plumes of water vapour might look like being ejected from Europa's south pole. Image: NASA, ESA, L. Roth (Southwest Research Institute, USA/University of Cologne, Germany) and M. Kornmesser.

Paganini and the other scientists said they detected enough water to fill an Olympic-size swimming pool in minutes; about 2360 kg/second (5202 lbs/sec.) They also report that the water appears only infrequently. "For me, the interesting thing about this work is not only the first direct detection of water above Europa, but also the lack thereof within the limits of our detection method."

The results stem from observing time with the W.M. Keck Observatory in Hawaii. Over the course of 17 nights of observing in 2016 and 2017, the team found the faint, distinct signal of water vapor only once. The vapor was detected on Europa's leading hemisphere as it orbits Jupiter. (Europa is tidally locked to Jupiter, just as the Moon is to Earth.)

Water emits infrared light in specific frequencies when it interacts with solar radiation. By using a spectrograph on the Keck telescope, scientists measured the chemical composition at Europa's leading hemisphere.

Water molecules emit specific frequencies of infrared light as they interact with solar radiation.
Credits: Michael Lentz/NASA Goddard

"This first direct identification of water vapor on Europa is a critical confirmation of our original detections of atomic species, and it highlights the apparent sparsity of large plumes on this icy world," said Lorenz Roth, an astronomer and physicist from KTH Royal Institute of Technology in Stockholm who led the 2013 Hubble study and was a co-author of this recent investigation.

Roth is referring to the detection of the components that make up water being found above Europa. While intriguing, that's not the same as discovering water. To find the water, the team had to use the ground-based Keck Observatory and its spectrograph, since no current spacecraft have the capability to detect water.

The twin Keck telescopes shooting their laser guide stars into the heart of the Milky Way on a beautifully clear night on the summit on Mauna Kea. Credit: keckobservatory.org/Ethan Tweedie

Determining that it's water rather than just the components of water is not easy, especially from Earth. The team behind this study had to contend with the water in Earth's atmosphere, and to do that they relied on complex mathematical modelling and computer modelling.

The team is confident in their results, even while they acknowledge that a mission to Europa is needed to really understand the moon.

"We performed diligent safety checks to remove possible contaminants in ground-based observations," said Avi Mandell, a Goddard planetary scientist on Paganini's team. "But, eventually, we'll have to get closer to Europa to see what's really going on."

Hopefully, scientists—and the rest of us—won't have to wait too much longer to get some more definitive answers to Europa's many questions. The Europa Clipper was moved to its final design stage in August 2019, and is due to launch sometime in the mid 2020s. It'll carry a whole suite of instruments to probe Europa's mysteries. The most exciting of all might be its ground-penetrating radar. It might see right through the ice and confirm the existence of a subsurface ocean once and for all.

As if an orbiter wasn't enough, there's also talk of a Europa lander.

Artist's rendering of a possible Europa Lander mission, which would explore the surface of the icy moon in the coming decades. Credit:: NASA/JPL-Caltech

In 2019, Congress awarded NASA $195 million to look into developing a lander as part of the Clipper mission. NASA never requested that money, probably partly because the surface of Europa is a difficult environment to land on. Maybe Congress knows that landings attract a huge amount of public interest.

Of course, it's not just the surface environment of Europa that's problematic. The radiation around Jupiter is extreme, and in order to be successful, the Europa Clipper will have to follow wide elliptical orbits, only getting close to Europa for periods of time, before retreating to safety. This is how NASA's Juno spacecraft contends with Jupiter's radiation.

But even so, the Clipper will be able to directly image any plumes, and even sample them with its mass spectrometers. It'll also be able to investigate the surface in more detail than ever before.

We'll have to be patient though. Juno took five years to reach Jupiter. If the Europa Clipper mission launches in the mid-2020s, we won't get any science results until 2030 or later.

SpaceX Launches Another 60 Starlink Satellites

In May of 2019, Elon Musk began delivering on his promise to create a constellation of satellites (named Starlink) that would offer broadband internet access. It all started with the launch of the first sixty Starlink satellites and was followed by Musk sending the inaugural tweet using the service this past October. Earlier today, another batch of Starlink satellites was sent into space as part of a live-streamed launch event.

The mission, known as Starlink-1, saw the launch of another 60 satellites from Space Launch Complex 40 at Cape Canaveral Air Force Station, Florida, atop a *Falcon 9* rocket. Unlike previous launches, this mission involved the latest version of Starlink (Starlink 1.0), which feature a number of upgrades and refinements over the previous version (Starlink 0.9) and made this mission the heaviest Starlink launch to date.

E Mails Viewings Logs and Images from Members.

Hi Andy,
Here are my submissions for the December 2019 WAS Newsletter.

The first two images are the Mercury Transit on 11/11/2019. I went to a Remembrance Service at Lydiard Park. There was a clear blue sky up to midday. Then on the drive back home the clouds rolled in although there were gaps. The clouds obscured first and second contact. These two images are the first and last clear sightings I had of the transit event.
Canon SX50HS, 1800mm (50x Optical and 25 x Digital), ISO 100, F8, 1/1000 sec
Baader Solar Filter, Post Processed in Affinity Photo and Photoshop CS2
The third image is Saturn (top left), Crescent Moon and Venus (bottom right). Jupiter is somewhere in the murk bottom right. This is a composite of three images at 0.6, 0.8 and 1 second exposures processed in Affinity Photo.

Canon 1100D, ISO 1600, F4.5 and Sigma 17-70mm lens at 70mm (effective focal length approx. 110mm).
Clear Skies,
John

Hi Andy,

Last month, after finding out that the street lights in Chippenham and the surrounding area were soon to be converted to LED lights, I emailed Wiltshire Council to voice my approval and asked if our's and the adjoining roads could be early adopters of the new lights. Today a van and hoist arrived in our road along with two workmen and most of the local lights have now been changed over to the new type. What a difference this has made; the road is now comparatively dark and the over-spill into the back garden from adjacent roads has largely disappeared - adjoining properties are no longer illuminated by that horrible orange glow!

Maybe the early changeover is more of a coincidence than a result of my request, but who knows, it may just be worth asking.

Dave B

Dear Sir,
Many thanks for your email.
Firstly, we are aware of issues related to varying spectral distribution in our assets and also upward light but the asset is constantly being replaced with most up to date equipment when a unit is no longer financially viable to maintain, and as such the variance exists.
The industry as you may know is going through a large scale and rapid change in regards to lamp technologies, and we have had to keep up with it to some degree for maintenance equipment due to pressures of energy reduction. Until a few years ago, there was only really a choice of Sodium lanterns.

LOW PRESSURE SODIUM > HIGH PRESSURE SODIUM > FLUORESCENT > CERAMIC METAL HALIDE > LED (COOL > NEUTRAL > WARM). Once you get a mixture due to premature failures, we agree it doesn't paint a pretty picture up to now.
With regards to the zero cut off LED lamps installed, I can confirm these are very much temporary replacement whilst we were mobilising our new LED replacement programme and lack of availability of Low Pressure Sodium lamps.
You will be pleased to know this has now commenced and began in Chippenham area 3 week ago. We can confirm that units in Lowden Hill that aren't full cut-off LED will be replaced with new full cut-off warm white 3000K LED equipment, I would anticipate this to be complete before end of December.

All equipment incorporates dimming capability and will be set to dim as standard once assets registered in monitoring software.
Also for information, we have been working with Cranbourne Chase AONB to assist in their Dark Skies Park application and as a direct result of that, all AONB's and Conservation Areas in the Authority will be fitted with 2700K LED.
You will find out more about the project at the following location.
http://www.wiltshire.gov.uk/highways-improvements-led-lighting
I trust our response is welcoming.
Regards
Stuart Brown *BEng (Hons)*
Exterior Lighting Consultant
UK & Europe
Engineering, Design and Project Management

From: Andrew Burns <anglesburns@hotmail.com>
Sent: 11 November 2019 10:03
To: Wiltshire Street Lighting <streetlightinginWiltshire@atkinsglobal.com>
Subject: Street lighting in Lowden Hill, Chippenham
In September the lighting at the railway bridge end of Lowden Hill was changed from poor cut-off sodium fittings to even worse zero cut off bright white (blue end of spectrum) lights that directly shine in bedroom windows ABOVE the lighting fitting. At the bottom end (A4) end new full cut off LED lights were fitted on these have been very good. A middle 3 lights are still the old sodium lights... A real mishmash of band widths and quality.
As this is also deemed an emergency vehicles route the lights are on all night every night.
Three immediate problems are created by the new lights:
1) Safety. Driving up the hill the glare from the lights shine at the brow of the hill making it difficult to see vehicles coming towards you from over the brow. It also hides people at the top of the hill in the glare of lights (exactly 1 year ago today someone was killed on the brow of the hill, but this was because they fell across the road hidden to the vehicle driving west.
2) Unless thick curtains are drawn the lighting is annoying and breaking sleep. This must be even worse for the nature that is around the local area. The owls that used to roost in the trees at this end of the tree have not been heard for 2 months.
3) The mixture of lighting types means it is impossible to view the night sky, as no filter covers all the spectrum of light being emitted.
Full cut off, warmer grade lighting would cure these issues and be more economical in use.
Yours,
Andrew Burns (Wiltshire Campaign for Dark Skies coordinator).
Also affected resident at the Knoll, Lowden Hill.

I've sent an email to Lacock Parish Council asking if they can put down some gravel.

Dave.

Subject: Re: Lacock Viewing Area

It is National Trust loaned to the village. The NT get very parochial about it. Best to go through them.

From: David Buckle <david.buckle@outlook.com>
Sent: Tuesday, November 26, 2019 12:03:32 PM
To: anglesburns@hotmail.com <anglesburns@hotmail.com>
Subject: Lacock Viewing Area

Hi Andy,

Attending the last viewing session at Lacock recently, I noted that the pathway between the car park and the field is becoming very muddy and puddled again. I'm not sure who is responsible for maintenance but I wondered whether at the next meeting we could approve the purchase of 3 or 4 bags of aggregate to put down to improve drainage - we have plenty of money in the society account and this would also serve a wider community purpose (maybe we need to ask the National Trust or somebody else first)?

https://www.wickes.co.uk/Tarmac-10mm-Gravel-Pea-Shingle---Major-Bag/p/131882

Dave.

Viewing Log for 1st December

Finally after weeks of cloudy skies or the Moon has been near full there has been a clear sky and I have the evening free!

So after packing up my astro gear, I headed out to my usual viewing position of Uffcott which is just off the A4361 about five miles south of Swindon? The temperature when I arrived was + 2 °C and with little wind should be a reasonable experience for viewing? I was using my Meade LX90 GOTO telescope but for a change I would not use the Pentax XW14 mm eye piece but instead would use the Televue Ethos 13 mm eye piece, not much differences in magnification but it meant I needed two counterbalance weights as the Ethos is much heavier than the Pentax, I think this is the first time I have used two weights on this telescope? I noticed while doing the set ups the last time I was out was five weeks ago, I knew it had been a while! Anyway I was ready by 19:38, I could see the waxing crescent Moon not far above the horizon so I thought I would attack this object first before it went into the hedge and not viewable, (would set 48 minutes later)? Even with a Moon filter on the eye piece and the object low in the sky it was still bright for my eye. I could not focus on the terminator very well, thermals in the sky stopped that I guess? So it was a case of just looking at it and going from there, I could make out a few nice craters, Mare Nectaris and Mare Tranquillities were starting to show themselves along the terminator, Moon phase was 27.3 % lit or 5.19 days old and a distance of 396,659 km's from Earth (all info from Virtual Moon Atlas). Now the Moon was done, hopefully my eye sight would return to normal? Onto the planets and again I would try for Uranus, once slewed to the position I could not find it! Looking thru the finder scope I saw a reasonable bright star/planet not far away from the crosshair? So slewing to the object, I finally found Uranus had a try for Neptune but had no luck finding this planet. The Moon was also not in the eye piece when I went to it, had to slew the scope a bit before it was centred! When I went to all the deep sky objects later on, they were all in the field of view of the eye piece, maybe not centre but I could see them, strange?

With the solar system objects now finished it was time to attack my deep sky list for the evening, I would be using a let's go to this constellation area and once there use my Sky & telescope Pocket Sky Atlas for other objects to view. So it would be the Cygnus area of the sky, first was M 27 probably the best Planetary Nebula (PN) in the sky followed by the second best PN in M 57 (these are my choice, there could be better in the sky but not from the Swindon area?). After M 57, it was a short hop to M 56 a small Globular Cluster (GC), I think I could make out the odd star in the GC? Up the neck of the Swan to M 29 a loose Open Cluster (OC) which looks like a slightly crushed rectangle of six stars? Pass the tail of the Swan too M 39, another loose OC which was better to view with the finder scope as with the eye piece I was looking thru it and only see a few stars? Time to look at the atlas, I saw IC 5146, the Cocoon Nebula? Once punched into the hand controller, this also comes up as C 19, yet to me I could not see much, just a fuzzy blob? Another Caldwell object popped up (C 19), I went to NGC 6826 (Blinking Planetary), this PN was similar to M 57 but a bit duller and smaller but still worth a visit. Time to go south and into Sagitta and the only Messier object in this constellation and M 71, this is a faint GC to look at, could not make out any real detail from it? Another GC was next, M 15 is a tight and much brighter object to look at. Above the Square of Pegasus is NGC 7331 (Stephan's Quintet), also known as C 30, of the five objects all I could see was one and that faint fuzzy blob to look at, typical Spiral Galaxy (SG) to me! Time to go overhead and look at the Cassiopeia area, first was the Bubble nebula (NGC 7635 or C 11), there was something to be seen but I could not make anything out? Looking at the info from the hand controller, this object is best viewed with a camera and not the eye! Not far away is M 52 a rather dim OC, the other Messier object in Cass was much better to look at, M 103 looked more like a triangle of stars? Often overlooked in this constellation is NGC 457, the ET or Owl cluster, it gets this name as from two of the brighter stars in this OC the other stars form into wings (loosely) and hence this name? Off to two OC's that is not in Messiers list, namely NGC 884 and 869, better known as the Double Cluster. Personally I think 869 is the better looking of the two? Going south thru Andromeda into Triangulum and M 33, I had to tap the eye piece to find this SG as it is dim to look at? Back into Andromeda and M 31, this SG you cannot miss as it has a bright central core? Orion had now cleared the hedge so I turned the scope in that direction. Started with M 1, the Crab nebula just above Orion, could make it out but no detail? Onto M 78 just above and to the east of the belt stars of Orion, all I could make out of this reflection nebula was two stars and nothing else? I could put it on par with M 40 a double star in Ursa Major but I am sure it is a lot better than that? It is actually the brightness diffused reflection nebula in the whole sky coming in a magnitude + 8.3. A quick blast at some OC's, namely M 35 (large and loose), M 36 (much smaller than 35), M 37 (large and bright) and finally M 38 (large but spaced out), of the four I think M 37 is the best? Final object's for the evening as my fingers and feet where starting to get cold was M 42 and 43, as usual there great to look at, so much detail to be seen. A few nights earlier I had been at Andy's house taking pictures of this object, hopefully you can see one somewhere in this magazine?

It was now 21:22 and with some frost over (temperature had dropped to + 1 °C) the equipment and car I was all packed up in seven minutes! During the 100 odd minutes I was out only two cars pass me one at 20:05 and another at 20:25, the second was going very slowly, I thought it was rubber necking me at it went past but it turned out a dog was lose and going up the road. One way to walk or should that be drive your dog I guess?

Clear skies to all.

Peter Chappell

PS for years I had been wondering if you could see both the winter triangle of stars namely Sirius, Procyon and Betelgeuse and the summer triangle of stars, namely Altair, Deneb and Vega above the horizon from Swindon. Turns out if I had stayed around for another 25 minutes I might have seen all six stars above the horizon assuming the view was clear, with the high hedge I have in the area that would probably not happen?

INTERNATIONAL ASTRONOMY SHOW AND FILTERS

Andy Burns

The International Astronomy Show which took place in the Warwickshire Agricultural Showground on 15h November is a joy to walk around compared to the squash and rabble of the Astrofest, And the speakers are getting better too, as the sort a better building with auditorium attached (and great bacon butties available in the café).

The main advantage is the space available for the retailers to be given (comparatively) much cheaper space to lay out their wares, however this year two European retailers with slightly different kit found the insecurities of Brexit indecision left them unable to attend the show (so much for no affects yet).

Some of the retailers based in the UK are also experiencing problems with dealing in Europe with orders for Pulsar domes drying up.

One Chinese developed piece of glass I was chasing was the relatively new Optilong LEnhance filter (along with other filters for photographic work with DSLRs).

I also ordered and picked up some nice tripod mount binoculars for the observatory in Spain. A few meteorites and that was me done for the year. And certainly makes me reluctant to go to Astrofest in London next February.

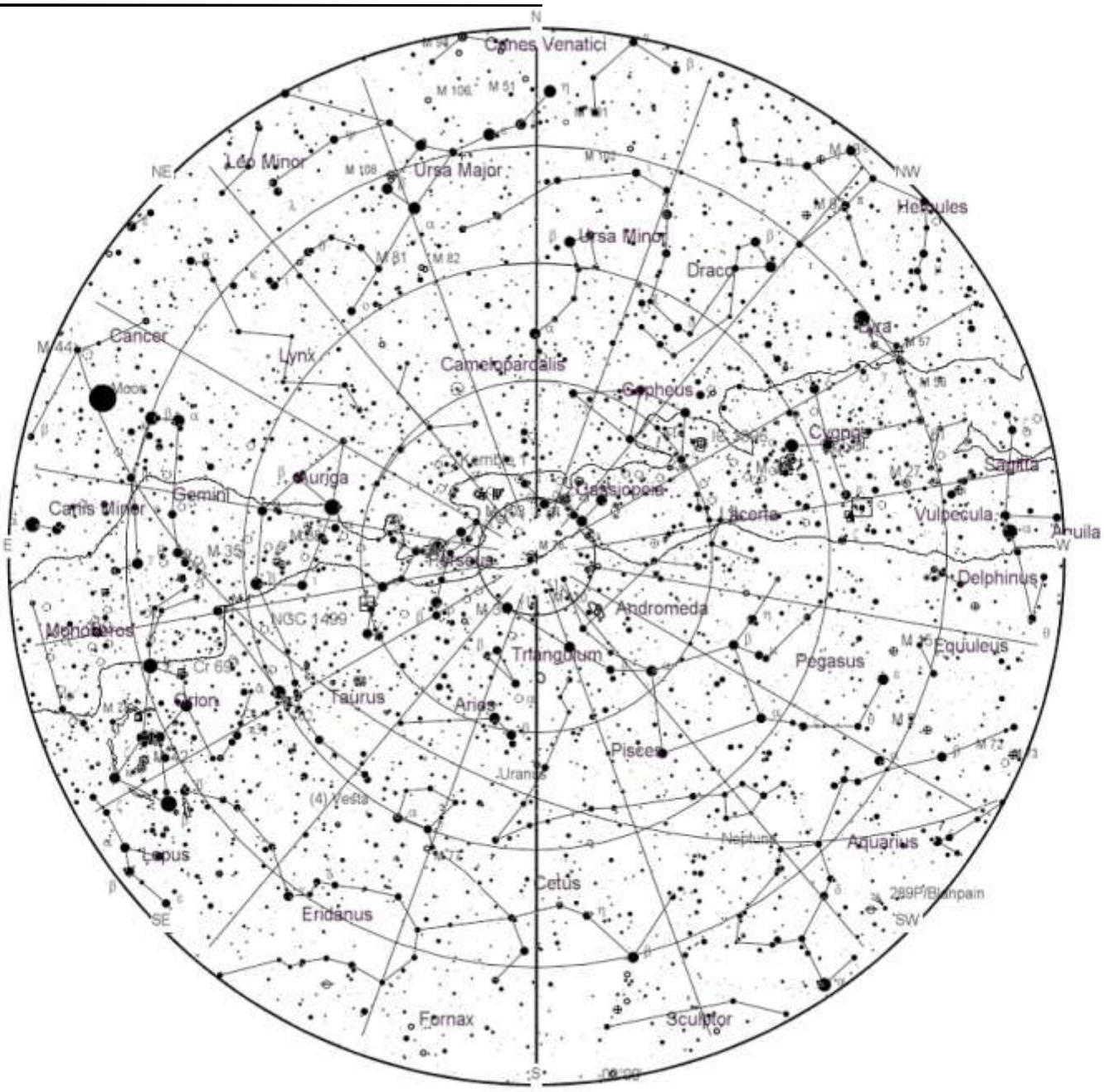
Now for the filters.

The first Moon free evening was not until last Friday and I invited members to come round and see the filters in use, And Peter was quick to offer up his Canon D600 for first use of the L Enhance filter, straight out of the box. He had never seen let alone imaged the Banard33 dark nebula over IC434 hydrogen area that makes up the Horsehead near Orion's belt. We had to try several exposures tests and ISO settings but eventually came up with something.

Also the Orion nebula came out well but the Pleiades were not good… but the nebulosity here is very different to the the excited hydrogen reds of the other objects.

The graininess could be helped with software or even stacking lots of lower ISO pictures, but we were also trying to see it on the camera screen.

WHATS UP, December 2019



.December 12 - Full Moon. 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 05:14 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.

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. Unfortunately the nearly full moon will block out many of the 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 22 - December Solstice. The December solstice occurs at 04:19 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 waning crescent moon should not interfere too much this year. Skies should still be dark enough for what could be a good show. 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 26 - 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 05:15 UTC. This is the best time of the month to observe faint objects such as galaxies and star clusters because there is no moon-

light to interfere.
December 26 - Annular Solar Eclipse. An annular solar eclipse occurs when the Moon is too far away from the Earth to completely cover the Sun. This results in a ring of light around the darkened Moon. The Sun's corona is not visible during an annular eclipse. The path of of the eclipse will begin in Saudi Arabia and move east through southern India, northern Sri Lanka, parts of the Indian Ocean, and Indonesia before ending in the Pacific Ocean. A partial eclipse will be visible throughout most of Asia and northern Australia.

The Geminids

The Geminids are considered to be one of the most spectacular meteor showers of the year, with the possibility of sighting around 120 meteors per hour at its peak, which is on December 13 or 14, depending on your time zone.

The shower owes its name to the constellation Gemini because the meteors seem to emerge from this constellation in the sky.

An Asteroid Meteor Shower

Unlike most other meteor showers, the Geminids are not associated with a comet but with an asteroid: the 3200 Phaethon. The asteroid takes about 1.4 years to orbit the Sun.

What Time Does the Meteor Shower Peak?

The table is updated daily and shows the position of the Geminids radiant in the sky for the upcoming night. Use the date drop down above the Interactive Meteor Shower Sky Map to change dates.

Direction to see the Geminids in the sky:

Azimuth is the direction, based on true north; a compass might show a slightly different value.

Altitude is height in degrees over horizon.How to See the Geminids

You don't need any special equipment or a lot of skills to view a meteor shower. Even though all you really need is a clear sky, lots of patience, and our handy Interactive Meteor Shower Sky Map with a visibility conditions meter to see a meteor shower, the following tips can help maximize your shooting star viewing experience.

- Find a secluded viewing spot, away from the city lights. Once at the venue, your eyes may take 15 to 20 minutes to get used to the dark.

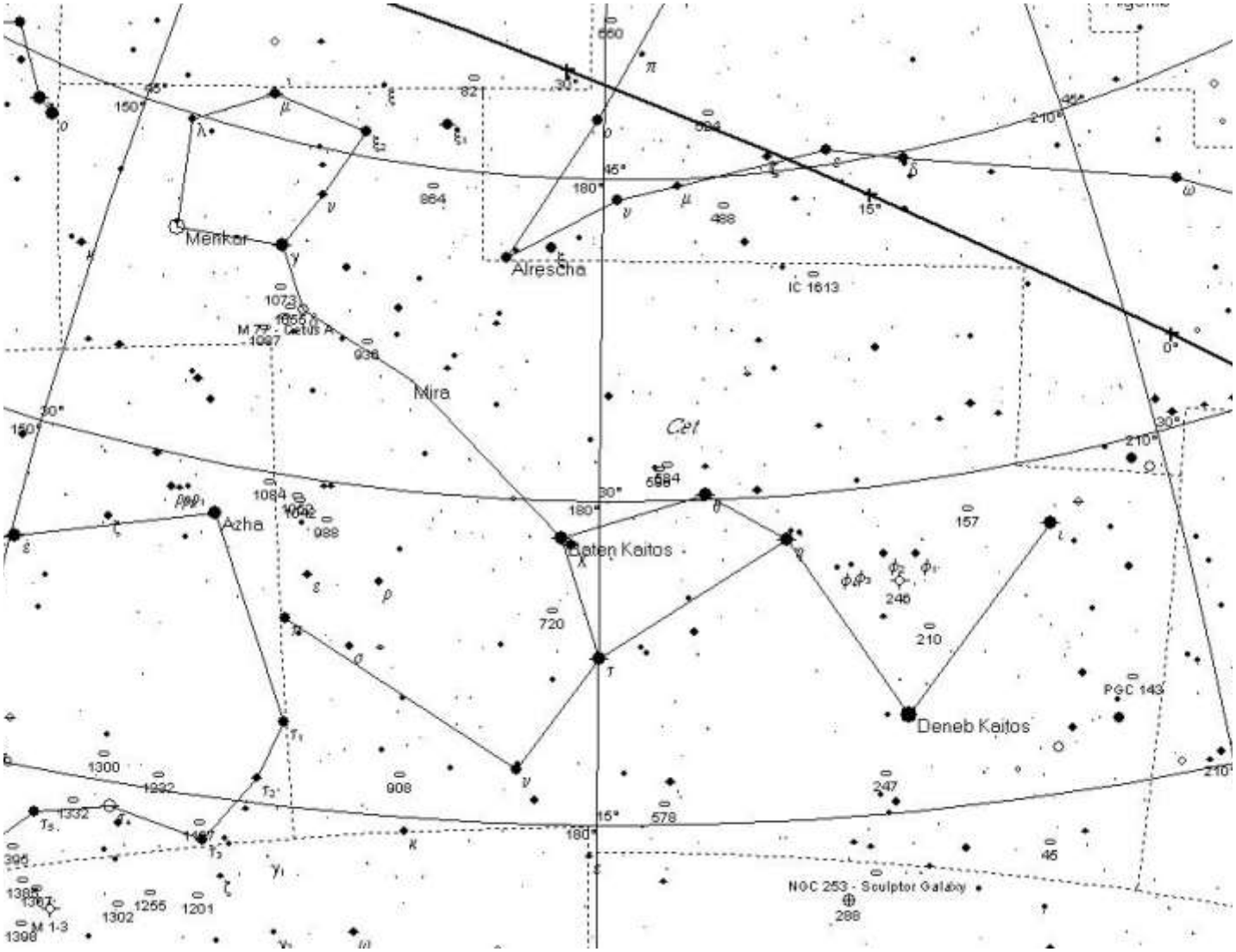
Dress for the weather, and make sure you are comfortable, especially if you plan to stay out long. Bring a blanket or a comfortable chair with you—meteor watching can be a waiting game.

Once you have found your viewing spot, lie down on the ground and look up in the direction of the radiant. Use our Interactive Meteor Shower Sky Map or the table above to find the current direction of the radiant in the sky.

Geminids meteor shower for Cheltenham (Night between 14 December and 15 December)

Time	Azimuth/ Direction	Altitude
Sat 17:00	35°	3.3°
Sat 18:00	46°	9.2°
Sat 19:00	57°	16.4°
Sat 20:00	67°	24.5°
Sat 21:00	77°	33.3°
Sat 22:00	88°	42.5°
Sat 23:00	101°	51.7°
Sun 00:00	117°	60.4°
Sun 01:00	141°	67.6°
Sun 02:00	176°	71.1°
Sun 03:00	213°	68.7°
Sun 04:00	239°	62.1°
Sun 05:00	256°	53.5°
Sun 06:00	269°	44.4°
Sun 07:00	280°	35.2°

CONSTELLATIONS OF THE MONTH: Cetus



The Cetus Constellation

In the 2nd century CE, Greek-Egyptian astronomer Claudius Ptolemaeus (aka. Ptolemy) compiled a list of all the then-known 48 constellations. This treatise, known as the *Almagest*, would be used by medieval European and Islamic scholars for over a thousand years to come, effectively becoming astrological and astronomical canon until the early Modern Age.

One of these constellations is Cetus, which was named in honour of the sea monster from Greek mythology. Cetus is the fourth largest constellation in the sky, the majority of which resides just below the ecliptic plane. Here, it is bordered by many "watery" constellations – including Aquarius, Pisces, Eridanus, Piscis Australus, Capricornus – as well as Aries, Sculptor, Fornax and Taurus. Today, it is one of the 88 modern constellations recognized by the IAU.

Name and Meaning:

In mythology, Cetus ties in with the legendary Cepheus,Cassiopeia, Andromeda, Perseus tale – for Cetus is the monster to which poor Andromeda was to be sacrificed. (This whole tale is quite wonderful when studied, for we can also tie in Pegasus as Perseus' horse, Algol and the whom he slew to get to Andromeda and much, much more!)

As for poor, ugly Cetus. He also represents the gates to the underworld thanks to his position just under the ecliptic plane. Arab legend has it that Cetus carries two pearl necklaces – one broken and the other intact – which oddly enough, you can see among its faint stars in the circular patterns when nights are dark. No matter what the legends are, Cetus is an rather dim, but interesting constellation!

History of Observation:

Cetus was one of many Mesopotamian constellations that passed down to the Greeks. Originally, Cetus may have been associated with a whale, and is often referred to as the Whale. However, its most common representation is that of the sea monster that was slain by Perseus.

In the 17th century, Cetus was depicted variously as a "dragon fish" (by Johann Bayer), and as a whale-like creature by famed 17th-century cartographers Willem Blaeu and Andreas Cellarius. However, Cetus has also been variously depicted with animal heads attached to an aquatic animal body.

The constellation is also represented in many non-Western astrological systems.In Chinese astronomy, the stars of Cetus are found among the Black Tortoise of the North (*B?i F?ng Xuán W?*) and the White Tiger of the West (*X? F?ng Bái H?*).

Cetus sprawls across 1231 square degrees of sky and contains 15 main stars, highlighted by 3 bright stars and 88 Bayer/Flamsteed designations. It's brightest star is Beta Ceti, otherwise known as Deneb Kaitos (Diphda), a type K0III orange giant which is located approximately 96.3 light years away. This star has left its main sequence and is on its way to becoming a red giant.

The name Deneb Kaitos is derived from the Arabic "*Al Dhanab al Kaitos al Janubiyy",* which translates as "the southern tail of Cetus". The name Diphda comes "*ad-dafda at-tani*", which is Arabic for "the second frog" – the star Fomalhaut in neighboring Piscis Austrinus is usually referred to as the first frog.)

Then there's Alpha Ceti, a very old red giant star located approximately 249 light years from Earth. It's traditional name (Menkar), is derived from the Arabic word for "nostril". Then comes Omicron Ceti, also known as Mira, binary star consisting located approximately 420 light years away. This binary system consists of an oscillating variable red giant (Mira A).

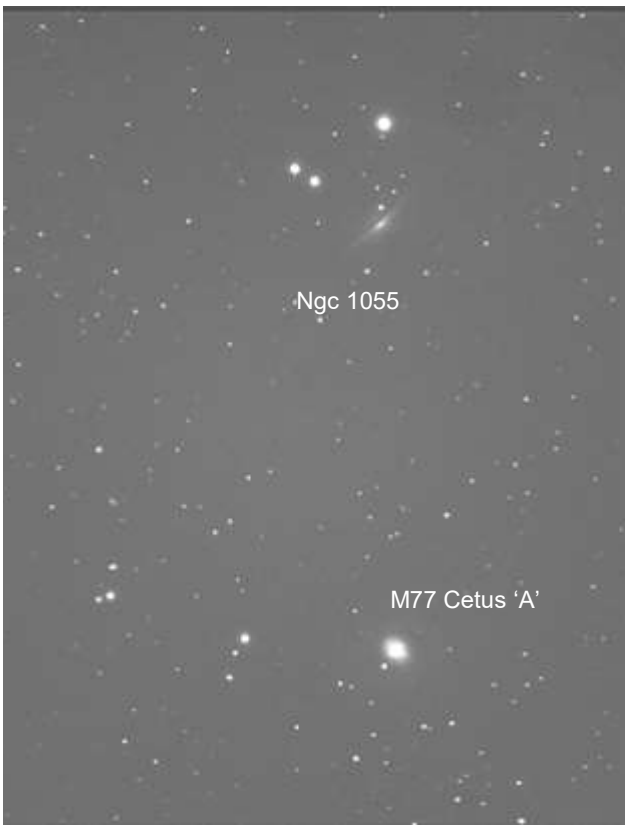
After being recorded for the first time by David Fabricius (on August 3, 1596), Mira has since gone on to become the prototype for the Mira class of variables (of which there are six or seven thousand known examples). These stars are red giants whose surfaces oscillate in such a way as to cause variations in brightness over periods ranging from 80 to more than 1,000 days.

Cetus is also home to many Deep Sky Objects. A notable examples is the barred spiral galaxy known as Messier 77, which is located approximately 47 million light years away and is 170,000 light years in diameter, making it one of the largest galaxies listed in Messier's catalogue. It has an Active Galactic Nucleus (AGN) which is obscured from view by intergalactic dust, but remains an active radio source.

Then there's NGC 1055, a spiral galaxy that lies just 0.5 north by northeast of Messier 77. It is located approximately 52 million light years away and is seen edge-on from Earth. Next to Messier 77, NGC 1055 is a largest member of a galaxy group – measuring 115,800 light years in diameter – that also includes NGC 1073 and several smaller irregular galaxies. It has a diameter of about 115,800 light years. The galaxy is a known radio source.

Finding Cetus:

Cetus is the fourth largest constellation in the sky, is visible at latitudes between +70° and -90° and is best seen at culmination during the month of November. Of all the stars in Cetus, the very first you must look for in binoculars is Mira. Omicron Ceti was the very first variable star discovered and was perhaps known as far back as ancient China, Babylon or Greece. The variability was first recorded by the astronomer David Fabricius while observing Mercury.



Now aim your binoculars at Alpha Ceti. It's name is Menkar and we do know something about it. Menkar is an old and dying star, long past the hydrogen and perhaps even past the helium stage of its stellar evolution. Right now it's a red giant star but as it begins to burn its carbon core it will likely become highly unstable before finally shedding its outer layers and forming a planetary nebula, leaving a relatively large white dwarf remnant.

Hop down to Beta Ceti – Diphda. Oddly enough, Diphda is actually the brightest star in Cetus, despite its beta designation. It is a giant star with a stellar corona that's brightening with age – exerting about 2000 times more x-ray power than our Sun! For some reason, it has gone into an advanced stage if stellar evolution called core helium burning – where it is converting helium directly to carbon.

Are you ready to get out your telescope now? Then aim at Diphda and drop south a couple of degrees for NGC 247. This is a very definite spiral galaxy with an intense "stellar" nucleus! Sitting right up in the eyepiece as a delightful oval, the NGC 247 is has a very proper galaxy structure with a defined core area and a concentration that slowly disperses toward its boundaries with one well-defined dark dust lane helping to enhance a spiral arm. Most entertaining! Continuing "down" we move on to the NGC 253. Talk about bright!

Very few galactic studies come in this magnitude (small telescopes will pick it up very well, but it requires large aperture to study structure.) Very elongated and hazy, it reminds me sharply of the "Andromeda Galaxy". The center is very concentrated and the spiral arms wrap their way around it beautifully! Dust lanes and bright hints of concentration are most evident. and its most endearing feature is that it seems to be set within a mini "Trapezium" of stars. A very worthy study…

Now, let's hop off to Delta Ceti, shall we? I want to rock your world – because spiral galaxy M77 rocked mine! Once again, easily achieved in the small telescope, Messier 77 comes "alive" with aperture. This one has an incredible nucleus and very pronounced spiral arms – three big, fat ones! Underscored by dark dust lanes, the arms swirl away from the center in a galactic display that takes your breath away!

The "mottling" inside the structure is not just a hint in this ovalish galaxy. I guarantee you won't find this one "ho hum"… how could you when you know you're looking at something that's 47.0 million light-years away! Messier 77 is an active galaxy with an Active Galactic Nucleus (AGN) and one of the brightest Seyfert galaxies known.

Now, return to Delta and the "fall line" runs west to east on the north side. First up is galaxy NGC 1073, a very pretty little spiral galaxy with a very "stretched" appearing nucleus that seems to be "ringed" by its arms! Continuing along the same trajectory, we find the NGC 1055. Oh, yes… Edge-on, lenticular galaxy! This soft streak of light is accompanied by a trio of stars. The galaxy itself is cut through by a dark dust lane, but what appears so unusual is the core is to one side!

Now we've made it to back to the incredible M77, but let's keep on the path and pick up the NGC 1087 – a nice, even-looking spiral galaxy with a bright nucleus and one curved arm. Ready to head for the beautiful variable Mira again? Then let her be the guide star, because halfway between there and Delta is the NGC 936 – a soft spiral galaxy with a "saturn" shaped nucleus. Nice starhoppin'!

For more information, check out the IAUs list of Constellations, and the Students for the Exploration and Development of Space page on Canes Venatici and Constellation Families.

Sources:
Constellation Guide – Cetus Constellation
Windows to the Universe – Cetus
Chandra Observatory – Cetus
Wikipedia – Cetus
Universe Today – Cetus Tammy Plotner

Hi Andy,

Just spotted this on Wiltshire council website:

http://www.wiltshire.gov.uk/highways-improvements-led-lighting

Starting Oct 2019 street lights are beginning to be replaced throughout Chippenham and surrounding area. Work is scheduled to take approx. 2 years to complete.

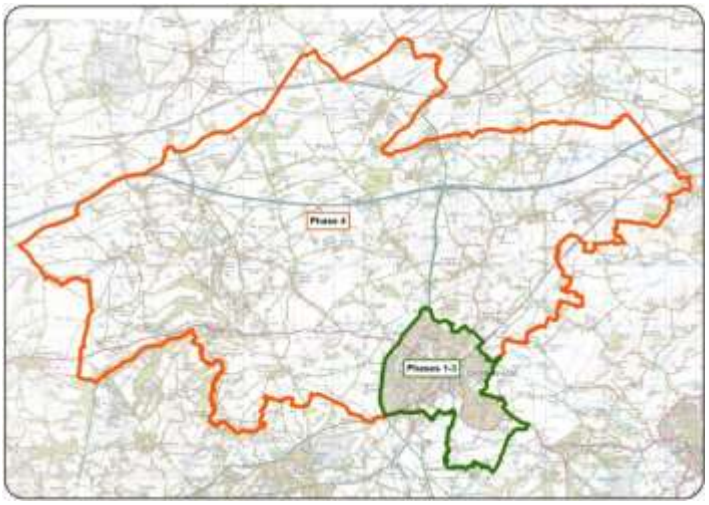
Wiltshire Council LED Street Lighting Project

Wiltshire Council is making a £12 million investment to convert its street lighting to LED lighting. The older types of lights are going out of production and the cost of energy is becoming prohibitive. The new lights are much more energy efficient and have a reduced carbon footprint.

The light from the LED units looks different as it is not orange in colour as some of the older lighting is. The new lights will provide similar lighting levels with less light spill and be considerably cheaper to operate and maintain. Instead of being turned off for part of the night many of the lights will be dimmed during off peak periods to further reduce energy consumption.

The conversion will be carried out quickly in most locations with little disturbance and disruption as it is only the electrical equipment being changed. However, in a few cases it may be necessary to renew the lighting column which will require excavation in the pavement to provide and connect the new column.

The operation of the lighting and the dimming regime will be reviewed after six months. The Frequently Asked Questions below have been developed below to aid any queries regarding this project.



Programme of work

Work is starting in Chippenham and the surrounding area in October. The first three phases of the project will focus on the replacement of lighting within the Town of Chippenham highlighted within the green area above. Phase four will see the lighting replaced in the surrounding Chippenham community area highlighted within the orange area above. These initial phases are expected to take around two months to complete. Following the completion of the Chippenham Community area the project will move forward, this website will be updated to show the upcoming phases.

Whilst most of the lights will be changed to the new type during the planned visit there will be occasions when special units are required. In such circumstance the special units will be fitted later in the programme.

The advantages of LED lighting include:

- LEDs are much more efficient and use much less electricity than other lamps or bulbs for similar output, reducing energy costs.
- Have extremely long lives compared to traditional lights.
- Produce very little heat.
- Produce much fewer carbon emissions through energy generation.
- Contain no mercury.
- Can operate effectively in both cold and hot environments.
- Produce a white light to enable the human eye to see natural colours at night.
- Are much more directional than other lights, reducing ‘sky glow’ and glare.
- LEDs are instantaneous and function at full output when switched on. No warm-up times as with most street lighting.
- They can be dimmed at off peak times.
- They provide improved uniformity of light.

Variation in colour temperatures are available for specific applications.
There are massive energy savings possible with the modern units. Older low pressure sodium lights will no longer be in production from 2020, and it will be necessary to replace them eventually.

Street lighting has benefits in terms of road safety and public safety. It supports the night time economy and helps reduce the fear of crime.

It is proposed to use LED units with what is known as a colour temperature of between 2700k and 3000k for most of the lights, which are often referred to as warm. Some other LED lights have a higher colour temperature of 4000k which some campaigners have had concerns about. The units to be used for this project will be Axia 3 lights manufactured by Urbis Schreder.

It is proposed to dim most of the lighting between 8pm and 6am, with additional dimming after 11pm. Lights at zebra crossings, areas with greater highway safety requirements, and areas with significant night time activity would generally not be dimmed.

The introduction of the new lighting will provide the opportunity dim and reduce lighting levels at sensitive locations. The scheme has the potential to have environmental benefits compared to most existing lighting types due to significant reduction in the emittance of UV light.

Older street lighting tends to spread light in all directions, including upwards. LED street lighting is less wasteful and directs the distribution of light down towards the road and pavement. This helps in reducing any light intrusion into homes and gardens. Where appropriate additional dimming or shielding could be applied to further minimise concerns.

ISS PASSES For December 2019 From Heavens Above website maintained by Chris Peat

Date	Brightness (mag)	Start			Highest point			End		
		Time	Alt.	Az.	Time	Alt.	Az.	Time	Alt.	Az.
03 Dec	-3.7	16:36:13	10°	W	16:39:34	87°	SSE	16:42:57	10°	E
03 Dec	-3.9	18:12:59	10°	W	18:16:20	83°	SSW	18:16:27	81°	SSE
04 Dec	-3.8	17:24:31	10°	W	17:27:53	88°	N	17:30:01	21°	E
04 Dec	-1.4	19:01:18	10°	W	19:02:55	24°	W	19:02:55	24°	W
05 Dec	-3.3	18:12:48	10°	W	18:16:06	56°	SSW	18:16:32	50°	SSE
06 Dec	-3.6	17:24:18	10°	W	17:27:40	71°	SSW	17:30:15	16°	ESE
06 Dec	-1.2	19:01:21	10°	W	19:03:10	20°	WSW	19:03:10	20°	WSW
07 Dec	-2.1	18:12:40	10°	W	18:15:42	32°	SSW	18:17:01	23°	SSE
08 Dec	-2.6	17:24:05	10°	W	17:27:18	43°	SSW	17:30:31	10°	SE
08 Dec	-0.7	19:02:18	10°	WSW	19:03:23	11°	SW	19:04:00	11°	SSW
09 Dec	-3.1	16:35:33	10°	W	16:38:52	58°	SSW	16:42:09	10°	ESE
09 Dec	-0.9	18:12:53	10°	W	18:15:07	17°	SW	18:17:20	10°	S
10 Dec	-1.3	17:24:00	10°	W	17:26:46	24°	SSW	17:29:32	10°	SSE
11 Dec	-1.8	16:35:19	10°	W	16:38:22	33°	SSW	16:41:26	10°	SE
12 Dec	-0.4	17:24:41	10°	WSW	17:26:02	12°	SW	17:27:22	10°	SSW
13 Dec	-0.6	16:35:23	10°	W	16:37:42	18°	SW	16:40:02	10°	S
21 Dec	-0.5	06:54:45	10°	S	06:56:30	14°	SE	06:58:14	10°	ESE
23 Dec	-1.5	06:52:43	10°	SSW	06:55:34	26°	SSE	06:58:24	10°	E
24 Dec	-1.1	06:04:39	10°	S	06:07:03	19°	SE	06:09:28	10°	E
25 Dec	-0.8	05:17:35	11°	SSE	05:18:36	13°	SE	05:20:08	10°	ESE
25 Dec	-2.8	06:51:30	10°	SW	06:54:43	48°	SSE	06:57:57	10°	E
26 Dec	-2.3	06:04:25	20°	SSW	06:06:07	35°	SSE	06:09:11	10°	E
27 Dec	-1.5	05:18:07	24°	SE	05:18:07	24°	SE	05:20:20	10°	E
27 Dec	-3.7	06:51:01	13°	WSW	06:53:57	76°	SSE	06:57:18	10°	E
28 Dec	-3.4	06:04:32	45°	SW	06:05:16	60°	SSE	06:08:34	10°	E
29 Dec	-1.7	05:17:57	28°	E	05:17:57	28°	E	05:19:48	10°	E
29 Dec	-3.8	06:50:50	18°	W	06:53:13	87°	N	06:56:34	10°	E
30 Dec	-3.9	06:04:09	71°	WSW	06:04:28	86°	S	06:07:49	10°	E
31 Dec	-1.6	05:17:24	27°	E	05:17:24	27°	E	05:19:04	10°	E
31 Dec	-3.8	06:50:17	20°	W	06:52:28	87°	N	06:55:49	10°	E
01 Jan	-4.0	06:03:29	76°	WNW	06:03:42	85°	N	06:07:03	10°	E
02 Jan	-1.6	05:16:39	26°	E	05:16:39	26°	E	05:18:15	10°	E
02 Jan	-3.7	06:49:32	20°	W	06:51:39	74°	SSW	06:54:58	10°	ESE
03 Jan	-4.0	06:02:41	78°	W	06:02:52	86°	SSW	06:06:12	10°	E
04 Jan	-1.6	05:15:49	26°	E	05:15:49	26°	E	05:17:25	10°	E
04 Jan	-3.2	06:48:42	20°	W	06:50:42	46°	SSW	06:53:54	10°	SE
05 Jan	-3.7	06:01:50	60°	SSW	06:01:57	61°	SSW	06:05:14	10°	ESE
06 Jan	-1.5	05:15:00	24°	ESE	05:15:00	24°	ESE	05:16:30	10°	ESE
06 Jan	-2.3	06:47:53	17°	WSW	06:49:35	25°	SSW	06:52:22	10°	SSE
07 Jan	-2.8	06:01:04	35°	SSW	06:01:04	35°	SSW	06:03:57	10°	SE
08 Jan	-1.2	05:14:17	19°	SE	05:14:17	19°	SE	05:15:21	10°	SE
08 Jan	-1.5	06:47:10	12°	WSW	06:48:16	13°	SW	06:49:53	10°	SSW
09 Jan	-1.7	06:00:27	18°	SSW	06:00:27	18°	SSW	06:02:04	10°	S

END IMAGES, OBSERVING AND OUTREACH

On the 11th of November we got our last chance to view a transit of Mercury until November 13th 2031.

It was not looking promising before midday and then the sky cleared enough to see the start of the transit and though blighted by thin cloud that the Halpha scopes had problems with the Herschel Wedges and the Mylar filter as used here on a photographic rig using a bridge camera with Mylar filter, Nikon P1000.

Mercury was tiny, but there. And we were able to share this with lots of members of the public too.

Andy

Wiltshire Astronomical Society	**Observing Sessions 2019/20**	
Date	**Moon Phase (%)**	**Moonrise/Targets**
2019		
27th December 6:30pm start	0%	East to West Milky Way
2020		
24th January	0%	Orion and Taurus high to S.
28th February	16% 4day crescent	Venus, Messier Marathon Day.
27th March	6% 2.3day set before start	Venus, Milky Way South to North
24th April not dark until 9:30pm	0%	Venus high, galaxies of Leo and Virgo clusters
22nd May not dark until 10pm	0%	Summer triangle rising

OUTREACH

Our December observing sessions may also have some members of Broughton Gifford school as mentioned in our e-mail pages. Any one with telescopes please.

28th January Westbury Leigh School Talk the observing session from 5pm. Help needed. We will need 4/5 telescopes manned.