NWASNEWS

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January 2020

Newsletter for the Wiltshire, Swindon, Beckington Astronomical Societies

Happy New Year

Happy New year. And we start our year with the usual forum of questions and answers plus any beginners queries for the evening. Even 'seasoned' astronomers have questions that may seem easy but confused. We hope that you can learn something from tonight.

I have only received one formal question on equipment that I could pre research for, and it is a piece a equipment I have seen but never bought, even for Spain.

But we will find answers for most questions and can through together some talks or pictures that we can learn from.

I have included in the full Newsletter a page that showed my latest mistake when imaging. A whole evening of deep sky tests wasted by a little software error that I forgot to compensate for. Error in the drive speed being auto set by the control panel. I have upgraded my paddle to series 4 but have yet to test if the same error occurs. I need some more clear nights to test.

It may seem we had a cloudy year for observing, but I can confirm it wasn't as bad as we may think, with February and March being the worst months in total nights available, but in an El Nino year we have had much worse periods of poor weather.

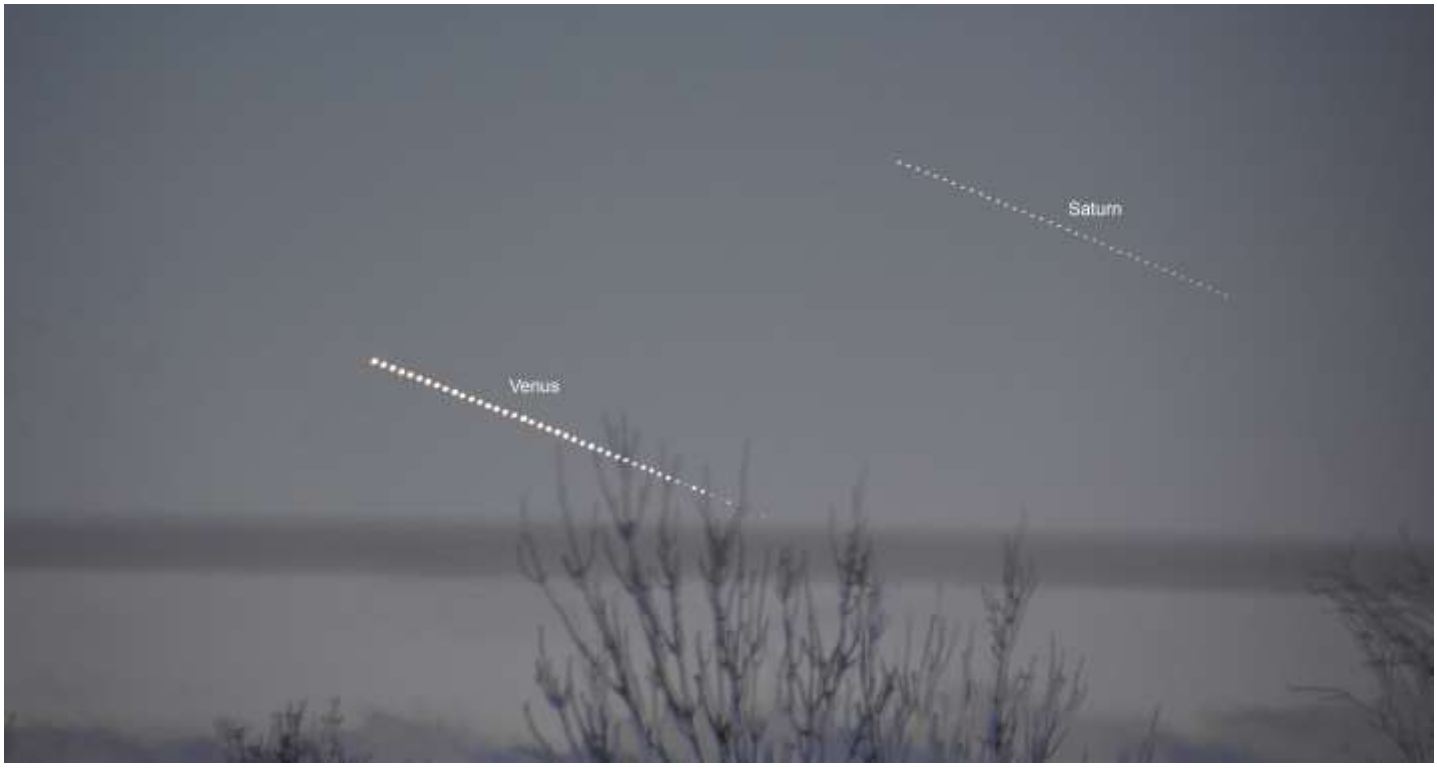
Chris Brooks has been monitoring the Sunspot activity on the Sun, And while we have one or two spots recently that are part of the new cycle there were over 280 days in 2019 with no Sunspots, This is the highest low activity year for over 135 years, and the last cycle one of the worst recorded. The significance for Earth's climate is an unknown, but it worth noting.

See the Spaceweather web page for historical numbers.

Clear skies Andy Burns.

The evenings have been putting on a show of planets in the south west, unfortunately an area of the sky cut off to me through trees, electrical cables or houses. But with the winter leafless state I caught a series of exposures with Venus and Saturn between clouds. 40 exposures from upstairs window… stacked in Startrails.

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

NEW SEASON 2019/2020

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'.

Tonight is our forum and beginners Q and A session.

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)

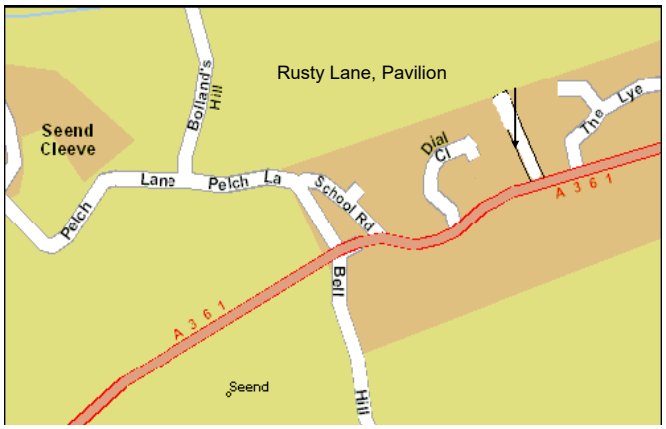
Peter Chappell (Speaker secretary)

Nick Howes (Technical Guru)

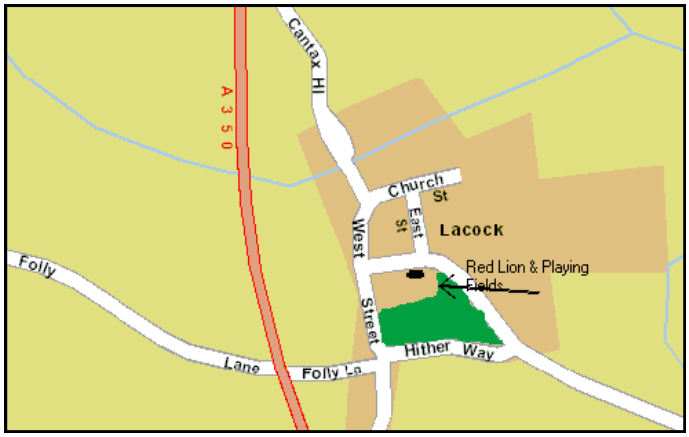
Observing Sessions coordinators: Chris Brooks, Jon Gale,

Web coordinator: Sam Franklin

Contact via the web site details.



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. bat-tery. 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

January meeting

We reconvene on January 17th when Ian Smith will be presenting a presentation on ' Imaging Planetary Nebula', the first of two sessions on astrophotography this 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 2020

Friday 17 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

-------Summer Break------

Friday 18 September

Programme: Ian Smith - Narrowband Imaging

Friday 16 October

Programme: Dr James Fradgley MSc, FRAS: The Universe - 'A brief overview of what we know, or think we know'

Friday 20 November

Programme: Dave Eagle FRAS PGCE BSc (Hons): 'Comets, Enigmatic and Beautiful Visitors'

Website:
http://www.swindonstargazers.com

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dark sky wales
dywyllwch awyr cymru

The Night Sky in January 2020

Winter is upon us but beautiful constellations of Orion, Auriga, Taurus and Gemini are available in the early evening and the spring groups rise after midnight.

Moon in January

New: 24thJanuary
First quarter: 3rdJanuary
Full: 10thJanuary
Last Quarter: 17thJanuary

Planets in January

Mercury: may just be caught in the western sky by mid month shining quite brightly at magnitude -1.2. Venus will not be far away.

Venus: is an evening object in the constellation of Aquarius, very bright at magnitude -3.9 and unmistakable as a bright white starlike object in the west

Mars: is an early morning object in the constellation of Scorpius, rising at 03:00 by mid month and shining feebly at magnitude 1.5

Jupiter: Is still in Sagittarius and not really available for good viewing this month

Saturn: Is also in Sagittarius and unavailable for good observations this month as it is in conjunction with the Sun.

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 but sets after midnight.

Neptune: can be found in Aquarius but it shines feebly at magnitude 7.9 setting by 22:00 by mid month

Meteor showers in January

The annual Quadrantid meteor shower peaks every year around January 3 or 4, but is nominally active for roughly two weeks, from about December 27 till January 10. However, peak activity lasts less than a day. The expected peak night is January 3-4 (late evening January 3 till dawn January 4), with the predawn hours on January 4 being the best bet.

Interesting Events in January

At full moon on the 10th January there is a penumbral lunar eclipse visible in its entirety from the UK. The mid eclipse point will be reached by 19:25 UT. It will be the deepest penumbral eclipse of 2020 and may be worth watching.

Comets in January

There are no bright comets reported for observation this month.

Constellation of the Month: Lynx

Lynx is a rather obscure collection of stars, most of which are 5th magnitude objects, and widely spaced in the sky. The constellation lies to the north east of Gemini, bordering on Auriga, but contains few objects of note. The group is possibly an ancient constellation as it is mentioned by Aratus as being positioned in front of the great bear. Its modern pattern was created by Hevelius to fill a convenient gap between the constellations of the winter sky and those of spring.

Lynx contains two objects of note, although the observer equipped with binoculars had better move on, or simply note the position of this constellation, as these objects are beyond such modest instruments. The first deep sky wonder is a lovely edge on spiral galaxy of Sb type, NGC 2683, which lies just above the borderline with cancer, west of the star Alpha Lynxis and on a line with it. NGC 2683 is a 10.6 magnitude smudge of blue white light that is easy to spot in a low power eyepiece, the most difficult part is finding it among the barren stars of this group!

The most observed object in this constellation is a remote globular star cluster NGC 2419, which can be located close to the 5th magnitude star phi Lynxis, above the glowing luminance of Castor in Gemini. This is not the greatest cluster you will ever see, in fact it is one of the dimmest, shining as it does at magnitude 11.2 In addition its stars are virtually irresolvable in a small telescope. Its fame lies in the fact that it is the most distant globular cluster known to belong to our Milky Way galaxy.

NGC 2419 was discovered by William Herschel in 1788, but its actual distance was not known until earlier this century when the astronomer Harlow Shapley calculated that it lies at the enormous distance of 278,000 light years from us, over 300,000 light years from the focus of its orbit, our galactic centre. NGC 2419 contains over 175,000 Sun-like stars, making it a respectable cluster despite its remoteness.

About 150 globular clusters are known to orbit our galaxy, but they mostly lie within a sphere of 65,000 light years of the galactic nucleus. Why NGC 2419 should be different is a mystery. The theory has been put forward that it does not really belong to our galaxy at all but is an "Intergalactic Tramp" or wanderer through the galaxies of the local group. However, studies of its recessional speed indicate that it may not have sufficient velocity to escape the gravitational tug of the Milky Way, and in a few million years it may come bounding back to us, charging through space at quite a rate as it obeys Kepler's third law of orbital motion.

NGC 2419 is not the only globular cluster to lie at such a remote distance. The other object known to be at a comparable distance is NGC 7006, a globular cluster in Delphinus, lying in the opposite direction to this one in Lynx. That being the case, the separation of these clusters must be huge, at least 5 times the diameter of the disc of the Milky Way! Make a diligent search therefore for both these remote objects, revelling in their independence from our galactic home.

Martin Griffiths

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
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.

ATMOSPHERIC DISPERSION CORRECTION.

The ability to produce good quality high-resolution planetary images is hampered by atmospheric dispersion, an effect in which white light is separated vertically into a spectrum of colours, with blue at the top and red at the bottom. The atmosphere effectively acts like a weak prism, causing light entering at an angle to be bent by refraction to a slightly steeper angle. Because refraction is wavelength dependent, an effect known as dispersion, the apparent 'lift' that the object gets from atmospheric refraction varies according to the colour of the light (see figure 1 below). Atmospheric dispersion gets more pronounced when the altitude of the object is lower. That's bad news for those in the Northern hemisphere because the brightest planets Jupiter, Saturn, and Mars will be at low elevations during their oppositions for the next several years through 2020 and beyond.

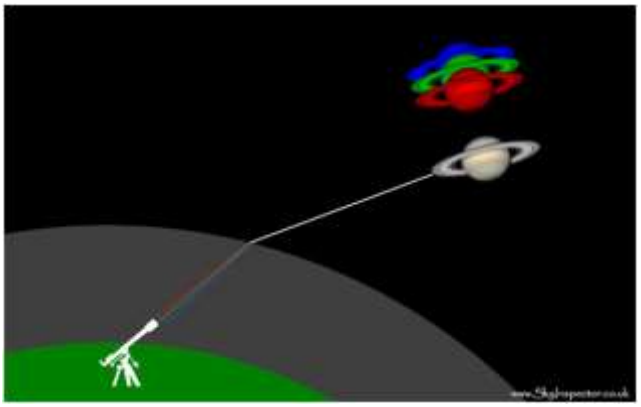


Figure 1: Atmospheric dispersion causes white light to be separated into its component colours with blue at the top and red at the bottom.

You can align the separate red, green and blue images manually or automatically during processing to remove the worst effects of atmospheric dispersion. But you can't use this method to correct any dispersion occurring within the colour band itself. Dispersion within the colour band is worse for shorter wavelengths like blue, worsens with decreasing altitude, and is much more problematic for one-shot colour (OSC) cameras. That's because these cameras have much wider colour bands than monochrome cameras which are usually used with dedicated high-quality R,G, and B filters.

To help planetary imagers and visual observers combat atmospheric dispersion, adjustable devices called Atmospheric Dispersion Correctors (ADCs) have become commercially available in recent years. These devices contain a pair of thin circular prisms which act to nullify the dispersion caused by the passage of light through the atmosphere by introducing dispersion of the opposite direction.

ADCs can give considerable benefits in image quality when planets are less than 30° high, but they also help improve detail when the planet is as high as 60°. An ADC can help with RGB mono imaging, one-shot colour imaging, true luminance imaging, and even during visual use (You can learn more about the operation of atmospheric dispersion correctors at this link)

ADCs operate best at higher focal ratios (>f/20), and this generally means they should be placed between the Barlow lens and the camera. Adjustment of an ADC involves setting the mid-point of the prism's horizontal and then moving the two prism control levers apart by equal amounts until the colour fringing from the atmosphere is cancelled out. Again, the link above gives more information on how to actually do this.

Prior to the launch of the new ZWO ADC at the end of 2015, three commercial ADCs were available on the market. By far the most expensive was made by Gutenhurst Optics. It is really targeted at professional users and it costs several thousand dollars. Unlike other commercial ADCs, this device has prisms each made of a crown and flint pair to eliminate the image positional shift that unfortunately usually goes hand in hand with the corrective dispersion.
Lower cost ADCs, priced for the amateur market, have been available for a number of years from ASH (Astro Systems Holland, http://www.astrosystems.nl) and from Pierro Astro in France (http://www.pierro-astro.com). Both devices cost around $500. Although much less expensive than the Gutenhurst ADC, this pricing is high enough to remain a major barrier to wider adoption by amateur planetary imagers.
The ZWO ADC is a much lower-cost device. It's available for about $130 in North America, and it promises to open up the benefits of ADCs to a much greater number of imagers. But how does such a low-cost device perform compared to its competitors? To answer this, I assessed an early production model of the ZWO ADC bought at the end of 2015.
To this we can add the Televue Paracorr range devised by Al Nagler.

The ZWO ADC, or Atmospheric Dispersion Corrector, reduces prismatic smearing during planetary imaging, resulting in images with finer details. It also improves the image when doing visual planetary observations, allowing the observer to see more surface detail.
Optical dispersion is an effect caused by the refractive quality of the atmosphere as light passes through it, and is dependent on the angle of the light as well as its wavelength. Optical dispersion spreads the incoming light into a vertical spectrum of colors, causing the object to appear higher in the sky than it truly is. The amount of “lift” that occurs is exaggerated when objects are closer to the horizon, and because optical dispersion is wavelength dependent, it causes the image to separate into different colors. That is why you will see a bluish fringe on the top of an object, and a red fringe at the bottom when atmospheric dispersion effects are particularly bad.
A correctly adjusted ADC, placed between the camera or eyepiece and a Barlow lens, will reduce the effects of optical dispersion and improve image resolution. It does this by applying the opposite amount of dispersion caused by the atmosphere to the image and then re-converging the light of the different wavelengths at the focal plane.
The ZWO ADC has three components: The ADC body, a 1.25" barrel adaptor for the bottom and 1.25" eyepiece adaptor for the top (with a brass compression ring). The two ends of the ADC body are female T -threaded. Two slots overlap to allow both levers to move together over a wider range to accommodate a changing orientation of the null location (without having to rotate the body).
A nice feature of the ZWO ADC is the white locking screw on the scale marking the horizontal position and the rotatable scale. This allows the null point to be readily seen to set the levers symmetrically on either side and allows you to finely position the null point without having to rotate the body. The black plastic prism adjusting levers also have a nice adjustable frictional resistance using O-rings at their base.
The two H-K9L (BK-7 equivalent) prisms in the device each have 2° deviation angles and are said to be of 1/10 wave accuracy.

Televue Paracorr

Paracorr is a universal corrector that tightens and intensifies star images on all f-ratios down to f/3! (see spot size graphs: **PDF** or **JPG**) without adding any false color or spherical aberration! You no longer have to constantly shift a Dobsonian to keep objects centered for sharp viewing. Using a Tele Vue eyepiece, put M-13 at the edge of the field and enjoy fully resolving its beauty as it drifts across your view.

Paracorr is easy to use. It slips into your focuser, just like a Barlow. To minimize focuser in-travel, due to additional length, a mild 15% Barlow effect was designed into Paracorr to effectively push the focus out. Paracorr is recommended for use with all Tele Vue eyepieces because our Plössls, Radians, Panoptics, Naglers, Ethos and Delos eyepieces achieve higher levels of aberration correction than competitive models. However, Paracorr is also compatible with other eyepiece makes.

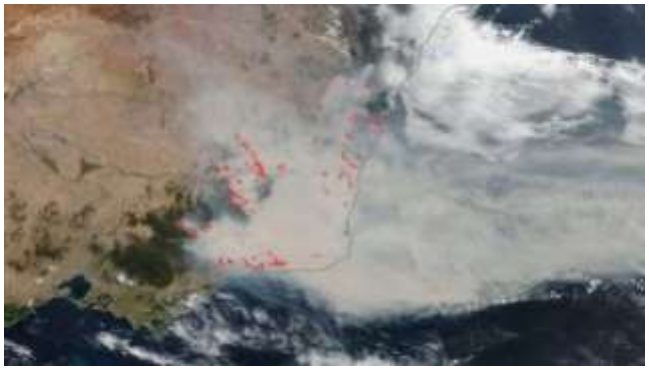
Try Paracorr on your "DobNewt." We think you'll agree that the revolution is complete.

SPACE NEWS FOR January 2020

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

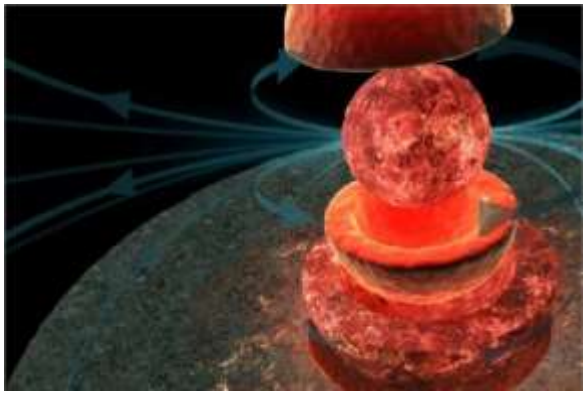
Australia's Deadly Wildfires in Photos: The View from Space

By Christine Lunsford an hour ago
Satellites are tracking Australia's devastating fires.



Wildfires devastated southeastern Australia in the final months of 2019 and in January 2020. See photos of those wildfires from space as NASA tracks them with satellites.
(Image: © NASA EOSDIS)
Fueled by a lengthy and intensifying drought, an early kickoff to fire season in the Australian states of Queensland and New South Wales began in September 2019 and continued into early 2020. Upwards of 100 wildfires have devastated Australia's southeast coast, killing at least 17 people.
Satellites from NASA and other agencies are tracking the deadly wildfires from space. Scroll down to photos of Australia's wildfires from space.
Full story: Satellite Images Show Australia's Devastating Wildfires from Space
This story was updated with new imagery on Jan. 6.

The Moon's Magnetosphere Used to be Twice as Strong as the Earth's



For decades, scientists have held that the Earth-Moon system formed as a result of a collision between Earth and a Mars-sized object roughly 4.5 billion years ago. Known as the Giant Impact Hypothesis, this theory explains why Earth and the Moon are similar in structure and composition. Interestingly enough, scientists have also determined that during its early history, the Moon had a magnetosphere – much like Earth does today.
However, a new study led by researchers at MIT (with support provided by NASA) indicates that at one time, the Moon's magnetic field may have actually been stronger than Earth's. They were also able to place tighter constraints on when this field petered out, claiming it would have happened about 1 billion years ago. These findings have helped resolve the mystery of what mechanism powered the Moon's magnetic field over time.

"Super-Puff" Exoplanets Aren't Like Anything We've Got in the Solar System

The study of extrasolar planets has really exploded in recent years. Currently, astronomers have been able to confirm the existence of 4,104 planets beyond our Solar System, with another 4900 awaiting confirmation. The study of these many planets has revealed things about the range of possible planets in our Universe and taught us that there are many for which there are no analogs in our Solar System. For example, thanks to new data obtained by the *Hubble Space Telescope*, astronomers have learned more about a new class of exoplanet known as "super-puff" planets. Planets in this class are essentially young gas giants that are comparable in size to Jupiter but have masses that are just a few times greater than that of Earth. This results in their atmospheres having the density of cotton candy, hence the delightful nickname!

Spaceflight Stories Expected for 2020

The year two thousand and twenty is almost upon us. And as always, space agencies and aerospace companies all around the world are preparing to spend the coming year accomplishing a long list of missions and developments. Between NASA, the ESA, China, SpaceX, and others, there are enough plans to impress even the most curmudgeonly of space enthusiasts.
While it is tough to summarize them all briefly, 2020 is expected to be the year where several major milestones are achieved. These will include the restoration of domestic launch capability to the United States, the deployment of new robotic missions to the Moon and Mars, the rise of the satellite internet market, and more steps taken that will eventually lead back to the Moon and on to Mars.
Here's a rundown of the missions that are sure to be the highlights of 2020 (in alphabetical order):

NASA's Orion spacecraft will carry astronauts further into space than ever before using a module based on Europe's Automated Transfer Vehicles (ATV). Credit: NASA

Artemis 1

First and foremost, the year 2020 will see NASA's taking the first major step on the road that will take it back to the Moon, otherwise known as Project Artemis. After years of preparation, testing, and unfortunate delays, the Space Launch System (SLS) and the Orion Multipurpose Crew Vehicle (MPCV) will be making their inaugural flight together.

Known as Artemis 1 – aka. Exploration Mission-1 (EM-1) – this mission will be the second planned flight involving an uncrewed Orion capsule and the first time the spacecraft is sent to the Moon. The launch will take place in November 2020 (at the earliest) from Launch Complex 39B at the Kennedy Space Center in Florida and is expected to last three weeks.
During this time, the Orion will fly to the Moon, spend a total of 6 days in a retrograde orbit, and then return to Earth. The mission will test key systems in the SLS and Orion to determine if they are ready to conduct crewed missions to space and the lunar surface. If all goes well, it will be followed by Artemis 2 – Exploration Mission 2 (EM-2) – which will see a crewed Orion make the trip around the Moon between 2022 and 2023.

Chang'e-5

China has made some very impressive gains in space exploration lately and has many impressive plans for the future. In 2020, many of these plans will be coming to fruition or taking important steps in that direction. First up is the ***Chang'e-5*** mission, the latest installment in the Chinese Lunar Exploration Program, which will launch sometime during the coming year.

China's Chang'e-4 lander on the lunar surface. Credit: CNSA/ CLEP

Like its predecessor, this mission will consist of a lunar lander and rover that will use a variety of instruments to study the surface. It will also be China's first sample-return mission to be sent to the Moon, which will make it the third nation to do so (after the US and Russia). It is to be followed by three more *Chang'e* missions, all of which are intended to pave the way for China's first crewed lunar mission.

Hayabusa2 Returns

In June of 2018, the ***Hayabusa2*** mission rendezvoused with the asteroid Ryugu, becoming the second mission sent by JAXA to a near-Earth asteroid. Following in the footsteps of its predecessor (***Hayabusa***), the mission surveyed the asteroid using a series of robotic landers and obtained samples from the surface for eventual return to Earth.
In November of 2019, *Hayabusa2* left orbit around Ryugu and began making its way home. In late 2020, it will return to Earth carrying its samples of Ryugu's surface, which scientists will analyze in the hopes of learning more about the early history of the Solar System – which could include details about its formation and subsequent evolution.

Hope Mars Mission

If there's one thing the modern space age is known for, its the way that more nations are taking part like never before. And 2020 will be the year that the United Arab Emirates, an upstart power in space, will send the ***Hope Mars Mission*** (a robotic probe) to Mars. This will be the first mission to Mars by any Arab or Muslim majority country.

Artist's impression of the UAE's Hope satellite in space. Credit and ©: UAE Space Agency

Once it reaches Mars, the probe will study the Martian atmosphere and provide details regarding the daily climate, the nature of Martian weather in different locations, seasonal cycles, and major events like dust storms. Ultimately, the probe is intended to help shed light on enduring questions about Mars' atmosphere, like how it is losing hydrogen and oxygen to space and why it experienced such dramatic climate change in the past.

HX-1

Another major milestone that is planned for 2020 is China's plan to deploy an orbiter and rover to Mars. Known as the Mars Global Remote Sensing Orbiter and Small Rover (HX-1), the mission is planned to be launched in July or August of 2020 and will reach Mars in February of 2021. Once there, it will join its NASA and ESA companions, assessing the environment and searching for evidence of past and present life.

Mars 2020

NASA will be launching the next mission in its Mars Exploration Program this coming year. Known as the ***Mars 2020*** rover (an official name is still in the works), this robotic explorer will follow in the footsteps of its sister-mission ***Curiosity***. Its main objectives will be to gather evidence of the history of Mars and looking for evidence of past (and possibly present) life.
The planned launch will take place on July 17th, 2020, and the rover will land on Mars by February 18th, 2021, in the Jezero crater. This region contains a fan-delta that is believed to have been created flowing water, is rich in clays and minerals and is thought to be an ideal place to find the fossilized remains of ancient life.

This artist's concept depicts NASA's Mars 2020 rover exploring Mars. Credit: NASA

The samples it collects will be placed in a cache for retrieval by an eventual crewed mission (still planned for sometime in the 2030s) and then returned to Earth for analysis. The rover will use many of the same components as the Curiosity mission but will also carry new instruments like a core drill and a helicopter drone.

OSIRIS-REx

Speaking of sample-returns, NASA's Origins, Spectral Interpretation, Resource Identification, Security, Regolith Explorer (OSIRIS-REx) mission will make its closest approach to as-

teroid Bennu in July of 2020. Descending to the surface, the robotic spacecraft will extend its TAGSAM robotic arm and gather samples of regolith. These samples will be returned to Earth by 2023 for analysis.

Rosalind Franklin

The ESA will also be sending another robotic explorer to Mars in the coming year as part of the ExoMars program (which is by the ESA and Roscosmos). Previously known as the ExoMars 2020 rover, this mission is now known as the *Rosalind Franklin* – an English chemist whose research revolutionized our understanding of molecule structures, viruses, and how DNA and RNA work.

This name was selected since the *Rosalind Franklin* (like *Curiosity* and *Mars 2020*) will be searching for evidence of past life on Mars. It is scheduled to launch in July 2020 and will rely on an ESA carrier module and Russian lander (*Kazachok*) to reach the surface. Once there, the ESA's *Trace Gas Orbiter* (which arrived around Mars in 2016) will operate as the rover's relay satellite.

Artist's impression of the ESA's Rosalind Franklin rover on Mars. Credit: ESA

Tiangong-3

In the coming year, China also plans to test a new generation of crewed spacecraft that will take its taikonauts to orbit, to the Moon, and beyond. They also plan to commence construction on the Chinese large modular space station (aka. Tiangong-3), which will begin with the launch of the Tianhe Core Cabin Module (though its possible that this will be delayed until 2021).

Space Internet

The years 2020 will also be the year that satellite-based internet services become a reality. Having already commenced with the deployment of their Starlink network with the launch of the first two batches of satellites in 2019, SpaceX plans to begin offering broadband services with the launch of an additional 720 upgraded satellites by the end of 2020.

By late 2020, OneWeb also hopes to begin offering satellite-internet services with the deployment of the first 300 or so satellites that will make up its constellation. The first batch is scheduled to go up in January of 2020, which will offer low-latency broadband services to the US and its territories. The OneWeb constellation is expected to grow to over 600 satellites by the end of the year.

Starship and Dragon 2

Elon Musk and his colleagues at SpaceX also have some bold plans for 2020. As part of NASA's Commercial Crew Development (CCD) program, the company is scheduled to conduct its first crewed flights with the *Dragon 2* spacecraft. Combined with the launch of the SLS, this will effectively restore human spaceflight capability to the US, which it has not had since the retirement of the Space Shuttle in 2011.

Artist's rendering of a Starship taking off from a lunar base. Credit: SpaceX

By November, SpaceX also hopes to be conducting the next phase of testing with the *Starship* and *Super Heavy* launch system. This will consist of high altitude, high-velocity flights using the *Starship Mk. 2*, tests involving the first constructed *Super Heavy* booster. It is also possible that orbital flights involving the *Starship Mk. 3* could be taking place at this time. These tests will place SpaceX and the *Starship/Super-Heavy* on track to accomplish their first lunar landing by 2022, their first circumlunar flight by 2023 (the #dearmoon campaign), and sending crews to the lunar surface by 2024. They will also be a major step towards the realization of Elon Musks' long-term goal of sending the first humans to Mars and creating a base there (which he hopes to do before the 2020s are out).

Top Astronomical Events for 2020

Ready for another amazing year of sky watching and astronomy in 2020? Hard to believe, were already a fifth of the way into the 21st century. 2020 rounds out the final year of the second decade, promising an amazing year of skywatching to come.

The events that follow are excerpted mostly from our book, *The Universe Today Ultimate Guide to Viewing the Cosmos*. Chapter 10 lists top astronomy events all the way out to 2024, and the next great total solar eclipse across North America.

The planet Venus rules astronomy 2020, with one each favorable apparitions in the dawn and dusk sky. Mars also makes a fine apparition in October, reaching 22" in size at opposition. Watch for a dramatic occultation of Mars by the waning crescent Moon on the morning of February 18th. A fine close pairing of Venus and Jupiter in the dusk also ends out the year.

The solar minimum marking the end of Cycle #24 and the start of Cycle #25 should also occur on or around mid-2020… or will solar cycle #25 be absent all together?

Meteor Showers in 2020

Two top meteor showers to watch for in 2020 are the surefire August Perseids and the December Geminids.

In describing meteor showers for the year, we'll list two main factors: the expected zenithal hourly rate (ZHR), or the rate you would expect to see under ideal conditions (pristine dark skies with the shower radiant directly overhead) and the phase of the Moon at the shower's peak.

Coming right up after New Year's Day are the Quadrantid meteors on January 4th, with an estimated ZHR of 100 per hour. In 2020, however, these will vie with a waxing gibbous Moon.

Favorable showers for the year include:

-The Lyrids **(Apr 22)** ZHR=20, Moon 0.5% illuminated, waning crescent.

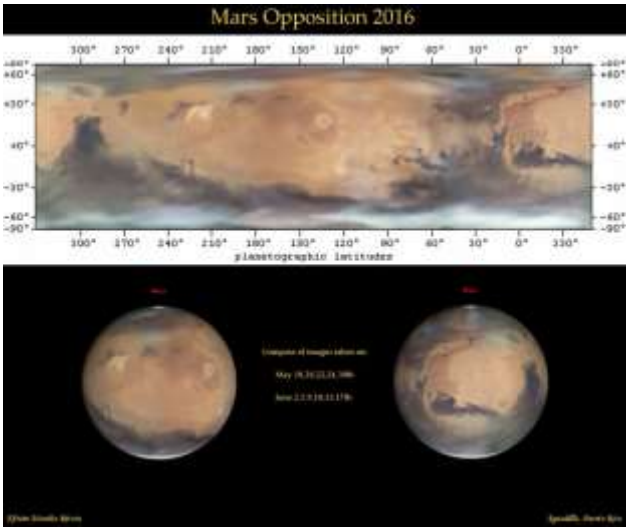
-The June Boötids **(Jun 27)**, ZHR=50, Moon 41% illuminated, waxing crescent.

-The Perseids **(Aug 12)**, ZHR=100, Moon 40% illuminated, waning crescent.

-Taurids **(Oct 10)**, ZHR=10, Moon 43% illuminated, waning crescent.

-The Orionids **(Oct 21)**, ZHR=20, Moon 32% illuminated, wax-

ing crescent.
-The Leonids **(Nov 17)**, ZHR=20, Moon 10% illuminated, waxing crescent.
-The Geminids **(Dec 14)**. ZHR=120, Moon 0.1% illuminated, New Moon.



Mars at opposition from 2016. Image credit and copyright: Efrain Morales-Rivera.

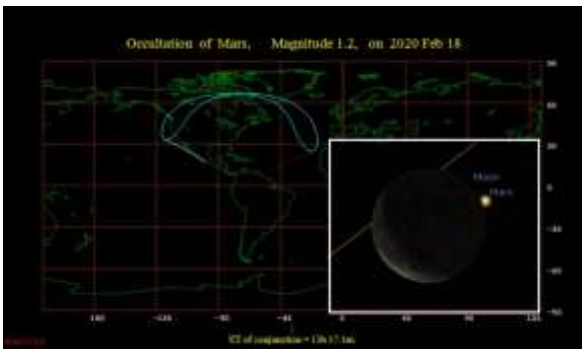
-The Outer Planets in 2019: The very best time to observe an outer planet is when it reaches opposition, and rises opposite to the setting Sun, staying above the horizon for the entire evening until sunrise. All of the outer planets except Mars reach opposition once a year; Mars reaches opposition every other year, and 2020 is such a year. Here are the opposition dates centered on the best observing seasons for each of the naked eye outer planets in 2020:
–Mars **(Oct 13)**
–Jupiter **(Jul 14)**
-Saturn **(Jul 20)**
-Uranus **(Oct 31)**
-Neptune **(Sep 11)**
-Pluto **(Jul 15)**
–**The Inner Planets in 2020:** Venus reaches greatest elongation twice in 2020, dominating the dusk sky for the first half of the year, and the dawn sky in the last half. Greatest elongation is a great time to try and spy Venus in the daytime, and two easy dates to pull this off are March 28th and August 15th, when the crescent Moon is nearby. Also, mark April 4th and April 5th on your calendar, as Venus will nick the Pleiades star cluster. Venus did so in 2012 and will do so once again in 2028, part of the 'Great Eight Year Cycle' of repeating patterns for the planet, as 13 orbits of Venus very nearly equals eight orbits of the Earth.

Venus versus the Pleiades on April 5th. Credit: Stellarium.

Mercury reaches greatest elongation six times in 2020, three times each in the dusk and the dawn:
-Mercury **(Feb 10)** 18 degrees east (dusk).
-Mercury **(Mar 24)** 28 degrees west (dawn).
-Mercury **(Jun 4)** 24 degrees east (dusk).
-Mercury **(Jul 22)** 20 degrees west (dawn).
-Mercury **(Oct 1)** 26 degrees east (dusk).
-Mercury **(Nov 10)** 19 degrees west (dawn).
Eclipses in 2020: There are six eclipses in 2020, two solar and four lunar. Southern Asia gets a near repeat of the 2019 Boxing Day annular eclipse, while the extreme southern tip of South America gets the only total solar eclipse of the year. Unfortunately, all four lunar eclipses are faint penumbrals, with the Moon just grazing the outer bright shadow of the Earth.

The December 26th, 2019 annular solar eclipse. Image credit and copyright: Shahrin Ahmad.

-A penumbral lunar eclipse **(Jan 10)**, with a maximum penumbral immersion of 88% for Europe, Africa, Asia and Australia.
-A penumbral lunar eclipse **(Jun 5)**, with a maximum penumbral immersion of 59% for Europe, Africa, Asia and Australia.
– An annular solar eclipse **(Jun 21)** with a maximum duration of annularity of 38 seconds crossing central Africa, southern Asia, China and the Pacific.
-A penumbral lunar eclipse **(Jul 5)** with a maximum penumbral immersion of 36% for the Americas, southwest Europe and Africa.
-A penumbral lunar eclipse **(Nov 30)** with a maximum penumbral immersion of 74% for Asia, Australia, the Pacific and the Americas.
-A total solar eclipse **(Dec 14)** with a maximum duration of 2 minutes and 10 seconds with totality crossing the South Pacific, Chile, Argentina and the South Atlantic.
Closest conjunctions in 2020
-Planet vs. planet: Watch for Jupiter and Saturn **just** 6′ apart on December 21st, 30 degrees east of the Sun in the dusk sky. This is a fine close conjunction, with the two gas giants passing 1/5th the apparent distance apart of a Full Moon.
-Planet vs. bright star: Venus passes 5' from Regulus on **October 2nd**, 40 degrees west of the Sun in the dawn.
Best occultation of a planet by the Moon in 2020: Watch for the waning crescent Moon to occult **Mars for North America February 18th.** There are 10 occultations in 2020 involving the Moon and four planets:
-Mercury (1): **(Dec 14)** Europe, 0.1% Moon (unobservable, only 3 degrees from the Sun).
-Venus (2): **(June 19)** NE North America, -4% Moon – **(Dec 12)** NE Asia -5% Moon.
-Mars (5): **(Feb 18)** North America, -24% Moon – **(Mar 18)** the southernmost tip of South America, -30% Moon – **(Aug 9)** SE South America -72% Moon – **(Sep 6)** Central South America -85% Moon – **(Oct 3)** the southernmost tip of South America, -98% Moon.



The Moon occults Mars on the morning of February 18th. Credit: Occult/Stellarium.

-Jupiter (2): **(Jan 23)** Australia/New Zealand in the daytime, -3% Moon – **(Feb 19)** Antarctica, -13% Moon.

The Moon does not occult a +1 magnitude or brighter star in 2020.

Periodic Comets over magnitude +10: There aren't any great naked eye comets on tap for 2020, but there are a few binocular comets worth watching out for:

-P/2017 T2 PanSTARRS may reach +8th magnitude as it crosses into Ursa Major and reaches perihelion **(May 6)**.

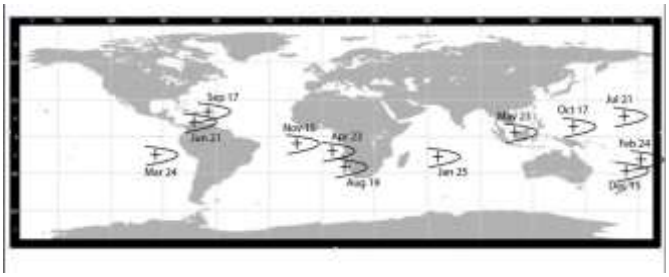
-88/P Howell perihelion **(Sept 26**, mag. +9) near the Libra-Scorpius border.

-2/P Encke reaches perihelion **(Jun 26**, mag. +8) in Gemini.

Finally, there are two naked eye stars occulted by asteroids in 2020:

-A +4.3 magnitude star in Ophiuchus occulted by asteroid 191 Kolga across the southern U.S. on February 10th.

-A +3.8 magnitude star in Virgo occulted by asteroid 498 Tokio across northern Russia on December 12th.



Sighting opportunities for the thin waxing crescent Moon worldwide in 2020. Credit: Dave Dickinson.

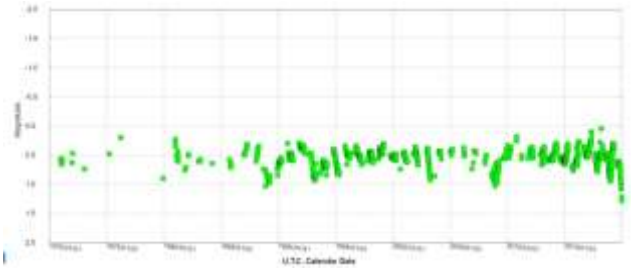
All amazing events coming to a sky near you in astronomy 2020.

Waiting for Betelgeuse: What's Up with the Tempestuous Star?

Have you noticed that Orion the Hunter—one of the most iconic and familiar of the wintertime constellations—is looking a little… different as of late? The culprit is its upper shoulder star Alpha Orionis, aka Betelgeuse, which is looking markedly faint, the faintest it has been for the 21st century.

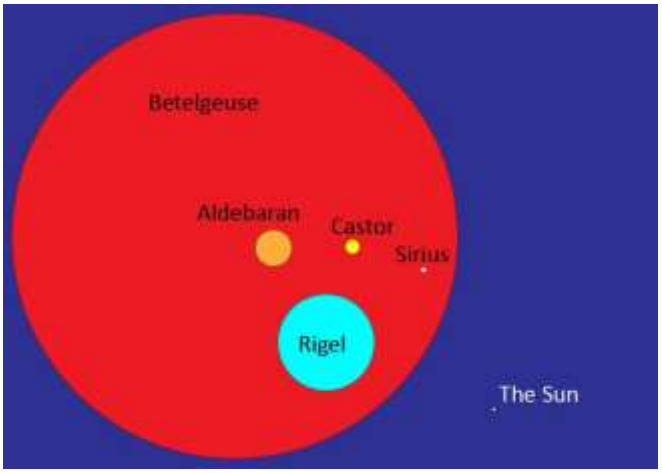
When will this nearby supernova candidate pop, and what would look like if it did?

The story starts, as all good astronomy and space stories seem to, on Friday night going into a holiday weekend. We started seeing discussion on Betelgeuse trending on social media on the evening of Friday, December 20th, and dug down to the source of the excitement: a December 8th paper on '*The Fainting of the Nearby Red Supergiant Betelgeuse*' by researchers at Villanova University. Light curve estimates courtesy of the American Association of Variable Star Observers (AAVSO) verified the assertion that the star had indeed faded about one magnitude, or a little over one half from its usual magnitude +0.5 to +1.5. Noticing the sky was clear, we headed up to our parking garage rooftop observing site in downtown Norfolk, Virginia to take a look. Betelgeuse *was* indeed noticeably fainter, about a shade dimmer than nearby +1st magnitude Aldebaran.



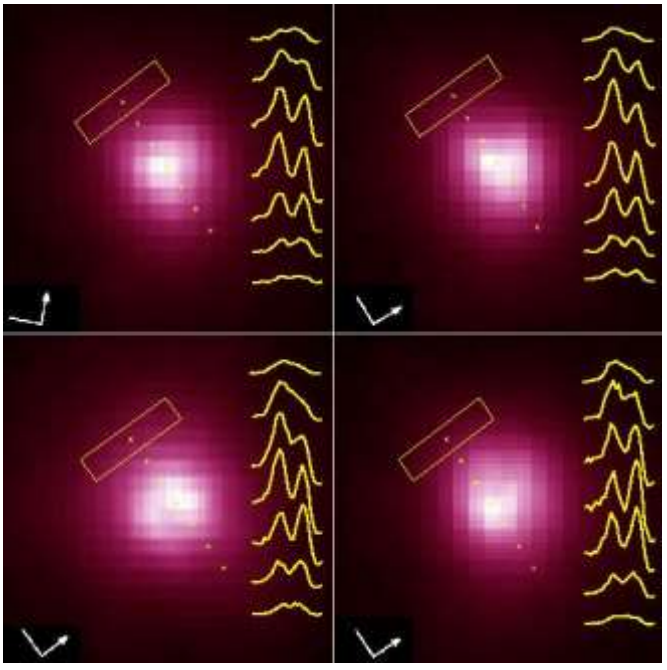
Magnitude estimates of Betelgeuse, going back to 1970. Credit: The AAVSO.

Now, a change in one magnitude isn't unusual for a variable star such as Betelgeuse… but such a large dip always gives the astronomical community pause. A red giant star 12 times as massive as our Sun and about 700 light years distant, the variability of red-orange Betelgeuse was first noted by astronomer Sir John Herschel in 1836. Physically, the star is currently bloated out to a radius of perhaps eight Astronomical Units (AU). If you plopped it down in the center of our solar system, Betelgeuse might extend all the way out to past the orbit of Jupiter.



Our (puny) host star, versus the neighbors, including Betelgeuse. Credit: Dave Dickinson

This fact also allowed astronomers to use the first crude optical interferometric measurements from the 2.5 meter telescope at Mount Wilson Observatory to measure Betelgeuse's physical diameter of 50 milliarcseconds. In the late 1980s, astronomers used in emerging technique of aperture masking interferometry to obtain the first direct 'image' of Betelgeuse.



A pulsating Betelgeuse in the ultraviolet. Credit: NASA/HST
Betelgeuse is always worth keeping an eye on, as it's one of the closest candidates in our galaxy for a nearby supernova. We see supernovae frequently in distant galaxies, but such an event has not been witnessed in our galaxy in the telescopic era: Kepler's Star in 1604 in the constellation Ophiuchus was the last supernova observed in the Milky Way, though a supernova in the nearby Large Magellanic Cloud put on a good show in 1987. A red giant like Betelgeuse lives fast and dies young, exhausting its supply of hydrogen fuel in just under 10 million years. The star is destined to undergo a core implosion and massive collapse and rebound as a Type II supernova. Such an explosion could occur 100,000 years from now… or tonight.

Still fading… our brief smartphone capture of Betelgeuse and Orion from Virginia Beach on Christmas Day 2019. Credit Dave Dickinson
Is the fading act a prelude to a truly spectacular show, or a false alarm? Astronomers are unsure, but a supernova event just 700-odd light-years away would be an unrepresented opportunity to study one up close. Not only would every optical telescope get trained on the exploding star, but assets such as the Laser Interferometry Gravitational Wave Observatory (LIGO) could detect gravitational waves from a nearby supernova, and neutrino observatories such as Ice Cube buried in the Antarctic ice could detect the event as well.
…and fortunately for us, we're safely out of the 50 light-year 'kill zone' for receiving any inbound lethal radiation from Betelgeuse: a supernova would simply be a scientifically interesting event, and put on a good show. Ancient supernovae may have had a hand in the evolution of life on Earth, and a recent study suggests that one might even have forced early humans to walk upright. Here's the rogues gallery list of stars that are current nearby supernovae candidates:

Closest Supernovae Candidates out to 1,000 light-years

Star	Constellation	Magnitude	Distance	Supernova Type
IK Pegasi	Pegasus	+6	154 ly	1a
Spica	Virgo	+1.0	250 ly	2
Alpha Lupi	Lupus	+2.3	465 ly	2
Antares	Scorpius	+1.1	554 ly	2P
Betelgeuse	Orion	+0.5	720 ly	2P
Pi Puppis	Puppis	+2.7	800 ly	2

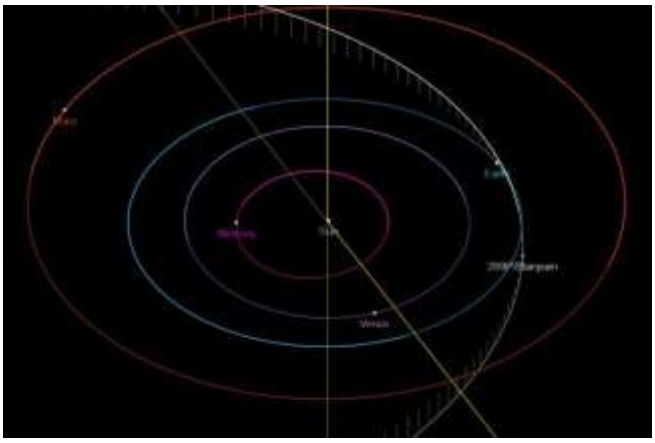
Nearby supernova candidates out to 1,000 light-years. Credit: Dave Dickinson
What would a supernova in Orion look like? Well, using the last supernova in the Large Magellanic Cloud (also a Type IIb event) as a guide, we calculate that when it does blow, Betelgeuse would shine at magnitude -10. That's 16 times fainter than a Full Moon, but 100 times brighter than Venus, making it easily visible in the daytime sky. A Betelgeuse-gone-supernova would also easily cast noticeable nighttime shadows.
But see the ongoing fading event for yourself. Betelgeuse is easy to find in December, rising to the east at dusk. In fact, northern hemisphere winter is the very best time for the star to blow, as it's roughly opposite to the Sun, and would dominate the night sky. Summer would be the *worst* time, as it would tease us from beyond the far side with the Sun in the daytime sky. You can even guesstimate Betelgeuse's brightness yourself, using the nearby stars of the Winter Hexagon asterism as a guide:

Betelgeuse, versus the stars of the Winter Hexagon with annotated magnitudes (note: this was taken prior to the current dimming event). Image credit and copyright: Steve Brown.
What's next? Well, expect Betelgeuse to brighten again in early 2020… though if it rebounds into negative magnitude territory past Rigel and Sirius, well, then things could get *really* exciting.
For now though, we're in a wait-and-see-mode for any New Year's Eve fireworks from Betelgeuse. Such an occurrence would be bittersweet: we would be extraordinarily lucky to see Betelgeuse go supernova in our lifetime… but familiar Orion the Hunter would never look the same again.

Will Blanpain Perform? Comet Prospects for 2020

Looking forward to the next bright comet in 2020 or beyond? You're not alone. Though we've had a steady string of decent binocular comets over the past few years, we haven't had a good naked eye comet since W3 Lovejoy beat solar death during its blistering perihelion passage in 2011. But this survivor turned out to be bashful, and headed for southern hemisphere skies… Comet P1 McNaught followed suit in 2007, hiding from northern hemisphere observers at its best. And we all remember what happened to Comet S1 ISON—touted as the next great 'Comet of the Century' on U.S. Thanksgiving Day 2013. Here it is almost 2020, and you have to go allll the way back nearly a quarter of a century to Hale-Bopp and Hyakutake to remember just how brilliant a good naked eye comet can be.
Unfortunately, 2020 prospects are slim when it comes to good comets, though a few binocular ones (comets brighter than +10th magnitude but fainter than +6 magnitude) are on tap. Keep in mind, this can always change with the appearance of an undiscovered, long-period comet headed our way. It *does* happen occasionally.
Here's how prospects for cometary action currently breaks down for the coming year:
One wildcard worth watching out for is period comet 289P/Blanpain. This comet was discovered by French astronomer Jean-Jacques Blanpain from the Marseille Observatory two centuries ago, on the night of November 28th, 1819. The comet was lost on subsequent passages through the 19th and 20th century, earning it a 'D' (think 'deceased') designation until its recovery as asteroid WY25 in 2003. Further observations cinched its cometary nature due to the faint coma

it displayed, and PanSTARRS witnessed an outburst which increased in brightness by 9 magnitudes in 2013. That's an increase in brightness by 4,000 times, one of the largest increases ever seen, exceeded only by 17P/Holmes in 2007).



The orbital path of Comet Blanpain. Credit: NASA/JPL.

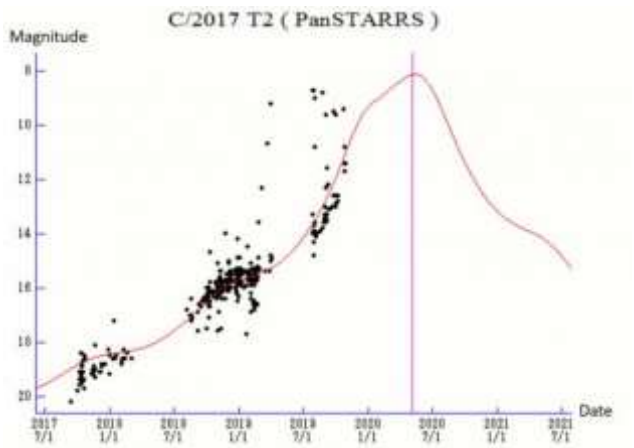
Orbiting the Sun once every 5.2 years, Blanpain will only be of interest if it produces another outburst. Blanpain reaches perihelion on 0.891 Astronomical Units (1 AU equals 93 million miles) from the Sun on December 20th when it's 0.18 AU from Earth, and is favorable through early January as it races northward through the constellations Pegasus, Andromeda and Cassiopeia.

The path of Comet Blanpain through the first half of January 2020. Credit: Starry Night.

The comet is also the source of the faint Phoenicid meteor shower, which produced an outburst in 2019. Comet Blanpain passes 0.09 AU from Earth on January 11th, 2020, one of its closest passes for the 21st century. Currently, Blanpain is only at +18 magnitude, and expected to only reach a faint +15th magnitude. If, however, it pulls off another powerful nine magnitude outburst at just the right time post-perihelion, things could get interesting.

Comets to watch for in 2020 brighter than +10 magnitude

First, Comet 2017 T2 PanSTARRS may top out at +8th magnitude in the Spring. T2 PanSTARRS reaches perihelion on May 6th, 1.6 AU from the Sun. The comet passes 1.52 AU from Earth on New Year's Eve 2019. At perihelion, T2 PanSTARRS will be moving just under a degree a day (twice the apparent diameter of a Full Moon) through the constellation of Ursa Major, the Great Bear. T2 PanSTARRS is on a just under 10,000 year long orbit. This will make T2 PanSTARRS a fine circumpolar object for northern hemisphere observers, during short summer evenings.

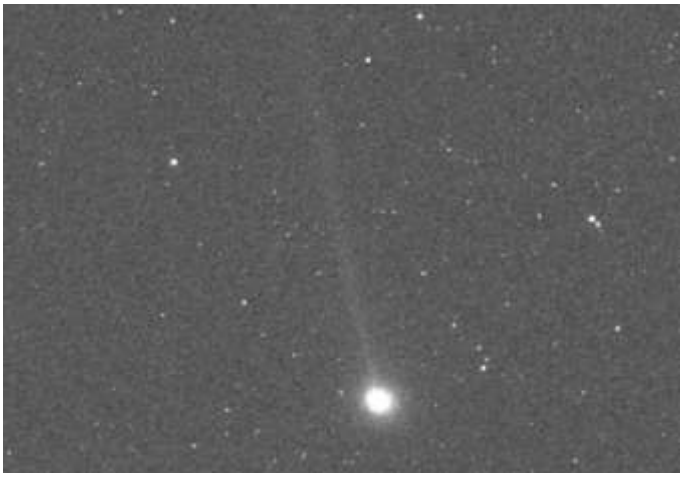


The projected light curve for T2 panSTARRS through 2020. Black dots are actual observations, and the purple line represents perihelion. Credit: Adapted from Seiichi Yoshida's Weekly information About Bright Comets.

Next up, we may get a favorable apparition of periodic comet 88/P Howell in 2020. On a 5.5 year orbit, 88P/Howell will reach perihelion 1.4 AU from the Sun on September 26th, as it crosses the Libra-Scorpius border. At its best, 88P/Howell will top out at +9th magnitude. 88P/Howell was discovered by astronomer Ellen Howell on August 29, 1981. This apparition for Comet Howell will favor mid-equatorial to southern observers at dusk. Comet Howell is on the shortlist for a proposed New Frontier sample return mission laid out by the Johns Hopkins University of Applied Physics Laboratory (JHUAPL) dubbed the Comet Rendezvous, Sample Acquisition, Investigation and Return mission, or CORSAIR.

88P Howell in late September 2020 at dusk, looking to the southwest. Credit: Stellarium.

Finally, comet 2P/Encke reaches perihelion on June 25, 2020 reaching +8th magnitude as it crosses the constellation of Gemini the Twins. This apparition will see the comet riding high to the southeast at dawn, as seen from mid-northern latitudes. 2P/Encke has the shortest period of any known comet, at 3.3 years. 2P Encke is also the source of the November Taurid fireballs.



2P/Encke, as seen by NASA's Mercury MESSENGER spacecraft. Credit: NASA.

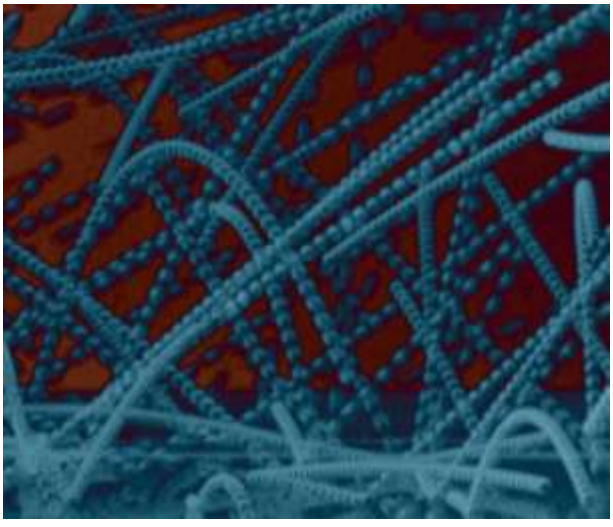
For sure, 2020 is shaping up to be a meagre year for comets. But that could always change. Just take a look at the rollcall hall of fame for 'Great Comets of Yore,' stretching back over the past 70 plus years:

Name	Perihelion	Magnitude	Notes
C/2011 W3 Lovejoy	December 16, 2011	-5	Passed 87,000 mi from the Sun
C/2006 P1 McNaught	January 12, 2007	-5.5	Brightest in the 21st century
C/1995 O1 Hale-Bopp	April 1, 1997	-0.5	Discovered 7.2 AU from the Sun
C/1996 B2 Hyakutake	May 1, 1996	0	Passed 0.1 AU from the Earth
C/1975 V1 West	February 25, 1976	-3	Followed Kohoutek
C/1969 Y1 Bennett	March 20, 1970	0	Was to be imaged by Apollo 13
C/1965 S1 Ikeya-Seki	October 21, 1965	-10	One of the brightest comets
C/1962 C1 Seki-Lines	April 1, 1962	-1	
C/1956 R1 Arend-Roland	April 8, 1957	-1	
C/1948 V1 "Eclipse Comet"	October 27, 1948	-1	Discovered during a solar eclipse
Great Southern Comet	December 4, 1947	0	Faded soon after discovery

Bright comets for the last 75 years. Credit: Dave Dickinson.
This was adapted from our 'bright comets of the past century' table from our book, *The Universe Today's Guide to Viewing the Cosmos*.
Binoculars are your best bet for nabbing and following comets brighter than +10th magnitude… simply sweep the suspect field, and look for a fuzzy 'patch' looking like a globular cluster that stubbornly refuses to snap into focus. I always love to hunt down comets and show 'em off at star parties, as their surprise appearance punctuates an otherwise predictable clockwork Universe. There's no bright 'Comet of the Century' on tap for the coming decade… yet. For now though, you can test your observing chops on these fine fuzzball comets. Whether it's near or far in time and space, the next 'big one' is out there.

Planets Started Out From Dust Clumping Together. Here's How

According to the most widely accepted theory of planet formation (the Nebular Hypothesis), the Solar System began roughly 4.6 billion years ago from a massive cloud of dust and gas (aka. a nebula). After the cloud experienced gravitational collapse at the center, forming the Sun, the remaining gas and dust fell into a disk that orbited it. The planets gradually accreted from this disk over time, creating the system we know today.
However, until now, scientists have wondered how dust could come together in microgravity to form everything from stars and planets to asteroids. However, a new study by a team of German researchers (and co-authored by Rutgers University) found that matter in microgravity spontaneously develops strong electrical charges and stick together. These findings could resolve the long mystery of how planets formed.
Put simply, physicists have been in the dark about how nebular material can accumulate to form large bodies in space. Whereas adhesion can cause dust particles to stick together and large particles are drawn together by mutual gravity, the in-between stage has remained elusive. Basically, objects that range from millimeters and centimeters tend to bounce off each other rather than sticking together.



Glass particles in microgravity. Credit: Gerhard Wurm, Tobias Steinpilz, Jens Teiser and Felix Jungmann
For the sake of their study, which recently appeared in the journal *Nature*, the team conducted an experiment where glass particles were placed in microgravity conditions to see how they behaved. Surprisingly, the team found that the particles developed strong electrical charges. So strong, in fact, that they polarized one another and behaved like magnets. The team followed up on this by running computer simulations to see if this process could bridge the gap between fine particles clumping together and larger objects aggregating due to mutual gravity. What they found here was that planetary formation models agreed with their experiment data, so long as electrical charging is present.
These results effectively fill a longstanding gap in the most widely accepted model of planetary formation. In addition, they could have numerous industrial applications here on Earth. Said Troy Shinbrot, a professor of biomedical engineering at Rutgers University-New Brunswick and a co-author on the study:
"We may have overcome a fundamental obstacle in understanding how planets form. Mechanisms for generating aggregates in industrial processes have also been identified and that – we hope – may be controlled in future work. Both outcomes hinge on a new understanding that electrical polarization is central to aggregation."

Artistic rendition of a protoplanet forming within the accretion disk of a protostar Credit: ESO/L. Calçada http://www.eso.org/public/images/eso1310a/
The potential for industrial applications is due to the fact that similar processes are used on Earth in the production of everything from plastics to pharmaceuticals. This consists of gas pressure being used to push particles upwards, during which time they can aggregate due to static electricity. This can cause equipment failures and lead to flaws in the final product.
This study could therefore lead to the introduction of new methods in industrial processing that would be more effective than traditional electrostatic controls. Moreover, it could lead to a refinement of planetary formation theories by providing the missing link between fine particles and larger aggregates. Another mystery solved, answer piece to puzzle. One step closer to answering 'How did it all begin?"

Wow, Meade Instruments Just Filed for Bankruptcy Protection

Meade Instruments, a company familiar to any backyard astronomer who's drooled over their telescopes, has filed for bankruptcy. The company has fallen on hard times in recent years, as they've faced increasing competition. Meade also recently lost a lawsuit, which pushed them over the edge into bankruptcy.
The company is based in Irvine, California, and was founded in 1972. They started out selling small refracting telescopes. They expanded into Newtonian reflectors and Schmidt-Cassegrain telescopes over the years. Now, they sell telescope models worth upwards of $10,000.
Meade is a subsidiary of Chinese company Ningbo Sunny Electronics Co. Ningbo purchased Meade in 2013. Another company, Orion Telescopes and Binoculars, filed an anti-trust lawsuit against Ningbo, claiming that Ningbo and Meade were part of a price-fixing scheme and that they tried to force

competitors out of the market. Meade and their parent company lost that lawsuit, and a jury found Meade liable for $16.8 million. Meade has filed for bankruptcy claiming they have debts between $10 million and $50 million.

The Meade LX850 ACF. As of now, the Meade website is active and the company is still operating. Image Credit: Meade Instruments.

The life of large companies like Meade is punctuated with legal actions. They've scuffled in the courts with telescope maker Celestron over patent-infringement, and with other companies over claims of false-advertising.

Chapter 11 Protection gives a company an opportunity to be sold or to reorganize and restructure its debt. The goal is usually to keep the company alive and develop a plan to repay its creditors over time.

Today it was reported that Meade will try to sell itself through a court-supervised sale process. According to Bloomberg Law, Meade has reached out to Force 10 Partners, a firm specializing in "corporate restructuring, challenged businesses, litigation, and other special situations" as they say on their website.

The exact future timeline for Meade is unclear, but on December 6th they posted this brief statement on Facebook:

"As in recent news, Meade Instruments has filed for Chapter 11 Bankruptcy Protection Reorganization on Dec. 4th, 2019. Please be assured that we will continue to support our products, our customers, and our network of Dealers throughout this process. Our customers will remain our highest priority. We thank you for your valued support and look forward to continuing the Meade name."
Meade Instruments statement on Facebook.

Many people have long experience with Meade telescopes, and the company has a long history of innovation. They seem to have lots of loyal customers. Whether these legal troubles spell the end for Meade is unknown, but many of their customers are hoping they stay in business. If a new owner steps up, who knows how things might turn out.

We Know We're Made of Stardust. But Did it Come From Red Giants?

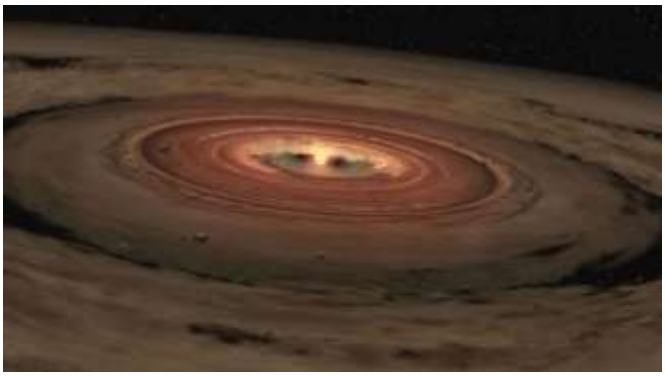
We've all heard this one: when you drink a glass of water, that water has already been through a bunch of other people's digestive tracts. Maybe Attila the Hun's or Vlad the Impaler's; maybe even a Tyrannosaurus Rex's.

Well, the same thing is true of stars and matter. All the matter we see around us here on Earth, even our own bodies, has gone through at least one cycle of stellar birth and death, maybe more. But which type of star?

That's what a team of researchers at ETH Zurich (Ecole polytechnique federale de Zurich) wanted to know.

The story of our Solar System started about 4.5 billion years ago when a molecular cloud collapsed. At the center of that collapsed cloud the Sun came to life in a burst of fusion, and a disc of gas and dust formed around it. Eventually, all of the planets in our Solar System formed from that protoplanetary disc.

Within that disc of material were dust grains that had formed around certain other stars. These special grains were distributed unevenly throughout the disc, "like salt and pepper," according to Maria Schönbächler, a professor at the Institute of Geochemistry and Petrology at ETH Zurich. As the planets of the Solar System formed, each one contained its own mixture of gas and dust, and of those special grains.



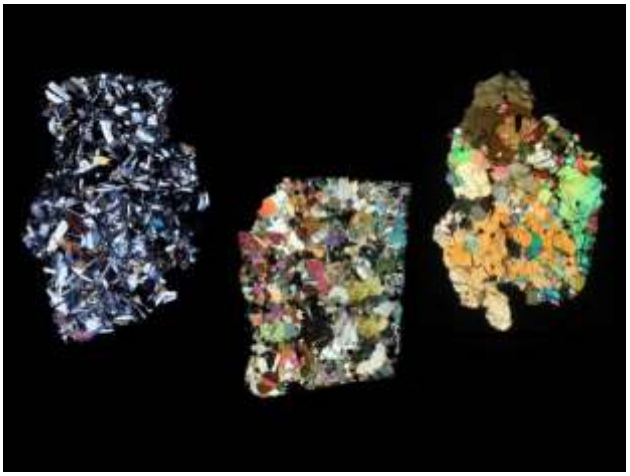
An illustration of a protoplanetary disk. Planets coalesce out of the remaining molecular cloud the star formed out of. Within this accretion disk lay the fundamental elements necessary for planet formation and potential life. Credit: NASA/JPL-Caltech/ T. Pyle (SSC) – February, 2005

Advances in measuring techniques allow scientists to detect the material the planets formed from, and to determine its origin. It all comes down to isotopes. An isotope is an atom of a given element with the same number of protons in its nucleus, but a different number of neutrons. For example, there are different isotopes of carbon, like C13 and C14. While all carbon isotopes have 6 protons, C13 has 7 neutrons while C14 has 8 neutrons.

The mixture of different isotopes in a planet—not just of carbon but of other elements too—is like a fingerprint. And that fingerprint can tell scientists a lot about a body's origins.

"Stardust has really extreme, unique fingerprints – and because it was spread unevenly through the protoplanetary disc, each planet and each asteroid got its own fingerprint when it was formed," Schönböchler said in a press release.

Over the years, scientists have been studying these fingerprints on Earth and in meteorites. Comparisons between the two reveal how long-dead red giant stars have contributed matter to the formation of Earth and everything on it. Including us.



These are sections of meteorites that came from the asteroid Vesta, but were recovered on Earth. Scientists know Vesta is the parent body to many meteorites, thanks to NASA's Dawn mission. Credit: NASA/University of Tennessee.

Scientists have been able to compare these isotopic anomalies between the Earth and meteorites for more and more elements. Schönböchler and the other scientists behind a new study have been examining meteorites that were part of the core of asteroids destroyed long ago. They've focused on the element palladium.

Previous studies by other scientists have examined isotope ratios for other elements, like ruthenium and molybdenum, which are palladium's neighbours on the periodic table. Those prior results allowed Schönböchler's team to predict what they would find when they looked for palladium isotopes.

They expected similar amounts of palladium but got a surprise.

Palladium (atomic # 46) and its neighbours Molybdenum (Mo) and Ruthenium (44). Image Credit: By Offnfopt – Own work, Public Domain, https://commons.wikimedia.org/w/index.php?curid=62296883

"The meteorites contained far smaller palladium anomalies than expected," says Mattias Ek, postdoc at the University of Bristol who made the isotope measurements during his doctoral research at ETH.

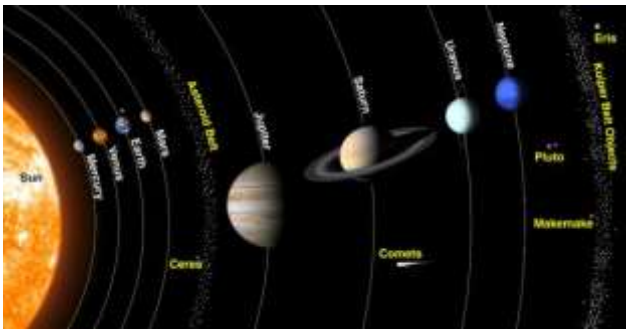
In their paper, the team presents a new model to explain these results. The paper is titled "The origin of *s*-process isotope heterogeneity in the solar protoplanetary disk." It was published in the journal Nature Astronomy on December 9th, 2019. The lead author is Mattias Ek.

Their model shows that even though everything in our Solar System was created from stardust, one type of star contributed most to Earth: red giants, or asymptotic giant branch (AGB) stars. These are stars in the same mass range as our Sun which expand into red giants when they deplete their hydrogen. Our own Sun will become one of these in about 4 or 5 billion years.

As part of their end-state, these stars synthesize elements in what's called the s-process. The s-process, or slow neutron capture process, creates elements like palladium, and its neighbours on the periodic table, ruthenium and molybdenum. On an interesting note, the s-process creates these elements with seeds of iron nuclei, which themselves were created in supernovae in previous generations of stars.

"Palladium is slightly more volatile than the other elements measured. As a result, less of it condensed into dust around these stars, and therefore there is less palladium from stardust in the meteorites we studied," Ek says.

There is a greater abundance of material from red giants in Earth's makeup than there is in Mars, or in asteroids like Vesta further out in our Solar System. The outer region contains more material from supernovae. The team says they can explain why that is.



In our young Solar System, dust from red giants resisted evaporation or destruction from the Sun better than dust from supernovae. That's why, according to the authors of the study, Earth contains more matter from red giants than bodies further out. Credit: NASA

"When the planets formed, temperatures closer to the Sun were very high," Schönbächler explains. Some of the dust grains were more unstable than others, including ones with icy crusts. That type was destroyed in the inner Solar System, close to the Sun. But stardust from red giants was more stable and resisted destruction, so it's more concentrated close to the Sun. The authors say that dust from supernova explosions is also prone to evaporate more quickly since its smaller. So there's less of it in the inner Solar System, and on Earth.

"This allows us to explain why the Earth has the largest enrichment of stardust from red giant stars compared to other bodies in the solar system," Schönbächler says.

E Mails Viewings Logs and Images from Members.

Viewing Log for 3rd of January

Finally got back from our northern New Year's tour, Xmas decorations taken down for another year, I had a free evening to myself AND the sky was clear! My phone app said there would be broken cloud arriving later in the evening but I should have a good hour before that comes? This meant I would go out and do my first viewing session of 2020 J.

I arrived at my usual viewing place of Uffcott just off the A4361 about three miles south of Swindon and had my Meade LX90 GOTO telescope set up and ready by 19:59, I would be using a Televue Delos 14 mm eye piece instead of my usual Pentax XW 14 mm one. The air temperature was currently 4 °C and with no wind should make it a comfortable evening for viewing? With the Moon currently at half phase I thought I might be able to see the Lunar 'X' and 'Y' features along the terminator (later told by Andy Burns that I had missed them by a couple of hours?), I thought I could see something like the 'X' but not sure, so to be safe I have taken a picture of the Moon (picture elsewhere in magazine?) to look at it later.

With the astro pictures taken it was time to start viewing. When I slewed to the Moon, it was only at the edge of my finder scope, so I had to do some adjustments to centre it! The finder scope was aligned with the main scope, so no problems there? Hand controller might need an update to remove this error as finding some planets can be hard to locate as I will find out! Off to Uranus and Neptune, could not locate either of the ice giant planets? So it would be brighter deep sky objects only as the Moon could affect some items to look at? Had a look at Messier (M) 81, now this really looked like a comet tonight, had a bright core which could confused as a comet? M 82 nearby could not be confused as a comet, it was long and thin. I had a try at M 15 in Pegasus but this was just in a cloud bank not far off the horizon. With Andromeda high overhead, I had a look at M 31, looked really big and bright this evening! Had an idea about using the 'High Precision' mode on the telescope (the object you wish to view, the telescope would go to a near bright star. Which you would centre manually and press enter on the hand controller, then the telescope would go off and find the object you wished to look at), also decided to change to a 17.3 mm eye piece. This would give me a wider field of view which might pick up the planets I had missed earlier in the evening. Using this method I managed to find Uranus after a short while, as for Neptune not a chance? I now noticed some cloud coming in from the north west and starting to cover the sky, only area not covered was to the south east and Orion area. Started off with M 42/43, still look great to me, M 78 looked like a double star guess the Moon light was washing out the nebula part of this object? M 1, only Supernova remnant on the list in Taurus looked like a dim large blob, could not make out any detail. Cloud was now coming fast and last object to view was M 41 an Open Cluster (O C) about four degrees below the star Sirius, this O C looked loose?

Do I pack up or wait? Scanning the sky I thought I could make out a star (Deneb) out to the north east, so I would give it a while and see what happens. After waiting about 15 minutes, the sky started to clear again, yes! Going low, just above hedge level I could make out M 29 in Cygnus, just the main eight stars of this O C. Still in Cygnus but a lot higher in the sky is M 39, this is a large very loose O C? At this point (21:18) I had two vans go past me within three minutes of each other, not done badly for first white light of the evening? Also nearly overhead was M 52 in Cassiopeia, this is a tight compact O C, yet M 103 is about the same size as M 52 is much looser. Onto NGC 884, one part of the famous Double Cluster, like M 42 also great to look at! When I went to M 45, the Pleiades, the 'High Precision' mode did not kick in? This O C is better looked at with the finder scope as it is too big for the main scope? The only Globular Cluster (G C) for the evening and this is really an odd ball as there is no other bright G C in the winter sky is M 79 in Lepus, this G C was small to look at, did not help being so low in the southern skies. M 50 is about a third of the way from Sirius to Procyon, this O C is fairly loose to look at.

Time was getting on and the thicker cloud was rolling in quite fast. Before I packed up I had heard over social media recently that Betelgeuse had gone dimmer? So I compared this red giant star to Bellatrix, a 'B' class star. To me, there was no real difference but there is one magnitude differences in official figures (0.6 to 1.6)? Final object to look at was the terminator on the Moon, some very interesting shadows I could make out, think I could make out a nice Rill in one of the craters, again, picture in this magazine?

It was now 22:02 and while putting the equipment away I noticed no dew on any of the equipment used, must have been fairly dry air during the evening?

Clear skies.

Peter Chappell

Peter the lunar V and X are quite short lived in hours of light and the X is part of the Werner and Purbech craters well in daylight on the 3rd January, however you have caught the significant scarp cliff face that is Rupes Recta near the Thebit crater at the edge of Mare Nubium.
This January the X was visible around middayon the 2nd January.
Below (over the page) are the predicted view dates and times for the lunar X in 2020

	Sun Angle		Sub-Solar Point		Librations		Phase
Date	Time UT	Azimuth	. Long.	Lat.	Elong.	%Illum.	Age
02/01/2020	20:24:54	90.5635	-1.579	6.864	85.703	46.854	7.633
01/02/2020	10:15:05	91.4447	-4.464	6.024	83.699	43.959	7.523
01/03/2020	23:52:56	92.0331	-6.640	3.667	79.563	41.848	7.348
31/03/2020	13:05:18	92.1654	-7.674	0.282	80.302	40.967	7.151
30/04/2020	01:44:46	91.8243	-7.183	-3.286	79.426	41.595	6.971
29/05/2020	13:52:08	91.1227	-5.033	-5.962	83.393	43.720	6.843
28/06/2020	01:36:21	90.2559	-1.612	-6.774	85.534	46.926	6.788
27/07/2020	13:11:50	89.4489	2.156	-5.348	91.262	50.435	6.819
26/08/2020	00:54:34	88.9108	5.264	-2.186	92.778	53.372	6.926
24/09/2020	12:58:26	88.7919	7.106	1.591	96.654	55.102	7.082
24/10/2020	01:32:38	89.1429	7.523	4.798	95.169	55.368	7.251
22/11/2020	14:40:13	89.8847	6.585	6.605	95.384	54.235	7.398
22/12/2020	04:17:20	90.8112	4.470	6.675	91.728	51.978	7.500

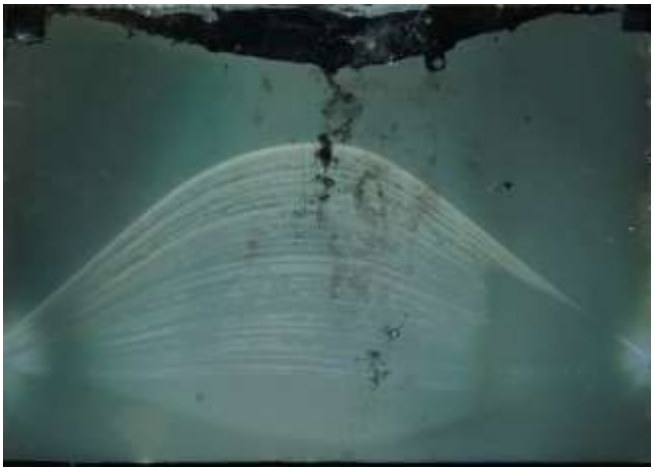
Average age: 7.2 days.

As you can see the average age is 7.2 days, the chart is in UT for viewing around the world, so check if the Moon is over the horizon before searching. The Lunar V or L is slightly longer in view. The average is about 3 degrees of solar travel for viewing time, the moon rotates 360degrees in 28days so the X is visible for 3-4 hours per month.
Andy

Hi Andy,
Happy New Year!

Attached are my submissions for the January 2020 WAS Newsletter. Given the poor weather I did not expect to have anything!

First, one of my Solstice June 2019 to December Solargraphs. Even this shows a lot of damage from rain over the six months.



Second, ISS Christmas Day flypast at 06:55. I think I should have pointed the camera a bit more to the West.
Canon 1300d, Rokinon 8mm Fish Eye (effective focal length 13mm) ISO 3200, F3.5, 8 sec
38 images stacked in Starstax and post processed in Affinity Photo

Third, 19% Waxing Crescent Moon and Venus in the late evening twilight. Even now there is still a dark purple showing which has been a feature of twilight images this year due to volcanic ash in the atmosphere.
Canon 1100D, Sigma F2.8 17-70mm, ISO 400, F3.5, 4 Sec

Post Processed in Canon DPP.
Clear Skies,
John

Hi Andy,
Did you catch the special edition of the Sky at Night about comets and asteroids on 29th Dec?
I spotted a couple of suspicious characters in a red coat

and a fluffy hat 😉 among one of the clips at 3:32 and 3:36 mins into the programme. If you missed it, it is on IPlayer.

Dave.

Error/Lesson page

I thought I'd share some experiences gained from some

poor results while imaging this month.

3rd of January was the first clear hours of night we have had for a while so I wanted to test some of the enhancing filters I got from the IAF in November. But first I set up my mount using the SynScan hand controller to grab a few shots and videos of the Moon. Find Moon, tweek for top, middle and bottom view and shoot stills and video on a DSLR. Then leave set up running on Betelgeuse region and step out 3 hours later. Check alignment on Betelgeuse, take pictures including Lenhance filter and take about 30 images of deep sky objects and stars under the half Moon and end up in the northern skies… just checking object is in frame a few times and letting the controller do most of the work.

Come in at midnight and process the images from RAW files.

Then enlarge to process the nebula. Aaaargh. Very disappointing. Then more images. And all the 2 minute exposure show exactly the same problem. Ill defined nebula and the stars are trailing a little in all the exposures. Not full 2 minute not running trails (after all the go to was working), but little streaks and nebula spreading stretch.

Go to bed and think.

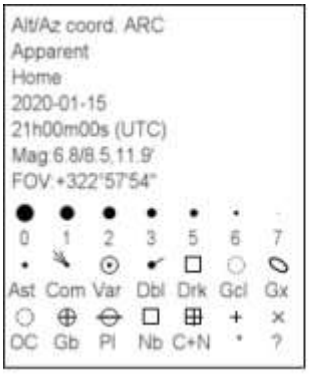
Yes it has happened before and yes, I've discovered the problem. The Synscan controller automatically choses lunar rate of travel if you search for the Moon through the paddle go to. Bot it doesn't go back to stellar rate of travel if you use goto star or deep sky object, even going to RA DEC search mode it stays on lunar tracking mode,

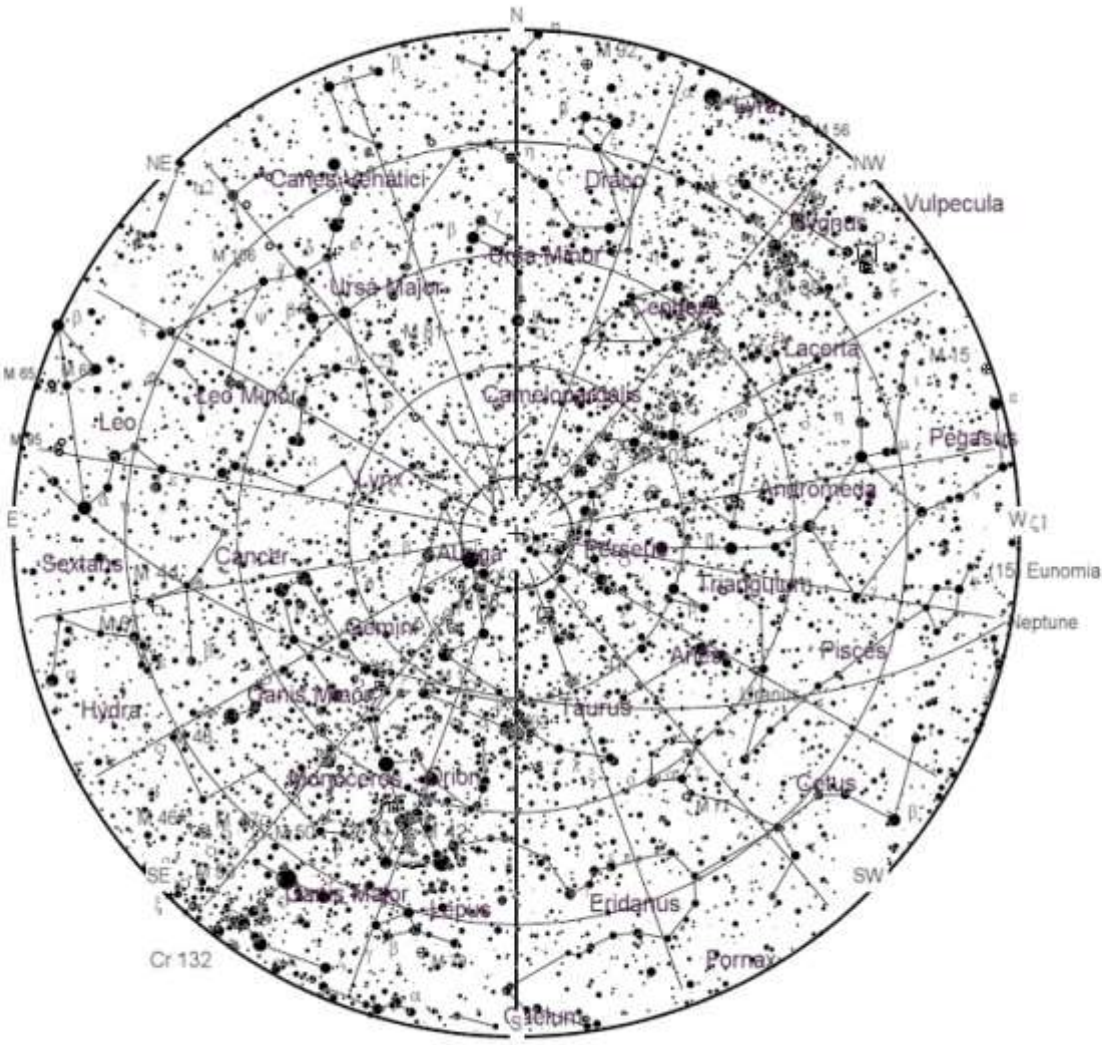
Easy to correct if you remember to change after any lunar viewing. BUT lesson learned, next low moonlight clear night is weeks away…

The second Cocoon Nebula image shows what I was expecting to see.

Finally the Christmas Morning transit of Father Christmas leaving his piece of coal for me...

WHATS UP, January 2020





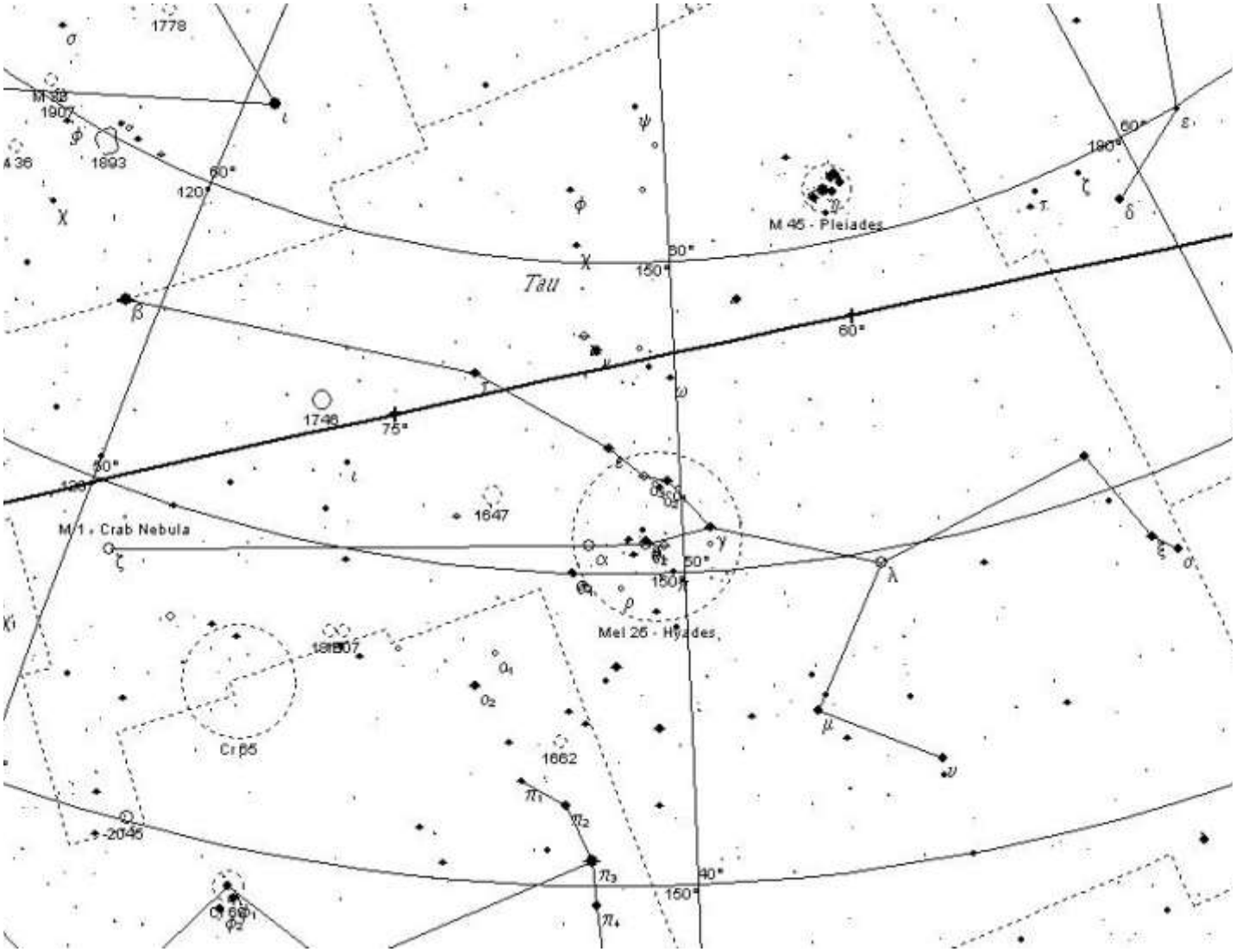
January 3, 4 - **Quadrantids Meteor Shower.** The Quadrantids is an above average shower, with up to 40 meteors per hour at its peak. It is thought to be produced by dust grains left behind by an extinct comet known as 2003 EH1, which was discovered in 2003. The shower runs annually from January 1-5. It peaks this year on the night of the 3rd and morning of the 4th. The first quarter moon will set shortly after midnight, leaving fairly dark skies for what could be a good show. Best viewing will be from a dark location after midnight. Meteors will radiate from the constellation Bootes, but can appear anywhere in the sky.

January 10 - **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 19:23 UTC. This full moon was known by early Native American tribes as the Full Wolf Moon because this was the time of year when hungry wolf packs howled outside their camps. This moon has also been know as the Old Moon and the Moon After Yule.

January 10 - **Penumbral Lunar Eclipse.** A penumbral lunar eclipse occurs when the Moon passes through the Earth's partial shadow, or penumbra. During this type of eclipse the Moon will darken slightly but not completely. The eclipse will be visible throughout most of Europe, Africa, Asia, the Indian Ocean, and Western Australia. (**NASA Map and Eclipse Information**)

January 24 - **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 21:44 UTC. This is the best time of the month to observe faint objects such as galaxies and star clusters because there is no moonlight to interfere.

CONSTELLATIONS OF THE MONTH: Taurus



The ancient zodiacal constellation of Taurus was one of Ptolemy's original 48 constellations and remains today as part of the official 88 modern constellations recognized by the IAU. It is perhaps one of the oldest constellations of all and may have even been recognized prehistorically. Taurus spreads over 797 square degrees of sky and contains 7 main stars in its asterism with 130 Bayer Flamsteed designated stars located within its confines. It is bordered by the constellations of Auriga, Perseus, Aries, Cetus, Eridanus, Orion and Gemini. Taurus is visible to all observers located at latitudes between +90Â° and ? 65Â° and is best seen at culmination during the month of January.

There is one major annual meteor shower associated with the constellation of Taurus, the annual Taurids, which peak on or about November 5 of each year and have a duration period of about 45 days. The maximum fall rate for this meteor shower is about 10 meteors per hour average, with many bright fireballs often occuring when the parent comet – Encke – has passed near perihelion. Look for the radiant, or point of origin, to be near the Pleiades.

Taurus is considered by some to be one of the oldest recognized constellations known, and may have even been depicted with the Pleiades in cave paints dating back to 13,000 BC. According to Greek myth, Taurus was the god Zeus, transformed into a bull in order to woo princess Europa, and perhaps could represent one of the Cretean Bull of Herculean fame. The ancient Egyptians also worshiped a bull-god for which this constellation might represent, just as the Arabs also considered it to be bovine by nature. The Hyades cluster was meant to represent the sisters of Hyas, a great hunter, placed in the sky to honor their mourning for the loss of their brother – just as the Pleiades represent the seven sisters of Greek mythology – as well as many other things in many other cultural beliefs. The Persians called this group of stars "Taura", just as the Arabs referred to it as "Al Thaur". No matter what way you want to look at it, this handsome collection of stars contains many fine deep sky objects to pique your interest!

Let's begin our binocular and telescope tour of Taurus with its brightest star- Alpha – the "a" symbol on our map. Known to the Arabs as Al Dabaran, or "the Follower," Alpha Tauri got its name because it appears to follow the Pleiades across the sky. In Latin it was called Stella Dominatrix, yet the Olde English knew it as Oculus Tauri, or very literally the "eye of Taurus." No matter which source of ancient astronomical lore we explore, there are references to Aldebaran.

As the 13th brightest star in the sky, it almost appears from Earth to be a member of the V-shaped Hyades

star cluster, but this association is merely coincidental, since it is about twice as close to us as the cluster is. In reality, Aldebaran is on the small end as far as K5 stars go, and like many other orange giants, it could possibly be a variable. Aldebaran is also known to have five close companions, but they are faint and very difficult to observe with backyard equipment. At a distance of approximately 68 light-years, Alpha is "only" about 40 times larger than our own Sun and approximately 125 times brighter. To try to grasp such a size, think of it as being about the same size as Earth's orbit! Because of its position along the ecliptic, Aldebaran is one of the very few stars of first magnitude that can be occulted by the Moon.

Now, head off to Beta Tauri – the "B" symbol on our chart. Located 131 light years from our solar system, El Nath, or Gamma Aurigae, is a main sequence star about to evolve into a peculiar giant star – one high in manganese content, but low in calcium and magnesium. While you won't find anything else spectacular about El Nath, there is a good reason to remember its position – it, too, get frequently occulted by the Moon. Such occultations occur when the moon's ascending node is near the vernal equinox. Most occultations are visible only in parts of the Southern Hemisphere, because the star lies at the northern edge of the lunar occultation zone and occasionally it may be occulted as far north as southern California.

Now, turn your binoculars or small telescopes towards Omicron – the "o". Omicron is sometimes called Atirsagne, meaning the "Verdant One", but there's nothing green about this 212 light year distant yellow G-type giant star, only that it has a great optical companion! Be sure to take a look at Kappa Tau, too… the "k". Kappa is also a visual double star – but a whole lot more. Located 153 light years from Earth, this Hyades cluster member is dominated by white A -type subgiant star K1 and white A-type main sequence dwarf star, K2. They are 5.8 arcminutes, or at least a quarter light year apart. Between the two bright stars is a binary star made up of two 9th magnitude stars, Kappa Tauri C and Kappa Tauri D, which are 5.3 arcseconds from each other and 183 arcseconds from K1 Tau. Two more 12th magnitude companions fill out the star system, Kappa Tauri E, which is 136 arcseconds from K1 Tau, and Kappa Tauri F, 340 arcseconds away from K2 Tau. Still more? Then have a look at 37 Tauri, an orange giant star with a faint optical companion star… or 10 Tauri! 10 Tauri is only 45 light years away, and while it just slightly larger and brighter than our Sun, its almost the same age. It is believed to be a spectroscopic binary star, but you'll easily see it's optical companion. What's more, thanks to noticing a huge amount of infrared radiation being produced by 10, we know it also has a dusty debris disk surrounding it!

Now, let's have a go at variable stars – starting with Lambda, the upside down "Y" on our map. Al Thaur is in reality a binary star system as well as being an eclipsing variable star. The primary is a blue-white B-type main sequence dwarf star located about 370 light years away. However, located at a distance of 0.1 AU away from it is a white A-type subgiant star, too… and a third player even further away. Watch over a period of 3.95 days as first one, then the other passes in front of the primary star, dimming it by almost a full stellar magnitude! Don't forget to check out HU Tauri, too. It is also an eclipsing binary star that drops by a magnitude every 2.6 days!

Ready to take a look at Messier 45? Visible to the unaided eye, small binoculars and every telescope, the Pleiades bright components will resolve easily to any instrument and is simply stunning. The recognition of the Pleiades dates back to antiquity and they're known by many names in many cultures. The Greeks and Romans referred to them as the "Starry Seven," the "Net of Stars," "The Seven Virgins," "The Daughters of Pleione" and even "The Children of Atlas." The Egyptians referred to them as "The Stars of Athyr," the Germans as "Siebengestiren" (the Seven Stars), the Russians as "Baba" after Baba Yaga, the witch who flew through the skies on her fiery broom. The Japanese call them "Subaru," Norsemen saw them as packs of dogs and the Tongans as "Matarii" (the Little Eyes). American Indians viewed the Pleiades as seven maidens placed high upon a tower to protect them from the claws of giant bears, and even Tolkien immortalized the star-group in The Hobbit as "Remmirath." The Pleiades have even been mentioned in the Bible! So, you see, no matter where we look in our "starry" history, this cluster of seven bright stars has been part of it.

The date of the Pleiades culmination (its highest point in the sky) has been celebrated through its rich history by being marked with various festivals and ancient rites â€" but there is one particular rite that really fits this occasion! What could be spookier on this date than to imagine a bunch of Druids celebrating the Pleiades' midnight "high" with Black Sabbath? This night of "unholy revelry" is still observed in the modern world as "All Hallows Eve" or more commonly as "Halloween." Although the actual date of the Pleiades' midnight culmination is now on November 21 instead of October 31. Thanks to its nebulous regions M45 looks wonderfully like a "ghost" haunting the starry skies. Binoculars give an incredible view of the entire region, revealing far more stars than are visible with the naked eye. Small telescopes at lowest power will enjoy M45's rich, icy-blue stars and fog-like nebulae. Larger telescopes and higher power reveal many pairs of double stars buried within its silver folds. No matter what you chose, the Pleiades definitely rocks!

Our next most famous Messier catalog object in Taurus is M1 – the "Crab Nebula". Although M1 was discovered by John Bevis in 1731, it became the first object on Charles Messier's astronomical list. He rediscovered M1 while searching for the expected return of Halley's Comet in late August 1758 and these "comet confusions" prompted Messier to start cataloging. It wasn't until Lord Rosse gathered enough light from M1 in the mid-1840's that the faint filamentary structure was noted (although he may not have given the Crab Nebula its name). To have a look for yourself, locate Zeta Tauri and look about a finger-width northwest. You won't see the "Crab legs" in small scopes – but there's much more to learn about this famous "supernova remnant".

Factually, we know the "Crab Nebula" to be the remains of an exploded star recorded by the Chinese in 1054. We know it to be a rapid expanding cloud of gas moving outward at a rate of 1,000 km per second, just as we understand there is a pulsar in the center. We also know it as first recorded by John Bevis in 1758, and then later cataloged as the beginning Messier object – penned by Charles himself some 27 years later to avoid confusion while searching for comets. We see it revealed beautifully in timed exposure photographs, its glory captured forever through the eye of the camera â€" but have you ever really taken the time to truly study the M1? Then you just may surprise yourselfâ€¦ In a small telescope, the "Crab Nebula" might seem to be a disappointment – but do not just glance at it and move on. There is a very strange quality to the light which reaches your eye, even though at first it may just appear as a vague, misty patch. To small aperture and well-adjusted eyes, the M1 will appear to have "living" qualities – a sense of movement in something that should be motionless. This aroused my curiosity to study and by using a 12.5″ scope, the reasons become very clear to me as the full dimensions of the M1 "came to light".

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

Date	Brightness	Start			Highest point			End		
	(mag)	Time	Alt.	Az.	Time	Alt.	Az.	Time	Alt.	Az.
06 Jan	-2.0	05:25:29	32°	ESE	05:25:29	32°	ESE	05:27:25	10°	ESE
06 Jan	-2.1	06:58:25	13°	W	07:00:30	22°	SW	07:03:10	10°	SSE
07 Jan	-2.7	06:12:26	30°	SW	06:12:41	31°	SSW	06:15:41	10°	SSE
08 Jan	-1.7	05:26:30	23°	SSE	05:26:30	23°	SSE	05:28:00	10°	SE
08 Jan	-1.3	07:00:05	10°	WSW	07:00:56	11°	SW	07:01:47	10°	SSW
09 Jan	-1.7	06:13:32	16°	SSW	06:13:32	16°	SSW	06:15:19	10°	S
10 Jan	-0.9	05:27:42	12°	SSE	05:27:42	12°	SSE	05:28:05	10°	SSE
20 Jan	-0.9	18:58:47	10°	S	18:58:51	10°	S	18:58:51	10°	S
21 Jan	-1.3	18:12:14	10°	SSE	18:13:00	11°	SE	18:13:00	11°	SE
21 Jan	-0.5	19:45:55	10°	SW	19:45:57	10°	SW	19:45:57	10°	SW
22 Jan	-2.0	18:58:05	10°	SSW	19:00:02	25°	S	19:00:02	25°	S
23 Jan	-2.1	18:10:27	10°	SSW	18:13:07	22°	SE	18:14:02	19°	ESE
23 Jan	-0.9	19:46:09	10°	WSW	19:46:58	16°	WSW	19:46:58	16°	WSW
24 Jan	-1.6	17:23:06	10°	S	17:25:09	15°	SE	17:27:12	10°	ESE
24 Jan	-3.1	18:58:05	10°	WSW	19:00:54	48°	SSW	19:00:54	48°	SSW
25 Jan	-3.0	18:10:07	10°	SW	18:13:18	40°	SSE	18:14:47	25°	E
25 Jan	-1.1	19:46:34	10°	W	19:47:43	20°	W	19:47:43	20°	W
26 Jan	-2.4	17:22:16	10°	SSW	17:25:14	29°	SSE	17:28:14	10°	E
26 Jan	-3.7	18:58:23	10°	WSW	19:01:33	75°	SW	19:01:33	75°	SW
27 Jan	-3.7	18:10:15	10°	WSW	18:13:36	68°	SSE	18:15:21	25°	E
27 Jan	-1.2	19:46:59	10°	W	19:48:16	21°	W	19:48:16	21°	W
28 Jan	-3.3	17:22:09	10°	SW	17:25:27	53°	SSE	17:28:44	10°	E
28 Jan	-3.8	18:58:46	10°	W	19:02:03	82°	NW	19:02:03	82°	NW
29 Jan	-3.8	18:10:33	10°	W	18:13:56	89°	N	18:15:50	24°	E
29 Jan	-1.3	19:47:21	10°	W	19:48:45	23°	W	19:48:45	23°	W
30 Jan	-3.9	18:59:08	10°	W	19:02:31	89°	S	19:02:31	89°	S
31 Jan	-3.8	18:10:53	10°	W	18:14:17	85°	N	18:16:19	22°	E
31 Jan	-1.4	19:47:42	10°	W	19:49:15	24°	W	19:49:15	24°	W
01 Feb	-3.6	18:59:26	10°	W	19:02:47	65°	SSW	19:03:05	61°	SSE
02 Feb	-3.7	18:11:11	10°	W	18:14:33	79°	SSW	18:16:57	18°	ESE
02 Feb	-1.4	19:48:07	10°	W	19:49:53	22°	WSW	19:49:53	22°	WSW
03 Feb	-2.6	18:59:44	10°	W	19:02:54	38°	SSW	19:03:51	30°	SSE
04 Feb	-3.0	18:11:26	10°	W	18:14:43	51°	SSW	18:17:54	11°	SE
04 Feb	-1.0	19:49:04	10°	WSW	19:50:51	14°	SW	19:50:51	14°	SW
05 Feb	-1.4	19:00:16	10°	W	19:02:51	20°	SW	19:05:02	12°	S
06 Feb	-1.8	18:11:46	10°	W	18:14:42	28°	SSW	18:17:39	10°	SSE
08 Feb	-0.8	18:12:32	10°	WSW	18:14:30	15°	SW	18:16:28	10°	S

END IMAGES, OBSERVING AND OUTREACH

A belated Merry Christmas!

Please see attached photo of today's partial solar eclipse taken with my iPhone Xs at 14.29 local time in Cebu, Philippines. The shot is approx 2 mins past the maximum.
If you have space feel free to put it in WASNEWS.

All the best for 2020
Simon

Wiltshire Astronomical Society	Observing Sessions 2019/20	
Date	**Moon Phase (%)**	**Moonrise/Targets**
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

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

Stoner School are interested in creating a link with our society.