NWASNEWS

Volume26 Issue 1

September 2020

Newsletter for the Wiltshire, Swindon, Beckington Astronomical Societies

Silent Bangs and Life on… Venus???

This is a big issue, not for selling outside Smiths, but with the discovery of phosphine in the high atmosphere of Venus the prospect of searching for life in the atmosphere of the hot planet twin of Earth has taken a big stride. Though there is plenty of doubt about the source of the phosphine but the only way to produce this chemical on Earth is via bacterial life (including the gut of Penguins which is why their pens at zoos smell so badly)

I am not suggesting penguins on Venus but something on Venus created the conditions, the near molten surface which rejuvenates itself due to viscous volcanoes, or intense pressure of the sulphuric acid filled atmosphere… something is causing the high volume discovered. It may have been seen before by a pioneer mission but was ignored as an anomaly.

The discovery has certainly kick started more missions, this time staying in the atmosphere at 50km above the surface. Venus is more easily reached than Mars but is extremely hostile.

The Space News section of the news letter is full of information and conjecture, along with deep subsurface 'water' on Mars.

Tonight is the first of our requested visits to the extension of astronomy, cosmology. And Martin Griffiths takes us right back to the start of it all. The Big Bang. Controversial even in its name (a deliberate joke by Fred Hoyle when the theories of the expanding universe were sent backwards in theory to when all matter started at the same point in time)..

Cosmologists have pushed the astronomers to look further into space , effectively looking back in time. The Cosmological Microwave Background, the birth of galaxies in the Hubble Deep Space Field, Extrapolations from the Hubble Constant (or is it), so many fields of practical astronomy push back time to when the Quiet Big Bang happened…..

Andy Burns is inviting you to a scheduled Zoom meeting.

Topic: Andy Burns' Zoom Meeting WAS October

Time: Oct 6, 2020 07:45 PM London

Join Zoom Meeting

https://us02web.zoom.us/j/87278391344?pwd=WlVNejFLdzAyZXpBNmRFL3JYeC9TQT09

Meeting ID: 872 7839 1344

Passcode: 025434

Meeting ID: 872 7839 1344

Passcode: 025434

Keep good health...

Clear skies Andy Burns.

With the evenings getting earlier each night, and the rotation of the skies advancing at roughly the same rate we can still get the high Milky Way objects through Cygnus with ease through to December.

The start of the Cygnus rift (actually a massive cloud of molecules between us and the next star rich spiral arms in our galaxy) is clear to see, and within this dust lane cloud are regions where the cloud is rotating fast enough to condense enough to start star formation which in turn excites the hydrogen atoms enough emit radiation that we see in the hydrogen alpha range. These are the red sections of the clouds.

80mm lens, Nikon D610a, 60seconds f3.5.

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 2020/2021.

During COVID19 ZOOM meetingd

HALL VENUE the Pavilion, Rusty Lane, Seend

Meet 7.30 for 8.00pm start

SEASON 2020/21

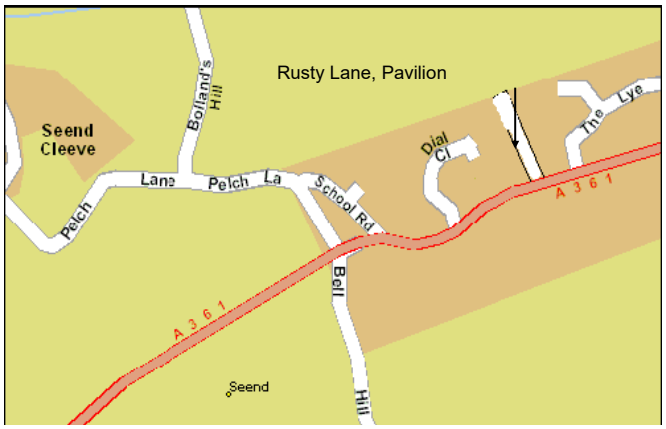
6 Oct Martin Griffiths/The Big Bang, Evidence & Estiblishment
3 Nov Andrew Lound/A Jupiter Odyssey
1 Dec Dr Lilian Hobbs/Eisa Eisinga: The Planetarium in the Bedroom.
2021
5 Jan Open Forum/Beginner meeting.
2 Feb Prof David Southwood/Moon and Mars the next Giant Leap.
2 Mar Pete Williamson/The moon & Moons of the Solar System.
6 Apr Prof Mike Edmunds/The Clockwork universe.
4 May TBC
1 Jun Robert Harvey/Understanding the Universe.

Thank you Peter and those that have helped get a list together in the circumstances.

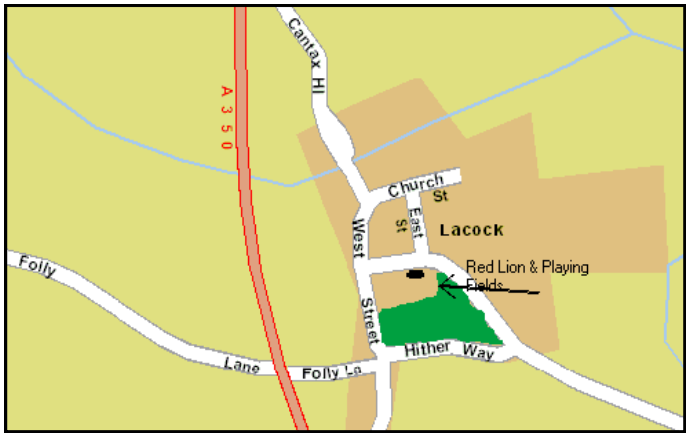
Membership Meeting nights £1.00 for members £3 for visitors

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



Martin Griffiths

Martin Griffiths BSc. (First Class Honours) MSc. (Distinction) FRAS. FHEA.

Martin Griffiths is an enthusiastic science communicator, lecturer, writer and professional astronomer utilizing astronomy, history and science fiction as tools to encourage greater public understanding of science.

He was a founder member of NASA's Astrobiology Institute Science Communication Group, active between 2003-2006 and managed a multi-million pound ESF programme in Astrobiology for adult learners between 2003-2008. Martin has written and presented planetarium programmes for key stages 1, 2 and 3 and has been an adviser to several museum projects

Martin continues to promote cross-disciplinary links between science and culture that reflect his educational background and interests. He has written monographs on the science communication of the proto-feminist Margaret Cavendish, Duchess of Newcastle; and the 18th century scientist, assay master and political adviser Joseph Harris of Breconshire. He is also a regular contributor to the online science journal LabLit: the culture of science in fiction and fact. Recently he assisted the Brecon Beacons National Park in surveying the darkness of the night sky for their successful bid for the International Dark Sky Association's Dark Sky Reserve Status – the first such reserve in Wales.

Martin is a Fellow of the Royal Astronomical Society; a Fellow of the Higher Education Academy; a member of the British Astronomical Association; the Webb Deep-Sky Society; the Society for Popular Astronomy, The Astronomical Society of the Pacific and the Astronomical League. He is also a local representative for the BAA Campaign for Dark Skies. Martin broadcasts regularly on BBC Wales radio and has appeared on science programmes for the BBC, Einstein TV, Granada TV and the Discovery Channel.

He is also a member of the Honourable Society of Cymmrodorion, dedicated to promoting the science, arts and literature of Wales.

He is now working for Dark Sky Wales in their outreach work to schools and adult learning groups. He has now written four books in the Springer Astronomy Series. And completed another book on the myths in the skies.

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Swindon's own astronomy group

Meetings cancelled

Due to the current crisis our meetings, like many others physical meetings have been cancelled at until further notice.

Ad-hoc viewing sessions postponed

All ad-hoc meetings are currently cancelled until further notice.

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

For insurance reasons you need to be a club member to take part.

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 18 September Zoom meeting

Programme: Bob Gatton: The Red Planet

Friday 16 October Zoom meeting

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

Friday 20 November Zoom meeting

Programme: Ian Smith: Narrowband Imaging

Friday 11 December Zoom meeting

Programme: Prof. Martin Hendry FRSE: Einstein Goes to Hollywood

Meeting Dates for 2021

Friday 15 January Zoom meeting
Programme: David Bryant: Meteorites and their planet of origin

Friday 19 February Zoom meeting
Programme: Prof Rene Breton: Cosmic Fireworks

Friday 19 March Zoom meeting
Programme: AGM + speaker: Viv Williams 'Setting up and using telescope mounts'

Website:

http://www.swindonstargazers.com

Chairman: Robin Wilkey

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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
19th June	To Be Informed	

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

Bath Astronomers are holding webinar sessions linking in with Stargazers web sight.

STAR QUEST ASTRONOMY CLUB

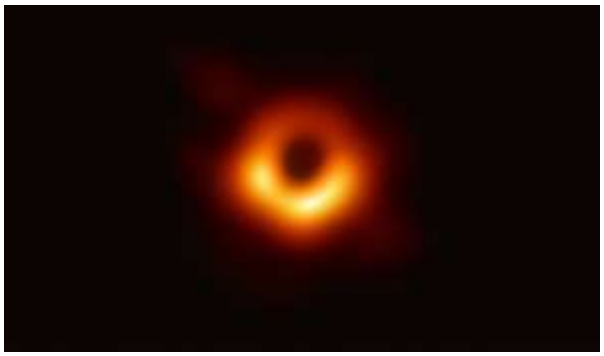
BATH ASTRONOMERS

The Bath astronomers meet regularly on line.
Please check out.

SPACE NEWS FOR OCTOBER 2020

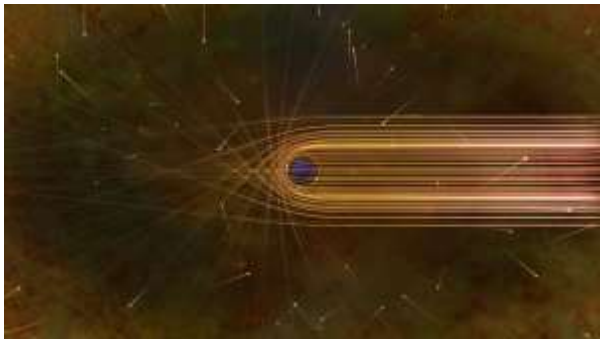
Einstein. Right again

Most of what we know about black holes is based upon indirect evidence. General relativity predicts the structure of a black hole and how matter moves around it, and computer simulations based on relativity are compared with what we observe, from the accretion disks that swirl around a black hole to the immense jets of material they cast off at relativistic speeds. Then in 2019, radio astronomers captured the first direct image of the supermassive black hole in M87. This allows us to test the limits of relativity in a new and exciting way.



First direct image of the supermassive black hole in M87. Credit: Event Horizon Telescope Collaboration

General relativity is a robust scientific theory that has passed numerous scientific tests. But it is not without its problems. Most significantly, it doesn't play well with the other robust scientific theory, quantum mechanics. Theoretical physicists have proposed several alternatives to general relativity. These models only differ from Einstein's theory slightly, making them difficult to test. A new paper in *Physical Review Letters* shows what our observations of the M87 black hole can tell us about these alternative models.



When a black hole is surrounded by hot gas, light can be focused by gravity to create a shadow of the black hole. Credit: Nicolle R. Fuller/NSF

The fuzzy ringed glow we see in the image of M87* is caused by radio light that has been gravitationally deflected by the black hole. It is essentially a shadow of the black hole with a bright, gravitationally-lensed edge. General relativity predicts the shadow's size from the mass of the black hole and the brighter and darker regions of the ring from the black hole's rotation. Alternatives to general relativity would predict slightly different shadow sizes and ring shapes. So a team looked at the M87* data and asked how it constrains alternative theories.

Any alternative to general relativity will make different predictions about how gravity behaves in the extreme regions near a black hole. Some of these alternatives differ more significantly than others. The team found that the observed size of M87* gives these alternative models very little wiggle room. The LIGO and Virgo gravitational wave observatories have confirmed general relativity for the regions of black holes up to about 150 solar masses. This new study improves upon this by a factor of 500. This means that if an alternative theory is correct, its differences must lie only in extremely strong gravitational regions. Stronger than the areas around most black holes.

Soon, astronomers will release a direct image of the supermassive black hole in our own galaxy. When they do, it could narrow down the wiggle room even further. Or it could reveal the shadow of new physics beyond what even Einstein could imagine.

Reference: Dimitrios Psaltis et al. "Gravitational Test beyond the First Post-Newtonian Order with the Shadow of the M87 Black Hole." *Physical Review Letters* 125.14 (2020): 141104

Did Scientists Just Find Signs of Life on Venus?

A team of scientists has just published a paper announcing their discovery of a peculiar chemical in the cloudtops of Venus. As far as scientists can tell, this chemical, called phosphine, could only be produced by living processes on a planet like Venus. So the whole internet is jumping on this story.

But did they find signs of life? Or is there another explanation?

Decades ago, scientists and script writers wondered about life on Venus. No spacecraft had visited, and we couldn't see through the thick, hazy atmosphere, so imaginations were unfettered. Almost anything could be going on down there, out of sight. Once spacecraft started visiting in the early 1960s, however, it became clear that life on Venus was unlikely. Venus was revealed as a blistering hot hellhole, with a toxic atmosphere and crushing pressure.

Prior to gaining a scientific understanding of Venus, it was anything goes for science fiction writers. This is an Avon comic book cover from 1950. By Gene Fawcette – Pulp covers, Public Domain, https://commons.wikimedia.org/w/index.php?curid=4320460

But the thinking behind life on Venus didn't disappear completely. In recent times, scientists have wondered if simple life might survive in Venus' unusually cloudy atmosphere. Extremophiles, the thinking goes, might be able to survive in the acidic upper parts of the planet's atmosphere, where temperatures were cooler than the 462 degree Celsius (864 F) surface temperatures. In those upper layers, the pressure and temperature is similar to Earth's.

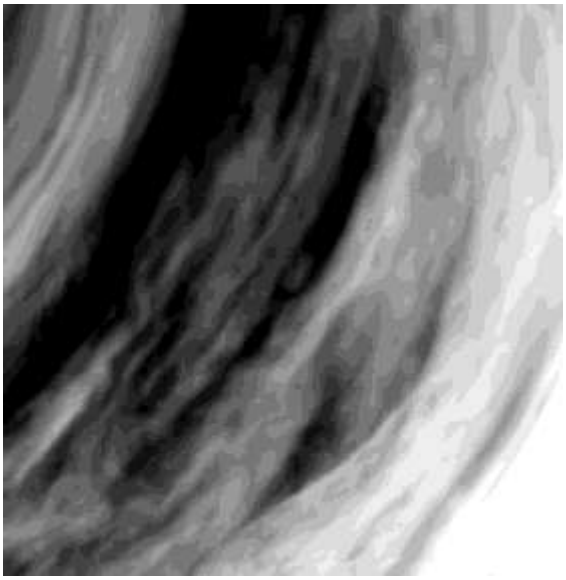
That's where the discovery of phosphine (PH_3) in the clouds comes in.

"The reason phosphine is special is, without life it is very difficult to make phosphine on rocky planets."

Clara Sousa-Silva, Co-Author, MIT's Department of Earth, Atmospheric and Planetary Sciences

The new study announcing this discovery is titled "Phosphine gas in the cloud decks of Venus." It's published in the journal Nature Astronomy, and the lead author is Jane Greaves of Cardiff University. Other authors come from MIT, Cambridge, and a handful of other research institutions around the world.

First of all, the discovery of phosphine is not direct evidence of life. Phosphine is a possible biomarker. That means we know that it can be produced by microorganisms. Here on Earth, it's produced by organisms on decaying organic matter, and phosphine is a regular constituent of the atmosphere. As far as scientists know, phosphine is either produced by life, or by chemical processes that require an enormous amount of energy.



Cloud structures in Venus' atmosphere, seen by Venus Express' Ultraviolet, Visible and Near-Infrared Mapping Spectrometer (VIRTIS) in 2007 (ESA)

Phosphine has also been found in Jupiter's atmosphere. On a gas giant like Jupiter, there's enough energy for phosphine to form abiotically. Deep in the atmosphere, extreme temperature and pressure can create phosphine, and currents can dredge it up high into the atmosphere. But on a lifeless, rocky world like Venus, phosphine is not supposed to be there. It should be oxidized, and there just isn't enough energy there to produce it.

"If this is not life, then our understanding of rocky planets is severely lacking."

Co-Author Janusz Petkowski, Research Scientist, MIT's Dept. of Earth, Atmospheric and Planetary Sciences

So its presence in Venus' atmosphere has caught everyone's attention.

The team is very confident that they've found phosphine. In their paper they write "We are unable to find another chemical species besides PH_3 that can explain the observed features. We conclude that the candidate detection of PH_3 is robust…".

They made an exhaustive analysis of their findings, trying to come up with some way that Venus' phosphine could be explained without a living source. In their paper they write that "The presence of PH_3 is unexplained after exhaustive study of steady-state chemistry and photochemical pathways, with no currently known abiotic production routes in Venus's atmosphere, clouds, surface and subsurface, or from lightning, volcanic or meteoritic delivery."

The team is hoping that other scientists can find an explanation.

"It's very hard to prove a negative," says Clara Sousa-Silva, research scientist in MIT's Department of Earth, Atmospheric and Planetary Sciences (EAPS). "Now, astronomers will think of all the ways to justify phosphine without life, and I welcome that. Please do, because we are at the end of our possibilities to show abiotic processes that can make phosphine."

The phospine has to either come from life, or there's a chemical process at work that scientists don't know about yet.

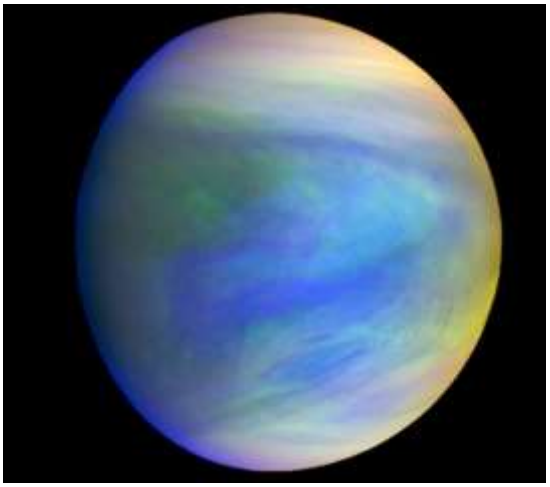
"This means either this is life, or it's some sort of physical or chemical process that we do not expect to happen on rocky planets," adds co-author and EAPS Research Scientist Janusz Petkowski.

The location of the phosphine is part of what's piqued everyone's interest.

Venus' atmosphere is hot, dense, toxic, and extremely acidic. It can be a billion times more acidic than Earth, stretching the definition of what we would call an extreme environment for life. "Venus is a very challenging environment for life of any kind," Seager says.

But there's one region, high in Venus' atmosphere, where things are different.

Between about 48 and 60 km (30 and 37 miles) above the surface, the temperature isn't so lethal. At that altitude, the temperature ranges from -1 C to 93 C (30 to 200 degrees F). It's very controversial, but some scientists have wondered if life could survive there. And that's where this team of researchers found the phosphine.



A composite image of the planet Venus as seen by the Japanese probe Akatsuki. The clouds of Venus could have environmental conditions conducive to microbial life. Credit: JAXA/Institute of Space and Astronautical Science

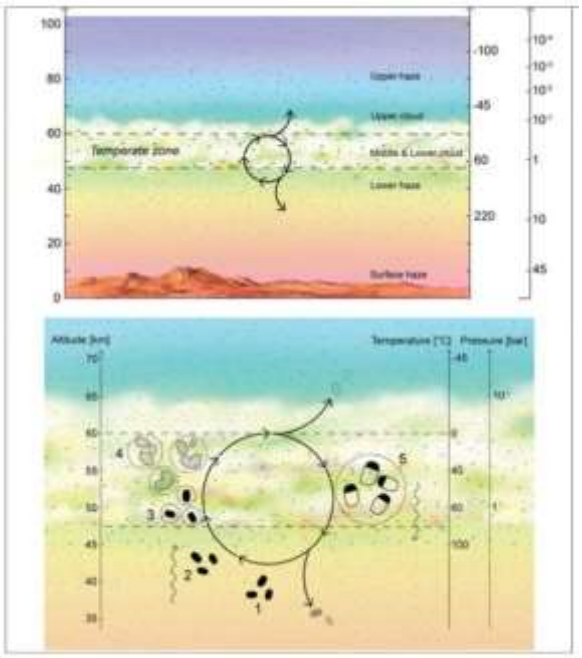
"This phosphine signal is perfectly positioned where others have conjectured the area could be habitable," Petkowski says.

Greaves and her team made the initial phosphine detection with the James Clerk Maxwell Telescope in Hawaii. They were looking for unexpected molecules in Venus' atmosphere that might be signals for life. Then they contacted Sousa-Silva, who is an expert in phosphine.

Sousa-Silva is interested in phosphine because it's a biosignature. But she expected to be looking on distant exoplanets for the molecule, as part of the overall scientific effort to identify life elsewhere in the galaxy.

"I was thinking really far, many parsecs away, and really not thinking literally the nearest planet to us," Sousa-Silva said in a press release.

The team wanted more confirmation for their finding, so they turned to the European Southern Observatory's ALMA (Atacama Large Millimeter/sub-millimeter Array). It has greater sensitivity than the James Clerk Maxwell Telescope (JCMT), which made the initial finding. ALMA observations confirmed what the team had found: a pattern of light that matched what phosphine gas would emit within Venus' clouds.



This figure is from a 2020 paper by some of the same authors of the newly-published paper. It shows a proposed lifecycle for Venusian aerial microbial life. (1) Desiccated spores (black blobs) persist in the lower haze. (2) Updraft of spores transports them up to the habitable layer. (3) Spores act as CCN, and once surrounded by liquid (with necessary chemicals dissolved) germinate and become metabolically active. (4) Metabolically active microbes (dashed blobs) grow and divide within liquid droplets (solid circles). The liquid droplets grow by coagulation. (5) The droplets reach a size large enough to gravitationally settle down out of the atmosphere; higher temperatures and droplet evaporation trigger cell division and sporulation. The spores are small enough to withstand further downward sedimentation, remaining suspended in the lower haze layer "depot." Image Credit: Seager et al, 2020.

With their ALMA and JCMT data, they turned to a model of Venus' atmosphere to help make sense of it. That model was developed by Hideo Sagawa of Kyoto Sangyo University. Sagawa is also a co-author of the new study.

The results of that showed that phosphine was a very minor part of Venus' atmosphere, at a concentration of only 20 ppb (parts per billion.) Though that's an extremely tiny fraction, in Earth's atmosphere, where the only source is biological, the concentration can be even lower.

Then the team got busy trying to fit their findings with everything that scientists know about Venus. They explored all the pathways that could explain the presence of phosphine without life. They considered a whole host of possibilities involving sunlight, surface minerals, volcanic activity, a meteor strike, and lightning.

"We really went through all possible pathways that could produce phosphine on a rocky planet," Petkow-

ski says. “If this is not life, then our understanding of rocky planets is severely lacking.”

If life is behind this phosphine, then that life is in a tough spot. It’s trapped in Venus’ temperate cloud deck, way above the planet’s hellish surface. How did it get there?

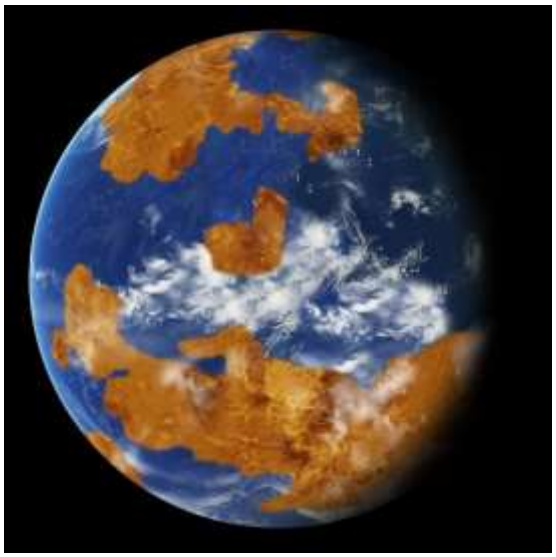
Scientists think that Venus may have been habitable billions of years ago. It may even have had oceans. It may even have been the first habitable planet in our Solar System. It’s possible that any life living in the clouds is a descendant of ancient surface life, just like remnants of Earth’s early life are surviving in oxygen poor muds, banished by the changing conditions.

“A long time ago, Venus is thought to have oceans, and was probably habitable like Earth,” Sousa-Silva says. “As Venus became less hospitable, life would have had to adapt, and they could now be in this narrow envelope of the atmosphere where they can still survive. This could show that even a planet at the edge of the habitable zone could have an atmosphere with a local aerial habitable envelope.”

It would be a strange form of life that could exist in Venus’ clouds. It would have to perpetually reproduce. And it would have to use a liquid other than water for its cellular functions. “You can, in principle, have a life cycle that keeps life in the clouds perpetually,” says Petkowski, who envisions any aerial Venusian life to be fundamentally different from life on Earth. “The liquid medium on Venus is not water, as it is on Earth.”

The team intends to follow up these results with more research. They want to use other telescopes to try and map out the phosphine, and to see if it comes and goes in daily or seasonal cycles, which might suggest that life is behind it.

This isn’t the first time that scientists have found potential signs of life in the Venusian atmosphere. But most chemical signs of life can be produced by non-living processes, too. Phosphine is different.



Observations suggest Venus may have had water oceans in its distant past. A land-ocean pattern like that above was used in a climate model to show how storm clouds could have shielded ancient Venus from strong sunlight and made the planet habitable. Credits: NASA

“Technically, biomolecules have been found in Venus’ atmosphere before, but these molecules are also associated with a thousand things other than life,” Sousa-Silva says. “The reason phosphine is special is, without life it is very difficult to make phosphine on rocky planets. Earth has been the only terrestrial planet where we have found phosphine, because there is life here. Until now.”

So that’s where it stands for now. There are plenty of headlines out there saying, or at least implying, that scientists have found signs of life on Venus. But it’s a little more nuanced than that.

While phosphine can be a sign of life, it can also not be one. The truth is we just don’t know yet. As co-author Sousa-Silva says, “It’s very hard to prove a negative.” And as we get better and better at studying other planets and moons, we’re finding a bewildering variety of physical and chemical processes and outcomes.

This could be, and probably is, one of those.

It’s intriguing to think what it’ll look like if we ever do find life elsewhere. The Hollywood/Sci-Fi version of that often involves the sudden appearance of a technologically advanced alien race, their enormous ships hovering menacingly over Earth’s cities. Or a brave team of explorers/scientists investigating some distant world suffers death by xenomorphic parasitic reproduction.

But in reality, it might look more like this. A tiny chemical signal, faint at first, then verified by stages. Just a single type of unlikely molecule, lurking where it should not be.. Unexpected and persistent.

Did Pioneer See Phosphine in the Clouds of Venus Decades Ago?

The discovery of phosphine in Venus’ atmosphere has generated a lot of interest. It has the potential to be a biosignature, though since the discovery, some researchers have thrown cold water on that idea.

But it looks, at least, like the discovery is real, and that one of NASA’s Pioneer spacecraft detected the elusive gas back in 1978. And though it’s not necessarily a biosignature, the authors of a new study think that we need to rethink the chemistry of Venus’ atmosphere.

The recent study found only tiny amounts of phosphine in Venus’ atmosphere: 20 parts per billion. But it was still there. And it looks like it’s been there for a while, according to the results in a new paper.

A team of researchers announced the Pioneer phosphine data in a paper titled “Is Phosphine in the Mass Spectra from Venus’ Clouds?” The lead author is Rakesh Mogul, a Professor of Biological Chemistry at California State Polytechnic University. Mogul is also associated with the SETI Institute, and NASA’s Office of Planetary Protection. The paper is available on the pre-press site arxiv.org.

“Considering the implications of the reported single spectral line detection of phosphine (PH3) by Greaves et al., we were inspired to re-examine data obtained

from the Pioneer-Venus Large Probe Neutral Mass Spectrometer (LNMS) to search for evidence of phosphorus compounds," the researchers write in the beginning of their paper.

The Pioneer Venus Multiprobe, also called Pioneer Venus 2, or Pioneer 13, detected it with its Large Probe Neutral Mass Spectrometer (LNMS) instrument.

Engineers inspecting NASA's Pioneer Venus Multiprobe spacecraft bus with the four probes attached. Image Credit: By NASA Ames Research Center (NASA-ARC) – http://nix.larc.nasa.gov/info;jsessionid=6v6flfypvl37?id=AC77-0376-8&orgid=9, Public Domain, https://commons.wikimedia.org/w/index.php?curid=2354021

The nomenclature around NASA's Pioneer program deserves some clarification. There were actually two Pioneer programs.

The first involved a series of spacecraft launched between 1958 to 1960. It sent spacecraft to orbit the Moon, to fly-by the Moon, and to investigate the interplanetary space between Venus and Earth.

The second part launched spacecraft between 1965 and 1992. It sent out four spacecraft, two of which were sent to Venus. Those two comprised the Pioneer Venus project, consisting of the Pioneer Venus Orbiter, and the Pioneer Venus Multiprobe.

Still with us?

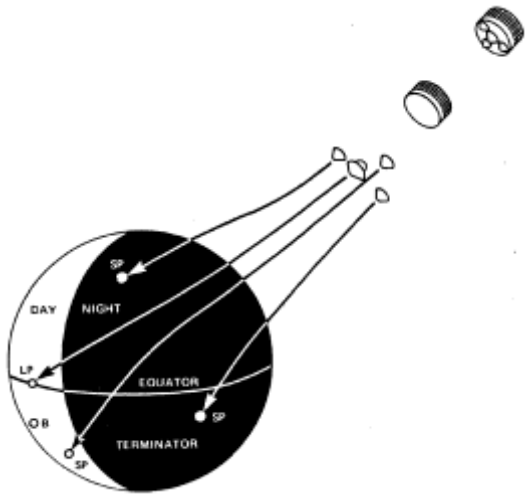
It's the Pioneer Venus Multiprobe (PVM) and the data it gathered that's at the heart of this study. The PVM was made up of a main spacecraft that carried four separate probes. One was large, and three were smaller. On December 9th, 1978, all four probes were released into the Venusian atmosphere at different locations, gathering data as they descended through the thick clouds.

A NASA poster from the archives illustrates the components of the Pioneer Venus Multiprobe. Image Credit: By NASA/Glenn Research Center – https://archive.org/details/C-1978-1565, Public Domain, https://commons.wikimedia.org/w/index.php?curid=71788219

The largest of the four probes is simply referred to as the Large Probe. It carried more instruments than the smaller probes; seven, in fact. And it lowered itself via parachute, while the other three didn't. One of its instruments was the Large Probe Neutral Mass Spectrometer

When Greaves et al discovered phosphine in Venus' upper cloud layers, the team of researchers behind this work decided to look for evidence of the phosphine from earlier days. Since the LNMS studied neutral gases and their masses at different altitudes, they reasoned, perhaps it "saw" phosphine in the upper cloud layers, way back in 1978.

After going over the data, the team wrote, "We find that LMNS data support the presence of phosphine; although, the origins of phosphine remain unknown."



The Pioneer Venus Multiprobe released a total of four probes into the Venusian atmosphere. Image Credit: By NASA – http://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/19780020162.pdf, Public Domain, https://commons.wikimedia.org/w/index.php?curid=38737173

It took some work to get to that conclusion. After all, the data is over 40 years old.

They starting by testing the accuracy of the data, and the instrument that gathered it, to make sure. "To estimate the resolution and resolving power of the LNMS, we first compared measured and expected masses for CO2, SO2, N2, 40Ar, and 36Ar, which were identified by Hoffman et al," they write. "In all cases, measured masses (from the spectra) and expected masses differed by <0.003 amu <atomic mass unit>)." That difference is not significant in this work. In their paper, they explain the accuracy of their data in greater detail.

"In this light, we leveraged the high-resolution data and dynamic range to uncover the presence of phosphine. We note that phosphorous compounds were not reported in the initial analyses…" of LNMS data. But that doesn't mean the signal wasn't there.

The authors say that the data confirms the presence of phosphine in Venus' atmosphere. They also list a few other conclusions, which only the especially chemically-minded might find interesting. Interested readers can check out the paper, which is a fairly short read.

In short, there's some initial ambiguity in the readings, suggesting that what appears to be PH_3 could potentially be H_2S, or hydrogen sulfide. But in the end, it's PH_3 and its sibling PH_2 that account for it, in the authors' analysis.

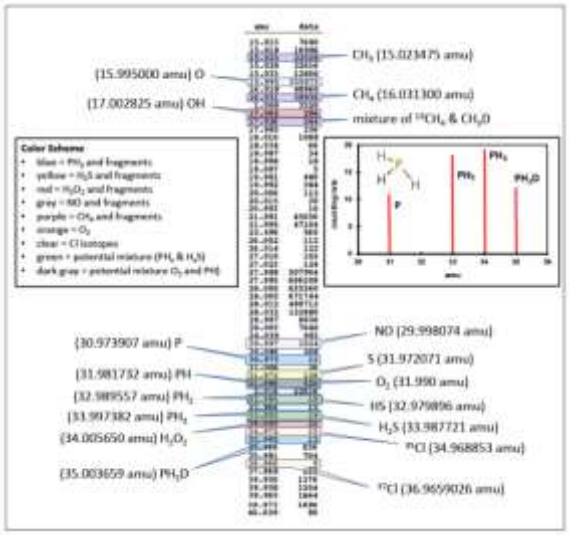
Balloon Missions to Venus have been proposed for both exploration as well as colonization. Image Credit: NASA

They also found some other incongruential data for other chemicals in Venus' atmosphere. Again, this is likely of interest to only the chemically-minded among us, but it's worth mentioning. They say the presence of these chemicals is at odds with Venus' oxidizing atmosphere. These include methanes, nitrous oxide, and hydrogen peroxide.

In their conclusion, the authors write that "this re-evaluation of Venus' mass spectra shows the detection of atomic phosphorous as a fragmentation product from a neutral gas. Moreover, the spectra show a tantalizing possibility for the presence of PH3, along with its associated fragments…"

They also point out that the LNMS signal for phosphine is weak, but it matches with the 20 ppb figure in the study from a couple weeks ago.

"While intensities of the peaks are low, they are perhaps consistent with the ~20 ppb abundances reported by Greaves et al. Together, the tentative assignments suggest that the reported abundances of H2S (from mass spectra) across Venus' atmosphere may actually be PH3;"



This figure from the study shows tentative assignments of different chemicals to the spectra obtained by the Neutral Mass Spectrometer on NASA's Pioneer Venus Probe. Image Credit: Mogul et al, 2020.

In total, the team thinks that we might need to rethink Venus' atmosphere, and its potential to harbour life. Not only because of the Greaves et al study, but because of their own results. "We believe this to be an indication of chemistries not yet discovered, and/or chemistries potentially favorable for life."

"Looking ahead," they write, "and to better understand the potential for disequilibria in the clouds, we require a sustained approach for the exploration of Venus."

More science?

Sounds good.

Maybe Volcanoes Could Explain the Phosphine in Venus' Atmosphere

The detection of phosphine in Venus' atmosphere was one of those quintessential moments in space science. It was an unexpected discovery, and when combined with our incomplete understanding of planetary science, and our wistful hopefulness around the discovery of life, the result was a potent mix that lit up internet headlines.

As always, some of the headlines were a bit of an over-reach. But that's the way it goes.

At the heart of it all, there is compelling science. And the same, overarching question that keeps popping up: Are we alone?

For people who don't follow the search for life too closely, finding 20 parts per billion of some obscure chemical that most people have never heard of doesn't sound much like discovering life. But in the scientific world, this is the reality: the discovery of life likely means finding a strange chemical signature that leads us to single-celled organisms somewhere. Just like we did on Venus.

We're not likely to discover some type of complex life like the type that populates Earth. Never say never, but the odds are against that.

That's why the discovery of phosphine (PH_3) has generated so much interest in the scientific world. As far as scientists know—and knowledge is incomplete—phosphine is the direct result of living processes, in most cases. Without life, it takes an enormous amount of energy to create, and that energy is absent on Venus and planets like it.

The planet Venus, as imaged by the Magellan mission. Credit: NASA/JPL

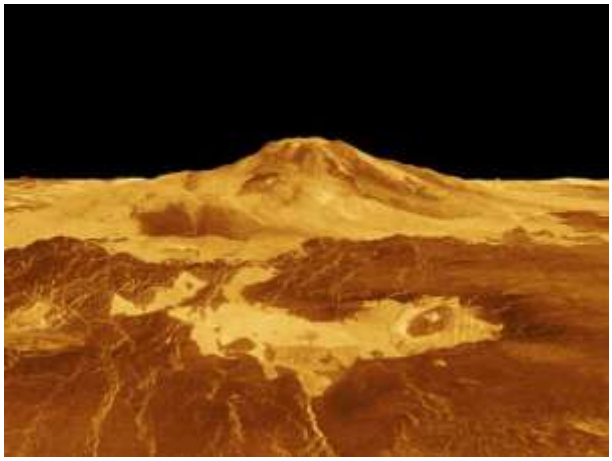
While the discovery has led to a lot of conjecture, some of it over the top, it's still an intriguing discovery. With further study, we'll either eventually find an organism somehow creating the phosphine, or we'll learn something more about Venus that we didn't know.

A new study proposes an abiotic source for Venus' phosphine: volcanoes. It's titled "Hypothesis Perspectives: Might active volcanisms today contribute to the presence of phosphine in Venus's atmosphere?" The authors are Ngoc Truong and Jonathan I. Lunine. Lunine is a planetary scientist and physicist at Cornell University, and Truong is a grad student at Cornell. The paper is available on pre-press site arxiv.org.

"The … hypothesis that life is producing PH3 in the clouds of Venus requires both the extraordinary claim that life exists in the clouds, and a mechanism to maintain its viability…"

Truong and Lunine, 2020.

"We propose an abiotic geological mechanism that accounts for the abundance of phosphine detected by Greaves et al., 2020," the authors write in their paper. "We hypothesize that trace amounts of phosphides formed in the mantle would be brought to the surface by volcanism, and then subsequently ejected into the atmosphere, where they could react with water or sulfuric acid to form phosphine."



3-D perspective of the Venusian volcano, Maat Mons generated from radar data from NASA's Magellan mission. Image Credit: NASA

Let's back up for a minute. A couple weeks ago a team of scientists reported the discovery of phosphine high up in Venus' atmosphere. A few facts explain why this is an interesting discovery.

Phosphine is a biomarker for life. It's not direct evidence; it's just that here on Earth it's only created through living processes. Without a living source, it takes an awful lot of energy to create it. And Venus lacks that energy. Clara Sousa-Silva is one of the authors of the phosphine study. In a press release accompanying the discovery, she explained that "The reason phosphine is special is, without life it is very difficult to make phosphine on rocky planets. Earth has been the only terrestrial planet where we have found phosphine, because there is life here. Until now."

Also, phosphine is rapidly destroyed, so finding it means that some process is continuously producing it. It can't be a relic from the past.

In the original paper presenting the discovery, the authors wrote that "The presence of PH_3 is unexplained after exhaustive study of steady-state chemistry and photochemical pathways, with no currently known abiotic production routes in Venus's atmosphere, clouds, surface and subsurface, or from lightning, volcanic or meteoritic delivery."

Could Venus' hostile environment harbour life? Could there be an unlikely refuge for simple organisms high in the planet's atmosphere? Credit: ESA

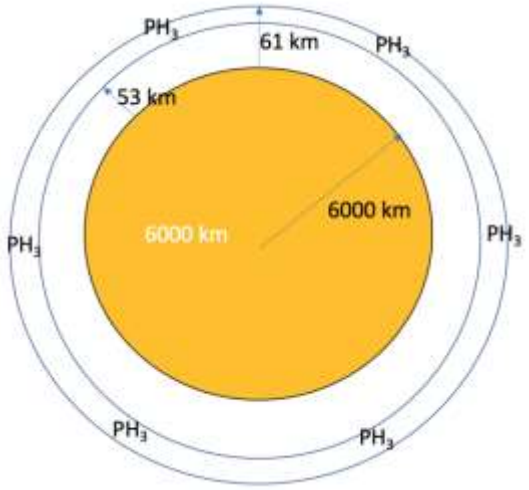
The authors of the new paper think they may have the answer. And despite the initial paper ruling out volcanic activity as the source of Venus' phosphine, that's exactly what the new hypothesis states: that phosphides from basaltic lava activity are entering the atmosphere, then reacting with either water or sulphuric acid to form phosphine.

Despite earlier claims that it takes either living processes, or very energetic processes to produce phosphine, the authors point out one other pathway. It stems from impurities in iron and how they react with other substances.

"On Earth, one of the known processes is the production of phosphine gas by aqueous or acid corrosion from phosphorous-containing impurities in iron," they explain. In a 2010 experiment, "aqueous corrosion produced a significant amount of phosphine gas comparable to the amount detected in natural terrestrial environments, while sulfuric acid corrosion could produce an amount of phosphine gas three orders of magnitude higher than aqueous corrosion."

This lines up with their hypothesis for a volcanic source of phosphides ejected into the atmosphere by volcanic activity, and then reacting with water of sulfuric acid. To test their hypothesis, they carried out an order of magnitude calculation.

First hey had to find the volume of phosphine present in Venus' atmosphere. There are 20 parts per billion in an atmospheric layer 8 km thick, between 53 and 61 km (33 to 38 mi) above the planet's surface.



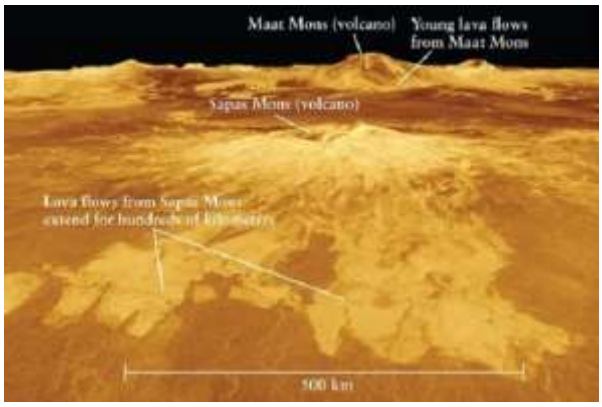
This figure from the study illustrates the atmospheric layer that contains phosphine. Image Credit: Truong et al, 2020.

In their paper the pair of scientists show their calculations. But the end result of all the calculations shows that Venus' atmosphere contains 2.7 x 10^{10} kg of phosphine. That's 27,000,000,000 kg, or 27 billion kg.

The other part of the picture is the destruction rate for phosphine in Venus' atmosphere. In the original paper announcing the discovery, Greaves et al examined that issue in depth. The new paper leans on that, and says "We shall assume here that, in the layer 53-61 km, phosphine could be stable for their uppermost value– about a year."

So each year, Venus would need to produce the same amount of phosphides as the amount of phosphines in the atmosphere at any given time: 27 billion kg. "Based on this assumption, volcanoes would need to produce ~ 2.7 x 1010 kg of new phosphide every year to continuously pump into the middle atmosphere, which then react with the sulfuric acid droplets to produce the observed phosphine.

Then it comes down to lava. The authors calculate that Venus would need to produce 93 cubic kg of lava every year to produce enough phosphides.

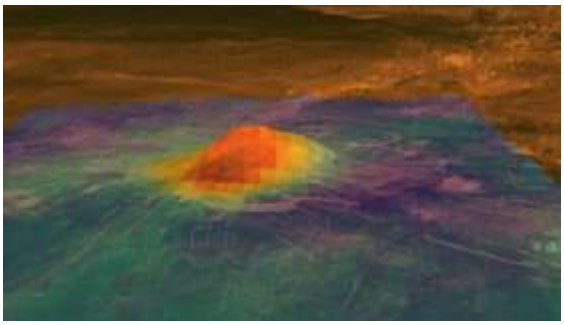


Volcanoes and lava flows on Venus. There are over 1,000 volcanic structures on the surface of Venus, and the surface of the planet is over 90% basalt,

indicating that Venus has likely been resurfaced almost completely with lava. Credit: NASA/JPL

The question that all of this rides on is "Does Venus produce this much lava each year? And this is where it gets tricky, if it isn't already.

There are wide-ranging scientific estimates of Venus' volcanic activity. Some of that research says yes, Venus can produce that much lava. Others say no. There's no agreed-upon conclusion in the scientific world, yet. But the estimates are informed by scientific data, particularly from the VIRTIS instrument on the ESA's Venus Express.



The colored overlay shows the emissivity derived from VIRTIS surface brightness data, acquired by ESA¹s Venus Express mission. The high emissivity area (shown in red and yellow) is centered on the summit and the bright flows that originate there. Image courtesy NASA/JPL-Caltech/ESA; image created by Ryan Ollerenshaw and Eric DeJong of the Solar System Visualization Group, JPL.

"Rather than pointing to the existence of life in the clouds, we argue that phosphine is pointing to a Venus that is geologically active today…"

Truong and Lunine, 2020.

In this paper, the author referenced one study that calculated Venus' lava production between 23 km^3/year and 235 km^3/year. They discuss additional detail in lava production estimates before writing "All these estimates are comparable to the 93 km3 /year we calculate as required to produce the phosphide-source of the phosphine."

Is this the end of the postulation that life in Venus' clouds could be producing phosphine? Who knows.

"The Greaves et al., 2020 hypothesis that life is producing PH3 in the clouds of Venus requires both the extraordinary claim that life exists in the clouds, and a mechanism to maintain its viability as droplets in the aerosol layer grow and sink," the authors write. And of course we all know what Carl Sagan said about extraordinary claim.

To the authors, their own hypothesis is more likely. "Our hypothesis, instead, requires that Venus be currently experiencing a high rate of basaltic volcanism, but one that is consistent with spacecraft observations and laboratory experiments."

"Rather than pointing to the existence of life in the clouds, we argue that phosphine is pointing to a Venus that is geologically active today—a conclusion perhaps disappointing to biologists but surely intriguing to planetary scientists."

To be fair to the authors of the original paper announcing the discovery of phosphine at Venus, they never claimed it was proof of life. They themselves were circumspect about that conclusion. "If this is not life, then our understanding of rocky planets is severely lacking," said co-author Janusz Petkowski.

And co-author Clara Sousa-Silva said, "Now, astronomers will think of all the ways to justify phosphine without life, and I welcome that. Please do, because we are at the end of our possibilities to show abiotic processes that can make phosphine."

Sounds like it's time for a mission to Venus to sort this all out.

A Balloon Mission that Could Try to Confirm Life On Venus

So, Venus might have life! But how do we find out for sure?! We need to GO there.

Here's a recap of the Venusian Life story thus far:

On September 14, the discovery of phosphine gas in the Venusian clouds was announced by a team of scientists led by Jane Greaves of Cardiff University.

In light of the phosphine detection, a 103 page research paper entitled *"Phosphine on Venus Cannot be Explained by Conventional Processes",* co-authored by some of the original scientists on the phosphine detection research team including William Bains, Janusz J. Petkowski, and Sara Seager, was submitted to Astrobiology Magazine. After examining "gas reactions, geochemical reactions, (and), photochemistry" as potential producers of the phosphine the paper concluded that:

None of these potential phosphine production pathways are sufficient to explain the presence of ppb (parts per billion) phosphine on Venus.

Bains et al 2020

We do know of one way that phosphine is created, however… by life. On Earth, the paper reiterates, "phosphine is exclusively associated with anthropogenic (human activity) and biological sources."

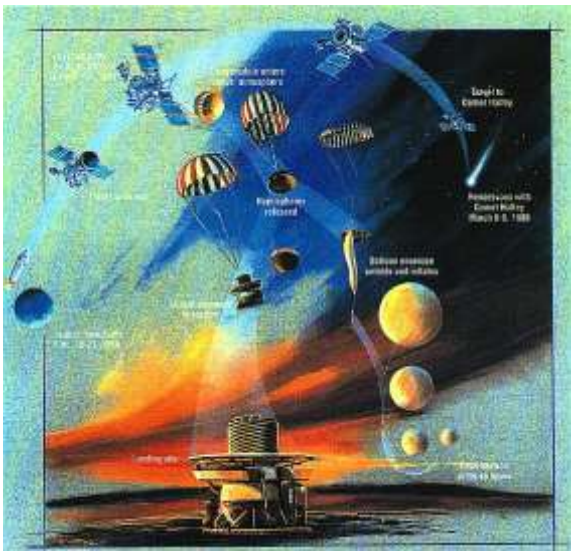
Do the clouds of Venus harbour life? c. NASA

Two days after the phosphine announcement, Mansavi Lingam and Abraham Loeb confirmed that the concentrations of phosphine in the Venusian atmosphere could plausibly be generated by microbes residing in the clouds. Had the phosphine concentrations been much higher, the gas may yet be the result of an unknown chemical or geological process. But even biomass orders of magnitude lower than what we find in our own aerial biosphere on Earth could theoretically generate the 20 ppb phosphine concentrations we've observed.

Wow…so we are living in a time where we're seriously discussing extant life on another world in our Solar System. Certainly, the entire astrobiology community (and the rest of us as well) wants a biosignature – a potential marker for life like phosphine – to actually be life. However, because of scientific discipline, we don't want to simply jump to the conclusion that it's aliens. We need to return to the clouds themselves to discover the true nature of the phosphine detection.

Back to Venus:

I say "return" because Earth has sent missions to the clouds of Venus in the past. In 1986, the Russian *Vega* mission (a combination of the Russian Words *Venera* and *Gallilei* – Venus and Halley) used a balloon probe to understand Venusian meteorology. The mission had two objectives, first to take advantage of Comet Halley's pass through the solar system that year capturing images of the comet, and then continued to Venus.



Vega Mission Diagram – Public Domain

Vega consisted of a lander and also a balloon that remained at cloud altitudes around 53.6km. The balloon itself was 3.4m in diameter with total a total mass of 21kg. The instrumentation package connected to the balloon measured meteorological conditions of Venus over a 46 hour period transmitting data back to Earth at 2kb/s (2 kilobits per second….not far off from my first dial-up connection.) At this altitude above the Venusian surface, temperature and pressure are similar to those on Earth…they also correspond to the altitudes where phosphine has been detected.

Vega balloon probe on display at the Udvar-Hazy Center of the Smithsonian Institution. Photo by Geoffrey A. Landis. CC by SA 4.0

Since Vega, other possible missions with their respective devices have been explored. In 2010, Aeronautical Engineer Graham Dorrington compiled a review of various engineering solutions for the exploration of Venus' clouds. The solutions included paragliders, kites, fold out wing gliders, solar powered aircraft, and airships. Large scale versions of these solutions have even been suggested for future colonization of Venus in cloud-based habitats. Dorrington concluded, based on the results of the Vega program, that continuing to use balloon-based designs seemed to be the "most favored platform." So, with the recent phosphine detection at the altitudes Vega operated, and past research of the efficacy of balloons, a new proposed life-seeking balloon mission was developed by a team including Mansavi Lingam; co-author of the theoretical required biomass for the phosphine signature. While Vega was a meteorological study of Venus, these balloons would be launched with life-detection as their primary mission. As the research team states: *"The most unambiguous method…is to send spacecraft to Venus to carry out on-site measurements and experiments of its cloud layers."*

Artist rendition of balloon/blimp technology which in the future may be used fore future colonization of Venus as well as exploration – c. NASA

Balloon 2.0

This new Venus balloon mission would have 4 key objectives. 3 of these would be primary life-seeking objectives with one fourth side-quest meteorological objective. The 3 primaries are:

1) Collect aerosol and dust samples to search for microscopic life. Past research by MIT planetary scientist Sara Seager suggested that microbes could live in aerosols within the Venusian clouds that would alter between states of hydration and desiccation as they precipitated to lower and hotter altitudes. In addition to the phosphine detections, a curious absorption of UV light has also been observed in the clouds of Venus. It's been suggested that UV light is being absorbed for photosynthetic processes by microbes in the cloud layers. If either such life-form exists, the balloon would be able to find them using tiny collection plates, petri dishes, and small cameras operating as microscopes.

2) Search for signs of macroscopic life. Macroscopic life could potentially be observed simply by using a camera on board the balloon. The proposal suggests a unit similar to the 250g megapixel camera aboard the Curiosity Rover on Mars which has produced incredible images from the surface of the Red Planet. Aerial macroscopic life isn't out of the realm of possibility for a world like Venus. In 1976, Carl Sagan and Edwin Salpeter hypothesized an aerial ecology in the clouds of Jupiter. They envisioned "sinkers and floaters" throughout the Jovian atmosphere – a combination of organisms resembling photosynthetic plankton being fed upon by creatures using "float bladders" to stay aloft in the clouds. If there is any such macroscopic ecology in the clouds of Venus, a camera should be able to detect it.

3) Look for building block materials of life. These would include complex organic compounds, polymers, amino acids, and nucleotides. This mission would require the installation of a miniature mass spectrometer within the balloon's instrumentation package. A mass spectrometer would be the heaviest and most power demanding of the instruments aboard the balloon.

4) Meteorological studies of the Venusian clouds. This objective is similar to the previous Vega mission which would require outfitting the balloon with atmospheric sensors. The is the side-quest mission.

Artist's rendition of a theoretical balloon probe in Venus Clouds c. T.Balint ESA

As with anything you send into space, your mission is constrained by weight and power. You can do more things in space with more stuff…but getting stuff up there, and giving it power, gets more difficult with more stuff. It's physics! The team proposed two architecture variants of the balloons. The category 1 variant is lighter weight and only carries equipment to complete mission objectives 1 and 2. Objective 3 is the heaviest necessitating the mass spectrometer and objective 4 is still a side mission. Each category 1 balloon would weigh a total of 1.7kg (amazing when you think about all it needs to accomplish with that weight) and would operate for an estimated 48 hours – similar to the Vega operating window. In that 48 hours, a single balloon could send 20MB of data back to Earth which would include a total of 140 images. Given the previous estimates for biomass density a single balloon could theoretically sequester as many as 1700 microbes from the atmosphere in the same time frame. Even if the biodensity estimates are way off, by orders of magnitude, the research team concludes "it seems conceivable that each (category) 1 probe may stumble across a microbe." At least one. Theoretically the balloon could operate at under 5W of power.

The category 2 probes are bulkier and carry room for the mass spectrometer allowing completion of mission objective 3 and possibly 4. They are an order of magnitude more massive at 16.1kg but that affords higher data transmission rates allowing 108MB total for a 48 hour period which includes 715 images. Power requirements would be higher – probably around 15W or more (still less than a typical LED bulb in your house).

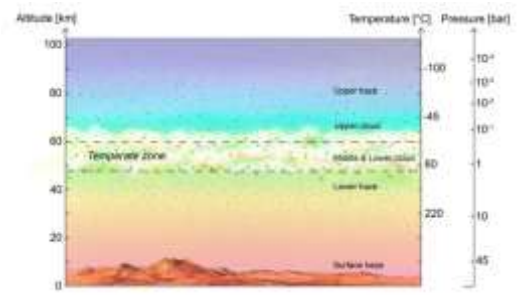


Fig 1. from Bains et al 2020 showing the temperate zone in the Venusian Clouds where life may be possible and where Phosphine has been detected. (figure modified from (Seager et al. 2021))

Both balloon designs use "off-the-shelf" technology that is presently available meaning that the mission could be launched within the next 2-3 years. While the category 2 probe could do more research on Venus, the higher payload means you can send far fewer of the balloons at once. At some point there are diminishing returns. So, the authors outline a plausible mission using the category 1 balloons. A mission based on the category 1 architecture could send a vehicle to Venus carrying 11 of the balloons for about 20 million dollars. You know, discovering life on another world within the next 3 years for 20 million seems like a worthwhile investment to me.

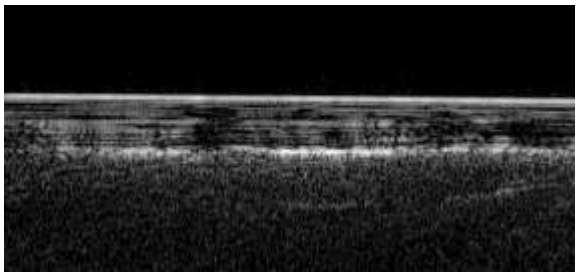
As I was writing this article, I had goosebumps. We're possibly discussing one of the greatest discoveries of all time unfolding before us. That unfolding is important too! That's the science – it's how science works! We won't just have suddenly put balloons on Venus and found life. What we're seeing is one discovery – phosphine, built on previous research which leads to more study – ruling out geology/chemistry, leading to more research – biodensity calculations, leading to mission design proposals. Each of these steps involves more scientists, researchers, engineers, and the collaboration of them all to make discovery possible. That process is sometimes excluded with the big scientific announcements. But these individual steps, and being able to look back at the journey, is why we can be certain of the discoveries we have made. Now we have to wait and see if anyone picks up this mission design proposal for implementation. In the meantime, let's keep our heads in the clouds – you never know what you may find there.

Mars Express Finds Even More Ponds of Water Under the Ground on Mars

Evidence of Mars' watery past is written all over the surface of the planet. Between dried-up river valleys, outflow channels, and sedimentary deposits, it is clear that Mars was once a much different place. But until recently, the mystery of where this water went has remained unsolved. This changed in 2018 when data obtained by the ESA's *Mars Express* probe indicated the existence of water beneath the south pole of the planet.

According to the *Mars Express* probe's Mars Advanced Radar for Subsurface and Ionosphere Sounding (MARSIS), this body of water is in a 20 km (~12.5 mi) wide area about 1.5 km (~1 mi) beneath the surface. And now, further analysis of the data by a team led by the Roma Tre University has revealed the existence of three new ponds, the largest of which measures about 20 x 30 km (~12.5 x 18.5 mi) and is surrounded by many smaller ponds.

A research paper that describes the discovery was recently published in the journal *Nature Astronomy*. The study was led by Dr. Sebastian Emanuel Lauro (a researcher with the Dept. of Mathematics and Physics at the Roma Tre University) and included researchers from the University of Southern Queensland, Jacobs University Bremen, the Istituto Nazionale di Astrofisica (INAF), and the Italian National Research Council (CNR).



Radar sounding data obtained by the ESA's Mars Express probe, indicating the presence of underground water. Credit: ESA

Based on decades worth of surface and atmospheric data, scientists have determined that over three billion years ago, Mars had standing bodies of water, rivers, and ocean an ocean that covered much of its northern hemisphere. Today, it is impossible for water to remain stable on the surface owing to the extremely thin atmosphere. However, there is considerable amounts of water frozen in its polar regions.

Furthermore, the radar investigation conducted by the *Mars Express* probe showed that beneath the southern polar ice cap, the subsurface is made of many layers of ice and dust down to a depth of about 1.5 km in the 200 km-wide area analyzed in this study. The MARSIS data also found a particularly bright radar reflection beneath the layered deposits that measured roughly 20 km (~12.5 mi) in area.

The techniques used to analyze the MARSIS radar data are similar to those used to investigate subglacial lakes in Antarctica, Canada, and Greenland. A good example is Lake Vostok, which is located beneath 4 km (mi) of ice in Antarctica. Since its discovery, scientists have speculated that this lake (and others like it) might harbor unique ecosystems, which makes them a useful analogy for astrobiologists how life can survive in extreme environments.

The latest analysis of this data indicated that there are at least more ponds in the 200 km (125 mi) region scanned by *Mars Express*, which the team believes are the kind of hypersaline perchlorate brines (aka. very salty water) that are known to form in the Martian polar region. These results open the possibility that an entire system of ancient salty lakes might exist underground that date back millions (or even billions) of years.

While they would be difficult to reach, these would be the ideal spots to search for evidence of present-day life on Mars. Much like the existence of liquid water on the surface, scientists speculate that the only place where life could still exist on Mars is underground, most likely in

patches of briny water. The existence of life in subsurface ponds also raises ethical questions about humans living on Mars in the future.

Several proposals for establishing a permanent human presence on Mars depend upon the availability of subsurface aquifers. But if in fact these are home to simple life forms or entire biospheres, then harvesting the water would be an ecological disaster and tantamount to genocide, and could even harmful for human beings consuming it.

This, among other recent discoveries, highlights the need for more research on Mars before we attempt to send regular missions there.

A Rogue Earth-Mass Planet Has Been Discovered Freely Floating in the Milky Way Without a Star

If a solar system is a family, then some planets leave home early. Whether they want to or not. Once they've left the gravitational embrace of their family, they're pretty much destined to drift through interstellar space forever, unbound to any star.

Astronomers like to call these drifters "rogue planets," and they're getting better at finding them. A team of astronomers have found one of these drifting rogues that's about the same mass as Mars or Earth.

Finding something in deep space that emits no light of its own is extremely challenging. But two organizations are doing just that. They're the OGLE (Optical Gravitational Lensing Experiment) collaboration and the KMTN (Korean Microlensing Telescope Network) collaboration.

Now, a team of scientists from both groups have announced the discovery of a low-mass rogue planet. There are no stars near it, and its distance from Earth is unconfirmed. The team says it proves that the microlensing technique is effective at finding Earth-mass planets that are free-floating in space.

An artist's illustration of a rogue planet, dark and mysterious. Image Credit: NASA

The paper presenting this discovery is titled "A terrestrial-mass rogue planet candidate detected in the shortest-timescale microlensing event." There are 30 authors listed as contributors for this work, and the lead author is Przemek Mróz, a postdoctoral scholar in astronomy at Caltech. The paper is available on the pre-press site arxiv.org.

Astronomers think that in the early days of a solar system, some low-mass planets will be ejected from the star's gravitational grip. Things can be chaotic in the early days, and gravitational interactions between the star and all the planets can sometimes send small planets out into space to fend for themselves. "According to planet-formation theories, such as the core accretion theory, typical masses of ejected planets should be between 0.3 and 1.0 Earth masses," the authors write.

Finding these tiny bodies in the vast darkness of space requires an innovative approach: gravitational lensing.

Gravitational lensing requires two things: A distant light source, usually a star, and a closer object with enough mass to act as a lens, and to bend the light from the light source. In this case, the low-mass planet acts as the lens. And depending on how much the light from the distant star is affected by the foreground object, astronomers can learn quite a bit.

This animation shows how gravitational microlensing can reveal island worlds. When an unseen rogue planet passes in front of a more distant star from our vantage point, light from the star bends as it passes through the warped space-time around the planet. The planet acts as a cosmic magnifying glass, amplifying the brightness of the background star. Credit: NASA's Goddard Space Flight Center/CI Lab

A relatively tiny object like a low-mass planet doesn't bend much light, and not for too long, either. In their paper the authors say "Microlensing events due to terrestrial -mass rogue planets are expected to have extremely small angular Einstein radii (.1 μas) and extremely short timescales (0.1 day)." According to the authors, this is the "most extreme short-timescale microlens discovered to date."

In the last couple of decades, knowledge of exoplanets has exploded. We now know of thousands of them, and we expect that almost every star hosts planets. All of this knowledge has led to updated theories and models of planet and solar system formation. And those models show that there should be a lot of rogue planets that were ejected from their systems.

Theoretical work shows that there could be billions, or even trillions, of free-floating planets in the Milky Way. In their work, the authors lists the ways these planets can end up orphaned: Planet-planet scattering; dynamical interactions between giant planets that lead to orbital disruption of smaller, inner planets; interactions between the stars in binary or trinary systems and star clusters; stellar fly-bys; and the evolution of the host star past the main sequence.

Artist's rendering of an Earth-sized rogue planet approaching a star. Credit: Christine Pulliam (CfA)

Microlensing offers a method of finding these smalle rogue planets. But it's difficult. It's not that they're so dim that's the problem. It's that the microlensing events for bodies this small are on a very short timescale due to their size. The newly-discovered planet, which has been named "OGLE-2016-BLG-1928," was discovered in a micro-lensing event which lasted only 41.5 minutes. That's not much time for detailed data to be gathered.

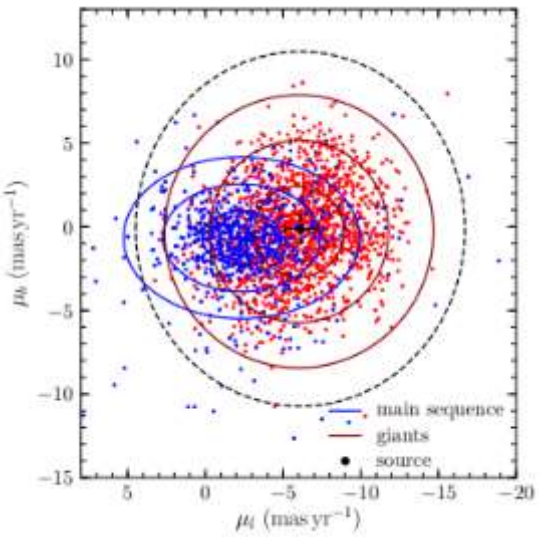
Only four other small rogue planets like this one have been found before, each one in a short timescale micro-lensing event. Together, these events provide "strong evidence for a population of rogue planets in the Milky Way," the authors write.

The researchers faced a host of difficulties in not only detecting this event, but in determining that it was indeed a planet.

"As in the case of other short timescale microlensing events, we cannot rule out the presence of a distant stellar companion," they write. They were able to exclude any stellar companions out to a distance of only 8 AUs. But many planets orbit their stars at much greater distances than that.

This planet was also found "…at the edge of current limits of detecting short-timescale microlensing events," the paper says. The authors say this points out how difficult the search for these events is. The event was detected with relatively few data points, too: only 15. (11 were from OGLE and 4 were from KMTN.)

The small number of data points in the detection means that the "declining part of the light curve is not fully covered with observations." That data shortfall means there's some uncertainty around the nature of the microlensing event, and some uncertainty around it actually being a planet. Part of that uncertainty stems from the background star itself.



This figure from the study shows the star that acted as the light source in the micro-lensing event. Red dots mark red giant stars in the galactic bulge, and blue dots represent main sequence stars in the galactic disk. Gaia data indicates that the source star is a red giant in the galactic bulge. Image Credit: Mroz et al, 2020.

"The source star is located in the red giant branch in the color–magnitude diagram, and some giants are known to produce stellar flares," the authors write. Could they conclusively rule out stellar flares as the cause of the event, rather than a rogue planet?

"However, the properties of the event (its duration, amplitude, and light curve shape) do not match those of flaring stars." they conclude.

But even with the uncertainties, this discovery is still important. "Thus, the lens is one of the best candidates for a terrestrial-mass rogue planet detected to date," they write. Even though their mass measurement for the object is somewhat ambivalent, the other properties of the event are "…consistent with the lens being a sub Earth-mass object with no stellar companion up to the projected distance of about 8 au from the planet."

Rogue planets have almost zero potential for hosting life, so they may never be the intense field of study in the same way that exoplanets have become. But they're still intriguing, and like everything else, they hold clues to how nature works.

In the future, the Nancy Grace Roman Space Telescope will aid in the search for rogue planets. It has a lot on its plate for its mission, including some huge topics like dark energy, and some eagerly-awaited tasks like imaging exoplanets and obtaining spectra of their atmospheres.

But part of its job is also to find free-floating rogue planets as small as Mars. The ultra-powerful space telescope will conduct a large microlensing survey to find more of these planets. Its findings will help us understand better how our own Solar System stacks up to others.

"As our view of the universe has expanded, we've realized that our solar system may be unusual," said Samson Johnson, a graduate student at Ohio State University in Columbus, in a press release. "Roman will help us learn more about how we fit in the cosmic scheme of things by studying rogue planets."

Astronomers think they've found an exoplanet in a galaxy 23 million light-years away

Using a variety of techniques astronomers have successfully identified thousands of exoplanets, which are planets orbiting stars outside of our own solar system. But a new research paper introduces a breakthrough: the first detection of an exoplanet not just in another solar system, but in an entirely different galaxy sitting millions of light years away.

Finding exoplanets is a relatively straightforward yet painstaking job. You stare at a star for a really long time. If any planets orbit that star, and if their orbits line up just right so that they cross the face of the star from our line of sight, you will see a noticeable dip in the brightness of that star. The painstaking part is that you have to stare at thousands of stars for extended periods of time in order to catch one of these lucky breaks.

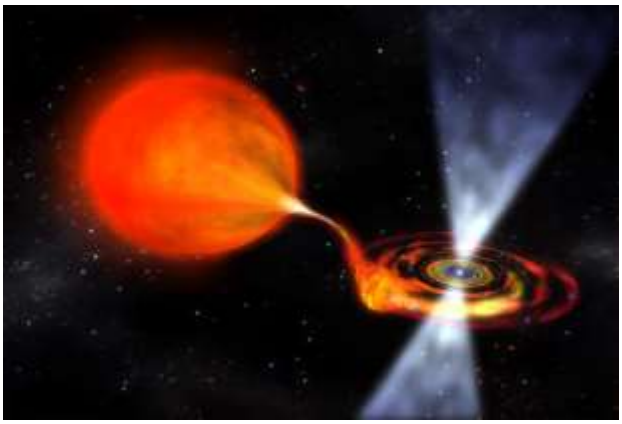
But using this technique instruments like the Kepler Space Telescope and TESS have pinned thousands of

candidate planets of all sorts of shapes and sizes orbiting all sorts of stars, revealing a galaxy full of variety.

But so far we have just probed tiny slices within our own Milky Way galaxy. Astronomers assume – for very good reason – that other galaxies host exoplanets as well. After all, if they can form here, why can't they form anywhere?

But this simple question hasn't been answered until today.

The challenge is the incredible distances to other galaxies. The technique outlined above, called the transit method, works to within a few hundred light-years, up to maybe a few thousand light-years, depending on how bright the target star is. Galaxies are millions of light years away, making this technique almost impossible to apply. Heck, at those distances it's hard to see even individual stars.



Artist's impression of an Accreting X-Ray Pulsar drawing material from its companion star. – NASA

But if a galaxy hosts a super-duper bright star, and we get lucky enough, then we can see an exoplanet cross the face of that star. And that's exactly what we did. According to a new paper appearing on the preprint journal arXiv, a team of astronomers studied an extremely bright X-ray source in M51, the Whirlpool Galaxy, which sits 28 million light-years away from Earth.

The X-ray source is intense enough that we could observe it and study any changes in its brightness. The astronomers noticed over the course of many observations the distinct dimming due to a crossing exoplanet, which they suspect is roughly the size of Saturn.

It's a strange world indeed. That planet orbits a binary pair, with one of the pairs being the leftovers of a giant star – either a neutron star or a black hole – with the other being a giant companion feeding material down onto it, creating the intense X-ray glow.

It's not exactly a pretty place to live, but it does show us that planets are plentiful throughout the universe.

Gaia has Already Given Us 5 New Insights Into the Milky Way

The European Space Agency launched the Gaia mission in 2013. The mission's overall goal was to discover the history of the Milky Way by mapping out the positions and velocities of one billion stars. The result is kind of like a movie that shows the past and the future of our galaxy.

The mission has released two separate, massive data sets for researchers to work through, with a third data release expected soon. All that data has spawned a stream of studies into our home galaxy.

Recently, the ESA drew attention to five new insights into the Milky Way galaxy. Allof these discoveries directly stemmed from the Gaia spacecraft.

Gaia's job was to create the largest, most precise, catalog of stars in the Milky Way. It's gathered data on one billion objects, mostly stars but also some quasars, comets, and other objects. Gaia monitored each of its target objects 70 separate times, which accounts for the data's precision. Its mission was originally planned for five years, but it's been extended because it has enough fuel to operate until about November 2024.

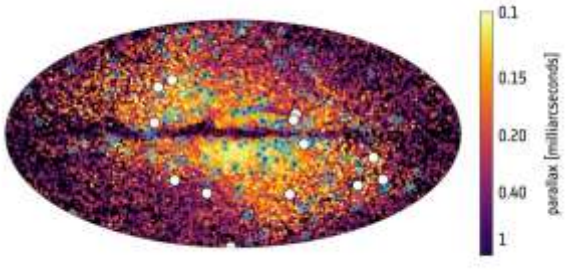
In a new press release, the ESA outlined five important results of its Gaia mission.

Cannibalistic Spiral

Astronomers have thought for a long time that the Milky Way has grown by consuming other smaller galaxies that get caught up in its gravitational pull. But Gaia's data gave astronomers an unprecedented look at how this has happened in the past, and how it's still happening now.

A team of researchers working with Gaia data found a family of 30,000 stars moving through the Milky Way. These stars are all around us, interspersed with other stars, and they're all moving the same speed and direction. But their motion is separate from the rest of the Milky Way. They're moving in "elongated trajectories in the opposite direction to the majority of the Galaxy's other hundred billion stars, including the Sun," according to a press release.

They also stood out from other stars on the Hertzsprung-Russell Diagram. The team behind that research concluded that this was a separate population of stars. This group was the result of a galactic merger some time in the past. "The collection of stars we found with Gaia has all the properties of what you would expect from the debris of a galactic merger," said Amina Helmi, lead author of the paper published in *Nature*.



This graphic shows the distribution of the Gaia-Enceladus stars across the Milky Way. The stars of Gaia-Enceladus are represented with different colours depending on their parallax – a measure of their distance – with purple hues indicating the most nearby stars and yellow hues the most distant ones. White circles indicate globular clusters

that were observed to follow similar trajectories as the stars from Gaia-Enceladus, indicating that they were originally part of that system; cyan star symbols indicate variable stars that are also associated as Gaia-Enceladus debris. Image Credit: ESA/Gaia/ DPAC; A. Helmi et al 2018

Gaia data not only allowed researchers to find this merger remnant, it allowed them to piece together what happened. About 10 billion years ago, the Milky Way collided with a galaxy about the size of one of the Magellanic Clouds. The lost galaxy, called Gaia-Enceladus, was consumed by the Milky Way. The Milky Way was much smaller then, only about four times larger than Gaia-Enceladus, so the collision must have created enormous upheaval.

We now know that there've been other collisions, and we also know that the Milky Way is in the process of consuming the Magellanic Clouds, starting with their halo of gas.

A Galactic Collision Formed the Sun?

Collisions and mergers play a huge role in the Milky Way, and possibly in our very existence.

One of the Milky Way's neighbours is the Sagittarius Dwarf Galaxy (SDG). It's been orbiting the much more massive Milky Way for billions of years. While the Milky Way has a few hundred billion stars, its little neighbour has only a few tens of millions of them. So the Milky Way is something like 10,000 times more massive.

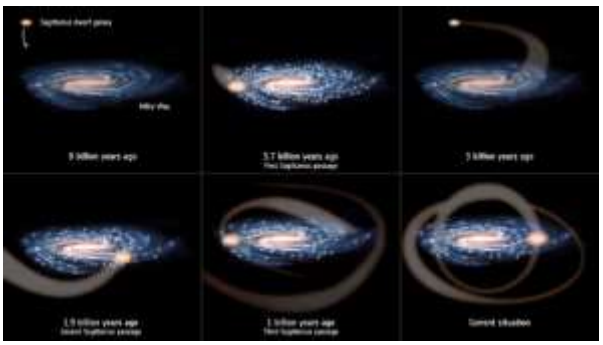
But even though the SGD is tiny compared to the Milky Way, it's had a huge effect on it, especially on our little corner.

"The galaxy was relatively quiet. Suddenly, Sagittarius fell in and disrupted the equilibrium…"

Tomás Ruiz-Lara, Instituto de Astrofísica de Canarias | IAC

Each time the SGD orbits the Milky Way, it slams into it. Of course, there's no actual slamming. There's too much space between all the stars for any to actual physical encounters. The slam is more of a gravitational slam; an interaction.

Astronomers think that the SGD has struck the Milky Way at least three times already: five or six billion years ago, two billion years ago, and one billion years ago. Each time it does so, the Milky Way steals some of its stars, and the SDG becomes less massive after each encounter. But the encounter also triggers star formation in the Milky Way.



The SGD has collides with the Milky Way at least three times, triggering accelerated star formation. One of those encounters may have led to the birth of the Sun. Image Credit: ESA

A paper published in 2020, and based on Gaia data, showed that these encounters led to episodes of increased star formation in the Milky Way. That paper called the SDG the "main dynamical architect of the Milky Way disk." Each time the SDG passed through the Milky Way, it created ripples and compressions in the gas, which lead to accelerated star formation.

"After an initial violent epoch of star formation, partly triggered by an earlier merger, the Milky Way had reached a balanced state in which stars were forming steadily," says Tomás Ruiz-Lara, the lead author of the 2020 study. "The galaxy was relatively quiet. Suddenly, Sagittarius fell in and disrupted the equilibrium, causing all the previously still gas and dust inside the larger galaxy to slosh around like ripples in water."

One of those encounters took place about 4.7 billion years ago, the same time the Sun and the Solar System formed. While scientists stop short of saying that the Sun was definitely formed via collision with the SDG, the idea is there. It's possible that our very existence stems from one of these encounters. Future studies will likely confirm or rule it out.

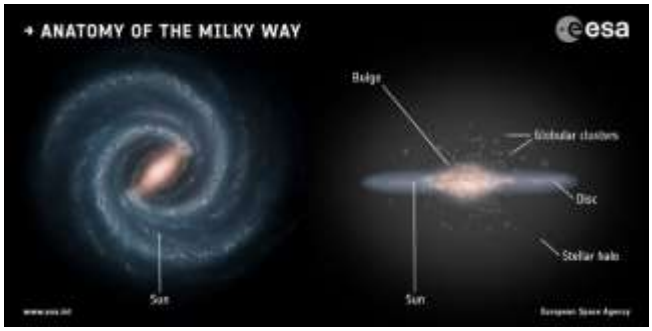
Living Arms, Living Disc

Prior to Gaia, astronomers knew a lot about the Milky Way. The trouble is, it's difficult to observe from inside, and so some of what we know about the Milky Way is based on observing other galaxies like it.

For example, when we look at other galaxies, the spiral arms can appear bluer than other parts of the galaxy. That blue indicates stars burning at higher temperatures. Hot stars are massive, and massive stars are young. So researchers concluded that the spiral arms are areas of intense star formation. But astronomers weren't certain if the Milky Way had two arms, or four.

Gaia allowed astronomers to examine individual stars in the arms directly.

"Before Gaia, we didn't know whether there were two or four spiral arms in the Milky Way," says Sergey Khoperskov, an astrophysicist at the Max Planck Institute for Extraterrestrial Physics in Germany. "Now we have clear evidence that there are four of them. With Gaia, we can measure the distance to the stars and see where they are more densely packed together, which is an indication of a spiral arm."



The anatomy of the Milky Way. Image Credit: ESA

Another question around the spiral arms concerns their longevity. Some researchers say that the arms are actually manifestations of a travelling density wave, and that they're short-lived phenomena—in astronomical terms. The arms can disappear and then reform later. "Many astronomers believe that spiral arms are short-lived structures caused by some sort of gravitational instability and that they disappear within a couple of rotations and then re-emerge with some different pattern," said Sergey Khoperskov, an astrophysicist at the Max Planck Institute for Extraterrestrial Physics.

Jos de Bruijne is a deputy project scientist with the Gaia mission. He says that the arms don't contain the same stars over their billions of years history. Instead, he says, the spiral arms are kind of like a traffic jam.

"Stars are moving out at the front but the traffic jam stays because stars are piling up at the back," he says. "We still don't know exactly why these traffic jams form and I am convinced that Gaia will shed light on this."

Gaia also showed us that the entire galactic disk is a busy, active place. There are a variety of forces acting on the parts of the Milky Way, and they create all kinds of movement. Its satellite galaxies are constantly interacting with it, creating movement, tension, and shaping the galaxy.

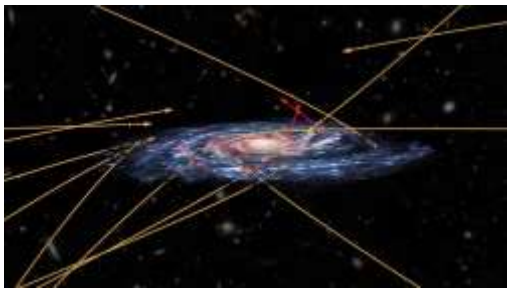
Some astronomers even think that collisions with the SDG gave the Milky Way its spiral shape.

The Milky Way is Like a Magnet, Stealing Stars from Other Galaxies

A bully and a thief. That's what the Milky Way is. But the niceties and rules of human behaviour are lost amongst the vastness of the Universe.

The Milky Way is not a nice neighbour. It's constantly taking stars from other star clusters and smaller galaxies. Gaia has shown us this in great detail, and has found streams of stars torn form other galaxies, stretching through space. Some of these streams stretch for thousands of light years. Gaia observations of these streams can tell astronomers a lot about the Milky Way's gravitational power, and its mass.

Gais has also found stars travelling through the Milky Way at very high speeds.



Gaia has found stars that are sprinting at high speeds through the Milky Way. Some of them might have enough velocity to eventually escape the galaxy. Image Credit: ESA

Some of these fast-moving stars have enough velocity to escape the Milky Way. If they do, they won't be reunited with their former homes. Instead, they'll likely spend an eternity travelling through intergalactic space. They're a bit of a puzzle for astronomers.

"Of the seven million Gaia stars with full 3D velocity measurements, we found twenty that could be travelling fast enough to eventually escape from the Milky Way," explains Elena Maria Rossi, from Leiden University, the Netherlands, one of the authors of a recent study. "But rather than flying away from the galactic centre, most of the high-velocity stars we spotted seem to be racing towards it."

There's one thing at the center of the the Milky Way that's so massive it could be drawing these stars towards it: the supermassive black hole Sagittarius A-Star (Sgr A*). Conversely, a supermassive black hole in another galaxy could've flung these stars outwards.

"Stars can be accelerated to high velocities when they interact with a supermassive black hole," Elena explains. "The presence of these stars might be a sign of such black holes in nearby galaxies."

Another possibility is that these stars were in binary pairs. If their partner exploded as a supernova, that could've propelled them outward at high velocities.

Or, astronomers admit, these sprinting stars could have a more prosaic explanation. They could be from the Milky Way's own halo. Interactions between the Milky Way and its satellites could've could've plucked these stars from more stable gravitational relationships and sent them speeding through space.

Better data on these stars might constrain their age and composition, providing important clues to their origins. "A star from the Milky Way halo is likely to be fairly old and mostly made of hydrogen, whereas stars from other galaxies could contain lots of heavier elements," says the study's co-author Tommaso Marchetti. "Looking at the colours of stars tells us more about what they are made of."

Our Sun is a Solar Surfer

In our Solar System's neighbourhood there are clouds of interstellar gas. A 2019 study showed that they form an undulating wave 9000 light years long. Its undulations take it up to 500 light years above and below the Milky Way's disk. The wave is about 400 light years wide, and astronomers have named it the Local Arm. They say it's a small spiral arm of the Milky Way.

Astronomers like to keep a keen eye on gas clouds, because that's where new stars form. Prior to the 2019 study, astronomers thought that gas clouds in the Sun's neighbourhood were concentrated in a feature called the Gould Belt. The Gould Belt is a ring-shaped structure of stars, dust, and gas about 3000 light years long that rises above and falls below the galactic plane.

But Gaia showed that the Gould Belt is not the dominant gas structure. It showed scientists that the massive, newly-discovered wave structure is dominant.

"Instead, what we have observed is the largest coherent gas structure we know of in the galaxy, organised not in a ring but in a massive, undulating, narrow and straight filament," says João Alves, a professor of Stellar Astrophysics at the University of Vienna, a 2018-2019 Radcliffe fellow, and one of the three scientists who discovered the structure. The structure is now named the Radcliffe Wave, after the Radcliffe Institute.

Our Sun is only 500 light years from the Radcliffe Wave at its closest point. It almost looks like its surfing on the wave. In fact, it was only 13 million years ago—about the time that apes were getting going on Earth—that the Sun last crossed the wave, and it's likely to surf across it again in the future.

The discovery of this wave demonstrates Gaia's power. The wave has always been there, but until got busy mapping stars, there was no way to see it. "The wave has been right in front of our eyes all the time, but we couldn't see it until now, João adds.

"We don't know what causes this shape but it could be like a ripple in a pond as if something extraordinarily massive landed in our galaxy," said Alves in a press release. "What we do know is that our Sun interacts with this structure. It passed by a festival of supernovae as it crossed Orion 13 million years ago, and in another 13 million years it will cross the structure again, sort of like we are 'surfing the wave'."

Researchers don't know what caused this wave structure. The unexpected undulating structure is not revealing its secrets, yet. It's possible that, like a lot of features of the Milky Way, interactions with another small galaxy created it. Some researchers suggest that dark matter might be involved. Some say the Radcliffe Wave spawned the Sun. It'll take more study to come up with an explanation.

Whatever its cause, the discovery of the Radcliffe Wave was a shock to some astronomers.

"We were completely shocked when we first realised how long and straight the Radcliffe Wave is when looking down on it from above in 3D, but also how sinusoidal it is when viewed from Earth," said Alyssa Goodman, Professor of Applied Astronomy and co-director of the Science Program at the Radcliffe Institute of Advanced Study. "The Wave's existence is forcing us to rethink our understanding of the Milky Way's 3D structure."

Forcing us to rethink things. That's science's role throughout history. And it's something that missions like Gaia continuously do.

The third Gaia data release is coming soon. An early portion will be released by the end of this year, with the full third data release in the first half of 2021.

What will all of that data force us to rethink?

Cygnus supply ship reaches space station with titanium toilet

Northrop Grumman's Cygnus supply ship is grappled by the Canadian-built robotic arm at the International Space Station. Credit: NASA TV / Spaceflight Now

A Northrop Grumman Cygnus cargo ship arrived at the International Space Station on Monday, delivering nearly four tons of supplies and experiments to the research lab and its crew, including a $23 million titanium toilet and a high-definition virtual reality camera planned for use on a future spacewalk.

Capping an automated laser-guided rendezvous sequence, the Cygnus cargo freighter moved within 40 feet (12 meters) of the space station early Monday, close enough for the lab's Canadian-built robotic arm to reach out and grapple it.

NASA astronaut Chris Cassidy, assisted by Russian cosmonaut Ivan Vagner, took control of the 58-foot-long (17.7-meter) robotic arm to capture the Cygnus spacecraft at 5:32 a.m. EDT (0932 GMT) Monday.

Northrop Grumman named the Cygnus supply ship the "S.S. Kalpana Chawla" in honor of the first woman of Indian descent to fly into space. Chawla flew on two space shuttle missions, and she died with her six crewmates on the space shuttle Columbia in 2003.

"In the name of space exploration, all have given some, some have given all," Cassidy said after capturing the Cygnus spacecraft Monday. "It's an honor to welcome the good ship Kalpana Chawla. Welcome aboard the International Space Station, KC."

Ground controllers at the Johnson Space Center in Houston took control of the robot arm later Monday morning to attach the Cygnus spacecraft to a berthing port on the space station's Unity module, where it will stay for around two months.

Cassidy and his crewmates will open hatches leading to the S.S. Kalpana Chawla's pressurized cargo compartment to begin unpacking the supplies and experiments inside.

The arrival of the S.S. Kalpana Chawla supply ship Monday marked the 14th delivery of cargo to the space station by a Cygnus spacecraft since 2013.

The Cygnus cargo mission blasted off Friday night from the Mid-Atlantic Regional Spaceport aboard an Antares rocket, following delays earlier in the week caused by bad weather and a ground software issue.

The S.S. Kalpana Chawla is packed with 7,829 pounds (3,551 kilograms) of supplies and experiments heading to the International Space Station. Here's a breakdown of the cargo manifest provided by NASA:

- 2,712 pounds (1,230 kilograms) of vehicle hardware
- 2,683 pounds (1,217 kilograms) of scientific investigations
- 1,874 pounds (850 kilograms) of crew supplies
- 333 pounds (151 kilograms) of spacewalk equipment
- 156 pounds (71 kilograms) of computer resources

The Cygnus supply ship will remain berthed Unity module until mid-December, when it will be released by the station's robotic arm. The automated cargo carrier, loaded with trash after its departure from the station, will perform an in-flight combustion experiment before re-entering the atmosphere and burning up over the South Pacific Ocean to end its mission.

The fresh food packed inside the S.S. Kalpana Chawla supply ship includes prosciutto, chorizo, salami, summer sausage, brie, smoked gouda, smoked provolone, and fruits and vegetables.

Among clothing and other crew provisions, the Cygnus mission will deliver an upgraded toilet to the space station, allowing astronauts to test its functionality before a similar commode flies on the Orion crew capsule to the moon.

The new toilet, or Universal Waste Management System in NASA-speak, is roughly the size of a camper commode. It's about 65 percent smaller and 40 percent lighter than the toilet currently on the space station, according to Melissa McKinley, logistics reduction manager for the agency's advanced exploration systems division.

NASA partnered with Collins Aerospace to develop the new toilet, which officials said is better suited for female crew members than the existing commode on the space station. Engineers made parts of the toilet out of titanium to withstand acid used to pre-treat urine before the fluid is

recycled back into drinking water for the astronauts, said Jim Fuller, the toilet's project manager at Collins Aerospace.

"On Earth, we have gravity that helps pull the feces and urine away from our body and into the toilet," Fuller said. "In space, where we have microgravity, we don't have that luxury. The dual fan separator actually creates the motive force by creating a strong airflow that helps pull the urine and feces away from the body.

"When the astronauts have to 'go,' we want to allow them to boldly go," Fuller said.

NASA astronaut Kate Rubins, in blue, receives a briefing on the new space station toilet earlier this year. Credit: NASA

Designers wanted the new toilet to be easier to use for women flying on the space station,

"The funnel design was was completely re-contoured to better accommodate the female anatomy," McKinley said. "And particularly, this is a concern when the crew members are trying to do 'dual ops,' when they're they're doing both defecation and urination at the same time, just the alignment of all of that at once … Trying to make that more appropriate for female use was a big driver."

There's also a virtual reality camera flying to the space station that will capture imagery of a future spacewalk.

The cosmetics company Estée Lauder is also flying 10 bottles of its "Advanced Night Repair" serum to the space station, where the bottles will be photographed with Earth as a backdrop. Estée Lauder says it will use the images in social media and marketing campaigns, and then plans to auction the serum returned to Earth from the space station, with the proceeds going to charity.

It's part of a new NASA program that dedicates 5 percent of space station cargo capacity and crew time to commercial marketing activities. Estée Lauder will reimburse NASA around $128,000 for the space station resources used in the night serum marketing initiative, according to Phil McAlister, NASA's director of commercial spaceflight development.

Northrop Grumman's Cygnus spacecraft shares space station resupply duties with SpaceX's Dragon capsule, the Russian Progress resupply freighter, and Japanese cargo missions.

A New Mass Extinction has been Discovered, Wiping Out Life 233 Million Years Ago, and Leading to the Rise of the Dinosaurs

Most everybody knows that the dinosaurs perished rapidly in a tumultuous extinction, caused by an asteroid strike about 66 million years ago. But it looks like another extinction prior to the appearance of the dinosaurs paved the way for their long reign. That extinction took place about 233 million years ago.

And scientists have only now discovered it.

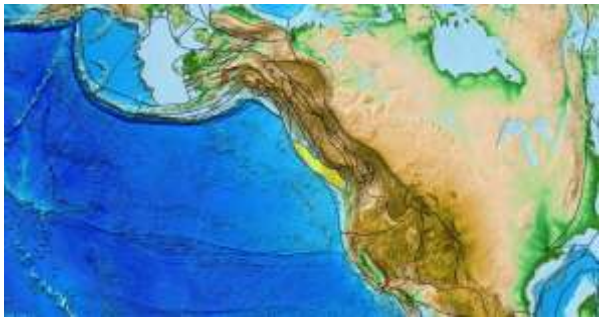
The extinction took place during what's called the Carnian Pluvial Episode (CPE). Researchers have examined this period of time before, because they knew the climate changed abruptly then. The climate change was likely caused by copious volcanic activity that created Large Igneous Provinces (LIP). But now a team of researchers have conducted a thorough review of geologic and paleontological evidence from that time and have concluded that a mass extinction took place.

"The eruptions were so huge, they pumped vast amounts of greenhouse gases like carbon dioxide, and there were spikes of global warming."

Jacopo Dal Corso, Co-Author, China University of Geosciences

The title of the new research is "Extinction and dawn of the modern world in the Carnian (Late Triassic)." The lead authors are Jacopo Dal Corso of the China University of Geosciences at Wuhan, and Mike Benton of the University of Bristol's School of Earth Sciences. The new research is published in the journal Science Advances.

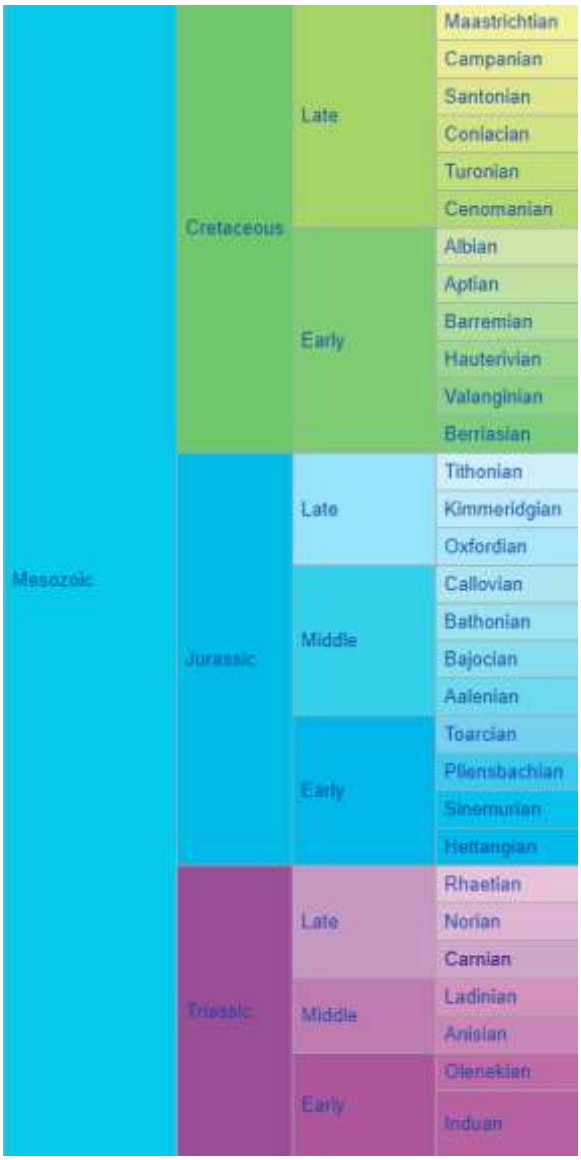
Much of the western coast of North America is made up of volcanic basalt. That's the result of massive volcanic eruptions that created what's known as the Wrangellia Province. The Wrangellia Province formed in the middle to late Triassic as an oceanic igneous province, and became part of North America in the Late Jurassic or Early Cretaceous.



Wrangellia is an arc terrane located on the North American westcoast, stretching from Vancouver Island to central Alaska. Highlighted here is Southern Wrangellia, also known as Wrangell. Image Credit: By Fama Clamosa – Own work, made using Gplates and data sets listed below., CC BY-SA 4.0, https://commons.wikimedia.org/w/index.php?curid=85176529

The authors of the new research say that the eruptions that created Wrangellia also caused severe climate change, and that global warming led to the demise of many of the world's species, paving the way for the dinosaurs.

“The eruptions peaked in the Carnian,” said Dal Corso in a press release. “I was studying the geochemical signature of the eruptions a few years ago and identified some massive effects on the atmosphere worldwide. The eruptions were so huge, they pumped vast amounts of greenhouse gases like carbon dioxide, and there were spikes of global warming.”



A partial geologic timescale of Earth. Bottom is older, top is younger. The Triassic Period began about 252 mya with the Induan Age. The Cretaceous Period ended about 72 mya, at the end of the Maastrichtian Age. The Wrangell Province formed in the middle-late Triassic, and joined North America in the late Jurassic or early Cretaceous Period. Image Credit: Wikipedia

One of the first indications of climate change and extinction during the Carnian was evidence of a prolonged period of increased rainfall. Geologists first discovered this rainfall in the 1980s, and they thought the period lasted about one million years. As the climate changed during that time, it caused a major loss of biodiversity, on land and in the oceans.

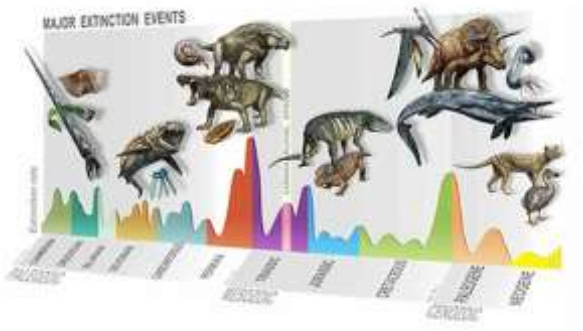
As a result of that extinction, coniferous forests expanded, and other, newer types of plant life appeared. The Earth’s ecosystems began to look more like modern-day Earth. But the shift meant a food crisis for existing herbivores.

“The new floras probably provided slim pickings for the surviving herbivorous reptiles,” said Professor Mike Benton. “I had noted a floral switch and ecological catastrophe among the herbivores back in 1983 when I completed my PhD. We now know that dinosaurs originated some 20 million years before this event, but they remained quite rare and unimportant until the Carnian Pluvial Episode hit. It was the sudden arid conditions after the humid episode that gave dinosaurs their chance.”

This is a photograph of the Nikolai Formation along Glacier Creek in the Wrangell Mountains, Alaska. It’s part of the Wrangellis Igneous Province, and shows a deposit of basaltic lava about 1000 meters tall. The yellow line shows the top of the basalt, with a limestone formation above it. The volcanic activity that created this basalt also caused the climate to change rapidly, creating an extended period of rainfall, the Carnian Pluvial Event. That event triggered a mass extinction. Image Credit: Greene et al, 2008.

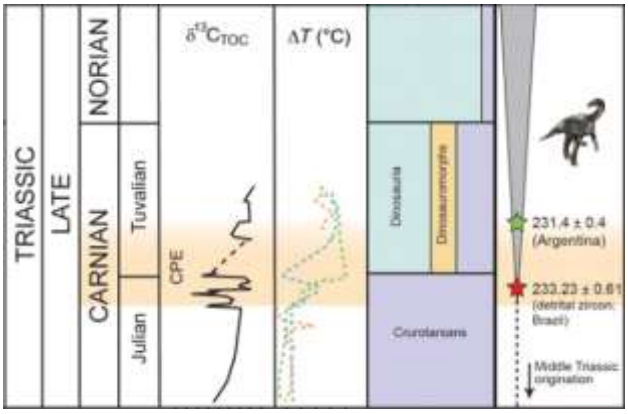
A bunch of new species appeared at the same time. The Carnian Pluvial Episode didn’t just create space for dinosaurs. The first turtles, crocodiles, lizards, and mammals also appeared. In the oceans, the first coral reefs appeared, as well as many modern plankton groups. The changes in the oceans’ plankton suggest “profound changes in the ocean chemistry and carbonate cycle,” according to the authors.

In their paper they write that “In the sea, the rise of the first scleractinian reefs and rock-forming calcareous nannofossils points to substantial changes in ocean chemistry. On land, there were major diversifications and originations of conifers, insects, dinosaurs, crocodiles, lizards, turtles, and mammals.”



Summary of major extinction events through time, highlighting the new, Carnian Pluvial Episode at 233 million years ago. Image Credit: © *D. Bonadonna/ MUSE, Trento.*

"So far, palaeontologists had identified five "big" mass extinctions in the past 500 million yeas of the history of life," says Jacopo Dal Corso. "Each of these had a profound effect on the evolution of the Earth and of life. We have identified another great extinction event, and it evidently had a major role in helping to reset life on land and in the oceans, marking the origins of modern ecosystems."

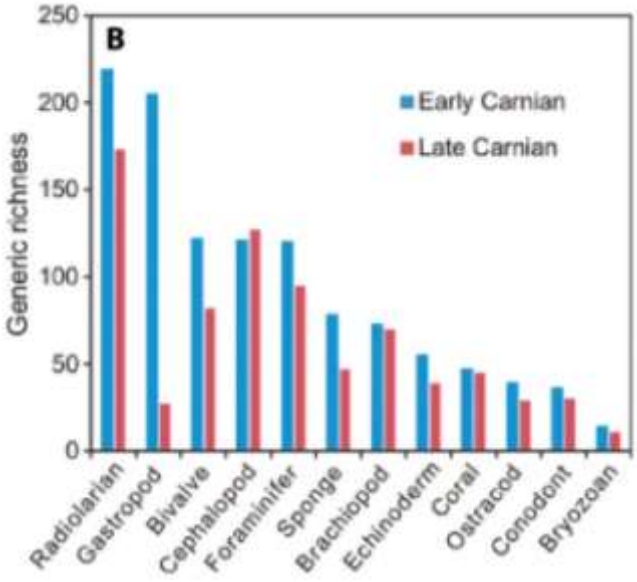


A portion of one of the figures from the study. It shows the Carnian Pluvial Episode in yellow, and the explosion of dinosaur species is marked with the red star. <Click image to see entire table> Image Credit: Dal Corse et al, 2020.

The changes caused by one million years of rainfall were profound. Terrestrial environments shifted dramatically. Europe became an area dominated by lagoons and freshwater lakes. In other areas around the world, large river systems formed, with abundant freshwater lakes, and extensive deltas and sedimentation. Other "complex palaeoenvironmental system consisting of interlinked inland basins," formed, according to the authors, in areas like the "North Atlantic rift system, extending from Greenland to Morocco."

Carbon isotope records show that the Earth's carbon cycle was subjected to repeated disruptions and perturbations during the CPE. Those same records "indicate repeated injections of ^{13}C-depleted carbon into the ocean-atmosphere system, which may have increased the pCO_2 and likely triggered global warming," the authors write in their paper.

Biodiversity data from fossil records show that many invertebrates suffered elevated extinction rates at the time. Most other marine groups, including gastropods and bivalves, suffered similar extinctions.



This figure from the study shows the decline of marine groups during the Carnian Pluvial Event. Image Credit: Dal Corse et al 2020.

Extinctions are depressing, when we think of all the species that have disappeared. They're gone forever. But extinctions are also about renewal, as this paper shows.

In their summary, the authors write that, "Evidence indicates a possible cascade of events similar to other mass extinctions: LIP eruption as the trigger, release of volcanic gases, rapid shifts in temperature and ?^{13}C, ocean anoxia, and major ecosystem remodeling characterized by both extinctions and diversifications…"

The CPE may have ended the game for many species, but it did herald the appearance of more modern ecosystems, including the expansion of Earth's coniferous forests. Though extinctions are seen as a kind of setback, they also present new opportunities and niches for new species to exploit. As the paper shows, the dinosaurs only proliferated after the CPE extinction.

The team behind this research is confident that they've identified another mass extinction in the data. But they're more cautious when it comes to the certain cause of it. As they write in their conclusion, "However, because of the lack of precise stratigraphic and geochronological links between Wrangellia and the CPE, we can only speculate on the possible volcanic triggers for the observed extinctions and environmental changes by analogy with other LIP-related events."

It Looks Like Firefighters Saved Mt. Wilson Observatory

Every year, the Pacific Northwest and California experience “wildfire season,” a period where heat and low humidity combine, leading to an increased risk of fires. This year has been particularly bad and in California alone, wildfires have destroyed over two million acres of land, forced hundreds of thousands of people from their homes, and threatened many historic institutions and landmarks.

One of them is the Mount Wilson Observatory that sits atop Mount Wilson in the San Gabriel Mountains overlooking Pasadena (northeast of LA). This famous observatory is home to several telescopes that were, for a time, the largest of their kind in the world. And thanks to the heroic efforts of firefighters, it looks as though the Mt. Wilson Observatory is now safe amid a particularly bad wildfire season.

SpaceX aborts liftoff of GPS satellite, continuing streak of launch scrubs

October 3, 2020 Stephen Clark

A Falcon 9 rocket aborted its launch just 2 seconds prior to liftoff Friday night. Credit: SpaceX

For the fourth time this week, a rocket launch from Cape Canaveral was stopped with seconds remaining in the countdown Friday night, when a SpaceX Falcon 9 rocket automatically aborted its liftoff with a new GPS navigation satellite during the engine startup sequence.

The Falcon 9 rocket was just two seconds from launching the U.S. Space Force’s next GPS satellite at 9:43 p.m. EDT Friday (0143 GMT Saturday) when an automated abort halted the countdown.

“Five, four, three,” a member of SpaceX’s launch team called out on the countdown audio net. “And we have an abort. All agencies stand by.”

John Insprucker, a veteran SpaceX engineer providing commentary on the company’s launch webcast, confirmed the team scrubbed the launch attempt Friday night because there was not enough time in the 15-minute window to identify and resolve the problem.

“We got down to about T-minus 2 seconds approximately,” Insprucker said on SpaceX’s launch webcast. “We were just starting the engine ignition sequence when we had a hold. We then began safing (the rocket). We did not get into lighting all nine of the Merlin rocket engines.”

While it did not appear the engines fired, a flash of green light from the base of the rocket suggested the engines’ TEA-TEB ignitor source briefly activated before computers stopped the countdown at Cape Canaveral’s Complex 40 launch pad.

“Right now the vehicle is being safed,” Insprucker said before signing off on the webcast. “There don’t appear to be any issues on the launch pad, but that does end our launch opportunity for tonight.”

While engineers started probing the cause of the hold Friday night, the launch team kicked off steps to drain the Falcon 9 rocket of its kerosene and liquid oxygen propellants.

SpaceX had a backup launch opportunity reserved Saturday night at 9:39 p.m. EDT (0139 GMT Sunday) on the military-run Eastern Range at Cape Canaveral. But SpaceX did not confirm if teams would prepare for another launch attempt Saturday, or if the problem might cause a longer delay.

Elon Musk, SpaceX’s founder and CEO, tweeted that the Falcon 9 launch was aborted after an “unexpected pressure rise in the turbomachinery gas generator,” referring to equipment used on the rocket’s Merlin main engines.

In any event, forecasters at Cape Canaveral were predicting stormy weather Saturday night. In an outlook issued earlier Friday, they expected an 80 percent chance of unfavorable weather for a launch attempt Saturday night.

A Lockheed Martin-built GPS navigation satellite was ready for liftoff on top of the Falcon 9 rocket Friday night. It is the fourth in a new generation of GPS satellites with longer lifetimes, higher power, and more accurate navigation signals.

The GPS 3 SV04 spacecraft is set to join 31 operational GPS satellites in orbit 12,550 miles (20,200 kilometers) above Earth.

Friday’s launch attempt was the first for the Falcon 9 rocket carrying the GPS 3 SV04 satellite, but the abort echoed similar last-minute holds encountered by other launchers earlier in the week.

A Falcon 9 rocket with a brand new first stage booster is set to launch the U.S. Space Force's fourth GPS 3-series navigation satellite from Cape Canaveral. Credit: SpaceX

SpaceX fueled a different Falcon 9 rocket two times this week on nearby pad 39A at the Kennedy Space Center, aiming to send the launcher into space with 60 more satellites for the company's Starlink internet work.

But SpaceX scrubbed a launch attempt Monday morning just 31 seconds prior to liftoff due to poor weather. The Falcon 9 rocket was again fueled for launch Thursday morning on pad 39A, but SpaceX called off the mission with 18 seconds left in the countdown after detecting unexpected data from a ground sensor.

The same Starlink launch was initially planned for launch Sept. 17. But SpaceX delayed the mission to wait for improved sea conditions in the Falcon 9's offshore recovery zone, where a drone ship is positioned in the Atlantic Ocean for landing of the the rocket's first stage booster.

SpaceX aims to try again to launch the Falcon 9 rocket with the 60 Starlink satellites Monday at 7:51 a.m. EDT (1151 GMT).

Musk tweeted early Saturday that SpaceX is beginning a "broad review of launch site, propulsion, structures, avionics, range & regulatory constraints this weekend" in a bid to improve launch availability.

"I will also be at the Cape next week to review hardware in person," Musk tweeted.

A Delta 4-Heavy rocket from United Launch Alliance, a rival of SpaceX in the U.S. launch services market, was also supposed to blast off from Cape Canaveral on Wednesday night. Its launch was also aborted in the final minute, when the computer-run countdown sequencer stopped the clock seven seconds before liftoff, a moment before the Delta 4-Heavy's three main engines were programmed to ignite.

ULA has not announced a new launch date for the Delta 4-Heavy rocket, which is set to loft a classified payload for the National Reconnaissance, owner of the U.S. government's fleet of intelligence-gathering spy satellites.

The Delta 4-Heavy rocket had also run into a series delays before the countdown abort Wednesday night. ULA announced Aug. 26 as the original launch date for the Delta 4-Heavy rocket and its NRO spy cargo, but the mission has been grounded repeatedly, primarily by problems with the Delta 4 launch pad at Cape Canaveral.

A countdown Aug. 29 stopped at T-minus 3 seconds, after one of the Delta 4-Heavy's three main engines had ignited. ULA traced that problem to a pressure regulator on the launch pad.

Engineers refurbished the launch pad's pressure regulators before setting a new target launch date Sept. 26. But the flight was again delayed to assess a potential issue with the launch pad's swing arms designed to retract from the Delta 4-Heavy rocket at liftoff.

ULA teams contended with stormy weather during a pair of launch attempts Monday and Tuesday. After storms cleared from the spaceport Tuesday afternoon, technicians discovered a hydraulic leak on the ground system that rolls the launch pad's mobile gantry into position for liftoff, forcing another canceled launch attempt before Wednesday night's countdown ended in the final seconds.

Amid the string of scrubs at Cape Canaveral, another U.S. launcher was set to fire into orbit from Wallops Island, Virginia, with a cargo ship bound for the International Space Station.

Northrop Grumman scrubbed the Antares rocket's launch attempt Thursday in Virginia less than three minutes before takeoff. Officials later attributed the scrub to an issue with ground software, and a second countdown Friday culminated in a successful launch to begin a mission to deliver nearly 8,000 pounds of supplies and experiments to the space station.

The Antares rocket blasted off at 9:16 p.m. EDT (0116 GMT), just 27 minutes before the Falcon 9's abort Friday night.

E Mails Viewings Logs and Images from Members.

Hi Andy,

I hope you are well.

Here are my submissions for the WAS October 2020 Newsletter.

06/09/2020

An early evening view of the 87% Lit Waning Gibbous Moon and Mars.

Canon SX50HS 1200mm, ISO 80, F8, 1/160 sec

Converted to tiff in DPP, cropped and post processed in Affinity Photo.

14/09/2020

The crescent Moon and Venus on a foggy/misty morning.

Canon G16 28mm, 28mm, ISO 800, F1.8, 10 sec

20/09/2020

ISS UK 1940 UT (2040 BST) flyby arching over Saturn and Jupiter.

55 images stacked in Starstax. Post processed and cropped in Affinity Photo to remove star trails.

Canon 1100D, Rokinon 8mm (effective focal length 13mm)

ISO 1600, F3.5, 5 sec

24/09/2020

57% Lit Waxing Gibbous Moon

Canon SX50HS 1200mm, ISO 80, F8, 1/100 sec

100 raw images converted to tiff in DPP, cropped and centred in Pipp, stacked in Registax 6 and post processed in Affinity Photo.

Also on 14/09/2020 my neighbour and I went to Milk Hill to capture images of the Milky Way. There was a lot of light pollution due to flares over Salisbury Plain. As a result the attached image is a bit of a mess at the bottom of the frame which I have not found a good way of cleaning it up. This is a stack of 6 x 3 minute exposures stacked in Sequator and post processed in Affinity Photo. Equipment used was a Canon 1300D, Samyang 14mm F2.8 (effective focal length 23mm) at F2.8, ISO 1600 tracked on a Vixen Polarie tracker. I converted the image to black and white which did reduce the impact of the light pollution.

Clear Skies,

John Dartnell.

Hi Andy,

Two viewing logs and some pictures for mag.

Tech details:

Picture	f number	shutter speed	ISO rating
Conjunction of Jupiter, Saturn and Moon	5.6	0.25 seconds	200

Jupiter and it's Moons 6.3 0.8 seconds 5000

(cropped picture)

White Horse and Moon f6.3 1/320seonds 250

Waxing gibbous Moon 6.3 1/200 seconds 320

All pictures taken with Canon D70 attached to Manfrotto tripod

Peter

Viewing Log for 9th of September

I arrived at my usual viewing spot near Uffcott off of the A4361 at 21:30. When I got out of the car I noticed a reasonable strong wind to keep me company, with a temperature of 15 ° C I should not be too cold this evening?

I would be using my faithful Meade LX90 GOTO telescope with a 10 mm WX Pentax eye piece, while setting up a car went past me which did not affect my night vision as the tailgate light was still on and giving off a white light! While setting up I noticed Mars had just cleared the horizon, too low for any viewing of this planet currently?

First target for the evening was Jupiter, I could make out the two main weather belts quite easy and found three main moons only, the inner most moon, Io was being occulted by Jupiter? Noticed a bright light coming down the road, so I turned around and closed my eyes (trying to keep any night vision I had?), a tractor went past followed by two cars, within a minute another two cars went past me! Onto Saturn and see what that had to offer, thought I could make out three of the moons, found out later while referring to Stellarium I had located Titan and Rhea plus a magnitude 9.65 star nearby?

After doing these two planets (these were starting to set in the western skies and the conditions for these planets would only get worse?) I thought for a change I would follow a feature in the current issue of Astronomy Now. On page 50, there was an article called 'Deep-sky objects for autumn months'. First object was Messier (M) 2, this globular cluster was large and bright to view, and being mag 6.5 it should be easy to look at? Next was NGC 752 also in Patrick Moore's list as Caldwell (C) 12, this open cluster (O C) I was actually looking thru it, being twice as large as the Moon it was better to use the finder scope? Nearby was NGC 753 but I could not locate it at all! Looking at the magazine I noticed it was a mag 12.9 galaxy which I could never pick up with my eyes? Another stoppage for me as two cars went past me in the other direction, wonder if they were the same that went past earlier in the evening? Turning the page and onto M 31, the Andromeda galaxy, a bright blob to look at. A couple of satellite galaxies to M 31 was NGC 147 and 185 also listed as C 17 and 18, could not make out either of these galaxies out? Think I was having trouble with my set up as several objects I had to slew around the area to find the object I wanted to view? Managed to find M 76, the Little Dumbbell nebula, this was a faint fuzzy blob to look at? Only found M 76 after again slewing in the general area. Same result for M 34 an O C in Perseus, this O C is very loose and I was actually looking thru it, better with lower magnification? After doing a reset, I managed to find Uranus in the eastern sky and Neptune slightly ahead of Uranus in the south eastern sky. Final object for the evening was Mars, this planet had gained enough height to be looked reasonably, could not make out any surface details on the red planet?

By now it was 22:55 and my feet were starting to ache a bit (had being playing golf during the afternoon/early evening), so I packed up my equipment and went home. I was surprised by the amount of traffic for a mid-week evening and the lateness of my start?

While heading home I noticed the waning gibbous Moon had just cleared the horizon, so if I had stayed the skies would start to be washed out by moon light?

Clear skies.

Peter Chappell

Viewing Log for 13th of September

After having a game of golf during late afternoon/ early evening I decided to carry on my doing one of my other hobbies, astronomy viewing J. With another clear sky I went out to my usual slot at Uffcott, hopefully being a Sunday evening I should not have so much traffic going past me like I had last week?

I arrived and had my Meade LX90 eight inch (203 mm) GOTO telescope set up by 21:30, with a temperature of 16 °C and no wind I should have good conditions for seeing the sky? Usual first targets for the evening would be Jupiter and Saturn in Sagittarius, starting to get lower in the south western skies. With Jupiter I could make out the two main weather belts plus only two moons? Looking for a while thru the eye piece (Pentax WX 14 mm) I thought I could make out a shadow transit (turns out checking a programme called 'Jupiter 2') I have what I actually saw was the moon Callisto transiting the surface of Jupiter with Io and Ganymede either side of the giant planet, Europa was in eclipse with Jupiter. Using a number 8 (Light Yellow) Lumicon filter, this enhanced the view a bit? On to Saturn and this time I made out the Cassini division in the ring system, been a long time since I have seen this, the skies much be pretty good this evening I thought? Staying with the planets I next tried to find Neptune, not a chance! Tried Mars, if this was not in the eye piece at least I could slew to the object being mag -2.6 it was the brightness object currently on view! What a surprise it was not in the eye piece, so I did a slight adjustment and had a look, could make some markings out on the planet but no polar ice cap?

That was the end of the planets for a while, as I had my copy of Sky & Telescope 'Pocket Sky Atlas' with me I thought I would try some deep sky objects in Sagittarius before they got too low for viewing, either the hedge or sky conditions? Started with Messier (M) 70, this globular cluster (G C) was behind a hedge, so I knew my limits for the evening? Onto M 22, I could make out a few stars in the G C and it looked large as well? No joy with M 55, another G C! M 75 is still in Sagittarius but right on the border with Capricornus, sometimes over looked if people are looking in the 'Teapot' area of the sky? This G C is small and looked like a faint blob (F B) but had a bright core? M 8, the Lagoon nebula was dim to see, probably the lowness of the object from UK latitudes did not help? I could not make out any nebula in this emission nebula but noticed a few stars which gave the idea we have a loose open cluster (O C) as well? The Trifid nebula AKA M 20 was fairly large in the eye piece but more like a faint

fuzzy blob (F F B) to view? M 23 was also large to look at, this is a loose O C. M 24 is an odd ball in Messier's list, it is the only Milky Way cloud in the whole list, all I could say about this object, it was not very bright to look at? M 25 is similar to M 23, a loose O C? M 17, the Omega nebula was a grey blob to look at, similar to M 1 to look at but totally different! M 16, the Eagle nebula I could only make out the O C part of this region? I was now viewing above – 10 ° declination (Dec), so the objects should be better to look at and I have moved from Sagittarius to Scutum constellation. M 26 is a dim and small O C to view. M 11, the Wild Duck cluster is the opposite to M 26, this O C is nice and bright but on the compact side? Over the page to 66 from 67 in the atlas and I noticed the Little Gem sign, this is a planetary nebula (P N) AKA NGC 6818, all I could make out was the F F B description for it! Very close by is Barnard's galaxy, not that I could make it out, shining at mag 10 it is about my limit for seeing objects? It has the number C 57 or NGC 6822 as well. Going a bit higher in Dec and further westward I came across M 14, again this G C was a F F B to look at? On to one of the better G C's in the northern skies and M 13, the great G C in Hercules, all my notes say about this object is 'Great'! Close by is the runner up for G C's in Hercules and M 92, this has a bright centre and the next brightest G C in Hercules and NGC 6229, the G C is a F B to look at. An object near the North Ecliptic Pole is NGC 6543 or C 6 or the Cat's Eye nebula, (sure it might have some other names as well?) this P N was a F B to look at? By now Uranus should high enough to look at? Just like Neptune it was not in the eye piece, looking at the finder scope I saw some bright points of light, by slewing to one of them I found Uranus, the 7th planet from the Sun. I noticed a clump of stars further east and slightly lower than Mars, thought it looked like M 45, the Pleiades or Seven Sisters, and thought it was a bit early for that as it is a winter object? Any way I put the numbers in for M 45 and it took me to this clump, I was a bit surprised how high it already was? Better to view this object with the finder scope as it is too big using main scope. On to Albireo, probably best coloured double stars in the whole sky? Final object for the evening would be M 27, the best P N to look at?

By now it was 23.37, I had been out for just over two hours and in that time only three cars past me which was a lot better than the eight that went past me the last time I was out! They was not much dew on any of the equipment I had out but would still needed to be dried overnight before putting away for storage?

Clear skies.

Peter Chappell

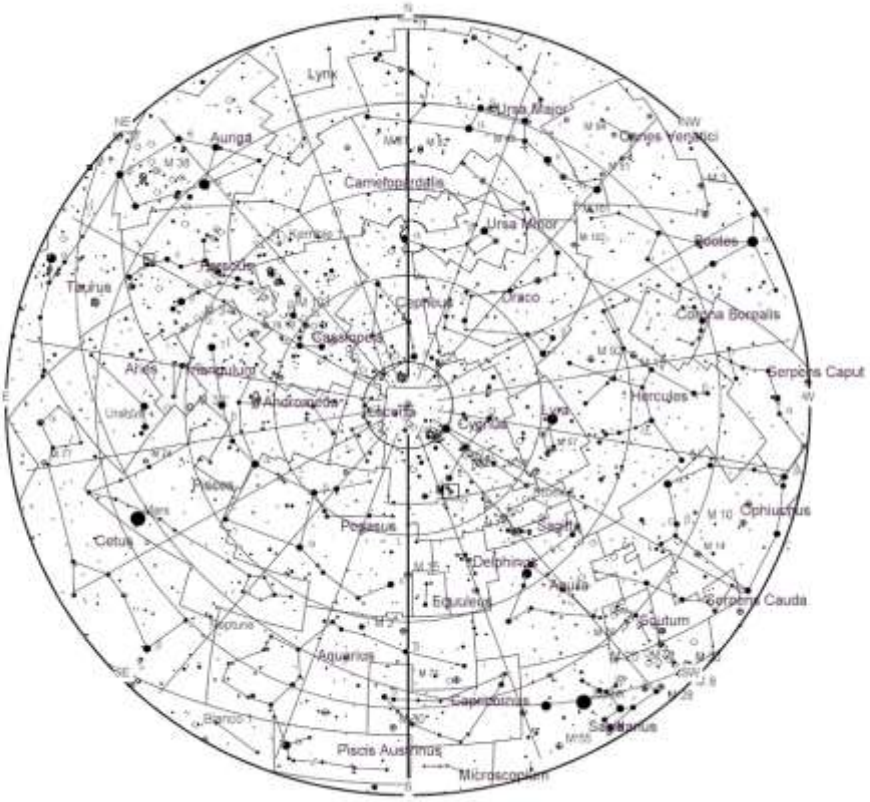
Right:

Moon terminator 7500 frames across 10 zones, ZWO345 camera, 4x Powermate on 125mm Skywatcher Esprit Super APO.

The sky conditions were awful!

Andy Burns

WHATS UP, OCTOBER 2020



•**October 1** - **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 21:06 UTC. This full moon was known by early Native American tribes as the Hunters Moon because at this time of year the leaves are falling and the game is fat and ready to hunt. It has also been known as the Travel Moon and the Blood Moon. This full moon is also known as the Harvest Moon. The Harvest Moon is the full moon that occurs closest to the September equinox each year.

•**October 1** - **Mercury at Greatest Eastern Elongation.** The planet Mercury reaches greatest eastern elongation of 25.8 degrees from the Sun. This is the best time to view Mercury since it will be at its highest point above the horizon in the evening sky. Look for the planet low in the western sky just after sunset.

•**October 7** - **Draconids Meteor Shower.** The Draconids is a minor meteor shower producing only about 10 meteors per hour. It is produced by dust grains left behind by comet 21P Giacobini-Zinner, which was first discovered in 1900. The Draconids is an unusual shower in that the best viewing is in the early evening instead of early morning like most other showers. The shower runs annually from October 6-10 and peaks this year on the the night of the 7th. The second quarter moon will ensure dark skies in the early evening for what should be a good show. Best viewing will be in the early evening from a dark location far away from city lights. Meteors will radiate from the constellation Draco, but can appear anywhere in the sky.

•**October 13** - **Mars at Opposition.** The red planet will be at its closest approach to Earth and its face will be fully illuminated by the Sun. It will be brighter than any other time of the year and will be visible all night long. This is the best time to view and photograph Mars. A medium-sized telescope will allow you to see some of the dark details on the planet's orange surface.

•**October 16** - **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 19:32 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.

•**October 21, 22** - **Orionids Meteor Shower.** The Orionids is an average shower producing up to 20 meteors per hour at its peak. It is produced by dust grains left behind by comet Halley, which has been known and observed since ancient times. The shower runs annually from October 2 to November 7. It peaks this year on the night of the 21st and the morning of of the 22nd. The waxing crescent moon will set before midnight leaving dark skies for what should be a good show. Best viewing will be from a dark location after midnight. Meteors will radiate from the constellation Orion, but can appear anywhere in the sky.

•**October 29, 30** - **Southern Taurids Meteor Shower.** The Southern Taurids is a long-running minor meteor shower producing only about 5-10 meteors per hour. This shower is, however, famous for producing a higher than normal percentage of bright fireballs. The Southern Taurids is produced by debris left behind by Comet 2P Encke. The shower runs annually from September 10 to November 20. It peaks this year on the the night of the 29th and morning of the 30th. The nearly full moon will block out all but the brightest meteors this year. If you are patient, you may still be able to catch a few good ones. Best viewing will be just after midnight from a dark location far away from city lights. Meteors will radiate from the constellation Taurus, but can appear anywhere in the sky.

•**October 31** - **Full Moon, Blue 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 14:51 UTC. Since this is the second full moon in the same month, it is sometimes referred to as a blue moon. This rare calendar event only occurs every few months, giving rise to the term "once in a blue moon".

•**October 31** - **Uranus at Opposition.** The blue-green planet will be at its closest approach to Earth and its face will be fully illuminated by the Sun. It will be brighter than any other time of the year and will be visible all night long. This is the best time to view Uranus. Due to its distance, it will only appear as a tiny blue-green dot in all but the most powerful telescopes.

Observing Notes - October 2020

Get 'em while you can!

This time of year as the dark skies arrive earlier and earlier, astronomers and particularly astrophotographers are eagerly awaiting the rise of Orion as this easily recognisable constellation peaks its head above the horizon at midnight and heralds the imminent arrival of colder clear nights and the easiest nebula to see in the skies; M42.

However this time of year also carries other great sites in to the night skies and not all of them are faint fuzzies, so before they dip down to the murky horizon or even disappear from our skies until spring the following sites.

Deep Sky Objects

(Closest to the horizon first)

Messier 10 (M10) is a rich, bright globular cluster located in the constellation Ophiuchus.

▲ Looking South West to M10 and M12

With a visual magnitude of 6.4, even the cluster's bright core is too faint to be seen without binoculars.

A small telescope (3-inch) will reveal about half the cluster's size; roughly 8 to 9 minutes of arc, its bright central region. Larger telescopes show the cluster extending across 15.1 arc minutes and reveal a large, bright central core.

In reality, the cluster is about two thirds the size of the full Moon, but its outer regions are very dim and invisible except in very large telescopes.

Messier 12 (M12), also known as the Gumball Globular, is a globular star cluster is also located in the constellation Ophiuchus.

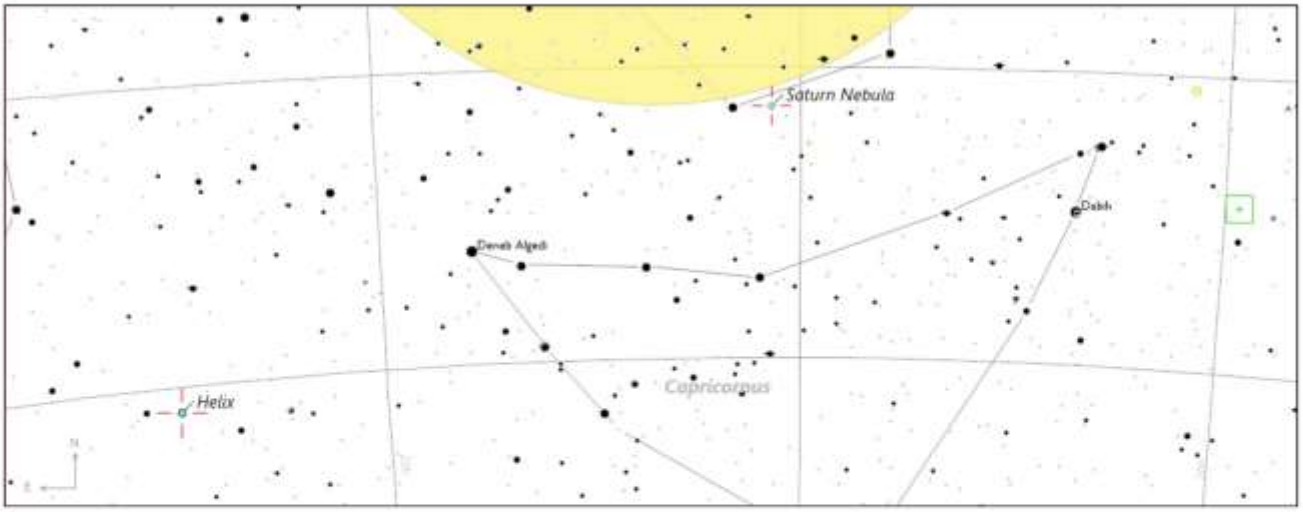
Messier 12 is invisible to the naked eye, but can be seen with binoculars in good conditions, with clear dark skies and no light pollution. Stars in the cluster can be resolved with an 8-inch or larger telescope. A 10-inch instrument reveals the core with a diameter of 3 arc minutes and a halo of stars stretching across an area of 10 arc minutes.

The cluster lies about 3 degrees in the sky from Messier 10. Both clusters (M10 and M12) can be found about half a fistwidth west of the bright star Beta Ophiuchi, also known as Cebalrai, with Messier 10 lying a bit lower in the sky, to the south of M12. M10 lies along the line from Cebalrai to Zeta Ophiuchi, the third brightest star in Ophiuchus. It is only a degree away from 30 Ophiuchi, an orange giant star with an apparent magnitude of 4.8.

▲ Messier12

In the constellation of Aquarius is *NGC 7293*, the Helix Nebula, which is also listed as Caldwell C63. It is a planetary nebular around magnitude 7.6 so it should be the easy to spot. However, it will be this month's biggest challenge as it never gets very high from UK locations so you will need both very good seeing and a clear view looking south at 10pm to spot it.

Start at the 3rd magnitude star Delta (δ) Aquarii. look 4° southwest for 5th magnitude 66 Aquarii. It should fit in the same finder field with Delta and shine with an orange tint.



▲ Helix and Saturn Nebulae

Continue along that line another 2.8° and you will come to yellow-white Upsilon (υ) Aquarii, the brightest star in the area at magnitude 5.2. The Helix sits 1.2° west of Upsilon and is best sought with a low-power eyepiece. Two 10th-magnitude stars lie halfway between, helping pinpoint the Helix in two easy jumps.

NGC 7009 or Caldwell C55 is also in Aquarius and is known as the Saturn Nebula because it appears to have 'ears' and perhaps looks a bit like how Galileo would have first seen the planet Saturn and its rings. It shines at around mag 8 so should be detectable in even a small telescope, especially with its greenish glow.

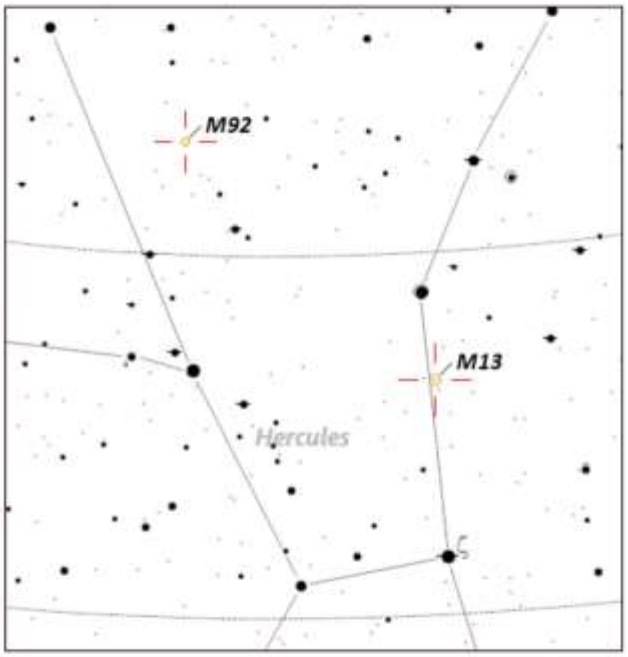
The Saturn Nebula lies in the western corner of Aquarius, just over a degree west of 4th magnitude Nu (ν) Aquarii.

Just as a side note the asterism M73 is 2 degrees southwest of the Saturn Nebula, with 9th magnitude globular cluster M72 a further 1.5 degrees west of M73 should you want to try those also.

Messier 13 (M13), also known as the Great Globular Cluster in Hercules, and is (funny enough) a globular cluster located in Hercules.

The 5.8 magnitude cluster can be seen without binoculars in exceptionally good viewing conditions, with clear skies and no light pollution.

It can be found about a 3rd of the way along a line drawn between the right-hand keystone asterism stars η and ζ Herculis and stretches



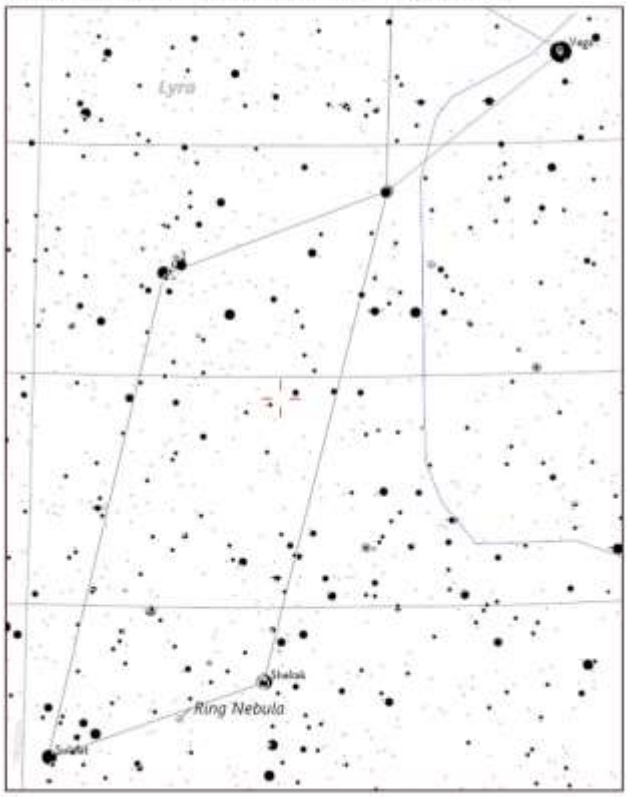
▲ Messier 13 and 92

across 20 arc minutes of the sky and easily visible in binoculars or a small scope.

Messier 92 (M92) is another a globular cluster located in the northern constellation Hercules. It is positioned north of the Keystone asterism in Hercules, between the Keystone star Eta Herculis and Iota Herculis.

In 10×50 binoculars, M92 appears like a blurry star with a brighter core. Small and medium-sized telescopes will resolve some of the stars in the outer regions of the cluster. 6-inch and 8-inch telescopes show an oval-shaped cluster with a bright centre, surrounded by a halo of stars. 12-inch telescopes resolve dozens of individual stars in the halo and throughout the cluster.

The cluster lies about 60 percent of the way from Eta to Iota. It forms a triangle with the two northernmost stars of the Keystone, Eta and Pi Herculis and can be found by first locating the bright Etamin (Eltanin, Gamma Draconis), an orange giant in Draco, and then moving about 6 degrees in the direction of the Keystone.



▲ Messier 57

Messier 57 (M57) is known as the Ring Nebula and is a planetary nebula located in the northern constellation Lyra.

The Ring Nebula has a magnitude of 8.8 and lies to the south of Vega, the brightest star in Lyra and one of the stars that form the Summer Triangle. The nebula is easy to find as it is located roughly 40 percent of the distance from Sheliak, Beta Lyrae, to Sulafat, Gamma Lyrae.

Unfortunately, the nebula cannot be resolved in small binoculars but small telescopes will reveal the nebula's ring shape, but the nebula is best seen in 8-inch and larger telescopes.

The Solar System

The Moon

October 1 - Full Hunters Moon is named because at this time of year the leaves are falling and the game is fat and ready to hunt... apparently. Other names are the Travel Moon and the Blood Moon and the Harvest Moon. The Harvest Moon is the full moon that occurs closest to the September equinox each year. Personally I think there is more interest in observing the texture of the moon surface around terminator during the waxing and waning phases.

On October 16 the Moon is new and will not be visible in the night sky so this is the best time of the month to observe faint objects such as galaxies and star clusters

The Planets

October 1 - Mercury is at its Greatest Eastern Elongation from the Sun but it is very low in the sky from the UK making observing very difficult.

▲ Mars, Jupiter and Saturn

Venus rises in the constellation of Leo at about 03:30 at the beginning of the month, a good three hours before sunrise, so is easily observable for the early risers.

October 13 - Mars will be at its closest approach to Earth and its face will be fully illuminated by the Sun. It will be brighter than any other time of the year and will be visible all night long. Located in the constellation of Pisces, this is the best time to view and photograph Mars. A medium-sized telescope will allow you to see some of the dark details on the planet's orange surface.

Both Jupiter and Saturn are still visible to the south but are getting closer to the western horizon as the month passes. Still a magnificent site even in smaller telescope the mirk of the horizon means the seeing good surface detail is becoming less likely.

On October 31 the blue-green planet Uranus will be at its closest approach to Earth visible all night long in the constellation of Aries. This is the best time to view Uranus. Due to its distance, it will only appear as a tiny blue-green dot in all but the most powerful telescopes.

The disk of Neptune is even more difficult to see but the planet is visible almost from sunset to sunrise bordering the constellations of Aquarius and Pisces.

Meteor Showers

October 7 - Draconids Meteor Shower. The Draconids produce only about 10 meteors per hour. The Draconids is an unusual shower in that the best viewing is in the early evening instead of early morning like most other showers.

The shower runs annually from October 6-10 and peaks on the night of the 7th. The moon will be at last quarter so will help the early evening observers see meteors radiate from the constellation Draco.

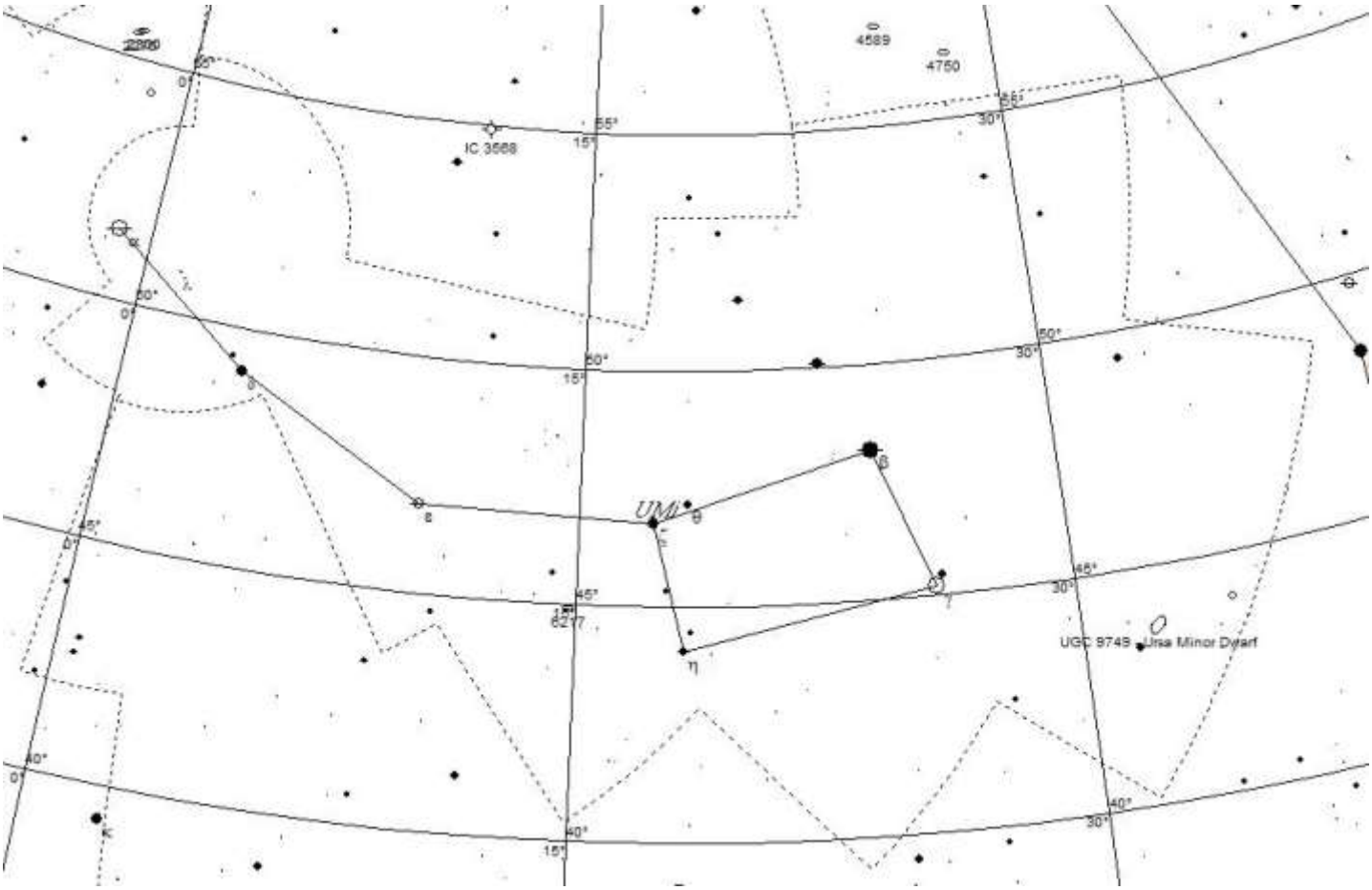
October 21, 22 - Orionids Meteor Shower. The Orionids produces up to 20 meteors per hour at its peak. It is produced by dust grains left behind by comet Halley, which has been known and observed since ancient times.

The shower runs annually from October 2 to November 7. It peaks this year on the night of the 21st in to the 22nd. The moon is a waxing crescent setting before midnight when the meteors will appear to radiate from the constellation Orion.

Lastly, clocks go back on the 25th of the month so we can enjoy the night skies even earlier.

Chris Brooks
WAS Observing Team

CONSTELLATIONS OF THE MONTH: URSA MINOR



Ursa Minor

The northern circumpolar constellation of Ursa Minor was one of the 48 original constellations listed by Ptolemy, and remains one of the 88 modern constellations recognized by the IAU. Ursa Minor is currently the location of the north celestial pole, yet in several centuries, due the precession of the equinoxes, it will change. Ursa Minor covers 256 square degrees of sky and ranks 56th in size. It contains 7 main stars in its asterism and has 23 Bayer Flamsteed designated stars within its confines. Ursa Minor is bordered by the constellations of Draco, Camelopardalis and Cepheus. It is visible to all observers located at latitudes between +90° and ?10° and is best seen at culmination during the month of June.

There is one annual meter shower associated with Ursa Minor called the Ursids. Beginning on or about December 17th of each year, we encounter the meteoroid stream and activity can last through the end of December. The meteor shower itself is believed to be associated with Comet Tuttle and was probably discovered by William F. Denning during the 20th century. The peak date of activity occurs on December 22 during about a 12 hour window and you can expect to see about 10 meteors per hour on the average from a dark sky location.

In mythology, Ursa Minor is meant to represent a baby bear with a very long tail. Perhaps this springs from the “tale” of Kallisto and her son, who were placed in the sky as a bear and son. The tail is believed to be elongated from have been swung around the north star! In some forms of mythology, the seven stars of the Little Dipper were considered to be the Hesperides, daughters of Atlas… and it forms the “dragon’s wing” in yet other stories. While the “Little Dipper” asterism is a bit more difficult to recognize because its stars are more faint, once you do understand the pattern, you’ll always remember it. How? The star at the end of the little dipper handle is Polaris, the North Star. Polaris is easily identified by drawing a mental line through the two stars which form the end of the “bowl” of the Big Dipper and extending that line five times the distance.

Now, let’s take a look at Ursa Minor! While there are only a very few deep space objects here (and they require a large telescope) that doesn’t mean the constellation isn’t interesting. One handy thing to note is the stars themselves. The four stars in the “bowl” of the little dipper are unusual because they are of second, third, fourth and fifth stellar magnitude. While that might not seem like a big deal, it’s a great way to judge your sky conditions. What is the dimmest of the stars that you can see? Beta (B) is 2, Gamma (Y) is 3, Zeta (the squiggle) is 4 and the unmarked corner is Eta (n) and it is stellar magnitude 5.

Ready for the brightest star? Then say hello to Alpha (a) – Polaris. Alpha Ursae Minoris is also known as the “North Star” and even as the Lodestar. While it might be 430 light-years from Earth, it is currently the closest star to the north celestial pole and a main sequence supergiant star. But don’t just glance at it and walk away… Get out your telescope! In 1780, Sir William Herschel noticed something a little strange when he was looking at Polaris, and so will you… it has a companion star. That’s right. Polaris is a binary star. Not only that… But when astronomers were examining Polaris B’s spectrum, they noticed something else… You got it! Polaris B also has a spectroscopic companion, making this a tertiary star system. Are you ready for more? Then get this… Polaris A is also a Cepheid variable star! While its changes are very small (about 0.15 of a magnitude every 3.97 days), Polaris has brightened by 15% since we first began studying it and its variability period has lengthened by about 8 seconds each year since. That makes Polaris more than just another star… It’s a super star!

Now aim your binoculars at Beta Ursae Minoris. Its name is Kochab and it is about 127 light years from our solar system. This orange giant star shines about 130 times more brightly than our own Sun. Somewhere around 3000 years ago, Kochab was once the pole star – but as Earth’s precessional motion changed, so did its position. Even then it still wasn’t quite as close as Polaris!

How about Gamma Ursae Minoris? That's the "Y" symbol on our chart. Known as Pherkad, this spectral class A3 star is about 480 light years away and it is pretty special, too. Why? Because it's a Delta Scuti type variable star and its brightness varies by 0.05 magnitudes with a period of 3.43 hours. While you're not going to notice any change by just watching, image the power behind a star that shines 1100 times more luminous than the Sun, and possesses a radius 15 times larger!

Are you ready for Epsilon? Then get out the telescope, because 347 light year distant Epsilon is an eclipsing spectroscopic binary star. (Say that five times fast!) It is classified as a yellow G-type giant star with a mean apparent stellar magnitude of 4.21. In addition to light changes due to eclipses, the system is also classified as an RS Canum Venaticorum type variable star and its brightness varies from magnitude 4.19 to 4.23 with a period of 39.48 days, which is also the orbital period of the binary. The binary it orbited by a third component, Epsilon Ursae Minoris B, which is an 11th magnitude star, 77 arc seconds distant.

Now for Delta – the "8". Delta Ursae Minoris is about 183 light years away and goes by the strange name, Pherkard. While it isn't as grand as its mates, at least it is a white A-type main sequence dwarf star!

Last, but not least, is RR Ursae Minoris. You've got it… The double letter designation denotes a variable star. While changes are very small (4.73 at minimum and magnitude 4.53 at maximum) it's the period that counts here. The changes take period of 748.9 days to happen! This means that RR has been highly studied to make sure it doesn't have a spectroscopic companion – and so far none have been found.

A consequence of the precession is a changing pole star. Currently Polaris is extremely well-suited to mark the position of the north celestial pole, as Polaris is a moderately bright star with a visual magnitude of 2.1 (variable), and it is located within a half degree of the pole.

On the other hand, Thuban in the constellation Draco, which was the pole star in 3000 BC, is much less conspicuous at magnitude 3.67 (one-fifth as bright as Polaris); today it is invisible in light-polluted urban skies.

The brilliant Vega in the constellation Lyra is often touted as the best north star (it fulfilled that role around 12000 BC and will do so again around the year AD 14000), however it never comes closer than 5° to the pole.

When Polaris becomes the north star again around 27800 AD, due to its proper motion it then will be farther away from the pole than it is now, while in 23600 BC it came closer to the pole.

It is more difficult to find the south celestial pole in the sky at this moment, as that area is a particularly bland portion of the sky, and the nominal south pole star is Sigma Octantis, which with magnitude 5.5 is barely visible to the naked eye even under ideal conditions. That will change from the eightieth to the ninetieth centuries, however, when the south celestial pole travels through the False Cross.

This situation also is seen on a star map. The orientation of the south pole is moving toward the Southern Cross constellation. For the last 2,000 years or so, the Southern Cross has nicely pointed to the south pole. By consequence, the constellation is no longer visible from subtropical northern latitudes, as it was in the time of the ancient Greeks .

Like a wobbling top, the orientation of the Earth's axis is slowly but continuously changing, tracing out a conical shape in a cycle of approximately 25,765 years (the so called Great or Platonic year, and also the determining factor in the length of an astrological age). This movement is caused by the gravitational forces of the Sun and the Moon, and to a lesser extent other bodies, on the equatorial bulge of the spinning Earth. The term "precession" typically refers only to this largest periodic motion; other changes in the alignment of Earth's axis — nutation and polar motion — are very much smaller in magnitude.

The precession of the Earth's axis has a number of observable effects. Firstly, the positions of the north and south celestial poles appear to move in circles against the (assumed fixed) backdrop of stars, completing one circuit in approximately 25,700 years. Thus, while today the star Polaris lies approximately at the north celestial pole, this will change over time, and other stars will become the "north star". As the celestial poles shift, there is a corresponding gradual shift in the apparent orientation of the whole star field, as viewed from a particular position on Earth.

Secondly, the position of the Earth in its orbit around the Sun at the solstices, equinoxes, or other time defined relative to the seasons, slowly changes. For example, suppose that the Earth's orbital position is marked at the summer solstice, when the Earth's axial tilt is pointing directly towards the Sun. One full orbit later, when the Sun has returned to the same apparent position relative to the background stars, the Earth's axial tilt is not now directly towards the Sun: because of the effects of precession, it is a little way "beyond" this. In other words, the solstice occurred a little earlier in the orbit. Thus, the tropical year, measuring the cycle of seasons (for example, the time from solstice to solstice, or equinox to equinox), is about 20 minutes shorter than the sidereal year, which is measured by the Sun's apparent position relative to the stars. Note that 20 minutes per year is approximately equivalent to one year per 25,700 years, so after one full cycle of 25,700 years the positions of the seasons relative to the orbit are "back where they started". (In actuality, other effects also slowly change the shape and orientation of the Earth's orbit, and these, in combination with precession, create various cycles of differing periods; see also Milankovitch cycles. The magnitude of the Earth's tilt, as opposed to merely its orientation, also changes slowly over time, but this effect is not attributed directly to precession.)

For identical reasons, the apparent position of the Sun relative to the backdrop of the stars at some seasonally fixed time, say the vernal equinox, slowly regresses a full 360° through all twelve traditional constellations of the zodiac, at the rate of about 50.3 seconds of arc per year (approximately 360 degrees divided by 25,700), or 1 degree every 71.6 years.

The precession of the equinoxes is caused by the gravitational forces of the Sun and the Moon, and to a lesser extent other bodies, on the Earth.

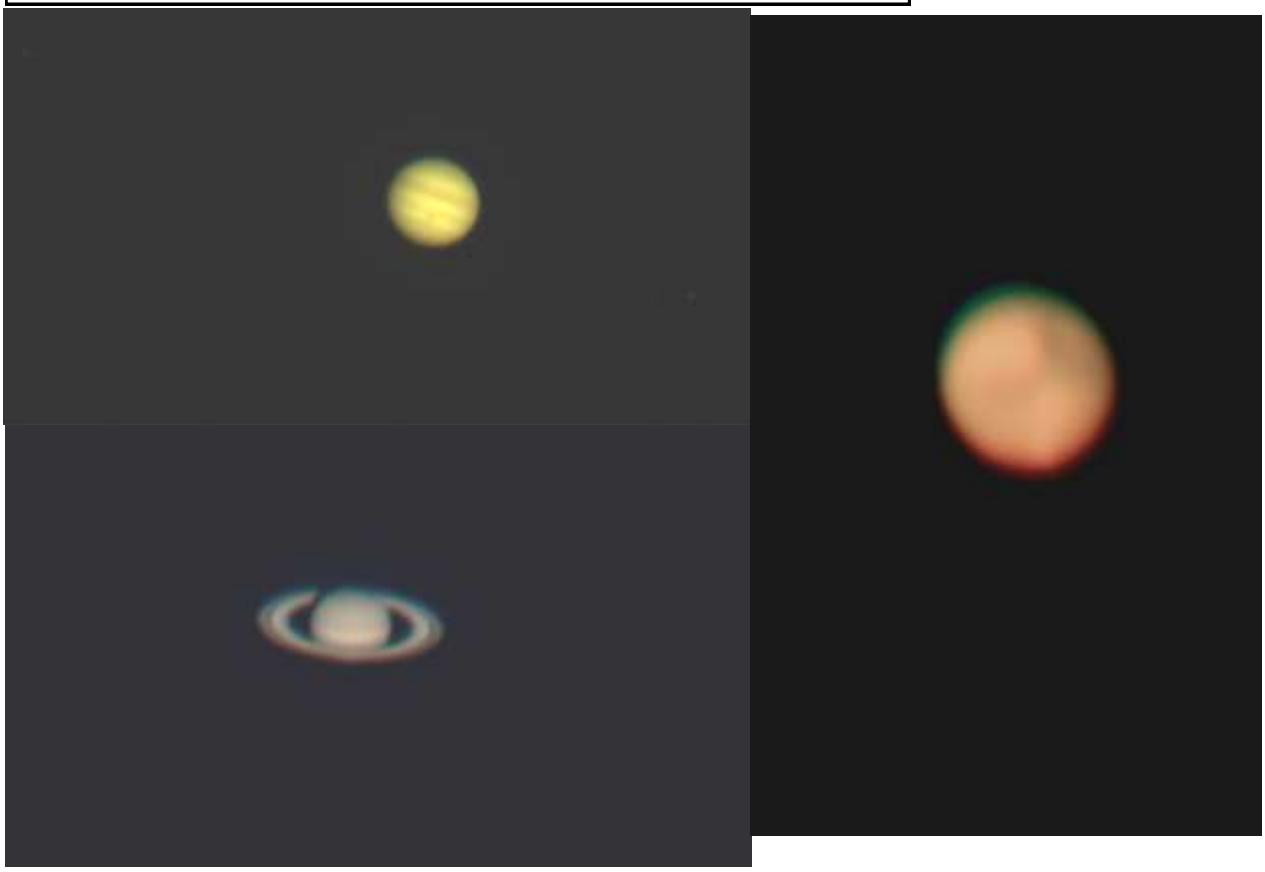
In popular science books, precession is often explained with the example of a spinning top. In both cases, the applied force is due to gravity. For a spinning top, this force tends to be almost parallel to the rotation axis. For the Earth, however, the applied forces of the Sun and the Moon are nearly perpendicular to the axis of rotation.

The Earth is not a perfect sphere but an oblate spheroid, with an equatorial diameter about 43 kilometers larger than its polar diameter. Because of the earth's axial tilt, during most of the year the half of this bulge that is closest to the Sun is off-center, either to the north or to the south, and the far half is off-center on the opposite side. The gravitational pull on the closer half is stronger, since gravity decreases with distance, so this creates a small torque on the Earth as the Sun pulls harder on one side of the Earth than the other. The axis of this torque is roughly perpendicular to the axis of the Earth's rotation so the axis of rotation precesses. If the Earth were a perfect sphere, there would be no precession.

ISS PASSES For October/Nov 2020 From Heavens Above website maintained by Chris Peat

Date	Brightness	Start	Highest point	End						
	(mag)	Time	Alt.	Az.	Time	Alt.	Az.	Time	Alt.	Az.
22 Oct	-0.6	06:45:14	10°	SSE	06:46:40	12°	SE	06:48:07	10°	ESE
24 Oct	-1.6	06:45:18	10°	SSW	06:48:07	25°	SSE	06:50:58	10°	E
25 Oct	-1.2	04:58:27	10°	S	05:00:48	18°	SE	05:03:10	10°	E
26 Oct	-0.9	04:13:12	12°	SE	04:13:31	12°	SE	04:14:58	10°	ESE
26 Oct	-2.8	05:46:27	10°	SW	05:49:42	46°	SSE	05:52:58	10°	E
27 Oct	-2.4	05:00:58	24°	SSW	05:02:17	34°	SSE	05:05:23	10°	E
28 Oct	-1.6	04:15:38	23°	SE	04:15:38	23°	SE	04:17:43	10°	E
28 Oct	-3.6	05:48:36	14°	WSW	05:51:23	75°	SSE	05:54:46	10°	E
29 Oct	-3.5	05:03:10	47°	SW	05:03:53	61°	SSE	05:07:13	10°	E
30 Oct	-1.8	04:17:40	30°	ESE	04:17:40	30°	ESE	04:19:39	10°	E
30 Oct	-3.8	05:50:38	17°	W	05:53:06	86°	N	05:56:30	10°	E
31 Oct	-3.9	05:05:05	64°	WSW	05:05:33	87°	SSE	05:08:55	10°	E
01 Nov	-1.8	04:19:29	30°	E	04:19:29	30°	E	04:21:21	10°	E
01 Nov	-3.8	05:52:27	18°	W	05:54:48	88°	N	05:58:12	10°	E
02 Nov	-3.9	05:06:50	67°	WNW	05:07:13	85°	N	05:10:37	10°	E
03 Nov	-1.8	04:21:12	29°	E	04:21:12	29°	E	04:23:00	10°	E
03 Nov	-3.7	05:54:09	19°	W	05:56:26	70°	SSW	05:59:48	10°	ESE
04 Nov	-3.9	05:08:32	71°	W	05:08:51	83°	S	05:12:14	10°	ESE
05 Nov	-1.7	04:22:55	28°	E	04:22:55	28°	E	04:24:37	10°	E
05 Nov	-3.1	05:55:52	19°	W	05:57:55	42°	SSW	06:01:07	10°	SE
06 Nov	-3.6	05:10:17	55°	SSW	05:10:22	55°	SSW	05:13:40	10°	ESE
07 Nov	-1.5	04:24:43	23°	ESE	04:24:43	23°	ESE	04:26:07	10°	ESE
07 Nov	-2.1	05:57:41	17°	WSW	05:59:13	22°	SW	06:01:54	10°	SSE
08 Nov	-2.5	05:12:11	29°	SSW	05:12:11	29°	SSW	05:14:44	10°	SSE
09 Nov	-1.0	04:26:44	14°	SE	04:26:44	14°	SE	04:27:23	10°	SE
09 Nov	-1.4	05:59:42	10°	SW	06:00:18	11°	SW	06:01:05	10°	SSW
10 Nov	-1.3	05:14:20	13°	S	05:14:20	13°	S	05:14:59	10°	S

END IMAGES, OBSERVING AND OUTREACH



Back in late July after a couple of our meeting a seeing the lunar work of James Harrop I took the plunge and bought a ZWO ASI385MC webcam. That brought 6 weeks of uninterrupted cloud, and then the low position of the early Moon phases in Summer and Jupiter and Saturn only appearing in a 15 degree gap between two houses only got two chances to try it out, once testing software and finding video standard settings, then poor sky turbulence and misty skies below 20degrees and I was up against it. The 21st September was first night when anything was possible, even then Jupiter was in twilight skies as it entered the gap for viewing… Different exposures for the Moons than the image used here, but the Great Red Spot is darker than I have observed it for many a year.
Saturn then came out, Cassini division in the rings easily defined plus some atmospheric bands, plus shadow on rings. About 600 frames stacked and finally processed in Registax.
Mars was another challenge just rising above the trees to my east, and over here I have the centre of Chippenham and rivers valley with rising mists, but just about picked out the tiny south polar cap and the dark patches of Syrtis Major and Terra Meridian. Not a Damian Peach, but delighted to get through an APO refractor with powermate.
The next time out the atmospheric turbulence was the worst I've had… Andy

October Observing Suggestion

We have updated the observation targets this month for those with binoculars or smaller wide field telescopes to have something to search for.

As restrictions are slowly eased each month the WAS Observing Team will provide recommended observing sessions for you to do while maintaining social distancing away from the home or as part of your social bubble at the homes of close friends or relatives. Please always follow the latest government guidelines if observing away from the home.

These observing recommendations will continue until we can start our group observing again (hopefully) in the new season.

Most target objects can be found around due south at about 2200.

Where To Look This Month: Cassiopeia
Just select 'What's Up' link below to get the PDF file.
What's Up Link: WAS_September_2020.pdf

There is a full version copy in this Newsletter, around page 32.

OUTREACH
On hold during Isolation/Social Distancing