The Prime Focus
The newsletter of the Columbus Astronomical Society
Volume 74 #1, January 2025

President's Message

The cold weather is here. For those that received or gave themselves new equipment for the Holidays, now is the time to read those manuals and practice putting it all together. It's always best to get familiar with new equipment in the comfort of your home before going out under the stars.

If you can brave the cold, there's a great celestial event coming up. The Moon will occult Mars on the night of January 13-14 starting at just after 9:00 PM. Two days later, on January 15, Mars will reach opposition.

There are two other planets to view this month- Venus high in the southwest at sundown and Jupiter is near the Zenith in the evening.

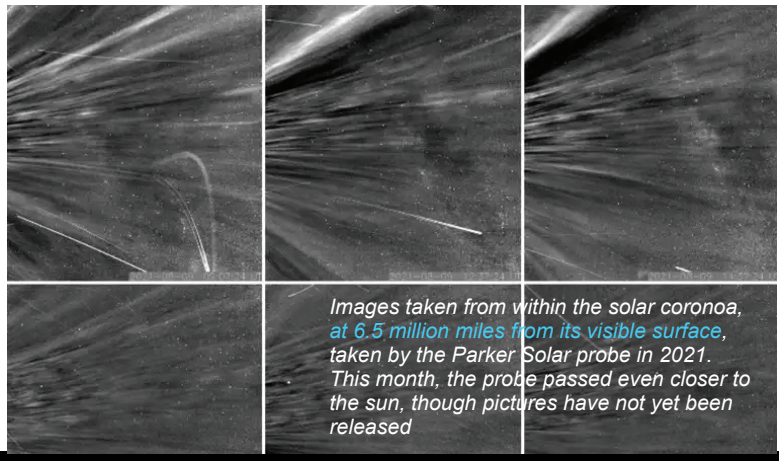
This month's meeting features the return of Professor Sultana Nahar, who will be giving a talk titled **"The search for clues of life in exoplanets."**

As always if we can help with your scope at the meeting or answer a question you might have. Members can also sign up to borrow a scope from our collection. We are glad to help!

Charles Lusco, *CAS President*

Quick Calendar

January 11.....CAS Meeting at Perkins @ 8:00 PM
January 25.....Outreach Event, Highbanks
February 8.....CAS Meeting at Perkins @ 8:00 PM
February 15.....CASIS @ Perkins 1:00 PM



Images taken from within the solar coronoa, at 6.5 million miles from its visible surface, taken by the Parker Solar probe in 2021. This month, the probe passed even closer to the sun, though pictures have not yet been released

One Drawing: by Vic Wolfe (from the CAS Archives)

Before the age of easy digital photography, the best way for an amateur to capture an image of the planets was to sit down at a telescope with pencils and paper in hand and make a sketch.

A patient human observer, like Vic Wolfe when he made this image using his 8" telescope, can pick up the details of a small world like Mars and set them down when the air calms enough to present a clear view.

As many observers know, moments of clarity are often fleeting due to the ever shimmering, roiling atmosphere, which jostles and distorts our view of the cosmos. (It is this phenomenon, known as *scintillation*, which gives rise to the twinkling of stars.)

This drawing, made on February 6, 1995 when Mars was a puny 13.8 arcseconds across (smaller than it will be at opposition this year) shows several details that may be visible in small telescopes this time around. The most notable is the bright northern polar cap, which appears at the bottom of this image at 5 o'clock on the disk.

Also visible is the prominent albedo feature Syrtis Major, the triangular dark patch at top. Next to it, along its right side, is the lighter region of Elysium. Circling the polar cap are the dark plains north of Utopia Planitia, where the Viking 2 lander set down, and the setting of the fictional Starfleet shipyards of the Star Trek universe.

If you want to absorb the details of a world through a telescope, taking the time to capture them by hand is a good way of helping them sink in. *-ed.*

What's Up in 2025
by Brad Hoehne

Welcome to 2025!. A new year always brings with it hope. Sometimes it brings trepidation as well. However you may feel, know that in the realm of things astronomical there is much to look forward to. Here's a summary of 2025's highlights.

The Solar System

January 15: Mars Opposition

If you could peel Mars like an orange and flatten out its surface on some great cosmic kitchen counter, the area it would take up would just about match a similar peel made up of the land area of Earth.

In other words, Mars is much smaller than our world. With a diameter of only 6,780 kilometers, it spans just 53% of Earth's girth.

This year, one can get a visceral sense of that small size during its upcoming opposition.

Every 26 months, Earth catches up to Mars, which lumbers around the sun every 686.93 days. When Earth, Mars, and the Sun are lined up, Mars is said to be at *opposition*. This is generally quite close to, but not exactly at, the time when Mars is at its closest.

This year opposition occurs when Mars, whose orbit is far more *eccentric* than Earth's, is relatively far from the sun. Through a telescope, the world will grow to a meager 14.6 arcseconds- a tiny peach-colored dot in all but the highest power eyepieces. During more favorable oppositions, Mars can appear over 25 arcseconds across.

Detail on Mars, which shows up of faint brownish albedo markings, blue-white polar caps, and pale white morning fog along its limb, will be challenging to spot. If you want to try, make sure your telescope is properly collimated, and ensure that it has had time to cool to the ambient air temperature of before you begin observing.

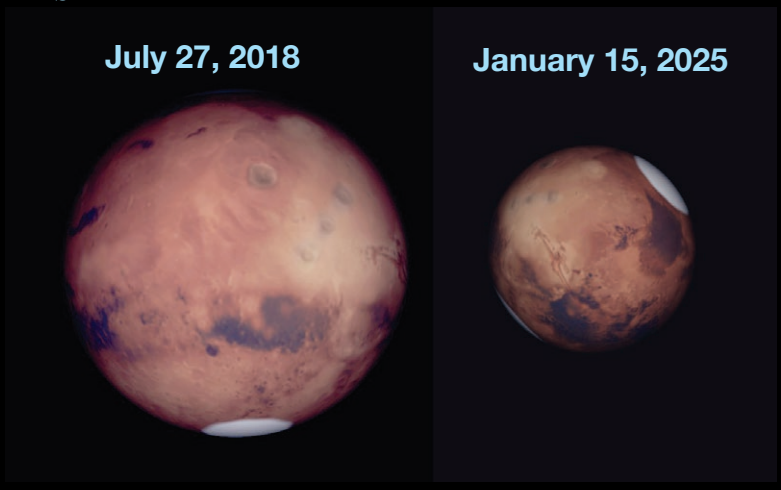
While Mars will be small this year, there is one thing about this opposition that might make detail a bit easier to see this time around. The closest oppositions of Mars occur, unfortunately for us in the northern hemisphere, when Mars is passing in front of the southern constellations of Sagittarius or Scorpius. For us in Ohio, this means that Mars at its biggest is seen through the murky atmosphere near the horizon.

This year, Opposition occurs when Mars is in the northern parts of Gemini alongside Castor and Pollux. In the middle of the night, when Mars reaches culmination, it will be high in the sky, not far from the Zenith. Light that reaches our eye from celestial bodies near the zenith does not pass through as much of the blurring atmosphere as light close to the horizon.

So, while Mars will be small, it might very well appear sharp.

Mars Oppositions Compared

Compare the apparent size of Mars during 2018's opposition with that of 2025. Simulations made using Stellarium.



January 13: The Moon Occults Mars

On the night of January 13, the moon will loom large next to distant Mars. For those of us in Columbus, Ohio the planet will be visible alongside the moon as it rises at dark. Over the next few hours the moon will slowly creep towards the orange-ish dot. Then, at just after 9:09 PM, the moon will slowly start to cover Mars. A few minutes later, Mars will have vanished behind the mountains along the limb of the moon.

This event will give observers an opportunity to appreciate just how tiny Mars appears in our skies. Indeed, there are many individual craters on the moon into which Mars could seemingly fit.

I love events like this, as they give me a visceral sense of the clockwork precision of the motions of the celestial bodies.

Mars Occultation by the Moon
9:10 PM January 13, 2025

Venus in 2025

The sun set on 2024 with Venus a shining beacon high in the southwest sky. Over the next month, Venus will continue to be a beacon in the evening. The planet will reach its greatest elongation, that is its greatest eastward extent from the sun, on the evening of January 10. On that day it will appear 47.2 degrees from the sun, but somewhat lower than that in the sky due to the tilt of the ecliptic relative the the horizon.

At the eyepiece of the telescope it will go through rapid changes in January. The planet starts out the year as a gibbous world, a bit larger than a "half-Venus." On January 1, it appeared 22 arcseconds across.

At the end of January that telescopic view will appear quite different. Observers will see a distinct crescent 32 arcseconds across.

The planet will reach its greatest elongation, that is its greatest eastward extent from the sun, on the evening of January 10. On that day it will appear 47.2 degrees from the sun. That evening it will set at 9:22, after gleaming in the southwest sky for over four hours.

On January 12, 2025 Venus will be at dichotomy. In linguistics or philosophy, a *dichotomy* is a distinct division or separation between two things or cocepts. In astronomy, a dichotomy is when the terminator of a planet, that is the edge of the shadow, perfectly bisects the planet.

On February 1, the crescent moon will be seen alongside of Venus. The two worlds, just 2.3 degrees apart, will appear a similar shape, though a very different size.

Over February, Venus will change even more rapidly, as it rounds the sun, catches up and passes Earth on its inside-track orbit. The crescent will get thinner and thinner as the world gets larger and larger at the eyepiece. By March 1 it will appear 49.4 arcseconds across and will be diving deeper and deeper into the ever later evening twilight.

By March 13, when it passes by Mercury, which is leaping up from the horizon at the same time, it will be challenging to make it out over the WSW horizon.

The planet reaches inferior conjunction, the point where it slides between the Earth and the Sun, on March 22, making it visible only to intrepid astrophotographers looking to capture a view of the thinnest possible Venus crescent against a bright blue noon sky.

Venus will pop up in the morning sky in mid-April, and perform the whole sequence of phases we had just witnessed in reverse.

On April 24, Venus will be again alongside the crescent moon, 2.4 degrees away. Again, the two worlds will mirror each other's shape.

The planets orbit the sun in nearly, though not exactly, the same plane. Because of this, they appear to travel across the stars along the same "cosmic superhighway." From time to time, they pass by one another, the inner planets, Mercury and Venus, and perhaps Mars, screaming by the more sluggish outer worlds.

On August 12, Venus will fly by Jupiter, coming, from our point of view, within just 0.8 degrees. The two will be an eye-catching sight in the morning sky. Those staying up late (or getting up early) to catch a Perseid Meteor or two through the glare of the bright moonlight might enjoy a brief side journey to this event.

The most visually captivating close pass of the moon by Venus will occur on **September 19, 2025**, when the planet will shine just 0.8 degrees from a very thin crescent moon Through a telescope, however, the worlds will not mirror each other's shape. At this point in time we will be seeing Venus not on "our side" of the sun, but from across the inner solar system, almost fully illuminated, yet quite tiny at the eyepiece. If conditions are exceptionally clear, the bright star Regulus, in Leo, joins the two, just a degree and half from the moon.

Those with a clear horizon, and clear skies, will see Venus as a fixture of the morning sky until mid-November, when it will again dive into deep twilight and pop up again in the evening in early 2026.

The simulated phases of Venus from late 2024 through March 2025.

Two Lunar Eclipses in 2025

There are two total lunar eclipses in 2025, one of which will be perfectly placed and timed for us here in Ohio to see, and the other which will require a long flight to Eastern Europe or Asia to enjoy.

The first occurs on the morning of March 14.

When those who predict lunar eclipse give the times of various events, they pay closest attention to the moments when the moon enters and leaves the *penumbra*, the outer fuzzy shadow of the moon, and the *umbra*, the inner total shadow.

The *penumbra* timings are given with a P. P1 marks the first entry of the the edge of the moon into the penumbra. P2 is the point where the moon is first fully inside the penumbra. P3 is the last moment that the moon is fully inside the penumbra and P4 is when it last exits.

More interesting to observers are the moments marked by "U", the the events related to the umbra, which are labeled similarly.

Here are the timings of this eclipse:

P1: 11:57 PM EDT March 11
U1: 1:09 AM EDT March 12
U2: 2:26 AM EDT ""
U3: 3:31 AM EDT
U4: 4:47 AM EDT
P4: 6:00 AM EDT

We in Ohio will enjoy this eclipse from beginning to end. Those with a tracking mount and a good camera will be able to take a compelling time lapse or sequence of phases as the moon slides through the Earth's shadow in front of the stars in Virgo.

The second eclipse of this 2025 occurs on the evening of September 7 and 8. It will last longer and the moon will likely get even darker. Alas, those of us in Ohio will need to fly halfway around the world to somewhere between East Africa and Eastern Europe (AKA, Russia and Ukraine) and Western Australia, China and Mongolia. The good news is that the vast majority of Humanity will be in place to witness this event. Alas, if we stay home, we will not be among them.

Virgo

Leo

Simulated view of eclipse near its darkest

Sextans

Saturn's Rings Edge On: March 23, 2025

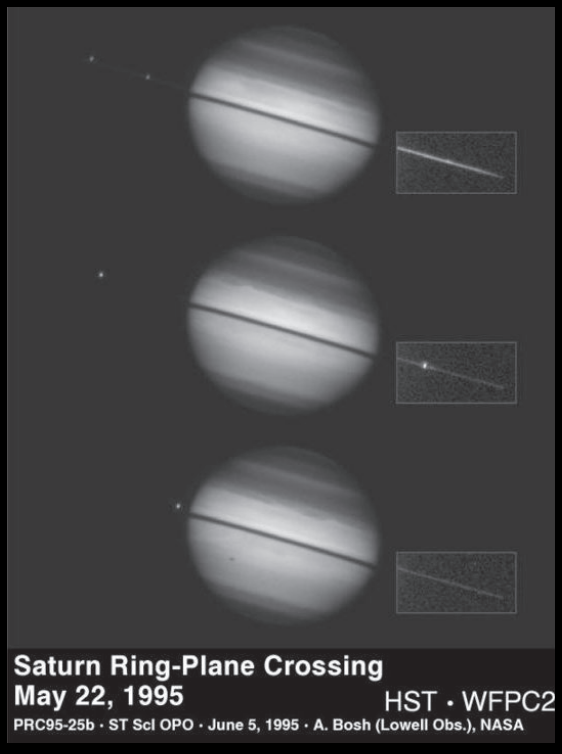
Saturn's rings are thin… if you look at them a certain way. By human standards, they're actually quite thick, ranging anywhere from 5 meters or so to over 100 meters in places. That's somewhere between house-height and football-field-length.

By "thin" I mean *compared to their diameter* (282,000 km) their thickness is almost not there at all.

If you shrunk the rings down to the diameter of the largest circle you can cut out of a piece of ordinary typing paper, the rings would be thinner than the paper- much, much, much thinner. In fact, if the rings were 8 inches (20 cm) across, the thickest part of them would be smaller, 70 nanometers, than the diameter of a SARS Cov-19 Virus, around 100 nanometers.

Granted, there are a few places where the rings are warped a bit by the gravity of small moons embedded within them. In this case, the edges of the rings stretch up, like a frayed piece of paper, a kilometer or so.

The thinness of the rings can be visually appreciated every 15 years or so when they appear to us edge on.



Saturn's takes 29.4 years to orbit the sun. Saturn's orbit is tilted at 26.7 degrees to its orbit, giving the planet seasons like Earth. The axis of a world like Saturn (or the Earth), is quite fixed, and tends to stay pointed at roughly the same point in space as it orbits. Earth's axis, for instance, points to a spot in the sky close to the medium-bright star, Polaris. (The spot its points to slowly moves over thousands of years, but on short times scales this is not relevant.)

Saturn's north pole points to a spot in the celestial sphere about six degrees away from Polaris in the northernmost reaches of Cepheus. Over its orbit it stays steadfastly aligned with this spot in the sky.

For this reason, as Saturn orbits the sun, we see its rings from different angles. At times, the rings are splayed out in front of us, with the "far side" of them peeking up, just a bit, over the pole of the planet.

This year, the opposite will happen: Saturn's rings will appear edge-on to us. In addition, all this year the rings will appear uncommonly thin to telescopic observers.

On March 23 of this year, Earth will pass through the ring plane, rendering the rings (if we could see Saturn) almost invisible.

Alas, at that time, Saturn will be nearly in conjunction with (that is, over on the other side of) the sun, and spotting it and appreciating its lack of rings will require exceptionally clear skies and extremely careful pointing of a telescope (so as to avoid the dangers of the sun's intense glare) during daylight hours.

Undoubtedly an intrepid amateur photographer, and perhaps a few observatories, will capture the event photographically.

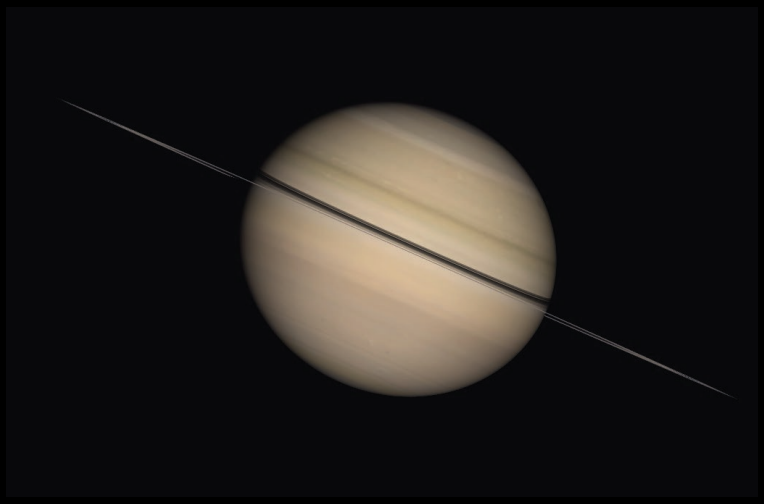
Will anyone actually *see* it? It's not likely, but who knows?

Some years, Earth's slightly tilted orbit relative to Saturn, brings it back up for an additional pair of ring plane crossings. They always occur in groups of three or solo. This is not one of those years, but it will be close.

Those who miss the singular ring plane crossing on March 23 can console themselves with a *near* ring plane crossing that occurs in November. As we ride Earth about the sun, our point of view will "rise up" a bit relative to the ring plane (which had been crossed earlier) and bring the rings *almost* to a close for a few days around Thanksgiving.

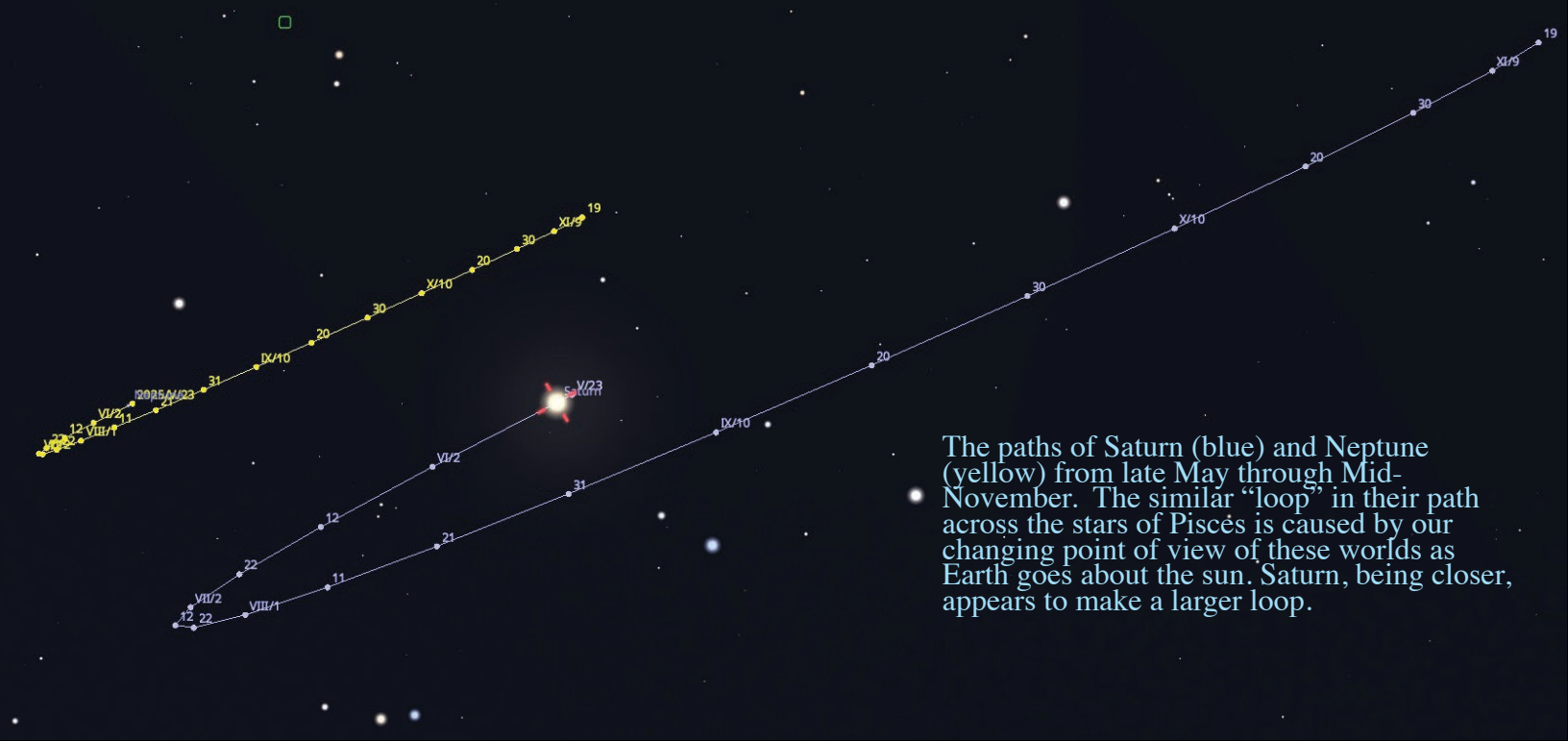
Happily, this will occur at a time when Saturn is well-placed in the evening sky for observation between rounds of turkey and stuffing.

Simulated view of Saturn as it will appear on Thanksgiving, November 27, 2025



Saturn Points the way to Neptune: May-October 2025

If you've ever struggled to hunt down the elusive and faint Neptune, you'll have some help finding it in 2025 in the form of the thin-ringed Saturn. From around late May, when it rises out of the morning twilight, through October, the two worlds will be less than five degrees apart in the sky. Moreover, while they will dance about each other over the course of the summer and early fall, most of the time time they'll be around 2 degrees apart or less. The views will be best in late June-August, but Saturn rises well after midnight at that time of year. By early September, the pair are well placed for those who prefer to tuck in before midnight.

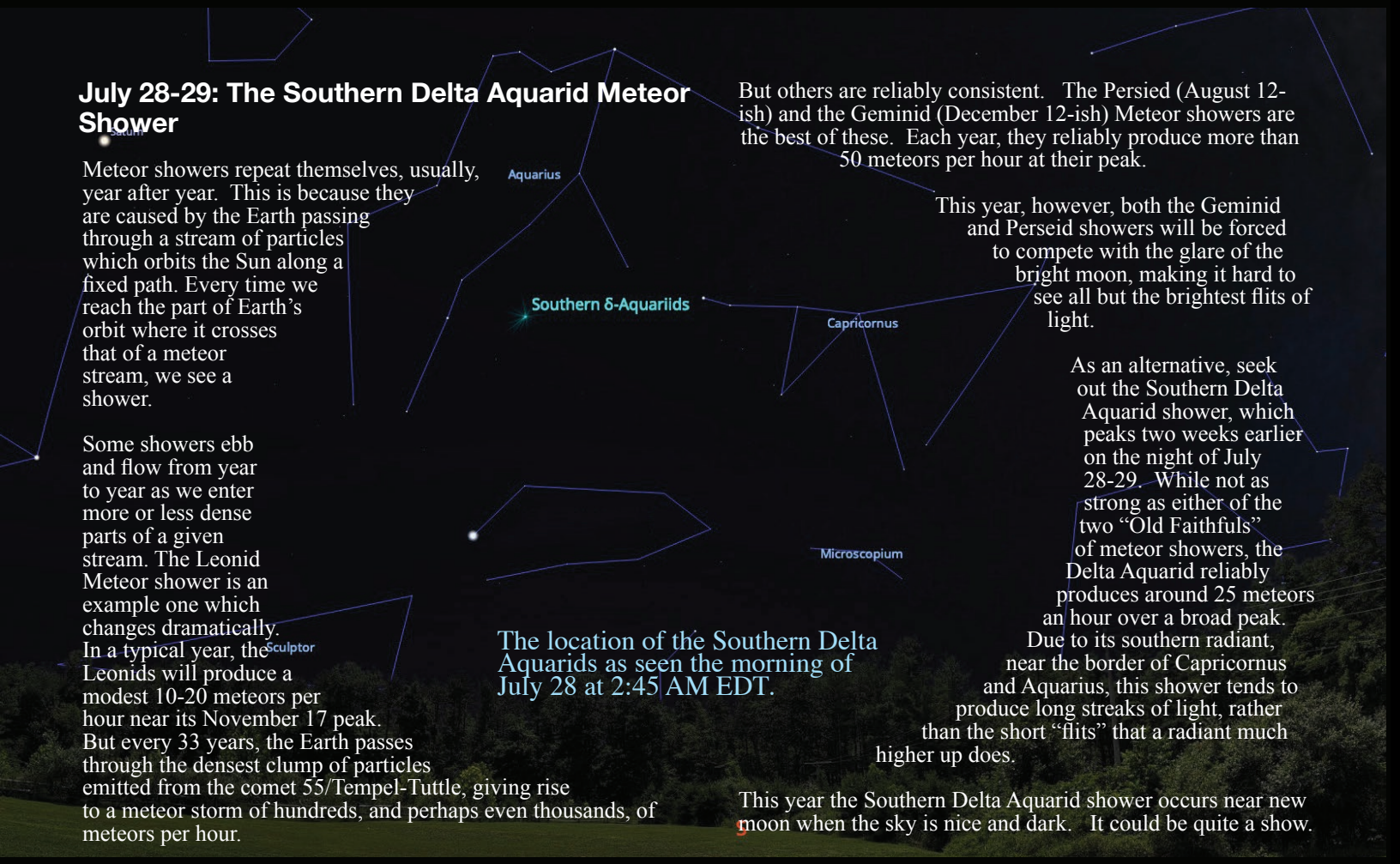


The paths of Saturn (blue) and Neptune (yellow) from late May through Mid-November. The similar "loop" in their path across the stars of Pisces is caused by our changing point of view of these worlds as Earth goes about the sun. Saturn, being closer, appears to make a larger loop.

July 28-29: The Southern Delta Aquarid Meteor Shower

Meteor showers repeat themselves, usually, year after year. This is because they are caused by the Earth passing through a stream of particles which orbits the Sun along a fixed path. Every time we reach the part of Earth's orbit where it crosses that of a meteor stream, we see a shower.

Some showers ebb and flow from year to year as we enter more or less dense parts of a given stream. The Leonid Meteor shower is an example one which changes dramatically. In a typical year, the Leonids will produce a modest 10-20 meteors per hour near its November 17 peak. But every 33 years, the Earth passes through the densest clump of particles emitted from the comet 55/Tempel-Tuttle, giving rise to a meteor storm of hundreds, and perhaps even thousands, of meteors per hour.



The location of the Southern Delta Aquarids as seen the morning of July 28 at 2:45 AM EDT.

But others are reliably consistent. The Persied (August 12-ish) and the Geminid (December 12-ish) Meteor showers are the best of these. Each year, they reliably produce more than 50 meteors per hour at their peak.

This year, however, both the Geminid and Perseid showers will be forced to compete with the glare of the bright moon, making it hard to see all but the brightest flits of light.

As an alternative, seek out the Southern Delta Aquarid shower, which peaks two weeks earlier on the night of July 28-29. While not as strong as either of the two "Old Faithfuls" of meteor showers, the Delta Aquarid reliably produces around 25 meteors an hour over a broad peak. Due to its southern radiant, near the border of Capricornus and Aquarius, this shower tends to produce long streaks of light, rather than the short "flits" that a radiant much higher up does.

This year the Southern Delta Aquarid shower occurs near new moon when the sky is nice and dark. It could be quite a show.

Space Mission Highlights in 2025

2025 is packed with robotic and, for the first time in a while, *manned* exploration highlights.

Here's what to watch for:

Europa Clipper and Hera Flybys of Mars: March

Mars will be a busy place this March as two separate missions will be making flybys.

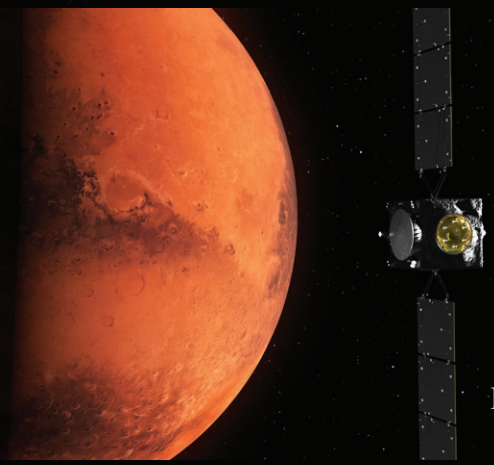
Europa Clipper March 1. The first of these is NASA's Europa Clipper mission, which will be using Mars's gravity to sling itself onwards toward an encounter with its ultimate goal, the Jupiter system and an intensive study of the ocean world Europa.

Mission planners will be breaking in the probe's thermal imaging cameras and other instruments by gathering data with them as the craft passes between 300 and 600 miles of Mar's surface.

Europa Clipper

Hera: Later on in March. ESA's flight center in Darmstadt, Germany will be busy imaging Mars as its Hera spacecraft passes by the planet on its way towards an encounter with the NASA-battered asteroid moonlet Dimorphos, which was impacted (on purpose) by the DART probe on September 26, 2022. Hera will ultimately be assessing how much of a change to Dimorphos's orbit about the larger asteroid Didymos the high speed impact made.

Along the way, however, Hera will be trying out its cameras on Mars, which it will image from a distance of 6,000 km, and Mars's smaller moon Deimos, which it will train its cameras on from a mere 1,000 km. That's the closest any craft has passed by that world to date. The data gathered will inform the planners of JAXA-DLR's Martian Moons eXploration (MMX) mission to the moons of Mars, due to launch in 2026.



Hera

Lucy in the Sky: April 20

NASA's Lucy mission has not one, but *seven* planned targets. The first of these, Asteroid (152830) Dinkinesh, it encountered on November 1, 2023. Images showed it to be a gemstone-shaped body with a small bi-lobed moon.

It will pass by its next target this. April 20. Asteroid (52246) Donaldjohanson is an aptly named target for this mission. Donald Johanson was the paleoanthropologist whose team discovered the fossil *Lucy,* a 3.2 million year old australopithecus afarensis, a species which is thought to be, if not a direct ancestor of modern humans, a close relative. In fact, Dinkinesh is also an apt name, being the Ethiopian name for the same fossils. (You'd think the mission leaders planned all this... hmm...)

Lucy is thought to be a fragment of an asteroid collision, which sprayed the asteroid belt with a family of asteroids known as Erigone.

After its flyby, Lucy will continue on its mission to Jupiter's Trojan Asteroids, a family of worldlets which are held in place by the gas giant's strong gravity, 60 degrees ahead of and 60 degrees behind its orbit. The mission will begin at Jupiter's L4 point, ahead of the planet. It will then fall inwards towards the sun and cross over to Jupiter's L5 point, behind the planet in its orbit.

This is an extraordinary mission which will, upon its completion in 2033, have given us close-up views of at least seven celestial bodies for the first time. (Or nine, if you count the two known binary asteroid systems that it will study.)

Asteroid Dinkinesh as imaged by the Lucy craft on November 1, 2023.

The Moon is Swarmed in 2025

NASA has put the moon in its sights and has planned at least five different robotic and orbital missions in 2025. These missions are collectively known as the Commercial Lunar Payload Services (CLPS) initiative.

For these missions NASA scientists are partnering with commercial space delivery services to conduct studies of the moon from orbit and on the surface.

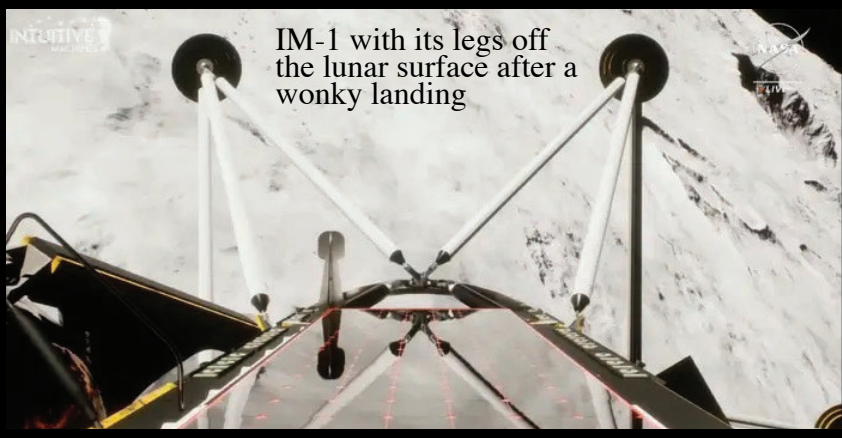
Two of these missions have already launched with only marginal success. The 2024 Pergrine Mission 1, to be delivered by the company Astrobotic, failed to land on the moon. Intuitive Machines Mission 1 was marginally more successful. This "proof of concept" mission to the south pole region successfully deployed six small experimental payloads. The craft itself, however, tilted over on landing and, with its communications systems impeded, was only able to return a small trickle of data, including a jarringly tilted landscape, from its payload.

Will upcoming CLPS missions be more successful? These companies have been generous in sharing data regarding their failures, which allows other CLPS mission planners to learn from their pioneering experiments.

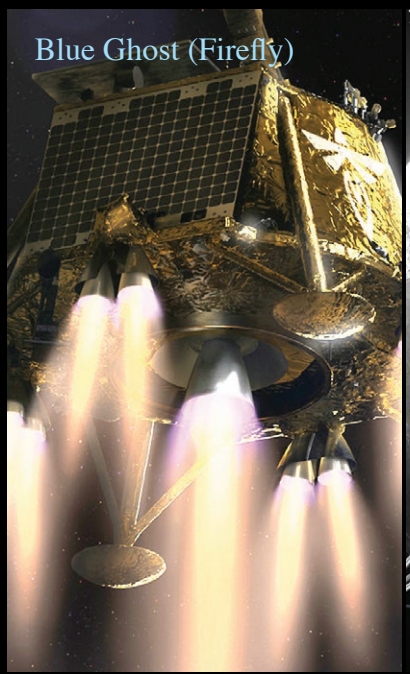
Here's what to look out for:

Blue Ghost Mission 1 (Firefly) will deliver a suite of ten experiments to the surface of Mare Crisium (the left "eye" of the man on the moon). It is due to launch sometime in mid-January (so watch out for it!)

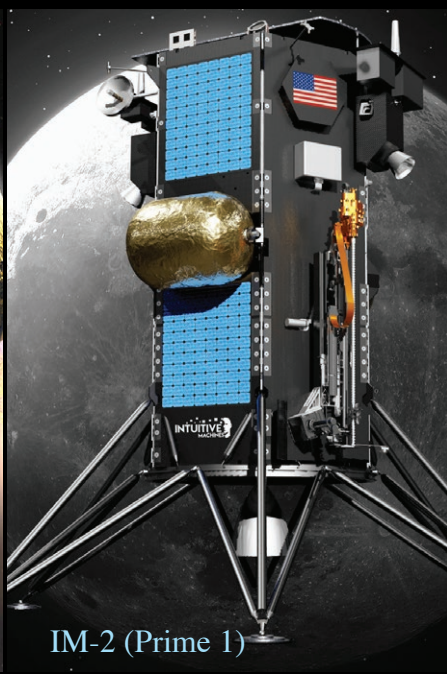
Intuitive Machines 2, (Prime 1). This mission will land near the south pole on a narrow ridge known as the Shackelton Connecting ridge. It is designed to drill into the



IM-1 with its legs off the lunar surface after a wonky landing



Blue Ghost (Firefly)



IM-2 (Prime 1)

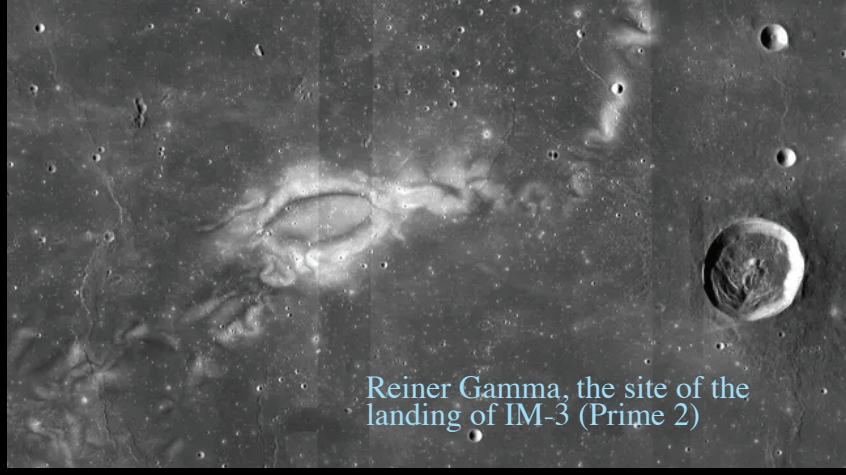
lunar regolith and search for water ice buried beneath the surface. If successful, it will be landing near to the planned site of the next manned landings sometime before the end of this decade. No specific launch date has yet been given for Prime 1, but it is slated to lift off in early 2025.

The same mission will launch **Lunar Trailblazer**, an orbital platform designed to detect ice from orbit.

Intuitive Machines 3 (Prime 2) will deliver an army of small robots designed to spread out and analyze the plasma environment of the moon. Collectively, these tiny robots are known as CADRE: The Cooperative Autonomous Distributed Robotic Exploration. It is due to launch in late 2025 and will land near a curious "coffee swirl" in the lunar surface (visible to backyard telescopes) known as Reiner Gamma. This region is thought to be rich in commercially valuable metals and minerals.

Blue Ghost Mission 2 is designed to land on the lunar far side. Like several other lunar missions, it will be searching for water on or near the lunar poles. At the same time, it will be taking advantage of the fact that it will be out of sight from mankind's blast of radio energy to conduct astronomical observations in radio light. It is slated to launch at the very end of 2025 and will land some time in early 2026.

Also: The ESA's Lunar Pathfinder is a communication system in Lunar Orbit, designed to provide data relay back to Earth for the increasingly busy lunar environment. It will be riding along with Blue Ghost 2.



Reiner Gamma, the site of the landing of IM-3 (Prime 2)

Blue Ghost Mission 2, with its radio antennae unfurled.

People go to the Moon! September

While this flotilla of commercial lunar exploration will produce striking images and compelling science (if the CLPS mission go a bit better than they have so far) their missions will be overshadowed by the most dramatic planned mission of 2025: Artemis II.

Artemis II, which is slated to launch in September, will mark the return of humans into the lunar gravity well. This will also mark the first exploration of deep space, higher than low Earth orbit, since Apollo 17 in 1972.

Over a 10-day mission, the Orion capsule, with its four occupants, will go around the moon one time on a "free return" trajectory- that is, a single loop around the moon which will require no additional rocket burns to bring it inexorably back to Earth.

Over the coming year the names of the four astronauts who are due to ride the Orion capsule into lunar orbit will undoubtedly become familiar to space enthusiasts *(left to right)*:

Jeremy Hansen: Canadian Space Agency (CSA) mission specialist, and the first non-American to leave low Earth orbit
Victor Glover: NASA pilot, and the first Black person to leave low Earth orbit
Reid Wiseman: NASA commander
Christina Koch: NASA mission specialist, and the first woman to leave low Earth orbit

Missions like this are extraordinarily difficult and setbacks and delays are common. However, if all goes well, we will be vicariously exploring the moon out the window of the Orion capsule this fall.

I can't wait.

Orion's Belt

by Tom Burns

During or after the holiday season, people often ask me why I don't tell stories from the Judeo-Christian tradition. Frankly, that tradition is not rich in star lore. Jews and Christians don't generally place their gods and heroes among the stars

Still, a notable constellation reference appears in the Bible's Book of Job. Job is upset with God because he has tried mightily to follow God's law, and all he's gotten from it is pain and poverty.

There seems to be no justice in the world, and Job doesn't hesitate to say so. In response, God asks Job, "Canst thou bind the sweet influence of the Pleiades, or loose the bands of Orion's Belt?" (Job 38:31-34, KJV)

We are at once reminded of God's power over the cosmos and its inscrutability. How can mere mortals understand the workings of God's mind or the complexity of the laws of nature God created?

Still, we can try. Seen in the light of modern astronomy, unfastening the belt stars of Orion is a tall order.

Just after dark right now, you can find Orion about halfway up to the top of the sky in the southeast. The three bright stars of his belt form an almost perfect straight line, the most recognizable star grouping in the heavens.

Virtually every culture in history has its own unique name for them. Early Christians saw the three Magi, who visited the Christ child soon after his birth.

In Polynesia, they were the "Three Canoe Paddlers." The Hindus called them the "Three- Jointed Arrow." To the ancient Chinese, they were "The Scale."

Western seafarers imagined a "Golden Yardarm. The French envisioned a "Rake," the Germans "Three Mowers," the Australians dancing "Young Men," the Laplanders a "Tavern," the Greenlanders "Seal Hunters," and so on.

To the Old Testament Jewish culture, they represented God's inscrutable power, as the passage from Job suggests.

The ancients saw the stars as unchanging, their positions and brightnesses established by the creator of the universe. They reflected the creator's power. Job had to learn that his human intellectual gifts were no match for God's, and the stars seemed a good way for him to learn.

The left star of the belt is called Mintaka, an Arabic word that means "Belt." It is the closest of the three stars at 1,500 light-years away.

At six trillion miles per light year, that's quite distant as far as bright, naked-eye stars go.

Mintaka's phenomenal energy output causes brightness in the sky. Minaka is a hot, young, blue star producing 20,000 times more energy than our day star, the sun.

But it's a piker compared to the middle star of the belt, a ferocious energy-producer called Alnilam, the "String of Pearls." Alnilam emits 40,000 times more energy than the sun and is one of the hottest stars known at about 80,000 degrees Fahrenheit.

Compare that to the sun's rather chilly 10,000 degrees. Alnilam is also the belt's farthest star at 1,630 light-years away.

The belt's right-most star is named Alnitak, "The Girdle." Its energy production is about midway between the other two stars at 35,000 suns. It is a bit closer to us than Alnilam at 1,600 light-years.

The three stars look bound together like the holes in a belt, but they aren't.

We know what Job could not. Orion's girdle is made up of stars located at remarkable distances from each other. If you stood on a planet orbiting Alnilam, you would see the other two stars on opposite sides of the sky. Their apparent closeness is an illusion created by our limited Earthly point of view.

I am writing these last lines on New Year's Day, and the time has come for New Year's resolutions. Here's mine — to learn from Orion's belt.

When people disappoint us, we often don't see things from their perspective. To gain any understanding, we must shift our perspective, just as we shifted our perspective to see the three stars' actual locations in the cosmos.

Therefore, I vow to try to see things from the perspective of those who seem to disappoint me. I will try to see them for what they are, not what I hoped them to be. I will judge my own failings from their perspective.

The three stars of the belt are moving away from each other at ungodly velocities. In the distant future, if humans survive to look up at the heavens, Orion's belt will have disappeared, its stars scattered to the far ends of the great deep.

From the Bible's point of view, only the Lord of the Heavens can "unfasten the belt of Orion." In fact, it appears to be happening now, but slowly and with immeasurable grandeur, as befits the creator of this vast and marvelous universe.

background image of Orion, centered on the three stars of its belt, by Brad Hoehne

Imaging the Ghosts of Long Dead Stars with Smart Telescopes

by Jason Hissong

Medium sized stars, like our sun, long-lived as they are, don't explode in a blaze of glory like their more massive-sized cousins when their fuel is used up. They shed their atmospheres out into space forming what is called a Planetary Nebula.

Planetary Nebula is somewhat of a misnomer as they are not planets at all, but only appear to be. The term originated because early astronomers thought that they looked like the planet Uranus because of their greenish color and because they appear round. For instance: William Herschel described them as resembling planets and Darquier de Pellepoix mentions that the Ring Nebula appeared "very dim but perfectly outlined; it is as large as Jupiter and resembles a fading planet".

Today of course, we know the true nature of this type of nebulae. Stars with one to eight solar masses end their lives as a planetary nebula.

All stars are a balancing act between the crushing force of gravity wanting to collapse the star in on itself, and the nuclear pressure of fusion occurring in their cores pushes back on the gravitational pressure.

The gravitational pressure is what causes hydrogen to fuse into helium. As the hydrogen fuel is used up, the core releases less energy to stop the force of gravity. This is when gravity starts taking over, further compressing the core and heating it up.

At about 100 million Kelvin, the core starts fusing the helium into carbon and oxygen. All the while, the outer atmosphere of the star starts to balloon out to form a red giant. This increases the luminosity of the star because of its larger surface area. At the same time the outer atmosphere cools.. Stars in this phase can lose 50 to 70 percent of their total mass from strong stellar winds.

Eventually, most of the atmosphere of the star gets blown away by the stellar winds, leaving behind a white dwarf. The ultraviolet radiation from the white dwarf causes the previously ejected atmosphere to ionize and glow, giving rise to the planetary nebulae that we see in telescopes.

Imaging Planetary Nebulae

Many planetary nebula are small and require steady skies and larger aperture. However, it is still fun to capture these dying stars using your smart telescope. The ZWO Seestar is an excellent choice for hunting down these nebulae because of the smaller pixel size. You can zoom in to capture a little more detail. In addition, it is fun to collect these fun objects in your astroimaging collection!

One of the nice attributes of a Smart Telescope, is that it is easy to set up and do imaging in an efficient manner. Similar to how I like to observe visually, I use one of the excellent observing manuals from the Astronomical League to help find things to image and observe. One of these is the Planetary Nebula Observing Guide.

Many planetary nebula are bright enough, especially using the included light pollution filter in the Seestar, that their light can pierce through the light pollution to get adequate results. Some are larger, more diffuse, and require darker skies. Presented here is a small sample of planetary nebula to chase down and image, even in light polluted skies.

Wintertime offers fewer planetary nebulae that the summertime, but I have imaged an interesting one: NGC2438. It is a planetary nebula that appears to be in the open cluster of M46. Based on

radial velocity studies, the planetary nebula is not associated with the surrounding cluster. It is located about 1,370 light years away (whereas M46 is located 4,920 light years away) so it is a foreground object based on our perspective here on Earth. Located in the constellation of Puppis, it is quite visible in amateur telescopes, it is a fun object to observe and image.

In summer skies I have imaged:

NGC7008, the Fetus Nebula
This is a fascinating planetary nebula, NGC7008 does look like a fetus. It illustrates that planetary nebula can take on interesting shapes. It is relatively small, only 1.4′ by 1.1′ and not too bright (+12.0). Because of its size, it is easy to capture using your smart telescope with your LP filter although more difficult with a telescope.

The Helix Nebula
Discovered by Karl Ludwig Harding in 1824, the Helix Nebula is located about 655 light years from Earth. Even though it has a similar magnitude of M27 (+7.3), it is more difficult to see in light polluted skies because of its larger size. When an object of similar magnitude is larger, that brightness is spread out over a larger area. You will need darker skies to get the best results.

...and many others, such as the familiar Ring Nebula (M57), The Dumbell Nebula (M27) and the more obscure NGC 7048, NGC 6894 and NGC 7094.

The next time it is clear, and you are looking for something to image, grab a cup of coffee, an AL Planetary Nebula List, and go capture the last vestiges of stars from long ago: The Ghost of Long Dead Stars.

The CAS Holiday Party, December 14, 2024

Members of the CAS slowly trickled in around 6:00 PM and, what initially looked to be a modest turnout grew into an overflow crowd at the annual CAS Holiday Party.

The long table along the west side of the library was filled from end to end with dishes that members brought. The end table under the portrait of Hiram Perkins held ham (provided by Jason Hissong) and other meats. Finally, the table on the side of the room with the bookshelves had many deserts.

After members were largely through their dinners, and had gotten settled in, CAS president Charles Lusco opened the business meeting. The first order of business was ushering in the new suite of officers with an uncontested election. Here are the results (provided by Jim Varadi):

Roster of Officers and Trustees for 2025

President - Charles Lusco
Vice President - Brad Hoehne
Secretary - Bethany Roten
Treasurer - Alex McCarthy
1 Year Trustee - Rajendra Hemant
2 Year Trustee - Isaac Cruz
3 year Trustee - Jason Hissong
4 year Trustee - Ben Roten
Past President Trustee - Mark Peter

Congratulations and good luck to all these folks!

Awards and thank yous were given for the presenters of lectures at monthly meetings and for those who submitted features to this newsletter.

After this, I (Brad Hoehne) formally announced that I would be stepping down as editor of the Prime Focus after 14 years. Charles surprised me with an award for this long service to the club. Ben and Bethany Roten have agreed to take up the task, so the PF will live on. Thank you both!

Astro Jeopardy returned after a pandemic hiatus. The three victims (er... particpants) were: Ben Roten, Mark Peter and Jason Hissong. All three were neck and neck for most of the game. Jason Hissong, for the first time in many tries, finally claimed victory.

A video of the meeting, and the Astro-Jeopardy! event can be seen on YouTube.

Images provided by Alex Jenson

CAS Outreach, January 25

Highbanks Metro Park would like to have a public outreach program on Astronomy in partnership with Columbus Astronomy Society on Saturday, January 25 from 5:30 PM to 7:30 PM at Highbanks Meadows.

We plan to have few people from CAS bring their scopes and show public night sky objects and talk about them. Mars will be rising in the east at this time and will make a compelling target for scopes. Jupiter and Venus will also be well situated.

If you'd like to help out or have questions, email: outreach@columbusastronomy.org

The Next CAS Meeting, January 11

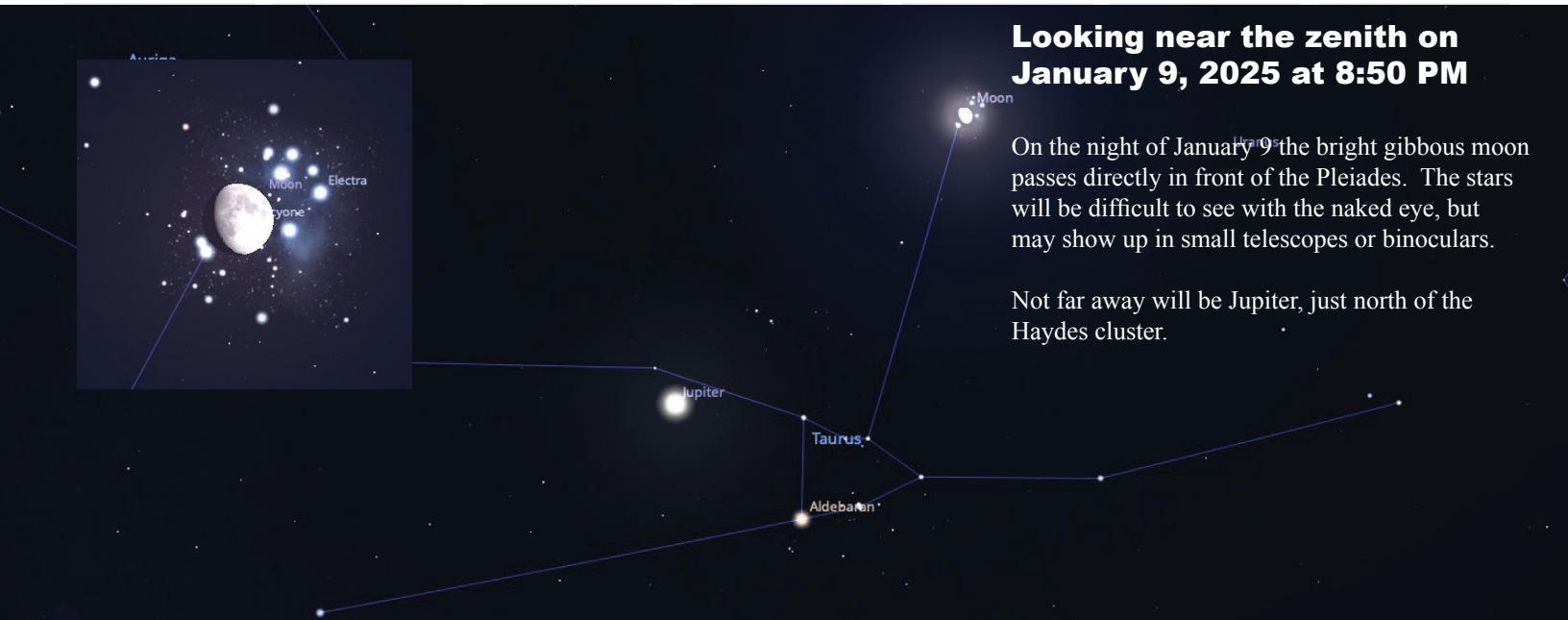
The Speaker for the next meeting is **Professor Sultana Nahar**, who gave an outstanding talk on the Sun and the presence of iron in its atmosphere at the March 2024 meeting.

This month, the title of her talk is:

"The search for clues of life in exoplanets"

CAS Calendar: January - February 2025

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
29	30	31	January1	2 Leslie Copus Peltier, 1900	3 Quadrantid Meteor Shower Peaks ~ 40 ZHR	4 Earth at Perihelion, 91,405,994 mi
5	6	7	8	9	10 Venus at Greatest Eastern (evening) Elongation	11 **CAS Meeting 8:00 PM @ Perkins**
12	13 17:26 EST Moon Occults Mars, 20:44 EST	14	15 Mars Opposition	16 Jill Tarter, 1944	17	18
19	20	21	22	23	24	25 **CAS outreach at Highbanks MP**
26	27 Beatrice Tinsley, 1941	28	29	30	31	February1
2	3 Cross-quarter Imbolc	4 Clyde Tombaugh, 1906	5	6	7	8 **CAS Meeting 8:00 PM @ Perkins**
9	10	11	12 08:53 EST Frank Washington Very, 1852	13	14	15 **CASIS 1:00 PM @ Perkins**
16	17	18	19	20	21	22
23	24	25	26	27	28	March1



Looking near the zenith on January 9, 2025 at 8:50 PM

On the night of January 9 the bright gibbous moon passes directly in front of the Pleiades. The stars will be difficult to see with the naked eye, but may show up in small telescopes or binoculars.

Not far away will be Jupiter, just north of the Haydes cluster.

The Prime Focus is the monthly newsletter of the Columbus Astronomical Society, a not-for-profit group of amateur astronomers interested in the night sky. Information can be obtained by writing to the address or emails listed below. Society members build telescopes, observe and image the splendors of the universe, contribute to scientific research and educate the publics at public programs around Ohio and at Perkins Observatory.

CAS web site: **http://www.columbusAstronomy.org** - application and renwal through PayPal available

President: **Charles Lusco**
president@columbusAstronomy.org

Vice President: **Brad Hoehne**
vicePresident@columbusAstronomy.org

Secretary: **Bethany Roten**
secretary@columbusAstronomy.org

Treasurer: **Alex McCarthy**
treasurer@columbusAstronomy.org

Prime Focus Editor: **Brad Hoehne**
primeFocus@columbusAstronomy.org

Outeach Coordinator: **Joe Stark**
outreach@columbusAstronomy.org

Mail To: **Columbus Astronomical Society**
P.O. Box 163004
Columbus, Ohio 43216

Columbus Astronomical Society Membership Application/Renewal Form

Please indicate: ☐ new member ☐ membership renewal
☐ magazine subscription ☐ magazine subscription renewal

I have checked the class of membership and magazine/s subscription/s desired and enclosed a check made payable to the Columbus Astronomical Society for:

☐ Annual Regular Membership:	$25 _____
☐ Annual Student Membership (under 18):	$10 _____
☐ Annual Family Membership:	$35 _____
☐ Annual Patron Membership:	$50 _____
☐ Lifetime Membership :	$500 _____

☐ Tax Deductable donation to CAS _____
☐ Tax Deductable Donation to Perkins Observatory _____
☐ **Total** _____

Please Print

Name _____

Address _____

City _____ State _____ Zip _____

Phone _____ E-mail _____

Today's Date _____