SkyWAAtch

The Newsletter of Westchester Amateur Astronomers

March 2025

The Rosette Nebula by Steve Bellavia

The Rosette (Caldwell 49) is a reflection and emission nebula in Monoceros. See page 25 for details.

Our club meetings are held at the David Pecker Conference Room, Willcox Hall, Pace University, Pleasantville, NY, or on-line via Zoom (the link is on our web site, www.westchesterastronomers.org).

WAA March Meeting

Friday, March 14 at 7:30 pm

NASA's Commercial Crew Program and the Role of Robotics

Carol Higgins
NASA/JPL Solar System Ambassador

In this presentation we visit the International Space Station, the world's premier space science research laboratory. We'll take a look at what it's like to live and work onboard the station, review the crucial services provided by NASA's Commercial Crew Program, and discuss some examples of the use of robotics to assist astronauts and ground teams.

Call: **1-877-456-5778** (toll free) for announcements, weather cancellations, or questions. Also, don't forget to visit the WAA website.

WAA Members: Contribute to the Newsletter!
Send articles, photos, or observations to
waa-newsletter@westchesterastronomers.org

Editor: Larry Faltz
Almanac Editor: Bob Kelly
Editorial Consultant: Scott Levine
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Also In This Issue

WAA April Meeting

Friday, April 9 at 7:30 pm

WAA 40th Anniversary Celebration

A special evening of commemoration, merriment, camaraderie, prizes, awards and refreshment. More information on page 3.

Starway to Heaven

Ward Pound Ridge Reservation, Cross River, NY

Saturday, March 22 (Sunset 7:11 p.m. EDT)
Saturday, March 29 (Sunset 7:19 p.m. EDT)
Weather permitting.

Westchester Amateur Astronomers

New Members

Vincent Ferret	Dobbs Ferry
Lia Kelerchian	Bronx
Linda Krueger & Sebastian Teunissen	Irvington
John McMenimon	Yonkers
Michael Presto	Port Chester
Jerry Stern	Katonah

Renewing Members

Linda Biderman	Plainview
Robert Brownell	Peekskill
Brian Carroll	Ossining
Joseph Depietro	Mamaroneck
Louise Gantress	Mt. Kisco
Patricia Gelardo & Frank Antinarella	Mamaroneck
Eli Goldfine and Family	Larchmont
Robbins Gottlock	Sleepy Hollow
Drexel Harris	Jamaica
Frank Jones	New Rochelle
Geoffrey McFadden	Stamford
Hans Minnich	Mahopac
Jonathan Suarez	Port Chester
Kathleen Thrane	Greenwich
Joseph Trerotola	Bethany

CELEBRATING 40 YEARS
Westchester Amateur Astronomers

Friday April 11, 2025

David Pecker Conference Room
Willcox Hall
Pace University
861 Bedford Road
Pleasantville, NY
(Entrance 1)

WAA members and their families and guests are cordially invited to attend the Westchester Amateur Astronomers 40th Anniversary Celebration!

6-7 pm	Social Hour & Dinner
7-8:30 pm	Program celebrating the last 40 years, with special guests and cool stuff to see and do!

We'd love to see you at the party!

If attending in person, please **RSVP by March 28th** to Eva Andersen at: andefam55@gmail.com

LET'S PARTY!

FAQs:

Is there a fee? No. This is a member event; feel free to bring family members or a guest. Just let us know when RSVPing.

Will food be served? Yes! Serving crudité, cheese & crackers, wedge sandwiches (meat & cheese/vegetarian), fruit, & birthday cake. Accommodation can be made for gluten-free and dairy-free. Let us know with RSVP by March 28th.

Can I consume alcohol? That's a no; it is against Pace University's classroom policy.

Need assistance? The lecture hall and restrooms are all-bodied accessible.

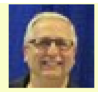
How about pets? No pets, sorry. Only registered service animals are welcome in Willcox Hall.

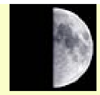
Will there be door prizes? Yes! Everyone in attendance (in-person & online) will be entered to win.

Will there be a Zoom link? Yes. All members will receive the link in advance.

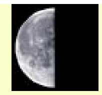
Think of something we didn't cover? Email Eva.

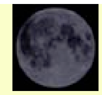
ALMANAC For March 2025
Bob Kelly, WAA VP of Field Events


Bob Kelly


1Q Mar 6

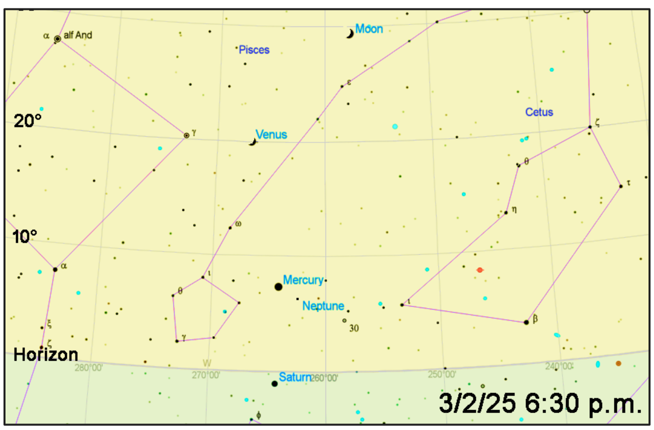

Full Mar 14


3Q Mar 22


New Mar 29

The top two events this month are the total lunar eclipse between midnight and dawn on the 14th and the partial solar eclipse at sunrise on the 28th. More about those on page 5.

There is a multi-object event on the evening of the 2nd when the Moon overhangs Venus and Mercury, best seen about 45 minutes after sunset. If the weather for the 2nd doesn't look good, try in the 1st when the Moon will hang with Venus above and Mercury below. Look out toward the western horizon. The pretty sight with the unaided eye can be captured with a wide-angle camera or maybe even a cellphone. Take a look in binoculars or a telescope to compare the crescent phases of the Moon and Venus. How similar are they? To see Mercury's gibbous phase, you'll need a telescope at high power, since the planet's disc will be only 6 arc seconds wide, one-eighth the apparent diameter of Venus.



Venus will spend early March diving toward Mercury, as if it was a bird of prey swooping down to snag the innermost planet. Mercury will reach greatest elongation from the Sun on the 8th, but it will dim from magnitude -1 on the 1st to 0 on the 10th. While Mercury is moving closer to Earth, it will be less illuminated as the month goes on. Venus and Mercury will be within a few degrees of each other for several days around the 11th. With Mercury quite a bit dimmer and the pair so low in the sky, you may need to use Venus to find Mercury in binoculars. It will be to Venus' left. Then, Venus beats Mercury to conjunction with the Sun on the 22nd. Mercury follows two days later.

Venus will give the Sun a wide berth during its conjunction. For several days around conjunction, Venus will be to the upper right of the Sun after sunset and to the upper left of the Sun after sunrise. You'll need clear horizons to the east and the west to make this double observation.

Mars spends the middle of March in the heart of Gemini. The Moon comes by, perhaps offering to do CPR, on the 8th. Mars has dimmed to magnitude 0, still an impressive sight in the middle of the Twins. By the end of March, Mars will have drifted over to the right hand of the conjoined twins, dimmer by half a magnitude than it was at the beginning of the month.

Jupiter is still hung up on the horns of Taurus the Bull, outshining the stars at magnitude-2.2. It sets about midnight. Shadows of two of its moons show up on the planet's cloud tops on the 4th and the 11th.

Saturn is outta sight! It reaches conjunction with the Sun on the 12th. Neptune is also in conjunction with the Sun on the 20th.

Uranus is still drifting among the stars between Aries and Taurus. At magnitude +5.8, it's worth a look in binoculars or a telescope before it disappears into the Sun's glare late next month.

Spring ahead! We shift to daylight savings time at 2 a.m. on the morning of 9th. The Vernal Equinox occurs at 4:59 a.m. EST on the 20th.

Sorry you can't see the potentially menacing object 2024 YR4, aiming to arrive in the general vicinity of Earth on December 22, 2032. It's so faint, magnitude +24, that near-earth asteroid hunters are planning to use the James Webb Space Telescope to improve the calculation of its orbit, which is showing a diminishing chance of hitting the Earth or Moon in 2032 or on future passes in December 2039 and 2047.

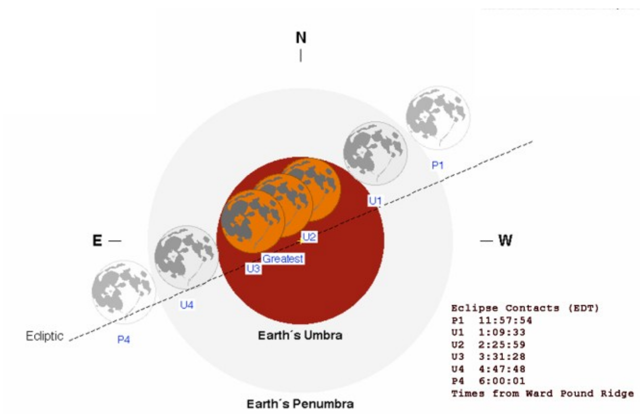
The International Space Station is visible in the morning until the 7th, and in the evening from the 10th through the rest of the month. China's Tiangong Station is visible in the morning through the 3rd and in the evening staring on the 18th.

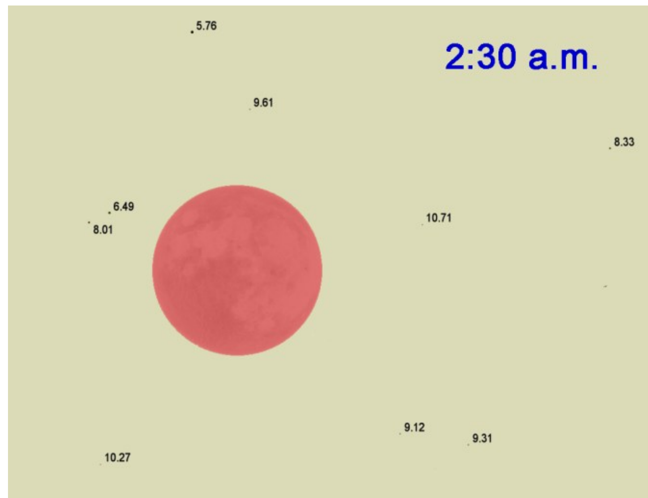
March Eclipses

Lunar Eclipse March 14th in the "wee hours"

Here's how you can watch the post-midnight total lunar eclipse early Friday morning, March 14th.

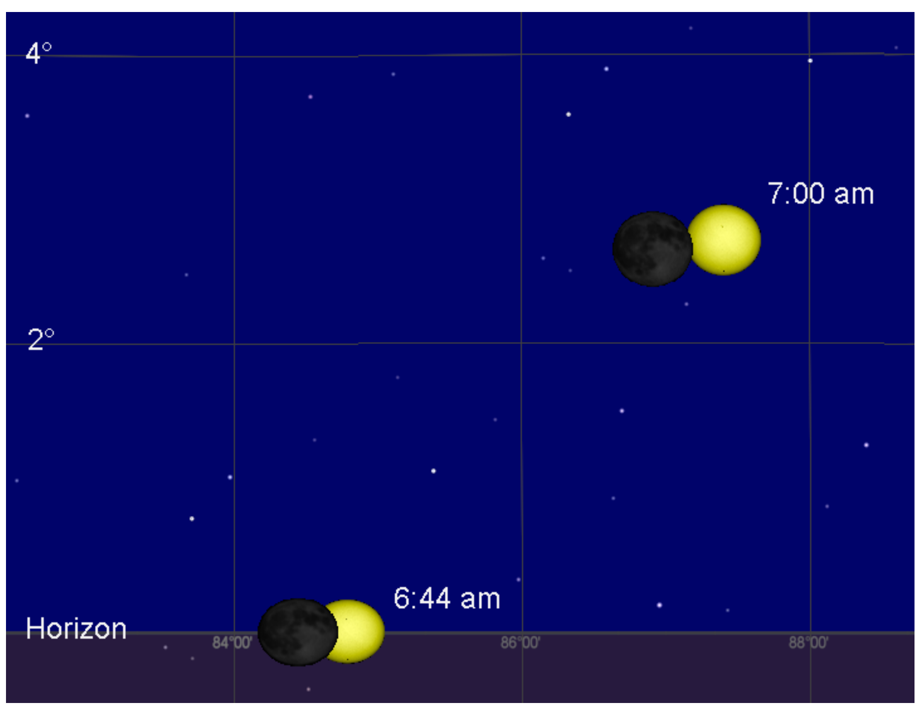
The Moon will be entirely in the Earth's umbral shadow for 66 minutes, between 2:26 a.m. and 3:32 a.m. EDT. Since the Moon will be about half-way up in our southwestern sky during totality (altitude 42° at 3:00 a.m.), you may have to get out from under your home's overhang or eaves to get a look at the eclipse. Binoculars will enhance the view. Look for the color shadings on the Moon. If you are outside for the penumbral phase of the eclipse, check the stars nearby in Leo to see if more of them become visible as the Moon is dimmed by the Earth's Shadow. The diagram below may help you.





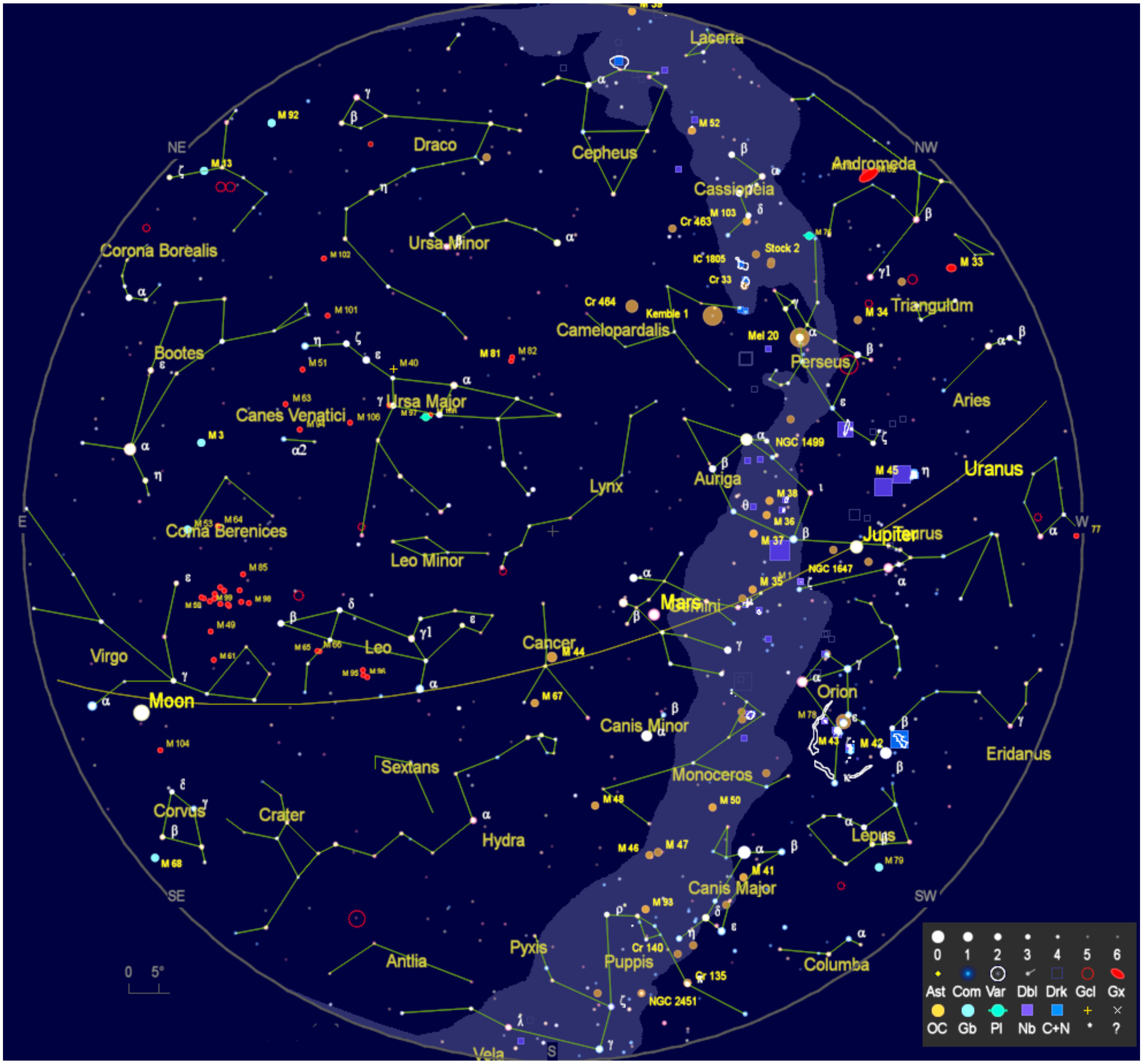
Solar Eclipse, at dawn on Saturday, March 29

There are two partial solar eclipses in 2025, but neither are favorable for viewing from Westchester. On March 29th, the Moon will cover 93.76% of the Sun at maximum eclipse, but that will occur half an hour before sunrise, which for us is at 6:41 EDT. We'll only see the Moon take a relatively small bite out of the Sun (but it's still a bite!). The eclipse ends at 7:05 with the Sun just 3½ degrees above the horizon, almost due east. You will need appropriate filters for your telescope or camera to view or image the eclipse.



A partial eclipse on September 21, 2025 will only be visible in the South Pacific, New Zealand and Antarctica.

Sky Map for March 2025



The map above shows the night sky from Westchester at 10 p.m. on March 15. Solar system objects will be in similar positions, except for the location of the Moon, at 10:45 p.m. on March 1 and 9 p.m. on March 31.

Join the WAA Discord Server

Discord is an app (iOS, Android, Windows) that will vastly enhance communication within the club and increase the value of your membership. It's free.

Join the "Office Hours" Discord chat hosted by WAA President Jordan Webber every other Wednesday at 7:00 p.m.

For more information, go to this link: https://is.gd/WAADisc

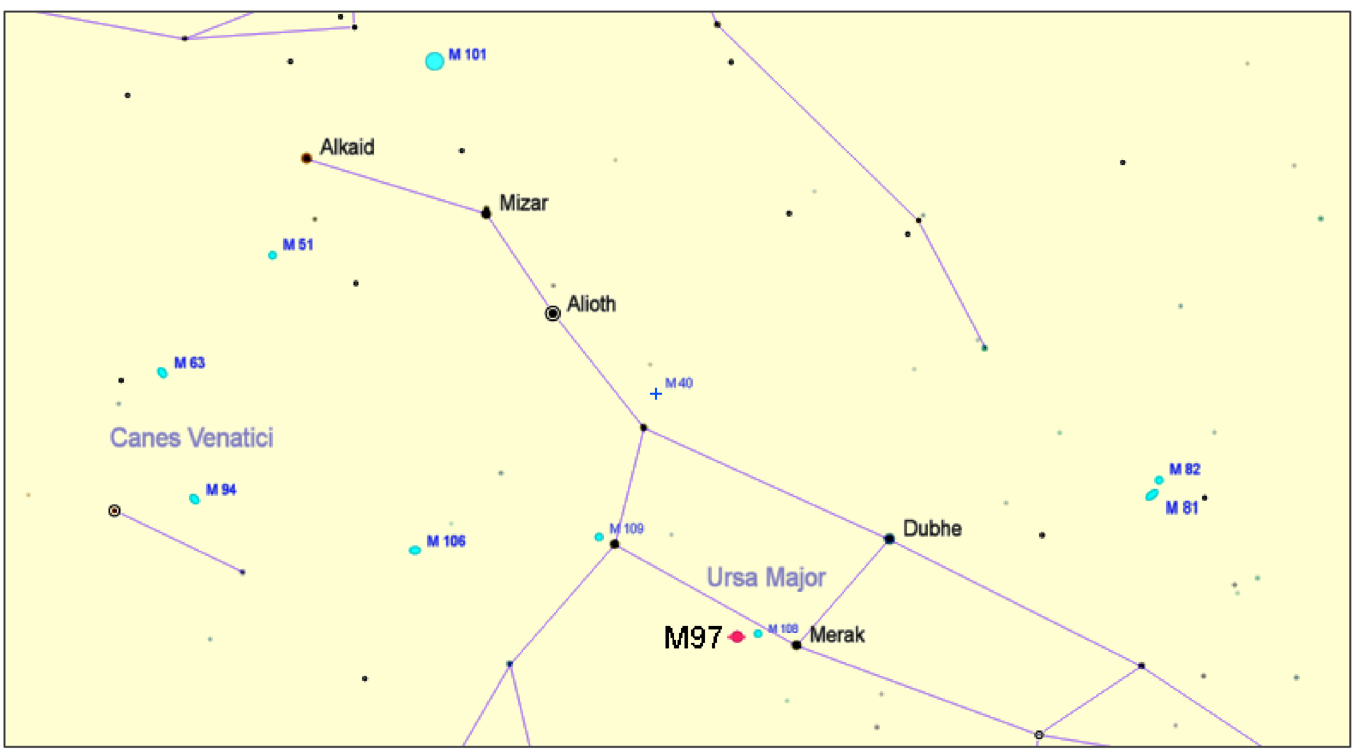
Deep Sky Object of the Month: Messier 97

Messier 97	
Constellation	Ursa Major
Object type	Planetary Nebula
Right Ascension J2000	11h 14m 47.734s
Declination J2000	+55° 01′ 08.50″
Magnitude	9.9
Size	3.4′ x 3.3′
Distance	2030 or 2800 LY
NGC designation	NGC 3587
Common Name	Owl Nebula
Discovery	Pierre Méchain, 1781

Most of the well-known planetary nebulas are located near the plane of the Milky Way, but the Owl hangs out among the Great Bear's galaxies. Although it's listed as magnitude 9.9, it has a relatively low surface brightness. In a dark sky, Stephen Jay O'Meara says a 4-inch scope can show it, and he even claims to have seen it from Hawaii with 7x35 binoculars. In Westchester it will take a good bit more aperture to see it. Observing M97 will benefit from averted vision. Imaging is fairly easy, however. Lord Rosse gave it the appellation "Owl" for its appearance in his famous 72-inch "Leviathan of Parsonstown."

Visibility for Messier 97			
2200	3/1 (EST)	3/15 (EDT)	3/31 (EDT)
Altitude	61°38′	60° 56′	69°19′
Azimuth	47°44′	48° 04′	39°49′

In the era of LED lighting, visual deep-sky filters have lost much of their value, but if you have a "light pollution filter" you should try it to increase contrast. If your scope is 8" or larger, try an OIII filter. You will certainly need this filter to make out the "eyes." Rod Mollise, in *The Urban Astronomer's Guide* (Springer, 2006), claims to have seen M97 from an urban area with a 60-mm scope and an OIII filter, but that was long before LED street lights cursed our skies.



Another Movie Telescope: The Venetian Affair

This 1966 film is typical of the slightly gritty spy movies (distinguished from the silly spoof spy movies that we've highlighted in this space before) that flooded theaters in the 1960s after the success of early James Bond. It stars Robert Vaughan as a hard-drinking newspaper photographer who is sent from New York to Venice to investigate a nuclear disarmament conference that was sabotaged. It just happens that he is an ex-CIA agent and it just happens that the guy in charge of the official investigation (Ed Asner) was the one who kicked him out of the agency. Vaughan's ex-wife (Elke Sommer) just happens to have been a Russian agent, and of course it just happens that she shows up in the middle of the movie. Among other notables in the cast for a few scenes are Boris Karloff and Luciana Paluzzi (we do love her even though she was the Bad Girl in *Thunderball*).

In this scene, Vaughan, on his way to retrieve something from Sommer's apartment, is spied on by one of his adversaries. We get to see a small Japanese refractor for a few seconds. It's typical of instruments from the late 1950s and early 1960s, usually well-made with decent optics, but rather small for general astronomical use. Many were 60-mm but this one looks like it might be 50-mm; we've even seen 42-mm models.

The star of this otherwise forgettable movie is not Robert Vaughan, who comes from the Robert Stack-Keanu Reeves school of wooden acting, but Venice, where the movie was filmed. It's not quite the love letter to *La Serenissima* that we get in *Casanova* (2005), but we enjoyed seeing familiar places in our favorite city. ■

The Astronomer at the Museum: Wedgwood Medallion of William Herschel

Josiah Wedgwood founded his eponymous ceramics company in 1759 and it continues to operate to this day. His goal was to become “Vase Maker General to the Universe.” His most recognized product was jasperware, white details on a dark background, most commonly a distinct robin’s egg blue that makes his work instantly recognizable.

Wedgwood established his factory in Staffordshire, in what is now Stoke-on-Trent. It was a pottery-making center and the entire region is now known as The Potteries. The English soccer team Stoke City F.C. is nicknamed “The Potters.”

In 1782, the company made a medallion to honor William Herschel, who had discovered Uranus on March 13, 1781, making him instantly famous throughout England and Europe. Several editions were struck over the next few years. They are part of a series of cameos of "Illustrious Ancients and Moderns," many of whom were British royalty and nobility. In addition, Wedgwood was an abolitionist and his 1787 medallion “Am I Not a Man and a Brother?” showing a chained slave pleading on his knees, was widely reproduced and apparently was highly influential. The British abolished slavery throughout the Empire in 1833.

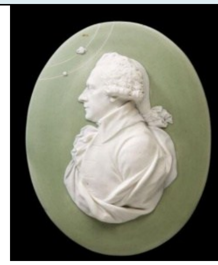

Metropolitan Museum of Art

All but one of the Herschel medallions I found show the musician-astronomer from his right side. Most also show Saturn and Uranus in their orbits (not, of course, to scale). Below, the name HERSCHEL is inscribed, although some versions have “DR W HERSCHEL.” In the majority of the versions the two planets are above his forehead on the oval, in some they are lower, and in some they are absent. It also appears that there are at least two sizes, about 10.5 cm high and 13 cm high, although some of the heights given may include frames when those are present.

We don’t have a count of how many were struck, but there were probably quite a few. They were popular in their day. The medallions are now found in a number of museums and of course some are in private hands.

The Metropolitan Museum of Art’s example is in a gilt frame. It was purchased from a collector in 1942. I’ve never seen it on display. The Fogg Museum at Harvard has a green one with a label on the back giving details of its manufacture and prior ownership. The Boston Museum of Fine Art (BFA) also has a green one with a bow on top of the gilt frame to act as the bail (attachment loop). The British Museum has two, both blue with gilt frames, similar to the Met’s.

The Victoria and Albert Museum in London has six of them, each slightly different except for a second copy of accession #WED.TN.5328, on a green jasper background without the planets. A wood-framed version (accession #465-1903) seems to be on a darker jasperware ground. The two planets are not visible, perhaps cut off by the frame or absent altogether; the photo has a reflection making it difficult to be sure. Two other versions in their collection are on a green ground. One of them shows Herchel from the left side. This one was probably based on the bust by Lochée (see below).

Herschel Medallions in the Victoria & Albert Museum, London				
				
465-1903	WED.TN.5327 & 28	WE.7980-2014	4956-1901	1488-1855

Florida International University, of all places, has a Herschel medallion that came from a decorative arts collection, part of an endowment of their College of Law. The online description states “Blue dipped jasper oval medallion in high white relief of Sir William Herschel (the astronomer) on blue field; lines depicting sun, moon and stars in upper right corner.” There’s a slight white dot opposite Herschel’s chest, but I don’t think it’s either the Sun or the Moon, and its Saturn and Uranus that are shown, not stars.

Florida International University

There is a photo on the internet, most likely taken by a museum visitor, labeled *“Medallion of John Frederick William Herschel*, Josiah Wedgwood and Sons, c. 1781, Jasperware, Honolulu Museum of Art, accession 1068.1.” The “John” is in error, John Herschel being William’s son, a famous scientist and astronomer in his own right. The Honolulu Museum does not list this object in its online catalog. If it’s really there, one wonders how it got all the way to Hawaii. There is also one in the Birmingham (Alabama) Museum but there’s no image on their web site.

Honolulu Museum of Art (?)

We have online reports of four auction sales of the medallion. One sold at Christies in London in 1991 for £209. One identical to the FIU medallion sold at Bonham’s, also In London, in 2007 for £960. Two years later, a version (the one pictured at the top of this article) sold at Bonham’s for £660, and another sold there in 2012 for £562.50. A light green background version in a rather extravagant oval wood frame (made by a framer in West Lawn, PA, as evidenced by a label on the back) was sold at auction by the Potomack Company, Alexandria, VA, on September 30, 2021 for just $225.

The portrait of Herschel was created by the prolific English sculptor John Flaxman, who in his early days worked for Wedgwood, although some of the catalogs, Harvard and BFA for example, list French sculptor Charles Lochée as the artist. The left-facing example in the V&A’s collection is certainly Lochée’s work. Information from London’s National Portrait Gallery tells us that,

> There is some doubt about the exact date of this profile. Caroline Herschel's inventory lists it as 'Medallion of Wm H. by Flaxman of 1782' (Mrs John Herschel, *Memoir of Caroline Herschel*, 1876, p 349 though she admits her uncertainty about dates). The Royal Astronomical Society and other later versions are clearly dated 1783 and incised: *FLAXMAN* on the truncation. Sir William Watson seems to put it shortly before the date of his letter to Herschel, Christmas Day 1784: 'I have got one (& I could procure but one) medallion of you, which I have presented to Sir Joseph [*Banks, President of the Royal Society, undoubtedly—Ed.*], who has put it into a frame & hung it up over the fire-place, in the inner room of his Library - The ground is blue - tho' I don't think it by any means a bad likeness, I wish however it to be more so - They have told the History of the discovery of the G. Sidus [*the Georgian Sidus (star),*

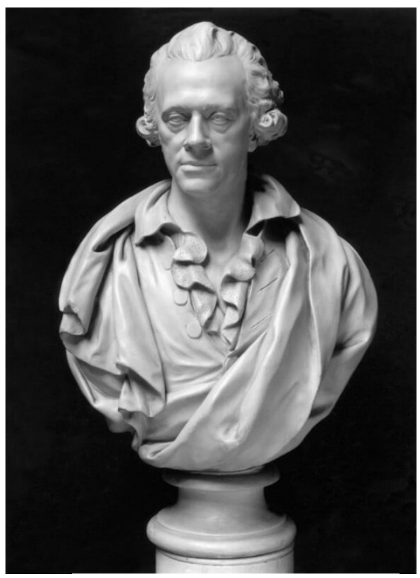
Auctioned by Potomack Company 2021

> *Herchel's original name for Uranus—Ed*.] very ill, with their two sections of Circles & a radiant Star on the inner one - I have written to Wedgewood [*sic*] in hopes he would amend it, & have further advised him to have the two Circles further apart from each other (by removing the inner one) & to put a round ball on the outward & a Saturn on the inner Circle - I hope he will attend to this …' (*RAS Herschel MSS.W.1/13(T) - 2/1.4*).
>
> It looks as though a profile was modelled by Flaxman in 1782 or 1783, a variant made on a smaller ground with the two circles added, and a third made by Lochée in 1787 with the circles further apart and a ball and Saturn added as suggested by Watson…. Flaxman's medallion was immediately pirated and published as an anon. line engraving in *The European Magazine*, 1 February 1785, and a drawing of it by Madame Dupiery was engraved by Thoenert for a French paper, also without acknowledgement.

London's National Portrait Gallery holds the most famous portrait of William Herschel, an oil by Lemuel Francis Abbott painted in 1785. The Gallery also has a small glass paste medallion of Herschel made by William Tassie after another portrait of the astronomer, but this one is in his later years, showing him more mature and portly (it's dated "after 1814"; Herschel died in 1822 at the age of 83). I think he looks rather like Sir Winston Churchill.

The National Portrait Gallery also displays a plaster cast of the wonderful 1785 bust of Hershel by Charles Lochée. The sculpture is 32½ inches high.

Sir William Herschel by William Tassie, after Friedrich Rehberg, glass paste medallion, after 1814



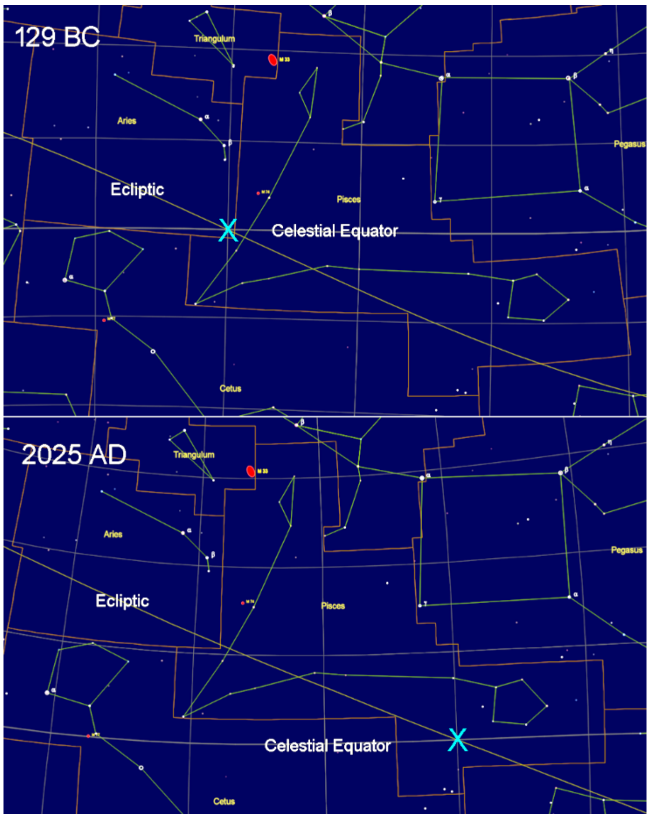
Sir William Herschel
by John Charles Lochée
plaster cast of bust, 1787
32 1/2 in.high

Sir William Herschel
by Lemuel Francis Abbott
Oil on canvas, 1785 30 in. x 25 in.

The Royal Astronomical Society has, since 1974, awarded the Herschel Medal "for investigations of outstanding merit in observational astrophysics. This medal is awarded for a single investigation, or a series of closely linked investigations, of outstanding merit (including emerging areas)." The award criteria are designed so that research by astrophysicists early in their careers can be acknowledged. The medal itself has portraits of both William and John Herschel but doesn't resemble the Wedgwood plaque (although William's face, on the left, may have been taken from Lochée's sculpture). Among the winners whom we've mentioned in *SkyWAAtch* over the years are Arno Penzias and Robert Wilson (1977), Gérard de Vaucouleurs (1980), William Morgan (1983) and Jocelyn Bell Burnell (1989). (LF) ■

The Wobbling Earth — Larry Faltz

Spring comes in the Northern Hemisphere when the Sun reaches the intersection of the ecliptic, its path through the sky, and the celestial equator, the projection of Earth's equator out to the cosmos. Cold days become memories, at least for the next half year. Plants bloom, farmers sow, birds fledge and warmth returns. Life is affirmed. The baseball season starts.



The blue X marks the position of the First Point of Aries. The stars are actually staying in the same place: it's the coordinate system that is shifting.

Many early cultures knew how to calculate the beginning of spring and fall, when the day and the night are of equal length (the equinox). On that day, the Sun crosses the equator on its journey either north or south, a consequence of the Earth's orbital tilt of 23.5 degrees. Hipparchus, around 129 BC, determined that in the spring the Sun was in the constellation Aries, the Ram, and so it is named the "first point of Aries."

So why is the "first Point of Aries" now in the constellation Pisces?

To make sense of this, we'll start by describing the coordinate systems that organize the celestial sphere.

Horizonatal (alt-azimuth) coordinate system

This is the universe as seen by the observer, with natural directions up, down, left and right from the observer's exact location. The horizon is at zero degrees, the zenith at 90° (the nadir at -90, but below our feet on the other side of the Earth). The infinite celestial sphere is a two dimensional (but spherically curved) surface on which any point can be labeled with two coordinates, altitude and azimuth. We have to pick a starting point for the azimuth (altitude is obvious) so we use the points of the compass and make north zero degrees.[1] The horizontal coordinate system does not rotate. The celestial objects change their altitude and azimuth as time goes by. The line that passes from north to south through the zenith is the meridian.

Some modern computerized telescope mounts move in alt-azimuth. They can track celestial objects because there is a direct translation in software between horizontal coordinates and the celestial coordinate system.

Celestial coordinate system

This system is equivalent to a projection of the Earth's lines of longitude and latitude onto the celestial sphere. The Earth's equator is the point of zero declination, or celestial elevation, and the location of zero longitude is set as the First Point of Aries. The deviation from the refence point is expressed in units of time. One hour equals 15 degrees (because the Earth rotates 360 degrees in 24 hours). As our planet rotates, celestial objects remain in their designated right ascension and declination positions: it's the entire sky that rotates (or, rather, seems to rotate).

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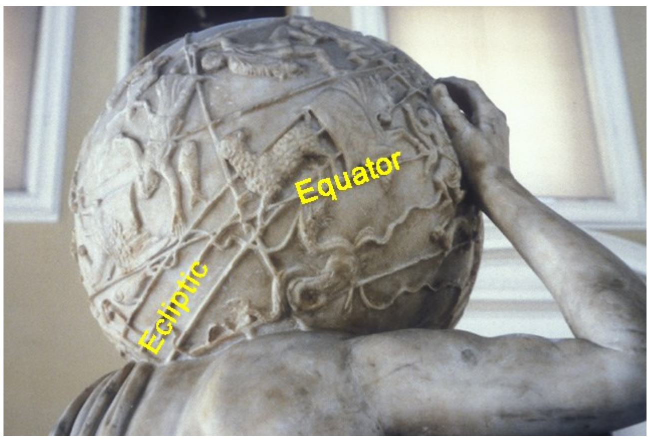
[1] Should you use true north or magnetic north? In our area they differ by about 12 degrees. True north should be used, and some compass apps include a way to switch between the two. Planetarium software knows how to make the correction, since you must specify your observing location, from which the deviation is calculated.

Ecliptic coordinate system

It was natural for early astronomers to use the ecliptic, the path of the Sun through the constellations, as the zero point of elevation. The Greeks certainly knew about the celestial equator, as evidenced by the orientation of the globe on the Farnese Atlas, the oldest extant celestial globe. The earliest printed star map, by Albrecht Durer in 1515, is oriented using ecliptic coordinates. The North Ecliptic Pole, at 90 degrees from the ecliptic itself, is currently in the constellation Draco, less than ten arcminutes from the Cat's Eye Nebula, NGC 6543.



The Farnese Atlas (National Archeological Museum Naples, Italy). A 1st century Roman copy of a Greek original. Note that the ecliptic crosses the equator near Aries, showing that the placement is consistent with the sky in Hipparchus' time.

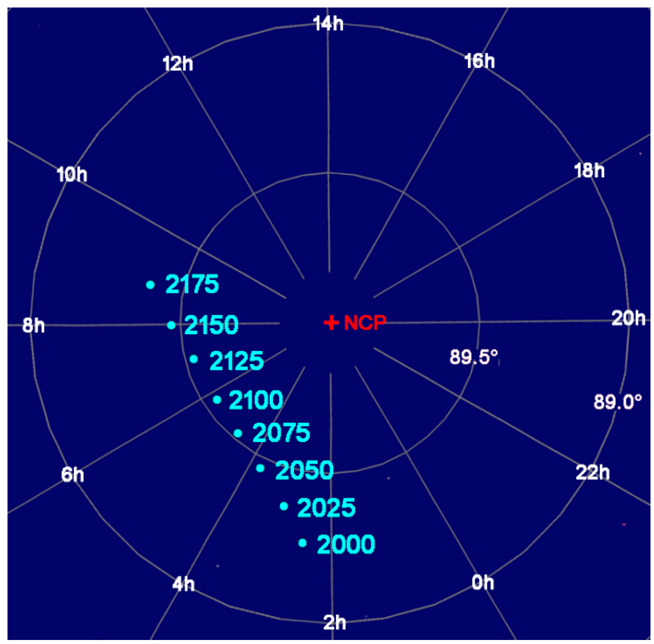
Two particular meridians link the celestial and ecliptic coordinate systems. These are the *equinoctial colure* and the *solstitial colure*, terms that we don't use anymore but were important to 18th century astronomers. The equinoctial colure is the great circle that passes around the sky through the poles and intersects with the celestial equator at the spring and fall equinoxes (where the ecliptic crosses). The solstitial colure is the great circle at the right ascension of the summer and winter solstices, the Sun's highest and lowest points (the longest and shortest days). These two colures are almost always featured on armillary spheres.

Galactic coordinate system

Astronomers interested in galaxies know that you can't see very many of them in the plane of the Milky Way. A galactic coordinate system was established by William Herschel in 1785, although he didn't really have a concept of galaxies, as distinguished from other nebulous bodies in the Milky Way. There were various later versions, until the IAU formalized the definition in 1958. The plane of the Milky Way is zero degrees galactic declination. The reference point for galactic longitude is close to, but not exactly at, Sagittarius A*, the black hole at the center of the Milky Way galaxy, because the system was set up before SgrA* was precisely measured. SgrA* is actually at +0° 07′ 12″ S galactic latitude, +0° 04′ 06″ galactic longitude rather than 0/0. The North Galactic Pole is currently in Coma Berenices.

Precession

The Earth spins on its north-south axis. Presumably a point directly above the north pole should be forever in the same position in the celestial, ecliptic and galactic coordinate systems. But it isn't.



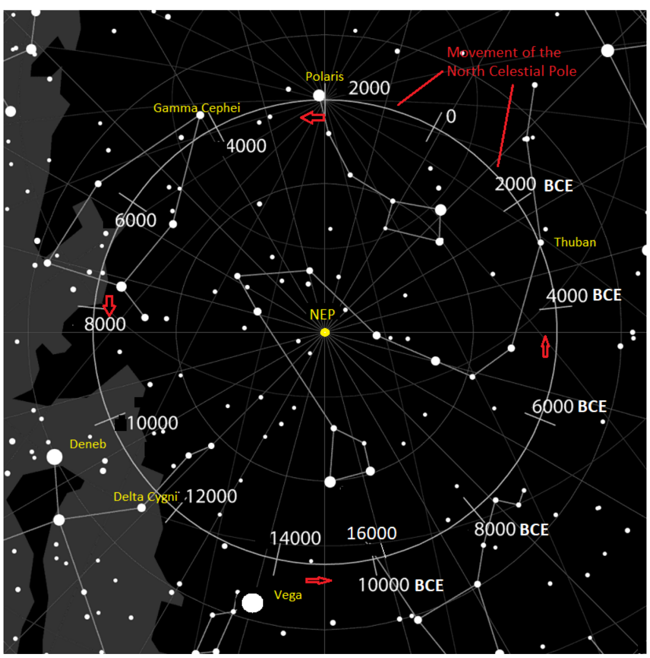
Position of Polaris 2000-2175. It is closest to the North Celestial Pole in 2100 (Cartes du Ciel)

Consider a top, a radially symmetric mass that spins around a central axis. It has angular momentum, which is a conserved property. Without any external forces acting on it, (friction, gravity, heat, etc.) a perfectly constructed absolutely symmetrical top will continue to spin in the same orientation forever. In a gravitational field the center of mass of the top is pulled in the direction of the field, which can apply a torque on the object. If the top is not exactly aligned with the gravitational field, although the angular momentum will keep it from falling over, its rotational axis will "precess" around a central point.

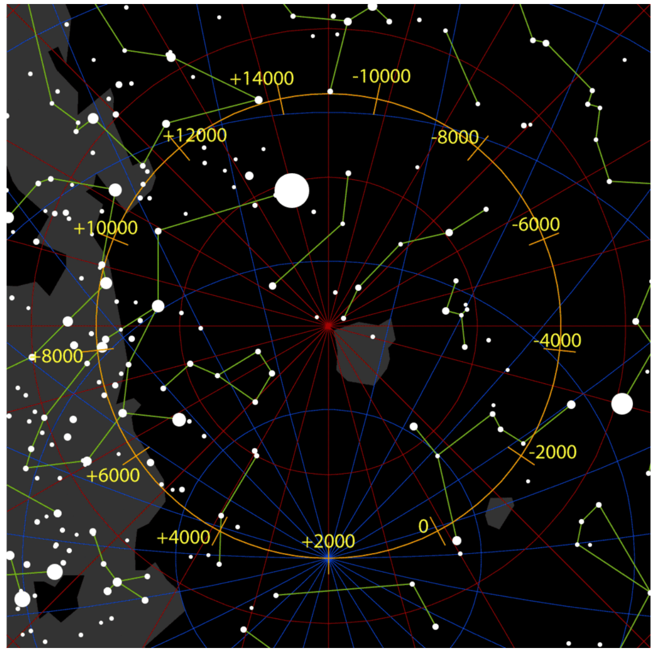
The spinning Earth is in the solar system's gravitational field and so is influenced by the mass of the Sun and the Moon and to a lesser extent the other planets. Hipparchus, using data recorded by the astronomers Timocharis and Aristillus two centuries earlier, calculated that the Earth's axis seemed to move among the stars at a rate of a little under one degree a century. More refined observations show that the rate is 50.3 arcseconds per year, or about one degree every 72 years. A complete cycle takes about 26,000 years. Newton, in the *Principia*, identified gravity as the cause of precession.

Right now, 2nd magnitude Polaris is within one degree of the North Celestial Pole, making polar alignment relatively easy for us northerners. There is no bright star within 20 degrees of the South Celestial Pole. Fortunately, new alignment methods with cameras and plate solving moot the need to sight on stars for polar alignment.

Over the next 26,000 years, Earth's polar axis will move along a circular track with a radius of 23.4° (equal to Earth's orbital tilt, or obliquity), getting fairly close to Deneb around the year 10,000 and Vega around 14,000. We expect telescope polar alignment routines will keep up with these changes!



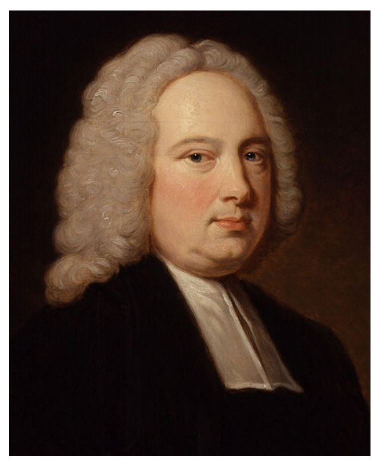
Precession of the north celestial pole



Precession of the south celestial pole

Nutation

Gyroscopes have another mode of rotation caused by the effects of torque. In addition to precession, the direction of spin has a secondary variance in the form of a bobbing motion called nutation, which is due to additional torque on the rotating body that arises during its precession. For the Earth, this torque is specifically contributed by the Moon.



In the February 2025 SkyWAAtch we reported on James Bradley's discovery of stellar aberration, the proof that the Earth moved in its orbit. Bradley compulsively logged the position of stars as they crossed the zenith and showed that they were displaced by as much as 20 arcseconds from their mean position during the course of the year, which he correctly reasoned was due to the ratio of the speed of light and the speed of the Earth in its orbit.

After publishing his findings in 1729, Bradley continued to record the position of stars as they crossed the meridian using the telescope he erected in Wanstead.

He was appointed the Savilian Professor of Astronomy at Oxford in 1732 but continued to make observations periodically in Wanstead, northeast of London. He was also named the third Astronomer Royal in 1742. His observation program ran for over twenty years. He finally reported his findings to the Royal Society in 1747 (published in 1748).[2]

The phenomenon of precession was well known to astronomers in the 18th century and was taken into account in their measurements of star positions.

Around the time of his discovery of stellar aberration, Bradley reported that,[3]

> ...my Attention was again excited by another *new Phaenomenon*, viz. an annual Change of Declination in fome of the fixed Stars; which appeared to be fenfibly *greater* about that time, than a Preceffion of the Equinoctial Points of 50" in a Year would have occafioned. The Quantity of the Difference, tho' fmall in itfelf, was rendered perceptible, thro' the Exactnefs of my Infrument....

Bradley understood the implications of Newton's theory of gravity on a cosmic scale, and recognized that

> The apparent Motions of the heavenly Bodies are fo complicated, and affected by fuch a Variety of Caufes; that in many Cafes it is extremely difficult to affign to each its due Share of Influence.

Bradley was a true scientist and took great pains to differentiate systematic error, caused by the limitations of his instruments,[4] with observational error, the random variations in any single measurement. He described these as

> unavoidable Errors, which aftronomical Obfervations muft be always liable to, as well from the Imperfection of our Senfes.

He addressed this problem the way all experimental scientists do, by making multiple observations and calculating the mean and deviations from it.

In the first year of his observations, he observed stars near the two colures and found that they deviated some 9" or 10" from the expected 50" annual precession, but to the north on one side of the sky and to the south on the other. Subsequently the deviations changed. Over a nine-year period, Gamma Draconis, the star that passes over London's zenith every day,

> Which in fhose nine Years fhould have gone about 8" more Southerly, was observed in 1736 to appear 10" more Northerly, than it did in the Year 1727.

Further observations led Bradley to postulate that

> *Some Part* of this Motion at the leaft, if not the *Whole*, was owing to the Moon's Action upon the Equatorial Parts of the Earth; which I conceived, might caufe a libratory Motion of the Earth's Axis.

Bradley continued making observations through the whole period of the Moon's nodes, which we today know as a saros cycle, the period when the geometry of the Sun, Earth and Moon return to an identical alignment.[5]

He made over 250 observations of Gamma Draconis, 200 of Beta Draconis, 164 of Eta Ursa Majoris (Alkaid), 100 of Alpha Cassiopeiae (Schedar), 80 of Alpha Persei (Mirfak), 65 of Beta Cassiopeiae (Caph), 60 of Tau Persei, and 40 of a 6.4 magnitude star identified as 35 Camelopardalis in Flamsteed's catalog but now known as HD 40873 and placed in Auriga,[6,7] among many other stars that he tracked during the period 1727-1747.

He was unable to make some observations due to bad weather, British climate being what it is. As he was living primarily in Oxford after 1732, he only occasionally returned to Wanstead. As a guest in the house, he quaintly reported that some of the stars

> came at fuch Hours of the Night, as would have incommoded the Family of the Houfe wherein the Infrument is fixed.

[2] A letter to the Right honourable George Earl of Macclesfield concerning an apparent motion observed in some of the fixed stars; by James Bradley D. D. F. R. S, *Philosophical Transactions of the Royal Society of London*, Volume 45, Issue 485, pages 1-41. https://royalsocietypublishing.org/doi/epdf/10.1098/rstl.1748.0002

[3] I couldn't resist using the original font and original spelling again.

[4] For example, he made multiple measurements to assure that the threads of his micrometer screw were precisely spaced.

[5] When a full moon is on the ecliptic, we get a solar eclipse.

[6] Chosen because its right ascension is 12 hours different than that of Gamma Draconis.

[7] Quite a few stars changed constellations when the IAU formalized constellation boundaries in 1930.

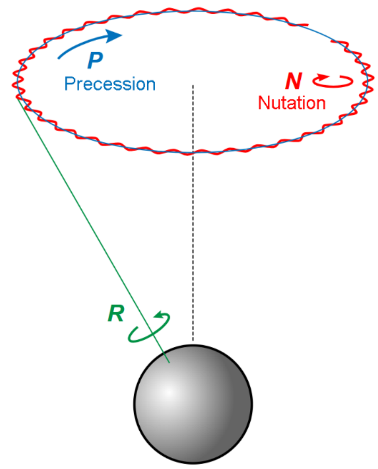
Correlating the positions of these stars over 20 years, he found that they returned to their expected positions (taking precession and stellar aberration into account) in 18.6 years. He concluded that

> The plane of the Moon's Orbit being at *one* time, above ten Degrees *more* inclined to the Plane of the Equator, than at *another*; it was reafonable to conclude, that the Part of the whole annual Preceffion, which arifes from her Action, would in different Years be varied in its Quantity, whereas the Plane of the Ecliptic, wherein the Sun appears, keeping always nearly in the fame Inclination to the Equator; *that* Part of the Precession, which is owing to the Sun's Action, may be fame every Year: and from hence it would follow, that, although the mean annual Preceffion from the joint Actions of the Sun and Moon, were 50"; yet the apparent annual Preceffion might fometimes exceed, and fometimes fall fhort, of that mean Quantity, according to the various Situations of the nodes of the Moon's Orbit.

Concerned that his observations would not be taken seriously, Bradley asked his readers to consider that,

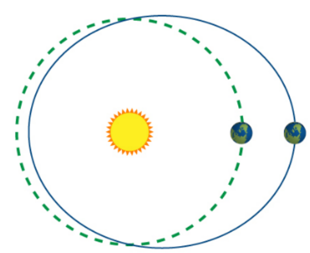
> When I fhall mention the *fmall* Quantity of the Deviation, which the Stars are fubject to, from the Caufe that I have been fo long fearching after; I am apprehenfive, that I may incur the Cenfure of fome Perfons, for having fpent fo much Time in the Purfuit of fuch a feeming Trifle: But the candid Lovers of Science will, I hope, make due Allowance for that natural Ardour, with which the Mind is urged on towards the Difcovery of Truths, in themfelves perhaps of *fmall* Moment, were it not that they tend to illu□rate others of greater Ufe.

Precession is the average of the gravitational forces exerted by the solar system bodies, but nutation is a variance that arises from the additional torque that results from the Moon's orbit being inclined 5.14 degrees from the ecliptic, having an eccentricity of 0.0549 and the Earth not being a true sphere, its rotation making the equatorial diameter some 43 km larger than its polar diameter.



Bradley was quite aware that the plane of the ecliptic was slightly offset from the "invariable plane" of the solar system (he uses the term on one occasion). The invariable plane is orthogonal to the angular momentum vector[8] of all the planets, which is located at the solar system's barycenter, the "center of mass." When all the large planets are on one side of the solar system, as they are now, the Sun's position deviates substantially, as much as 2.17 solar radii from the position it occupies when Jupiter is opposite Saturn, Uranus and Neptune. Earth's orbit is inclined zero degrees from the ecliptic, by definition, but it is inclined 1.57 degrees from the invariable plane, and that is also a source of torque on the Earth's rotational axis.

Additional cycles


Eccentricity

The Earth's orbit is an ellipse, currently with a *eccentricity* of 0.016 Due to gravitational pull of the larger planets its shape varies over the centuries, from a minimum of zero (perfect circle) to as much as 0.0679. Because the orbit changes shape, Earth's orbital velocity changes (per Kepler's Third Law), so the timing of aphelion and perihelion change, by one full day every 58 years. The full cycle takes about 100,000 years.

This has a mild effect on climate because the amount of sunlight falling on the Earth is proportional to the Earth-Sun distance. But the difference is relatively small, and the current eccentricity, on the low end of the cycle, cannot account for global warming.

[8] Recall that the direction of angular momentum is along the axis of rotation. The reason you can ride a bicycle is because the angular momentum of the wheels is parallel to the ground.

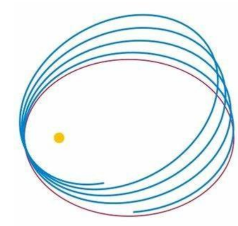
Year	Peri-helion	Distance	Aphelion	Distance
2025	1/4/2025 8:28	91,405,993 mi	7/3/2025 15:54	94,502,939 mi
2026	1/3/2026 12:15	91,403,637 mi	7/6/2026 13:30	94,502,962 mi
2027	1/2/2027 21:32	91,406,556 mi	7/5/2027 1:05	94,510,857 mi
2028	1/5/2028 7:28	91,404,129 mi	7/3/2028 18:18	94,506,289 mi
2029	1/2/2029 13:13	91,402,677 mi	7/6/2029 1:11	94,509,351 mi

* All aphelion/perihelion times are in local New York time.

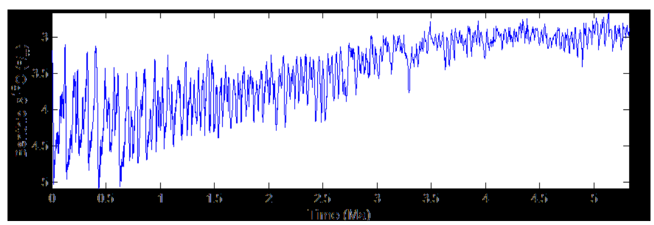
Obliquity

On February 14, 2025, the Earth's orbital tilt, or *obliquity*, was 23.43601°. Over the last million years, the obliquity has varied between 22.1 and 24.5 degrees with respect to the orbital plane. This cycle has a 41,000 year periodicity. It is currently decreasing and will reach a minimum in 10,000 years. The poles will receive less sunlight, allowing ice to build up and reflect more sunlight, decreasing the global temperature (except for the anthropic contribution to climate change, which far outweighs the effect of decreasing obliquity). Besides its slightly ovoid shape, the internal density of the Earth varies. The Asian land mass has a different density and height than the Pacific Ocean, for example. The Earth's mantle is not evenly distributed. We even learned in February 2025 that the outer part of Earth's dense iron core is changing shape, as determined from analysis of the last 100 years of earthquake records. These factors alter the torque applied by the gravitational field of solar system bodies and contribute to changes in obliquity.

The Earth's entire orbit precesses slowly around the Sun, with the line of apsides (the line connecting perihelion and aphelion) completing a rotation in 112,000 years. The best example of *apsidal precession* is that of Mercury. Calculations based on Newtonian dynamics could not account for 43 arcseconds per century (out of a total of 547 arcseconds per century). General relativity predicted a frame dragging effect due to the Sun's mass, which was found by Eddington and Dyson in 1919. The contribution of GR to Earth's apsidal precession is far less, but not zero.


Apsidal precession

The combination of precession, orbital obliquity and eccentricity affects Earth's climate through "Milankovitch cycles," first elucidated by the Serbian astronomer and geophysicist Milutin Milankovitch. The movements cause variations of up to 25 percent in the amount of insolation (solar radiation) at Earth's mid-latitudes. Milankovitch calculated that ice ages occurred at 41,000 year intervals because of these concurrent cycles. Within the last three-quarters of a million years, however, the periodicity of insolation-related climate change has apparently lengthened to about 100,000 years, which more closely matches Earth's eccentricity cycle, although Milankovitch thought that obliquity was the most important of the three mechanisms. The cycle is not all that regular, however, so the other factors are undoubtedly involved.



^{18}O concentrations in ice cores, which correlates with global temperature, showing a broadening of cycle frequency in the last million years or so. The current era is on the left side of the graph.[9]

The Earth's orbital tilt of 1.57° relative to the invariable plane not only adds torque but it also may affect the inclination of the ecliptic. This subtlety was only discovered in 1997, derived from climate data. It has a period of 70,000 years relative to the ecliptic but 100,000 years relative to the invariable plane, a cycle similar to the apsidal precession. The authors of the study propose that "extraterrestrial accretion from meteoroids or interplanetary dust [falling on the Earth] is … a mechanism that could link inclination to climate.[10] Changes to the Earth's mass (and distribution of mass) are constant, so its position and orientation can vary both regularly and irregularly. ■

[9] Lisiecki, L. E., and M. E. Raymo (2005), A Pliocene-Pleistocene stack of 57 globally distributed benthic d18O records, *Paleoceanography*, 20, PA1003, https://www.lorraine-lisiecki.com/LisieckiRaymo2005.pdf

[10] Muller, RA, Macdonald, CJ, Spectrum of 100-kyr glacial cycle: Orbital inclination, not eccentricity, *Proc. Natl. Acad. Sci. USA*,. 94, 8329–8334 (1997). https://www.pnas.org/doi/epdf/10.1073/pnas.94.16.8329.

Outreach Report Steve Bellavia

WAA now has two members who live in Virginia: Steve Bellavia, who relocated there in 2024, and long-time Virginia resident John Higbee, (see the January 2023 SkyWAAtch, page 10.)—Ed.

Steve writes:

I did my first astronomy outreach event in Virginia on Saturday, February 1, 2025. It was organized by the Richmond Astronomical Society. They actually held two events that night: one at the Virginia Museum of Science and another at Powhatan State Park, which is the one I attended. It was 1 hour, 45 minutes from my house.

We had spectacular skies, although it was a little chilly, around 40° F. There were about a dozen friendly, knowledgeable and fun club members, including the society's president, and maybe 60 to 70 polite and grateful visitors, with many children too. I had 20 people total stop by my 12-inch Orion Dobsonian.

I shared views of Saturn, Venus, Jupiter and Mars. I was surprised how visible Jupiter's moons were in the early bright twilight, perhaps an effect of good transparency. We also got to see Io sneak in front of Jupiter at around 6:40 p.m. EST (but we didn't get a chance to follow its journey across Jupiter's face.

Of course, our moon was also excellent (see the poor cell phone shot through the-eyepiece, below).

I also showed visitors (but sometimes just myself), the following deep space objects:

Galaxies:
Andromeda (M31)
Triangulum (M33)
M74
M81-M82, together, in the same field
NGC 2903

Open Star clusters:
Double cluster (NGC 844-869)
ET (NGC 457)

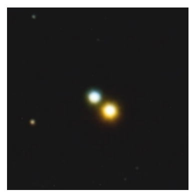
Galactic clusters
M35 (along with its fainter companion star cluster, NGC 2158),
M36, M37
Pleaides (M45, naked eye)

Double Stars:
Winter Albireo (145 G Canis Majoris)
Mintaka
Polaris

Nebulae:
Orion (M42)

M78

Globular Cluster:
M77

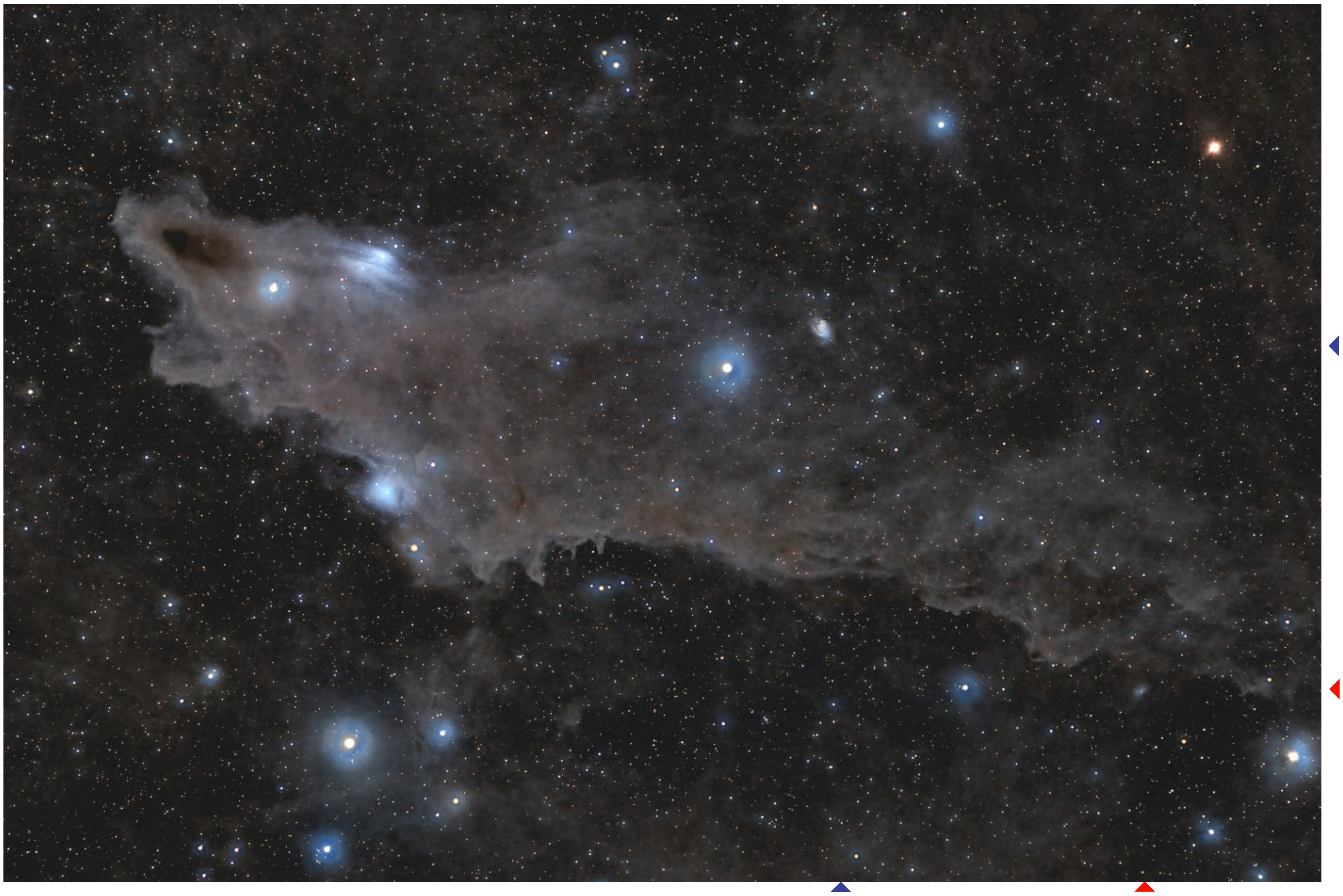


Steve's image of 145 G Canis Majoris. January 27, 2025

Most members stayed after the public left, taking advantage of the clear skies, but I was tired and left around 9 p.m. The drive home was a little scary, as I must have seen a hundred deer during the drive, some walking in the road and even in my driveway as I pulled in. It was a great night, and I am grateful to RAS for inviting me. ■

Images by Members

Shark Nebula in 19.8 Hours by Steve Bellavia



The Shark Nebula in Cepheus is an extremely faint zone of interstellar dust and hydrogen gas, illuminated and modulated by hot stars within it. It has both emission and reflection components. The brighter portion of the shark (though still very faint) is LBN (Lynds' Bright Nebula) 535, and the dark head (or eye) of the shark is LDN (Lynds' Dark Nebula) 1235. The two blue-white areas are reflection nebulae vdB 149 and vdB 150.

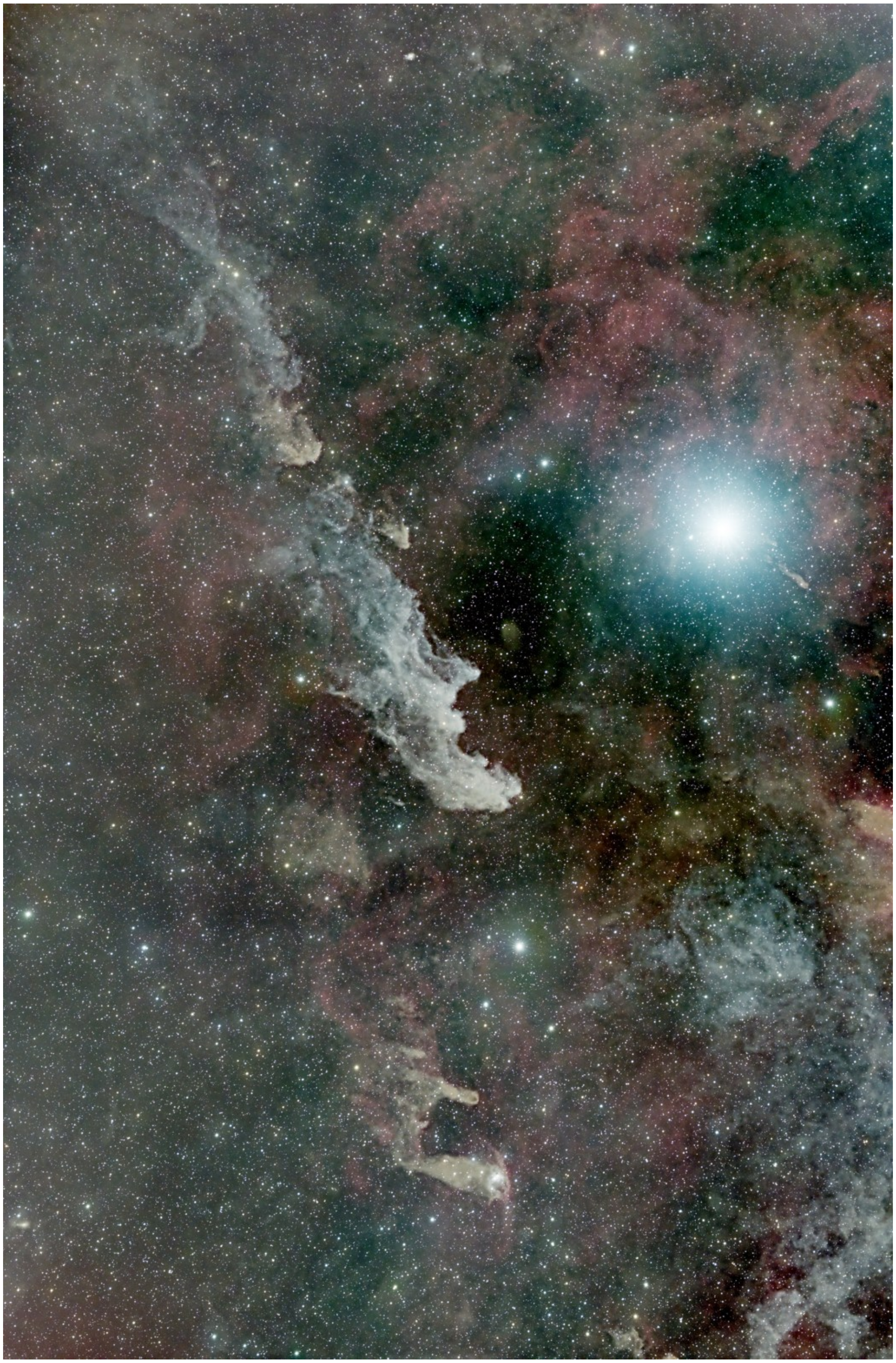
The nebula is about 1,000 light years distant. The class F5 star in the center, 16 Cephei, is 120 light years away, so not within the nebula.

Steve writes "I actually wasn't planning on getting 19.8 hours of data on LBN 535/LDN 1235, the Shark Nebula, but I was testing out some filters, and over the course of 6 nights of testing, I ended up with a lot of data that I decided to use." Full technical information and a full resolution image is at https://www.astrobin.com/vhxmlj/K/.

Also in the image are two galaxies. PGC 67347 (triangulate red markers), an SAb spiral also catalogued as UGC 11818, is 129.5 million light years distant and PGC 67671 (triangulate blue markers), an SBbc spiral galaxy also catalogued as UGC 11861, is 80.6 million light years away.

Beverly Turner Lynds published her catalog of dark nebulas in 1962 when she was at the National Radio Astronomy Observatory in West Virginia, and the bright nebula catalog in 1965 when she was at the university of Arizona. The catalog was developed by a critical examination of the Palomar Sky Survey blue and red plates. Lynds died in October 2024 at the age of 95.

The Witch Head by Robin Stuart



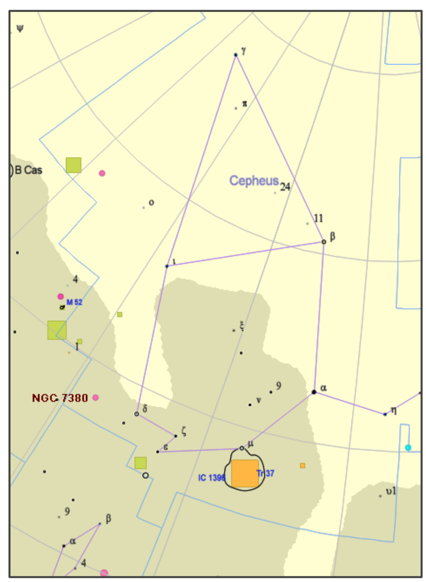
The Witch Head Nebula (IC 2118) is a faint reflection nebula lying at a distance of around 900 light years from Earth. It's in the constellation of Eridanus, the river, adjacent to Orion's left foot. IC 2118 is believed to be a supernova remnant and is illuminated by the supergiant star Rigel (β Orionis), seen blazing on the right.

The nebula's wind-swept form and comet-like protrusions suggest that it is being sculpted by the stellar winds from massive stars in the Orion OB1 association, of which the brightest stars in that constellation are members.

The reddish tinge in the top right are Hα emissions from gas in Barnard's Loop, a full image of which can be found in the January 2024 SkyWAAtch, page 24. In that image the Witch Head can just be made out at the lower right.

The image is a stack of fifty 5-minute subframes for a total of 4 hours 10 minutes. It was made in Eustis, Maine with a Rokinon 135-mm f/2 telephoto lens attached to a ZWO ASI2600MC camera. Most of the exposures were made on 24 January 2025 with the temperature hovering around 0° F. Processing was done with PixInsight. The StarNet2 plugin was used to de-emphasize the stars. No filters were used when taking the image and no enhancement to the color saturation has been applied. The image is 6.8° x 10.3°. South is up.

The Wizard Nebula by Tony Bonaviso



We had a witch (see page 20) so we might as well have a wizard.

Surrounding the open cluster NGC 7380 in Cepheus is a very faint emission nebula, nicknamed the Wizard. The cluster was discovered by Caroline Herschel in 1787 and listed by William Herschel as VIII 77 in his second catalog of 1789. Category VIII is “coarse clusters of stars.” Herschel himself observed it on November 1, 1788, finding that it was 8 arcminutes in diameter. It seems likely that neither he nor Carline saw the nebulosity, which is about 25 arcminutes across. It was catalogued as Sh2-142 in the 1959 Sharpless catalog, which was based on Palomar Sky Survey plates.

In *Deep Sky Companions: Hidden Treasures* (2007), Stephen James O’Meara calls the nebula “Harry Potter and the Golden Snitch,” writing “Try using your imagination to see the brightest stars in the region as Harry Potter on his Firebolt broomstick playing Quidditch and trying to grab the Golden Snitch.” Your Editor, not having participated in the Harry Potter thing, has no idea what this means.

NHC 7380 is a “young” cluster, between 2 and 4 million years old. The cluster contains about 125 stars, mostly types O and B. The Wizard’s emission is energized primarily by the 8.6-magnitude class O5V eclipsing binary DH Cepheii (HD 215835). All the stars in NGC 7380 are members of the Cepheus OB1 association.

The field is 1.6 x 1.1 degrees. Tony made the image at Ward Pound Ridge Reservation.

Soul Nebula by Arthur Miller

Here's a completely different take on the Soul Nebula, IC 1848 in Cassiopeia, compared to Steve Bellavia's narrowband, star-suppressed image in the January 2025 SkyWAAtch, page 18. Arthur's image, in the LRGB palette, emphasizes the star cluster within the nebula. When first catalogued in 1908 in the Second Index Catalog, it was the cluster that was deemed the important structure. Discovery is credited to E.E. Barnard, and its description in the 2nd IC is "Cl st F extends 8m f, in F neby" meaning "cluster of faint stars extending 8 arcminutes following [east] in a faint nebula." In Sue French's *Deep Sky Wonders*, the author notes that there are two clusters within the nebula. One shares the IC 1848 designation with the nebula, as is seen in the center of Arthur's image, while the other is identified as Collinder 34 and is just off the left edge of the image.

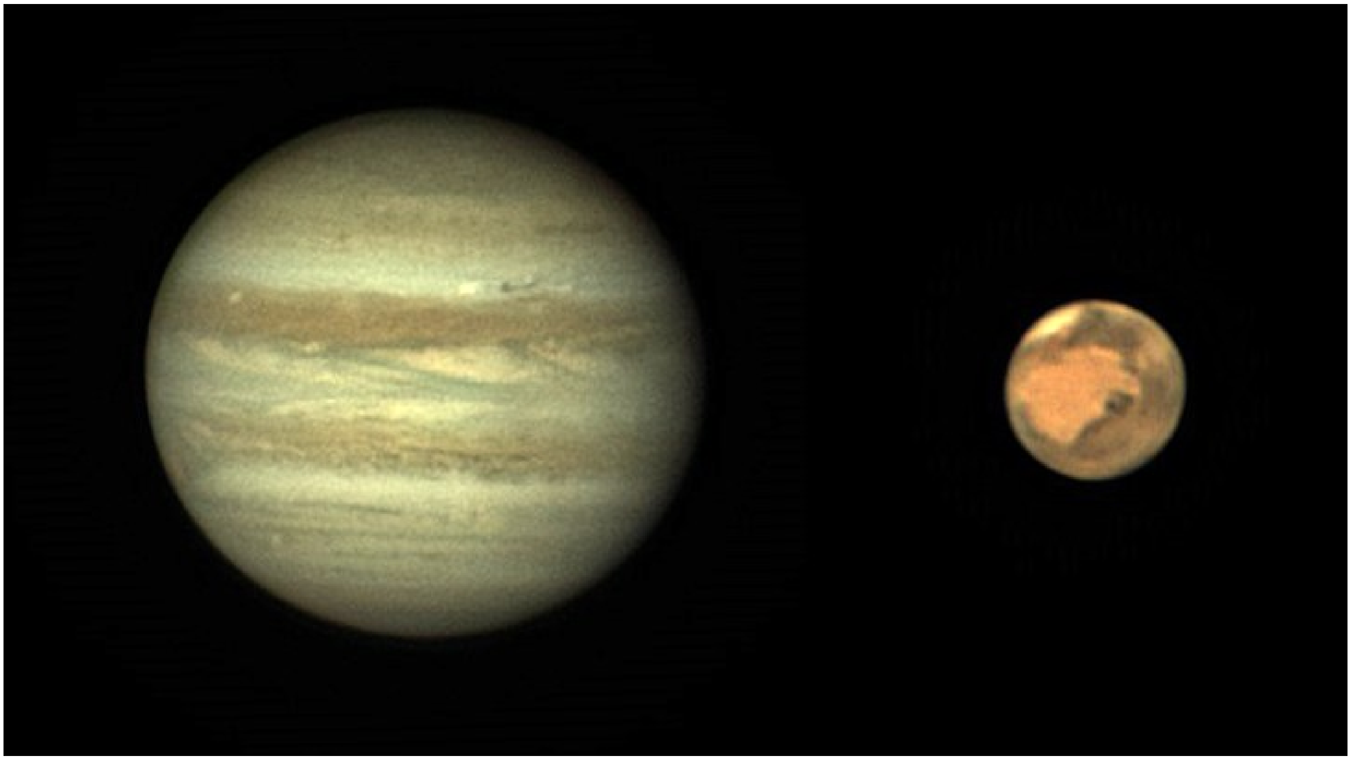
The brightest star in the image is actually a double star catalogued in the Washington Double Star Catalog as Σ306. The WDS catalog is maintained by the US Naval Observatory (see https://crf.usno.navy.mil/wds). It currently has 149,104 entries. Two of the most avid double star cataloguers were Friedrich Georg Wilhelm von Struve (1793-1864) and his son Otto Wilhelm von Struve, at the Pulkovo Obervatory near St. Petersburg, Russia. Double stars have a peculiar nomenclature: if you see a sigma (Σ) it means that the elder Struve first catalogued it; a prefix OΣ means the younger Struve was the cataloguer. In the Washington database, these prefixes are changed to STF and STT (possibly because early computers didn't like the Greek letters. So, for example, Σ306 is listed as ST306 in the WDS catalog that Cartes du Ciel uses.

The image was made in Arizona with a 127-mm refractor and QHY268C camera on an Astrophysics 900 GOTO mount. Arthur made 48 300-seccond subs. The field of view is 1.47 x 1.0 degrees.

The Lion Nebula by Larry Faltz

In October I was fiddling around at Ward Pound Ridge with my Stellarvue SVR-105, ZWO AM5 mount, ASI Air Plus and ASI533MC Pro camera (UV/IR cut filter only). For the first time, I used the planetarium feature of the ASIAir software rather than telling it to go to a specific object. On the ASIAir planetarium screen I saw the outline of a small nebula in Cassiopeia, with no identifier shown. It turned out to be the Lion Nebula, catalogued as Sh2-132 and LBN 473. I got 20 60-second subs of which a few had to be rejected because of satellites. Using Siril (it's free; I'm too cheap and not confident enough to invest in PixInsight), StarNet++, Topaz Denoise AI and GIMP (to punch the red a little), I managed to record some nebulosity. The result is hardly in the class of SkyWAAtch's top-notch imagers. It's full of noise, tracking errors and field curvature. I'm still a deep sky imaging beginner. But hey, I'm the Editor of *SkyWAAtch*, so here it is. The field of view is 50.4 arcminutes square. North is to the right.

Mars and Jupiter with a 7-inch Maksutov by John Paladini



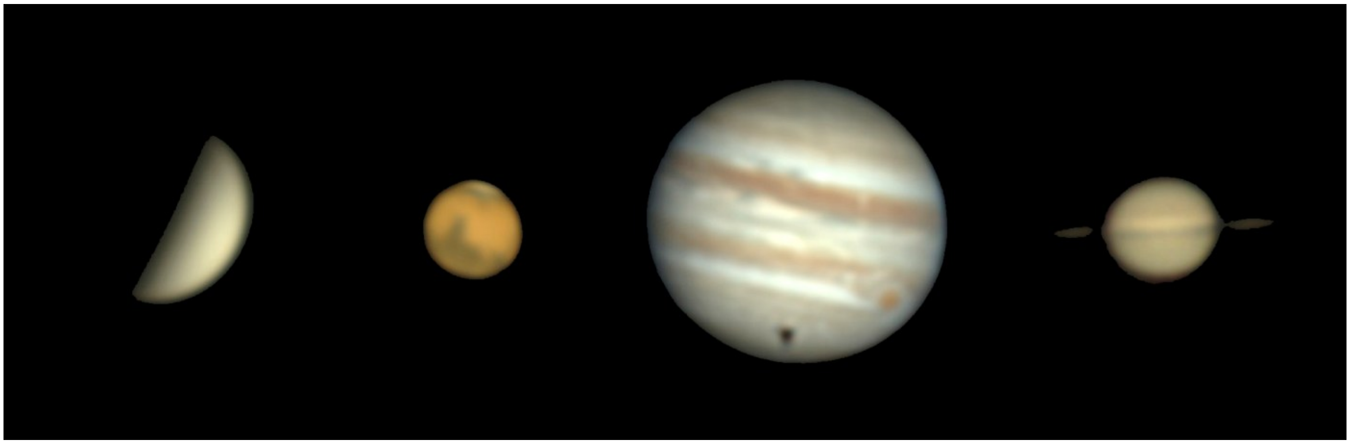
John took advantage of a clear sky and non-frigid temperatures on the night of January 17 to make these images of Mars and Jupiter with his Orion 7-inch Maksutov.

Catadioptric telescopes use a combination of mirrors and lenses. Both Schmidt-Cassegrain and Maksutov designs use fast spherical mirrors (f/2 or f/2.5), which would give severe spherical aberration. A corrector plate at the front of the instrument corrects for this aberration. In the case of the Schmidt-Casssegrain (SCT), the corrector plate is thin, with a complex figure. The spherical secondary is mounted behind the corrector plate. Maksutovs use a very thick spherically figured corrector plate with the secondary a simple non-adjustable aluminized spot on the back of the plate. Most of these scopes focus by moving the primary mirror.

Maksutovs are considered better for planetary viewing or imaging compared to an equivalent aperture SCT. They have longer focal lengths for their aperture compared to SCTs, the secondary provides a smaller central obstruction (which improves fine detail), and they almost never go out of collimation. One major disadvantage is that it takes quite a bit longer for Maks to cool down because the glass corrector plate is so thick. The larger the aperture, the longer the cool-down time. The telescope at the old Stamford Observatory, a 22-inch Maksutov that is now in New Mexico, was reputed to have been unable to reach ambient temperature on a cool night. That's why Maks generally aren't great for "grab-and-go" astronomy, but if you wait an hour or so for a 4- or 5-inch Mak, the scope will perform nicely. Maks are also a bit heavier than an equivalent-sized SCT because of the thick corrector plate. The tubes for Maks are a little longer than those for an equal aperture SCT. Meade once made a 7-inch (178-mm, f/15) Mak on a fork mount. They utilized the fork system from their 8" SCT, but the Mak's tube could not be rotated all the way face down for storage! It was simply too long. It also had a built-in counterweight in the mirror cell to balance the weight of the corrector plate, making it extra heavy.

The classical Cassegrain telescope is not catadioptric. The original design was the work of Sieur Guillaume Cassegrain in 1672. Newton, who had publicly announced his reflecting telescope in 1671, didn't think the Cassegrain would work! Modern Cassegrains use a parabolic primary and a hyperbolic secondary, but in the 17^{th} century no one could figure a hyperbolic surface. Ritchey-Chrétien scopes use two hyperbolic surfaces. Most modern research telescopes are of this design, including the Hubble Space Telescope. JWST is a three mirror Korsch design.

Planet Parade by Steve Bellavia



All of the planets except Mercury were above the horizon in the early evening of January 20, 2025, when Steve Bellavia captured them around 7 p.m. with his Explore Scientific 152-mm Maksutov. The images are all at the same scale. That's Ganymede's shadow on the face of Jupiter. Efficient as always, Steve sent these images at 8:52 p.m., along with a Stellarium graphic of the evening sky. Uranus and Neptune were also above the horizon as well but would have been tiny, featureless blue dots not much bigger than Ganymede's shadow, uninteresting for imaging. Full technical information and Steve's original image at https://www.astrobin.com/obstqb/.

Cover Image: The Rosette Nebula by Steve Bellavia

Steve's wonderful image on the cover of this issue was made with a 6-inch Celestron SCT with Hyperstar, which turns the scope into an f/2 astrograph. He used a cooled ASI533MC color camera and obtained 126 two-minute subs (4.2 hours), as well as flats and dark flats. He employed a ZWO duo-band filter, writing "I decided to use a much broader duo-band filter on this object. I feel that the Rosette does better this way. I think there are also reflection portions (in addition to the emission portions) that show up better." Technical information is at https://www.astrobin.com/fyiapy/.

The original image was 5700 x 5000 pixels. But the ASI533 camera only has 3008 x 3008 pixels. I asked Steve about the discrepancy. Where did the extra pixels come from? Steve replied, "I was under sampled, but had 6" of aperture, so I knew there was more resolution to be had. NASA' s DRIZZLE to the rescue! I made sure I dithered frequently, as I knew in advance I would do this. So it is actually cropped from a 6000 x 6000 image." The field is 2.0 x 1.75 degrees. Resolution is 1.26 arcseconds per pixel.

Drizzling is a very clever image-processing technique developed for the Hubble Deep Field to enhance resolution of distant galaxies. See https://en.wikipedia.org/wiki/Drizzle_(image_processing) for more information. High Point Scientific has a concise definition of sampling:

> When astrophotographers incorrectly pair their focal length and pixel size with their seeing conditions it can result in either undersampling or oversampling. Undersampling occurs when the pixels on your camera sensor are too large for a given scope's focal length. This creates blocky, pixelated stars. This indicates that there are not enough pixels within the star to create a round star shape. Oversampling, on the other hand, occurs when the camera's pixels are too small for a given scope's focal length. The incoming light is being spread over too many pixels resulting in a soft and bloated image. Generally, under average seeing conditions (~2 arcseconds), a very short focal length scope paired with large pixels will produce undersampled results. A long focal length scope paired with small pixels will produce oversampled results.

Drizzling is applied by PixInsight during stacking (if you choose to do it).

Research Highlight of the Month

Shahbandeh, M, et. al. (45 authors) JWST/MIRI Observations of Newly Formed Dust in the Cold, Dense Shell of the Type IIn SN 2005ip, arXiv:2410.09142v1, submitted to *Astrophysical Journal*.

Abstract: Dust from core-collapse supernovae (CCSNe), specifically Type IIP SNe, has been suggested to be a significant source of the dust observed in high-redshift galaxies. CCSNe eject large amounts of newly formed heavy elements, which can condense into dust grains in the cooling ejecta. However, infrared (IR) observations of typical CCSNe generally measure dust masses that are too small to account for the dust production needed at high redshifts. Type IIn SNe, classified by their dense circumstellar medium (CSM), are also known to exhibit strong IR emission from warm dust, but the dust origin and heating mechanism have generally remained unconstrained because of limited observational capabilities in the mid-IR. Here, we present a JWST/MIRI Medium Resolution Spectrograph (MRS) spectrum of the Type IIn SN 2005ip nearly 17 years post-explosion. The Type IIn SN 2005ip is one of the longest-lasting and most well-studied SNe observed to date. Combined with a Spitzer mid-IR spectrum of SN 2005ip obtained in 2008, this data set provides a rare 15-year baseline, allowing for a unique investigation of the evolution of dust. The JWST spectrum shows a new high-mass dust component ($\gtrsim$ 0.08 M⊙) that is not present in the earlier Spitzer spectrum. Our analysis shows dust likely formed over the past 15 years in the cold, dense shell (CDS), between the forward and reverse shocks. There is also a smaller mass of carbonaceous dust ($\gtrsim$ 0.005 M⊙) in the ejecta. These observations provide new insights into the role of SN dust production, particularly within the CDS, and its potential contribution to the rapid dust enrichment of the early Universe.

Type II supernovas show hydrogen absorption lines in their spectra, unlike Type I supernovas, which occur when matter from a companion star falls on a white dwarf and raises its mass above the Chandrasekhar limit of 1.44 Mʘ. The iron cores of massive (8 to 50 Mʘ) stars collapse because iron cannot be fused, so radiation energy is insufficient to oppose gravitation. When the supernova explodes, a shock wave travels through the surrounding interstellar medium. The brightness curves of Type II supernovas decay at a slower rate than Type I, some lasting a particularly long time. These are designated as Type II-P (for "persistent"), contrasted with Type II-L, which has a linear drop in magnitude. Type Iin, the "n" denoting "narrow," have narrow hydrogen absorption lines, which comes from outflowing radiation interacting with gas around the star. This gas arises from matter released from the surface of the aging star as it goes through its red giant stage. The supernova shock wave compresses the gas and results in the formation of dust.

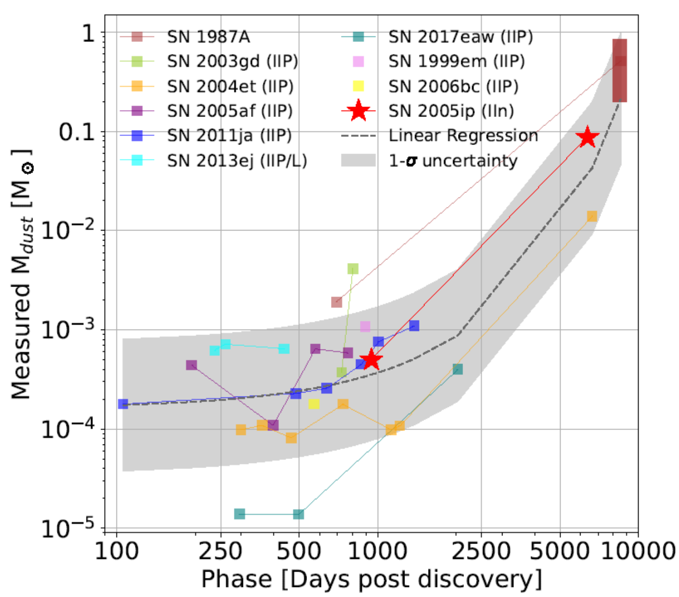


Figure 11 from the paper. The dust mass in SN 2005ip as a function of the epoch of MIR observations compared with other historic dusty SNe. Overall, compared to other historical SNe, the inferred dust mass in SN 2005ip is one of the highest to date.

Supernova 2005ip is in the spiral galaxy NGC 2906, in Leo, at a distance of 3.8. megaparsecs. The JWST spectra show a Mg-silicate feature that was not detected in the earlier Spitzer spectrum, indicating that new dust is forming in the shell of material behind the initial forward shock of the explosion, nearly two decades after the event. This process might well account for high levels of dust JWST found in early galaxies, which are enriched in massive stars. Type Iin supernovas appear to be more common in high-redshift galaxies.

Member & Club Equipment for Sale

Item	Description	Asking Price	Name/Email
NEW LISTING Celestron C90 Maksutov	90-mm f/11 spotting scope/telephoto lens/telescope OTA. In Celestron carrying case. Screw-on dew shield, 6x30 finder, diagonal. Mounts on photo tripod. Focuses like a camera lens by rotating the rubber collar on the tube. This is a Made in USA instrument, from the days when Celestron made extremely high quality optics at their factory in California. It's in superb condition and was probably rarely used. See it here. The current Chinese-made C90s list for $269. Donated to WAA.	$100	WAA ads@westchesterastronomers.org
6-inch f/8 reflector optical tube	Orion 6-inch f/8 reflector in very good condition. 2-inch focuser. Has Telrad finder base; you'd need to buy a Telrad. You would also have to supply tube rings or figure out how to make it into a Dobsonian. Mirror has center dot for collimation. Image of scope is here.	$25	David Parmet davidparmet@icloud.com
Skywatcher 120-mm f/5 refractor	This 600-mm focal length doublet achromat comes on a Sky-Watcher AZ-GTI mount. 2-inch diagonal, red dot finder. Eyepieces not included. The AZ-GTI mount is operated via wi-fi connection to a phone or tablet [it works well; your Editor has one]. You need to download the free SynScan app. A new AZ-GTI mount alone is $400. A great beginner scope	$550	Anthony Maida lvam1521@yahoo.com
Explore Scientific 10-inch f/5 Hybrid Truss Tube Dobsonian.	25-mm and 10-mm eyepiece s, red dot finder, collimation rod, two 2.5 lb. counterweights for using heavier 2-inch eyepieces. Just a few months old. Excellent condition, optically and cosmetically. Have the original box and packaging. Image at https://is.gd/XPwDUh. Local pickup; asking price reduced.	$485	Manish Jadhav manish.jadhav@gmail.com
iOptron IEQ45Pro equatorial mount head	Traditional German equatorial mount. Includes Go2Nova 8407 hand control (358K objects), counterweight, QHY PoleMaster for easy polar alignment, but no tripod. Payload 45 lbs (without counterweight). Mount weighs 25 lbs. This model is also discontinued by iOptron. The current very similar mount (GEM45) lists for $2,598 (plus $269 for the PoleMaster). A 1.75" iOptron "Lite-Roc" steel tripod costs $350; piers and other tripods are available. Specs for the IEQ45 are still on iOptron's web site. Donated to WAA.	$400	WAA ads@westchesterastronomers.org
ADM R100 Tube Rings	Pair of 100 mm adjustable rings with large Delrin-tipped thumb screws. Fits tubes 70-90 mm. You supply dovetail bar. Like new condition, no scratches. See them on the ADS site at https://tinyurl.com/ADM-R100. List $89.	$30	Larry Faltz lfaltzmd@gmail.com
1.25" Filters	Thousand Oaks LP-3 Oxygen III (2 available)	$50	Eugene Lewis genelew1@gmail.com
	Astronomic UHC (2 available)	$75	
	High Point Neutral Density (2 available)	$10	

Want to list something for sale in the next issue of the WAA newsletter? Send the description and asking price to ads@westchesterastronomers.org. Member submissions only. Please offer only serious and useful astronomy equipment. WAA reserves the right not to list items we think are not of value to our members. All receipts for items owned by WAA goes to support club activities.

Buying or selling items is at your own risk. WAA is not responsible for the satisfaction of the buyer or seller. Commercial listings are not accepted. Items must be the property of the member or WAA. WAA takes no responsibility for the condition or value of the item, or for the accuracy of any description. We expect but cannot guarantee that descriptions are accurate. Items are subject to prior sale. WAA is not a party to any sale unless the equipment belongs to WAA (and will be so identified). ***Prices are negotiable*** unless otherwise stated. Sales of WAA equipment are final. *Caveat emptor!*

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