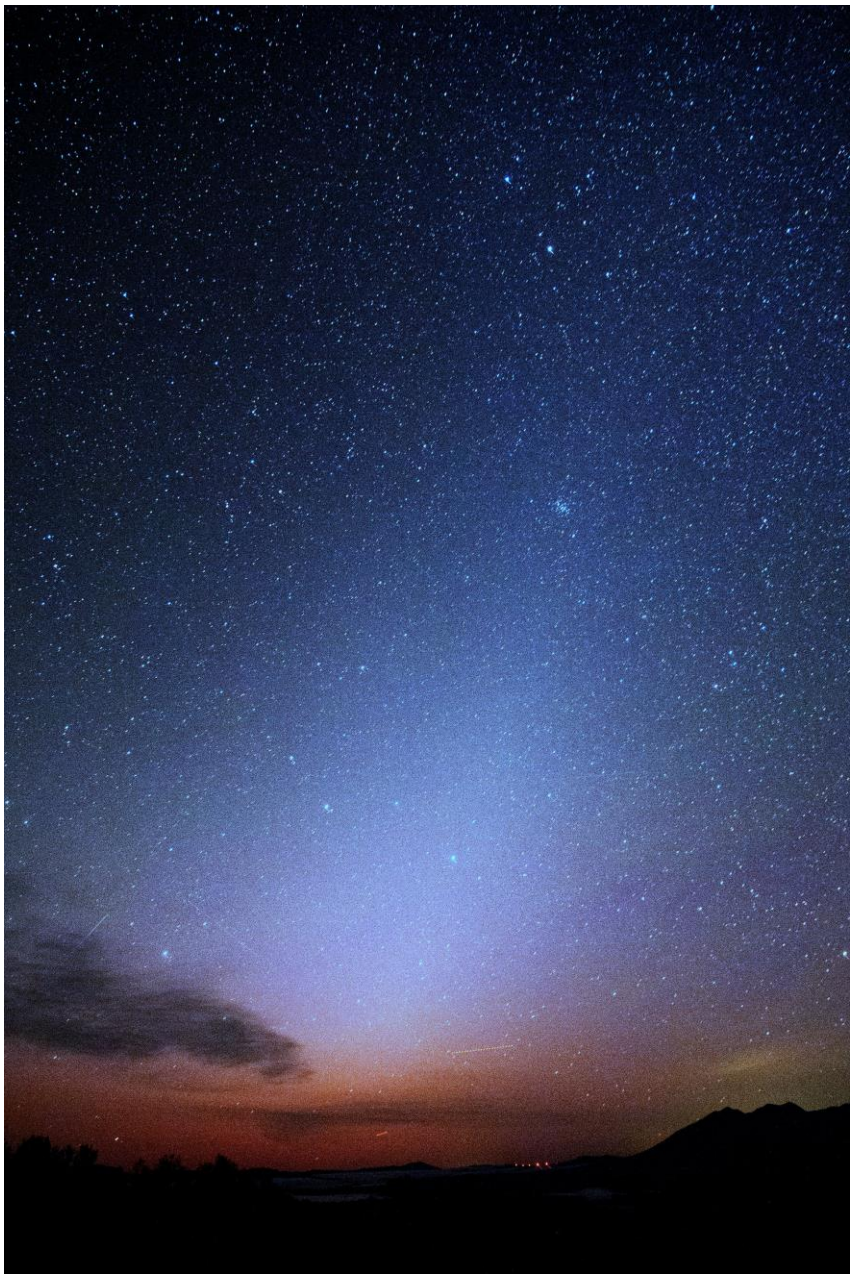
SkyWAAtch

The Newsletter of Westchester Amateur Astronomers

2021 APEX AWARDS FOR PUBLICATION EXCELLENCE 2022 APEX AWARDS FOR PUBLICATION EXCELLENCE

December 2022

The Lion and the Light by Robin Stuart



Canon 60Da DSLR, 15mm f/3.5 lens, 30 second exposure at ISO 3200.

Leo rising through the zodiacal light, or false dawn, is captured in this photograph taken from Eustis, Maine on October 4 at 4:49 EDT, about 15 minutes before the beginning of astronomical twilight. The beehive cluster in Cancer, also known as M 44 or Præsepe, is prominent near the center, with the stars Castor and Pollux of Gemini above it. As can be seen here, the zodiacal light tends to follow the ecliptic. The hours before sunrise around the autumnal equinox, when in the ecliptic makes a steep angle with the horizon, is one of the best times of year to see it.

The zodiacal light is produced by sunlight scattered off dust particles concentrated in the plane of the solar system. Until recently its source was uncertain, with comets or asteroids being flagged as likely culprits. In late 2013, on its way to Jupiter, the Juno spacecraft was pelted by tiny dust particles impacting at a speed of 16,000 km/h (10,000 mph). Enough data was gathered to determine that the particles follow the orbit of Mars. Dust from Martian storms is now believed to be the origin of the zodiacal light that we see from here on Earth, although the exact mechanism for ejection is unclear.

-- RS

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 December Meeting

Friday, December 9 at 7:30 pm

DART and the Dinosaurs

Dany Waller
Johns Hopkins Applied Physics Laboratories

The Double Asteroid Redirection Test (DART) was humanity's first attempt to change the course of an asteroid in space, to prove our ability to defend our planet from a potentially catastrophic impact event like the Chicxulub crater in the future. But fear not - DART's target asteroid is not a threat to Earth, before or after the impact! DART's target was chosen because it is part of a nearby binary system, a pair of asteroids orbiting a common point in space. DART successfully impacted the smaller asteroid (Dimorphos) so we could observe the effect a "kinetic deflection" has by monitoring the response in the larger asteroid (Didymos). This tenacious little spacecraft forever changed the way we think about near-Earth asteroids and how to protect our beautiful home world!] Dany Waller is a member of the DART Science Operations Center team.

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

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WAA January Meeting

Friday, January 13 at 7:30 pm

Cosmic Eras in the Infant Universe: What was happening during the first billion years?

Paul O'Connor
Instrumentation Scientist, Brookhaven National Laboratory

Astronomers and physicists build large facilities and instruments to tackle the big open questions of cosmology. In a previous lecture to WAA, Dr. O'Connor described Brookhaven Laboratory's work on the 3.2 gigapixel Large Synoptic Survey Telescope Camera, the world's largest digital camera, which will operate at the Vera Rubin Observatory in Chile. This lecture will review progress on the observatory's construction and will present several new instrument concepts for studying the physics of the early universe using the highly-redshifted radiation from atomic hydrogen, which we observe in radio frequency wavelengths.

Starway to Heaven

There are no star parties until March. Members can observe at the Meadow Parking Lot with prior notification to the park.

New Members

Chris Bubacz	White Plains
Mark Kleiman	Ossining
Michael Jen	Baldwin Place

Renewing Members

Kenneth Creary	White Plains
Eli Goldfine and Family	Larchmont
Manish Jadhav	Ossining
Albert Sayers	Pelham
Erika Soldano	White Plains
Robert Sour	Bedford
Robin Stuart	Valhalla
Jose Vega	Yonkers
Charles Wiecha	Hastings on Hudson
Albert Ysaguirre	White Plains

ALMANAC For December 2022

Bob Kelly, WAA VP of Field Events


Bob Kelly

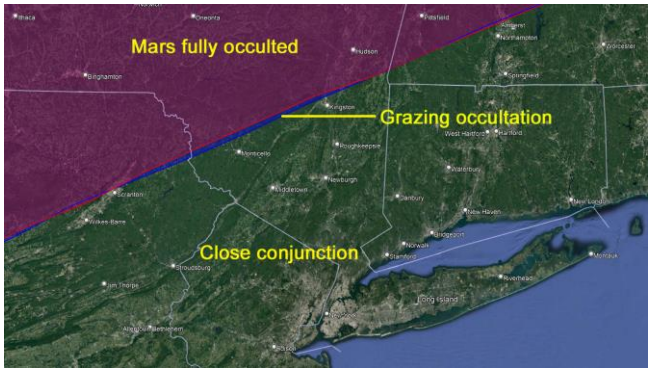

Full 12/7


3Q 12/16

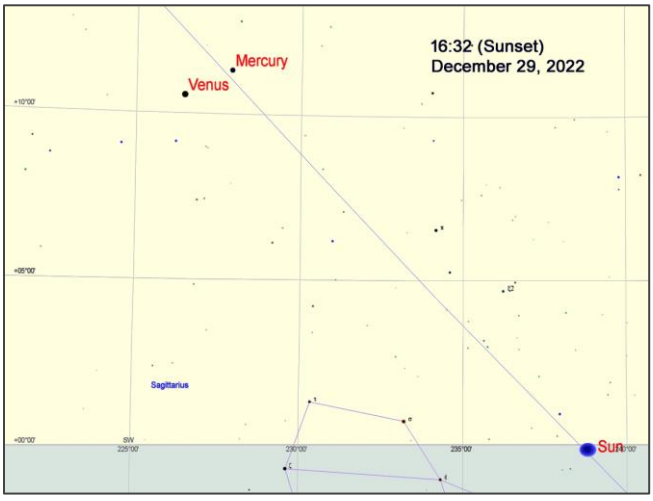

New 12/23


1Q 12/29

Mars starts the month closest to Earth and is the brightest planet at magnitude -1.9. Opposition occurs on the night of the 7th/8th. The Moon tries to rain on Mars' parade on the evening of the 7th by occulting Mars, visible in northern New York state. For our neck of the woods, the Moon will miss Mars by about one-quarter of the planet's diameter, the closest approach being at 10:56 p.m. EST.



Saturn takes its final bows ahead of conjunction with the Sun in February. Look for the shadow of the planet projected on the rings as a dark notch in the eastern side of the rings, behind the planet. Iapetus appears to skim along the outer edge of the rings on the evening of the 22nd.



Mercury and **Venus** came out from behind the Sun hand in hand into the evening sky in late November. Mercury leaps into the lead in December, getting away from Venus in the evening twilight. All of this will be happening very low in the west-southwest sky, just south of where the Sun sets. Mercury will get no higher than 12 degrees above the Sun, maxing out around December 24th. The 1-day old sliver Moon will join Venus and Mercury that night. On the 29th, Venus passes Mercury, putting an end to this 'Mercury first' nonsense. The two planets are so near each other on the 29th that the scene is worth trying to view in binoculars. Venus will then assert its dominance in the evening sky until August.

Jupiter remains the most prominent planet in the evening sky, halfway to the zenith in the south at the end of twilight. It's a great time to watch the dance of Jupiter's four brightest moons as they shuttle back and forth around the giant planet. Can you pick out the not so great, but quite red Great Red Spot? Check an app or planetarium software (there are several useful ones) for times when it faces our planet.

On the 24th, the **Moon** is closest to Earth 22 hours after New Moon. Look out for higher tides, especially if we get a coastal storm that weekend.

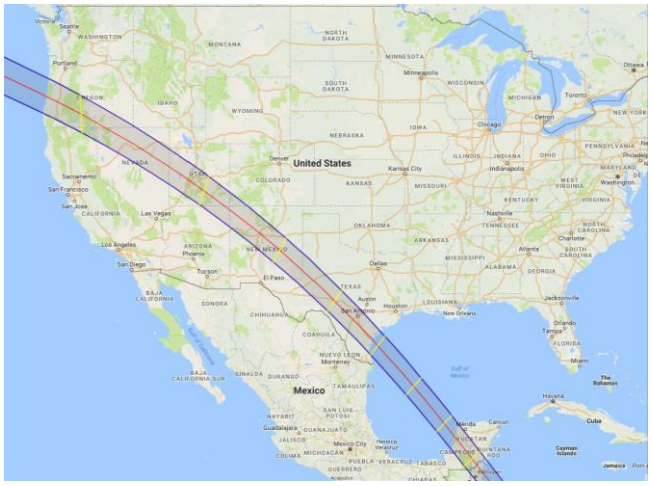
The **Geminid meteor shower** peaks after sunrise on the morning of the 14th. You might see several dozen meteors an hour before dawn, despite a last quarter Moon hanging out overhead. Since the Geminids approach the Earth from the side, and the radiant is up all night, you might see similar numbers in dark skies in the evening of the 13th and maybe after evening twilight on the 14th.

Northern Hemisphere **Winter Solstice** is on the 21st at 4:48 p.m., marking the least amount of daylight for the year. Are you still absorbing the shock of the earlier sunsets produced by the change to standard time on November 6th? Good news! Sunsets will start to move later after the 8th of December. Sunset will be 10 minutes later by the end of the month. For morning people, the Sun will rise 21 minutes later over the course of this month.

The **International Space Station** will be visible during the evening through the 10th and then in the morning starting on the 15th. ■

Solar System Highlights for 2023 — Bob Kelly

On October 14th, Westchester will get to see a **partial solar eclipse**. This is our view of the annular solar eclipse that will extend from Oregon to Texas and cross the Yucatan. In our area, no more than 24 percent of the Sun will be covered. The eclipse will last from 12:10 to 2:45pm EDT.



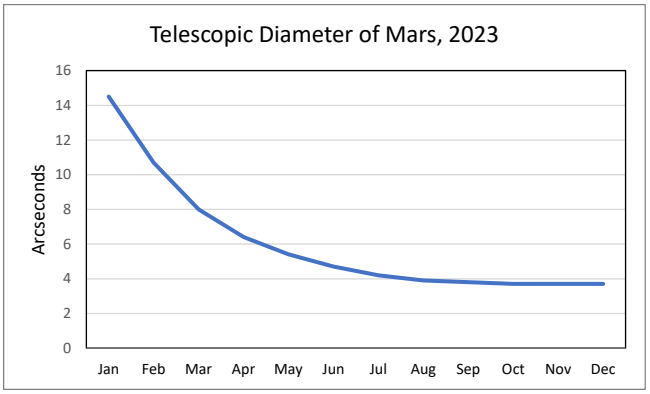
Path of annularity of the October 14, 2023 solar eclipse

The closing penumbral portion of a **lunar eclipse** may be visible as a slightly smudged Moon for a half hour after its rising on October 28th. The darkest part of the partial lunar eclipse ends before the Moon rises here.

Mercury makes four appearances in the morning sky and four in the evening sky in 2023. The best times for us to see the innermost planet are in mid-April in the evening and late September in the morning.

Venus dominates the western evening sky through July; it's highest above the horizon in May. It's back in the morning sky by the end of August, hanging there for the rest of the year. Venus is at its highest morning elevation in October and November and brightest in September at magnitude -4.8.

Mars is high in the evening sky in most of 2023, following its closest approach to Earth on December 8, 2022. The diameter of its disc will be shrinking rapidly as the distance between it and Earth increases. It settles too close to the Sun to be seen from October through the end of the year. Our next close approach to Mars occurs in January 2025. Mars' brightness will reach a minimum of magnitude +1.8 in early August.



Jupiter is visible in the evening sky until March. By May, it's back in the morning sky. We are closest to Jupiter at opposition on November 3rd, when it can be seen all night at its brightest, magnitude -2.9.

Saturn dives into the sunset in January. It comes into the morning sky in March. Saturn reaches opposition on August 27th. After that, it is an evening sky object through the end of the year. Compared to 2022, at opposition, Saturn will be somewhat higher in the sky and a bit brighter, at a maximum magnitude of +0.4.

Uranus and **Neptune** reach opposition on November 13 and September 19, respectively.

Vesta is the brightest of the dwarf and minor planets in 2023, maxing out at +6.6 at its opposition in December. **Pluto** dims to magnitude +15 this year.

"Supermoons" for 2023 occur on August 1/2 and August 30/31. The Moon's closest approach to the Earth for 2023 occurs on January 21st, only one minute from the time of new Moon.

It could be a great year for the August **Perseid** and December **Geminid** meteor showers, since they peak during a new Moon.

Comet C/2022 E3 (ZTF) will start the year up all night. It should be bright enough to find with binoculars in January and February and may get brighter than predicted.

Keep alert for news later in 2023 about **Comet 62P/Tsuchinshan**, reaching perihelion on Christmas Eve 2023.

Sources: Astronomical Phenomena for the Year 2023, US Naval Observatory and Her (now His) Majesty's Nautical Almanac Office. Guy Ottewell's Astronomical Calendar for 2023. ■

Brother Robert Novak, Ph.D.

We are sad to report that Brother Robert Novak, PhD, passed away on November 13.

Brother Novak was a long-time member and supporter of WAA, and a member of our Advisory Board.

He obtained his undergraduate degree from Iona and a PhD in physics from Columbia. He returned to Iona and was a faculty member there for 42 years. He was Chair of Physics at Iona College at the time of his recent retirement. His research focused on using terrestrial telescopes in Hawaii to detect methane and other trace gases in the Martian atmosphere. He received grant support from NASA's Astrobiology Institute at the Goddard Flight Center and the National Science Foundation, involving many undergraduate students in his projects. We were privileged to hear presentations about his research work at our February club meetings.

He was a coauthor of more than three dozen publications including two we think have particular significance: Mumma, MJ., Villanueva, GL, Novak, RE, Strong Release of Methane on Mars in Northern Summer 2003, *Science* 323:1041-1045 (2009), the first significant mapping of methane on Mars, and Villanueva, GL, Mumma, MJ, Novak, RE, et. al., Strong water isotopic anomalies in the Martian atmosphere: Probing current and ancient reservoirs, *Science* 348:218-221 (2015), which found evidence for an early ocean of considerable size on Mars.

He was a member of the Congregation of Christian Brothers (CFC), a religious order within the Catholic Church dedicated to education.

In addition to his teaching and research, Brother Novak coached the rowing teams at Iona.

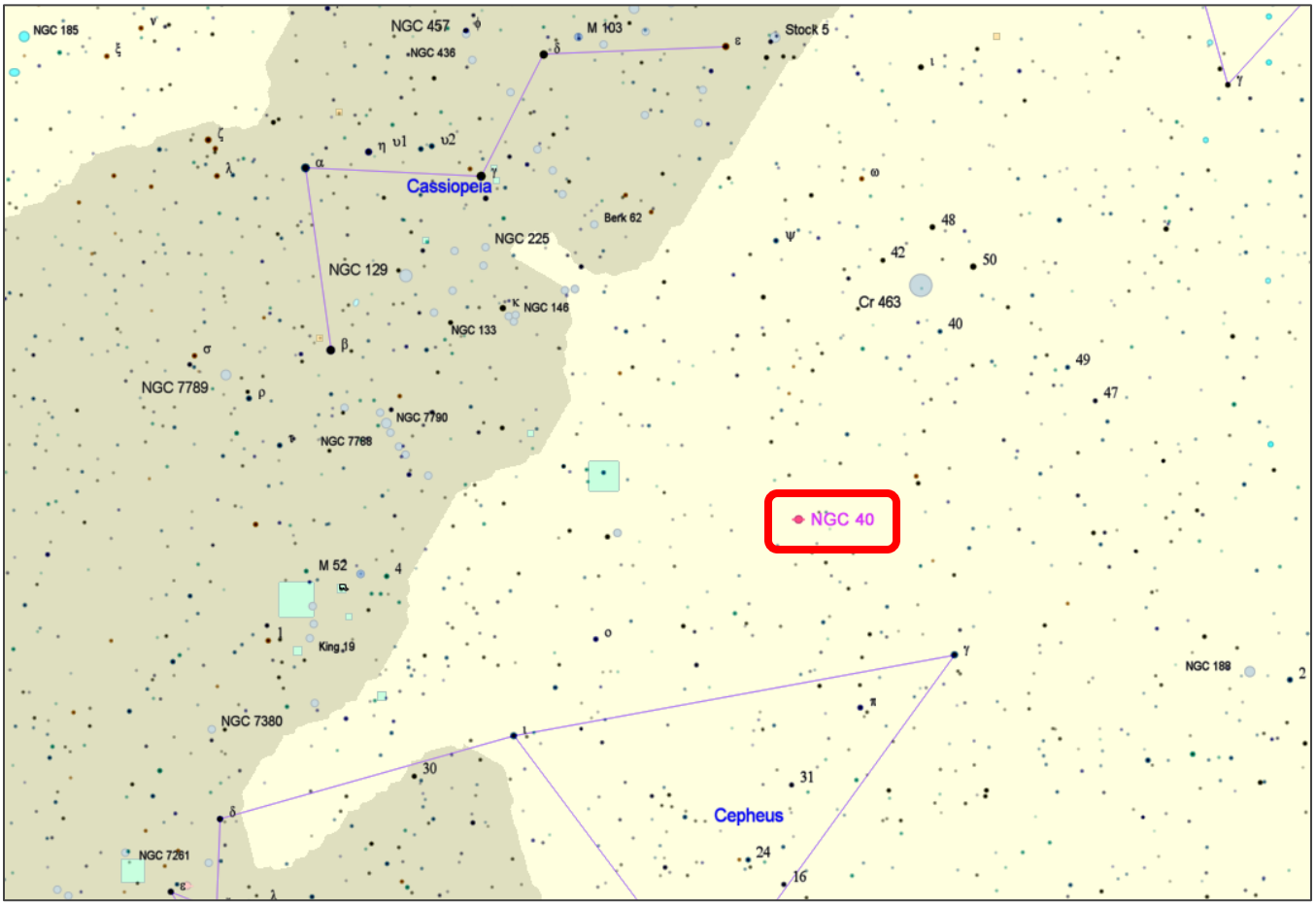
An enthusiastic teacher and astronomer with a wry sense of humor, Brother Novak will be missed by all who knew him.

Deep Sky Object of the Month: NGC 40

NGC 40, the Bow-Tie Nebula	
Constellation	Cepheus
Object type	Planetary Nebula
Right Ascension J2000	$00^h\ 13^m\ 01.015^s$
Declination J2000	+72° 31’ 19.085”
Magnitude	10.7
Size	38” X 35”
Distance	3,500 LY
Caldwell	C2
Discovery	William Herschel, 1788

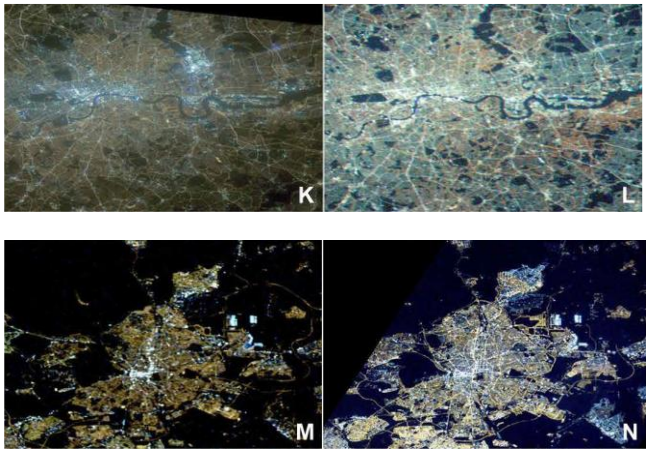
The central star, a hot Wolf-Rayet star with a temperature of over 50,000 K, is brighter than the nebula (unlike the Ring or Dumbbell). On a clear dark night with good optics and averted vision the nebula can be appreciated. Images show a more complex structure, with the nebula appearing red due to its hydrogen content. Look for it soon: in 30,000 years it will have dissipated.

Visibility for NGC 40			
10 p.m. EST	12/1/22	12/15/22	12/31/22
Altitude	54° 16’	50° 42’	46° 09’
Azimuth	341° 28’	338° 08’	336° 28’



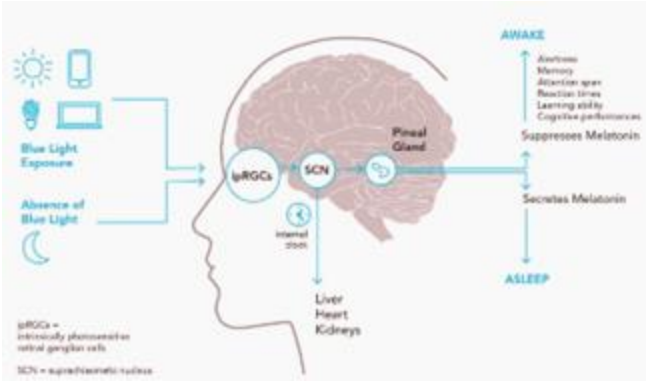
WAA Advocates for County Action on Light Pollution — Larry Faltz

Just like other populated places, Westchester's nights are too bright. The cause is not solely due to our proximity to New York City (our "dark sky" site at Ward Pound Ridge Reservation is just 40 miles from Times Square), but local development, increased numbers of blue-rich LED streetlights, more decorative home lighting, business illumination, and hyper-bright vehicle headlights also contribute. A recent study using calibrated photographs from the International Space Station[1] compared the color and intensity of night views of many major cities on Earth. Over less than a decade, all had become much brighter and much bluer. Blue wavelengths are the most disruptive to the biosphere. Circadian rhythms in humans, birds and even insects are more negatively impacted by blue light than by other wavelengths.



Calibrated images from the ISS:
Top row: London (K=2012, L=2020)
Bottom row: Madrid (M=2012, N=2017)

There are two main reasons why blue light is particularly problematical. The first is the neurophysiologic response to light. In addition to the image-forming rods and cones in the retina, there are "intrinsically photosensitive retinal ganglion cells" (ipRGCs).[2] These non-image forming cells use the chemical melanopsin to convert energy to electrical signals, rather than rhodopsin in rods and the three photopsins in cones. Melanopsin sensitivity peaks at 480 nm in the blue part of the spectrum. The ipRGCs send impulses to the suprachiasmatic nucleus (SCN) in the hypothalamus to regulate and synchronize circadian rhythms. The SCN communicates to other sites in the nervous system and to the pineal gland, where melatonin is synthesized and secreted. Melatonin is a typical peptide hormone: it binds to receptors on a wide variety of cells, triggering a cascade of intracellular chemical reactions that ultimately reach the cell's nucleus to activate or suppress various genes, influencing cellular function. Melatonin has significant effects on the endocrine and immune systems, as well as impacting blood pressure, alertness and sleep. Exposure to blue light, especially just prior to going to bed, suppresses melatonin and disrupts physiologic effects that the body needs. A potent source of blue light is LED screens in computers, televisions and smart phones. Don't use these just before bed (a tough rule to follow in modern life).

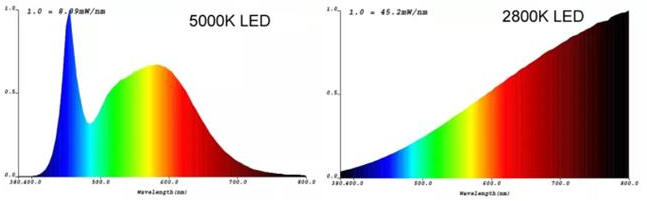


Neurological pathways of intrinsically phtosensitive retinal ganglion cells

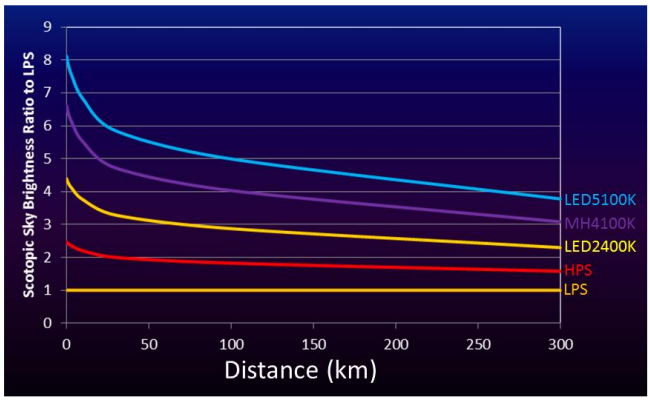
The second problem with blue light, primarily but not solely for astronomy, is scattering. Light in the visual spectrum scatters off small molecules in the atmosphere (N_2 and O_2), the amount of scattering proportional to the inverse fourth power of the wavelength (Rayleigh scattering). This means that blue wavelengths scatter more than red, which of course is why the sky is blue. Blue wavelengths from artificial sources scatter over longer distances than red wavelengths, illuminating the background and reducing contrast. Before the implementation of LED streetlights in the late 2000's, the sodium lamps in use had mostly yellow wavelengths that scattered less and could even be filtered out by astronomers. When LED streetlights first appeared on the scene and were rap-

[1] Sanchez de Miguel, A, et. al., Environmental risks from artificial nighttime lighting widespread and increasing across Europe, Sci. Adv. 8, eabl6891 (Sept. 14, 2022)
[2] ipRGCs were not identified histologically until around 1980, and melanopsin wasn't isolated until 2000.

idly adopted by cities and towns, they had a temperature of 5000 K,[3] throwing out massive amounts of blue light. It is only recently that lower temperature lights for commercial applications have been available, but most municipalities are not going to replace the older lights until the end of their lives, which can be as long as 25 years.



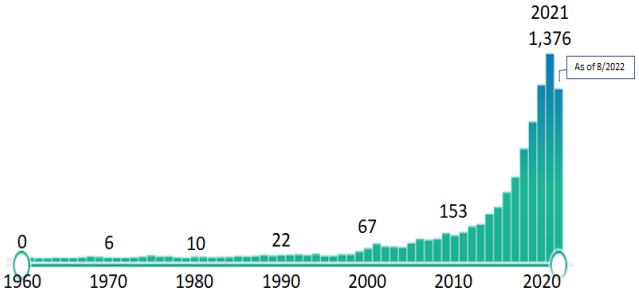
Spectral output of LEDs



Scattering of light from different sources (LED=light emitting diode, MH=metal halide, HPS=high pressure sodium, LPS=low pressure sodium)

Artificial light at night (ALAN) can have profoundly deleterious effects on human health and on ecology in general. One study concluded, "ALAN acts as an environmental disruptor with generally negative consequences on the brain, physiology, and behavior, including disruptions of clock gene rhythms, neuronal activity, immune function, hormone function, reproductive behavior, metabolic function, foraging activity, and migratory behavior."[4] Organisms in all biospheres, except perhaps the deepest oceans and darkest caves, evolved in a diurnal cycle of light and darkness, but now many places have a cycle of light and only less light. As Elizabeth Kolbert wrote in her 2014 Pulitzer Prize winning book *The Sixth Extinction*, "In times of extreme stress, the whole concept of fitness, at least in a Darwinian sense, loses its meaning: how could a creature be adapted, either well or ill, for conditions it has never before encountered in its entire evolutionary history?" It's no wonder that substantial changes are being detected in many biologic environments, including inside our bodies.

In human beings, ALAN is associated with increased risks of breast cancer and prostate cancer, Increased rates of obesity, myopia in school-age children, atopic diseases in young adults, nocturnal hypertension, poor sleep in older adults and Increased rates of behavioral disorders. The American Medical Association has made recommendations to control ALAN. The World Health Organization declared nightshift work a carcinogen. There is a growing research literature on ALAN's effects on a vast range of species, reflecting the mounting concern that lighting up the night is an attack on the entire environment.



Number of research papers in the PubMed database (National Library of Medicine), searching on "Artificial Light at Night." There will be well over 1700 papers in 2022.

Light pollution is increasing globally at more than 2% per year but the rate of increase is probably greater in our area. Those of us who have been observing at Ward Pound Ridge for at least 10 years acutely perceive the loss of the dark night sky. My SQM (Unihedron sky quality meter) used to measure 20.40 on a good night a decade ago, but on a particularly clear night this October it read a measly 19.99 (the Atacama Desert in Chile reads 21.8, and the darkest skies in the world are 21.99). We need to take action to keep things from getting worse.

The International Dark-Sky Association (IDA) advocates for improvements in lighting to reduce the deleterious effects of artificial light at night (ALAN). A benefit, of course, is the improved night sky for as-

[3] The temperature is the blackbody equivalent. For comparison, the Sun's surface temperature is 5780 K. When seen above the atmosphere, the Sun is bright white, like those LEDs..

[4] Bumgarner JR, Nelson RJ. Light at Night and Disrupted Circadian Rhythms Alter Physiology and Behavior. *Integr Comp Biol*. 2021 Oct 4;61(3):1160-1169

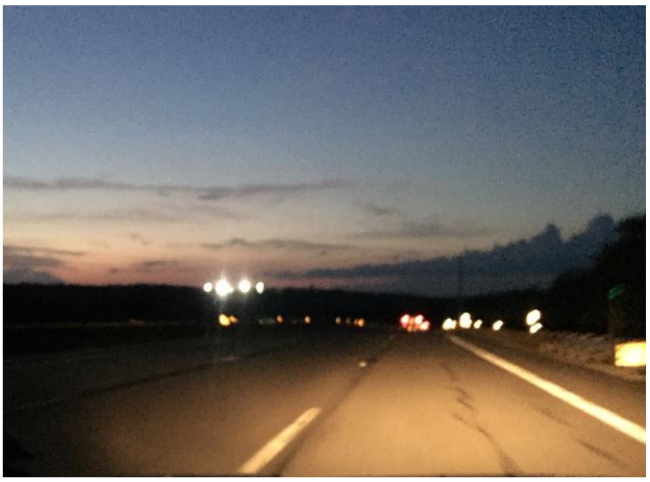
tronomers. But to interest the larger non-astronomer community, we need to make the broader case for reducing the intensity of ALAN: mitigation of harm to humans and animals and energy savings.

Many WAA members are also members of IDA. We feel it is time to be more organized and proactive in our quest for a darker night sky. While being so close to New York City is always going to be a problem, every unnecessary lumen we can eliminate locally, or even just shift towards the red, will have a benefit.

Light at Ward Pound Ridge. Note that it is not shielded.

On November 10, WAA Treasurer Paul Alimena and I had a working breakfast with Westchester County Executive George Latimer to discuss energizing local government to address the ALAN problem. We educated Mr. Latimer regarding the nature of light pollution, the growth of ALAN across the globe, human physiologic responses to it, the impact it has on human health, and the precepts of effective lighting as embodied in the IDA's outdoor lighting principles. We also talked about the actions that some towns and cities have taken to utilize lower-temperature LEDs, reduce light trespass and scatter, and decrease energy consumption. In particular, we highlighted the recent decision by Pittsburgh to adopt the IDA principles and require new construction and major renovations to meet them, as well as directing city facilities to reduce their nighttime light footprints.

We also showed some recent examples of undesirable lighting, including the infamous (to us) white LED at Ward Pound Ridge on the side of the main building, which is not shielded, and illuminates our viewing site some three-tenths of a mile away.[5] We showed him an image of the lights at the Granite Knolls sports complex, which was supposed to have been built with fully shielded fixtures that would be compliant with local lighting requirements. The installed fixtures were not shielded and cast bright, glaring beams into the eyes of drivers on the Taconic State Parkway and into the homes of residents of Putnam Valley.



Lights from the Granite Knolls Sports Complex as seen from the northbound Taconic State Parkway

We basically asked for three things from the county: (1) to assess its own facilities and implement changes consistent with good lighting practices; (2) to work with the municipalities, which control the actual rules for lighting in their jurisdictions; and (3) to assist us in with public awareness to reduce home and business light trespass and energy consumption. Mr. Latimer was eager to help us. He assigned one of his staff members to be our liaison. Of course we have to recognize the realities of dealing with government: the county can't drop or divert its vast responsibilities and limited resources to focus on us. But we can work together to address the issues. Mr. Latimer wanted to hear from for club members who live in Westchester via email; this would demonstrate the intensity of WAA's internal support. We sent a draft email to WAA's Westchester members on November 10 and many have responded. It's a good start. We'll keep you informed of progress.

■

[5] The WPRR management sometimes shuts the light off when we have a star party, but it's not a consistent practice.

Cartoons by Eli Goldfine

The Maya and Venus

Alex Mold

On September 16, 2022, I gave a presentation on the Maya Calendar at WAA's Members' Night. This article, the first in a series of follow-ups to that discussion, provides additional context for my statement that Venus was a special object in the night sky for the Maya.

The first facet of Venus that anyone can map using just a static point and their eyes is the path the planet snakes across the night sky. To properly track the apparent motion of the planet, you need to stand in the same spot at the same time each day, fixing your eye on a static point in the distance (it can be done with a stick, as shown in the diagram). Using this static point, align it with the planet Venus. Over the course of eight years, you can track the trajectory the line has to follow each time to reach Venus to build your own map of the apparent orbit (Aveni, 1997). While the exact method the Maya used is not recorded, this method of tracking Venus was likely the one used.

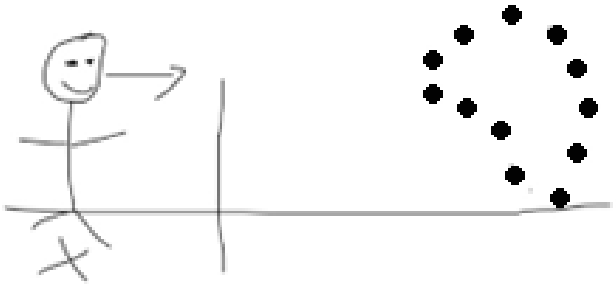


Figure 1: Sighting Venus

Venus has a repeating path in the night sky over the course of 584 days (see Figure 2). During this orbit, it is visible for 236 days, disappears behind the sun for 90 days, is again visible for 250 days, and disappears behind the sun for 8 days. This pattern explains why Venus can be a morning star and an evening star at least once a year, in rare occasions reaching a maximum of five cycles in a single year. With this understanding of Venus' apparent motion, how do archaeologists know the Maya appreciated this pattern (Aveni, 1997)?

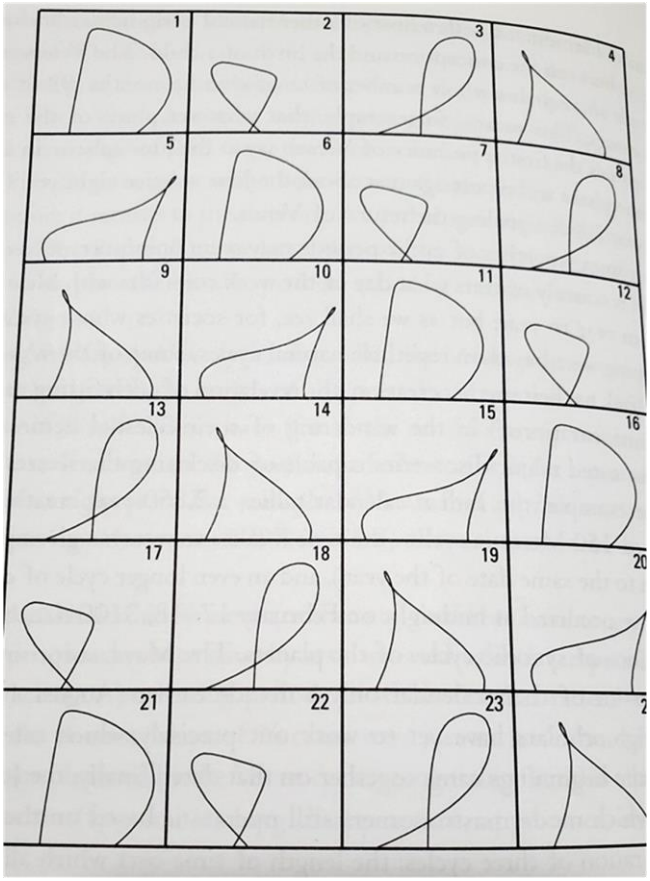


Figure 2: Venus' path in the sky for various apparitions

Figure 3, page 12, shows a map of the Maya city of Uxmal[1] located in the Northern Yucatan. All of the buildings align themselves along the East-West axis with the exception of a building called the "House of the Governor." This building is set off from the city's regular alignment, with a large open doorway facing south to southeast, which is an unusual feature for Maya architecture (Aveni, 1997; Milbrath, 2000). From the doorway to the House of the Governor, the view (today, anyway) is mostly jungle except for the top of the tallest temple in the nearby former Maya city of Cehtzuc. From the doorway (Figure 4, page 12) the top of the pyramid aligns itself with the southernmost point of Venus' rising. This architectural design is likely evidence of the importance of Venus in Maya society and further confirmation of the ruler's legitimacy as one who could predict the heavens (Milbrath, 2000) (Aveni, 1997). The ruler of Maya cities, usually male, traced his linage back to the first

[1] Pronounced "Ushmal."

four humans created by the Gods. According to the Maya creation myths, these humans, who followed Venus towards the Sun's first dawn, had descendants who ruled the Maya cities (Tedlock, 1996).

Figure 3: Map of the Maya city of Uxmal

The Dresden Codex is one of the best-preserved Maya books, with descriptions of their religion, astronomy, and ceremony. It contains a set of pages displaying a series of numbers. The Maya used a base 20 system with "dots" representing a value or quantity of one and "bars" representing five (Coe, 2012; Coe & Stone, 2006). The first bottom section represents the numbers 1-19. The section above represents the numbers 20-399. The next section above records the numbers 400-7999. It can continue upwards from there, but the Dresden Codex only requires an understanding of the first two sections. For an example, see figure 5, below.

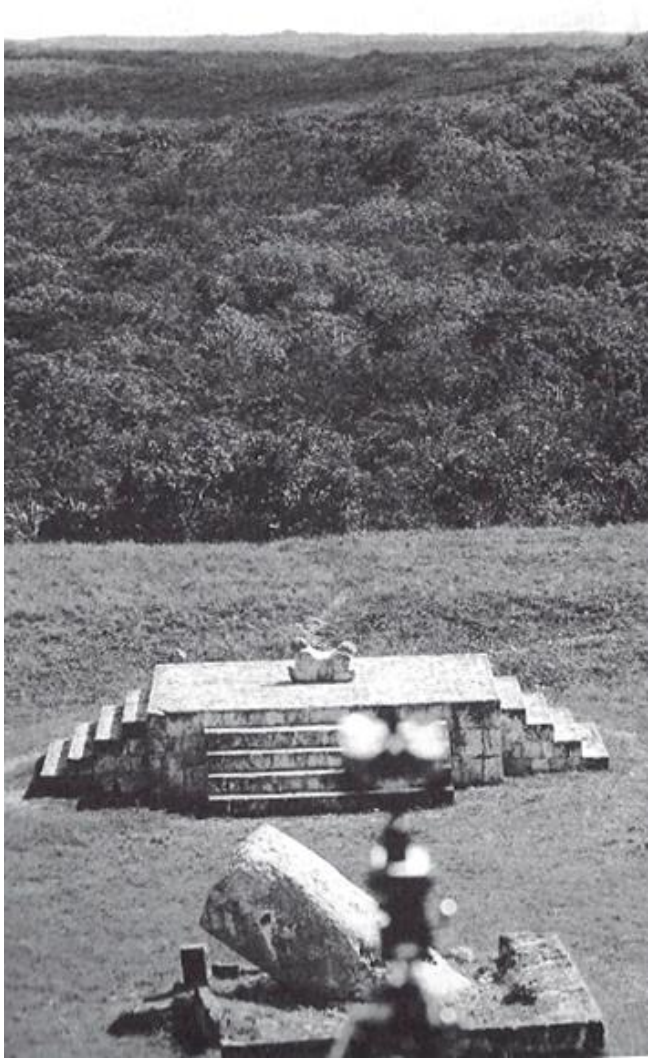


Figure 4: View from the doorway of the House of the Governor. note the small pyramid at the tree line at the top of the image.

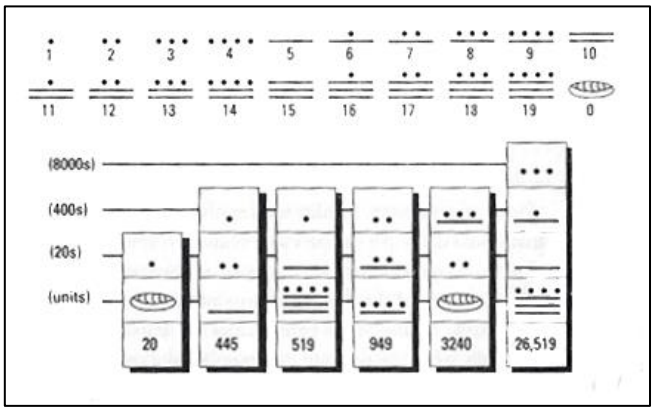


Figure 5: Counting in Mayan Hieroglyphs

The Dresden Codex uses five different Mayan hieroglyphs to describe the five different apparent orbits of Venus as seen in the bottom two lines on pages

46-50. These lines (figure 6 starred with a red 7-pointed star) show the same repeating pattern of 236, 90, 250, and 8 followed by a figure representative of Venus or, as the Maya called him, K'uk'ulkan[2] (Aveni, 1997).

The top table in figure 6 (starred with a blue 5-pointed star) shows the important dates in the calendar for each of the time periods listed below it. To properly read this, start at the top of the first page and read the adjacent column to the right then zig zag back and forth down the first two columns until reaching the end. At the end of the columns, return to the next two paired columns and continue reading in a zig zag patter (Coe & Stone, 2006). Each date listed represents the date in which a phase cycle of Venus changed. These dates are important to the Maya religion. The total length of time covered in these pages is 104 years, which corresponds to the time when Venus, the Moon, and the Sun are all back to their respective starting points in their cycles as the total time of the 584 Venus orbital days, 260 days tzolk'in[3], and 365 solar years are all evenly divisible by each other (Aveni, 1997).

From the Dresden Codex, the Maya were not content with simply drawing K'uk'ulkan; they also had separate glyphs dedicated to each face of K'uk'ulkan. These included clarifying glyphs about the nature of the orbit and the directionality. In figure 7, a series of glyphs from the Dresden Codex depicts how and from what direction Venus rose on its particular path across the night sky (Aveni, 1997). The purpose of tracking the path and date allowed for dates to align with proper representation of K'uk'ulkhan for religious holidays in the Tz'olkin. This alignment allowed for the right face of Venus to be worshiped at the proper time.

Each face of K'uk'ulkan from the Dresden Codex has a different meaning. These meanings change based on whether Venus is a morning star or an evening star (Coe & Stone, 2006). As a morning star, K'uk'ulkan the warrior has a shield and atlatl[4] because he fights the darkness from Xibalba, to bring forth the Sun. As an evening star, K'uk'ulkan is the priest who shepherds the Sun into Xibalba. These stories of K'uk'ulkan shepherding the Sun come from the *Popol Vuh*[5] where K'uk'ulkan appears above the horizon in the time before the Sun as the messenger for the Sun's arrival (Tedlock, 1996) (Milbrath, 2000).

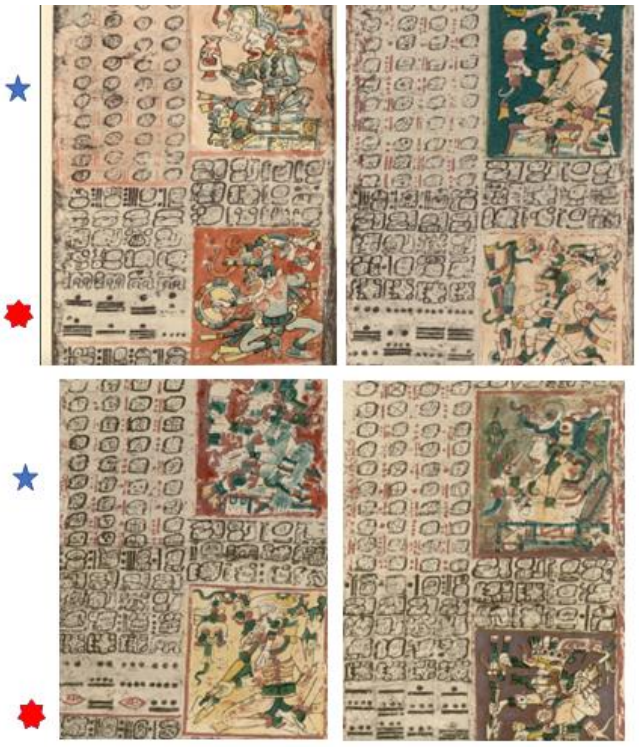


Figure 6: Pages 46-50 from the Dresden Codex. The red star at the bottom represents the apparent orbit of Venus which the reader can follow using the rules listed above. The blue star at the top are the dates that each of these changes in the position of Venus occur.

The Maya had a cult like devotion to K'uk'ulkan. They were not content with simply observing the sky and documenting changes, but actively chose to base their culture around the planet Venus. Maya architecture, urban planning, writing, and calendar-making reflect that devotion to this deity was truly an important aspect of life. Despite the end of the Classical Maya period nearly 1000 years ago, the impact of

[2] Coming from the words *k'uk'* meaning feather and *ul* turning it into the adjective *feathered* and *kan* meaning snake, more commonly referred to in Nahuatl as *Quetzalcoatl*. The k' sound is pronounced like stopping in the middle of the letter k.

[3] The 260-day calendar used for tracking religious holidays and celestial events.

[4] A type of spear throwing weapon.

[5] The Popol Vuh is the sacred text of the Maya. It tells the story of how the world was created, where the heavens came from, and it relates the story of mankind from creation to century noble lineages.

Venus on Maya society can still be observed in the artifacts from that area.

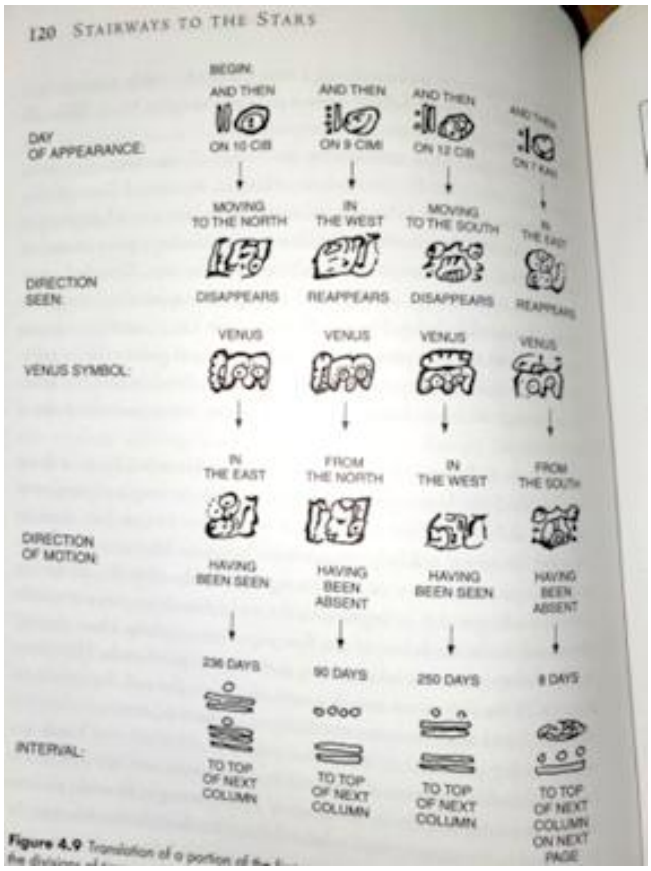


Fig 7: A series of Mayan hieroglyphs for K'uk'ulkan and a summary of how to read figure 5 (Aveni, 1997)

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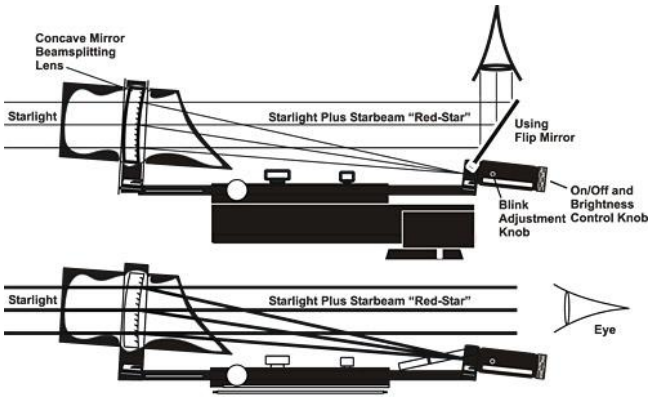
The author thanks Elle Chan for her editorial assistance. ■

From The Editor: Another Finder

Robin Stuart wrote to point out that I had neglected to mention the Televue Starbeam red-dot finder in my review in the November 2022 SkyWAAtch.

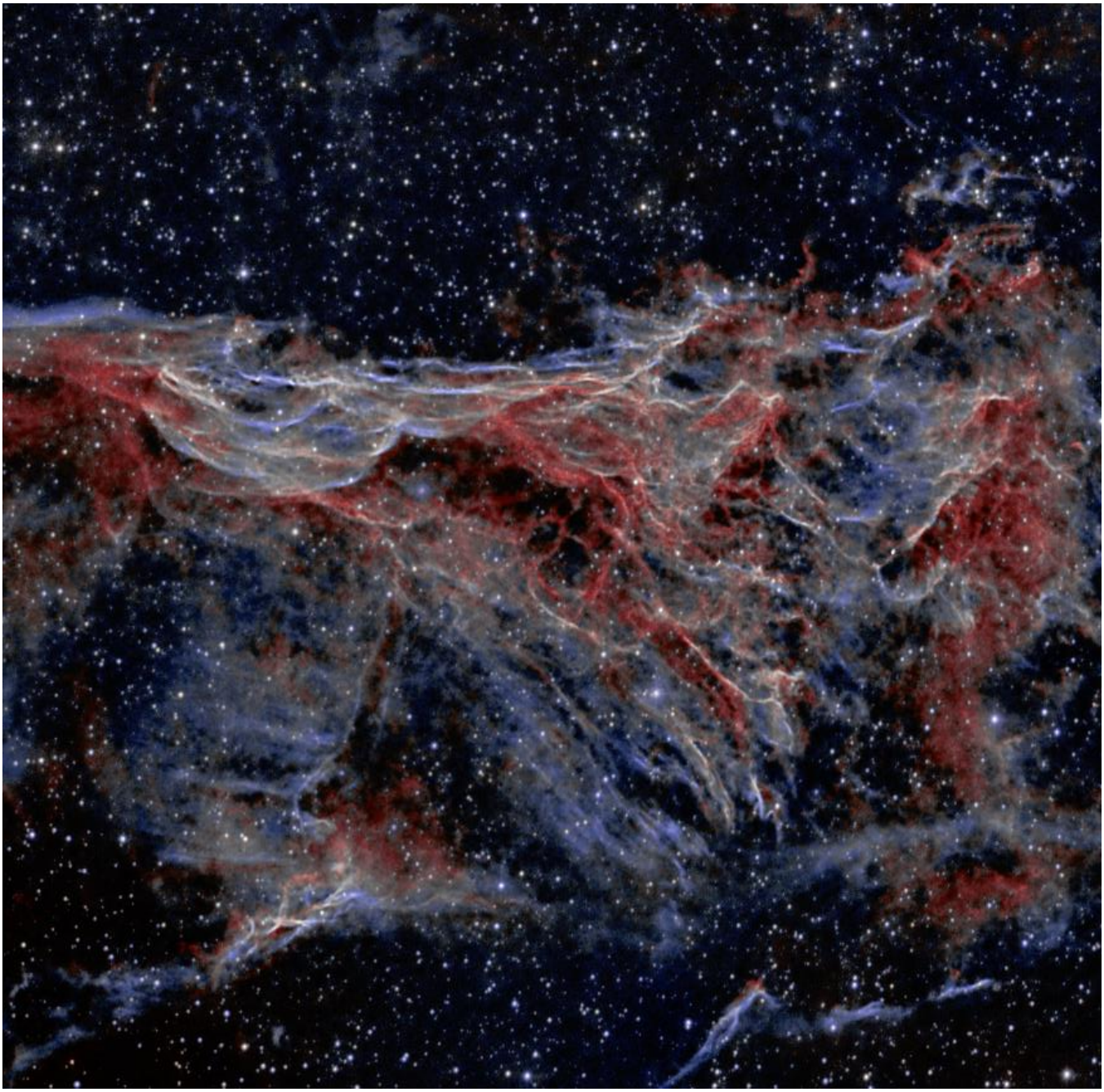
The Starbeam is a red-dot finder with a difference. The front lens acts as a beam-splitter, keeping the red dot stationary regardless of the angle of view. It has a flip mirror on the back end to allow sighting of objects overhead without craning your neck. However, when using it you can only see the field that's reflected in the mirror, which may not be as wide as you would like during the initial alignment step where the scope is often not that close to where you think it is. For alignment purposes, you don't want an overhead star, but even at 60 degrees the view might be suboptimal. I also suspect the flip mirror might be subject to dewing, and no commercial dew heater is available for it.



It's a typically solid Televue device, although the flip mirror may be a bit fragile. The Starbeam is somewhat large, and compared to other devices I mentioned last month, it's very expensive, currently listing at $349. The Starbeam has many adherents, although there are detractors as well. Of course, astronomy gearheads are notoriously opinionated, and there's hardly a piece of equipment out there that doesn't have its partisans and disparagers.■

Images by Members

Fleming's Triangular Wisp by Rick Bria



Fleming's Triangular Wisp, a detail of the Veil Nebula, is named after its discoverer, Williamina Fleming. She was one of the first Harvard "computers" and later became the leader of an extraordinary group of women who made many discoveries through their meticulous study of the photographic plates taken by the Harvard College Observatory. Originally, Edward Pickering, the head of the observatory, was given credit for the discovery, but it is now clear that Fleming first pointed out this object. The incredible story of Fleming and her colleagues is told in Dava Sobel's wonderful book, *The Glass Universe: How the Ladies of the Harvard Observatory Took the Measure of the Stars* (2017). This image was made using the PlaneWave CDK14 at Mary Aloysia Hardey Observatory in Greenwich.

The Double Cluster in Perseus by Gary Miller

One of the glories of the autumn and winter sky, the Double Cluster in Perseus consists of NGC 889, on the left of this image and east in the sky, and NGC 884. You need at least full degree of actual field of view to squeeze them into in eyepiece. They were seen by Hipparchus (see this month's Research Highlight on page 25) as a fuzzy patch, and first recognized as a cluster of stars by William Herschel on November 1, 1788.

It's not known for sure why Charles Messier didn't include them in his list. This omission is scrutinized in detail by Stephen James O'Meara in *Deep Sky Companions: The Caldwell Objects* (the Double Cluster is Caldwell 14). Messier's original list had 41 objects; before publication in 1774 he added four more: the Orion Nebula (M42 and 43), the Beehive (M44) and the Pleiades (M45). But, asks O'Meara, why not the Double Cluster? O'Meara notes that the Messier catalogue was not intended to be a list of the greatest treasures in the sky, which is how we use it today, but a guide for serious comet hunters, telling them what to avoid when looking for new comets. O'Meara's thesis is based on the manner in which comet-hunting was done in the 17th century, primarily scanning within 45 degrees of the Sun, since comets get brighter as they approach perihelion. Serious comet hunters would have known about the Double Cluster since it was so obviously a non-moving object, and during the times it is within 45 degrees of the Sun they would not be fooled by it.

Because it is in the Perseus arm of the galaxy, there's enough dust to dim it by about 1.6 magnitudes. The clusters are thought to be about 13 million years old. Each component has a population of about 300 stars, many of which are blue-white supergiants, but there are enough cooler, older stars to provide some color.

Images from Arizona Dark Skies by Arthur Miller

WAA member Arthur Miller spends the winter months in the resort community of Quail Creek, Arizona, about 25 miles south of Tucson and just 14 miles from Mt. Hopkins and the Fred Lawrence Whipple Observatory, the largest unit of the Smithsonian Astrophysical Observatory, which hosts the 6.5-meter MMT and the Veritas Array. Quail Creek has lighting restrictions, like Tucson and its scattered surrounding desert municipalities. The Quail Creek governing documents note that the development "has been established as a Low Ambient Lighting Zone in line with local Dark Sky ordinances and restrictions. As part of this approach, Quail Creek does not have street lighting."

Under the dark skies of the Sonoran Desert, Arthur images with an 11-inch Celestron Edge SCT on an Astrophysics GTO3 mount. A Celestron 0.7X focal reducer/field flattener routes the image to QSI 683, QSI 6120 or QHY 268C cameras. Guiding is done with a Vario guide scope and Lodestar X2 camera. The equipment is controlled with Focusmax V4, Maxim DL, TheSkyX and CCD Commander.

Arthur usually takes 5-minute subs, gathers data for an hour then moves to a star to refocus. Then he returns to the object, plate solves for field accuracy and acquires more data. He usually obtains four hours of signal which he processes with Pixinsight WBPP, Startools and Photoshop CS6 with Topaz add-ons.

An active member of the Sonoran Desert Astro Imagers, Arthur participates in their meetings via Zoom when he is in New York.

Arthur sent us a more than a dozen images, which we'll spread out over a few issues of SkyWAAtch.

Messier 63

"Sunflower Galaxy" in Canes Venatici

IC 405

(detail)

Flaming Star Nebula,
SH 2-229
Caldwell 31 in Auriga

Messier 31, M32 and M110

Andromeda

This image was made with a Starizona Hyperstar, which converts the f/10 SCT to an f/2 astrograph.

Horsehead Nebula

Barnard 33

Orion

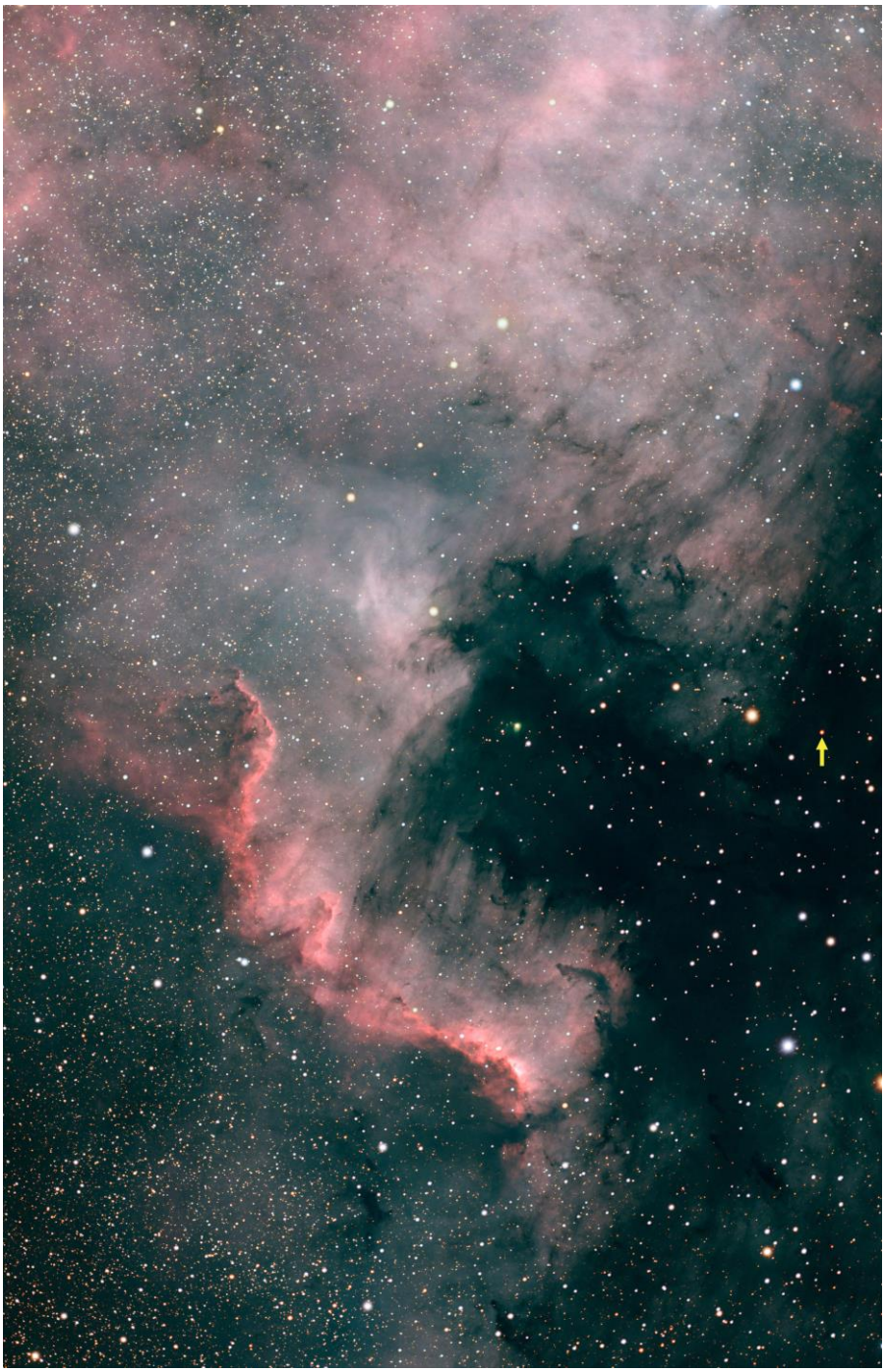
NGC 4565

Needle Galaxy

Caldwell 38

Coma Berenices

More Images from Robin Stuart



This image of the North American Nebula (NGC 7000) in Cygnus is a stack of 34 10-minute subframes taken over 3 nights in August and September in Eustis, Maine. I used a ZWO ASI2600MC camera on a Televue NP127.The total exposure was 5h 40m. It was processed with PixInsight with Photometric Color Calibration and therefore is a close match to the colors as they would be perceived by the human eye. The nebulosity and stars were separated using Starnet2 and stretched separately before being recombined.

This HII region lies 2,600 light years from Earth. The source of the ionizing radiation energizing the emission nebula is the so-called Bajamar Star (Gaia EDR3 ID 2162889493831375488), shown with an arrow at the right center of the image. It is a binary system with one component that blazes with a scorching surface temperature of 40,000 K. For comparison the Sun's surface is a relatively modest 5,800 K. Note that the Bajamar Star is located roughly at the center of the bright arc of the Cygnus Wall that runs along the "Pacific coast of Mexico." Although we see the star as magnitude 13.2, it would shine with a magnitude of 3.6 if its light was not attenuated by a factor of nearly 10,000 by an intervening dark cloud. The cloud's presence is hinted at by the relative paucity of stars in the "Caribbean" compared to the "Pacific." The Bajamar Star is named for its location off the nebula's "Florida coast" with *Islas de Bajamar* (Low Tide Islands) being the original Spanish name for the Bahamas.

Compare the color of this image to the deep red produced with a narrowband filter on page 21 of the October 2022 WAA newsletter. Here the nebula gets its pinkish hue from a combination emission and reflected light. By subtracting an image taken a through a Radian Triad Ultra filter from the unfiltered image we are left with the ghostly white outline of the reflection nebula.

The name ***Cave Nebula*** was coined by Patrick Moore for this rich region in Cepheus, designated Caldwell 9 in his catalog. It's a collection of emission, reflection and dark nebulosity along with an abundance of stars. Variation in the density of stars across the field traces the absorption of light by interstellar matter.

The image is a stack of 33 10 minute subframes for a total 5½ hours of exposure over two nights in Eustis, Maine. ZWO ASI2600MC, TeleVue NP127.

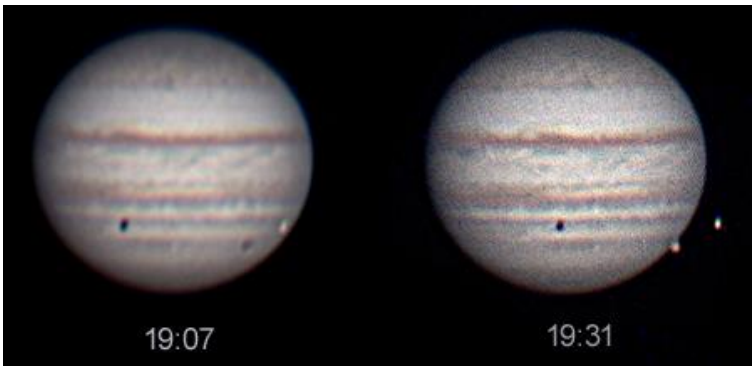
Gossamer folds of nebulosity are illuminated by the stars of the **Pleiades (**Messier 45, also called the "Seven Sisters.") The nebulosity is a chance encounter with dust in the interstellar medium, not material left over from the cluster's formation. The stars are moving at 18km/s relative to the dust in the nebula. The Pleaides are relatively young, having been formed within the last 100 million years. At a distance of 444 light years, they are one of the closest clusters to Earth. The image is a stack of 12 10-minute subframes for a total of 2 hours exposure on October 29. Same equipment as above.

-Robin Stuart

Double Shadow Transit of Jupiter, November 2, 2022 by Larry Faltz

The distorted ovoid shadow of Ganymede (8 o'clock) has just fallen on Jupiter's western edge as the smaller circular umbra of Europa (4 o'clock) is preparing to move off the planet's face. Ganymede is the larger of the two moons on the right, with Europa farther from the planet's disc on the image, but in a closer orbit. Io is on the left, having come out of eclipse 30 minutes earlier.

The image was made at 20:32 EDT with a Celestron CPC800, Celestron 3X Barlow (f/30), Mallincam DS287 camera (1/3" CMOS sensor, 720x540 pixels). The small but sensitive DS287 is very fast: it acquired the frames at a rate of 313 fps. Processing with Autostakkaert!3 (best 25% of 5000 frames) and Registax 6.1. Taken at the Crossways Ballfield, Scarsdale. Jupiter was 41 degrees above the horizon.



I made the first image of the evening at 19:07 with a 2X Barlow (f/20). Jupiter was just 30 degrees above the horizon. Europa was a shiny spot right on the planet's eastern limb at the 4 o'clock position. Just below it and to its left, the dark dot is Ganymede (not its shadow!). Europa's shadow is seen further to the left, on a band closer to Jupiter's equator. I watched as Europa crossed the limb, with Ganymede following it about 20 minutes later. I adjusted the image scale to make the discs the same size.

LF

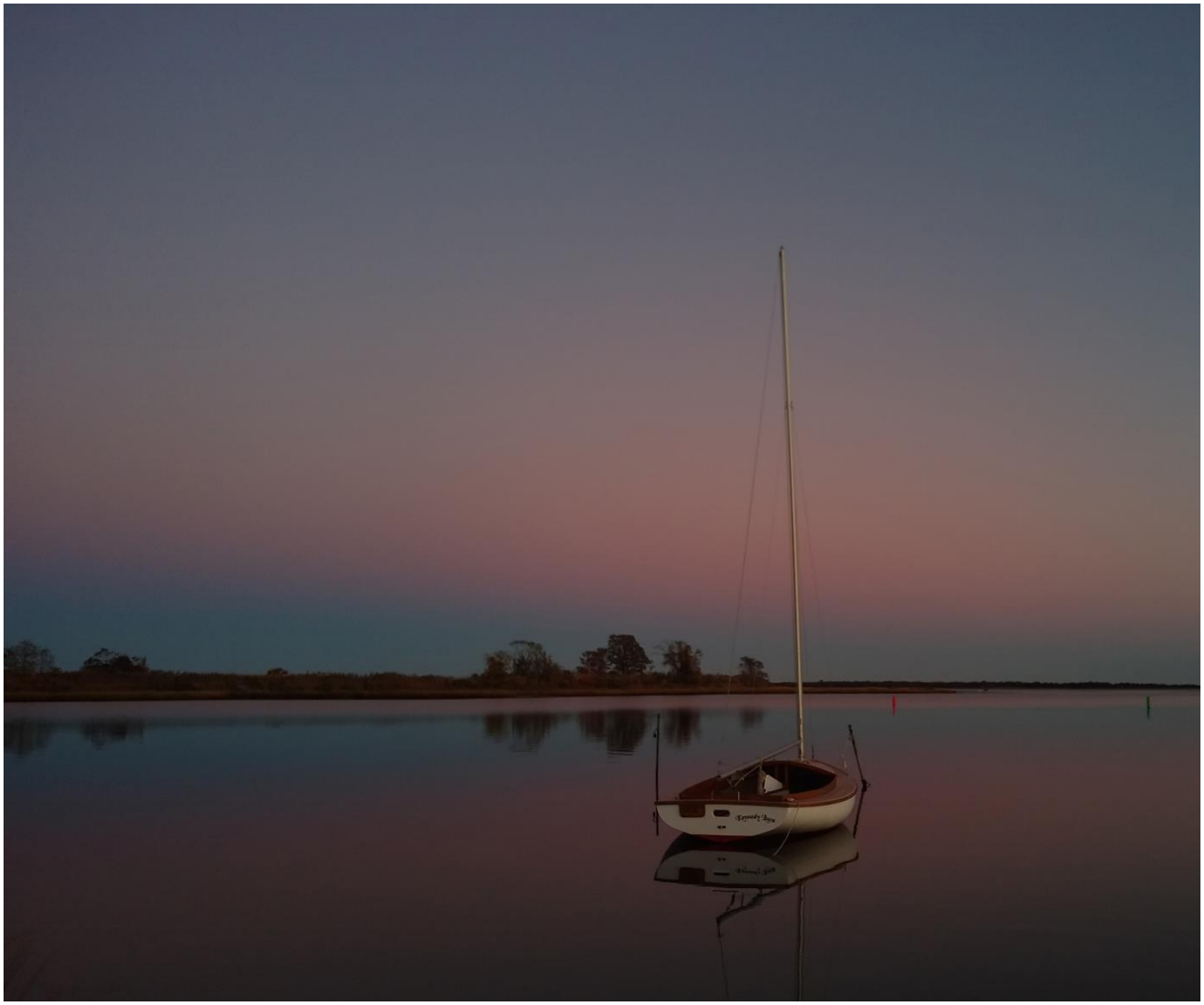
November 8 Lunar Eclipse

Steve Bellavia put together a sequence of images from just after the eclipse started until mid-totality.

Rick Bria's image at 5:16 a.m. with TV-85 and Canon DSLR, from the Mary Aloysia Hardey Observatory in Greenwich, CT

Elyse Faltz (blue hat) observed the eclipse with Sky &Telescope Senior Editor Kelly Beatty and his wife Cheryl. They were at the Quaker Ridge School on Weaver Street. Photo by Larry Faltz.

Steve Bellavia Proves the Earth is Round!



Steve sent in this painterly image, looking east just after sunset at Orient Point on the North Fork of Long Island on October 29. The Belt of Venus is clearly seen, with the dark band of the Earth's dark shadow under a reddish zone of reflected sunlight. The color is due to longer (red) wavelengths of sunlight getting reflected to the observer by atmospheric particles, the blue wavelengths having already been scattered by small molecules (N_2 and O_2) during their first pass across the atmosphere at sunset. The Earth's shadow noticeably tapers towards the right (south) because the Earth, being round, casts a circular shadow. The Belt of Venus, if you can see it from horizon to horizon, would be a complete arc 180 degrees in extent, although it might be so thin at the margins, and lost in the airmass, as to be invisible. The Earth's dark shadow is highest in the middle, opposite the Sun, which has set below the horizon behind the observer (or has not yet risen for pre-dawn Belts of Venus, seen in the west). The Belt is generally more vivid during the winter months.

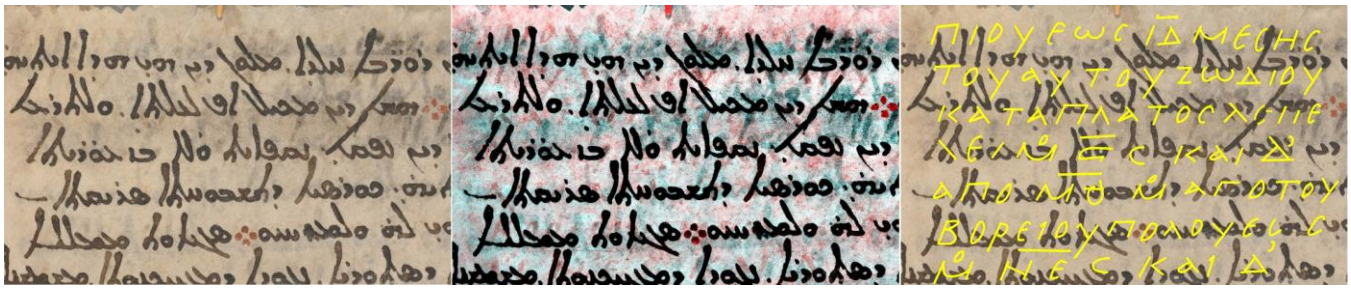
This is one of the two visual phenomena for an observer on the Earth's surface that proves the Earth is round (if it was flat, the shadow wouldn't be an arc), the other being the Earth's shadow on the Moon during the partial umbral phase of a total lunar eclipse, as seen on page 23.

Research Highlight of the Month

Gysembergh, V., Williams,P.J., Zingg, E. New evidence for Hipparchus' Star Catalogue revealed by multispectral imaging, *Journal for the History of Astronomy* (2022) 53: 383-393 (https://is.gd/hipcat). Commentary in *Nature* (Oct. 18, 2022) at https://www.nature.com/articles/d41586-022-03296-1.

The only text by the great Greek astronomer Hipparchus to come down to us is his Commentary on Aratus' *Phaenomena* (Aratus wrote it in c. 275 BC) itself a version of a work by the same name by Eudoxus (c.360 BC). His other 13 books no longer exist but his discoveries, among them, trigonometry, lunar motion and the precession of the equinoxes, were commented upon in detail by Strabo and Pliny. He was said to have made an accurate celestial map, and even a celestial globe. The positions of the stars given by Claudius Ptolemy in the *Almagest* (c. 150 AD) are mostly taken from Hipparchus' catalog, complied in 129 BC, of around 850 stars, as Ptolemy notes. Ptolemy's star positions are expressed in ecliptic coordinates while Hipparchus apparently measured offsets from the celestial equator, and Ptolemy also used his own observations and a few from other astronomers.

A trio of French scholars examined the *Codex Climaci Rescriptus*, a collection of Syriac texts dating from around 1,000 AD. These palimpsests (material on which the original writing has been erased to make room for later writing, but traces of the original remain) were originally located at the Greek Orthodox St. Catherine's Monastery in the Sinai peninsula but are now held at the Museum of the Bible in Washington, DC. Multispectral imaging at the Early Manuscripts Electronic Library in California and the University of Rochester in New York revealed astronomical information in Greek dating from the 5th or 6th-century AD, including some of Aratus' *Phaenomena* and passages by Eratosthenes, the great Alexandrian scholar who also commented on Aratus. Some of the Greek text was interpreted to be the coordinates of stars in the constellation Corona Borealis. Adjusted for the precession of the equinoxes, the star positions lined up with those in 129 BC. The authors used the free software *Stellarium* to check the coordinates. They believe that these coordinates are Hipparchus' actual measurements.



An excerpt from the *Codex Climaci Rescriptus*. (L) The text as it appears in normal light; (C) One of the multispectral images, showing the Greek text emerging from behind; (R) In yellow, tracing of the Greek text.

The translated text reads:

> Corona Borealis, lying in the northern hemisphere, in length spans 9¼° from the first degree of Scorpius to 10¼° in the same zodiacal sign (i.e. in Scorpius). In breadth it spans 6¾° from 49° from the North Pole to 55¾°.
>
> Within it, the star (β CrB) to the West next to the bright one (α CrB) leads (i.e. is the first to rise), being at Scorpius 0.5°. The fourth star (ι CrB) to the East of the bright one (α CrB) is the last (i.e. to rise) [unclear] 49° from the North Pole. Southernmost (δ CrB) is the third counting from the bright one (α CrB) towards the East, which is 55¾° from the North Pole.

The authors also confirmed that coordinates for Ursa Major, Ursa Minor and Draco, given in a medieval Latin version of Aratus' *Phaenomena,* must also come directly from Hipparchus. He probably used an armillary sphere and/or a dioptra (a sighting tube fitted with protractors to measure altitude and azimuth). The positions seem to be accurate to within one degree, or even less. ■

Member & Club Equipment for Sale

Item	Description	Asking price	Name/Email
Televue Big Barlow	2” Barlow. 1.25" eyepiece adapter, 48 mm filter threads, captive lock screws, brass compression ring, full multicoating on the high quality optics. Weight 0.75 lb.	Best offer	Peter Rothstein peterrothstein01@gmail.com
Telrad finder	Excellent condition, with removable base.	Best offer	Peter Rothstein peterrothstein01@gmail.com
Celestron 127mm Maksutov-Cassegrain	f/11.8. Celestron’s version of this compact, high-performing telescope. Excellent optical and cosmetic condition. Well cared for. OTA only. Image here.	$400	Manish Jadhav manish.jadhav@gmail.com
Orion Short Tube 80mm refractor	2-element achromat f/5.0. Metal tube rings and dovetail for Vixen saddle. A classic travel scope. Excellent optical condition, and very good cosmetic condition. Diagonal and a 25mm Celestron eyepiece included. Image here.	$200	Manish Jadhav manish.jadhav@gmail.com
Celestron Cometron telescope	Small, lightweight 114 mm f/4 reflector. Red dot finder, 25 mm eyepiece. Dovetail bar with tapped ¼x20 hole (for camera tripod). A starter scope for a smart, interested child. No tripod. Excellent condition.	$50	WAA Ads@westchesterastronomers.org
Meade 8” SCT LX-80	Go-to mount, tripod. Tube wrapped in Reflectix for faster cooling. See https://is.gd/16F0Tv.	$600	Greg Borrelly gregborrelly@gmail.com
Celestron SE mount	No optical tube. Go-to alt-az mount and tripod. Can carry 12 lb payload or tube up to 17”. Upgradeable hand control.	$300	Greg Borrelly gregborrelly@gmail.com
Celestron Binoviewer	Use both eyes with your telescope. Original case, with two 18-mm eye pieces.	$180	Greg Borrelly gregborrelly@gmail.com

Want to list something for sale in the next issue of the WAA newsletter? Send the description and asking price to waa-newsletter@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 members.

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 subject to prior sale. WAA is not a party to any sale unless the equipment belongs to WAA (and will be so identified). Sales of WAA equipment are final. *Caveat emptor!*

A couple weeks back, I took my kids on a trip to New Mexico, just the three of us. One of our hotels was just a couple minutes' walk from the plaza in Taos and had its own secluded courtyard. Even though it was cold, in the teens, I stepped outside without a coat and looked up. The Moon hadn't risen yet. While I watched, I counted eight Pleiades, though, who knows, we all lie to ourselves sometimes, and the rest of the sky was glowing with starlight. Eventually, my younger kid came out broke the stillness, and pulled me back in, but there really is magic there if you know where to look. It's something I'm very thankful for.

--Scott Levine, November 2022

Binoculars: A Great First Telescope

David Prosper

Do you want to peer deeper into the night sky? Are you feeling the urge to buy a telescope? There are so many options for budding astronomers that choosing one can be overwhelming. A first telescope should be easy to use and provide good quality views while being affordable. As it turns out, those requirements make the first telescope of choice for many stargazers something unexpected: a good pair of binoculars!

Binoculars are an excellent first instrument because they are generally easy to use and more versatile than most telescopes. Binoculars can be used for activities like stargazing and birdwatching, and work great in the field at a star party, along the hiking trail, and anywhere else where you can see the sky. Binoculars also travel well, since they easily fit into carry-on luggage – a difficult feat for most telescopes! A good pair of binoculars, ranging in specifications from 7x35 to 10x50, will give you great views of the Moon, large open star clusters like the Pleiades (M45), and, from dark skies, larger bright galaxies like the Andromeda Galaxy (M31) and large nebulae like the Orion Nebula (M42). While you likely won't be able to see Saturn's rings, as you practice your observing skills you may be able to spot Jupiter's moons, along with some globular clusters and fainter nebulae from dark sites, too.

What do the numbers on those binocular specs actually mean? The first number is the magnification, while the second number is the size in millimeters (mm) of the lenses. So, a 7x35 pair of binoculars means that they will magnify 7 times using lenses 35 mm in diameter. It can be tempting to get the biggest binoculars you can find, but try not to get anything much more powerful than a 10x50 pair at first. Larger binoculars with more power often have narrower fields of vision and are heavier; while technically more powerful, they are also more difficult to hold steadily in your hands and "jiggle" quite a bit unless you buy much more expensive binoculars with image stabilization, or mount them to a tripod.

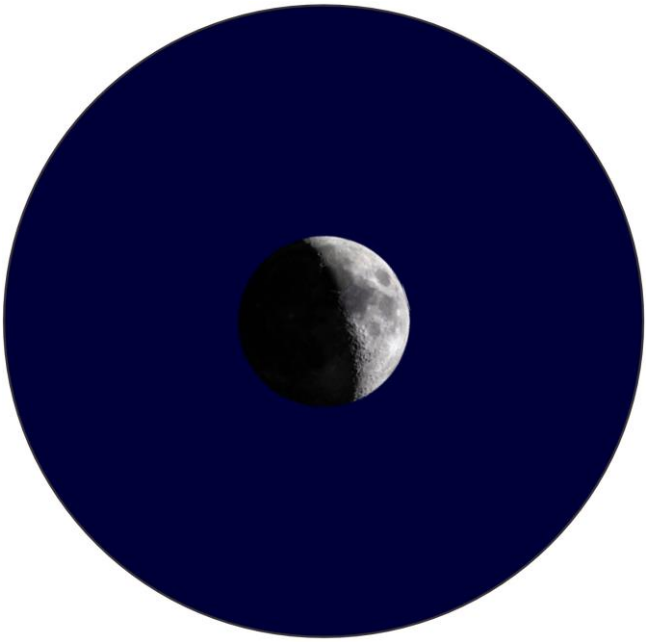
Would it surprise you that amazing views of some astronomical objects can be found not just from giant telescopes, but also from seemingly humble binoculars? Binoculars are able to show a much larger field of view of the sky compared to most telescopes. For example, most telescopes are unable to keep the entirety of the Pleiades or Andromeda Galaxy entirely inside the view of most eyepieces. Binoculars are also a great investment for more advanced observing, as later on they are useful for hunting down objects to then observe in more detail with a telescope.

If you are able to do so, real-world advice and experience is still the best for something you will be spending a lot of time with! Going to an in-person star party hosted by a local club is a great way to get familiar with telescopes and binoculars of all kinds – just ask permission before taking a closer look! You can find clubs and star parties near you on the Night Sky Network's Clubs & Events page at bit.ly/nsnclubsandevents, and inspire your binocular stargazing sessions with NASA's latest discoveries at nasa.gov.

The two most popular types of binocular designs are shown here: **roof-prism** binoculars (*left*) and **porro-prism** binoculars (*right*). Roof prisms

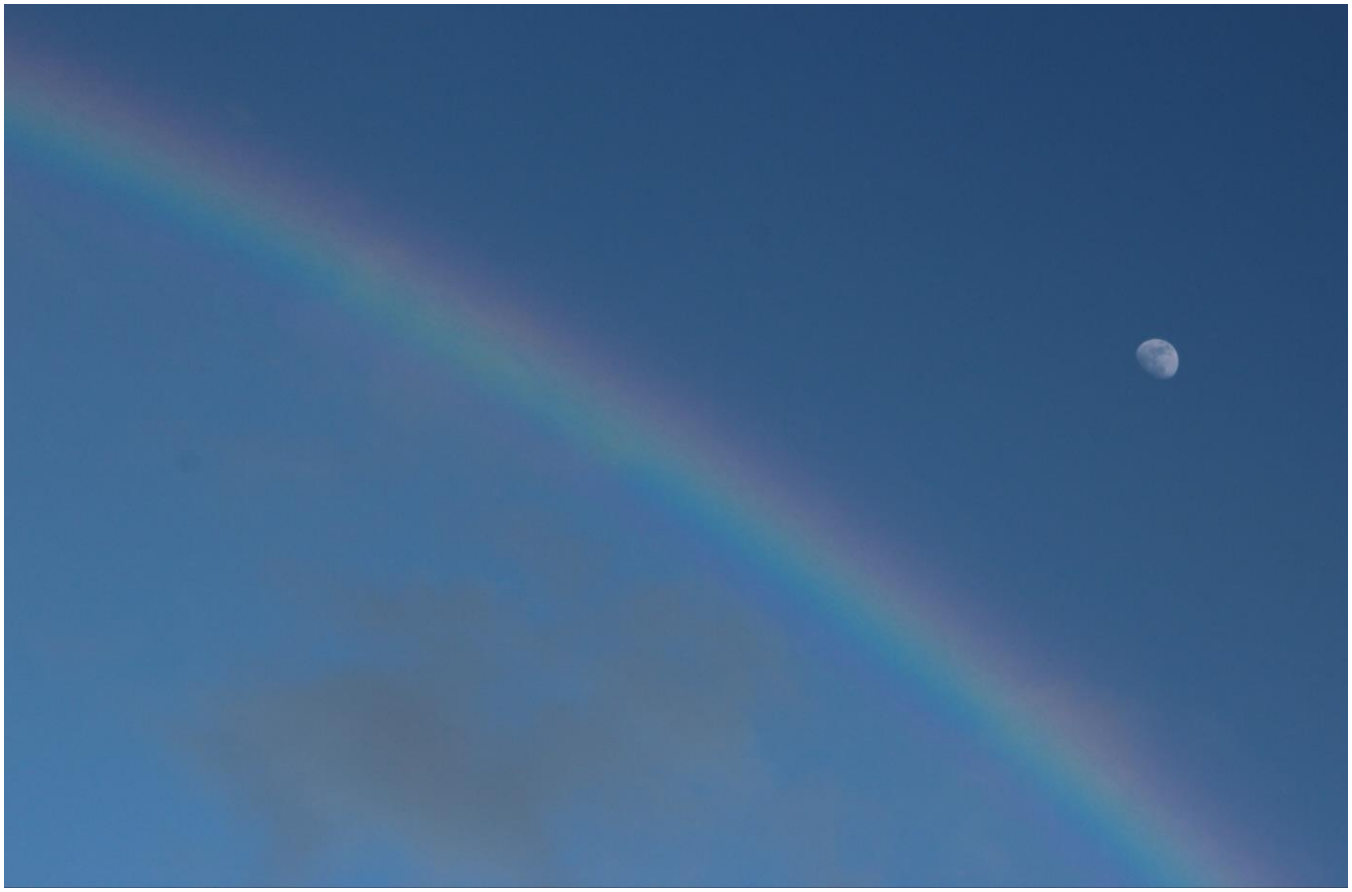
tend to be more compact, lighter, and a bit more portable, while porro-prisms tend to be heavier but often offer wider views and greater magnification. What should you choose? Many birders and frequent fliers often choose roof-prism models for their portability. Many observers who prefer to observe fainter deep-sky objects or who use a tripod with their observing choose larger porro-prism designs. There is no right answer, so if you can, try out both designs and see which works better for you.

A pair of good binoculars can show craters on the Moon around 6 miles (10 km) across and larger. How large is that? It would take you about two hours to hike across a similar-sized crater on Earth. The "Can You See the Flag On the Moon?" handout showcases the levels of detail that different instruments can typically observe on the Moon, available at bit.ly/flagmoon. ■



Moon image courtesy Jay Tanner

From the photo archives:



Chain of Craters Road, Hawai'I Volcanoes National Park, July 2012. Canon DSLR. Larry Faltz