THE DELAWARE VALLEY
amateur ASTRONOMER
sharing the wonder and science of astronomy

VOL. 46 NO. 11
NOVEMBER 2022

Joe Lamb and Len Jensen found Charles Messier's gravesite in the Père Lachaise cemetery in France. Detail of the plaque below:

PLAN ON IT!

Nov. 8 (4:09 am - 6:42 am) Total Lunar Eclipse More info

Nov. 9 (7:30 - 9:30 pm) Astrophotography Workshop More info

Nov. 11 (7:30 pm) In-person General Meeting at Radnor Township Building; will also be livestreamed. More info

Nov. 11-12 Under One-Sky Conference More info

Nov. 12 (5:00 pm - 8:00 pm) Public Star Party at Valley Forge National Historical Park model airplane field. More info.

Dec. 9 (7:00 pm) In-person General Meeting at Radnor Township Building: member night; topic: "Winter Observing"; will also be livestreamed. More info

Dec. 11 (2:00-4:00 pm) Annual Business Meeting (Members Only) More info

FOR ALL EVENTS, SEE THE DVAA WEBSITE www.dvaa.org FOR ADDITIONAL INFORMATION AND UPDATES.

CONTENTS:

Welcome New DVAA Members!

Craig & Tracy Block (Langhorne)
Susan Brereton (Ambler)
Samuel Chernack (Ambler)
Michael Harris (Paoli)
Rick Kuchan (Media)
Bill Montgomery (Philadelphia)
Kevin Pettit (Philadelphia)
Mark Scafonas (Sterling VA)
Daniel Simons (Elkins Park)
Kelsey Smith (Philadelphia)
Erik Toorens (Philadelphia)

We welcome all new members to enjoy the most our club has to offer by participating in DVAA activities. You are encouraged to ask questions and pursue your interests in astronomy through the club.

We suggest that new members attend our observing events and special interest group meetings, or volunteer to help with an outreach event or committee. Participation can advance your skills and enjoyment of the hobby and help you get to know your fellow members. New members are entitled to all benefits of membership.

Brian Lee
Welcoming Committee Chair
welcoming@dvaa.org

DVAA Board & Committee Chairs

Title	Name	Email
President	Harold Goldner	president@dvaa.org
Vice-President	Jan Rush	veep@dvaa.org
Secretary	Mike Tucker	secretary@dvaa.org
Treasurer & Astronomical League Coordinator	Louis Berman	treasurer@dvaa.org
Members-at-Large	Barry Johnson Tracey Trapuzzano Scott Vanaman	mbratlarge@dvaa.org
Astrophotography	Lou Varvarezis	astrophotography@dvaa.org
Camping and MSSP	Bill McGeeney	camping@dvaa.org
Door Prizes	Roy Patton	doorprizes@dvaa.org
Newsletter Committee	*(see note at right)*	newsletter@dvaa.org
Night Sky Network	Al Lamperti	nightsky@dvaa.org
Light Pollution Abatement	Barry Johnson	ltpollution@dvaa.org
Observing	Andrew Hitchner	observing@dvaa.org
Outreach	Roy Patton	outreach@dvaa.org
Programs	Jeremy Carlo	programs@dvaa.org
Publicity	Bill McGeeney	publicity@dvaa.org
Scope Rentals	Joe Lamb	rentals@dvaa.org
Website	Louis Berman	website@dvaa.org
Welcoming	Brian Lee	welcoming@dvaa.org
Women of DVAA	Jan Rush	women@dvaa.org

Mark Your Calendars!

Upcoming Monthly Meetings

Friday, November 11, 2022: Dr. Richard Schwarz, from Harvard Center for Astrophysics, will speak about TESS mission exoplanet science. *Details on p. 5.*

Monthly Meetings have returned to the Radnor Township Building. All are welcome to attend in-person. Meetings will also be livestreamed on YouTube.

Meeting Location: Radnorshire Room
301 Iven Avenue, Radnor, PA 19087

Upcoming 2022 Meeting Dates: (all Friday evenings): Nov. 11 and Dec. 9.

2022 Public Star Parties

DVAA public star parties are held at Valley Forge National Historical Park on the Model Airplane Field. (Google Maps). ***Weather Hotline: 484-367-5278.***

The monthly star party has returned to the traditional public telescope viewing format. The Board will continue to monitor the pandemic status throughout the year. Check the website (www.dvaa.org) for updates.

Public Star Party dates for 2022 (all Saturday evenings): **Nov. 12** (5:00).

New this year: Backup dates will be designated the Sunday following each date above. Check your email or the website, or dial the hotline, for the final weather call.

Newsletter Editorial Committee: Jeremy Carlo, George Keighton, Tom Nolasco, Dana Priesing, Jan Rush and Barclay Thorn.

If you would be interested in joining us on the Newsletter Committee, or serving as guest editor for one month, just drop us a line at newsletter@dvaa.org — we'd love to have you on board, regardless of your experience level! Online tutorials are available to get you quickly up to speed.

Thanks to Tom Nolasco for taking the lead for the October issue. Dana Priesing is the lead for November. Pardon the typos.

Follow the DVAA on Facebook and YouTube!

DVAA Facebook group
DVAA Photo Enthusiasts
YouTube Channel

YouTube

Astronomy is My Religion

Harold Goldner email

It is partly cloudy, and I do not want to schlepp my equipment out of the shed, moving it to my car, and getting everything ready for a night of stargazing when there is just no guarantee that these cursed clouds will ever clear. That is the hazard of amateur astronomy, because that is what the hobby demands. Astronomy is all about staring up at a cloudless sky and studying what is far beyond (or at least outside of earth's atmosphere). While cloudgazing might be easier, it does not offer the same thrills.

Later, I stand in my driveway and notice that only part of the front lawn of my house is getting thin sunlight through the clouds. It is well past the equinox and my northerly facing house is starting to lose any direct sunlight as the winter solstice approaches. Knowing that, recognizing that the sun moves through the sky and changes what it illuminates --- that is also astronomy.

When I visit the Outer Banks of North Carolina for the first time, I recognize that the barrier islands are north-south oriented, but there are areas where the land mass is wider. One could get utterly lost wandering around the random and disorganized back roads of Duck. I recognize that I am not disoriented because I know what time it is and where the sun is, and that makes navigation easy. That is also astronomy.

I look out from my perch on a barstool gazing over the Atlantic Ocean one evening I notice Jupiter high in the east glowing brighter and clearer than usual, and I know that is because opposition was not very long ago. Mars is also starting to brighten, and I know that is because its opposition is coming up in December. Merely recognizing things in the sky at first glance without second thought is also astronomy.

I return to the car after we eat and I recognize the stars of the Subaru insignia, and I know that "Subaru" is what the Japanese call the Perseids, and that is how they developed the logo design, and just knowing that is astronomy.

Wikipedia tells us:

> Astronomy is a natural science that studies celestial objects and phenomena. It uses mathematics, physics, and chemistry in order to explain their origin and evolution. Objects of interest include planets, moons, stars, nebulae, galaxies, and comets.

Now while I love astronomy I am not as engaged by the mathematics, physics, and chemistry. I mean, I understand how an airfoil works, but I still cannot comprehend how those giant airplanes get up in the air, let alone at 32,000 feet when I can barely get my suitcase up the stairs. While I understand how spectroscopy works, and how light is a particle and a wave, such concepts are as mysterious to me as how WD-40 works as a cleaning product. I have read all about spooky action at a distance but my hair hurts when I start to think about the speed of light as fixed and being tied intimately to the movement of time. All of that is astronomy, too, but for me it ends up closer to a matter of faith, rather than even a rudimentary comprehension of the actual quantum mechanics.

I know that when I look at the summer sky, my eyes will drift towards Sagittarius and Scorpio, watch for "the teapot," and imagine that I am staring past the event horizon into the invisible heart of Sagittarius A*. I know it is there without actually seeing it. I believe in that astronomy, just as during the winter months I can easily pick out Sirius, Taurus, the Perseids and Orion dominating the sky. And while I cannot resolve the Orion nebula naked eye, I know that it is up there, hanging from Orion's belt, 1344 light years distant.

Google says that astronomy is "the branch of science which deals with celestial objects, space, and the physical universe as a whole."

The physical universe as a whole. I like that. You could say that astronomy is the branch of science studying the physical universe as a whole and leave the rest of that definition out altogether. The physical universe as a whole, meaning that those stars, planets, celestial objects as well as you readers, as well your families and your homes, neighborhoods, nations, continents, and so forth are all astronomy, too. As get ready to fall asleep I look up in the darkness of my room and gaze up through the skylight. I spot the belt stars of Orion and the Orion Nebula staring back at me. I know that I am a part of the physical universe as a whole. Nothing could be easier than believing in that astronomy.

October 15th Green Lane Park Observing Clinic

Jan Rush

Green Lane Park was the scene of a DVAA Dark Sky Observing clinic the evening of Oct. 15. A total of about 20 (mostly new) members brought 11 telescopes of various configurations and received help from eight expert DVAA staff. The most popular topics were aligning finderscopes, collimating, go-to scope alignment, and how to find bright telescopic objects. The sky treated us to lovely views of the Andromeda Galaxy, Ring Nebula, Owl Cluster, Hercules Cluster, and Alberio, as well as the brighter autumn constellations and, of course, Jupiter and Saturn. Image credits: George Keighton.

Clinic attendees, left to right: Melissa Varvarezis, Fran Jennings, Craig and Tracy Block, Lowell Gustafson, Rob Dolson (son Eric behind Brian), Brian Ampolsk, Kelsey Smith, John Gaskill, John Moran (behind), Kwong Ha and daughter Juniper, Yuki Kim, Jim McCambridge, Dottie and Dave Hogue. (Missing from photo: Brody, Kerri and Briley Carpenter).

Jan Rush and Dave Hogue refine the alignment of Dave's Celestron NexStar Evolution 8.

DVAA staff Jan Rush, Stan and Betsy Williams, Al Lamperti, Gary Trapuzzano, Lou Varvarezis, Jeremy Carlo. (Missing from photo: George Keighton and Barry Johnson).

Next Monthly Meeting: November 11, 2022

"So Many Worlds:
Exoplanet Science From The TESS Mission"

Presenter: Richard (Rick) Schwarz, PhD, Exoplanet Scientist, TESS Mission, Harvard Center For Astrophysics

In August, 2019, Rick gave a presentation to DVAA describing the TESS Mission (Transiting Exoplanet Survey Satellite). Since then, working in the TESS Photometry Subgroup, he has been extensively involved in the ground-based follow-up of potential exoplanet detections made on-orbit, using the one- and two-meter telescopes and state-of-the-art imaging systems in the Las Cumbres Observatory Global Telescope (LCOGT) Network. Rick will present some important results from the over 1,400 exoplanet transit observations he has conducted, analyzed and reported over the past three years.

INTERNATIONAL DARK-SKY ASSOCIATION CONFERENCE

Publicity Chair Bill McGeeney reports that the IDA is having its annual Under One Sky conference, which has great workshops, talks, and more. Highly recommended for anyone interested in learning and advocating for better public policy at the local level here in PA. For more information, go to https://conference.darksky.org.

The October Monthly Meeting

Jeremy P. Carlo email

The DVAA October meeting was held jointly with the Southeastern Pennsylvania Section of the American Association of Physics Teachers (SEPS-AAPT), a first for both organizations. DVAA VP Jan Rush and SEPS President Jeremy Carlo (Villanova University) co-presided over the meeting, which brought DVAA members together with high school and college physics teachers from the Philadelphia region. As the two organizations share an interest in educating the public about physics and astronomy topics, there were plenty of areas for synergy, including the possibility of the DVAA hosting astronomy outreach programs at area schools, and an opportunity for physics teachers to get more involved in "practical" astronomy.

Jeremy opened the meeting with an overview of the Southeast Pennsylvania Section of the AAPT. While the AAPT is a national-level professional organization for physics educators, SEPS provides local resources for physics teachers in the area, including several local conferences and workshops, as well as connections to Pennsylvania educators, local job listings, and the like.

Jan then gave an overview of the DVAA's activities, with a particular focus on our outreach and educational activities. These include monthly public star parties at Valley Forge (the next of which, and the last for 2022, will take place on Nov. 12), monthly meetings at Radnor (livestreamed online), and scheduled community star parties. Jan also gave a plug for the new DVAA Youth Awards Program, which provides awards for middle school and high school students undertaking astronomy-related projects; further details about eligibility, judging, and awards, may be found on the DVAA website.

Welcoming Chair Brian Lee announced that we have eleven (!) new members in the past month. Treasurer Lou Berman reminded members that the time for dues renewal is coming up with the new year, and gave a reminder of the upcoming elections, as several current officers are term-limited so we are actively soliciting nominees for those roles. Finally, Light Pollution Chair Barry Johnson informed the audience that he will conduct a light pollution exhibit at an upcoming event at the Temple University Ambler campus.

With committee reports completed, Programs Chair Jeremy Carlo (after switching hats) introduced the evening's invited speaker. Dr. Joey Neilsen of Villanova University, whose topic was "The Shadow of a Sleeping Giant."

Joey started by showing a multi-wavelength image of the region around the galactic center in Sagittarius. At the galactic center, we now know, is a black hole with a mass about four million times of the sun, although it is only about 20 times the sun's diameter. As most of us know, a black hole is what results when mass is crammed into such a small space that not even light can escape from it, and anything which gets too close is inexorably sucked in, hence the name "black hole." The "point of no return," the radius at which not even light (the fastest moving object in the universe) cannot escape, is known as the event horizon. While supermassive black holes are large in absolute terms (millions to billions of miles in diameter), at their distances of thousands or millions of trillions of miles, their angular diameter is so small (on the order of micro-arcseconds) that until very recently it was thought impossible to actually image one. (For comparison, the smallest details you can resolve with an amateur telescope tend to be on the order of arcseconds, while even the largest professional optical telescopes such as the JWST and Hubble, can only resolve down to tens of milli-arcseconds.)

In order to understand black holes, one must understand Einstein's theory of general relativity, our most expansive understanding of gravity to date. In contrast to the older Newtonian picture of gravity as a force exerted between two masses separated by a distance d, Einstein envisioned gravity as the result of masses warping spacetime around them, while other masses attempt to navigate the shortest and most direct path through this warped medium. The classic analogy of this is a bowling ball sitting on a trampoline; the bowling ball bends the trampoline's surface, causing other objects in

(Continued on next page)

The October Monthly Meeting (continued)

the vicinity to move along apparently curved paths. Put another way, the force you feel pulling you toward the center of the earth is exactly the same as the force you would feel if you were in an elevator accelerating upwards at a particular rate; gravity is indistinguishable from motion (specifically, acceleration).

While the distinctions between these theories seem rather pedantic, it turns out that under extreme conditions (with black holes being the textbook example of "extreme") these two models make somewhat different predictions about the results of experiments; in every test so far, general relativity has passed with flying colors while Newtonian mechanics has yielded incorrect predictions in some cases. One of the first tests which showed such differences was made in 1919, when starlight passing near the sun was observed during a solar eclipse; the amount of deflection was consistent with Einstein's prediction but diverged from the older Newtonian prediction, confirming that general relativity indeed supersedes Newtonian gravity.

This bending of light near massive objects gives rise to another astronomical phenomenon, that of gravitational lensing (which Dr. Dave Goldberg told us about last month). Indeed, the first image released from the JWST showed numerous galaxies whose light was bent and lensed around by massive foreground objects. Under absolute perfect alignment, light from a star would be bent into a perfect ring (an "Einstein ring") by a dark object in the foreground.

One may then ask what sort of gravitational lensing would be caused by the most extreme of massive objects, black holes. In this case, lensing can even include light which goes all the way around the black hole before being sent on its way, resulting in the appearance of arcs or rings surrounding an inky-black shadow (which, counterintuitively, is several times larger than the black hole itself). But, as mentioned before, even the largest of these "shadows" is on the order of micro-arcseconds in size, thousands of times smaller than can be resolved with any optical telescope. In addition, black holes tend to be surrounded by loads of gas and dust, which are highly opaque to optical wavelengths.

Enter the Event Horizon Telescope, which is a network of radio telescopes designed to image the two angularly-largest black holes, those at the center of our own galaxy, and at the center of the galaxy M87 in Virgo. While M87's black hole is about a thousand times further away from our own (named Sgr A*, or "Sagittarius A-star"), it's about a thousand times more massive, so the angular diameters are similar. These telescopes work together at a wavelength of 1.3 mm or a frequency of 230 GHz; this was chosen because (a) these wavelengths penetrate well through the gas and dust surrounding black holes, and (b) the wavelength is relatively short, but also long enough that the data from telescopes around the world can be combined together, though a technique called interferometry, to produce sufficient angular resolution to resolve both black holes.

What is interferometry? Well, all forms of electromagnetic radiation (including radio waves and visible light) are composed of waves, which have a definite wavelength. As a result, any finite imaging aperture (a fancy term for "telescope") can only resolve angular details down to a certain level. In the case of optical telescopes, this limit is typically expressed (after a bunch of unit conversions) as 4.56 divided by the aperture in inches. This is known as the "diffraction limit," and represents the smallest angular details which can be resolved by a telescope of that aperture. The larger the aperture, the smaller the details which can be resolved (unless, of course, there are other limits imposed by the atmosphere, etc). However, there is no requirement that the aperture be a single circle. In fact, you can combine the light from several smaller telescopes separated by large distances, and the effective resolution corresponds to the overall size of the array! The further apart the telescopes, the smaller the resolvable details. (Of course, the light gathering power is still limited by the actual light collecting area of the telescopes.) This is a rather involved process, as the light must be combined in a way which preserves the "phase" information of the incoming light, so you can't just stack images together! So, you make a bunch of telescopes, spread them out across the globe, and now you have a telescope that is effectively the size of the earth!

Well, this is a whole lot easier said than done, but the Event Horizon Telescope collaboration made this happen, with telescopes spread out over the entire world (including one at the South Pole!). In 2019, the EHT collaboration released an image of the black hole in M87. Our own black hole's im-

(Continued on next page)

The October Monthly Meeting (continued)

age was not released until early 2022; Joey explained that the reason for the delay is that our black hole exhibits a lot more variability in time, which made the analysis much more complicated. While M87's black hole is waaaaay bigger, that means that it's much more stable, as individual stars (or whatever) getting gobbled up have much less of an impact on the overall image. Much like an enormous crowd, individual voices are lost and it all settles into a dull and constant roar. This makes the data analysis somewhat easier.

Joey finished up by discussing some ongoing projects. It would be nice, for example, to have simultaneous imaging data from the EHT, along with data from x-ray or conventional radio telescopes capable of making more detailed timing or spectroscopy measurements, as our black hole is actively gobbling up a star. Another nice addition would be to add in some space-based telescopes to increase the effective aperture (and, hence, angular resolution) even more. An active Q+A session followed, with Joey answering many questions from the audience about the physics of black holes, and potential future observations.

Many thanks to Joey Neilsen for an exciting and accessible introduction to the science of black holes! And hopefully this joint meeting of the DVAA and SEPS-AAPT will lead to future collaborations and opportunities for interaction.

Camping Trip Survey

Camping Tsar Bill McGeeney would love to hear from interested club members about their camping preferences for 2023. He's put up a survey:

https://docs.google.com/forms/d/e/1FAIpQLSfsAeu_sqoi2bKmSTV8sMofC42Kr7bS4nhMnZNAoyYhu78wqw/viewform?usp=sf_link

If you're interested, please fill out the survey.

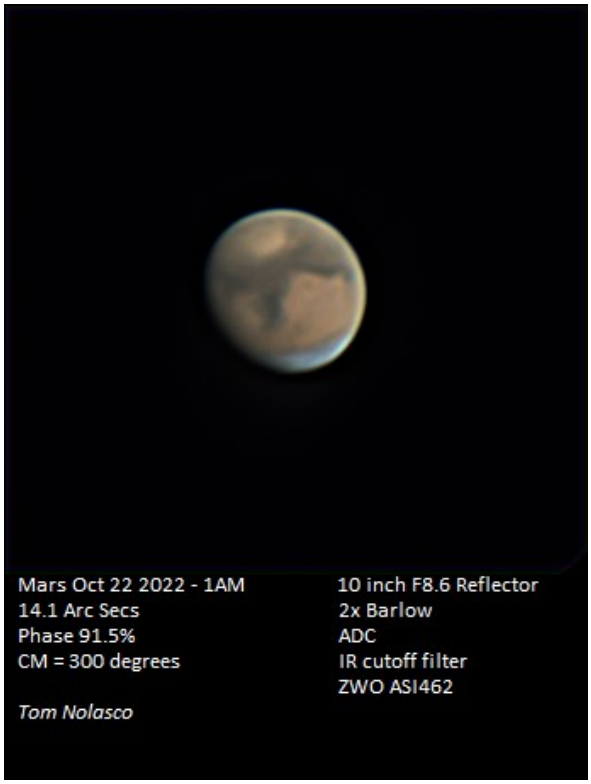
Left: this month's newsletter editor, getting set up in the observing field at Cherry Springs State Park in late August. She tried a few tips from Emily Levesque's wonderful book, *The Last Stargazers*, including having a midnight "second dinner." Thanks to Emily's advice, she was able to observe through her usual 2:00 am circadian low point, and managed to stay at it until the predawn hours.

Recent Images by DVAA Members

Image credit: Garret Wright. The Soul Nebula. Taken over approximately 20 hours, Oct. 14, 2022, Oct. 15, 2022, and Oct. 21, 2022, from Yardley, PA. Equipment: William Optics GT71; ZWO ASI2600mm w/ 3nm SHO filters; EQ6R; Astro Pixel Processor + Photoshop.

Image credit: Dan Stern. The Cat's Paw Nebula; data capture from Yass Australia, June & July 2022; Equipment: Data Processing - Pixinsight; Scope: SharpStar 140mm F4.8; Camera: SBIG STXL16200 FW8G; Filters: Ha LRGB all 3nm; Mount: Software Bisque Paramount MEII; FOV 138 x 110 arcmin; IS: 1.8 arcsec/pixel.

Recent Images by DVAA Members (continued)



If you would like to participate in DVAA's active astrophotography community, visit the Astrophotography Resource Page on the DVAA website.

Would you like to help with this newsletter?

We are looking for additional people interested in serving on the editorial board for the award-winning *Delaware Valley Amateur Astronomer.*

Generally this would involve being the "lead editor" for approximately two issues per year. (You choose which months!) For the rest of the year, you provide advice/feedback to the lead editor for that month. Editing is done in Microsoft Publisher (the Club will get you a copy if you don't have one!), which is similar to Microsoft Word but has some additional features. All distribution is through the club website (no printing / folding / mailing / licking stamps)!

If interested, contact us at newsletter@dvaa.org!

Recent Images by DVAA Members (continued)

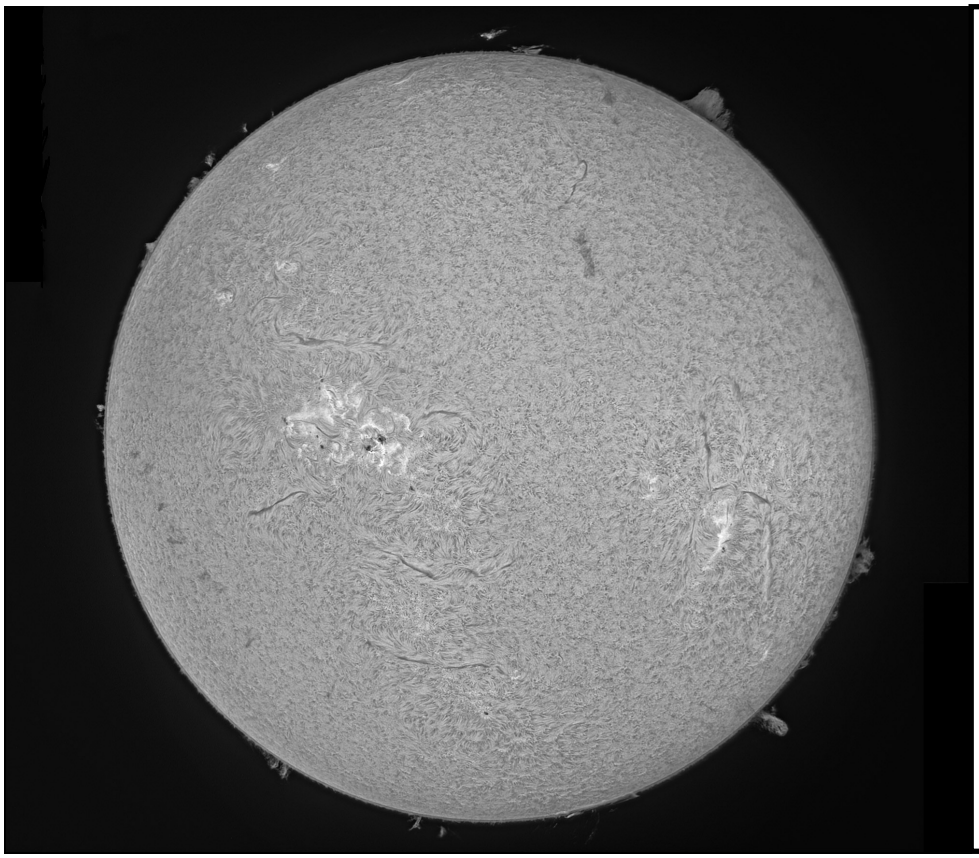


Image credit: Tom Nolasco. The solar image was taken on October 6th through a Lunt 60mm solar scope and 2x barlow using a ZWO ASI174mm camera.

Image credit: Wayne Reed. Solar image taken October 28. Equipment: Lunt 60THa scope and ASI385MC camera. Processing with Autostakkert, ImPPG, Registax, and Photoshop Elements.

Announcing the DVAA Youth Astronomy Awards for 2022-2023

Cash prizes for elementary, junior high and high school students!

Click on the "Youth Awards" button on the home page. www.dvaa.org.

News from the Astronomical League

New Observing Programs

Two new Observing Programs were recently adopted, and are now live on the Astronomical League Website.

The Solar Neighborhood Observing Program (Marie Lott is the interim Coordinator): This is a program designed to educate the participants about the stars that are the sun's nearest neighbors. https://www.astroleague.org/content/solar-neighborhood-observing-program

Bennett Observing Program (Al Lamperti is the interim Coordinator): This is a program of deep space wonders that is a southern sky equivalent of the Messier Observing Program. It is a complete (107 objects) Observing Program of its own, but it will also be a southern sky alternative to the Messier Observing Program as a requirement for the Master Observer Award. https://www.astroleague.org/content/bennett-observing-program

Program Coordinators Needed

It is once again time to search for Coordinators for some of our Observing Programs. We will begin the selection process in January 2023, but you may submit your name now, noting for which Coordinator roles you are applying. Currently we are looking for members who are interested and willing to help as a Coordinator for the following programs:

- Bennet Observing Program
- Galileo's TOES Certification
- Galileo's TOES-II Certification
- Jupiter Observing Program
- Mentor Award
- NASA Observing Challenge Certification
- Solar Eclipse Special Observing Award - 2024 (planned, not yet approved)
- Solar Neighborhood Observing Program
- And potentially others . . .

Cepheus: A House Fit for a King

David Prosper

This article is distributed by NASA's Night Sky Network (NSN). *The NSN program supports astronomy clubs across the USA dedicated to astronomy outreach. Visit nightsky.jpl.nasa.gov to find local clubs, events, and more!*

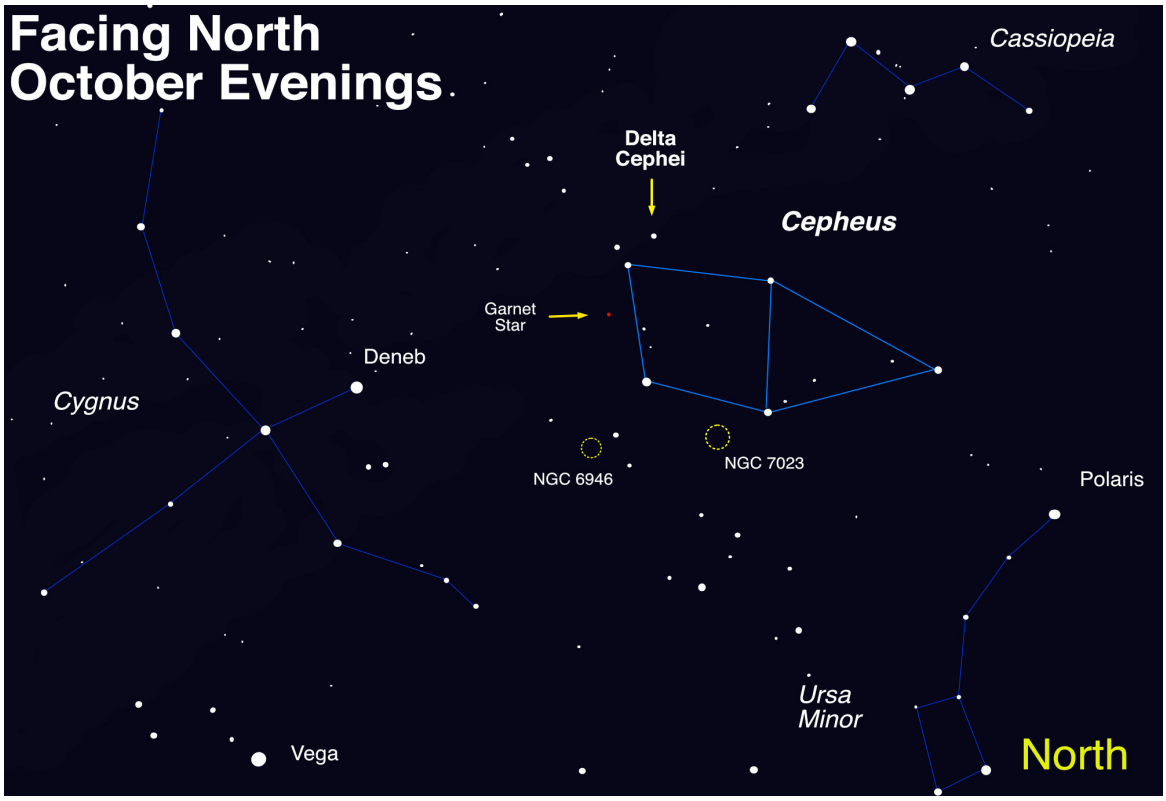
Sometimes constellations look like their namesake, and sometimes these starry patterns look like something else entirely. That's the case for many stargazers upon identifying the constellation of **Cepheus** for the first time. These stars represent Cepheus, the King of Ethiopia, sitting on his throne. However, many present-day observers see the outline of a simple house, complete with peaked roof, instead – quite a difference! Astronomers have another association with this northern constellation; inside its borders lies the namesake of one of the most important types of stars in modern astronomy: Delta Cephei, the original **Cepheid Variable**.

Cepheus is a circumpolar constellation for most observers located in mid-northern latitudes and above, meaning it does not set, or dip below the horizon. This means Cepheus is visible all night long and can be observed to swing around the northern celestial pole, anchored by Polaris, the current North Star. Other circumpolar constellations include Cassiopeia, Ursa Major, Ursa Minor, Draco, and Camelopardalis. Its all-night position for many stargazers brings with it some interesting objects to observe. Among them: the "Garnet Star" Mu Cephei, a supergiant star with an especially deep red hue; several binary stars; several nebulae, including the notable reflection nebula NGC 7023; and the "Fireworks Galaxy" NGC 6946, known for a surprising amount of supernovae.

Perhaps the most famous, and certainly the most notable object in Cepheus, is the star **Delta Cephei**. Its variable nature was first discovered by John Goodricke, whose observations of the star began in October 1784. Slightly more than a century later, Henrietta Leavitt studied the variable stars found in the Magellanic Clouds in 1908 and discovered that the type of variable stars represented by Delta Cephei possessed very consistent relationships between their luminosity (total amount of light emitted), and their pulsation period (generally, the length of time in which the star goes through a cycle of where it dims and then brightens). Once the period for a Cepheid Variable (or **Cepheid**) is known, its luminosity can be calculated by using the scale originally developed by Henrietta Leavitt, now called "Leavitt's Law.". So, if a star is found to be a Cepheid, its actual brightness can be calculated versus its observed brightness. From that difference, the Cepheid's distance can then be estimated with a great deal of precision. This revolutionary discovery unlocked a key to measuring vast distances across the cosmos, and in 1924 observations of Cepheids by Edwin Hubble in what was then called the Andromeda Nebula proved that this "nebula" was actually another galaxy outside of our own Milky Way! You may now know this object as the "Andromeda **Galaxy**" or M31. Further observations of Cepheids in other galaxies gave rise to another astounding discovery: that our universe is not static, but expanding!

Because of their importance as a "standard candle" in measuring cosmic distances, astronomers continue to study the nature of Cepheids. Their studies revealed that there are two distinct types of Cepheids: Classical and Type II. Delta Cephei is the second closest Cepheid to Earth after Polaris, and was even studied in detail by Edwin Hubble's namesake telescope, NASA's Hubble Space Telescope, in 2008. These studies, along with others performed by the ESA's Hipparcos mission and other observatories, help to further refine the accuracy of distance measurements derived from observations of Cepheids. What will further observations of Delta Cephei and other Cepheids reveal about our universe? Follow NASA's latest observations of stars and galaxies across our universe at nasa.gov.

(cont.)



The stars of Cepheus are visible all year round for many in the Northern Hemisphere, but fall months offer some of the best views of this circumpolar constellation to warmly-dressed observers. Just look northwards! Image created with assistance from Stellarium: stellarium.org.

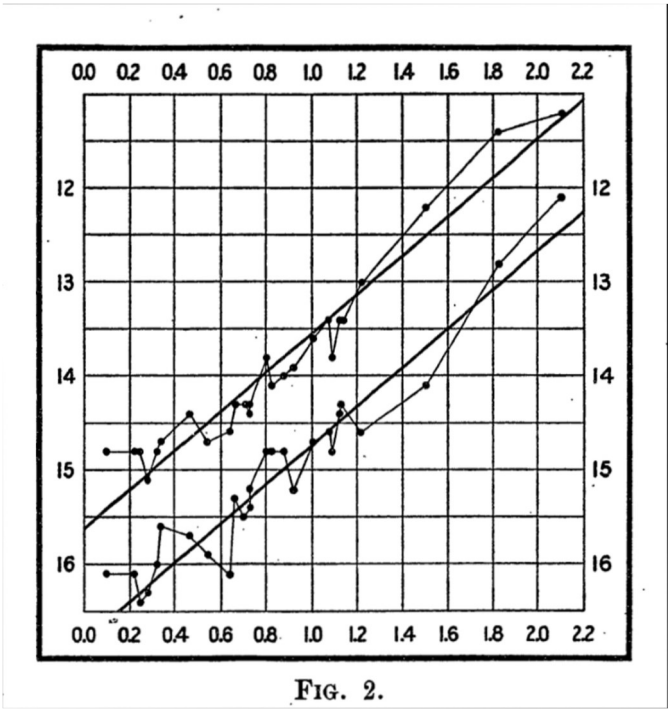


FIG. 2.

Left: This historical diagram from Henrietta Leavitt's revolutionary publication shows the luminosity of a selection of Cepheid Variables on the vertical axis, and the log of their periods on the horizontal axis. The line drawn through these points shows how tight that relationship is between all the stars in the series. From Henrietta Leavitt and Edward Pickering's 1912 paper, "Periods of 25 Variable Stars in the Small Magellanic Cloud," a copy of which can be found at: https://ui.adsabs.harvard.edu/abs/1912HarCi.173....1L/abstract

Mallon Planetarium Shows

Join Mallon Planetarium Director, Adam Chantry, for public shows the **third Wednesday of every month**! The public planetarium show schedule will be released in early September.

SAVE THE DATES

September 21st
October 19th
November 16th
December 21st

SHOWTIMES

5:30pm
7:00pm

TICKETS

Adults: $8
Students & Senior Citizens: $6

Click Here to Purchase Tickets

LASER LIGHT SHOWS RETURN

Mark your calendars! Mallon Planetarium Laser Shows return in February 2023!

RESERVE YOUR SEATS: www.methacton.org/planettix

Tickets MUST be reserved and paid for in advance via www.methacton.org/planettix to guarantee a seat. Any unreserved seats, will be sold on a first come, first serve basis the evening of the show. ONLY cash or check are accepted at the door for unreserved seats.

ABOUT THE MALLON PLANETARIUM

The Mallon Planetarium is located inside Arcola Middle School (4001-A Eagleville Road, Eagleville, PA 19403) in Methacton School District. Built in 1974, the planetarium has continuously provided unique learning experiences for ALL Methacton students. Our goal, as once stated by the original director and namesake of the planetarium Dr. Gerald Mallon, is to be a laboratory NOT to produce astronomers for the world, but to produce people who are aware of the world around us. The Mallon Planetarium provides co-curricular, extracurricular, and community opportunities for all life-long learners.

+3600 students visit annually
+1230 community members visit annually

SCHEDULE AN ASTRONOMY LESSON!

The Mallon Planetarium offers lessons to Methacton School District classes, outside district school classes, and non-profit community groups. Lessons can be scheduled in our planetarium, in an Arcola building classroom, or just about any location in, and around, Methacton School District. We also offer virtual presentations for groups that meet online.

To get more information on scheduling your group's lesson, please fill out the form at *www.methacton.org/planettix*.

WE'RE ON TWITTER!

@MSDPlanetarium

DVAA Telescope Rentals

Celestron NexStar 5SE

Orion 6” Dosonian

DayStar 60mm Solar Scope

Ioptron Tracker

Orion 6” StarBlast Dobsonian

All scopes include tripod/base, eyepieces, manuals, power, etc. Rental is $10/month with $20 deposit. More info at www.dvaa.org under the OBSERVING tab. To rent one of these scopes, contact Joe Lamb at rentals@dvaa.org.

The Delaware Valley Amateur Astronomers

Since 1976, the **DVAA**, a non-profit corporation, has **shared the wonder and science of astronomy** with thousands of amateur astronomers and the public in the Philadelphia area. Each month we host dark-sky and local star parties, telescope workshops, science & astronomy lectures, educational outreach sessions, and more. To learn more or to join DVAA, please visit **www.dvaa.org**.

Check the schedule for our **free monthly meetings open to the public**, now returning to face-to-face meetings in Radnor, and available on YouTube.

get in on the fun:
JOIN the DVAA TODAY!

Dues are $40 per year for an individual, $60 for a Family Membership, or $10 for a Junior or Student Membership. **Membership benefits** include our monthly newsletter, membership in the Astronomical League (including its publications), access to our dark-sky observing sites, and inexpensive rentals of fine telescopes. You can join or renew online at www.dvaa.org. If paying by mail, include a note stating what you are paying and membership category desired. Make checks payable to “DVAA” and send to our treasurer: Louis Berman, 477 Turner Avenue, Drexel Hill, PA 19026, or for more information contact treasurer@dvaa.org.