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Reflector

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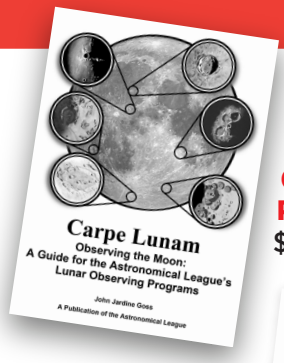

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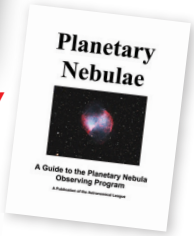

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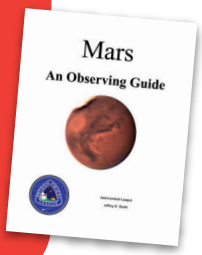

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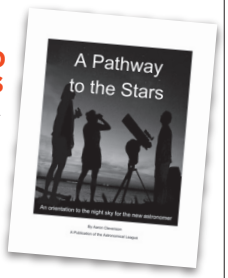

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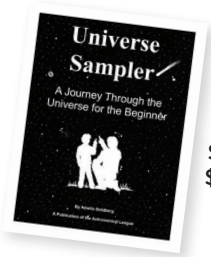

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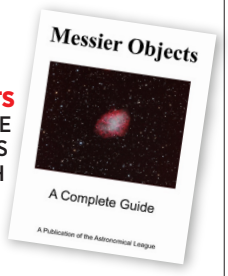

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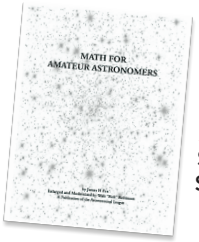

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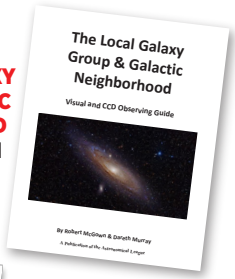

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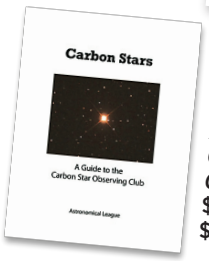

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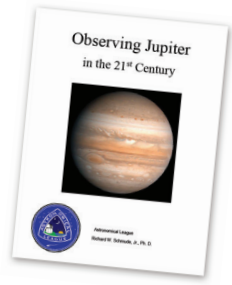

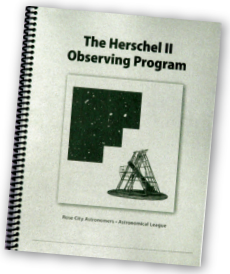

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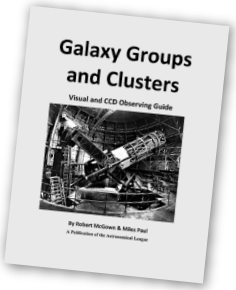

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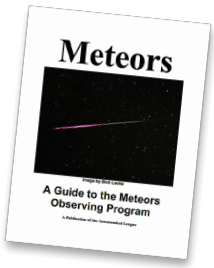

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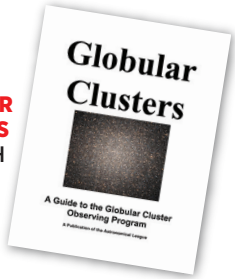

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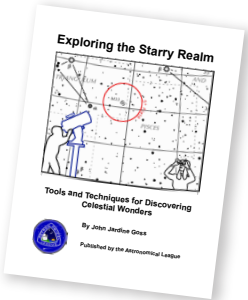

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NOTICE

The March issue of *REFLECTOR* will be a digital issue only. This one-time digital edition will assist the League in transitioning to a new publisher beginning with the June 2025 edition and in covering post-COVID convention expenses.

Matt Schricker *(South Shore Astronomical Society) captured this image of M45 – the Pleiades – over four nights near Boston using a ZWO ASI2600MC Pro camera with a William Optics RedCat 51 and an L-Enhance Quad filter.*

Reflector

The Astronomical League Magazine

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A FEDERATION OF ASTRONOMICAL SOCIETIES
A NON-PROFIT ORGANIZATION
To promote the science of astronomy

- by fostering astronomical education,
- by providing incentives for astronomical observation and research, and
- by assisting communication among amateur astronomical societies.

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Reflector

QUARTERLY PUBLICATION OF THE ASTRONOMICAL LEAGUE

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***REFLECTOR* AND CLUB ROSTER DEADLINES**

March issue	**January 1**
June issue	**April 1**
September issue	**July 1**
December issue	**October 1**

LETTERS TO THE EDITOR

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Errata

The December 2024 article on solar observing contained an incorrect URL. The Polish Society of Astronomy Enthusiasts' solar observing page can be found at *sosobserwacjeslonca.pl*.

President's Column

From Your League President

I hope you've all weathered the winter well. We are now looking forward to a successful AstroCon '25 at Bryce Canyon in June. Lowell Lyon has done a fabulous job with this event, which will focus on observing and imaging skills and provide access to national parks and Bortle 1 observing. In the meantime, let me bring you up to date on some important items.

Let me explain why this issue of the *Reflector* (just this one) is only available in digital form. First, we are transitioning to a new publisher that will be printing and mailing the *Reflector* starting with the June issue. Second, we were without an ad manager. Third, we needed to offset accumulated expenses from recent conventions and from our experiment with convention live streaming by eliminating $25,000 in printing and mailing costs for one issue. Yes, we could tap the trust fund for these expenses, but your executive committee unanimously agreed that good stewardship of the trust fund warranted an alternative solution to maintain adequate cash reserves in the League treasury.

Membership helps us financially, too, of course, and I am happy to report that our membership now stands at over 25,200, exceeding pre-COVID levels by more than 40 percent! To all our new League members out there, including the Sociedad Astronómica de Chihuahua in Chihuahua, Mexico, ¡gracias y bienvenidos!

For several years, since our website's transition to WordPress, we have been without our society listings. I know this has been a source of frustration for many of our societies who depend on these listings to connect with potential new members in their localities. Since last fall, however, we have been repopulating those lists on the website. If you haven't submitted your club's contact information and web site links yet, please see the "Society Officers" block on the first page of the League website.

Due to our earlier-than-normal convention this year, the application deadline for the Library Telescope Giveaway has been moved up to May 31. We hold a drawing to give away up to 11 Library Telescopes each year—one to a club in each region and one to a member-at-large for placement in a local library. Application information can be found by clicking the "Library Telescope Program" link at the bottom of the League website.

The 2025 awards season is now upon us. Do you have a webmaster or newsletter editor you'd like to nominate for a national award or a youth whose research, service to your club, outreach, or astrophotography warrants national recognition? Review the criteria for these awards, and many others, by clicking the "Awards" link at the bottom of the League website. Applications or nominations are due by March 31.

Finally, and importantly, ballots for the offices of secretary and executive secretary will be mailed out in May. The election ballot will be accompanied by an additional ballot asking you to vote on important bylaw changes unanimously recommended by the council. We need your vote on these changes to reach the required quorum for passage.

I look forward to seeing you under those dark Utah skies!

—Chuck Allen, President

Night Sky Network

20 Years of Night Sky Network

NASA's Night Sky Network (NSN) has turned 20! Since launching in 2004, this initiative has thrived thanks to the dedication and passion of amateur astronomers and astronomy clubs across the United States. Clubs like yours have played a huge part in bringing the wonders of the universe to schools, libraries, museums, parks, and places of worship, serving 7.4 million people over the last two decades.

NSN began through JPL's PlanetQuest program, leveraging amateur astronomers' enthusiasm and knowledge to connect the public with current NASA research. By its first year, over 100 clubs had joined. Today, NSN supports over 400 clubs nationwide, from Washington State to Puerto Rico, empowering them to inspire curiosity and expand science literacy.

Central to NSN's success are its outreach toolkits—educational materials and hands-on activities on topics like telescope mechanics and solar science. Although toolkits are based on availability, active clubs still qualify for these free kits by hosting a minimum of two outreach events per quarter. Coordinators can log into their NSN account (*nightsky.jpl.nasa.gov/login*) and review the number of kits received on their club's dashboard under the "My Club Calendar" section.

The program also offers archived video training, monthly webinars with global scientists, and "Night Sky Notes" for newsletters. In 2007, NSF-funded research enhanced the program's resources with video guides, a national event calendar, and online coordination tools. You can find a list of these resources under the article titled "Full Toolkit Manuals – all 13!" on the NSN site, or visit *nightsky.jpl.nasa.gov/club/news/207* .

As the Night Sky Network embarks on this third decade, the legacy of connecting communities to the cosmos is brighter than ever. Be sure to celebrate this success – you made it possible!

—Kat Troche

DarkSky Corner

Under One Sky 2024 was DarkSky International (DSI)'s largest and most successful global conference to date. Nearly 1,000 participants from 53 countries registered for the event. The conference had an eclectic group of speakers from around the world. Wildlife ecologists discussed light pollution and marine life, and even tourism experts in the Middle East showed the economic value of dark skies. The conference emphasized that we rely on the night, and the preservation of the night more than ever relies on us.

Highlights from Under One Sky 2024 are summarized at *darksky.org/news/reflecting-on-under-one-sky-2024-a-global-gathering-to-protect-the-night*.

Recordings from the conference are available on the DarkSky YouTube channel at *www.youtube.com/playlist?list=PLwHEmqG4ZaZoxt5YmVX122f-2CYFYuQ21i*.

—Tim Hunter

Full STEAM Ahead

A year ago in June, the Mobile Observatory was taken to an event hosted by Broken Arrow, Oklahoma, with schools from nearby rural areas also invited. Teachers from the town of Kiefer asked if we would consider coming to their school system, to which we replied, "absolutely." Kiefer sits just outside of Tulsa County and the middle, high, and upper elementary school buildings are all next to each other.

This July, their life science high school teacher, Brittany, contacted us, interesting in bringing a different science to her students. Ninety minutes later, Brittany and I had worked out a plan that focused on their middle school's 25 gifted and talented students, a school visit for high school students on black holes, and an art project for their six students with significant challenges. Of course, a discussion on purchasing a telescope ensued, and currently a grant is out to fund an 8-inch Celestron StarSense Dob.

Weekly visits were developed to introduce students to basic hands-on topics like the *Sky & Telescope* star wheel, lunar phases, Hertzsprung-Russell diagram, and meteors and meteor showers. The first event was solar observing, which just happened to be at the beginning of October when the Sun was generating aurora-causing X7 to X9 flares and coronal mass ejections.

Parents arrived to witness students looking through solar scopes and sketching the solar phenomena they viewed through the eyepiece. The students were excited, and all stated that it was the first time they had looked through a telescope. The students were also encouraged to look for the auroras that would show up later that night.

The next day, Brittany called to tell me that one boy was the son of the principal, and the father had recounted what happened on the way home and at dinner. It seems his son could not stop talking about the encounter, viewing the Sun through the scope, and learning about all the sunspots on the surface. In fact, at dinner, the son continued to talk about it with his siblings and his mom. She also talked about a grandmother who asked if we were returning the next day because of the impact the program had had on her granddaughter, and how she, too, wanted to come look through the telescope.

The best part was how other middle school students came to Brittany and asked if they could join this group. They begged her to open the program (for students who test high in math and science) to include them.

The enthusiasm even spread to the high school students. They arrived for their life science class and saw the *Astronomy* and *Sky & Telescope* magazines and astronomy and physics books that were given to them. Students started to pull books and asked if they could read them, so Brittany started a lending library. However, the academic team seems comfortable fielding astronomy questions, so I purchased the *Oxford Dictionary of Astronomy* and set to work. More to come...

Full STEAM Ahead (with homework),

—Peggy Walker,
AL STEAM and Jr. Activities Coordinator

Deep-Sky Objects

Throw a Ball to the Hunting Dogs

Canes Venatici, Latin for Hunting Dogs, is a small constellation located south of Ursa Major. The constellation was created and named by the Polish astronomer Johannes Hevelius in the 17th century. On many star atlases, the Hunting Dogs are depicted as the dogs of Boötes, the Herdsman. The two dogs are named Asterion and Chara.

Canes Venatici, along with its neighbors Ursa Major and Coma Berenices, contain a plethora of galaxies to observe during spring months. The constellation resides far from the band of the Milky Way in the night sky, so it is essentially devoid of star clusters. The exception is one splendid ball of stars known as the globular cluster M3.

M3 is located in the southeastern region of Canes Venatici, practically on the border where Canes Venatici meets Boötes and Coma Berenices. The star cluster is 12 degrees northwest of the bright star Arcturus. It lies 40 percent of the way along the line from Arcturus to Cor Caroli (Alpha Canum Venaticorum), the latter being the brightest star in Canes Venatici.

M3 was the first object in Charles Messier's catalog that he discovered himself before anyone else recorded it, in 1764. With his small crude refractors, he mistook it for a round nebula. It

wasn't until 1784 that William Herschel resolved M3 into individual stars. Today we know this giant ball of stars contains a half-million members, all gravitationally bound by the cluster's strong gravitational force.

M3 shines at magnitude 6.2, making it an easy find in binoculars. An 8-inch telescope resolves it into an uncountable number of stars. The cluster is located 34,000 light-years away and is approximately 18 arcminutes in size. The physical diameter of the cluster is 336 light-years. M3 is estimated to be more than 11 billion years old. A majority of its stars are old and red, however, it does contain myriad blue straggler stars. They are stars that formed more recently by two stars in the cluster merging, or by mass transfer from one star to another in a binary star system. Either process results in a more massive, hotter star that shines blue.

M3 is known for containing more variable stars than any other globular star cluster (nearly 300). The American astronomer Edward Pickering discovered the first one in 1889 while director of the Harvard College Observatory. Astronomers can use the brightness variations of some classes of variables to estimate the distance to the stars,

and thus the star cluster.

The image of M3 shown here was taken with an 8-inch f/8 Ritchey–Chrétien telescope with a 0.8× focal reducer/field flattener. It was captured with an SBIG ST-2000XCM CCD Camera and a 40-minute exposure. In the image north is up and east to the left. The bright orange star near the lower right corner is magnitude 6.2, the same as the integrated magnitude of the globular cluster.

—Dr. James R. Dire

References

Brosche, P., Odenkirchen, M., and Geffert, M. 1999. New Astronomy 4 (2), 133.

Shapley, H., and Sawyer, H. B. 1927. HCO Bulletin, 849, 11.

AL History Highlights: Years Ago

10 Years Ago—March 2015

History Highlights revives the format which Mike Stewart, the most recent former AL historian, used (p. 15). Places, people and events as shown in earlier *Reflectors* were featured in that format. The 50-year item was Lehigh Valley Amateur Astronomical Society measuring aspects of a total lunar eclipse in December 1964 with timings and video and still photography. (The next total lunar eclipse is March 15, 2025, for the western hemisphere.) The 25-year item was the opening of the George Observatory and its 36-inch Ritchey–Chrétien design telescope at Brazos Bend State Park by the Houston Museum of Natural Science on October 12, 1989. (This scope, known as the Gueymard Research Telescope, was refurbished and reopened the month after this highlight was printed. It and two other research scopes are still open to the public and used by researchers as well as amateur astronomers in the Houston area.) The 10-year item was the fantastic vivid and varied auroras of November 2005 captured as the cover photo by the late Vic Winter from Kansas City and in an article with Jeffrey J. Green's photography from Cincinnati in the March 2005 issue of the *Reflector*. (We are now at the peak of the current 11-year cycle of sunspot and solar activity with the potential for more aurorae this coming year. Check out *www.spaceweather.com* for real time info.)

25 Years Ago—February 2000

A popular activity in amateur astronomy at the most recent turn of the century was the discovery and cataloging of near-Earth asteroids, as we were becoming aware of the dangers that an unlikely yet potential impact could pose. There were some professional programs in action at that time, but amateur observers led the way. One of many such groups included members of the Astronomical Society of Kansas City featured in "ASKC Asteroid and Supernova Patrol: Making a Significant Contribution" by Larry Robinson (pp. 4–5). Three different observatories out of Kansas City and others in Kansas networked with other amateurs to position these objects and compute more accurate orbits. This time period was a conjunction of better imaging cameras, go-to telescopes, and the growth of the World Wide Web to facilitate such research. Supernovas and comets were a part of this ad hoc tracking and research across many states and countries. "A few months into its first year, the ASKC Asteroid Patrol discovered 16 asteroids and co-discovered 14 more." (Amateur tracking efforts have largely been replaced by government, university, and science foundation programs. But ASKC's asteroid tracking program was active for well over a decade and turned into ASKC's Imaging Center. It has recently been redesigned and is soon to reopen as an active special interest group for training, demonstration, and imaging for club members' own astrophotography.)

50 Years Ago—February 1975

Charles I. Gale compares the calculation, prediction and discovery of the (then) planet Pluto with that of Uranus and Neptune (pp. 35–38). Percival Lowell was essential to the calculation of its location for the search. His observatory selected Clyde Tombaugh, a Kansas farm boy, to search for the predicted ninth planet. Unfortunately, Lowell died before the discovery. "More than forty years have passed ... but we do not find ourselves much wiser than we were in 1930. Size, distance and composition of the tiny 23-arcsecond-wide and 15th magnitude dim orb were speculated.... What will those first pictures of Pluto's shadowy surface be like? A dry and rocky moonscape, with craters and dusty rilles? An ice-palace fantasy land of crystalline beauty, glistening faintly as it slowly turns in the pale light of the distant Sun? Or...? Let us hope that we shall soon find out." (Now we know. Pluto became a dwarf planet by IAU definition in 2006 and the New Horizons spacecraft's imaging on its 2015 approach and pass of Pluto revealed both predicted features and surprises.)

—Denise Moser, AL Historian

To the Editor:

I am a member of the Astronomy Enthusiasts of Lancaster County (AELC) club, based in Lititz, Pennsylvania. We have a membership of 70 and meet monthly in the community room of the Lititz Public Library. In reference to the article in the December 2024 issue of the *Reflector*, page 15, on the Library Telescope Program initiated by the New Hampshire Astronomical Society, our club donated a 4.5-inch Orion StarBlast Dob to the library several years ago. This was so successful and the demand so high that we donated another one two years ago.

(cont'd on page 21)

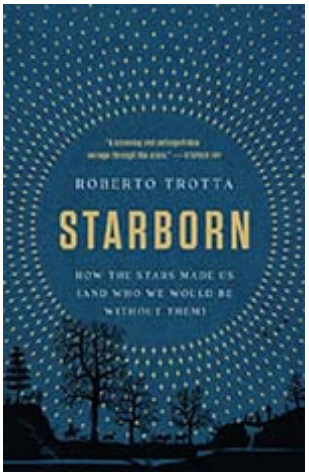
DAS Book Club:

By Mary Webb, Delaware Astronomical Society Librarian

We are pleased to share the Delaware Astronomical Society (DAS) book club calendar for 2025 (*delastro.org/members/das-book-club*). All Astronomical League members and their guests are invited to attend via Zoom. Questions? Please email *librarian@delastro.org*. Please consult the online calendar for any last-minute changes.

Sunday, March 30, 2025, 3 p.m. EDT

Starborn: How the Stars Made Us (and Who We Would Be Without Them) by Roberto Trotta

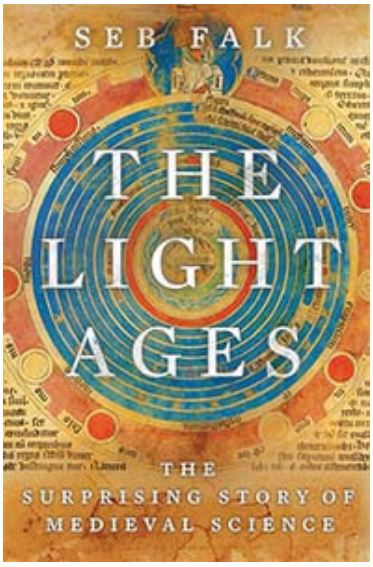


Dr. Robert Trotta will join us from Italy for our meeting. Greg McNiff, DAS and AAA member, will lead our discussion. Members of the Amateur Astronomers Association of New York will be joining us for our discussion.

Winner of the American Astronomical Society's Donald E. Osterbrock Book Award for 2025

Thursday, April 24, 2025, 5 p.m. EDT

The Light Ages: The Surprising Story of Medieval Science by Seb Falk

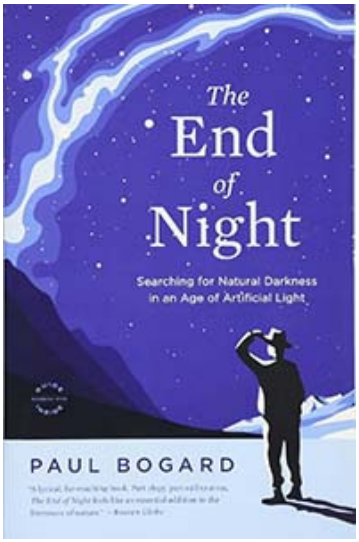


Seb Falk will join us via Zoom from England for the meeting. Greg McNiff, DAS and AAA–New York board member, will lead the meeting.

Paul Bogard will join us for our meeting. Professor Diane Turnshek, DAS book club member and special lecturer from Carnegie Mellon University, will lead our discussion.

Thursday, May 29, 2025, 7 p.m. EDT

The End of Night: Searching for Natural Darkness in an Age of Artificial Light by Paul Bogard



FUTURE EVENTS INCLUDE:

Thursday, June 26, 2025, time to be determined – *The Royal Observatory, Greenwich: A Glance at Its History and Work* by E. Walter Maunder
A celebration of the 350th anniversary of the founding of Greenwich Observatory with the members of the Flamsteed Astronomy Society in Greenwich is being planned.

Thursday, July 31, 2025, 7 p.m. EDT – *Attention Is Discovery: The Life and Legacy of Astronomer Henrietta Leavitt* by Anna Von Mertens

A portrait of trailblazing astronomer Henrietta Leavitt and an illustrated exploration of the power of attention in scientific observation, artistic creation, and the making of meaning.

Anna Van Mertens will be joining us for our discussion.

Thursday, August 28, 2025, 7 p.m. EDT – *The Interstellar Age: Inside the Forty-Year Voyager Mission* by Jim Bell

Jim Bell will join us for our meeting. DAS member Dave Hunter will lead the discussion.

Thursday, September 25, 2025, 7 p.m. EDT – *The Astronomers' Library* by Karen Masters, PhD, Haverford College

For more information, see the website listed above

We Are All Healthier Under a Starry Sky

By Mario Motta, MD, FACC

Light pollution is a subject that naturally interests many of the readers of the *Reflector*, given that our viewing of the wonders of a natural dark night sky is limited by excessive outdoor lighting. Many are also aware of some of the environmental harm of light pollution as well. What is less well-known is the adverse human health effects of severe light pollution, yet that is one of the more compelling reasons to bring light pollution under control. I became interested in this issue in 1990 through the pioneering work of Dr. Richard Stevens, an epidemiologist from the University of Connecticut. He hypothesized that light pollution's suppression of melatonin could lead to significant adverse health effects. Since that pivotal insight and publication, thousands of scientific studies have been published showing he was correct in his hypothesis, and this is now a burgeoning field of study.

Mario Motta in his observatory.

In 2012, as an elected member of the American Medical Association (AMA)'s council of science, I formulated a white paper in collaboration with some leading researchers in the light pollution field on the dangers of human health effects by excessive lighting, especially including outdoor lighting. This was published by the AMA to alert physicians and the public ("Light Pollution: Adverse Health Effects of Nighttime Lighting," 2012). This paper summarized the already extensive worldwide literature on the subject up to that time. It piqued general interest but was mostly ignored by the lighting industry. In 2016 with the United States about to embark on wholesale replacement of then-prevalent high-pressure sodium outdoor lighting with new energy-efficient LED lighting, I edited a report that the AMA council of science published to alert physicians and the general public of the adverse human health effects of excessively blue LEDs ("Human and Environmental Effects of Light Emitting Diode (LED) Community Lighting," 2016). Note this publication stated we should adopt LED lighting to curtail high energy use and allow us to diminish wasteful fossil fuel use, but that they should be the right type of LED lighting. Specifically, the AMA called on the United States to use LEDs that are of color temperature 3,000 K or less, in outdoor lighting replacements, avoiding the 4,000 K lighting then prevalent (35% vs. 21% blue emission). Many cities adopted this limit, much to the ire of the lighting industry at that time. Lighting companies then denied any of their products could harm either humans or the environment, and were downright hostile toward the published science. Happily, since then, most have come around and the latest Illuminating Engineering Society (IES) handbook in 2022 has come to endorse much of what the AMA first proposed in 2016. Now many (though not all) lighting engineers do attempt to limit severe light pollution and glare in their lighting designs and applications.

In early 2024, the *Journal of the AMA* asked me to produce an article that updates and summarizes the current state of the field, and I was happy to oblige. The full article was published on October 2, 2024, and is now available online (see the link at the end of this article). It is titled "We're All Healthier Under a Starry Sky," and is a full peer-reviewed article, with 42 peer-reviewed references. As a bonus, for any physicians reading this, you can obtain one AMA continuing medical education credit (CME) by reading it, and then answering a few questions that will satisfy your state CME requirements! I hope you enjoy reading this article, which summarizes the latest advances in this burgeoning field. It will also give you additional information to push for light pollution mitigation efforts when attending your local town halls, and is now free to share.

Whirlpool Galaxy. All images by author.

I will briefly summarize this paper here. First, glare is a serious issue that impedes safe driving at night. While glare is a problem for all, it is especially significant for older drivers. As we age, the lenses in our eyes develop microcalcifications (affecting nearly everyone by age 45), and with time these can slowly coalesce into cataracts as we age. Unshielded lights can scatter in the eye from these calcifications, and cause disability glare. What is worse, blue light, which comprises 35% of the emission from 4000 K lighting, scatters the most: 10 times the mount that red light scatters (just like sunlight in our atmosphere; the physics is the same). Yet this is easily fixed. Demand all streetlights and businesses shield lights so no direct light hits drivers, demand low correlated color temperature lighting (for example, no more than 3000 K; preferably 2700 K or less). As I tell many elderly attendees at my presentations, if you have trouble driving at night, the fault is not so much in your eyes, as it is with simply bad engineering. Public lighting should not create hazardous driving conditions or adverse human health effects.

The second issue is an increase in endocrine-related cancers with excessive light pollution. This is actually a well-researched subject these days. It is not that a photon causes a cancer directly; it is that light at night, including streetlights that shine through your bedroom window, suppress your nightly melatonin production from your pineal gland. Surprisingly little light can do this, as low as 2 microwatts. Melatonin is an immune system adjuvant that stimulates B and T lymphatic cells to find and destroy abnormal cells that we all produce daily. If we diminish our immune system with light in our bedrooms at night, then we have a small incremental increase in certain cancers tied to the endocrine system. Many large-scale studies have now proven this statement to be true. For example, a study that followed 130,000 nurses for over 20 years found a 15% increase in breast cancer in those exposed to outdoor light at night compared to more rural, less light polluted, areas. This has been replicated by 25 additional large-scale studies worldwide, including the most recent from Spain. Men have a similar increase in prostate cancer with light pollution. Recent studies out of Texas now show similar issues with pancreatic and thyroid cancers. These are all large-scale epidemiological studies, and that is the same level of proof as lung cancer studies regarding smoking.

Light pollution leads to higher levels of sleep disturbances, as you would expect, but that can lead directly to higher levels of psychosis and psychiatric disturbances, depression, and anxiety issues. Recent studies have linked light pollution to abnormal metabolism by disrupting leptin and other digestive hormones, leading to an increase in obesity and a subsequent increase in diabetes in outdoor light polluted areas. That has consequences with an increase in negative cardiovascular outcomes as well.

Excessive blue light (primarily indoor lighting in this case) can exacerbate macular degeneration; thus, you are well advised to limit excess blue light in indoor lighting. The iPhone does this automatically in its evening removal of blue emission. Indoor night lighting should not exceed a color temperature of 2400 K, which emits about 10% blue emission.

Finally, it is beyond the scope of this brief article or my paper to detail the immense environmental harm of excessive (and especially high levels of blue) light on our environment. Numerous articles detail this issue. I will point you to many articles in *Nature* magazine, especially those written by Travis Longcore of UCLA. Light pollution is contributing to an annihilation event on insects dubbed an "insect apocalypse" with dire consequences to our food supply via effects on pollination. Light pollution also has led to a dramatic reduction in bird life, turtle hatchlings, and nocturnal animals. Light pollution is bad for our planet, not just for our own personal health.

I do hope you read and enjoy the article in the link below, and use it to convince your local town and street lighting company to limit blue light at night, mitigating both human and environmental harm. As a beneficial side effect, we all get darker skies as a result!

Link to AMA journal article: *journalofethics.ama-assn.org/article/were-all-healthier-under-starry-sky/2024-10*.

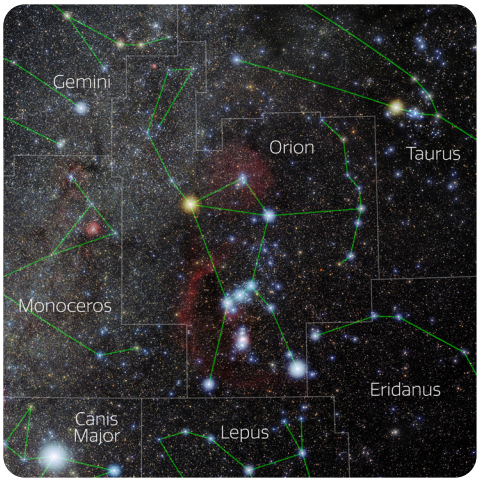
References:

Human and Environmental Effects of Light Emitting Diode (LED) Community Lighting: *https://lightaware.org/wp-content/uploads/2023/08/AMA_Report_2016_60.pdf*

Light Pollution: Adverse Health effects of Nighttime Lighting: *https://www.softlights.org/wp-content/uploads/2020/06/AMA_2012_Reports-of-the-Council-on-Science-and-Public-Health-A-12.pdf*

Stevens, R.G. 1987. *Am J Epidemiology* 125, 556.

NSF Launches 88 Constellations Project



The U.S. National Science Foundation's National Optical-Infrared Astronomy Research Laboratory (NSF NOIRLab) has released its new comprehensive 88 Constellations Project. For the first time, all of the nighttime optical/infrared observatories funded by NSF have been unified into a single organization, making NOIRLab the U.S. center for ground-based nighttime optical astronomy.

The resulting project is a comprehensive collection of free, high-resolution, downloadable images of all IAU-recognized constellations, including the largest interactive open-source all-sky photo of the night sky. The project is intended to serve as an educational archive for individual observers as well as scholastic applications.

According to its website (*noirlab.edu/public/news/noirlab2430*), "All sections include a comprehensive description of the constellation and its historic origins, as well as the corresponding standardized stick figure, outline drawing, finder chart and description of the constellation's most prominent deep-sky objects. Existing astronomical images of such deep-sky objects captured with various NSF NOIRLab telescopes such as the International Gemini Observatory, NSF Kitt Peak National Observatory, and NSF Cerro Tololo Inter-American Observatory are included. Downloadable flash cards and other audiovisual and educational materials make it easy to bring the constellations into classrooms." This is also a valuable resource for astronomy club outreach.

The project was funded by the U.S. National Science Foundation in collaboration with ESA/Hubble and is managed by the Association of Universities for Research in Astronomy (AURA) under a cooperative agreement with NSF, and is headquartered in Tucson, Arizona.

—Bob Kerr

The Few, the Proud, the Precise

The Photoelectric Photometry (PEP) Section of the American Association of Variable Star Observers (*www.aavso.org/aavso-photoelectric-photometry-pep-section*) is looking to add members to its team. Although any device that converts photons to electricity is photoelectric, PEP has a specific historical designation. It refers to photometry practiced with single-channel photometers. Before the advent of CCD cameras, photometers were the tool par excellence for measuring the brightness of stars. The foundations of stellar photometry were laid with these devices by Johnson, Cousins, Bessell, Landolt, and others. Today, most amateurs who practice PEP use SSP-3 or SSP-5 photometers from Optec, Inc. Though these products are no longer made, they still have a place in bright-star astronomy. CCD and CMOS cameras have given us access to fainter and fainter stars but they easily become saturated by targets brighter than 6th magnitude. Camera photometry of stars like Betelgeuse is difficult at best—PEP gives far better results. On top of that, PEP is easy! No flat-fields, no dark frames, no bias frames. I have taught high school students the basics of operation in a single evening.

The AAVSO PEP Section is currently working with professionals on a project to follow Alpha Cygni variable stars like Deneb and Rigel. We would eagerly welcome new participants and we have some photometers we can lend. You will need a Cassegrain-style reflector of at least eight inches aperture or a refractor of five inches aperture. The photometer slips into the focuser drawtube and can be installed or removed in a snap. A go-to mount with user-programmable objects is a huge help. If you have an SSP gathering dust, please consider putting it to use yourself or loaning or donating it to AAVSO. PEP inquires can be sent to *tjc@cantordust.net*. Come join us!

—Tom Calderwood, AAVSO PEP leader

The Historical Astronomy Division of the American Astronomical Society maintains two free online resources for the astronomy community: the This Month in Astronomical History column (*had.aas.org/resources/astro-history*) and the American Astronomical Society Obituaries project (*baas.aas.org/obituaries*).

First Light: New Frontiers, New People

By Tom Webber
Cedar Amateur Astronomers, Cedar Rapids, Iowa

As they used to say in the old *A-Team* TV series, "I love it when a plan comes together." The planning committee for the 2025 NCRAL Conference is working diligently to prepare for an exciting two days of astronomy.

This year's conference will take place April 25 to 26 in Minneapolis, Minnesota. Registration began January 25, 2025.

The theme for 2025 is "First Light: New Frontiers, New People" to reflect exciting advancements in astronomy and welcome new NCRAL members and other members who have not previously attended a conference.

CONFERENCE SCHEDULE

Early risers on Saturday will be treated to coffee and donuts followed by the NCRAL business meeting at 8 a.m. The morning sessions will begin at about 10 and there will be a break at noon for people to grab a box lunch or walk to any of the nearby restaurants for a bite to eat.

Afternoon sessions resume at about 1 p.m. and go until 5 when a group photo and social hour is scheduled. A buffet-style banquet and the keynote talk will round out the evening. Between sessions attendees can visit the vendor tables and view the astrophotography contest entries. Door prizes will be awarded throughout the day.

An impressive lineup of speakers have committed to give presentations. Speakers and titles include:

- John Rummel, Madison Astronomical Society, accomplished photographer – "Can the Milky Way Cast a Shadow?"
- Bob King, *Sky & Telescope* contributor, blogger, author – "NASA's Planned NEO Surveyor Hunts Down Killer Asteroids"
- Lawrence Rudnick, professor emeritus of astrophysics, University of Minnesota – "Game Changers in the Radio Sky"
- Clem Pryke, experimental cosmologist and educator, University of Minnesota – "Studying the Beginning of the Universe from the Bottom of the World"
- Mike Solontoi, associate professor of physics, Monmouth College–"Seeing the Universe Through New Eyes – The Vera C. Rubin Observatory"
- Mike Benson, PhD, vice president of research and development at Hormel Foods, accomplished astrophotographer, will discuss his experiences in astrophotography
- Evan Skillman, distinguished professor, University of Minnesota– "Using the Large Binocular Telescope to Measure the Primordial Helium Abundance"

A planning committee of volunteers from several NCRAL groups (rather than a single member club) is hosting the conference. The Minnesota Astronomical Society has graciously offered to host a Friday night star-b-que at Eagle Lake Observatory on April 25. Guests can head to Eagle Lake to enjoy dinner, tour the observatory, and listen to a brief presentation by Greg Bragg, acknowledged camera and telescope insider. Bragg will discuss "The State of the Astronomy Industry." Weather permitting, some observing will follow the discussion. More information to come.

RESERVATIONS

The committee reserved a banquet hall and a block of rooms at the Minneapolis Marriot Southwest, 5801 Opus Parkway, Minnetonka.

For more information and to make reservations, visit *ncral2025.org*. Rooms are available at the NCRAL rate and can be reserved by going to the website above or calling the hotel directly at 952-935-5500 and asking for the NCRAL Conference block. Direct questions to *NCRALConference@gmail.com*.

You can also visit the NCRAL Conference Facebook page at *www.facebook.com/profile.php?id=61570354787210*

Visitors can post questions, comments, and photos of your past and current conference experiences.

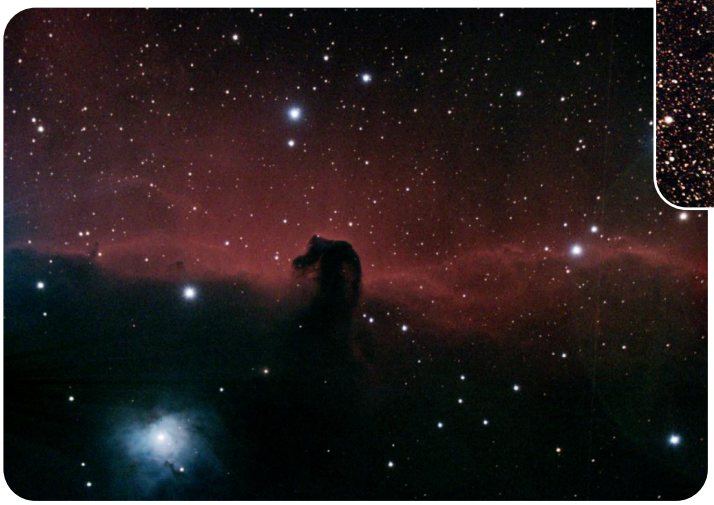
We look forward to seeing you in April!

E.E. Barnard and his Dark Nebulae

By Larry McHenry

Visible throughout our galaxy are clouds of interstellar matter, thin but widespread wisps of gas and dust. The radiation from some of the stars near these nebulae can excite the gas to shine; such nebulas are called emission nebula. If the stars are dimmer or further away, their light is reflected by the dust in the nebulae and are called reflection nebulae. But some nebulae are only visible by blocking the light from objects behind them. These are called dark nebulae.

Edward Emerson Barnard was a professional astronomer, and as a pioneer in astrophotography, he cataloged a series of dark nebula of the Milky Way. Through this work of studying the structure of the Milky Way, Barnard discovered that certain dark regions of our galaxy are actually clouds of gas and dust that obscured the more distant stars in the background. Today, we're going to look-back on his life and accomplishments.



B33 – Orion (Horsehead Nebula)
8" SCT optical tube @ f/6.3, Atlas Gem mount, ASI294MC and L-Pro filter @ 60 seconds livestacked for 15 minutes.

BARNARD'S EARLY YEARS

Edward Emerson Barnard was born on December 16, 1857 in Nashville Tennessee, at the cusp of the Civil War. His mother, Elizabeth, had moved the family from Cincinnati to Nashville a few months prior to Edward's birth, after his father, Reuben, had passed away. The family lived in near poverty, with Elizabeth as the sole provider working several small jobs. Due to the war, Edward did not have a traditional education, only getting in about two months of actual classroom time, although he was homeschooled by his mother (Tenn 1992, 164).

After the war ended, Edward was able to find a job in a local photography studio at the age of nine. Edward was responsible for keeping a giant portrait enlarger camera located on the shop's roof pointed at the Sun in order to provide enough natural light for the photo enlargements. From working with the camera, he developed an interest in camera lenses and photographic techniques.

B72 – Ophiuchus (Snake Nebula)
8" SCT optical tube @ f/6.3, Atlas Gem mount, ASI294MC and L-Pro filter @ 300 seconds livestacked for 20 minutes.

In 1870 a 13-year-old Edward acquired the parts from an old ship's spyglass and built a small refractor with a 2-inch lens which he used to study the Moon and the planets Venus and Jupiter. Then, at the age of 17, a friend left him a textbook on astronomy and Edward was able to learn the names of the stars and constellations that he had been watching since he was a young boy (Barnard & Dobek 2011, 355). By 1876, Edward had saved enough of his salary to buy an equatorially mounted 5-inch refractor. He used this telescope to continue observing the Moon, planets, double stars, and clusters. But he most enjoyed sweeping along the Milky Way with it.

The following year, the American Association for the Advancement of Science held its annual convention in Nashville at the new Vanderbilt University. Through his photography connections Barnard was able to meet astronomer Simon Newcomb. Edward asked Newcomb how to go about becoming a professional astronomer, hoping that he was already on the right track. After hearing of Barnard's background, Newcomb didn't hold out much hope for Edward, but did suggest that he should take up comet hunting as a way to become a professional

B86 – Sagittarius (Ink Spot Nebula)
EVO50mm f4.2 Refractor, Atlas Gem mount, ASI294MC and L-Pro filter @ 30 seconds livestacked for 8 minutes.

observer. Edward resolved to take Newcomb's advice and begin searching for comets (Sheehan 1995, 25).

BECOMING AN ASTRONOMER

After the meeting with Newcomb, Barnard hired a math tutor, and would spend cloudy nights studying and clear nights out observing. He also began to make more practical detailed observations, sketching Jupiter's bands, Great Red Spot, and the Galilean moons' shadow transits, and participated in recording observations of the 1878 Mercury transit. Through these efforts, Barnard became a skilled record keeper and planetary sketcher.

Three years later, on May 21, 1881, Barnard discovered his first comet. Unfortunately, he didn't know the proper technique to measure its position or how to correctly report it. Barnard realized that he needed help, so he reached out to contacts he had made at Vanderbilt University. The university had just recently completed building an observatory with a 6-inch refractor, but had no astronomer on staff to run it. The university offered Edward a job as an Assistant Astronomer, and enrolled Barnard as a student to acquire an education in math and physics.

This was the break Barnard was hoping for. He would spend days studying and nights observing the sky. Edward considered sleep a waste of time (Tenn 1992, 165) and he soon became known as "The Man Who Never Slept" (Barnard & Dobek 2011, 356). Before long, Edward's diligence paid off, as he discovered another comet, on September 17th, 1881, which became his first official find; a year later another came his way on September 14, 1882. By 1887 Edward had discovered 9 new comets.

In addition to comet sweeping, Barnard also spent time using the observatory's 6-inch refractor to observe the planets and deep-sky objects. On July 17, 1883, while observing near M20 in Sagittarius, Barnard discovered a small triangular-shaped 'dark-hole' near a small star cluster (NGC6520). This was Edward's first telescopic discovery of what would become known decades later as dark nebulae (Barnard & Dobek 2011, 357). It was also his favorite example.

Barnard never officially graduated from Vanderbilt University, as in 1887, Edward was offered a job as a staff astronomer at the new Lick Observatory on Mt. Hamilton with its 36-inch refractor. Barnard quit his job at Vanderbilt and moved to California.

LICK OBSERVATORY

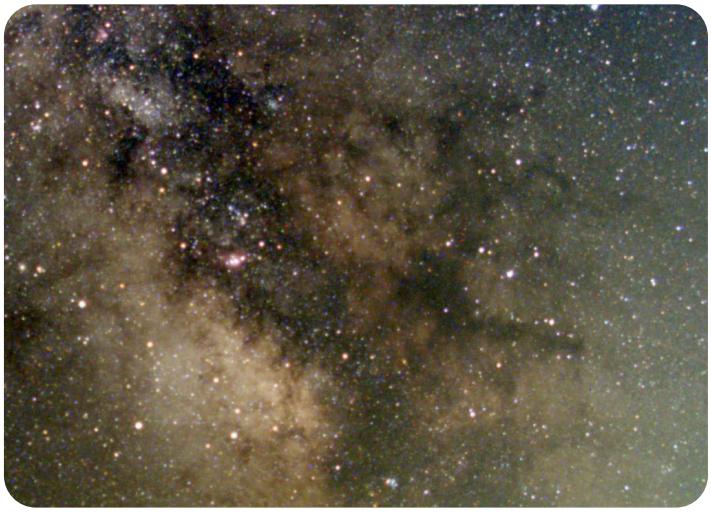
Lick Observatory was a hot topic of the day among the astronomical world, being the first observatory ever to be built on a mountaintop. The director of the observatory, Edward Holden, felt Barnard's keen observing abilities were what he needed for the new facility. Edward was offered a job as a junior member of the astronomy staff and assigned time on the observatory 12-inch Clark refractor and a small 6.5-inch equatorial refractor. Barnard wasted no time in sweeping up a new comet in September, and another in October.

One of Barnard's early assignments was to use his studio photography expertise and begin to systematically photograph the Milky Way. Barnard used a 6-inch studio-portrait lens (a Petzval doublet named the Willard lens) that the observatory had acquired and mounted it in a wooden box camera that he built by hand. Edward then piggybacked this home-made camera on the small 6.5-inch observatory refractor and began experimenting with guided exposures. His wide-field time exposures revealed details in the large-scale structures of bright star clouds, obscured by what looked to be dark holes, voids, lanes, or spots. His photographs soon became a popular item to be passed around

B142 & B143 – Aquilia (Barnard's "E")
EVO50mm f4.2 Refractor, Atlas Gem mount, ASI294MC and L-Pro filter @ 30 seconds livestacked for 30minutes.

by observatory staff, as they showed the Milky Way star clouds as never seen before (Tenn 1992, 166). This was the start of what became Barnard's life-work, gathering evidence as to the nature of these dark features—were they actually voids in space, or were they something else?

By the summer of 1892, the old 6-inch Willard studio lens camera had deteriorated and needed re-polished. A local benefactor of the observatory donated funds to build a dedicated dome with a dark room and equatorial mount for the refurbished



B56, B65, B66, B67, and B78 – Ophiuchus (Pipe Nebula)
Canon 5mm CCTV lens, Atlas Gem mount, ASI290MC & IR filter @ 60 seconds livestacked for 15 minutes.

Willard lens, now known as the Crocker Telescope. Using this Barnard continued photographing dramatic wide-field pictures of the Milky Way, particularly the striking dark holes in the Sagittarius region and around Rho Ophiuchi. Barnard gave fanciful names to some of these objects, such as the "Snake" (B72), the "Pipe" (B78), and the "Parrot's Head" (B86). Barnard still continued to view these objects as actual voids in space, but the data were beginning to point in another direction (Sheehan 1995, 270). Edward also purchased a small 1.5-inch projecting lens and made an even wider-field 'lantern' camera with it and piggybacked it on the Crocker Telescope. With this new camera he was able to photograph entire constellations.

YERKES OBSERVATORY

In 1895, George Hale made an offer to Edward Barnard to come work at the new Yerkes Observatory with a title of professor of practical astronomy, where he would have full access as a staff astronomer to the new 40-inch refractor. Barnard accepted, and was soon on his way to Wisconsin with his lantern camera and wide-field Milky Way photos.

In 1897, Barnard made a successful sales pitch to a wealthy Yerkes Observatory benefactor to fund a new wide-field 10-inch photographic refractor telescope for Barnard's exclusive use, which became known as the Bruce Telescope. With it Barnard took over 4,000 images, and made a number of photographic nebula discoveries, re-imaging the large-scale Milky Way structures he had earlier photographed at Lick. It was the richness of the star clouds and outstanding Milky Way features, showing much more fine detail in the dark regions than ever before, that became the center of Barnard's work. This was the evidence, from his own photographs, that eventually convinced Barnard in 1913 that these dark areas were actually obscuring dark material blocking the view of more distant Milky Way star clouds.(Sheehan 1995, 375). It was considered an important discovery among the astronomical world, as now astronomers had to take into account these dark clouds of dust and gas in their models.

BARNARD'S LEGACY

Barnard eventually obtained funding for a publication of his wide-field Milky Way photographs. But before he could finalize his atlas of dark nebulae, long-standing health issues that Edward had neglected finally caught up to him. Declining in health, brought on from untreated diabetes and heart issues, Barnard passed away on February 6, 1923, at the age of 65. Barnard was buried in his hometown of Nashville, where he was given a hero's funeral procession fit for a state official.

Barnard's assistant and niece, Mary Calvert, who started working for Edward in 1905, along with the director of Yerkes Observatory, Edwin Frost, dedicated themselves to finishing Barnard's work (Barnard & Dobek 2011, 358). Finally, in 1927, Edward Emerson Barnard's greatest accomplishment, his *A Photographic Atlas of Selected Regions of the Milky Way*, listing 370 of his "Barnard Objects" was published as a two-volume photographic atlas.

CONCLUSION

E.E. Barnard is considered by some to be the last great Victorian classical visual observer, living at the dawn of the age of the "new astronomy"—astrophysics. But Barnard was also one of the first pioneers of wide-field astrophotography, and his discoveries and studies of these dark voids broke new ground in astronomy, changing our perception of the Milky Way and star formation. Edward Emerson Barnard straddled the divide between the old and new astronomy, and his work lives on today, both for the professional astrophysicist and amateur astronomer alike.

Barnard considered a clear night observing with a telescope almost a sacred rite (Frost 1923, 21), when one could search for the truth in celestial places. So I encourage everyone to get out tonight and try your hand at finding and observing the celestial truth of these elusive deep-sky objects, the dark nebulae of Edward Emerson Barnard.

Editor's Note: If this article has piqued your interest in the Barnard Objects, Tim B. Hunter and co-authors' *The Barnard Objects* (Springer, 2023) was reviewed in the December 2024 *Reflector*.

—Larry McHenry
www.stellar-journeys.org

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Barnard, E.E., and Dobek, G. 2011. *A Photographic Atlas of Selected Regions of the Milky Way*. Cambridge.

Frost, E.B, 1923. ApJ 58, 1. *https://ui.adsabs.harvard.edu/abs/1923ApJ....58....1F/abstract*

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Further Reading:

Higgins, D. Sum. 1987. *Deep Sky* Magazine, 19.

Mumford, G. Jul. 1987. *Sky & Tel.*, 30.

Sheehan, W. Jun. 1996. *Astronomy*, 32.

Dan Crowson (Astronomical Society of Eastern Missouri) captured this image of NGC 2985 using an Astro-Tech AT12RCT with a SBIG STF-8300M camera from his from his observatory in Animas, New Mexico.

March Birthdays in Astronomy:

Urbain Le Verrier (March 11, 1811)

Dorrit Hoffleit (March 12, 1907)

Percival Lowell (March 13, 1855)

Caroline Herschel (March 16, 1750)

Walter Baade (March 24, 1893)

Adriaan van Maanan (March 31, 1884)

Time Flies When You Are Having Fun

By Peggy Walker, MSRAL regional representative

The year Jolly Rancher candies debuted their first three flavors, Harry S Truman was president and gas cost a mere twenty-seven cents a gallon –1949—a small group of amateur astronomers from two groups hosted a meeting at Fayette, Missouri. Two events happened concurrently, the formation of Central Missouri Amateur Astronomers and the genesis of the Mid-States Region of the Astronomical League. Dr. Floyd Helton of Central Missouri College, Gene Waters (future League archives), and Russell Maag (another future League president), met with members of the oldest MSRAL club, the Kansas City Astronomy Club, at the Morrison Observatory.

The first slate of officers was Russell Maag, chair; Stuart O'Byrne, vice chair; W. Magruder, secretary-treasurer; and E. Brooks, region representative. They started traditions that have been faithfully passed down to the present. Clubs in the region immediately started to partner up to co-host yearly conventions, starting with the Central Missouri Amateur Astronomers and Astronomical Society of Kansas City, who carried the region early on. In 1952, the St. Louis Astronomical Society jumped in with the Amateur Astronomical Society of Emerson Electric to host the 1952 event, with the Tulsa Astronomical Society partnering with the Wichita Astronomical Society in 1953. It was the second hosting for the Tulsa Astronomical Society that generated the early version of the Amateur of the Year Award, presented to S. Whitehead of the Wichita Astronomical Society in 1959.

Other clubs formed and reformed. In 1938, the Great Plains Astronomy Club began, drawing members from three states (Omaha, Nebraska; Topeka, Kansas; and Des Moines, Iowa), formed to coordinate amateur astronomers in the Midwest with a four-year rotating meeting. The Omaha Astronomical Society officially formed in 1962 with 15 members, and in 1963, Dr. Holyoke led a youth group consisting of 45 members, part of the League's Junior Astronomical Societies. Dr. Holyoke assembled a Messier observing list that made its way to all the youth societies, with Bob Wright helping to coordinate pin and certificate incentives. League president Gene Waters suggested that this youth observing program be opened to the adults—and, as they say, the rest is history.

The fifties showed huge growth, as reflected in an article on the front page of the Sunday edition of the *St. Louis Dispatch* (1952), "Astronomers Urged to Keep Watch for Saucers in Convention Here" (referencing a talk given at a MSRAL meeting). A short time later the Smithsonian Astrophysical Observatory established Operation Moonwatch for the International Astrophysical Year in 1956. Simple refractors were set up worldwide to encourage young people to observe the night sky and hunt for Sputnik. One location—Bartlesville, Oklahoma—had such a large community outpouring that the youth running that station formed the Bartlesville Astronomical Society in 1959.

The early history of the various regions in the League can be found in the early editions of *Sky & Telescope* magazine, courtesy of Charles Federer Jr., editor-in-chief and president of the newly formed Astronomical League. (Rumor has it that original magazines are at the main office archives.) Thorough reports were submitted by designated "reporters" from each region, with MSRAL's first being none other than Russell Maag of the Central Missouri Amateur Astronomers. Seventy-five years later, MSRAL is still alive and well and celebrating an important anniversary.

This year's convention, hosted by the Central Arkansas Amateur Society, will be held at the University of Arkansas at Little Rock from June 13 to 15, 2025. CAAS has invited high school and university students to submit poster presentations and secured Saturday night's banquet speaker, William I. Hartkopf, PhD, recently retired from the U.S. Naval Observatory, who will share 150 years of research from the 26-inch Alvin Clark refractor. No convention would be complete without the star-b-que on Friday night and an awards presentation; there will also be a 75th anniversary celebration.

For registration information, please go to *MSRAL.org* and click on the MSRAL Registration tab. Hope to see you there.

Celebrating Outreach Excellence

By Jerelyn Ramirez, Master Observer, Kansas Astronomical Observers

As the Kansas Astronomical Observers' outreach coordinator, I discovered I had access to our records of all club members' volunteer outreach hours since 2004. As I looked them over, I discovered many members qualified for the Outreach Observing Award Program sponsored by the Astronomical League. A couple of them had already submitted their logs for tiers one and two—Outreach and Stellar—of the Outreach Observing Award Program, but had not followed up on completing their logs for the next level, Master. Based upon the year they were awarded their latest certificate, I was able to find documentation of their continued public outreach work since then. I took it upon myself to log and submit their active participation as a club volunteer for public outreach to recognize their work. To my astonishment, a few other members had accumulated enough hours to qualify for the Outreach and Stellar levels.

I submitted the required logs to Maynard Pittendreigh, the program coordinator, and had him send me their certificate and pins. I then planned an awards presentation at the next club meeting in June 2024. To their surprise, I awarded certificates and pins to those who were in attendance at the meeting. I also handed out awards to those who earned the outreach award through the Night Sky Network. I had already earned all three tiers of the Outreach Observing Award Program back in 2009.

I'm including a narrative that is required to earn the Master award, honoring my friend, Richard Meredith:

I'm writing this on behalf of my good friend Richard "Red Star" Meredith. Red Star gets his name as he enjoys searching and observing carbon stars in the Milky Way galaxy. This is how I met Richard: I happened to go out to the Lake Afton Public Observatory soon after I bought my first telescope. While there he approached me and asked me if I would like to see a red star. This would be the beginning of a 20-year friendship.

This is what Richard does. He has a love for the night sky and enjoys sharing it with anyone who may happen by. He hangs out at the observatory every chance he has as it is open to the public every Friday and Saturday night. There is a concrete pad on the north side of the observatory where people can set up telescopes for a night of observing, free and open to the public.

Richard's telescope of choice is a 12-inch Dob. He'll have it set up on the pad as the curious would-be amateur astronomers migrate around the building to see what is going on there. It is there he will engage with you and find out what your interest level is by inviting you to see a red star, a star cluster, galaxy, or a nebula, depending on what he has his telescope trained on. Almost everyone is awestruck when they look through his 12-inch telescope. He will slew to the next object with ease as he shares another celestial marvel. He impresses upon people how he has many of the cosmic jewels memorized as he effortlessly moves from one object to the next, sometimes better than a go-to telescope.

Before the night is over, he would have you observing with his telescope and finding those deep-sky objects on your own. He enjoys meeting new people this way. If they are coming out to the observatory, they have an interest in astronomy, and he wants to be there to help you on your astronomy journey.

Top row (l to r):
John Bierens (Outreach and Stellar)
Chris Lamer (Outreach and Stellar)
Tim Hall (Outreach)
Richard Meredith (Master)
Charles Rivera (Outreach + NSN)
Ron Mallory (Outreach)
Phil Osborn (Outreach and Stellar)

Bottom row (l to r):
Jerelyn Ramirez (NSN Award)
Chris Ketron (Outreach and Stellar + NSN)
John Campbell (Outreach)
Mandy Mae Stout (Outreach)
Dennis Stout (Outreach)

Touching the Universe:
3D Printing for Education and Outreach

By Jennifer Piatek
Chair, Earth and Space Science Department, Central Connecticut State University

Introductory astronomy courses often ask students to make spatial interpretations in three dimensions but present data on 2D screens or paper. Learning to think in 3D is a critical skill that can be made easier using 3D models to connect flat images or data representations to the spatial concept we are trying to convey. In addition, 3D printed models are tactile and interactive, providing an additional way to visualize astronomical features that can enhance learning and make the features we are trying to explore accessible to those who struggle to interpret the images. These same techniques can be used in astronomy outreach, to bring the universe down to earth, especially for individuals with visual challenges.

3D printing technology continues to improve, making printers more affordable and accessible to the general user. Public libraries and universities are beginning to provide "maker spaces" where members of their communities can learn how to use tools like 3D printers without having to purchase their own. Although 3D prints can take a long time to complete (sometimes several hours), this is passive time that normally requires no input from the user. Filament for printers is readily available through online retailers in a variety of colors and is relatively inexpensive (about $30 for a 2 kg spool at the time of this article; most printed models referenced here used less than $2 of filament). As printers become more accessible, scientists are making more templates for 3D models available online, avoiding the need to learn complex software to create your own models, although tools for creating models are also freely available (for example, the open-source software Blender, *www.blender.org*, or the free web-based application Tinkercad, *www.tinkercad.com*).

For planetary astronomy, 3D models are ideal tools for representing the shapes of Solar System bodies (such as asteroids or comets) and the geomorphology of planetary surfaces. For example, I currently use 3D prints in two of my introductory lab exercises: one examining the surface of Mars and the other exploring the formation of impact craters. These exercises, along with others intended for physical geology courses, are available online at *www.physics.ccsu.edu/piatek/3d.html*.

The goal of the Mars activity is to examine the differences between the northern and southern hemispheres: the northern is overall lower in elevation with fewer impact craters than the southern (planetary scientists call this the "hemispheric dichotomy"). For this exercise, we have printed a 3D representation of the surface topography measured by the Mars Orbiter Laser Altimeter. The surface was broken into eight sections and the prints created with layers of different color filament (see Figure 1). The colors and heights of the models

Figure 1a: At top, a colorized representation of Mars topography used to generate 3D prints: (lowest) blue - green - tan - pink - silver (highest). Compare to photos of printed models (with the same color scheme) used in lab exercises (Figures 1b and 1c). The smoothest of the northern plains compared to the southern highlands can be felt as well as noted visually.

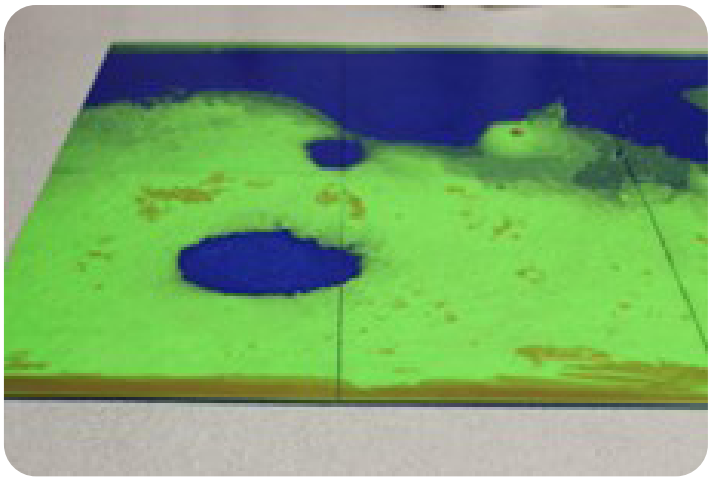


Figure 1b

illustrate differences in elevation, and the relative amounts of craters can be deduced from the smoothness of the models (rough indicates more craters, smooth indicates fewer craters). These observations are recorded on a map grid and can be compared with additional image datasets (composition, location of different types of valleys) to explore how the differences in the two hemispheres relate to the geologic history of Mars.

Impact craters have specific morphologies depending on the size of the crater: larger craters tend to be shallower (the ratio of depth to diameter decreases) but have more complex structures such as central peak mountains or multiple concentric rings of mountains. Although these can be observed in images and maps, they can be easier to explore using 3D models (see Figure 2). For our impact lab, students examine models of craters of different diameters and are asked to observe how the morphologies change

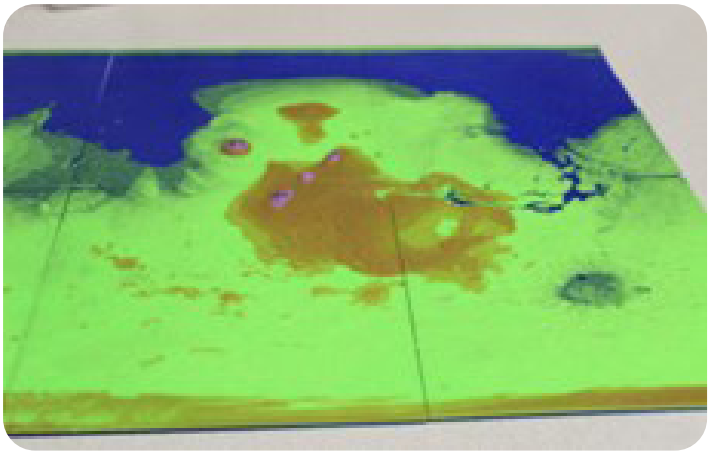


Figure 1c

with diameter. Many of them can deduce the change in the depth-to-diameter ratio with increasing size using the models rather than relying on a textbook explanation. They also identify the changes that happen as larger craters become more complex and can carry over these observations to later assignments.

Although these examples are focused on topography, more astronomical datasets are becoming available as 3D models, which are ideal for exploring astronomy spatially without having to interpret two-dimensional images. Some resources for 3D printable models relevant to astronomy include NASA's 3D Resources page (*nasa3d.arc.nasa.gov*), the 3D collection from the Smithsonian Institution (*3d.si.edu*), and "3D Printing the X-Ray Universe" from the Chandra X-Ray Observatory (*chandra.cfa.harvard.edu/deadstar*).

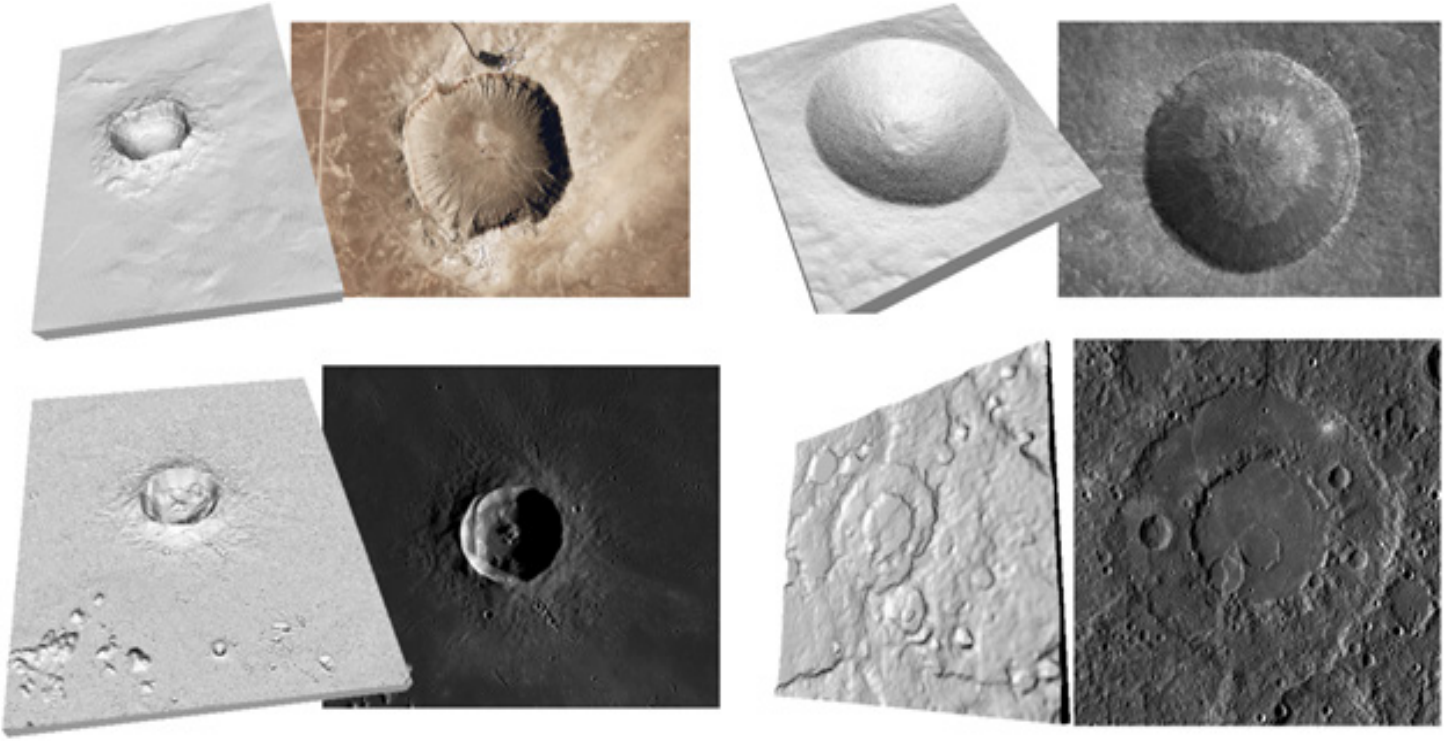


Figure 2: Images and 3-D models used to examine crater morphologies. The top two craters (left: Barringer, Earth; right: Linné, Moon) are smaller simple craters (1.2 km and 2.5 km diameter), while the bottom two (left: Euler, Moon; right: Renoir, Mercury) are larger (28 km and 220 km diameter respectively) and exhibit more complex morphologies.

Garnets in Meteorites: Gems of the Asteroid Belt

By Jessica Johnson

Believe it or not, there are garnets in the asteroid belt. Specifically, we find them in a subgroup of stony meteorites called carbonaceous chondrites.

Both figures above are examples of one of the more famous carbonaceous chondrites, Allende. The figure on the left is an unsliced piece with some of the fusion crust still intact (modified from Wikipedia). The figure on the right shows a piece that has been cut open revealing the structures inside (modified from Caltech).

The six main types of garnets. Images courtesy of Wikimedia Commons.

WHAT IS GARNET?

If you know what garnet is, there is a good chance your mind immediately goes to the radiant red gems that are the January birthstone. Perhaps you think of sandpaper, as garnet is used as an abrasive. While these are indeed common uses, there is much more to the garnet, including an astronomical connection.

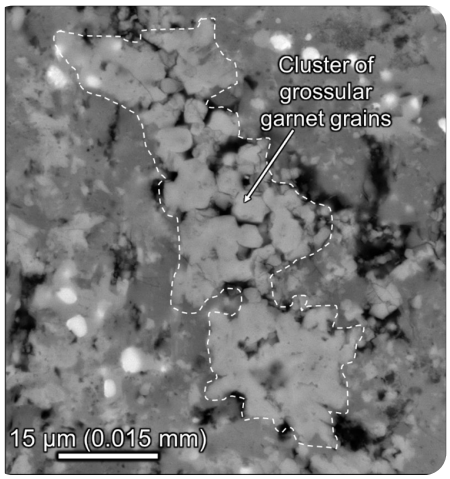
The word garnet is derived from the Latin *granatus*, likely derived from *granatum* (pomegranate), as the most common variety (almandine) resembles pomegranate seeds. There are many different varieties of garnet (32 in all), but there are six main types: almandine, andradite, grossular, pyrope, spessartine, and uvarovite. Garnet comes in a wide variety of colors and can form in different geologic environments.

How can one mineral have so many different colors and varieties? To answer this, we need to look at the elements it contains. Garnets can host combinations of many different elements, such as iron, calcium, aluminum, magnesium, manganese, titanium, chromium, and even small amounts of the rare earth elements. Geologists have utilized garnets to help unravel and understand many important geologic questions on Earth as well as in the asteroid belt because the type of garnet that forms depends on the environment in which it forms. The radiant red garnets (almandine) used as gemstones form in metamorphic conditions (rocks that are buried and heated over time); these are the most common garnets. Other garnets such as yellow grossular and brown-red andradite form through interactions between water and rock in environments where ores are formed here on Earth.

CARBONACEOUS CHONDRITES

Carbonaceous chondrites are stony meteorites comprised of materials—minerals, organic material, metals, and more – that represent some of the very first solids that formed in our Solar System, before the Earth was even a planet. We know of eight types of carbonaceous chondrites that differ in the abundances and chemistry of these materials. It is thought that these meteorites do not come from asteroids or other bodies that have undergone the process of differentiation that forms a core, mantle, and crust, like those of the Earth. Because these materials have not been melted and turned into planets, they preserve clues about the environment of the early Solar System.

For decades, geologists, meteoriticists, and physicists have studied these meteorites as they have pieced together the early history of our Solar System. Many of these materials are centimeter-size or even smaller; scientists therefore use a special microscope called a scanning electron microscope (SEM) to view objects down to the micron scale (objects smaller than the width of a human hair, which is about 50 microns wide). An SEM focuses an electron beam onto the surface of a sample. The electron beam interacts with the atoms in the material, emitting different types of signals that can then be detected by the SEM and viewed by the user. One kind of detector allows scientists to learn the composition of the materials being examined, an important piece of information for understanding the types of minerals present in meteorites.



SEM image of a cluster of grossular garnet in Allende. The grays in the image are a function of the atomic number of the elements present: lighter grays are minerals containing elements with higher atomic numbers. Note the size of an individual garnet grain; some are less than 15 microns. Image by Jessica Johnson.

Among other discoveries, SEM studies found grossular and andradite garnets in some of these meteorites. Applying the knowledge of how these two garnets form on Earth paired with other pieces of evidence observed in the carbonaceous chondrites, meteoriticists deduced how these meteorite garnets formed: The materials in the carbonaceous chondrites accreted with water ices onto their parent asteroids. Over time, the water ices melted due to heat from decaying radionuclides (radioactive isotopes). As the water ices melted, the water interacted with the original minerals, essentially dissolving them, and created new minerals (some of those being our space garnets). How incredible is that?

Meteoriticists are still studying the nuanced chemistry of these garnets today, hoping to learn even more about the interaction between water and early Solar System materials.

Further reading:

Interesting facts about garnets: *www.backyardgeology.com/2021/04/15/garnet*

Carbonaceous chondrites: *www.backyardgeology.com/2021/09/20/cosmic-dust-bunnies-in-the-early-solar-system*

—Jessica Johnson recently completed her PhD at the University of New Mexico. This article is based in part on her thesis work.

To The Editor (cont'd)

(from page 6)

A couple of weeks ago when the library was closed for the day, someone dropped into the return book bin a like-new pair of Orion 15×70 binoculars and tripod as a donation. The library public relations director emailed me and noted that since the two telescopes were so popular for loan-out, could the binoculars be loaned out also? I emailed back that that was a great idea and that the club would prepare them for library circulation and maintain them. Binoculars are obviously a good introduction into observational astronomy; some starting out with observing may find a telescope a bit intimidating to set up and use whereas binoculars are more intuitive to use, especially for children. If interest continues, a telescope would be the next step.

I think the 70 mm binoculars are a "sweet spot" in size since they provide more aperture for brighter deep-sky objects while keeping the weight down for ease of handling. I have ordered zoom binoculars to replace the 15×70s with a Celestron SkyMaster 15–35×70. The zoom magnification will be an added enhancement to observing for the Moon's craters, the deep sky and, with sky conditions of good seeing, even a view of Saturn's rings. Two sets for loan-out will be prepared along with a Celestron TrailSeeker binocular tripod that gives a fully extended height of 70.5 inches. The package is shown above with the eyepiece and objective lens dust caps attached with cord to the binocular case. Included with the package is a 31 by 10 by 10-inch travel bag that holds everything: *Sky & Telescope* field guide, *Binocular Highlights* by Gary Seronik, an L-bracket tripod adapter, flat head screwdriver for tightening the bracket, and setup and operating instructions.

I haven't heard of binoculars being donated to a library by an astronomy club before and I think this is a nice option along with the 4.5-inch Dob for loan-out to support both the club's public outreach and the library's STEM program. If you agree, I think this idea would be worth a blurb in the *Reflector* magazine for other astronomy club/astronomical society consideration.

Regards,
Tom Lugar, ALCor AELC Club Treasurer

Music and Astronomy Under the Stars (MAUS): How AL Clubs Can Set Up Outreach Programs at Outdoor Concerts

By Donald A. Lubowich,
Hofstra University (Donald.A.Lubowich@hofstra.edu)

Music and Astronomy Under the Stars (MAUS) is a NASA-funded program I created to bring astronomy to the public while attending outdoor concerts. MAUS does not organize the music events but partners with local parks or music festivals to provide an astronomy experience for large non-science audiences at outdoor concerts. AL member clubs can set up their own MAUS programs. Jason Cousins, president of the Amateur Observers' Society of New York (AOS), said "MAUS it is a mainstay for AOS and helps us with exposure, new members, localized excitement, and just clean wholesome fun. Five new members joined AOS from five MAUS events in 2024."

Free concerts are an ideal vehicle for astronomy education because they are a shared family-learning experience that targets people who may not otherwise participate in STEM activities. The audience has committed to be outside for several hours and will be exposed to astronomy with no additional travel time or cost. MAUS includes posters, banners, videos, daytime solar and nighttime telescope observations, hands-on activities, handouts, and information on local science museums, planetariums, and astronomy clubs.

MAUS activities occur before and after the concerts and during intermission, and the personal interaction with astronomy educators (club members) provides teachable moments for the audience. MAUS attracts large enthusiastic crowds, and many young children participate—often it was the first time they looked through a telescope. Between 800 and 30,000 people have attended the MAUS-related concerts or festivals, 400–2,000 people participated in astronomy activities at each event, and 75,000 people have participated in MAUS since 2009.

Partnering with AOS, MAUS has brought astronomy to music lovers attending 75 free classical, folk, pop, rock, opera, gospel, Caribbean, or county-western concerts on Long Island from 2009 to 2024. Working with local astronomy clubs, MAUS also had 14 programs at the Central Park Jazz, Newport Folk, Ravinia Music, and Tanglewood Music Festivals; the Woodstock Anniversary Concert at the Bethel Woods Performing Arts Center;

the Intrepid Air and Sea Museum (NYC), and the World Science Festival (NYC). Artists performing at these events included Yo-Yo Ma; the Chicago and Boston Symphony Orchestras; the McCoy Tyner Quartet; Ravi Coltrane; Esperanza Spalding; the Stanley Clarke Band; Phish (tailgate parking lot star party); Blood, Sweat & Tears;

Tommy James and the Shondells; Deep Purple; Patti Smith; Tony Orlando; and Wilco. Eighty-five percent were free events, and the music festivals had free or low-cost student tickets.

Our program evaluations showed that 40 percent of participants were families with children ages 4–12, and more than half of the participants had not been to a science museum, planetarium, star party, or watched a science TV show or video in the past year. Ninety-six percent of the participants reported that the astronomy experience was enjoyable, understandable, helped people learn new astronomy information, increased their desire

to learn more about astronomy, and increased their interest in science. MAUS appealed to concert attendees of all genders and ages, multiple levels of education, and varied musical tastes. MAUS demonstrates the considerable benefits of taking science education to the public and the data support the conclusion that bringing science to new audiences at musical events is effective.

Lessons learned: (1) Concerts with set starting and ending times worked best (for example, set up at 6:30 p.m. to be ready at 7 for an 8 o'clock concert) and the logistics were better at clubs than at festivals. (2) Because attendees often arrived an hour or more before the concert to get a good seat, there were more daylight activities (60 minutes) than nighttime activities (45 minutes) and the activities were designed for all weather conditions. The cloudy day/night events were well attended, and people were excited to just look through a telescope. We put pictures of Saturn in trees or on fences for the public to look at and we looked at a "star cluster" with 5 white stars against a blue background – the American flag. (3) Effective handouts include bookmarks and information on preserving the nights sky (from DarkSky International), information on citizen science projects, and Internet links to educational sites (see *www.hofstra.edu/physics-astronomy/links.html*). (4) Use equipment that has been tested and is easy to set up, use, take down, and store. Go-to telescopes and telescopes with tracking motors worked best with the long lines of people waiting to look through the telescopes. We used small hand-held demonstrations to educate the people waiting in line. An added bonus was that because we were part of the event we never paid for a permit or needed separate insurance.

Here are some additional helpful guidelines for astronomy clubs to setup their own MAUS programs:

• Identify possible concerts in your local region. They should be easily accessible to the public and club members. Decide how many concerts you want to attend and at which locations. While I select June–August concerts, clubs in warmer climates may extend their calendar. Select concerts by musical taste and convenience of club members.

• Contact parks or concert organizers to explain that you want to present free public astronomy programs at no cost. Partner with the concert organizers so MAUS will be a joint event. I have never been turned down when I asked to have a MAUS event at a park or venue. Park commissioners or directors have been excited by the dual use of their facilities (music and astronomy) and usually eagerly direct the requests to their superiors.

• Concerts should be selected to ensure large audiences by the choice of music and date, when there are interesting objects in the sky, and clear lines of sight to astronomical objects. AL clubs can reach underrepresented and underserved communities by contacting concert organizers, as there are concerts and musical events organized by the Black and Hispanic communities in large and small cities. Audiences are usually larger on Fridays and Saturdays: more families attend and it is generally easier for club members to participate.

• Always do a site inspection of the park, and in particular take note of their concert layout. MAUS is usually located at the back or edge of the audience to avoid interfering with the concert. Often we are near food trucks or on the way to the restrooms. Setup is before most of the audience shows up; facilities usually let us park close to the MAUS site and allow us to drive on the grass to unload and load equipment.

• MAUS events can have rain dates or cancellation policies depending on your preference, logistics, and availability of club members. All MAUS events require 50–75 person-hours.

• Multiple telescopes are needed to minimize long lines and waiting time. I use 3–4 solar telescopes and 6–10 optical telescopes so the audience can view multiple objects in the sky (the Moon, planets, star clusters, nebulae, multicolored double stars like Albireo, and galaxies). Astronomical images can be sent to tablets or cell phones with electronic telescopes.

• Hands-on activities and demonstrations should be geared for all ages. Many clubs already do hands-on activities at their star parties. Activities I have used at MAUS events include 1) Harvard Smithsonian Center for Astrophysics Cosmic Questions

"How big, how far, how old" – sorting images printed on magnets using a magnetic white board; (2) eclipse demos with a yardstick (Night Sky Network activity); (3) different versions of a scale model of the Solar System; (4) a scale model of planet sizes; (5) draw your own constellation on a star map (I used a Stellarium image with Orion and the Big Dipper); (6) UV-sensitive beads showing the Sun's UV radiation; (7) Doppler effect with a radar gun and tennis balls; (8) citizen science projects identifying sunspots, solar storms, features on Mars, or exoplanets transits from spacecraft photometry (*www.zooniverse.org*, *science.nasa.gov/citizen-science*, or more general projects at *www.scistarter.org*).

• Finally, you can invite local science museums, planetariums, educational institutions, science organizations, and companies to participate with handouts, activities, and demonstrations.

The cost to astronomy clubs is minimal because clubs already have solar and optical telescopes and many have electronic telescopes. Plastic tables cost $30–40 each. Outdoor banners or posters can be printed for reasonable cost, depending on size; Amazon carries banner stands with weighted bases. You can print a large QR code to send people to recommended websites (including your club's).

Please contact me if you are interested in more information, including templates for online or printed materials, banners, or posters. If your club participates in MAUS, please let me know so that we have an ongoing record of MAUS events. Also remember to log your hours of participation towards the League's Outreach Program. MAUS is a win-win: astronomy clubs may gain new members, new audiences are introduced to astronomy, and you hear great music on a summer evening.

Videos:

Music and Astronomy at Tanglewood Music Festival with the Boston Symphony Orchestra (1 minute)

drive.google.com/file/d/1CVm7oM4ffPZ7Vv0d8IFIck-F2XzkPVRZ

MAUS Overview (10 minutes) *drive.google.com/file/d/1dYKx4boSF-9k699pIVY88q6COWIIi10h*

"Galileo" at Tanglewood with Lute music composed by Galileo's Father (2 minutes)

www.dropbox.com/s/67v8kd68nppk5pv/Galileo-Tanglewood.MOV

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Sponsored by the MARS Region of the Astronomical League

This year, we will be under the stars for our conference!

- The Astronomical League is pleased to announce that **ASTROCON 2025** will be held during the new moon June 25-28 2025, at **Ruby's Inn**, near the entrance to **Bryce Canyon National Park**. Along with talks and workshops given during the day, nightly dark-sky observing will be offered at **Rainbow Point**.

- Bryce Canyon National Park features some of the darkest skies in the United States. Naturally, the National Park Service will hold a nightly public star gaze across the street from the **Bryce Canyon Visitor's Center** for both park visitors and ASTROCON attendees. **Ruby's Inn** is family-oriented with many options for fun and adventures. The area is full of possibilities.

- **Ebenezer's Barn and Grill** will host the **Star-B-Que** Friday at Noon to 2:00 PM and the **Gala Banquet** Saturday night from 5:00 PM to 8:00 PM. A room and/or RV Park/ tent camping site reservation link will be provided via email after registration to the conference has been confirmed. Lodging is available at a reduced rate, and will fill up fast.

- **Speakers and Workshops** will utilize the lecture hall at **Ruby's Inn** and **Ebenezer's Barn and Grill**.

- Reserved rooms with the ASTROCON rates are available the nights of June 24th through the 28th. This also includes the RV Park and Campground. If you want to come earlier or stay later, you will be charged the normal rate for those extra nights.

- Enjoy a **vacation extravaganza** to other National Parks and National Monuments within a days drive.

- Many activities available: hiking, mountain biking, horseback riding, guided ATV tours, and scenic flights.

- **Featured Workshops:**

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Astrophotography / Digital Imaging - Advanced
Observing: Personal Program / Journal
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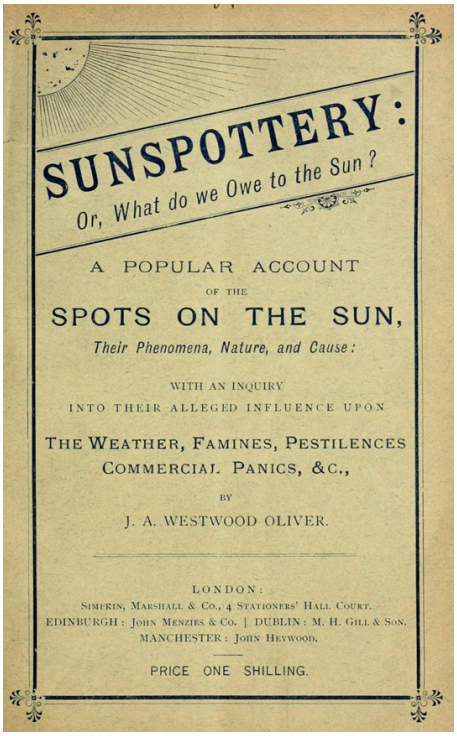
Sunspottery:
Sunspots and Human Behavior in the Popular Imagination

By Kristine Larsen

While solar scientists continue to investigate the behavior of the Sun throughout its sunspot cycle, questions have long been asked about possible impacts of solar activity on other kinds of behavior, namely that of humans. For example, a 2006 study reported correlations between sunspot activity, the unemployment rate, and suicide mortality in Japan (Otsu et al. 2006, 603). The question of causality – for example, how the sunspot activity could impact the unemployment rate – was left unanswered.

This type of unsubstantiated claim is not new. In 1883, J.A. Westwood Oliver published the pamphlet *Sunspottery: Or, What Do We Owe to the Sun?*, which critically evaluated "Sunspottery… that branch of investigation whose province it is to determine the relation between solar events and terrestrial events" (9).


SUNSPOTTERY:
Or, What do we Owe to the Sun?
A POPULAR ACCOUNT
OF THE
SPOTS ON THE SUN,
Their Phenomena, Nature, and Cause:
WITH AN INQUIRY
INTO THEIR ALLEGED INFLUENCE UPON
THE WEATHER, FAMINES, PESTILENCES
COMMERCIAL PANICS, &C.,
BY
J. A. WESTWOOD OLIVER.
LONDON:
SIMPKIN, MARSHALL & Co., 4 STATIONERS' HALL COURT.
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Some of the terrestrial events claimed to be correlated with sunspot activity include:

- Rainfall
- Cyclones and storms
- Famines
- Pestilence and diseases
- Locusts
- Shipwrecks
- Financial panics

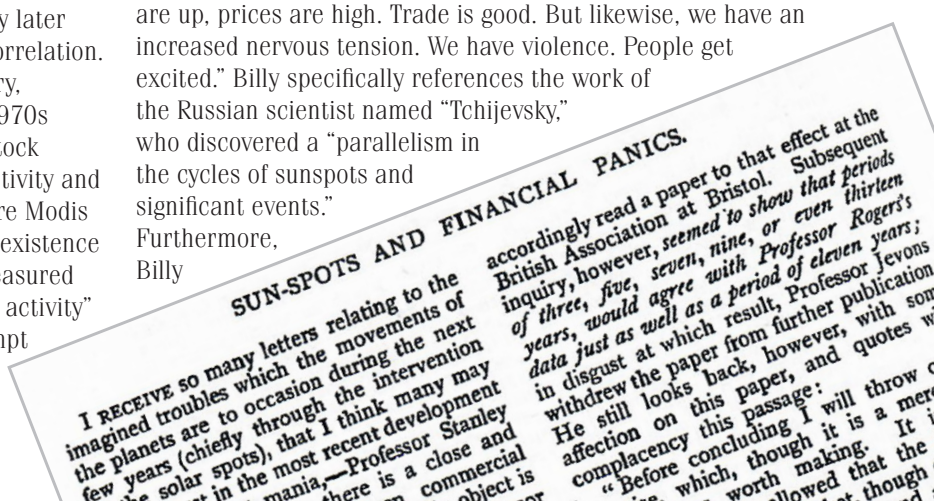
Oliver has no sympathy for those who ascribe to Sunspottery. For example, he recounts the story of a public lecture in which English economist (William) Stanley Jevons' 1878 paper "Commercial Crises and Sun-spots" was derided by the audience, urging that any reader "who wants to see the theory taken to bits should read Mr. Proctor's paper in Scribner's Magazine for June, 1880" (Oliver 1883, 54)

Although Oliver and Proctor debunked claimed connections between economics and sunspots in the 1880s, a century later some economists continued to claim some meaningful correlation. For example, investment expert Paul Macrae Montgomery, infamous for his "hemlines indicator" developed in the 1970s that connected "reversals in hemlines and reversals in stock prices" long argued for a connection between sunspot activity and economic indicators (2003, 1). Business analyst Theodore Modis claimed to have found "hard-to-dispute evidence for the existence of a correlation between stock-market movements as measured by the DJIA (Dow Jones Industrial Average) and sunspot activity" although he offered no "causal arguments" and "no attempt to understand the mechanisms behind the observed correlation" (2007, 1509). Modis made the easily debunkable forecast for a DJIA of 13,908 in mid-2008, and 7,919 in early 2014; in actuality, the DJIA closing levels from May 1 – Sep. 1, 2008 varied between 13,058.20 and 10,962.54, mostly in the 11,000s, and from Jan. 1 – April 1, 2014 between 16,530.94 and 15,372.80, clearly refuting his model (*finance.yahoo.com/quote/^DJI/history*).

In a similar way, correlations with weather patterns, pandemics, and other natural disasters (including earthquakes) have been debunked by numerous scientific studies. However, this does not deter authors from continuing to make such claims even in the 21st century. In the end, many of the proposed correlations with solar activity can be attributed to incomplete data, coincidences, or wishful thinking, examples of what Nobel laureate chemist Irving Langmuir termed "pathological science" or "the science of things that aren't so" (Langmuir & Hall 1989, 36). In the words of J.A. Westwood Oliver, such Sunspottery "is not what it is represented to be, but is for the most part humbug" (1883, 56). This persistence may be aided by popular media keeping such supposed correlations in the public imagination. As examples, I offer three short stories from the mid-20th century.

"SUNSPOT PURGE" BY CLIFFORD D. SIMAK (*ASTOUNDING SCIENCE-FICTION*, 1940)

Newspaper reporter Mike Hamilton notes a disturbing pattern of suicides and violent murders, giving science editor Billy Larson an idea for a story about how sunspots "affect human lives. Lots of sunspots and we have good times. Stocks and bonds are up, prices are high. Trade is good. But likewise, we have an increased nervous tension. We have violence. People get excited." Billy specifically references the work of the Russian scientist named "Tchijevsky," who discovered a "parallelism in the cycles of sunspots and significant events." Furthermore, Billy


SUN-SPOTS AND FINANCIAL PANICS.
I RECEIVE so many letters relating to the imagined troubles which the movements of the planets are to occasion during the next few years (chiefly through the intervention of the solar spots), that I think many may be interested in the most recent development in the mania,—Professor Stanley Jevons's theory that there is a close and regular connection between commercial panics and the appearance of sun-spots. The subject is accordingly read a paper to that effect at the British Association at Bristol. Subsequent inquiry, however, seemed to show that periods of three, five, seven, nine, or even thirteen years, would agree with Professor Rogers's data just as well as a period of eleven years; in disgust at which result, Professor Jevons withdrew the paper from further publication. He still looks back, however, with some affection on this paper, and quotes with complacency this passage: "Before concluding I will throw out a mere which, though it is a mere worth making. It is followed that the though

argues, "Scientists are pretty sure periods of excitement are explained by acute changes in the nervous and psychic characters of humanity which take place at sunspot maxima, but they aren't sure of the reason for those changes." He personally thinks enhanced ultraviolet emissions produced in the Sun's atmosphere are to blame, because "ultraviolet produces definite reaction in human glands, largely in the endocrine glands" (Simak 1940, 51). Mike and photographer Herb Harding travel 500 years into the future when their newspaper buys exclusive rights to a time machine, and find that civilization had fallen in 2143, it is suggested due to a sudden and permanent disruption in sunspot activity.

The reference to the physiological effects of ultraviolet light aligns with some scientific studies published around the time of the story's release, including the use of UV as a treatment for rickets. Interestingly, a 1931 study published in the *American Journal of Diseases of Children* found that UV exposure had no effect on the endocrine glands of rats (Hess & Smith 1931).

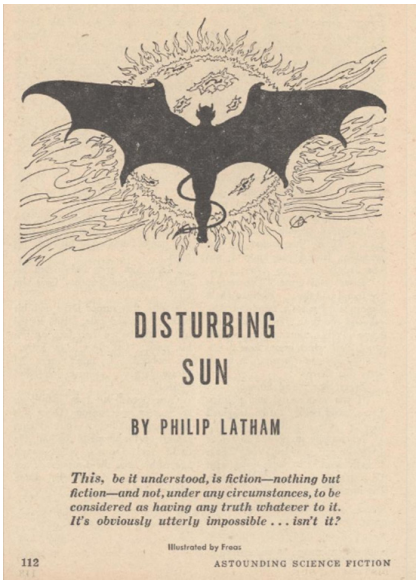
Billy's mention of a Russian scientist named Tchijevsky connects to the real world as well. Alexander L. Tchijevsky (alternately spelled Chizhevsky and Chizhevskii) is known as a founder of heliobiology, the study of supposed effects of solar activity on biological organisms (Laruelle 2019). Tchijevsky (1897–1964) aligned sunspot records with significant events in human history, including wars, revolutions, and riots, and claimed that the majority occurred near the time of solar maximum. His claims were brought to an American audience through a talk delivered in his stead at the 1926 annual meeting of the American Meteorological Society in which it was claimed that

The maximum of sunspot activity favors the excitability and uniting of the masses for attaining a certain general necessity brought forward by economic or other causes, and bring forth mass actions and leaders. But these acts are not inevitable; all depends upon previous events. For example; if a war is already in progress from the previous period, the general excitement may assume the form of ardor for peace at any price (Tchijevsky 1971, 21)

Note he is hedging his bets in the last two sentences, something that is common in such pseudosciences.

"THE YEAR OF THE JACKPOT" BY ROBERT HEINLEIN (*GALAXY SCIENCE FICTION*, 1952)

Tchijevsky's claims are echoed in Robert Heinlein's "The Year of the Jackpot." A modest young woman, Meade Barstow, inexplicably causes a scene on a city street. Statistician Potiphar "Potty" Breen takes her under his wing so she won't get arrested, and shares his discovery concerning an increasing number of incidents of peculiar behavior. Potiphar explains that there is an impressive number of cycles in the world, many of which he can correlate with sunspots, including "stock prices, or Columbia River salmon, or women's skirts. And you are just as much justified in blaming short skirts for Sun spots as you are in blaming Sun spots for salmon. We don't know. But the curves go on just the same" (Heinlein 1952, 16). The statistician is extremely concerned because he predicts that many of these cycles should converge in six months' time, hence the title of the tale. Spoiler: It somehow leads to the Sun going supernova.


DISTURBING SUN

BY PHILIP LATHAM

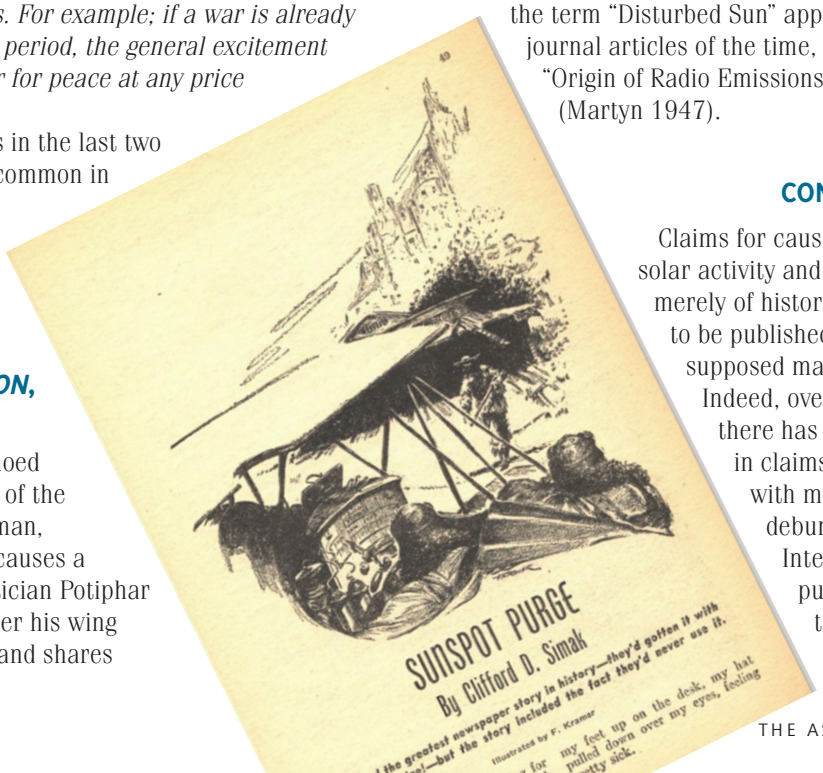
This, be it understood, is fiction—nothing but fiction—and not, under any circumstances, to be considered as having any truth whatever to it. It's obviously utterly impossible . . . isn't it?

Illustrated by Freas

112 ASTOUNDING SCIENCE FICTION

"DISTURBING SUN" BY PHILIP LATHAM (*ASTOUNDING SCIENCE-FICTION*, 1959)

This tale of the potential impact of a mysterious kind of radiation affiliated with sunspot activity was penned by Mount Wilson astronomer Robert Shirley Richardson under the pseudonym Philip Latham. In this fictional interview between the author and Dr. I.M. Niemand, director of the likewise fictitious Psychophysical Institute of Solar and Terrestrial Relations, Latham references real aspects of solar activity, including the existence of S-regions associated with sunspot activity, regions that emit radio waves. Niemand describes his discovery of incidences of "profound mental depression, anxiety, insomnia, alternating with fits of violent rage and resentment against life and the world in general" apparently correlated with S-regions, and postulates the existence of some kind of "malevolent energy" in the form of a particle emitted by S-regions as the cause (Latham 1959, 115). The behavior of real solar S-regions (associated with slowly varying radio emissions) was a topic of scientific investigation by radio astronomers in the 1940s and 1950s, which Robertson knew from his own work on solar activity. Interestingly, the term "Disturbed Sun" appears in several scientific journal articles of the time, including in the title of "Origin of Radio Emissions from the Disturbed Sun" (Martyn 1947).


SUNSPOT PURGE

By Clifford D. Simak

CONCLUSION

Claims for causal connections between solar activity and human behavior are not merely of historical interest, but continue to be published, largely based on supposed mathematical correlations. Indeed, over the past few decades there has been an alarming uptick in claims of sunspot correlations with many of the same phenomena debunked in *Sunspottery*. Interestingly, many are published by authors outside the western hemisphere and Western Europe. This

suggests a persistence in the impact of Tchijevsky (bolstered by the fact that he is often still cited in such works). In actuality, the only well-supported impact of the sunspot cycle on human behavior is in encouraging backyard observers to stare (safely) at the sun to provide data to the AAVSO Solar Section (*www.aavso.org/solar*) or complete the Astronomical League's Sunspotter Observing Program (*www.astroleague.org/sunspotter-observing-program*).

Kristine Larsen is CSU Distinguished Professor of Earth and Space Sciences at Central Connecticut State University and the editor of the *Reflector*. This article was adapted from her latest book, *The Sun We Share*.

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Call for Award Submissions

Applications or nominations for all League awards must be received no later than March 31, 2025, at 11:59 p.m. CDT. Award rules appear on the "Awards" page at *www.astroleague.org*. Submissions are not complete until you receive an email confirming receipt from the League vice president.

LEAGUE YOUTH AWARDS

National Young Astronomer Award – U.S. citizens or U.S. school enrollees under the age of 19 who are engaged in astronomy-related research, academic scholarship, or equipment design may apply. League membership is not required. The top two winners receive expense-paid trips to the League's national convention (U.S. travel only) and receive Explore Scientific telescope prizes. Email the application, research paper, and a photo of the nominee to *NYAA@astroleague.org*.

Service Award – League members under the age of 19 who are engaged in service to the League, their club, their school, or the astronomy community may apply for the Horkheimer/Smith Youth Service Award. Club or regional officers may nominate. The winner receives a plaque, a cash prize, and an expenses-paid trip to the League's national convention (U.S. travel only). Email the application and a photo of the nominee to *HorkheimerService@astroleague.org*.

Imaging Award – League members under the age of 19 who engage in astronomical imaging may apply for the Horkheimer/Parker Youth Imaging Award. Club or regional officers may nominate. The winner receives a plaque. The top three finishers receive cash prizes. Email the application, image, and a photo of the nominee to *HorkheimerParker@astroleague.org*.

Journalism Award – League members aged 8 to 14 may seek the Horkheimer/O'Meara Youth Journalism Award by submitting a 250-word science essay. The winner receives a plaque. The top three finishers receive cash prizes. Email the application, essay, and a photo of the nominee to *HorkheimerJournalism@astroleague.org*.

LEAGUE AWARDS

The following League awards are open to all League members regardless of age. Winners receive award plaques.

Mabel Sterns Award – Club officers may nominate their newsletter editor for the Mabel Sterns Award by emailing a copy of the club's newsletter as a .pdf file, or by emailing a link to an online newsletter, to *sternsnewsletter@astroleague.org* along with a nomination cover letter (.pdf) that includes the name, address, and photo of the nominee.

Webmaster Award – Club officers may nominate their webmaster for the Webmaster Award by emailing their club website link to *WebmasterAward@astroleague.org* along with a nomination cover letter (.pdf) that includes the name, address, and photo of the nominee.

Williamina Fleming Imaging Awards – These awards, sponsored by Explore Scientific, are open to female League members 19 years of age or older in four categories: deep sky (>500 mm excluding Solar System), Solar System (>500 mm), rich field (201–500 mm), and wide field (200 mm or less). Email the form, a photo of the entrant, and up to three .jpeg attachments not exceeding a total of 25 megabytes to *flemingaward@astroleague.org*.

Sketching Award – Members may apply by emailing one sketch as a high-resolution .jpeg file (10 megabytes maximum) along with a photo of the applicant to *Sketch@astroleague.org*. Cash prizes are awarded to the top three winners.

CALL FOR OFFICER NOMINATIONS

Nominations for League secretary (2-year term) and executive secretary (3-year term) beginning on September 1, 2025, must be received by nominating committee chair Terry Mann at *vicepresident@gmail.com* no later than March 25, 2025, at 11:59 p.m. CDT. The duties of each office appear in the League bylaws (see League website under "About Us"). Nominations should be accompanied by a background statement of 250 words indicating qualifications and/or reasons for seeking the position and a photo of the nominee, both for inclusion in the *Reflector* and on the ballots.

LIBRARY TELESCOPE GIVEAWAY

The League's annual Library Telescope Giveaway drawing will take place in July. The League gives away up to 11 Library Telescopes (4.5-inch StarBlast reflectors), one to a club in each of its ten regions and one to a member-at-large. Winners then place the telescopes with local libraries. This is an excellent recruitment tool for new and younger members for winning clubs. Applications may be found on the League website (see link at bottom for Library Telescope Program). Applications must be received by May 31, 2025, a month earlier than normal due to the June convention.

Gallery

ABOVE: C/2023 A3 (Tsuchinshan-ATLAS) – 102mm refractor – Larry Hubble

NEXT PAGE TOP: C/2023 A3 (Tsuchinshan-ATLAS) – DSLR and lens – Larry Hubble

NEXT PAGE BOTTOM: C/2023 A3 (Tsuchinshan-ATLAS) – 90mm refractor – Dan Crowson

C/2023 A3 Tsuchinshan-ATLAS
2024-10-16 - Defiance MO
00:23:54 - 00:33:58 UTC
Astro-Tech AT90EDT - SBIG ST-8300M
Luminance: 12x45s binned 1x1
Dan Crowson - dcrowson@crowson.com

Gallery

C/2023 A3 (Tsuchinshan-ATLAS) – Ernie Jacobs

C/2023 A3 (Tsuchinshan-ATLAS) – Gregg Ruppel

Gallery

ABOVE: C/2023 A3 (Tsuchinshan-ATLAS) – Mark Theissen and Joe Ziha

NEXT PAGE TOP: C/2023 A3 (Tsuchinshan-ATLAS) – Brian Ottum

NEXT PAGE BOTTOM: M.J. Post (Longmont Astronomical Society) captured this two panel image of LBN 903 using a PlaneWave CDK14 and a ZWO ASI 6200MC camera from his DSNM observatory in Animas, New Mexicot

OBSERVING AWARDS

SOLAR ECLIPSE OBSERVING CHALLENGE (2024)

Larry Dove, Gold, Flint River Astronomy Club; **Doug Lively**, Gold, Raleigh Astronomy Club; **Laura Stewart**, Gold, Member-at-Large; **Bradford Wilson**, Silver, Member-at-Large; **Steve Wolfgram**, Silver, La Crosse Area Astronomical Society

ACTIVE GALACTIC NUCLEI OBSERVING PROGRAM

No. 37-I, **Lauren Rogers**, Escambia Amateur Astronomers Association

ADVANCED BINOCULAR DOUBLE STAR OBSERVING PROGRAM AWARD

No. 66, **José Bosch Bailach**, Member-at-Large

ALTERNATE CONSTELLATION OBSERVING PROGRAM

No. 15, **Denise Terpstra**, Gold, Lifetime Member; No. 16, **Paul Harrington**, Gold, Member-at-Large; No. 17, **Peter Detterline**, Gold, Member-at-Large; No. 19, **Kevin McKeown**, Silver, Rio Rancho Astronomical Society; No. 20, **Denise Terpstra**, Silver, Lifetime Member; No. 21, **Peter Detterline**, Silver, Member-at-Large

ANALEMMA OBSERVING PROGRAM

No. 24, **Chris Randall**, Member-at-Large

ASTERISM OBSERVING PROGRAM

No. 82, **Michael Blase**, Olympic Astronomical Society

ASTEROID OBSERVING PROGRAM

No. 81, **Jenny Stein**, Gold, Houston Astronomical Society; No. 82, **Robert Stein**, Gold, Houston Astronomical Society; No. 83, **David Babb**, Gold, Member-at-Large

ASTRONOMY BEFORE THE TELESCOPE OBSERVING PROGRAM

No. 5, **Michael A. Hotka**, Longmont Astronomical Society

BENNETT OBSERVING PROGRAM

No. 6, **Aaron Clevenson**, North Houston Astronomy Club

BEYOND POLARIS OBSERVING PROGRAM

No. 77, **Denise Terpstra**, Lifetime Member; No. 78, **Jamye Fraser**, Ancient City Astronomy Club; No. 79, **David Princehorn**, The Albuquerque Astronomical Society

BINOCULAR DOUBLE STAR OBSERVING PROGRAM AWARD

No. 217, **Jack Shelton**, Minnesota Astronomical Society

BINOCULAR MESSIER OBSERVING PROGRAM

No. 1270, **Teresa Bippert-Plymate**, Bear Valley Springs Astronomy Club; No. 1271, **Edward Bartakovits**, Astronomy Enthusiasts of Lancaster County; No. 1272, **Mary Barteau**, St. Louis Astronomical Society

BINOCULAR VARIABLE OBSERVING PROGRAM

No. 69, **Joe Fazio**, Cumberland Astronomy Club

CALDWELL OBSERVING PROGRAM

No. 301 **Jerelyn Ramirez**, Silver, Kansas Astronomical Observers; No. 302, **Teresa Bipper-Plymate**, Silver, Bear Valley Springs Astronomy Club; No. 303, **Eric Hanson**, Silver, Member-at-Large

CARBON STAR OBSERVING PROGRAM

No. 163, **Scott Cadwallader**, Baton Rouge Astronomical Society; No. 164, **Dean Herring**, Raleigh Astronomy Club

CITIZEN SCIENCE SPECIAL PROGRAM

Dan Crowson, Bronze, Active, SPLUS: Science Hunters, Astronomical Society of Eastern Missouri; **Dan Crowson**, Silver, Active, SPLUS: Science Hunters, Astronomical Society of Eastern Missouri; **Dan Crowson**, Bronze, Active, Baby Star Search, Astronomical Society of Eastern Missouri; **Dan Crowson**, Silver, Active, Baby Star Search, Astronomical Society of Eastern Missouri; **Dan Crowson**, Gold Class 60, Active, Active Asteroids, Astronomical Society of Eastern Missouri; **Michael A. Hotka**, Gold Class 5, Observational, NEO Asteroid Observing, Longmont Astronomical Society; **Paul Harrington**, Gold Class 1, Observational, Variable Stars, Member-at-Large; **Rich Krahling**, Bronze, Active, The Daily Minor Planet, Richland Astronomical Society; **Rich Krahling**, Gold Class 1, Active, The Daily Minor Planet, Richland Astronomical Society; **Rich Krahling**, Gold Class 1, Active, Backyard World Cool Neighbors, Richland Astronomical Society; **Rich Krahling**, Gold Class 1, Active, Einstein@Home: Pulsar Seekers, Richland Astronomical Society; **Rich Krahling**, Gold Class 2, Active, Galaxy Zoo Mobile, Richland Astronomical Society; **Rich Krahling**, Gold Class 13, SuperWASP Variable Stars, Richland Astronomical Society; **Al Lamperti**, Gold Class 9, Active, Baby Star Search, Delaware Valley Amateur Astronomers; **Al Lamperti**, Gold Class 66, Active, Project PHAEDRA Smithsonian Trans. Ctr, Delaware Valley Amateur Astronomers; **Al Lamperti**, Gold Class 370, Active, Active Asteroids, Delaware Valley Amateur Astronomers; **Al Lamperti**, Gold Class 14, Active, SPLUS: Science Hunters, Delaware Valley Amateur Astronomers; **Al Lamperti**, Gold Class 12, Active, Space Warps: ESA Euclid, Delaware Valley Amateur Astronomers; **Jeff Rodriguez**, Bronze, Active, Catalina Sky Survey, Cincinnati Astronomical Society

COMET OBSERVING PROGRAM

144, **Kevin C Carr**, Silver, Minnesota Astronomical Society

DARK SKY ADVOCATE OBSERVING PROGRAM

No. 20, **Eric Edwards**, The Albuquerque Astronomical Society

DEEP SKY BINOCULAR OBSERVING PROGRAM

No. 455, **Craig Endres**, Milwaukee Astronomical Society

DOUBLE STAR OBSERVING PROGRAM

No. 717, **Laura Ryan**, Member-at-Large; No. 718, **Stephen Nugent**, Member-at-Large; No. 719, **Dave Komar**, Northern Virginia Astronomy Club

EXTRAGALACTIC OBJECTS OBSERVING PROGRAM

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FOUNDATIONS OF IMAGING OBSERVING PROGRAM

No. 11, **Jody Raney**, Shreveport-Bossier Astronomical Society

GALAXY GROUPS AND CLUSTERS OBSERVING PROGRAM

No. 61-I, **Lauren Rogers,** Escambia Amateur Astronomers Association

GALILEO OBSERVING PROGRAM

No. 80, **Clariza E. Kern**, Pontchartrain Astronomical Society; No. 95, **David Berish**, Greater Hazleton Area Astronomical Society; No. 96-B, **Robert Abraham**, Shreveport Bossier Astronomical Society; No. 97-B, **Pete Hermes**, Tucson Amateur Astronomy Association

GLOBULAR CLUSTER OBSERVING PROGRAM AWARD

No. 414-I, **Brian Cudnik**, Houston Astronomical Society

HERSCHEL 400-NORTHERN OBSERVING PROGRAM

No. 668, **Larry M. Elsom**, Member-at-Large

HERSCHEL 400-SOUTHERN OBSERVING PROGRAM

No. 5, **Michael Hotka**, Longmont Astronomical Society

HERSCHEL SOCIETY

Viola Sanchez, Silver, The Albuquerque Astronomical Society

IMAGING – CALDWELL OBSERVING PROGRAM

No. 10, **Brad Payne**, Silver, Northern Virginia Astronomy Club; No 11, **Tom Holman**, Silver, Minnesota Astronomical Society

IMAGING – MESSIER OBSERVING PROGRAM

No. 17, **Tom Holman**, Minnesota Astronomical Society; No. 18, **Robert Togni**, Central Arkansas Astronomical Society

LUNAR OBSERVING PROGRAM

No. 1237, **Andrew Wolfe,** Regular, Binocular, Eyes-Only, Member-at-Large; No. 1238, **Jonathan Cross,** Regular, Binocular, Eyes-Only, Seattle Astronomical Society; No. 1239, **Michael Huitt**, Regular, Binocular, Eyes-Only, Central Arkansas Astronomical Society; No. 1240, **Dave Komar**, Regular, Northern Virginia Astronomy Club; No. 1241, **John Bierman,** Regular, Binocular, Eyes-Only, Miami Valley Astronomical Society; No. 1242, **David Hiegel,** Regular, Central Arkansas Astronomical Society; No. 1243, **Armen Akopian**, Imaging, San Antonio Astronomical Association; No. 1244, **Jack Shelton**, Regular, Binocular, Eyes-Only, Minnesota Astronomical Society; No. 1245, **Robert Togni**, Imaging, Central Arkansas Astronomical Society; No. 1246, **Robert Abraham**, Binocular, Shreveport-Bossier Astronomical Society; No. 1247, **David Husom**, Regular, Binocular, Eyes-Only, Minnesota Astronomical Society; No. 1248, **Kevin Carr**, Binocular, Minnesota Astronomical Society; No. 1249, **Steve Boerner**, Eyes-Only, Member-at-Large; No. 1250, **Viola Sanchez**, Imaging, The Albuquerque Astronomical Society; No. 1251, **Lauren Rogers**, Eyes-Only, Escambia Amateur Astronomers Association

LUNAR II OBSERVING PROGRAM

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MESSIER OBSERVING PROGRAM

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SPACE WEATHER OBSERVING PROGRAM

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SUNSPOTTER OBSERVING PROGRAM

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