*Published by the Astronomical League*
**Vol. 77, No. 3 JUNE 2025**

# Reflector

**SOLAR TOOLKITS**

**SLIM PICKINGS IN THE CONSTELLATION DRACO**

**THE ARCHDUKE AND THE TELESCOPES**

**ASTRONOMY OUTREACH FOR SICK AND INJURED KIDS**

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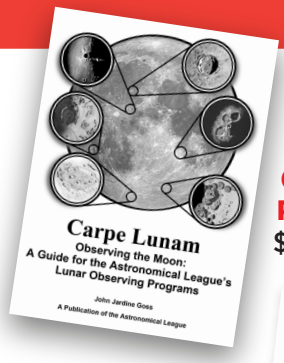


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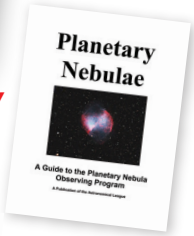


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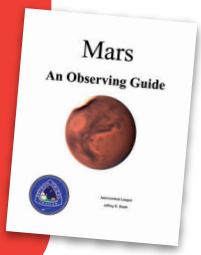


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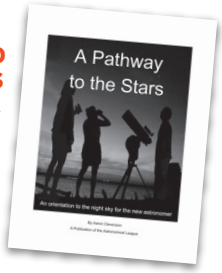


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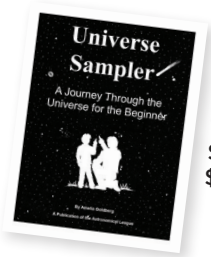


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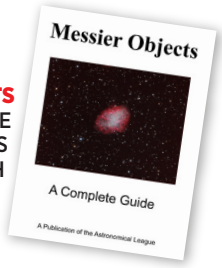


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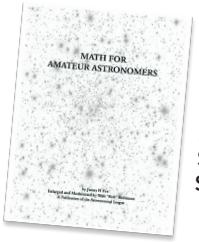


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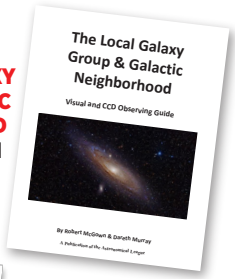


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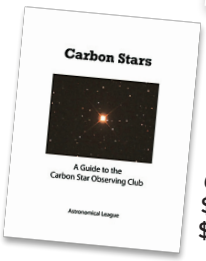


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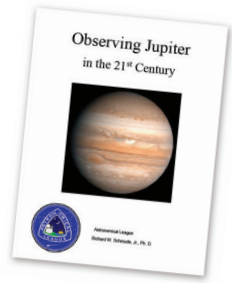


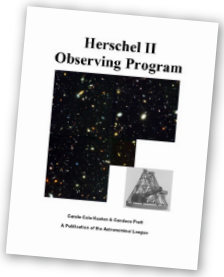


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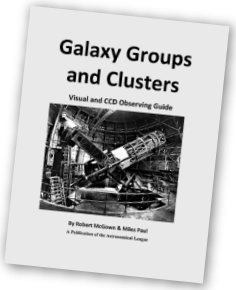


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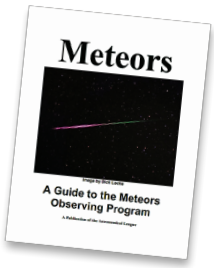


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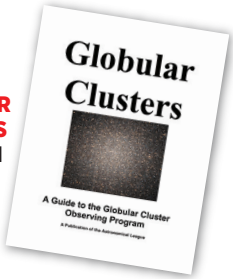


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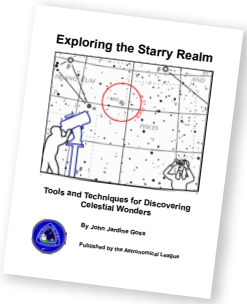


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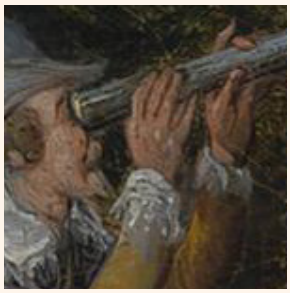

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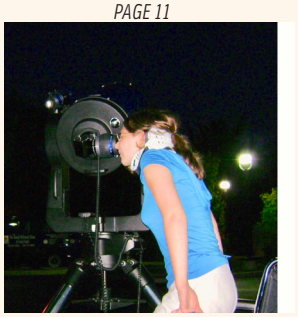

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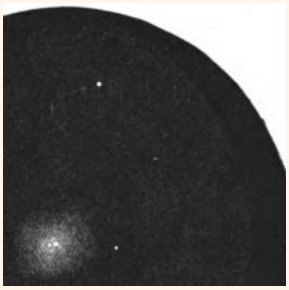



NASA's Polar Resources Ice Mining Experiment 1 (PRIME-1) completed 10 hours of drilling and mass spectrometry on the lunar surface. While the mission was hoped to return a longer series of data, mission scientists were pleased with this initial test-run. Read more at

*www.nasa.gov/missions/artemis/nasas-lunar-drill-technology-passes-tests-on-the-moon/.*


**Mark Theissen** (Low Country Star Gazers) and **Joe Ziha** (Astronomical Society of Eastern Missouri) captured this image of IC 1613 with a PlaneWave 14-inch CDK with and a ZWO ASI6200MM-Pro camera from their observatory in Animas, New Mexico.




# 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.

Astronomical League National Office:
9201 Ward Parkway, Suite 100, Kansas City, MO 64114

# Reflector

**QUARTERLY PUBLICATION OF THE ASTRONOMICAL LEAGUE**

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| | |
|---|---|
| **March issue** | **January 1** |
| **June issue** | **April 1** |
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**LETTERS TO THE EDITOR**

Send to *larsen@ccsu.edu* with subject line "letter to editor"

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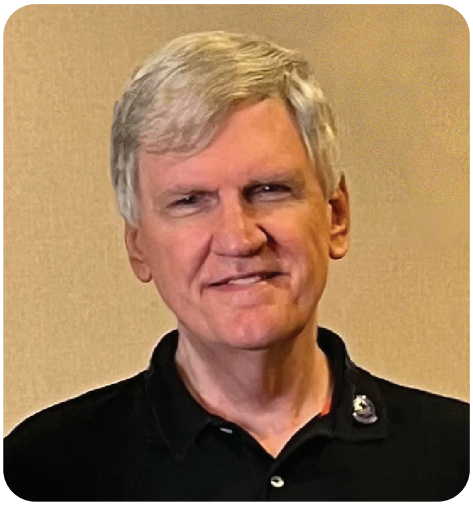
## President's Column



**From Your League President**

Thanks to your response, AstroCon '25 has approached maximum capacity in terms of registrations and room availability. This assures us of financial success as well as an event that our 15+ vendors will find attractive in future years. I want to offer a big shout-out to Lowell Lyon for all the work he has done in arranging our event at Ruby's Inn, organizing observing opportunities in Bryce Canyon National Park, securing excellent speakers, and attracting the most vendors we've had at a non-eclipse convention.

I have seen an uptick in both our Observing Program award submissions and our youth and general award submissions. In the three observing programs that I coordinate, I received 41 program submissions this quarter. We also received a record 42 nominations and applications for our National Young Astronomer, Horkheimer, Mabel Sterns, Webmaster, Sketching, and Fleming Awards. These increases are usually the result of one person, perhaps a club officer, an ALCor, or a club awards coordinator, who takes the time to promote these programs and opportunities to their members. Thank you for the work you do. It is noticed.

On April 5, while attending the Northeast Astronomy Forum (NEAF) with Terry Mann and Laurie Ansorge, I had the privilege of presenting the 2025 Astronomical League Award, our highest recognition, to Albert H. Nagler, founder of Tele Vue Optics.

Al, who turned 90 this year, enjoyed strong educational preparation that included the prestigious Bronx High School of Science and a subsequent BS in physics. While in high school, he built an 8-inch reflector that earned him a prize, a paid article in *Mechanix Illustrated*, and a job at Farrand Optical Company, where he worked for 16 years. Working under Farrand's Grumman Aerospace contract with NASA, he designed the optics for an infinity simulator used to train Gemini astronauts. After a stint as chief optical engineer at Keystone Camera Company, for whom he designed a zoom lens for the company's pocket camera, he founded Tele Vue in 1977. His work with Farrand introduced him to 45-lens optical elements that produced 145-degree fields, and he used that experience to develop the Tele Vue eyepieces that soon took astronomy by storm. In 1977, he introduced the Tele Vue Nagler eyepieces, whose 82-degree apparent fields and edge sharpness stunned observers. His newer eyepieces boast stunning 102-degree fields. He has even added a white phosphor night-vision eyepiece that can triple the effective aperture of a telescope. Congratulations to Al for a lifetime of work benefitting thousands of amateur astronomers and the public they serve.

Please welcome a new member of our League team! Willie Rainwater of Houston, Texas, has taken over the important role of advertising manager for *Reflector*. His business and IT skills will be invaluable in securing the needed income for our magazine. If you are interested in advertising in the *Reflector*, please contact Willie at *advertising@astroleague.org*.

The League is looking at possible joint sponsorship of an existing western star party that is held each October. This collaboration would benefit both the League and the event's current sponsors. Look for information in the next issue.

Finally, and importantly, two ballots were mailed out to all of you in May: an officer election ballot and a bylaws ballot. The bylaws ballot contains amendments unanimously recommended by the council at ALCon '24. We need your vote on these changes so we can reach a quorum for

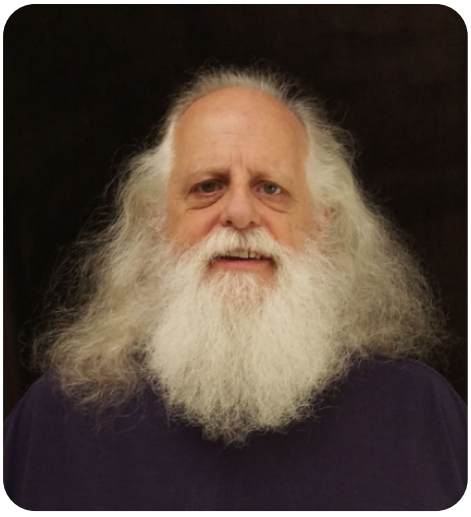
passage! Since our convention was too early to allow a reasonable time for voting, we extended the due date for the return of election and bylaws ballots to July 1. We will announce the results of the election and the vote on the bylaws changes on the website and in the September issue of the *Reflector*.

Thanks for reading, and I hope to see you in Utah!

**—Chuck Allen, President**

## OFFICER CANDIDATE BIOS

*Please note that we will not announce the results of the officer elections and bylaws vote until after the June convention. We want to give members more time to return their ballots than the June convention will allow.*



### AARON CLEVENSON
**CANDIDATE FOR SECRETARY**

Aaron Clevenson is very active in the Astronomical League and is the current League secretary. He is also an Observing Program director (since 2006), the assistant League webmaster, and the editor of current League Observing Manuals. He is the recipient of the League's 2014 G. R. Wright Award for Service and the 2022 Astronomical League Award.

Aaron was the author of many of the League's Observing Programs, including Constellation Hunter and Galileo, AL Observing Challenges, NASA Observing Challenges, and the Master Observer Progression. He has earned many of the AL's Observing Awards and is one of the League's Master Observer Triple-Crown awardees.

Aaron is a retired astronomy professor from Lone Star College in Montgomery, Texas, having taught introductory astronomy for 18 years. He is the author of the monthly *What's Up Doc?* newsletter and an electronic introductory textbook, *Astronomy for Mere Mortals*, both of which are available at no cost on the League website.

He is a member of the North Houston Astronomy Club in Texas and is the director of the Humble Independent School District's Insperity Observatory.

### LUCIA HARCUM
**CANDIDATE FOR EXECUTIVE SECRETARY**

Lucia Harcum is seeking the Astronomical League Council position of executive secretary. She holds a master's degree and PhD in architecture with more than 20 years' service in the academic roles of university faculty and department chair, teaching AutoCAD and building codes and specifications. Professionally, Lucia simultaneously supervised construction crews for multiple pre-stressed concrete projects and later residential homes via her own design/build firm. Her earlier research/design work involved healthcare projects in Saudi Arabia, Canada, and India.

Lucia enjoys working with nonprofit and volunteer organizations to support their missions, including serving 16-years on various City of Waco boards and as board president. To improve her understanding and communications with Section 501(c)(3) organizations, Lucia was the first to receive Baylor University's Nonprofit Professionals Certificate, requiring 60 hours and including six key areas of concentration: governance and leadership, financial management, fundraising, marketing and communications, human resources, and planning and evaluation.

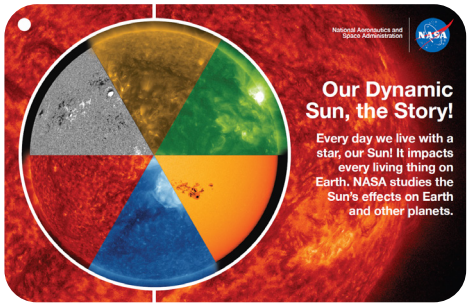
Now retired, Lucia is having fun completing her second year (of three) serving the Central Texas Astronomical Society (CTAS) as director-at-large. During her first year with CTAS, she formed an education committee. Through her fundraising efforts, a fully funded second observatory will open in spring 2026, focused on public outreach via STEAM programs.

Lucia's supervision philosophy involves highlighting individual strengths combined with teamwork goals through open communication and encouragement, while having fun. After all, the satisfaction, acknowledgement, and enjoyment of being a team is what binds and propels any organization toward the pursuit and success of its mission.

## Night Sky Network

### Here Comes the Sun... Kit!

Your Night Sky Network team, in collaboration with the NASA HEAT team, has developed a new solar toolkit for use at your solar telescope! This new kit, "Our Dynamic Sun," is an update to the very popular "Our Magnetic Sun" toolkit from 2012. Active NSN clubs should have received a copy this spring. This kit comes with a set of cards and a banner, and you can find a PDF version of those to print at home, along with a slide deck, in the NSN Resources. If your club is active in NSN and you have not received your toolkit, please contact us at *nightskyinfo@astrosociety.org*. A digital version of these resources is also available online at *bit.ly/suntoolkit*.




*Title card for the "Our Dynamic Sun" toolkit. Credit: NASA / Astronomical Society of the Pacific*

### Connect With Us!

Night Sky Network will be at AstroCon 2025 so be sure to come by and say hello! You can see the new materials in action.

Lastly, if you missed our first two NSN Social

Hour meetings, join us for the next one on July 9, 2025, at 5 p.m. Pacific (8 p.m. Eastern). The registration link for this event will be in your June 2025 Member News bulletin. The Social Hour meeting is a great way to connect with us and your fellow amateur astronomers nationwide. Log in to your NSN account to learn more.

**—Kat Troche**

## DarkSky Corner

DarkSky International recently sounded the alarm on a proposed industrial development, the INNA project, in northern Chile, that would threaten world-class astronomical resources. As they note,

> *The site would be located just kilometers from major observatories, including the Very Large Telescope, the Cherenkov Telescope Array, and the Extremely Large Telescope (ELT) – currently under construction and set to become the world's largest optical and near-infrared telescope of its kind. If approved, the INNA project would introduce light pollution, airborne dust, and atmospheric disruption – posing a permanent threat to some of the most important astronomical research on the planet.*

DarkSky International is opposing the project at its current location, and asks concerned individuals to join in the fight. Read the official position statement from the DarkSky board of directors and a news article further detailing the proposed project and DarkSky's concerns at the following links:

Position paper: *darksky.org/app/uploads/2025/03/DarkSky-position-briefing-paper-INNA-3-25-25-English.pdf*

News article: *darksky.org/news/dark-skies-vital-for-astronomy-in-northern-chile-now-at-risk*

**—Tim Hunter**

## Deep-Sky Objects

### Slim Pickings in the Constellation Draco

Draco, the Dragon, is the eighth largest constellation in the sky. The constellation wraps around much of Ursa Minor and separates the Big Dipper from the Little Dipper. Draco is circumpolar for most of North America, Europe, and Asia, which means it can be seen throughout the year. Located far from the plane of the Milky Way, Draco has essentially no galactic or globular star clusters within its boundaries. But the constellation contains an abundance of galaxies found on the NGC and IC deep-sky lists.

Despite the plethora of galaxies in Draco, none were bright enough to make Charles Messier's list. The exception is M102, which is controversial in that no one is sure if Messier ever saw or cataloged M102. Some think M102 was a duplicate entry of M101. Last century, M102 was assigned to NGC 5866 in Draco, which provides a target for those engaging in the annual springtime Messier Marathon.

At magnitude 10.7, NGC 5866 is on the west end of a chain of three edge-on spiral galaxies spanning 4 degrees near Draco's border with the constellation Boötes. The middle galaxy in the chain is NGC 5907, shining at magnitude 10.4. Although its integrated magnitude is brighter than NGC 5866, NGC 5907's light is spread out over a much larger area, so it has a lower surface brightness. Here, I want to concentrate on the third and eastern-most spiral in the chain, NGC 5965.

NGC 5965 is an ordinary spiral galaxy viewed nearly edge-on from Earth. The galaxy measures 5.1 by 0.8 arcminutes, quite slim indeed. NGC 5965 shines at magnitude 11.9 and is readily captured in an 8-inch telescope. The galaxy is located 150 million light-years away and has a diameter of 250,000 light-years. William Herschel discovered NGC 5965 on May 5, 1788. The galaxy is two degrees south and one degree east of magnitude 3.29 Iota Draconis.

My image of NGC 5965 was taken with an 8-inch f/8 Ritchey–Chrétien Cassegrain (with a 0.8× focal reducer yielding f/6.4) with a SBIG ST-4000XCM CCD camera using an 80-minute exposure. The bright orange-red (M1) star near the bottom of the image shines at magnitude 8. The galaxy has a bright star-like core in the eyepiece. But as the image herein shows, a prominent dust lane obscures part of the core. The galaxy is slightly tilted from edge-on, so we see more of the north side of the galaxy than the south side. In the image, some of the south edge of the galactic bulge is visible below the dust lane. Below and to the right of NGC 5965 in the image is galaxy NGC 5963, a magnitude 13.1 spiral. Although having a dimmer integrated magnitude, NGC 5963 is much smaller than NGC 5965 and is almost as easy to see in the eyepiece.

The star-like object just to the right of the core of NGC 5965 in the accompanying image is actually a more distant 17th magnitude spiral galaxy. This galaxy is visually beyond the reach of all but the largest amateur telescopes.

I encourage anyone panning for galaxies from a dark site this summer to not only put M102 on the observing list, but the other two edge-on spiral galaxies to the east of it. When you arrive at NGC 5965, you should be treated with a pair of galaxies in the same eyepiece field of view. While they are both in the eyepiece, take the time to observe how a faint, face-on spiral galaxy compares to a faint, edge-on spiral galaxy.

**—Dr. James R. Dire**

# Full STEAM Ahead

### BACK TO THE FUTURE

At the MSRAL 2025 Convention at Little Rock, Arkansas, chair Rick Heschmeyer introduced a new program focused on youth engagement and the development of a regional youth network. All youth in clubs or societies or members-at-large were invited to pursue research, planning and executing observing programs, participate in live Zoom sessions, become involved in the annual conventions, and receive assistance to submit forms for national awards. MSRAL's goal is to find a regional youth coordinator who, with the assistance of a committee, will network and mentor students pursuing degrees or careers in astronomy or related science.

The model will be what was in place back in the 1950s to 70s as recorded in *Sky & Telescope* magazine, the League's early *Reflector* and *Bulletin* articles, and Mid-States archives and photos. Students were actively observing, connected nationally via a newsletter, attending and presenting at ALCons, building telescopes, and posting data to the AAVSO database, all with the coordination of Bob Wright and national secretary Wilma Cherup. Ultimately, the goal is to not only get youth organized but provide extra guidance and help for clubs to develop and maintain their youth groups, finding mentors with the help from MSRAL's greatest resources – their astronomy and physics teachers, observing coordinators, and Master Observers.

The first milestone is to secure a regional youth coordinator volunteer who has time and works well with youth and regional leadership. (This person has not been found at the time of writing.) Step two is to have both councils help vet committee members who will be selected to fill specific aspects of the program. The key coordination particulars will focus on connecting with youth members-at-large, plan observing programs, provide resources for outreach, assist in research papers and article writing, help with developing presentations, provide guidance for planning convention activities, generate a newsletter, conduct live Messier Marathons, engage with people who would benefit from accessible astronomy sessions, develop an observatory network, encourage candidates for national awards, develop special interest groups, implement STEAM disciplines connected to astronomy and physics, and gather college student speakers to add to the regional speakers consortium and encourage mentoring of junior and senior high school students.

Currently the specifics are not in place; the committee will develop these after it is assembled. Committee members are currently being recruited and guidelines are being developed and documented for future reference. This is a huge project; because MSRAL's clubs are so active in youth outreach, this just seemed logical to move to the next level for regional engagement.

Hopefully, a full rollout of this youth engagement is scheduled for the 2026 MSRAL Convention where youth will be actively involved in the convention. For more information or volunteering opportunities, please contact MSRAL chair Rick Heschmeyer at *rickheschmeyer@gmail.com.*

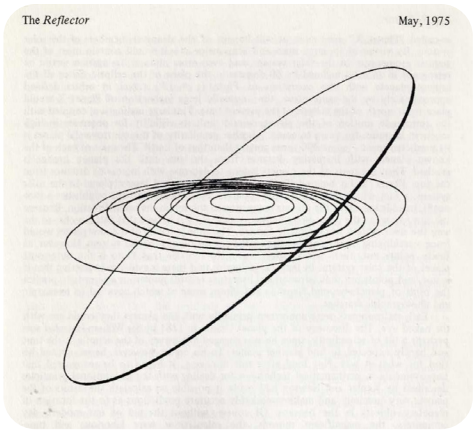
Full STEAM ahead, into the future!

**—Peggy Walker**

# AL History Highlights: Years Ago

## 25 years ago—May 2010

The League's *Reflector* newsletter made some administrative announcements in the May 2010 issue. Back then we didn't have the monthly "What's Up" on Facebook or social media to keep you up-to-date on League happenings. A small item announced that "League Sales items can now be purchased online." Before then, the *Reflector* was the display medium for League Sales and the transaction was completed by mail or phone. Modern times! A comparison of an archived copy of the website from 2011 at *www.waybackmachine.org* to the current website, *store.astroleague.org*, suggests product offerings have at least tripled in number over the past quarter century. A related ad for the "NEW Member-at-Large" program directed interested individuals to "join online at the new AL Sales website." With this innovation, individuals did not have to belong to a member society to participate in Astronomical League programs and activities. The program has grown phenomenally over the years and now has many international members.


The *Reflector* May, 1975

## 50 Years Ago—May 1975

Last time for "50 Years Ago," we featured an article about the then-planet Pluto and the years since its discovery. Here is another about the outer reaches of our Solar System: Planet X. "Does such a planet really exist? In this article, Dr. Ralph Buice discusses evidence pro and con, and offers a new search ephemeris to guide prospective discoverers...." Predicted to be a very massive body with an oddly eccentric orbit of 60 degrees orbiting well beyond Pluto (see insert), it has not been found, even yet. Note that a modern hypothesis for Planet X has been made by Mike Brown. You can Google it (or his book about how he "killed Pluto").

**—Denise Moser, AL Historian**

# To The Editor

### Studying the Sun

I found Milena Niemczyk's article "Studying the Sun: A Personal Perspective" very interesting and it brought back many memories. I immediately began to reminisce about my teenage years, so many years ago. In fact, I am 93 years old now. I always enjoy the *Reflector* as a life member of the Central Missouri Astronomical Association (CMAA).*

I feel that Milena and I started solar observing at about the same age. My active years were 1947 to 1949, age 15 to 18. I recorded daily sunspot activity and reported it monthly to Neil J. Heines, Solar Division of the AAVSO. He was my mentor, and I appreciated our personal interactions as I prepared for what I hoped would be an astrophysics career at Harvard University.

My dad helped me with a homemade telescope that was made of the finest 3-inch tin guttering with a 3-inch non-achromatic lens. It had an equatorial mounting atop a fine wooden

Continued on Page 12

# The Archduke and the Telescopes

By Bob Kerr

A nobleman gazes with great satisfaction through a spyglass in a painting from 1609 (Figures 1, 2). Archduke Albert VII, sovereign of the Habsburg Netherlands, surveys his estate through a newly acquired "far-seeing" device. It's recently arrived from The Hague, and he's been advised it's the work of the inventor. Experts believe this painting, *Extensive Landscape with View of the Castle of Mariemont* by Flemish artist Jan Brueghel the Elder, features the very first depiction of a spyglass. The painting is conserved at the Virginia Museum of Fine Arts in Richmond. Below, we'll consider Brueghel's portrayal of later archduke telescopes of remarkably advanced design.

*Figure 1.* Extensive Landscape with View of the Castle of Mariemont, *oil on canvas, 1609–1611. Jan Brueghel the Elder, Virginia Museum of Fine Arts, Richmond. Adolph D. and Wilkins C. Williams Fund, 53.10. Photo by David Stover.*

Archduke Albert VII was a member of the royal House of Habsburg and during this period administered Spain's interests in the Low Countries. His was a family that embraced science and astronomy. Like Albert, his brother Maximilian III, Archduke of Further Austria, collected telescopes and brother Rudolf II was Holy Roman Emperor and patron of Tycho Brahe.

Pierluigi Selvelli and Paolo Molaro, astrophysicists with the Astronomical Observatory of Trieste, Italy, research the origins and diffusion of early scientific devices. With particular curiosity about the telescopes in Brueghel's paintings, they write, "To our knowledge, the *Extensive Landscape with View of the Castle of Mariemont* represents the most ancient reproduction of a spyglass. It clearly typifies early 'Dutch design,' a convex objective lens and a concave eye lens made from spectacle glass" (Selvelli and Molaro 2011, 328). The researchers report the lenses appear to be fastened within a tin or paper tube approximately 460 mm in length and about 50 mm in diameter, with gilded end rings and a magnification of around 3×. They believe the inventor was

*Figure 2.* Extensive Landscape with View of the Castle of Mariemont. *Detail, Archduke Albert VII of Habsburg, Netherlands with spyglass. (See credit, Figure 1).*

likely Hans Lipperhey, whose spectacle-making business was in Middelburg, capital of Zeeland, about 60 miles south of The Hague, seat of Dutch authority.

There's a puzzling aspect of the contemporary view recognizing Lipperhey as inventor of the telescope. Upon demonstrating his spyglass at The Hague in October 1608 and requesting a patent as its inventor, a summary of the proceedings makes it clear authorities denied him that recognition, telling him the device was already known to others. We can presume they had at some time looked through spyglasses made with poor spectacle lenses or heard reports about such devices and had formed a low opinion of their usefulness. The unsatisfactory performance of such lenses is validated by the research of science historian and expert on the development of optics, Rolf Willach. He describes Ronchi-image tests he performed on the lenses of 57 spectacles from the early 16th and mid-17th centuries: Five were "fairly good," four were "mediocre," and 48 were "extremely bad" – only 10 percent were usable (Willach 2010, 108).

On the other hand, The Hague authorities were considerably astonished when Lipperhey's spyglasses showed distant objects clearly, "as though they were nearby" (Zuidervaart 2010, 40). Spectacle makers understood little about optics, but Lipperhey evidentially had mastered the lens-making craft well. There's an opinion that he may have also stumbled across the use of aperture stops that improved his telescopes' performance. (More about this when we discuss Galileo.) But the officials' satisfaction

alone is testimony to Lipperhey's ability to create lenses yielding images of acceptable quality. Delighted with the operation of his spyglasses, they rewarded him 900 guilders, about three times the average worker's annual income (14).

Within a year of Lipperhey's appearance at The Hague, replication and dissemination of Dutch spyglasses surged across Europe. Both the privileged and the commoner aspired to own one. More consequential to the telescope's future, the device took little time migrating from the hands of the spectacle maker into the hands of the telescope maker.

Several years after *Extensive Landscape*, two other archduke paintings, by Jan Brueghel and Peter Paul Rubens, depict striking silver telescopes of draw tube design displaying remarkable evolution in construction, seen here in detail views. *Sense of Sight* is oil on panel from 1617 (Figure 3) and *Sense of Sight and Smell* is oil on canvas from 1620 (Figure 4). Both are installed at the Museo Nacional del Prado in Madrid, Spain. The latter telescope is seen accompanied by an astrolabe, caliper, and gunner's rule. Selvelli and Molaro admire Brueghel's attention to detail: "Each instrument is meticulously painted with true Flemish skill, so even the minutest details are accurately characterized" (Selvelli and Molaro 2011, 328, 329).

*Figure 3.* Sense of Sight, *Detail, oil on panel, 1617. Jan Brueghel the Elder, et al. Museo Nacional del Prado, Madrid, Spain*

The first instrument consists of a main tube and seven compressed intermediary tubes, while the second features eight tubes fully drawn. The craftsmanship is extraordinary, each tube being secured with an enlarged metallic collar, one black, the other silvery, with lenses housed in large, rounded terminals. Using an optical ray tracer, Selvelli and Molaro calculate the tubes have tapered widths from 20 mm at the ocular to 70 mm at the objective, with fully extended lengths of approximately 1800 mm (2010, 195-198). But their focal lengths and optical configuration appear inconsistent with Dutch design, as the optics can be inferred from the large, boxy-shaped eyepieces requiring the eye to be placed precisely at the focus of an inverting compound convex ocular." The authors argue the telescopes surpass the abilities of a spectacle maker and reflect the skills of an experienced optician (2011, 330). Could Galileo or Johannes Kepler have constructed these telescopes?

At the University of Padua, Galileo immediately became intrigued. Experts debate whether Galileo ever saw a Dutch telescope. Giorgio Strano, curator, Museo Galileo, states "Although Galileo never claimed to have seen a Dutch spyglass, it is very hard to believe he had not" (Strano 2009, 3). "Galileo was not satisfied with the lenses from spectacle making shops and managed to set up his own lens-making workshop" (6). Aside from grinding superior lenses, he applied aperture stops or diaphragms to substantially sharpen optical performance. His 14× telescope aperture was stopped from 51 mm to 26 mm, and his 21× was reduced from 37 mm to 15 mm (26). The exteriors of his tubes were not elegant and certainly never silver. Galileo wrote that by early 1610 he had constructed over 60 telescopes (Greco et al. 1993, 6219), none known to use draw tubes. Other than one modest exception as a gift, his customary tubes embodied serviceability and were mostly constructed of rolled tin covered in cotton frieze. "Galileo himself commented his spyglasses lacked aesthetic value, and by 1610 he was not able to further improve the instrument.... Galileo had at hand an optical device that could not be developed further" (Strano 2009, 20, 46).

Rather, Selvelli and Molaro believe the archduke's draw tube telescopes typify Keplerian design. In his 1611 *Dioptrice*, Johannes Kepler presented a new theory of optics, conceiving a visual system which paired a *convex* primary lens with a *convex* eye lens. Although asserting such an arrangement of lenses would produce brighter images, wider fields, and longer focal lengths, he never mentioned the effects on magnification or image inversion. This has led many experts to question whether the actual construction of a telescope even crossed his mind (Molaro 2022, 511).

While Kepler had his detractors, many recognized his improved optical design would yield a type of telescope ideal for astronomical exploration. Wider fields, brighter images, and greater magnifications in exchange for inverted images would be quite agreeable. Inasmuch as Brueghel's paintings of the silver telescopes date from 1617 and 1620, Selvelli and Molaro question who could have perfected Kepler's innovative lens system in such a relatively short time.

There's some evidence for how Archduke Albert came to acquire Keplerian telescopes. As early as 1614 he learned that his brother, Archduke Maximilian III, had acquired a new kind of telescope that turned everything upside down. Maximilian frequently called upon Christopher Scheiner, a cleric, physicist, and astronomer, to discuss topics such as astronomy and mathematics and commissioned him to refashion the instrument. By adding an erecting lens, Scheiner produced a terrestrial version of the Keplerian telescope, and, while appreciating the elegance of its optical design, never claimed to have created it (Selvelli and Molaro 2011, 332). Possibly Albert arranged to have Scheiner or the original maker construct Keplerian instruments for him. However, the specific term "astronomical telescope" did not appear until 1645. The maker of the beautiful silver telescopes remains unknown.

Archduke Albert VII died in July 1621 at age 62. The Château of Mariemont and its extensive landscape were abandoned and his collections and telescopes lost. Fortunately, Brueghel's paintings survive to remind us of the rich history of our cherished instruments and the joy they bring us as we gaze with great satisfaction upon the extensive landscape we call the universe.

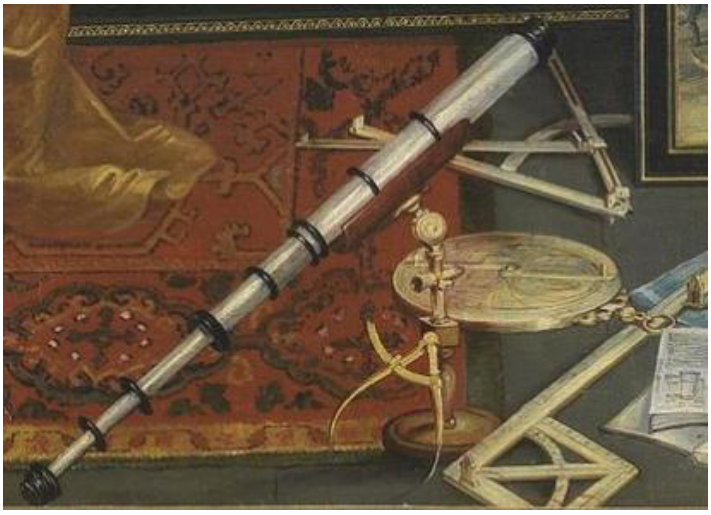


*Figure 4.* Sense of Sight and Smell, *Detail, oil on canvas, 1620. Jan Brueghel the Elder, et al. Museo Nacional del Prado, Madrid, Spain*

*Note: Two popular Astronomical League Observing Programs bracket the historic period in this article. "Astronomy Before the Telescope" (*www.astroleague.org/astronomy-before-the-telescope-observing-certificate*) features devices and methods for conducting naked eye observations, and the several "Galileo" programs replicate his telescopic discoveries (*www.astroleague.org/alphabeticobserving*).*

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**Acknowledgements**


*Extensive Landscape with View of the Castle of Mariemont* and detail, oil on canvas, 33 ⅜" × 51 ½", 1609–1611, Jan Brueghel the Elder. The Virginia Museum of Fine Arts (VMFA), Richmond, VA, USA. Adolph D. and Wilkins C. Fund, 53.10. David Stover photograph. ©*VMFA*. Howell Perkins, Image Rights Licensing Coordinator & Imaging Resources. Theresa A. Cunningham, PhD, Assistant Curator of European Art and the Mellon Collections.

*Sense of Sight*, oil on panel, 1617, detail. Jan Brueghel the Elder and Peter Paul Rubens. Museo Nacional del Prado, Madrid, Spain. ©*Museo Nacional del Prado*.

*Sense of Sight and Smell*, oil on canvas, 1620, detail. Jan Brueghel the Elder, et al. Museo Nacional del Prado, Madrid, Spain. ©*Museo Nacional del Prado*.

# Astronomy Outreach for Sick and Injured Children and Their Families: How Carl Sagan Inspired a Lifetime of Astronomy Outreach

By Donald Lubowich, Hofstra University
(*donald.lubowich@hofstra.edu*)

Did you know that amateur astronomers can create an outreach program for extremely ill or traumatically injured children, their siblings, and family members who are staying at hundreds of summer camps or the 300 U.S. Ronald McDonald Houses? The ill children are undergoing medical treatments at a nearby hospital or testing prior to their medical procedures and recover at the Ronald McDonald Houses when they no longer need active hospital care. Although they are open to all families, most families are poverty-level, low-income, or minorities (Hispanics or Black Americans) from all 50 states and many countries. This shared family experience helps children and their families learn about astronomy while providing a diversion from the stress of being sick or of having a sick family member hospitalized.


The Ronald McDonald Houses are independent charities that provide free or low-cost housing to one million families per year in a comfortable atmosphere where family members sleep, eat, relax and find support from other families in similar situations. Fees are minimal so that income will not prevent children from obtaining the best medical care. Families are kept united at a time when mutual support is often as critical as medical treatment. Because the sick children must be able to walk or use a wheelchair to reach the hospital, they all are able to go outside for telescope observations.

The Ronald McDonald House astronomy activities occur before or after meals, usually in the evening. This program is designed for children of all ages and includes an introduction to the night sky, often using apps or a large-screen TV, telescope observations, and hands-on activities. During cloudy weather remote or robotic telescope observations are shown.

After the stress of visiting their sick family members in the hospital all day, it is heartwarming to see the joy and excitement in their faces as they peer through a telescope, often for the first time, to see close-up views of lunar craters, Saturn's rings, Jupiter's satellites and colored cloud belts, Mars's polar caps, stars, and star clusters. This program brought smiles and the joy of astronomy to hundreds of children and their families. The adults are just as interested as the children. During the day a solar telescope is used to look at the Sun to see sunspots and solar eruptions.

When some children saw Saturn's rings, they thought that it was a picture of Saturn taped inside the telescope. One family related the telescope observations of Saturn to their home study program, and prior to her spinal surgery, one young lady held herself up at the edge of her wheelchair to look through the eyepiece at Jupiter for an "awesome telescope experience."

Karen Calma, House Manager of the Ronald McDonald House of Long Island, said "No matter how young or old, everyone looks forward to these demonstrations. The astronomy program has been a wonderful learning experience for the children, and they really look forward to his coming. From the first day Dr. Lubowich brought his program to the Ronald McDonald House it has received an excellent response from the parents and children. To see a child's face light up with surprise, awe, and happiness is priceless!" One six-year-old guest from Barbados, who was undergoing heart surgery, needed to climb on a stepladder to look through the telescope, and said "Wow! I never thought I would see the Man in the Moon like I see him in the cartoons!"

AL clubs and individual members can create their own outreach programs by contacting a nearby Ronald McDonald House, camp from the American Camp Association list (*find.acacamps.org*) or The SeriousFun Children's Network camps (founded by Paul Newman) and speaking to the executive director, house manager, or program manager. Offer to volunteer your time for an astronomy program and decide on an appropriate date. I prefer dates when the Moon or planets are visible, but there is always something interesting for the children to see. You can decide if you want a rain date or would prefer to do hands-

on activities. I have been awarded a NASA and International Astronomical Union grant to purchase telescopes and equipment for the Long Island and Chicagoland Ronald McDonald Houses and have provided training to their staff to use the go-to telescopes.

My own 25-year career in astronomy outreach was inspired by Carl Sagan after he passed away in 1996. The Carl Sagan Foundation created the Carl Sagan Discovery Science Center at the Children's Hospital at Montefiore Medical Center, Bronx, New York. It opened in 2001 with a planetarium, NASA videos, computer stations, and a rooftop observatory. After hearing a description of the Discovery Center on the radio in 2000, I contacted my local children's hospital to set up an astronomy program. I was told that they were not interested but that I should contact the nearby Ronald McDonald House. The Long Island Ronald McDonald House was enthusiastic, so I brought a telescope to them.

My astronomy outreach events have also included: edible demonstrations with a Big Bang chocolate chip cookie and Starburst planets; astronomy for churches, synagogues, seminaries, and clergy conferences; astronomy nights at the Sagamore Hill National Historic Site, the home of President Teddy Roosevelt; an astronomy float in the 2009 New York City Columbus Day Parade for the International Year of Astronomy 2009 honoring the 400th anniversary of Galileo using a telescope (seen by 500,000 people in New York City and millions on TV); Music and Astronomy Under the Stars with telescopes, posters, and hands-on activities at free outdoor concerts and festivals (reached 70,000 people); and the Astronomy Festival on the National Mall (first festival co-sponsored by the White House, largest annual outreach event in the U.S. [reached 30,000 people, 4,000–5,000 per event]). I encourage you to find your own pathway for outreach, perhaps through the Astronomical League's Outreach Award (*www.astroleague.org/outreach-award*).

**Additional resources:**

Ronald McDonald House TV interview with kids

*drive.google.com/file/d/1ew-kdwyjviZ8S1NapPHZEizGArl1o-1J*

Edible Astronomy Demonstrations

*drive.google.com/file/d/1nxnDtMCMX7aJ1T_UVXWPYj8SMRROhT5o*

Columbus Day Parade

*drive.google.com/file/d/1tzUJHFHBR4K06mqyhtgZupPcgDwz1ZFg*

Music and Astronomy Under the Stars

*drive.google.com/file/d/13ANnBtibzdOSYVHGMTcFDYd1y6RH_FYF*

Astronomy Festival on the National Mall images

*drive.google.com/file/d/1Xf17L9jKEcot-EP0i1Z2gHV3bfRtAwWy*

See the March 2025 issue of *Reflector* for a related article by Dr. Lubowich.

Photographs by Paulo Bretones.

Conti'd from page 7

ladder. I made filters daily using microscope slides and freshly lit wooden matches. The slides were used at the roughly 60-inch focal point with nary one broken. Daily I drew images of the Sun and summarized the data in AAVSO format

At age 15 I also spent two years with the AAVSO Variable Star Division. I made a 6-inch (home-ground) reflecting telescope with the assistance of my dad and Mr. Larry Bell, an IBM engineer. We rode to Fayette, Missouri, many times in his 1949 Buick for CMAA meetings.

I did not get the scholarship to Harvard and my parents could not afford the tuition, so I got my degree in accounting and statistics at the University of Missouri. But before that, in 1951, my life was about to change when I discovered my own "Heavenly Body." She was the candy clerk, and I a stock boy at the local dime store. The rest is history, as we were married in 1952. Then came the service in the United States Coast Guard. Now my astronomical past came to fore as I became at age 24 the operations officer and navigator of the USCG *Sebago*, a 255-foot cutter. After that I entered the business world of data processing, now known as IT. What happened in the intervening 31 years is mostly a lost memory, but we have four children, eight grandchildren, and 6+ great-grandchildren. I lost my wife of 54 years in 2007. I wish Milena many happy years in astronomy.

*We had a group of five or six of us in 1947 that met at Central College's Morrison Observatory for several years. We were known as the Central Missouri Amateur Astronomers. A couple of years later, in 1949, the group had grown to where it became a legal entity and was renamed the Central Missouri Astronomical Association.

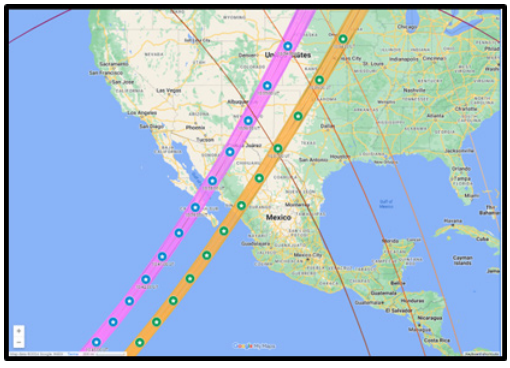
**—Gene T. Waters**

# An Experience to be Remembered

**By Ramesh Pattar, Texas Teen Astronomical Society**

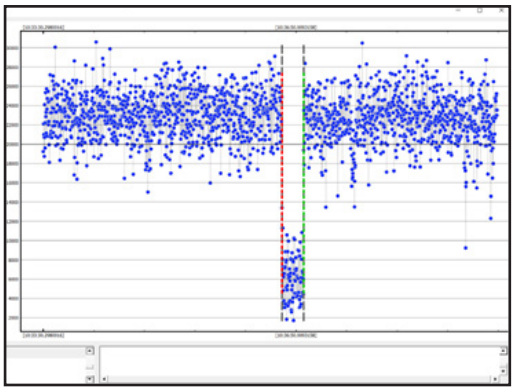
Some experiences are unforgettable, and one of these was my first asteroid occultation in mid-August. When coach Kevin Cobble first mentioned that he was going to do an occultation with Bill Kloepping, I immediately jumped at the opportunity. As a rising high school junior and a member of the Teen Texas Astronomical Society (TTAS), I was just getting into astronomical observing and this seemed like a great way to expose myself to this side of astronomy. Fellow TTAS member Hanson Du and I had no idea how impactful the experience would be. This effort was done with the NASA Lucy Occultation Team led by Marc Buie from the Southwest Research Institute (SwRI) in Boulder, Colorado.

An asteroid occultation is a phenomenon in which an asteroid is aligned with a star in the same fashion as a solar eclipse, allowing observers in the shadow areas on a particular path to get valuable information about the asteroid in question. In collaboration with the NASA Lucy mission, we were two of the 18 groups observing the occultation for a Trojan asteroid named Menoetius that was casting a shadow from a star on August 11, 2024. Menoetius is actually part of a double asteroid system with 617 Patroclus. The shadow followed the magenta path; another set of groups conducted the occultation for this asteroid. The path of this asteroid's shadow was all across west Texas (as seen with the yellow path) and our main challenge was battling the weather, mainly the cloud cover and wind.




Since we needed clear skies to practice with the actual equipment, including polar alignment and acquiring the target for a mock data collection, we hopped around to different cities every day. Although this part of the experience was tiring, it kept us engaged and allowed us to travel across Texas in search of decreased cloud cover. The first practice day was on August 8 in Lubbock and was an overall success; although a little cloudy, it helped us gauge setup time and get a feel for what the actual event would be like. Unfortunately, though, the clear skies did not stay in Lubbock so we had to travel farther west to Roswell, New Mexico, for the second night's practice. Here, we had our best practice since the site was very dark and clear, which was an amazing experience and problem-free.

On the day of occultation, we had to find a place on the track with good weather, so we traveled to Midland, Texas. At this point, Bill and Hanson went to survey their possible sites for the occultation while Kevin and I surveyed ours. Although we found an excellent site right on our track, we faced a new problem: wind. Winds were about fourteen miles per hour in the area, which could ruin our data, so we reached the site early in the morning and, after a quick workaround of parking our vehicles to block the wind, we were successful in getting aligned and on target. Part of the experience was waiting for the occultation time, during which we looked for meteors and just enjoyed the night sky. While taking the data, I felt a sense of satisfaction at all of our efforts over four days of practicing and driving.



This was an amazing experience for all of us, and Hanson and I learned so much from this observation, not only about astronomy but also overcoming obstacles that we couldn't control.

Our light curve of the event shows the brightness of the star during the occultation, and the large dip is when the asteroid occulted the star. These data, when combined with the data from the other groups, will be used to calculate the shape and orbit of the asteroids so NASA's Lucy spacecraft will have the dimensions and positions of both asteroids for its flyby in 2033. This truly was an experience to be remembered and solidified my interest in the field of astronomy.

*Ramesh is a high school junior in Texas and vice president of the Teen Texas Astronomical Society.*

# Observing OB Associations

**By Larry McHenry**
***stellar-journeys.org***

## INTRODUCTION

There is a somewhat neglected category of deep-sky object that is overlooked by many amateurs: the OB association. An OB association is a large, very loose star cluster consisting of young spectral type O and B stars. OB associations are best observed using low-power instruments – binoculars, small refractors, or small reflectors – which will give great views of these objects. Unlike nebulae and galaxies, OB associations can be observed under less-than-optimal sky conditions, such as thin haze or light pollution.

You may have run across some of these OB associations, such as the Alpha Persei Association or the Orion Association, while browsing your favorite star atlas or viewing the charts of a computer planetarium program. Most of these large clusters are faint and sparse, and not very appealing visually, but there are a number of "gems" that are worth looking for.

## STAR CLUSTERS

Star clusters come in three varieties: globular clusters, open clusters, and OB associations. The last two are similar, being made of younger stars and found in the disk of our galaxy. There are currently over 1,600 known open clusters in our galaxy (Kepple 2018, 4), with more being continuously identified by the Hipparcos and Gaia space-based telescopes. Open clusters are often bright and easily observable with small telescopes and even binoculars.

Open clusters are physically related groups of stars held together by mutual gravitational attraction. They are loose collections of anywhere from a few dozen to several thousand stars covering large expanses of space. Having formed together from the same cloud of gas and dust, the individual stars in a cluster are all of similar age, and about the same distance from us.

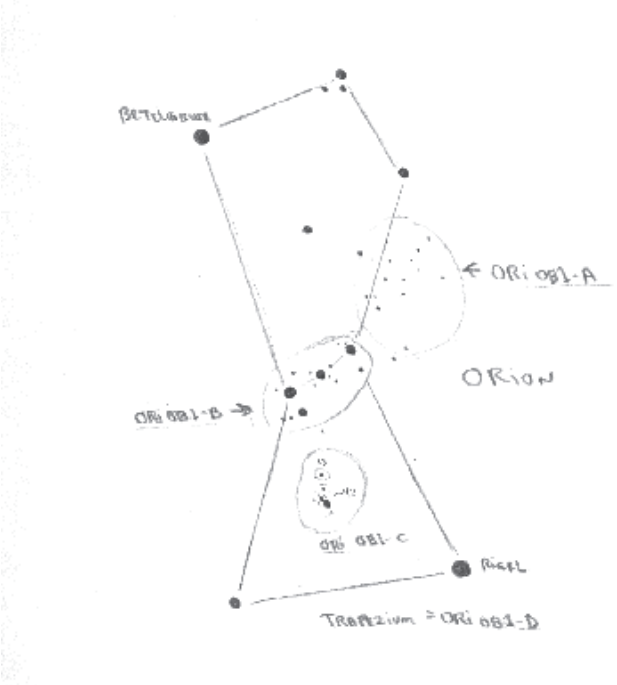
Clusters originate from large interstellar clouds of matter, cosmic gas and dust in our Milky Way galaxy that slowly collapse from gravity or compressed by shockwaves. Open cluster stars have evolved from material that has gone through many cycles of star birth and supernovae, which enrich the heavy element concentration in star-forming clouds. Currently, in many clouds visible as bright diffuse nebulae within our galaxy, star formation still takes place at this moment, allowing us to observe the formation of new young star clusters, in various stages.

Most open star clusters that we can visually observe are located within the spiral arms of our own galaxy. After star clusters form, they continue to orbit our galaxy scattered throughout its arms and disk. Most open clusters have only a short life as stellar swarms. As they drift along their orbits, some of their member stars escape from the cluster by gravitational attraction from other, more massive nearby objects that the cluster is passing, or are ejected by internal cluster interactions and become field stars within the galaxy. Eventually, all the individual cluster stars will merge into the background with the other stars within the spiral arms.

## OB ASSOCIATIONS

These deep-sky objects cover large volumes of space, generally between 30 and 100 parsecs (Jones 1981, 5), are loosely held together by gravity, and have very short lifetimes (a few million years) as distinct objects. They are found scattered along the Milky Way's spiral arms. While OB associations are considered a separate category from open clusters, both types can be found together, with an open cluster sometimes forming the core region of a larger OB association. OB associations may also still contain clouds of interstellar gas and dust visible as glowing emission nebulae, reflection nebulae, or dark nebulae.

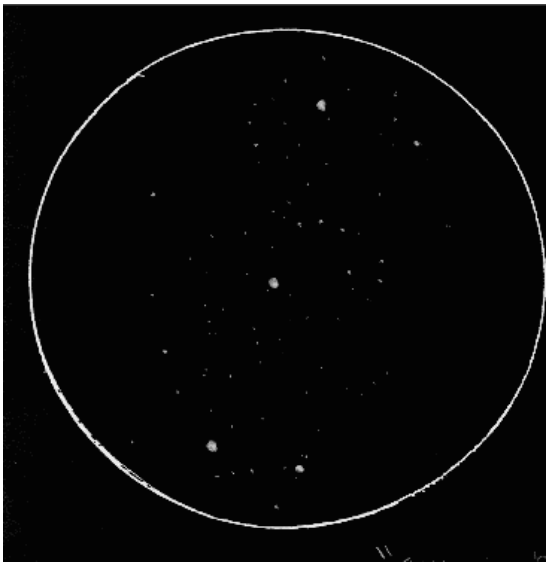
In time, the unstable outlying OB association will drift apart, merging with the other field stars in the region, leaving the more gravitationally bound open cluster as a still observable object. The remnants of some OB associations, called stellar streams or moving groups, can still be seen. The easiest of these to find is the Ursa Major Stream, with its core consisting of the stars of the Big Dipper (Archinal & Hynes 2003, 17).



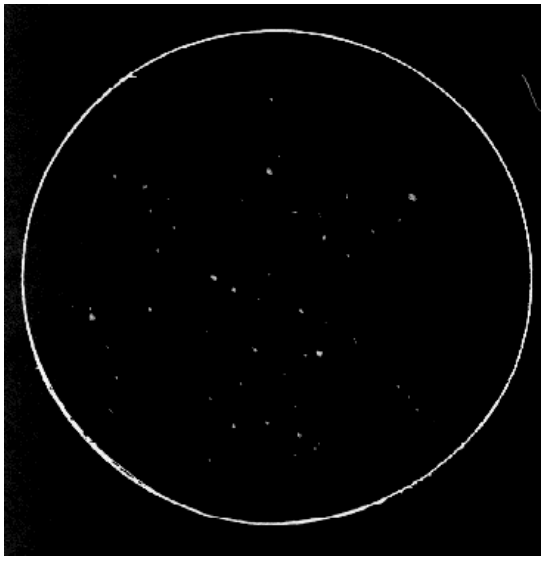
*Orion's Belt and Sword: Orion OB1-B, OB1-C, OB1-D*

*Canon 25 mm CCTV lens, Atlas Gem mount, ASI290MC and IR filter at 60 seconds livestacked for 10 minutes.*

Few star charts plot OB associations as distinct objects, but many can be found on star charts because of the number of their individual stars. A good example of this is Cygnus OB9, found around Gamma Cygni (Sadr), and nearby Cygnus OB3. Orion OB1-B surrounds Orion's Belt, and Orion OB1-C consists of Orion's Sword. Because of their large size, OB associations are best observed with binoculars or small rich-field telescopes at low magnification.



*Orion OB1-B*



*Orion OB1-A*

There are currently more than 70 known OB associations (Caruso 1986, 110) within our galaxy, of which I've sketched 19.

## HOW TO OBSERVE

So, where can you find OB associations? The same place you find many Messier or NGC clusters: along the plane of the Milky Way, as most open clusters and OB associations form and spend their stellar lives among the spiral arms.

Some large, bright clusters are best suited for the unaided eye, but others will require using binoculars or small rich-field telescopes. While a number of OB associations are fairly easy to find, many may require observing from a dark-sky country location.

Visually observing the fainter clusters requires maintaining dark adaptation, using good star charts, and slow sweeping with a wide-field, low-power telescope. An 80 mm f/5 or shorter refractor would work well. In general, for visual observers, it's best to hunt clusters starting with low-power, wide-field eyepieces to identify the target area. Once the cluster is centered, you can then switch to higher magnifications to pull out details in the object.

*Orion OB1-C*

For imagers, clusters can also be challenging, in that even with an accurate go-to mount, it may not position the telescope squarely on the object to where it's framed the way you want it.

Continued on page 20

# Library Telescope Program: New Horizons

**By Donald Ficken, Library Telescope Program President/Executive Director (St. Louis Astronomical Society) and Michelle Nichols, Library Telescope Program Vice President (Adler Planetarium)**

## HISTORY OF THE LIBRARY TELESCOPE PROGRAM

In 2008, Marc Stowbridge and the New Hampshire Astronomical Society (NHAS) introduced a groundbreaking idea: placing telescopes in public libraries for checkout, just like books. The program allows people of all ages and income levels to access telescopes through their local libraries, leveraging existing staff, facilities, and marketing programs. NHAS selected the Orion 4.5-inch tabletop reflector telescope for its lightweight design, ease of use, and powerful capabilities. Each telescope was modified for durability and user-friendliness, equipped with accessories such as a user's manual, constellation guide, Moon map, and night light. Amateur astronomers served as foster parents to the telescopes. NHAS published their program on their website, enabling anyone to adopt it, sparking grassroots efforts worldwide.


Marc's goals were modest when the program was launched: "I would have considered the program a success if NHAS could have placed three or four telescopes a year in local libraries," Marc admits. The program has since grown to over 1,000 library outlets in the United States, Canada, Europe, and Asia (visit *librarytelescope.org* to view a world map of known participating locations).

The New Hampshire program grew rapidly. "Librarians have a pretty sophisticated system for communication amongst themselves," Marc explains. "Word got out that the New Hampshire program existed and it was bringing in interested borrowers."

Support from Orion led to an article in their winter catalog, and *Sky & Telescope* magazine featured the program in January 2011. *Astronomy* magazine highlighted the program's success at the 2011 Northeast Astronomy Forum, and in mid-May, the NHAS Library Telescope Program received the Southern California Astronomy Expo raffle proceeds. In 2012, NHAS won *Astronomy* magazine's "Out of this World" outreach award, further boosting awareness of the program.

The Astronomical League has been a staunch supporter of the Library Telescope Program since its inception. In 2013, they generously provided telescopes as door prizes at ALCon and the Green Bank Star Quest. In 2014, an unexpected scheduling mix-up at ALCon led co-chair John Goss to step in and present about the Library Telescope Program, and he returned to ALCon in 2015 for another presentation on the subject. Goss also wrote an article about the program for the October 2013 issue of *Sky & Telescope*. Starting in 2015, with funding from the Horkheimer Charitable Fund, Orion Telescopes, and Celestron, the Astronomical League launched a program offering astronomy clubs across the United States the chance to win a library telescope through an annual drawing. To date, more than 80 library telescopes have been awarded to clubs through this initiative.

In 2022, the Astronomical League took an additional step to support the Library Telescope Program by creating a Library Telescope Award for members performing library telescope activities. Members can earn a silver award for 20 hours of service and a gold award for an additional 80 hours of service.

## FORMATION OF TASK FORCE

By 2020, based on research conducted by the Astronomical Society of the Pacific, the Library Telescope Program had expanded to at least 522 library outlets worldwide. Tom Lynch, from the Amateur Observers' Society of New York, created a Facebook page for the program, which had already attracted 460 followers. Don Ficken from the St. Louis Astronomical Society launched a website at *librarytelescope.org* featuring a clickable map showcasing all known locations. Additionally, Don started hosting monthly meetings of volunteers and Facebook webinars to promote the program. Formation of a task force helped spark continued growth.

According to the latest data, astronomy clubs with 25 or more telescopes in libraries include the Aldrich Astronomical Society, Central Arkansas Astronomical Society, Delaware Astronomical

Society, New Hampshire Astronomical Society, Omaha Astronomical Society, Saint Louis Astronomical Society, and Salt Lake City Astronomical Society. Ron Thompson, Southern Maine Astronomical Society, modified over 600 telescopes for Cornerstones of Science, which were shipped to libraries throughout the country.

Today, libraries in 48 states of the U.S. are participating, with only Hawaii and Mississippi yet to join. In Canada, libraries across nine regions are involved. Europe has participating libraries in Belgium, Portugal, the Netherlands, Switzerland, and the United Kingdom. Recently, the Republic of Korea (South Korea) in Asia joined the program.

## NEW BEGINNINGS

Orion closed its doors in 2024, which left the Library Telescope Program without the telescope it had used since the inception of the program. Library Telescope Program task force members Don Ficken, St. Louis Astronomical Society, and Michelle Nichols, Adler Planetarium, recognized this as a pivotal opportunity to rethink the program's expansion plans. The priority was to find a replacement for the Orion StarBlast and Zhumell Z114 telescopes. The task force aimed for a telescope designed to Library Telescope Program specifications developed from years of experience supporting libraries in the program.

After an extensive search, the Library Telescope Program secured an agreement with High Point Scientific in New Jersey to build a telescope tailored to the program's needs. Development of a custom telescope takes several months, so High Point Scientific agreed to provide the Library Telescope Program with an interim supply of telescopes by purchasing closeout stock of Zhumell Z114 telescopes which they modified to the program's specifications. Libraries could join the Library Telescope Program immediately and, for the first time ever, purchase a ready-to-deploy telescope directly from a supplier.

Next, a legal entity was necessary so the Library Telescope Program could sign an agreement with High Point Scientific. Husch Blackwell, a prominent law firm in St. Louis, agreed to provide pro bono legal services to make a 501(c)(3) a legal entity. The Library Telescope Program recruited a board of directors, consisting of Don Ficken, president (St. Louis Astronomical Society), Michelle Nichols, vice president (Adler Planetarium), Jerelyn Ramirez, secretary (Kansas Astronomical Observers), Patrick Rohrkaste, treasurer (a retired CPA and retired Partner from UHY Advisors, Inc., with expertise working with nonprofits), and Marc Stowbridge, director (New Hampshire Astronomical Society). On October 10, 2024, a 501(c)(3) tax-exempt legal entity called the "Library Telescope Program" was officially registered in the State of Missouri.

## 2025 AND BEYOND

The Library Telescope Program's grassroots growth has been remarkable, but a more structured and organized approach is needed for the program to expand to the next level. The new legal entity is an important step toward building that foundation. But other fundamentals need to be addressed too.

Don used the acronym SPACE to explain to the newly formed board of directors fundamentals that, if addressed, will encourage libraries to participate in the program:

**(S)**upport is important, primarily from knowledgeable astronomers in local communities, to encourage libraries to join the program.
**(P)**roducts such as telescopes and supporting parts must be ready-to-deploy and readily available at a reasonable price.
(**A**)wareness with patrons, libraries, and volunteers is critical for the program to grow.
**(C)**ash funding sources are necessary to help libraries, especially in underserved communities, join the program.
**(E)**xtended program opportunities, such as themed events around Astronomy Day and International Observe the Moon Night, are needed to make the program more attractive to libraries.

The Library Telescope Program task force, representing organizations from around the world, and the community at large has stepped up to the challenge. Volunteers are contributing on many fronts:

- Marketing and Communications: A marketing and communications team has been assembled to raise awareness and manage the brand.
- Outreach and Education: An outreach and education team is launching an ambassador network, similar to the Solar Eclipse Ambassador Program offered by the Astronomy Society of the Pacific for the 2024 solar eclipse. Modules are being developed to train and certify amateur astronomers, science teachers, and others to assist libraries in launching and supporting programs. Additionally, the Library Telescope Program is collaborating with various organizations to develop themed events to keep the program vibrant in libraries.
- New Program Launch: A team is being formed to support the launch of new library programs. Having a real person to guide libraries through the launch process will encourage more libraries to participate.
- Equipment: A team is identifying equipment needs and

Continued on Page 21

# The Nova of 1885

## and the Mystery of the Andromeda Nebula

**By Horace Smith**

Can an exciting new celestial discovery lead astronomers astray? One hundred forty years ago, the "new star" of 1885 did just that – for a time. As the summer of 1885 drew toward a close, a new star, a nova, appeared. Seemingly new stars had come before, and then faded, but this nova was different. It appeared close to the center of what was then called the Andromeda nebula (M31).

The Andromeda nebula is visible to the naked eye as a fuzzy, elongated spot in the sky. Today we know that fuzzy spot is another galaxy, a system of stars, gas, and mysterious dark matter larger than the Milky Way at a distance of two and a half million light-years. However, in 1885 the nature of the Andromeda nebula was far from settled. The term *nebula* means cloud or fog in Latin and the object in Andromeda certainly looked cloudlike to 19th century astronomers. Although many astronomers thought the Andromeda nebula was a gaseous nebula or an unresolved star cluster within the Milky Way, others disagreed and proposed instead that it was a galaxy far beyond our own. This disagreement was part of a larger argument: was the Milky Way the only galaxy or one of many? This fundamental question was unanswered on the moonlit evening of August 20, 1885, when Ernst Hartwig showed the Andromeda nebula to visiting friends.

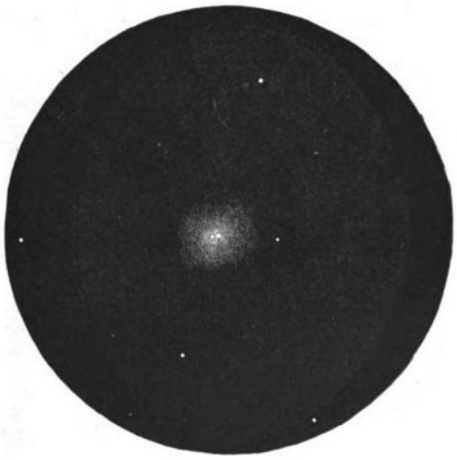


*Figure 1. Isaac Robert's photograph of the 1885 nova was published as a woodcut in the* Journal of the Liverpool Astronomical Society *(vol. iv, p. 1). The nova is near the center to the right of the nucleus of the Andromeda nebula.*

Hartwig, an astronomer at the Dorpat Observatory in Estonia, noticed something strange as he gazed through the observatory's 9-inch refracting telescope. There appeared to be a star near the center of the Andromeda nebula that he had not noticed before. Many years later, Hartwig would write that he had been sure from the beginning that the object was real and new, but the director of the observatory was not convinced, and would not allow Hartwig immediately to announce his discovery. Not until the new star had been seen in a moonless sky would the director permit an announcement to go out, and that did not happen until August 31. Then telegrams and letters spread word of the discovery around the globe. Observers quickly confirmed Hartwig's new star and a few observations made before Hartwig's came to light. At its peak, the new star was about magnitude 6, near the limit of naked eye visibility, although the surrounding nebula made it harder to see than it would have been against dark sky. Astronomical photography was in its infancy, but Isaac Roberts, a pioneer in that field, photographed the new star in early September (Fig. 1).

What was the new object? Some thought it was a newly formed star condensing from a cloud of gas as predicted by Laplace's nebular hypothesis. After its dramatic birth, such a new star would be expected to take its place among the multitude of stars in the Milky Way. But would this new star remain shining or would it fade like novae which had been seen outside the Andromeda nebula? The answer to that question came quickly: the nova in Andromeda was fading (Fig. 2). It disappeared beyond telescopic view early in 1886. When Isaac Roberts obtained much-improved photographs of the Andromeda nebula in 1888 and 1895, there was no sign of the 1885 nova. In 1898 the great observer Edward E. Barnard wrote, "It has been my custom, both here [Yerkes Observatory] and at the Lick Observatory, to frequently examine the great nebula for traces of the Nova of 1885, but nothing has ever been seen of it." However, although the nova had disappeared, it had implications for the question of whether the Andromeda nebula was, or was not, another galaxy. The brightness of the nova at its peak suggested that the answer to that question might be "no."

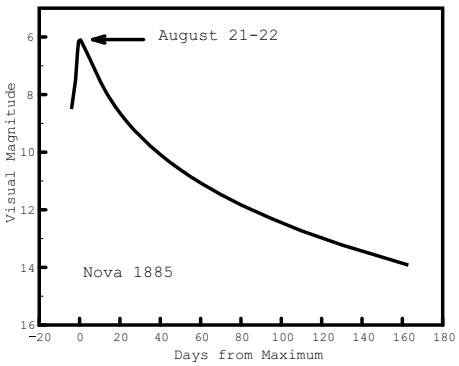



*Figure 2. The light curve of the nova, based on V magnitudes in de Vaucouleurs and Corwin (1985). The exact date of maximum light is uncertain.*

In the late 1800s and early 1900s, many believed that the nova at its peak would have been impossibly bright were the Andromeda nebula actually a distant galaxy. Astronomy historian and writer Agnes Clerke put the case in the 1905 edition of her book, *The System of the Stars*. She wrote that, if the Andromeda nebula were a galaxy 325,000 light-years away, then the

> star… which suddenly shone out in the midst of it in August 1885 should have been an absolutely portentous orb. In real

light it should have been equivalent to 762,000 stars like Sirius, or to sixteen million such suns as our own! But even this extravagant result inadequately represents the real improbability of the hypothesis it depends upon; since the Andromeda nebula, if an external galaxy, would almost certainly be at a far greater remoteness from a sister galaxy….

Such brilliance strained the credulity of turn-of-the-century astronomers to the breaking point. Some, like W. H. S. Monck, thought the nova might not even be a star. He suggested that it was instead a dark object raised to temporary brightness by friction as it raced through a gaseous Andromeda nebula.

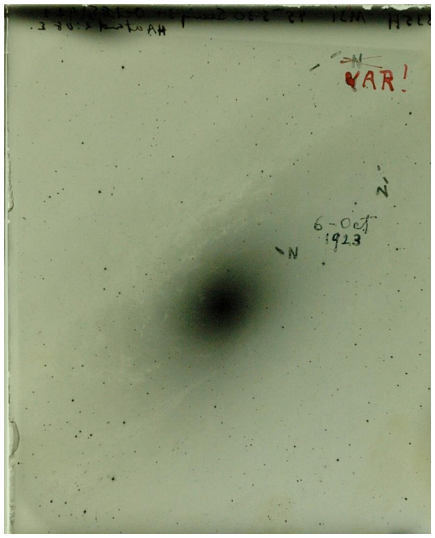



*Figure 3. Hubble's discovery photograph of a Cepheid in the Andromeda nebula. ©Carnegie Observatories. Reproduced with permission.*

What, then, was the bright nova of 1885? In 1934, Walter Baade and Fritz Zwicky divided novae into two groups, common novae and the much brighter supernovae. They pointed to the nova of 1885 as an exemplar of the latter. Thus, one type of variable star, a supernova, for decades confounded astronomers studying the Andromeda nebula while another type of variable star, a Cepheid, ended that confusion.

Even today there is much that we do not know about supernovae in general, and about the supernova in Andromeda in particular. Some supernovae mark the deaths of massive stars, but that is not thought to be true of the 1885 supernova. It is instead believed to have been a type Ia supernova, although one which did not become as bright as usual. Type Ia supernovae are thought to indicate explosions involving old white dwarf stars in binary star systems.

After the outburst of 1885, no new star was seen in the Andromeda nebula for three decades. The nova of 1885 was given an additional name, S Andromedae, but it remained lost from sight. Not until 1917 did G. W. Ritchey discover a second nova within the Andromeda nebula on photographic plates taken with the Mount Wilson 60-inch reflector. Others were discovered soon thereafter. Whereas the nova of 1885 reached 6th magnitude, these later discoveries remained fainter than magnitude 15 until they faded from view. In 1920, when Harlow Shapley and Heber D. Curtis disputed the scale of the universe in the so-called Great Debate, Curtis argued that the faint novae were consistent with the Andromeda nebula being a galaxy after all.

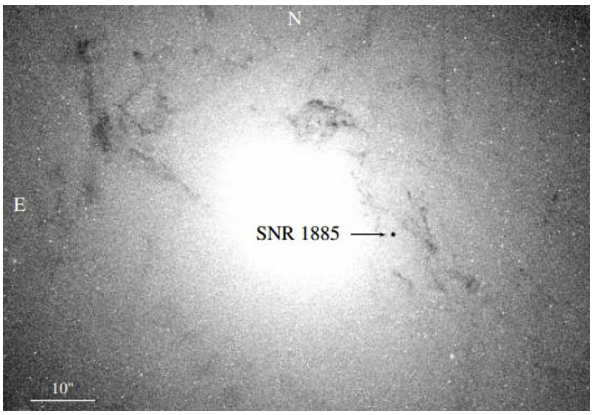



*Figure 4. The remnant of the 1885 supernova looks dark because of absorption by ionized calcium in this image taken with the Hubble Space Telescope. From Fesen et al. (2015). ©AAS. Reproduced with permission.*

In 1923 Edwin Hubble found a faint variable star in the Andromeda nebula on a photograph taken with the Mount Wilson 100-inch telescope. He at first marked it on the discovery photograph with an "N" for nova. However, he soon crossed out that N and replaced it with "VAR!" Hubble had discovered that this star did not vanish from view, instead it increased and decreased in brightness with a 31-day cycle (Fig. 3). It proved to be a Cepheid, a pulsating rather than an exploding variable, the first of many to be found in the nebula. Applying Henrietta Leavitt's relationship between the brightness and period of Cepheids as calibrated by Harlow Shapley, Hubble determined the distance to the Andromeda nebula to be 900,000 light-years. That was too small, but it was big enough to demonstrate conclusively that the Andromeda nebula really was another galaxy. The longstanding question had at last been answered.

More than a century after it faded from the view of nineteenth-century astronomers, the supernova of 1885 was in a sense rediscovered. Robert Fesen and collaborators detected its expanding remnant in silhouette on images taken in 1988 with the 4-meter Kitt Peak telescope and later with the Hubble Space Telescope (Fig. 4).

Astronomers had been misled by the brightness of the new star of 1885. Had that supernova not blazed when it did, more astronomers of the late 1800s and early 1900s would have been receptive to the idea that the Andromeda nebula is a galaxy. One hundred forty years later, the supernova of 1885 remains the only supernova outburst seen in the Andromeda Galaxy. Perhaps another will erupt in the lifetime of readers of this article. Nobody knows when that might happen. It might be next week or next year or decades from now. Surely, however, that is a reason to look carefully when viewing or imaging the fuzzy spot in Andromeda, our neighboring galaxy.

I thank Robert Fesen for his helpful comments and permission to use Figure 4.

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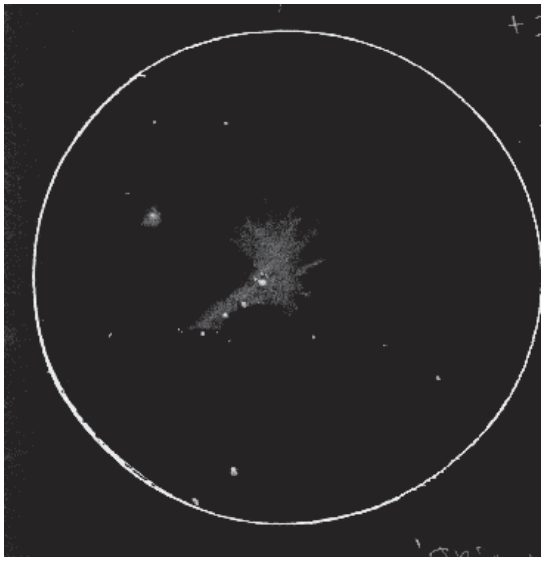

*Orion OB1-D*

Having a photographic atlas or picture of the cluster will help you in both locating and identifying the most interesting sections of the object and framing your image.

While you don't need to use filters for observing OB associations, a general broadband light-pollution filter will enhance both visual viewing and imaging star clusters. Specifically for imaging, an infrared filter should be used to help reduce and eliminate "star bloat" caused by infrared light not focusing at the same point as visible light.

## OBSERVING GUIDES

A number of good OB-association-related observing guides are available to the amateur astronomer.

*The Night Sky Observers Guide – Glories of the Milky-Way*, by George Kepple, is the fourth in the series of handbooks written by George Kepple and Glen Sanner. Each chapter covers a specific constellation, with finder charts, sketches, images, and visual descriptions of various deep-sky objects. Volume 4 focuses specifically on constellations and their objects that lie along the spiral arms of our galaxy.

Each constellation chapter lists all clusters visible within its boundaries.

*Star Clusters* by Brent Archinal and Stephen Hynes lists over 5,000 individual open clusters, globular clusters, and asterisms.

One of my favorite online resources to help confirm observations is the website *wikisky.org*. The site displays a photo-chart atlas of the heavens. Type the name of the star cluster you want into the search box and use the view slider to zoom in or out for the best view.

## CONCLUSION

These interesting wide-field clusters can be fun to hunt and observe. I hope I've inspired you to seek out and explore these often missed, but very rewarding, celestial objects.

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establishing repair and maintenance procedures to ensure libraries can keep their telescopes in good working order.

- Fundraising: Efforts are underway to secure grants to seed and grow the program, particularly in underserved areas.

## VOLUNTEERS, CLUBS, AND LIBRARY BENEFITS

The Library Telescope Program needs volunteers to act as ambassadors to libraries and work within the community to promote the program, and donors to support our mission. Volunteers can share their knowledge of astronomy with the community.

Clubs will benefit by providing more service opportunities for members and the ability to promote the club's other activities to the public.

Likewise, librarians benefit from increased patron traffic and attendance at activities, as well as greater exposure to the "library of things," expanding library services beyond books.

Visit *librarytelescope.org* to learn more, to become an ambassador, or to donate to our program. For inquiries on how to contribute your talent and help share the wonders of the night sky with everyone, please reach out to Don Ficken at *dficken@librarytelescope.org*. Together, we can inspire future scientists and promote amateur astronomy.

**Keep up with the latest discoveries from the James Webb Space Telescope at**

*webbtelescope.org/news/news-releases.*

# OBSERVING AWARDS

## SOLAR ECLIPSE OBSERVING CHALLENGE (2024)

**Blair Groden,** Gold, Raleigh Astronomy Club; **Tom Holman,** Gold, Minnesota Astronomy Society; **Bradford Wilson,** Gold, Member-at-Large; **Bethany Bennett,** Silver, Raleigh Astronomy Club; **Tom Holman,** Silver, Minnesota Astronomical Society; **Jenny Jo Johnson,** Silver, Prairie Astronomy Club; **Carl McCullough,** Silver, St. Louis Astronomical Society; **Christopher Randall,** Silver, Member-at-Large; **Laura Ryan,** Silver, Member-at-Large

## HUBBLE 35TH ANNIVERSARY SPECIAL OBSERVING CHALLENGE

**Laurie Ansorge,** Jan, Feb, Mar, Lifetime Member: **Roy Antonio,** Jan, Feb, Mar, Independent; **Mohammad Adnan Asif,** Jan, Feb, Raleigh Astronomy Club; **Mustafa M. Asif,** Jan, Feb, Raleigh Astronomy Club; **Chester Austin,** Jan, Independent; **Reed Austin,** Jan, Independent; **Douglas Balogh,** Jan, Feb, Mar, Indiana Astronomical Society; **Lindsey Benson,** Jan, Feb, Mar, Youth Member-at-Large; **Miranda Benson,** Jan, Feb, Mar, Independent; **Richard Benson,** Jan, Feb, Mar, Member-at-Large; **Misty Bentz,** Jan, Feb, Mar, Independent; **Dorit Betz,** Jan, Feb, Independent; **Robert Beuerlein,** Jan, Feb, NASA Langley Exchange Skywatchers; **Leander Bill,** Jan, Feb, Independent; **Heidi Bjerke,** Jan, Feb, Champaign-Urbana Astronomical Society; **Steve Boerner,** Jan, Feb, Mar, Member-at-Large; **Mariana Bonells,** Jan, Independent; **Bruce P. Bookout,** Jan, Feb, Mar, Colorado Springs Astronomical Society; **Dana Bostic,** Jan, Feb, Mar, Raleigh Astronomy Club; **Aaron Clevenson,** Jan, Feb, Mar, North Houston Astronomy Club; **James Collins,** Jan, Feb, The Albuquerque Astronomical Society; **Kevin Cook,** Jan, Stillwater Stargazers; **Daniel Ignacio Diaz Corredor,** Jan, Independent; **Dan Crowson,** Jan, Feb, Astronomical Society of Eastern Missouri; **Paul DeVoe,** Mar, Member-at-Large; **Jim Dole,** Jan, Feb, Mar, Planetary Studies Foundation; **Larry Dove,** Jan, Flint River Astronomy Club; **Steven Emenhiser,** Jan, Colorado Springs Astronomical Society; **William Ferguson,** Jan, Oklahoma City Astronomy Club; **Preston Feria,** Jan, Independent; **Billy Fisher,** Jan, Cleveland County Astronomical Society; **James Fouch,** Jan, Feb, Mar, Denver Astronomical Society; **Kevin Fowler,** Jan, Feb, Raleigh Astronomy Club; **Joe Fragola,** Jan, Feb, TAC-AL; **Jeff Francis,** Jan, Feb, Mar, Independent; **Mary Ann Francis,** Jan, Feb, Mar, Independent; **Finn Tjamo Greilich,** Jan, Feb, Independent; **Blair Groden,** Jan, Feb, Mar, Raleigh Astronomy Club; **Dave Halupowski,** Feb, Mar, Escambia Amateur Astronomers' Association; **Al Hamrick,** Jan, Feb, Mar, Raleigh Astronomy Club; **Kevin Hartnett,** Mar, Goddard Astronomy Club; **Jessica Hatfield,** Jan, Independent; **Naia Helms,** Jan, Feb, Mar, Independent; **Nowell Helms,** Jan, Feb, Mar, Independent; **Tawanna Hendrix,** Jan, Feb, Shreveport-Bossier Astronomical Society; **Milla Henrich,** Jan, Feb, Independent; **Dean F. Herring,** Jan, Feb, Mar, Raleigh Astronomy Club; **Susan Herring,** Jan, Feb, Raleigh Astronomy Club; **Cam Herringshaw,** Jan, Feb, Austin Astronomical Society; **Rick Heschmeyer,** Jan, Feb, Mar, Astronomy Associates of Lawrence; **Robert Hinton,** Feb, Independent; **Nicholas Hogan,** Jan, Independent; **Leonie Marie Honig,** Jan, Feb, Independent; **Karim Jaffer,** Jan, University Lowbrow Astronomers; **Vansh Jariwala,** Jan, Feb, Independent; **David E. Johnson,** Jan, Independent; **Steve Jones,** Jan, Independent; **Chris Kagy,** Jan, Feb, Northern Virginia Astronomy Club; **Michael Keefe,** Jan, Feb, Raleigh Astronomy Club; **Yoru Kiritani,** Jan, Independent; **Tim Klein,** Jan, Feb, Independent; **Amanda Lima,** Jan, Feb, Independent; **Doug Lively,** Jan, Feb, Mar, Raleigh Astronomy Club; **Marie Lott,** Jan, Feb, Atlanta Astronomy Club; **Cran Lucas,** Jan, Feb, Mar, Shreveport-Bossier Astronomical Society; **Edward Magowan,** Jan, Feb, Escambia Amateur Astronomers' Association; **Naveen Malik,** Jan, Feb, Raleigh Astronomy Club; **Joel F. Martin,** Jan, Feb, Independent; **Ralph McConnell,** Jan, Feb, Barnard Astronomical Society; **Scott McInnis,** Jan, Feb, Mar, NASA Langley Exchange Skywatchers; **Christopher Meneses,** Jan, Raleigh Astronomy Club; **Henry Mercik,** Jan, Feb, Independent; **Brittney Miller,** Jan, Feb, Atlanta Astronomy Club; **Jeffery S. Moorhouse,** Jan, Feb, La Crosse Area Astronomical Society; **Paul Morgan,** Jan, Feb, Mar, Umpqua Astronomers; **Angele Mott-Nickerson,** Jan, Rose City Astronomers; **Adrian Newland,** Jan, Independent; **Greg Nuber,** Jan, Member-at-Large; **Dean Ostergaard,** Jan, Feb, Southern Maine Astronomers; **Beverly Painter,** Jan, Independent; **Kirk Parnell,** Jan, Feb, Shreveport-Bossier Astronomical Society; **Jeffry Parr,** Jan, Feb, Astronomical Society of South East Texas; **John Robert Parsons,** Jan, Raleigh Astronomy Club; **Nathan Paskach,** Jan, Feb, Independent; **Aditya Pawar,** Jan, Independent; **Jacob Payne,** Jan, Cedar Amateur Astronomers; **Russell Pinizzotto,** Jan, Feb, Mar, Southern Maine Astronomers; **Jody Raney,** Jan, Feb, Mar, Shreveport-Bossier Astronomical Society; **Trevor Raney,** Jan, Feb, Member-at-Large; **Rob Ratkowski,** Jan, Feb, Mar, Haleakala Amateur Astronomers; **Nathan Raynor,** Jan, Raleigh Astronomy Club; **Rich Richins,** Jan, Astronomical Society of Las Cruces; **Greg Rigelman,** Jan, Feb, St. Louis Astronomical Society; **Lauren Rogers,** Jan, Feb, Mar, Escambia Amateur Astronomers' Association; **Rachel Ryan,** Jan, Colorado Springs Astronomical Society; **Can Sakarya,** Feb, Independent; **Maximilian Schafer,** Feb, Independent; **Miyuki Scovel,** Jan, Feb, Northwest Suburban Astronomers; **Gregory T. Shanos,** Jan, Feb, Mar, Southern Maine Astronomers; **Steven Shehade,** Jan, Independent; **Kendal Shipley,** Jan, Feb, Barnard Astronomical Society; **Jennifer Siders,** Jan, Feb, Tri-Valley Stargazers; **Michael Simmons,** Jan, Feb, Mar, Southern Maine Astronomers; **Mark Simonson,** Jan, Feb, Mar, Everett Astronomical Society; **Sean Sims,** Jan, Independent; **Henry Skirbst,** Jan, Feb, Member-at-Large; **Levin Sohn,** Jan, Feb, Independent; **Marlene Monika Stahl,** Jan, Feb, Independent; **Cassidy Statler,** Jan, Independent; **Lennard Strauch,** Feb, Independent; **Denise Terpstra,** Jan, Feb, Lifetime Member; **Catherine Trevino,** Jan, Astronomical Society of South East Texas; **Eddie Trevino,** Jan, Astronomical Society of South East Texas; **Charles Urban,** Jan, Feb, Shreveport-Bossier Astronomical Society; **Anastasia Vail,** Jan, Raleigh Astronomy Club; **Yvonne Varghese,** Jan, Raleigh Astronomy Club; **Bernard Venasse,** Jan, Feb, Lifetime Member; **Jannis Vogelsang,** Jan, Feb, Independent; **Debra Wagner,** Jan, Feb, Mar, Member-at-Large; **Nicole Walker,** January, February, Colorado Springs Astronomical Society; **David Warner,** Jan, Feb, Mar, Colorado Springs Astronomical Society; **Tom Gordon Wetz,** Jan, Feb, Independent; **Jill Wheeler,** Jan, Independent; **Richard Wheeler,** Jan, Feb, Northeast Florida Astronomical Society; **Ronan Wilson,** Jan, Independent; **Max Windolf,** Jan, Feb, Independent; **Chris Wittum,** Jan, Raleigh Astronomy Club; **Kelsey Yocum,** Jan, Rose City Astronomers; **Brad Young,** Jan, Feb, Mar, Astronomy Club of Tulsa; **Igor Zarzecki,** Jan, Feb, Mar, Independent; **Thilo Zerbe,** Jan, Feb, Independent

## NASA OBSERVING CHALLENGE SPECIAL AWARD: PARKER SOLAR PROBE #2

**Laurie Ansorge,** Lifetime Member; **Doug Balogh,** Indiana Astronomical Society; **Steve Boerner,** Member-at-Large; **Bruce P. Bookout,** Colorado Springs Astronomical Society; **Ken Boquist,** Popular Astronomy Club; **Aaron Clevenson,** North Houston Astronomy Club; **Dan Crowson,** Astronomical Society of Eastern Missouri; **Larry Dove,** Flint River Astronomy Club; **Dennis Hollatz,** Steele County Astronomical Society; **Vansh Jariwala,** Independent; **Edward Magowan,** Escambia Amateur Astronomers' Association; **Joel F. Martin,** Independent; **Russell Pinizzotto,** Southern Maine Astronomers; **Trevor Raney,** Member-at-Large; **Al Scheidler,** Popular Astronomy Club; **Gregory T. Shanos,** Southern Maine Astronomers; **Denise Terpstra,** Lifetime Member; **Dave Wood,** Astronomy Society of Eastern Missouri; **Jim Zappa,** Member-at-Large.

## ACTIVE GALACTIC NUCLEI OBSERVING PROGRAM

No. 38, **Cliff Mygatt,** Olympic Astronomical Society

## ADVANCED BINOCULAR DOUBLE STAR OBSERVING PROGRAM

No. 67, **Robert Abraham,** Shreveport-Bossier Astronomical Society

## ARP PECULIAR GALAXIES NORTHERN OBSERVING PROGRAM

No. 127-I, **Michael Goldstein,** The Albuquerque Astronomical Society

## ASTERISM OBSERVING PROGRAM

No. 83, **Aaron Clevenson,** Eyes Only and Binocular, North Houston Astronomy Club; No. 84, Binocular, **Paul Harrington,** Member-at-Large

## ASTEROID OBSERVING PROGRAM

No. 76, **Armen Akopian,** Silver, San Antonio Astronomical Association; No. 84, **Benito Loyola,** Gold, Back Bay Amateur Astronomers

## BENNETT – IMAGING OBSERVING PROGRAM

No. 1-I, **Matthew Russell,** Colorado Springs Astronomical Society

## BINOCULAR DOUBLE STAR OBSERVING PROGRAM AWARD

No. 218, **Eric Hanson,** Member-at-Large

## BINOCULAR MESSIER OBSERVING PROGRAM

No. 1273, **Brian Gugino**, Buffalo Astronomical Association

## CALDWELL OBSERVING PROGRAM

No. 301, **Brian McGuinness,** Silver, Northern Colorado Astronomical Society; No. 303, **Keith Lawrence,** Silver, Vermont Astronomical Society; No. 304, **Michael Blasé,** Silver, Olympic Astronomical Society; No. 305, **Eric Hanson,** Silver, Member-at-Large

## CARBON STAR OBSERVING PROGRAM

No. 165, **Robert Abraham,** Shreveport-Bossier Astronomical Society; No. 166, **Paul Runkle,** Chapel Hill Astronomical and Observational Society; No. 167, **Peter Natscher,** Member-at-Large; No. 168, **Alan Scott,** The Albuquerque Astronomical Society

## CITIZEN SCIENCE SPECIAL PROGRAM

**Dan Crowson,** Gold Class 7, Observational, Int'l Astro. Search Collab., Astronomical Society of Eastern Missouri; **Al Lamperti,** Gold Class 7, Active, Cosmic Disco: Characterizing Galaxy Collisions, Delaware Valley Amateur Astronomers; **Al Lamperti,** Gold Class 68, Active, Project PHAEDRA Smithsonian Trans. Ctr, Delaware Valley Amateur Astronomers; **Al Lamperti,** Gold Class 433, Active, Active Asteroids, Delaware Valley Amateur Astronomers; **Al Lamperti,** Gold Class 35, Active, SPLUS: Science Hunters, Delaware Valley Amateur Astronomers; **Al Lamperti,** Gold Class 18, Galaxy Zoo, Cloudspotting on Mars, Delaware Valley Amateur Astronomers; **Al Lamperti,** Bronze, Name That Neutrino, Delaware Valley Amateur Astronomers; **Brad Young,** Gold Class 32, Observational, EOSOP, Astronomy Club of Tulsa; **Brad Young,** Gold Class 16, Observational, Variable Stars, Astronomy Club of Tulsa

## COMET OBSERVING PROGRAM

No. 145, **Jeffrey S. Moorhouse,** Silver, La Crosse Area Astronomical Society; No. 146, **Herman Krug,** Silver, Lackawanna Astronomical Society

## CONSTELLATION HUNTER OBSERVING PROGRAM: NORTHERN

No. 320, **Tom Nelson,** Tucson Amateur Astronomy Association; No. 326, **Al Hamrick,** Raleigh Astronomy Club; No. 327, **Mark Prouty,** Olympic Astronomical Society; No. 328, **Dena Laterza,** Astronomical Society of Las Cruces; No. 329, **Gus Gomez,** Tucson Amateur Astronomy Association;

## CONSTELLATION HUNTER OBSERVING PROGRAM: SOUTHERN

No. 17, **Denise Terpstra,** Lifetime Member

## DARK SKY ADVOCATES OBSERVING PROGRAM

No. 21, **Lauren Rogers,** Escambia Amateur Astronomers' Association

## DOUBLE STAR OBSERVING PROGRAM

No. 720, **Peter Natscher,** Member-at-Large; No. 721, **Rick Ray,** North Houston Astronomy Club; No. 722, **Teresa Bippert-Plymate,** Bear Valley Springs Astronomy Club

## EXTRAGALACTIC OBJECTS OBSERVING PROGRAM

No. 5-I, **Brad Young,** Gold, Astronomy Club of Tulsa; No. 6-I, **Anthony J. Kroes,** Gold, Minnesota Astronomical Society

## FLAT GALAXY OBSERVING PROGRAM

No. 51-I, **Dean F. Herring,** Gold, Raleigh Astronomy Club

## GALILEO OBSERVING PROGRAM

Nos. 79 and 79-B, **Lauren Rogers,** Escambia Amateur Astronomers' Association; No. 62-B, **David Wickholm,** San Antonio Astronomical Association; No. 98-B, **Jason D. Wolfe,** Member-at-Large

## GLOBULAR CLUSTER OBSERVING PROGRAM AWARDS

No. 415-I, **Gregg Ruppel,** Tucson Amateur Astronomy Association; No. 416-I, **Tony Edwards,** Island County Astronomical Society; No. 417, **Edgar G. Fischer,** The Albuquerque Astronomical Society

## HERSCHEL II OBSERVING PROGRAM

No. 131, **Denise Terpstra,** Lifetime Member; No. 132-I, **Jack Fitzmier,** Madison Astronomical Society

## HYDROGEN ALPHA SOLAR OBSERVING PROGRAM

No. 88, **Carl Stanley,** Lifetime Member; No. 89-I, **Trevor Raney,** Member-at-Large; No. 90, **Greg Rigelman,** St. Louis Astronomical Society; No. 91-I, **Ken Boquist,** Popular Astronomy Society

## IMAGING-MESSIER OBSERVING PROGRAM

No. 19, **Keith Courter,** Member-at-Large; No. 20, **Michael Goldstein,** The Albuquerque Astronomical Society

## JUPITER OBSERVING PROGRAM

No. 7, **Brad Payne,** Northern Virginia Astronomy Club

## LIBRARY TELESCOPE AWARD

No. 47, **Eric Hanson,** Silver, Member-at-Large

## LOCAL GALAXY GROUP & NEIGHBORHOOD OBSERVING PROGRAM

No. 69-I, **Lauren Rogers,** Escambia Amateur Astronomers' Association

## LUNAR EVOLUTION OBSERVING PROGRAM

No. 39, **William Clarke,** Regular, Tucson Amateur Astronomy Association; No. 40, **Neil Perlin,** Regular, Member-at-Large; No. 41, **Jill Sinkwich,** Regular, Member-at-Large; No. 42-I, **Jody Raney,** Imaging, Shreveport-Bossier Astronomical Society

## LUNAR OBSERVING PROGRAM

No. 1252, **Dena Laterza,** Regular, Binocular, Eyes-Only, Astronomical Society of Las Cruces; No. 1253-I, **Tom Holman,** Imaging, Binocular, Eyes-Only, Minnesota Astronomical Society; No. 1254, **Andrew Hall,** Regular, Eyes-Only, Member-at-Large; No. 1255, **Jonathan D. Scheetz II,** Regular, Eyes-Only, Back Bay Amateur Astronomers; No. 1256, **David F. Berns,** Regular, Binocular, Eyes-Only, Champaign-Urbana Astronomical Society; No. 1257, **Joe Fazio,** Binocular, Eyes-Only, Cumberland Astronomy Club; No. 1258, **Sharife Gacel,** Regular, Binocular, Eyes-Only, Central Florida Astronomical Society; No. 1259, **Tyler Malone,** Regular, Eyes-Only, Barnard Astronomical Society: No. 1260, **Steve Boerner,** Binocular, Member-at-Large

## LUNAR II OBSERVING PROGRAM

No. 144, **Jill Sinkwich,** Member-at-Large

## MESSIER OBSERVING PROGRAM

No. 2913, **Tyler Malone,** Gold, Barnard Astronomical Society; No. 2936, **Mohammad Adnan Asif,** Gold, Raleigh Astronomy Club; No. 2938, **Scott Sudhoff,** Gold, Wabash Valley Astronomical Society; No. 2939, **Mason DuBois,** Gold, Youth Member-at-Large; No. 2940, **Dena Laterza,** Silver, Astronomical Society of Las Cruces; No. 2941, **Jeremy Howard,** Silver, Member-at-Large

## METEOR OBSERVING PROGRAM

No. 84, **Bill Hennessy,** Gold, Neville Public Museum Astronomical Society; No. 197, **Brad Payne,** Silver, Northern Virginia Astronomy Club;

## MULTIPLE STAR OBSERVING PROGRAM

No 29-I, **Rod Hughes,** Member-at-Large

## OPEN CLUSTER OBSERVING PROGRAM

No. 126, **Mary Barteau,** Gold, St. Louis Astronomy Club; No. 128, **Michael R. Martin,** Gold, Roanoke Valley Astronomical Society; No. 129, **Mike Blasé,** Gold, Olympic Astronomical Society; No. 130-I, **Armen Akopian,** Silver Imaging, San Antonio Astronomy Association; No. 131-I, **Peter Berbee,** Gold Imaging, Patron Member

## OUTREACH PROGRAM

No. 1234, **Trena Johnson,** Master, Minnesota Astronomical Society; No. 1294, **Dana R. Bostic,** Stellar, Master, Raleigh Astronomy Club; No. 1299, **Richard Benson,** Master, Rio Rancho Astronomical Society; No. 1303, **James Keebaugh,** Stellar, Master, Colorado Springs Astronomical Society; No. 1304, **Will Keebaugh,** Stellar, Master, Colorado Springs Astronomical Society; No. 1306, **David Koster,** Stellar, Colorado Springs Astronomical Society; No. 1307, **John Doryk,** Stellar, Master, Colorado Springs Astronomical Society; No. 1451, **L. John Keller II,** Stellar, The Villages Astronomy Club; No. 1584, **Blair Groden,** Stellar, Raleigh Astronomy Club; No. 1585, **Randall Gilbert,** Outreach, Stellar, The Villages Astronomy Club; No. 1593, **Laurie Averill,** Outreach, Stellar, Shoreline Astronomical Society; No. 1595, **Charles Webb,** Outreach, Fort Bend Astronomy Club; No. 1596, **Don Cooper,** Outreach, Fort Bend Astronomy Club; No. 1597, **Mike Hooper,** Outreach, Fort Bend Astronomy Club; No. 1598, **Ginny Pittendreigh,** Outreach, Stellar, Fort Bend Astronomy Club; No. 1599, **Nicole Walker,** Outreach, Colorado Springs Astronomical Society; No. 1600, **James Burnett,** Outreach, Colorado Springs Astronomical Society; No. 1601, **Liz Coehlo,** Outreach, Colorado Springs Astronomical Society; No. 1602, **Mark Hardies,** Outreach, Member-at-Large; No. 1603, **Anastasia Vail,** Outreach, Stellar, Master, Raleigh Astronomy Club; No. 1604, **Christopher Randall,** Outreach, Stellar, Master, Member-at-Large; No. 1605, **Laurie Harcum,** Outreach, Central Texas Astronomical Society; No. 1606, **James Mazur,** Outreach, Shoreline Astronomical Society; No. 1607, **William D. Laska,** Outreach, TriState Astronomers; No. 1608, **Matt Caminiti,** Outreach, River Bend Astronomy Club; No. 1609, **Bill Hennessy,** Outreach, Neville Public Museum Astronomical Society; No. 1610, **Blake Parker,** Outreach, Von Braun Astronomical Society; No. 1611, **Todd Anderson,** Outreach, Stellar, Von Braun Astronomical Society

## PLANETARY NEBULA OBSERVING PROGRAM

No. 110, **Wyatt Sanford,** Gold, Manual, Jackson Astronomical Society

## RADIO ASTRONOMY OBSERVING PROGRAM

No. 22, **W. Maynard Pittendreigh,** Gold, Lifetime Member; No. 35, **Stephen Kelly,** Silver, St. Louis Astronomical Society

## SKY PUPPY OBSERVING PROGRAM

No. 104, **Alaric Han,** Chester County Astronomical Society; No. 105, **Case Jones,** Independent; No. 106, **Ashton Daniels,** Independent

## SOLAR NEIGHBORHOOD OBSERVING PROGRAM

No. 14, **Viola Sanchez,** Telescope, The Albuquerque Astronomical Society; No. 18-I, **Robert Togni,** Telescope, Central Arkansas Astronomical Society; No. 31, **Lauren Rogers,** Binocular, Escambia Amateur Astronomers' Association; No. 34, **Bernard Vanesse,** Eyes-only, Lifetime Member; No. 35, **Jason Wolfe,** Binocular, Member-at-Large; No. 36, **Robert Abraham,** Binocular, Shreveport-Bossier Astronomical Society

## SOLAR SYSTEM OBSERVING PROGRAM

No. 235, **Paul Harrington,** Eyes-Only, Member-at-Large; No. 236, **David Wickholm,** Binocular, San Antonio Astronomical Association; No. 237, **Clariza Kern,** Regular, Binocular, Eyes-Only, Pontchartrain Astronomy Society; No. 238-I, **Tom Holman,** Imaging, Eyes-Only, Minnesota Astronomical Society; No. 239, **Anthony J. Kroes,** Binocular, Eyes-Only, Minnesota Astronomical Society; No. 240, **Andrew Wolfe,** Regular, Member-at-Large, No. 241-I, **Anthony J. Kroes,** Imaging, Minnesota Astronomical Society; No. 242, **Carl Stanley,** Regular, Lifetime Member; No. 243, **Jill Sinkwich,** Regular, Binocular, Eyes Only, Member-at-Large; No. 244, **John Jezak,** Regular, Astronomical Society of Kansas City; No. 245, **Lauren Rogers,** Binocular, Escambia Amateur Astronomers' Association; No. 246, **Teresa Bippert-Plymate,** Regular, Bear Valley Springs Astronomy Club

## SPACE WEATHER OBSERVING PROGRAM

No. 7, **David Whalen,** Atlanta Astronomy Club; No. 8, **Debra Wagner,** Member-at-Large; No. 9, **Jim Barbasso,** North Houston Astronomy Club

## SUNSPOTTER OBSERVING PROGRAM

No. 257-I, **Ken Boquist,** Popular Astronomy Club

## TARGET NEOS! OBSERVING PROGRAM

No. 34, **Brad Payne,** Intermediate, Northern Virginia Astronomy Club

## TWO IN THE VIEW OBSERVING PROGRAM

No. 69-I, **Kenneth Boquist,** Gold, Popular Astronomy Club; No. 70-I, **Mark Croom,** Gold, Lifetime Member; No. 71, **Lauren Rogers,** Gold, Escambia Amateur Astronomers' Association

## URBAN OBSERVING PROGRAM

No. 248, **Douglas L. Smith,** Tucson Amateur Astronomy Association: No. 249, **John Zimitsch,** Minnesota Astronomical Society

## VARIABLE STAR OBSERVING PROGRAM

No. 64-I, **Matthew Russell,** Colorado Springs Astronomical Society; No. 65, **Gerard Jones,** Minnesota Astronomical Society; No. 66, **Jack Fitzmier,** Madison Astronomical Society; No. 67, **Dean F. Herring,** Raleigh Astronomy Club

# MASTER OBSERVER PROGRESSION

## OBSERVER AWARD

**James D. Anderson,** Astronomical Society of Kansas; **Al Hamrick,** Raleigh Astronomy Club

## BINOCULAR MASTER AWARD

**Dave Wickholm,** San Antonio Astronomical Association

## MASTER OBSERVER AWARD

No. 271, **Larry M. Elsom,** Member-at-Large

## MASTER OBSERVER AWARD – SILVER

**Scott Cadwallader,** Baton Rouge Astronomical Society

## MASTER OBSERVER AWARD – GOLD

**Denise Terpstra,** Lifetime Member

## MASTER OBSERVER AWARD – PLATINUM

**Eric Edwards,** Lifetime Member; **W. Maynard Pittendreigh,** Lifetime Member

## MASTER OBSERVER – TRIPLE-CROWN AWARD

**W. Maynard Pittendreigh,** Lifetime Member

# Gallery

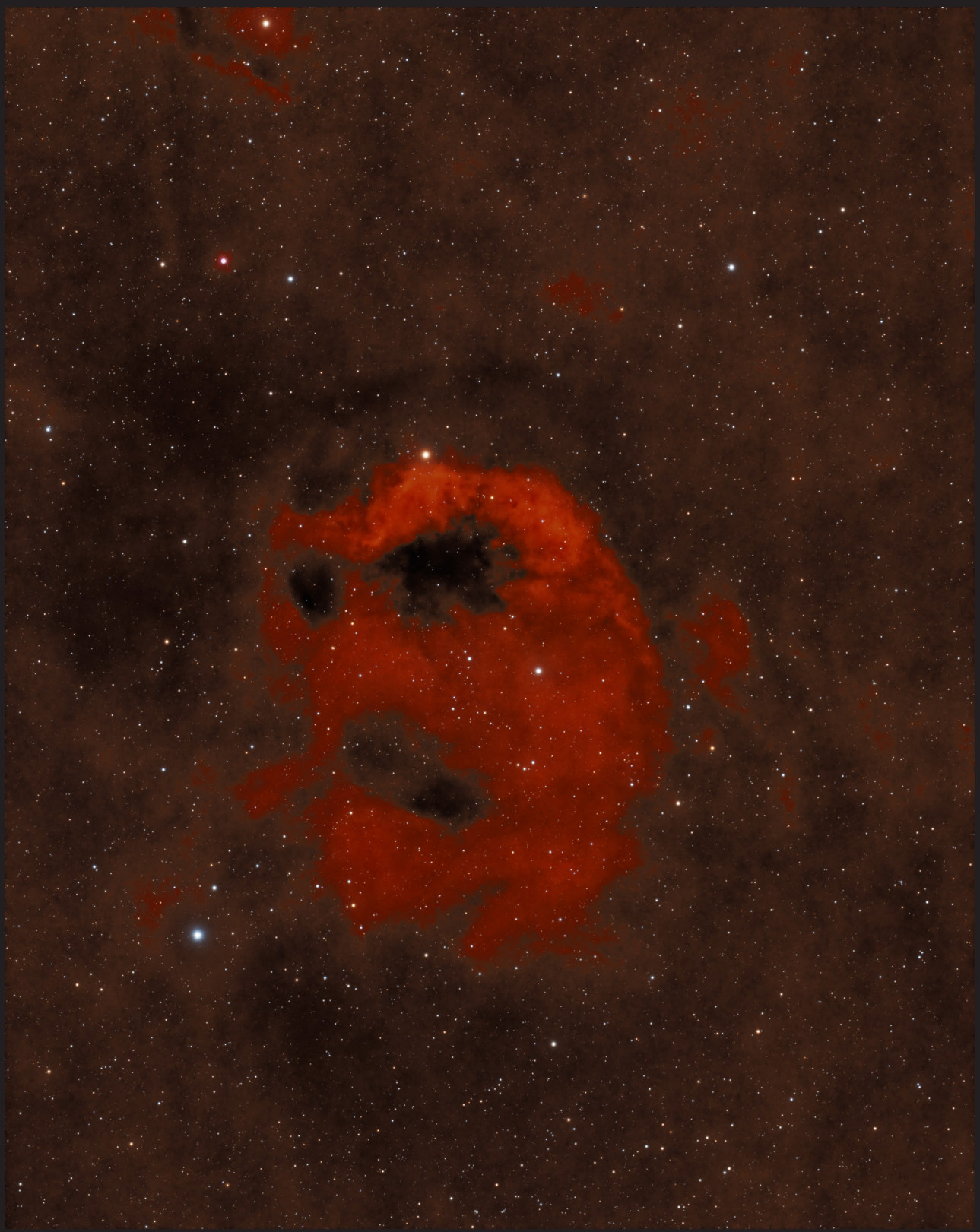

Images are processed by *Reflector* staff for better contrast and tonal range on the printed page.

Bernard Miller (East Valley Astronomy Club) captured this image of NGC 1788 in Orion with a PlaneWave 17-inch CDK with and a FLI 16803 CCD camera from his observatory in Animas, New Mexico.

Bernard Miller (East Valley Astronomy Club) captured this image of NGC 1931 in Auriga with a PlaneWave 17-inch CDK with and a FLI 16803 CCD camera from his observatory in Animas, New Mexico.

# Gallery





John Richards (Middle Georgia Astronomical Society) captured this image of Sharpless 173 – the Phantom of the Opera Mask – using a ZWO FF107 APO Refractor with a ZWO ASI 294MC Pro camera from his observatory in Warner Robins, Georgia.


Mark Christensen (Northwest Suburban Astronomers) captured this image of the Moon and Mars on January 13, 2025. Mark used a 12-inch Meade LX200 with a ZWO ASI2600MC camera.

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