Published by the Astronomical League
Vol. 77, No. 1 DECEMBER 2024

Reflector

A FLYING SAUCER IN CETUS

ALCON 2024

SEEING IN THE DARK (NEBULAE)

STUDYING THE SUN

HOW THE BINOCULAR CAME TO BE

SUPERNOVA REMNANT 1006

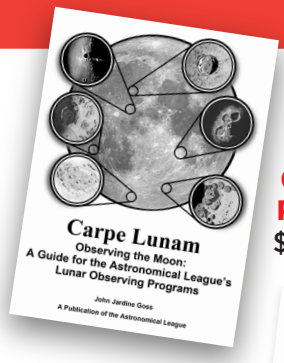
...A *STAR TREK* MEETING

GALAXY CLUSTERS

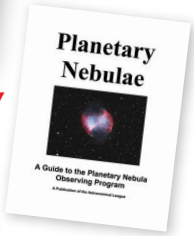
...AND MORE

SHOP OUR STORE

FOR WIDE VARIETY OF CLOTHING, BOOKS, HATS, & MORE—FAR TOO MUCH TO SHOW IN THIS AD!



NEW MANUAL! SUPPORTS ALL AL LUNAR OBSERVING PROGRAMS!
$20 PLUS $7 S&H



PLANETARY NEBULAE
$19 PLUS $6 S&H

ASTRONOMICAL LEAGUE VISUAL ASTRONOMICAL OBSERVING JOURNAL
$16 PLUS $6 S&H

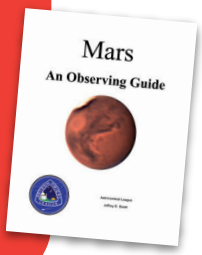
ASTRONOMICAL LEAGUE ASTRONOMICAL IMAGING JOURNAL
$16 PLUS $6 S&H

ASTRONOMICAL LEAGUE BASEBALL HAT
EMBROIDERED LOGO, ADJUSTABLE; ROYAL BLUE, MAROON, KHAKI, NAVY; $18 PLUS $5 S&H

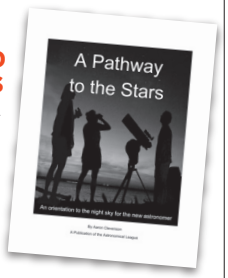
ASTRONOMICAL LEAGUE SPORTSMAN'S BUCKET HAT
EMBROIDERED LOGO, S/M OR L/XL; KHAKI ONLY
$22 PLUS $5 S&H

ASTRONOMICAL LEAGUE LAPEL PIN
(ONE-INCH DIAMETER)
$6 PLUS $3 S&H

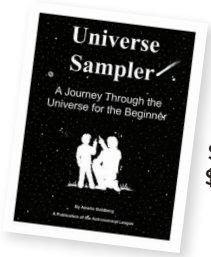
ASTRONOMICAL LEAGUE WINTER KNIT CAP
NAVY/GRAY, PURPLE, BLACK, MAROON, ROYAL BLUE, GRAY, DARK GREEN; $20 PLUS $5 S&H



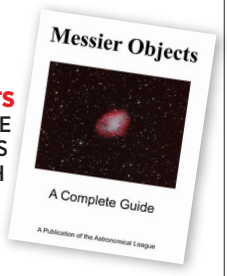
MARS – AN OBSERVING GUIDE
A SYSTEMATIC PROGRAM STUDY OF THE RED PLANET.
$20 PLUS $7 S&H



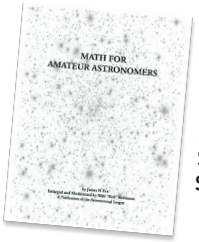
A PATHWAY TO THE STARS
THIS MANUAL IS A GREAT INTRODUCTION TO ASTRONOMY FOR THE NEW ASTRONOMER.
$10 PLUS $4 S&H



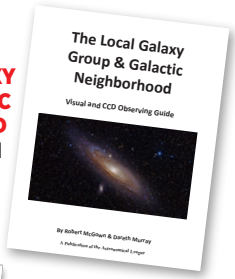
UNIVERSE SAMPLER
A JOURNEY THROUGH THE UNIVERSE FOR THE BEGINNER
$14 PLUS
$5 S&H



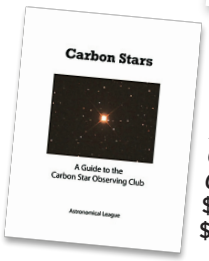
MESSIER OBJECTS
A COMPLETE GUIDE
$16 PLUS
$6 S&H



MATH FOR AMATEUR ASTRONOMERS
$15 PLUS
$5 S&H

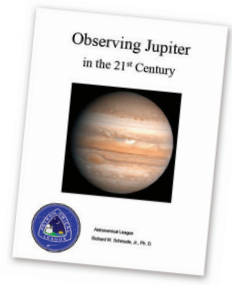


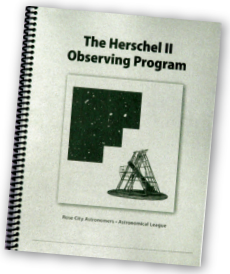
THE LOCAL GALAXY GROUP & GALACTIC NEIGHBORHOOD
$23 PLUS $8 S&H



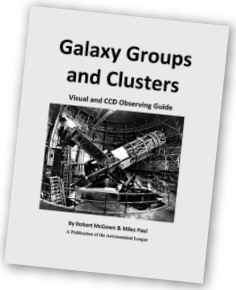
CARBON STARS
A GUIDE TO THE CARBON STAR OBSERVING CLUB
$12 PLUS
$4 S&H

OBSERVING JUPITER IN THE 21ST CENTURY
$14 PLUS $5 S&H

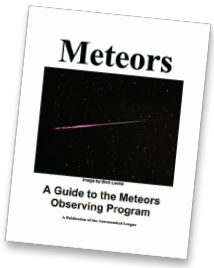




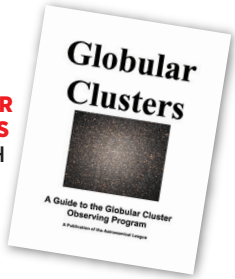
THE HERSCHEL II OBSERVING PROGRAM
$18, PLUS $7 S&H



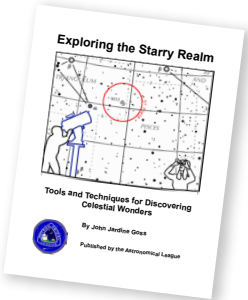
GALAXY GROUPS AND CLUSTERS
$20 PLUS $7 S&H



METEORS—
A GUIDE TO THE METEORS OBSERVING
PROGRAM
$12 PLUS $5 S&H



GLOBULAR CLUSTERS
$16 PLUS $5 S&H



EXPLORING THE STARRY REALM
TOOLS AND TECHNIQUES FOR DISCOVERING CELESTIAL WONDERS
$14 PLUS $5 S&H

HERSCHEL 400
NOW REVISED AND EXPANDED
$16 PLUS $6 S&H

ASTRONOMICAL LEAGUE CLOTH PATCH
(3" DIAMETER) FULL COLOR
$7 PLUS $1.50 S&H
BLUE & WHITE
$6 PLUS $1.50 S&H

SECURE ONLINE ORDERING FROM
STORE.ASTROLEAGUE.ORG

Or order by mail at Astronomical League Sales,
9201 Ward Parkway, Suite 100, Kansas City, MO 64114.
Enclose check for price and S+H charges as shown.

Contents

PAGE 10

Binocular
Opera Glass

NOTICE

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

John Noble *(Oakland Astronomy Club) captured this nine-panel mosaic image of Orion using a ZWO ASI2600MC Pro camera with a 135 mm lens at f/2.8 on top of a ZWO AM5 mount..*

Reflector

The Astronomical League Magazine

Vol. 77, No. 1 • ISSN: 0034-2963 • DECEMBER 2024

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

Issued by the Astronomical League in March, June, September, and December, *Reflector* (ISSN: 0034-2963) is sent directly, either by postal mail or via a digital link, to each individual member of its affiliate societies and to members-at-large as a benefit of League membership. Individual copies of *Reflector* are available at the following subscription rates, payable to the League's national office.

PAPER SUBSCRIPTIONS:

USA & possessions: $3.00 each or $10.00 per year (4 issues)
Canada: $5.00 each or $16.00 per year
Mexico: $6.00 each or $22.00 per year
Other countries: $7.00 each or $25.00 per year

DIGITAL SUBSCRIPTIONS:

All countries, possessions, and territories: $10.00 per year

***REFLECTOR* AND CLUB ROSTER DEADLINES**

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

LETTERS TO THE EDITOR

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

Errata

In the September 2024 issue, on page 23 the images are reversed from the descriptions on page 22. The bottom photo is the Flying Dragons. The top photo is the Flaming Star.

President's Column

From Your League President

I'd like to share some remarks that I made at the banquet in Kansas City. Carroll Iorg has served an unprecedented eight years as League president plus six years as vice president. During his recent tenure, he guided the League through COVID, approved a virtual convention in 2021, supervised an intensely difficult website transition from Drupal to WordPress, saw our membership soar from 18,000 to 24,000, and represented the League at NEAF, at regional conventions, and at scores of Global Star Parties and League Live events. The League presidency requires patience, dedication, and collegiality, and Carroll brought all three to the job. Thank you, Carroll, for a job extremely well done, and thank you, Betty, for sharing Carroll with us so generously.

John Martin and Aaron Clevenson are working diligently to fix bugs on our website so we can repopulate our club listings. We know how important the club listings are to you, but the task is challenging because of the WordPress structure we were given. Please bear with us.

We need active and current participation in our organization's leadership. To that end, I need to ask all regions that have not held elections in the last three years to please conduct them in 2025, by email or at a meeting or convention, or ask for League assistance in conducting them.

The League derives enormous benefit from its trust fund. Earnings on the trust fund help us fund awards and projects and keep dues low. Providing for your loved ones comes first, of course, but please consider leaving something to the League the next time you review your will. Bequests should be made to Astronomical League, Inc.

In 2025, the League will conduct imaging competitions with beautiful Olympic-style medals at AstroCon '25, at the NCRAL and MSRAL conventions, and at a GLRAL event. Register and bring your prints or sketches! And register for AstroCon '25 at Bryce Canyon soon! Our 275-room block at Ruby's Inn is going very fast. Lowell Lyon has chaired or co-chaired conventions four times, so he knows how to put together a great event! Over 400 attended our meeting at Bryce in 2011. You'll enjoy a spectacular national park, Bortle 1 skies, a banquet, a country and western show, vendors, and workshops entirely dedicated to astrophotography and visual observing. And if one of our Horkheimer/Parker Award winners is recognized for a photo taken near the Rio Grande, I promise not to call it Big Bang National Park again!

—Chuck Allen, President

Night Sky Network

Tips for Growing Your Club

As we enter 2025, the Night Sky Network would like to offer some tips to help keep your club healthy in the new year.

Engaging Your Community

Amateur astronomy clubs are no strangers to hosting events and star parties at schools, libraries, and community centers. Partnering with schools to establish a "junior astronomers" program can be a great way to educate the K–12 population. While inviting the families of students to join your club, you may also want to extend free membership to teachers, allowing them to have access to resources for their classrooms. You

can learn more about engaging younger audiences through our Confidence & Curiosity series: *go.nasa.gov/3GDseZz*

You can also encourage growth by hosting classes such as Astronomy 101, Astrophotography 101, and other topics. Classes can be a great way to educate the public in person and online. Finally, boost your club's visibility by hosting impromptu star parties in locations that might not expect it, such as places of worship, town halls, or establishments that may host game/trivia nights, live music, etc.

Like and Subscribe

Having an active social media presence can be a huge boost to any organization. By sharing event details (before and after) online and using creative hashtags, you encourage engagement by making it easy for others in your town to follow astronomy events you may host. For any online activity, we recommend using alt text for image accessibility. Alt text allows people with screen readers to hear a description of your image. Additionally, be sure to capitalize each word in a hashtag, so that tags are read aloud correctly by a screen reader. Example: #NightSkyNetwork

Having a strong social media presence can lead to younger audiences joining and sharing your club's activities with their networks, and, potentially, more volunteerism. Also, newer membership can offer new perspectives that help broaden your inclusivity, ensuring events are open to as many audiences as possible.

Leadership Turnover

As always, it is recommended that clubs have established policies and procedures in place allowing for a smooth transition of leadership. Having term limits in place can prevent burnout and ensure that new ideas and perspectives are introduced to the membership at large. This can be done with regular elections every two to three years, which can also double as social gatherings for your club.

Mentorship is also encouraged – if you have a new member, you want them to feel welcome. Be sure to introduce yourself and members of your club. Ask them what drew them to your organization and invite them to participate in the next outreach event you host. From there, you can build them up to serve in future leadership positions.

By implementing these strategies, astronomy clubs and the communities they serve can thrive, fostering a sense of belonging and purpose, and extending the life of your club for decades to come. For more information, check out our Growing Your Astronomy Club resource: *bit.ly/growingyourclub*.

—Kat Troche

DarkSky Corner

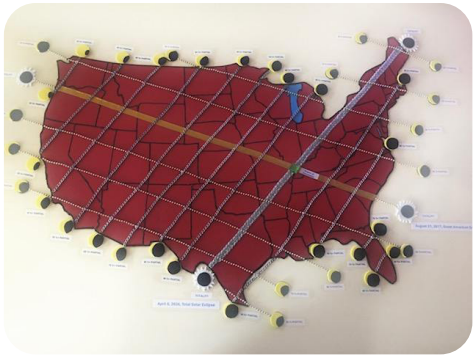
A guiding light in the fight against light pollution has left us. David Crawford, co-founder and long-time director of IDA (now DarkSky International) passed away this summer. I wrote a tribute to him, which is posted on the DSI website: *darksky.org/news/remembering-dave-crawford-founder-of-darksky-international*. I personally consider Dave to be one of the greatest environmentalists of the late 20th and early 21st centuries, and I hope you'll take a moment to read about Dave's role in the birth of the DarkSky movement.

—Tim Hunter

Full STEAM Ahead

TACTILE GREAT AMERICAN ECLIPSES, Part 2

In the last issue I described how I came to make tactile eclipse resources for the Oklahoma School for the Blind in Muskogee. Here I share the details of my resources. One was a 3-foot by 4-foot panel with the August 2017 and April 2024 total eclipses combined. The map was traced via a projector on red matboard, with state lines accentuated with glue lines.



To differentiate the two pathways, the materials used needed to be diverse to the touch to aid legally blind individuals. For the 2017 path of totality I decided on a thick gold braid ribbon; the partiality lines above and below were marked with a gold metallic beaded string. Care was taken to pass through the states as shown on the diagram, but clearly, the lines are not that straight. Moving them a little bit accommodated the foam core icons at the ends.

The 2024 eclipse path ran more north and south; I used a thicker silver metallic braid for the path of totality and a silver chain for partiality. A rhinestone the size of a small button was glued at the intersection of the two paths at Carbondale, Illinois.

Eighteen 2017 pathways (less two for totality) were smooth yellow circles cut and glued on top of the black glitter foam core and at the end of gold beads. On the 2024 pathways, two were totality icons, and the remaining forty-one were the black glitter pieces glued on top of the smooth yellow circles at both ends of the silver chains. Also at the icons were small labels listing the percentage of totality.

A typed narrative described the two different totality pathways; the teaching staff at OSFTB immediately translated this into a Braille booklet for the students to read and become familiar with so they could discuss the panel at the eclipse party.

This panel was on a table at the Fite Mansion eclipse watch party on April 8 in Muskogee. The School for the Blind students and administration shared this with the other attendees from local schools, parents, and civic and school leaders.

When these were dropped off at the beginning of March, they were invited to use these resources at the school if they were interested. It was also made clear that if they were going to be put in a basement and not used, that I would take them home for storage. The teachers asked if they could be on loan with their library, and I added that I had many other resources I made that I would bring to display in their library. That part of the project is currently in the works, as I need to write narratives for each of the items and connect them as a curriculum. I hope to deliver it soon.

Both Charles and I received thank you cards, some even in Braille. The icing on the cake was when the Oklahoma School for the Blind printed their yearbooks; a question asked the students, "What was your favorite thing that happened this year?" The response was "the eclipse watch party at the Fite Mansion."

Full STEAM ahead to the next celestial event.

.

—Peggy Walker,
AL STEAM and Jr. Activities Coordinatorr

Deep-Sky Objects

A Flying Saucer in Cetus

The constellation Cetus contains many galaxies found in the New General Catalog (NGC) of deep-space objects. Only one of these galaxies was bright enough to be catalogued by Charles Messier. This is M77, which I wrote about in this column last December. Another great galaxy to spy in Cetus is NGC 1055.

NGC 1055 can be found 2.8° south and slightly west of the star Gamma Ceti. Gamma Ceti is located 5° west of the bright star Menkar. Menkar is one magnitude brighter than Gamma Ceti. NGC

1055 is only a half a degree north and slightly west of M77. So both galaxies can be seen in the eyepiece at the same time.

NGC 1055 shines at magnitude 11.4 and has an apparent size of 7.6 × 2.7 arcminutes. M77 is slightly larger and 10 times (2.5 magnitudes) brighter than NGC 1055. An 8-inch telescope will capture both, but larger light buckets provide better views of NGC 1055.

William Herschel discovered NGC 1055 on December 19, 1783. The galaxy is classified as a barred spiral galaxy and is estimated to be 52 million light-years away. It is part of a small galaxy group with M77, NGC 1073, and a few smaller, fainter irregular galaxies.

My image of NGC 1055 was taken with a 10-inch f/6 Newtonian using a Paracorr Type 2 coma corrector and a SBIG ST-2000XCM CCD camera. The total exposure time was 210 minutes. In the image north is up and east to the left. The galaxy is seen nearly edge-on and has a relatively bright galactic core. An extremely large dust lane obscures the northern half of the galactic bulge. To me the galaxy looks like a flying saucer.

The spiral arms can be seen south of the dust lane. Although not apparent in my image, photos of the galaxy taken through large observatory telescopes do reveal the galaxy's central bar. The galaxy has strong emissions in infrared and radio wavelengths indicating large regions of star formation are present.

There are several bright stars around NGC 1055, which aid in locating the galaxy through a telescope. The brightest star in the image is spectral class K0 shining at magnitude 6.68. To the left of it is a pair of stars, one blue-white and the other orange. The brightest of the pair is spectral class F0, magnitude 7.57, and the dimmer is another K0 star shining at magnitude 9.93. See if you can spot the magnitude 11.1 star located on the northwest side of the galactic bulge above the dust lane. All of the stars in this image are in the Milky Way galaxy along the line of sight to NGC 1055.

NGC 1055 transits around 7:30 p.m. in mid-January. So this winter there is plenty of time to hunt galaxies in the Whale after astronomical twilight ends.

—Dr. James R. Dire

References

NASA. "Nebula NGC 7129." *Spitzer Space Telescope*, *www.spitzer.caltech.edu/download/MediaFile/612/binary/original*.

Straižys, V. et al. 2014, *MNRAS* 437, 1628

Stars and All That Jazz ALCon 2024

By most accounts, ALCon 2024, "Stars and All That Jazz," was a success. Hosted by the Astronomical Society of Kansas City (ASKC) – celebrating its 100th anniversary this year – the event was held at the DoubleTree by Hilton Hotel in Overland Park, Kansas. The conference theme was Kansas City Jazz.

Opening remarks by Overland Park Mayor Curt Skoog and Astronomical League President Carroll Iorg kicked off ALCon 2024.

The conference featured a full slate of 18 guest speakers, including:

- David Levy, comet hunter and author
- Scott Harrington, author and contributing editor, Sky & Telescope
- Lou Mayo, NASA planetary scientist
- Garrett Parkins, fluids design engineer, NASA Artemis program
- Tim Russ, amateur astronomer and movie actor

Topics included something for everyone: the latest from the James Webb telescope, eclipses, measuring properties of exoplanets, stellar lifecycles, historical images from the Moon, a history of McDonald Observatory, observing with binoculars, materials for amateur telescopes, the Artemis program, live stacking imaging at Powell Observatory, beginning visual astronomy, exploring space with ham radio, solar observing, and a history of the Voyager missions.

An astrophotography contest was held and organized by League Vice President Chuck Allen. Many fine images in a variety of categories were displayed, and awards for the best of each category were selected by a vote of conference attendees.

Several off-site events filled our evenings. First was a special presentation at the Arvin Gottlieb Planetarium at Kansas City's spectacular Union Station and Science City. ASKC has a long history of supporting the planetarium with donations of time and talent to upgrade the facility and projection systems. Guests can discover and explore not only within the planetarium, but also from the comfort of their own home on a weekly Facebook live stream that ties in current astronomical events. A special program demonstrating the planetarium's latest capabilities was generously provided by planetarium staff for conference attendees.

The next night featured a trip to Linda Hall Library, one of the world's leading science, engineering, and technology libraries. Linda Hall has extensive holdings in astronomy and associated topics. A quick search of the online catalog lists over 5,500 entries with astronomy-related subject headings, including over 1,000 non-proceedings titles, over 1,000 conference proceedings, and over 400 astronomical journals.
The library's rare book room is home to noted items on astronomy, including:

- The observation logs and journals of noted astronomer David Levy (Donated, 2015)
- Claudius Ptolemy's Almagest (1515)

and Giovanni Riccioli's New Almagest (Almagestum Novum, 1651)
- Learned: Tico Brahæ, His Astronomicall Coniectur of the New and Much Admired [Star] Which Appeared in the Year 1572 (1632)
- Harmonia Macrocosmica (1661), the seventh in a series of atlases published by geographer/cosmographer Gerard Mercator and Johannes Janssonius
- Francis Godwin's L'homme dans la Lune (Man in the Moone, 1666), considered one of the first works of science fiction
- All three versions of Galileo's seminal work, Sidereus Nuncius (1610), with Galileo's own handwritten notes. Linda Hall is the only library in the world with original copies of all three of these works.
- Numerous beautiful historical celestial atlases

The library event featured a special lecture by famed comet discoverer Dr. David Levy. Dr. Levy also presented samples of his own observing logs and his first telescope, all of which are housed at the library. Special thanks to Dr. Levy and the library staff for their generosity in hosting this amazing evening.

The final off-site event included a Star-B-Que dinner of Kansas City style bar-b-que at the Overland Park Arboretum. We were able to wander the beautiful arboretum and gardens before sitting down to a delicious dinner and special celebration of the 30th anniversary of Dr. Levy's discovery of Comet Shoemaker–Levy 9, the comet which broke apart and collided with Jupiter in 1994. The evening finished with a trip to ASKC's own Powell Observatory, where ASKC member and University of Kansas graduate student in astronomy, Rachel Cionotti, presented a program on dark energy and dark matter, which was followed by an evening of stargazing with a variety of telescopes, including the Ruisinger 30-inch reflector.

Several Astronomical League events were mixed in, including a general council meeting, president's panel, youth awards, Observing Awards committee meeting, and the closing evening awards ceremony.

The conference concluded Saturday evening with the traditional banquet at the hotel with a live jazz band performing Kansas City–style jazz, and a keynote talk by Brown University professor of astronomy and physics, jazz musician, and author, Dr. Stephon Alexander. Dr. Alexander is author of the popular book *The Jazz of Physics*. Before his presentation, Dr. Alexander accompanied the band on his saxophone for several numbers. Dr. Alexander's talk was followed by the Astronomical League awards ceremony.

Astronomical League Award winners included:
- Astrophotography Awards
- Betty Iorg: longest serving "first lady"
- Julian Shapiro: National Young Astronomer Award – 2nd place
- Laurie Ansorge: Astronomy Day Award
- Astronomical League Master Observer Awards
- Mitch Glaze: Astronomical League longtime contributor
- Stephon Alexander: keynote speaker
- Carroll Iorg: AL Live support
- Alan Lehman: Presidential Award for Lead Chair

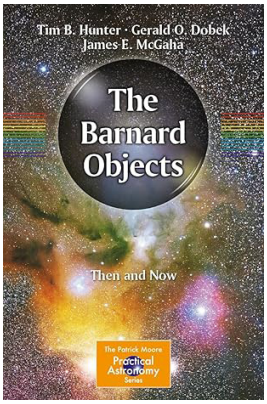
The ceremony celebrated Carroll's eight years as president and handed off the presidency to the current vice president, Chuck Allen.

Special thanks to the conference sponsors: AAVSO, DayStar Filters, Mile High Astronomy, Prime Capital, and the Astronomical Society of Kansas City.

—Alan Lehman, Lead Chair for ALCon 2024

Seeing in the Dark (Nebulae): A Book Review

The Barnard Objects, by Tim B. Hunter, Gerald O. Dobek, and James E. McGaha. The Patrick Moore Practical Astronomy Series. Springer. 2023.



As the Foreword sagely notes, it is difficult for anyone interested in astronomy to avoid hearing the name "Barnard," whether in the high proper motion Barnard's Star or the majestic Barnard's Loop in Orion, or as the discoverer of Amalthea, the first Jovian moon to be found post-Galileo, and fifteen comets. Barnard's pioneering contributions to astrophotography are likewise noteworthy. This book focuses on Barnard's seminal work, a catalogue of dark nebulae, one focus of his work at Yerkes, and its connection to his major life's project, *A Photographic Atlas of Selected Regions of the Milky Way*, completed after his death by Edwin Frost, director of Yerkes Observatory, and Mary Calvert, his niece and assistant. Barnard's life is fascinating in its own regard, as documented in William Sheehan's *The Immortal Fire Within* (1995). The Barnard Objects can be seen as a companion volume to that biography, and Sheehan's lengthy and detailed foreword in this volume (sharing highlights of Barnard's life) drives home that connection.

Asteroid and comet observer James McGaha brings his writing experience as contributor to *Skeptical Inquirer* magazine to the project, alongside professional astronomer Gerald Dobek, author of a 2011 annotated and updated edition of Barnard's *A Photographic Atlas of Selected Regions of the Milky Way*. The triumvirate is rounded out by Tim Hunter, perhaps best known in *Reflector* circles for his co-founding of the International Dark-Sky Association, who highlights his skill in chasing the light; in this case, his astrophotography fits seamlessly alongside Barnard's historical images. The similarities drive home the main message of this work as one of respect and love, both for Barnard and dark nebulae's role in understanding galactic structure.

Perhaps unavoidably, the book reads a bit fragmented at times, being penned by three different authors and covering topics as disparate as visual and photographic imaging, cataloging, astronomical history, and the physical characteristics of nebulae. The central focus is certainly the dark nebulae catalogue, "Barnard's Objects." As in the case of Messier's catalogue, there are "missing" objects, possibly duplicated objects, and suggestions of alternate objects. Barnard's original list (1919) included 182 dark nebulae (some notated with an additional letter, such as 44 and 44a), but the extended collection in the Atlas is numbered 1–370. Interestingly, there are no objects with numbers 176–200. As described in chapter eight, in his 2011 annotation and update of the Atlas Dobek included likely objects for this gap, based on Barnard's notations on certain plates. This sleuthing is a testament to the authors' deep knowledge of the source material and understanding of Barnard's methodology. Finder charts and photographs for these proposed objects are included in the chapter. While these additions are to be lauded, greater care should have been taken to distinguish between these objects and the incontrovertible Barnard Objects in the table at the end of the book.

Taken in total, this work will certainly interest those fascinated with observing lists of astronomical objects or the history of astrophotography. Those interested in the history of astronomy or photography more broadly will also find nuggets to keep their attention.

—Kris Larsen

Studying the Sun: A Personal Perspective

by Milena Niemczyk

Relatively few people know that with modest equipment we can study the activity of our star from our backyard. Importantly, our observations can go into worldwide databases. Here I explain how to do this, using my own observations as an example.

First of all, we need a telescope. It doesn't have to be huge; in my case it is a Skywatcher 90/900 refractor on an AZ3 mount. In addition, I use a 20 mm eyepiece, and if I want to look at active areas more closely, I use a 10 mm eyepiece. I do not use this telescope just for observing the Sun, but also for standard observations of the night sky, deep-sky objects, planets, the Moon, etc. But to safely observe the Sun through the telescope, you need a solar filter.

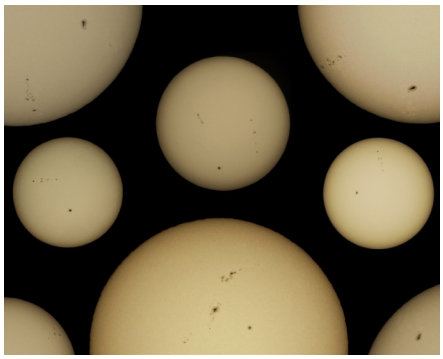
I use ND5 solar film, designed exclusively for visual observation. It is placed it in front of the telescope aperture and blocks 99.99% of sunlight from entering. Pieces of such film are sold in astronomy stores. A single sheet of this film needs to be placed in a cardboard frame, which you then fit to your telescope, as shown here: *www.youtube.com/shorts/r0HfyCcQlZs*.

After we have the telescope and filter ready, we are ready to observe. I start by checking the weather forecast. If I see the Sun breaking through, I start preparing. I check my filter to make sure it is intact and then carefully place it on the telescope. At this point, I also cover the finderscope tightly so that I don't accidentally look through it (since it does not have a filter on it). I know that some observers remove the finder on their solar telescope, but since I use this telescope for night observing as well, I make sure to cover the finder tightly when I am looking at the Sun.

After collecting my logbook, I check the filter one last time, making sure there are no creases or other damage, and set up the telescope on my balcony. To find the Sun, I search for the shortest shadow the telescope gives. Then I am fairly sure that when I look into the eyepiece, the Sun's disk will appear, or at the very least I will be in its vicinity. I position the Sun in the center of the field of view and adjust the focus. Depending on the state of activity for the day, there will be some number of sunspot groups. Different solar observing sections accept different kinds of data, so I prepare to make several different types of observations.

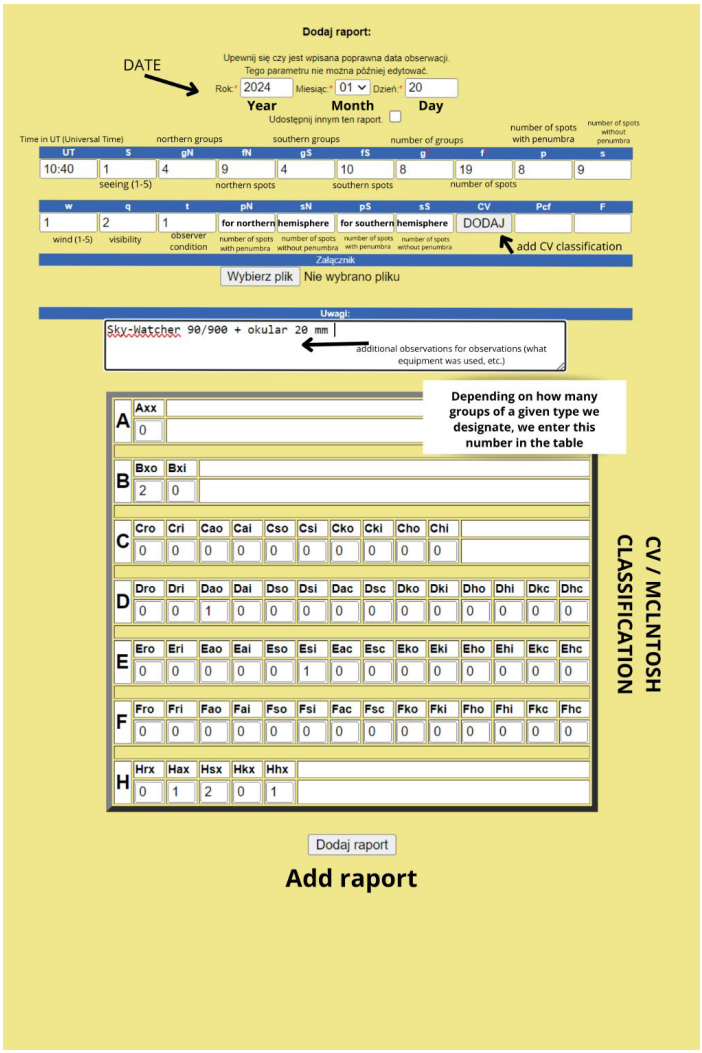
I start my observations by determining the number of sunspot groups and counting the individual spots. With this, we will already have a way to determine solar activity – the Wolf number (R). We multiply the number of groups times 10 and add to this the total number of spots: $R = 10 \times g + s$ (where g = groups, s = spots).

Then I analyze the spots and determine those that have a penumbra and those that do not. I multiply the number of spots with a penumbra times 10 and add to this the number of spots without a penumbra. From this we have a different determinant of solar activity. At this point, I also often determine the number of north and south groups and spots.



Later, I start analyzing another determinant, CV (classification values), which is based on the McIntosh classification. In this system we analyze the structure, type, and neighborhood of the group. The first letter of the notation of each group indicates its size and length, compactness (letters A–H); the second letter determines the penumbra in a given group, how many there are and whether there are any, and if so, what kind (letters x–k); the third letter determines the neighborhood of that group (letters x–c). When each group is given its letter value, its numerical value is established – from 1 to 60. In my notes, I determine the letter notation of the groups; only after the observations are finished do I determine the numerical notation from each group, which I then add together and the final CV value comes out. You can read more about this classification at *www.cv-helios.net*.

I end by noting the wind, seeing, and other conditions, carefully put away my telescope, and sit down at the computer to send my results to four different solar observing sections.



Additionally, I often take simple photographs of the Sun. I take my Nikon COOLPIX B700 camera, a tripod, and a piece of solar foil (placed in front of the lens, exactly the same as the telescope). On the previous page is some of my work.

Since many Reflector readers are familiar with the AAVSO Solar Observing Section (*www.aavso.org/solar*), I wanted to highlight the Polish solar section, SOS PTMA (*sos.poa.com.pl*). This organization collects data of all the types as shown above.

Wherever you submit your solar observations, I hope you will enjoy looking at the Sun as much as I do – just make sure you do it safely.

Editor's note: Milena is a young teenager from Poland. The *Reflector* encourages young observers to share their experiences with our readers. For more information on safe solar observing, please see *www.aavso.org/solar-observing-guide*.

GLRAL AT HIDDEN HOLLOW

On September 27-28, Terry Mann and Chuck Allen ran a Great Lakes Region astrophoto competition at the 2024 Hidden Hollow Star Party, hosted by the Richland Astronomical Society. Engraved medals were presented to winners in five categories. A regional meeting and elections were also conducted with Deloris Mlay elected regional representative, Mike Mlay elected regional vice chair, and Rich Kraling elected regional secretary. Chuck also displayed a remarkable collection of 100 chemical elements at the two-day event.

Astrophoto winners (l to r): Jason Wallace (2nd Deep Sky, 3rd Solar System), Alex McCarthy (2nd Solar System, 2nd Rich Field), Kim Balliett (1st Art and Sketching), Bob Rossiter (1st Deep Sky, 1st Solar System, 1st Rich Field, Best in Show), and Phil Hoyle (1st Wide Field, 3rd Deep Sky, 3rd Rich Field.)

—Chuck Allen, AL President

Long Journey into the Light: How the Binocular Came to Be

By Robert Kerr

During my 16th summer I had saved enough to buy a 7×50 binocular. I loved its substantial feel in my hands and couldn't wait for a clear night. Finally, I stood under a star-filled sky and held my breath as I pointed it overhead. I stared into the heart of Cygnus and gasped at what I saw. After many remarkable astronomy adventures, I have yet to be as thrilled as that night my binocular introduced me to the universe.

Binoculars provide a relaxing, non-complicated way to explore the bounties of the Milky Way. The Astronomical League offers 10 binocular observing programs including Messier, Deep Sky, Solar System and Double Star. Members can also earn the Binocular Master Observer Award. But wherever did this versatile instrument come from?

We've read reports speculating about who invented the telescope or "far-seeing" device. Of importance to our discussion is not who invented it, rather that someone with knowledge of such a device brought it to the attention of Dutch authorities, resulting in wide public curiosity. This is relevant, as the telescope and binocular share the same DNA. However, although their roots are intertwined, the terrestrial refracting telescope reached its modern design configuration in about a century. The binocular could not reach its full potential for almost three hundred years. Why? Huib J. Zuidervaart, retired senior researcher at the Huygens Institute for the History of the Netherlands, writes, "What happened in 1608 was in fact not an invention at all, but merely a recognition of the great potential of a device which must have been around for some decades" (2010, 10).

By the late 16th century, Dutch spectacle-makers were recognized as some of the most skilled craftsmen in Europe, even though they lacked knowledge of the optical properties of lenses. While they struggled to produce acceptable glass, they stocked lenses an inch or so in diameter, to provide convex lenses to compensate for farsightedness and concave lenses to assist those who were nearsighted. Galileo historians Yaakov Zik and Giora Hon, University of Haifa, report that virtually any pairing of these convex and concave lenses, even those of poor quality, would have produced a "looking device" capable of magnifying 3× (2013, 9).

Galilean design, 25 mm objectives, 2½ inches long, mid 1800s, Univ. of Arizona College of Optical Sciences

At age 38, Hans Lipperhey was a spectacle-maker in Middelburg, in the Dutch province of Zeeland, now part of the Netherlands. Nothing is known about when or how he constructed a "looking" or "far-seeing" device (referred to as a "telescope" in 1611). However, whether or not Lipperhey actually invented the device or was inspired by the work of others, he apparently was the first to anticipate the financial advantage of holding a patent.

In October 1608 Lipperhey filed his petition with Dutch authorities. Having heard reports of far-seeing devices, curious military-minded officials at The Hague requested he demonstrate the capabilities of his telescope. Historian Zuidervaart references a report from the time:

> "The bearer of this letter declares to have [found] a certain art with which one can see all things far away as if they were nearby by means of sights of glasses, which he pretends to be a new invention. (2010,11)"

Researchers conclude Lipperhey's "sights of glasses" device was fashioned with modified spectacle lenses, likely held within wooden mounts inside a 12- to 16-inch pasteboard tube dressed in vellum. Dutch authorities were impressed:

> "The said glasses are very useful in sieges and similar occasions, for from a mile or more away one can detect all things as distinctly as if they were very close to us. And even the stars which ordinarily are invisible to our sight and our eyes … can be seen by means of this instrument. (Zuidervaart 2010, 14)"

They denied him a patent on the grounds that it was a far-seeing device already known to others, although the application placed him in the history books. They tasked Lipperhey with delivering three of these devices, but requested he improve them for use with both eyes, granting him a stunning payment of 900 guilders. As instructed, he delivered the first "twin looking device" in December 1608 and the others two months later (Zuidervaart 2010, 14).

No documentation has been found regarding how he accomplished the necessary precise optical alignments and spacing of two tubes, or how he managed the problematical feat of hand polishing two sets of exactly matched lenses. But the deputies of the States-General examining committee reported they had seen

Lipperhey's instruments "for 'seeing far with two eyes' and found the same to be good and work satisfactorily" (Zuidervaart 2010, 15). So, while there's little chance any individual will be recognized as the inventor of the telescope, there's irrefutable evidence that Hans Lipperhey is the inventor of the binocular.

Here the trail goes cold, and we are not informed regarding the ultimate disposition of his looking devices. He died 11 years later, seemingly a wealthy man, and, as far as we know, he never ground another lens.

Descriptions and facsimiles of Lipperhey's device quickly spread across Europe. Upon hearing of the Dutch telescope, and

15 mm Porro prism design, 4× magnification, 4 inches long, early 1900s, Univ. of Arizona College of Optical Sciences

possibly fabricating one himself from spectacle lenses, Galileo recognized its simplicity but understood its potential and determined to transform this novelty into a scientific instrument. By the summer of 1609 he was experimenting with optical designs and conceptualizing a new theoretical framework for producing telescope lenses with specific figures, focal lengths, and aperture stops. Historians Zik and Hon have examined the characteristics of the two Galileo telescopes and objective lens preserved in the Museo Galileo in Florence, Italy (2013, 16). While protecting his most critical findings, Galileo's published research in 1610's *Sidereus Nuncius* became the foundation upon which others would build.

The late John E. Greivenkamp, professor emeritus at the College of Optical Sciences at the University of Arizona, researched the improvements to Galileo's design first proposed by Johannes Kepler and shortly followed by others. In his 1611 publication, *Dioptrice*, Kepler recommended an alternative lens arrangement, consisting of two convex converging lenses and two concave diverging lenses. This "Keplerian design" yielded wider fields and greater magnifications, but produced inverted images. In 1645, Anton Schyrle de Rheita introduced a three-lens erecting eyepiece to produce a terrestrial instrument, and in 1662 Christian Huygens introduced a four-lens eyepiece. By the 1700s, telescopes with Schyrle-Huygens erecting systems, some with an added field lens, were being used in surveying, navigation, and military settings (Greivenkamp 2010, 2). Progress in optics was being made, but the binocular was many years away.

Greivenkamp emphasizes that the value of seeing with two eyes was recognized, but the path to achieving it presented one problem after another: "The evolution of the binocular cannot be fully appreciated without understanding its unique design demands not encountered in the telescope, not only in optical design but in mechanical design, manufacturing, and materials" (2010, 1). He further underscores its unique prerequisites: 1) two exactly matched tubes are required, 2) the instruments must be individually focusable for each eye, 3) the optical tube axes must be exactly parallel, and 4) the interpupillary separation must be adjustable. Greivenkamp concludes, "Difficulties of alignment, focusing, and magnification-match made reproducible manufacturing almost impossible" (2010, 3).

In the 18th century, a miniature telescope called a "spyglass" or "opera glass" based on Galileo's design was produced by John Dolland of London. Its aperture was 30 mm and it featured his recently introduced achromatic doublet objective. It was popular but, typical of its Galilean lineage, the magnification was limited to 3×.

The appeal of seeing far with two eyes continued, and based on the success of the Galilean opera telescope, a true binocular-type instrument appeared around 1823. Optics pioneer Johann C. Voigtländer received a patent for combining two achromatic opera telescopes into matching, side-by-side or "twin-seeing" opera glasses by connecting and aligning them using a rigid frame with two bridges (Greivenkamp 2010, 5).

With the growing availability of quality glass and precision-produced optics, Voigtländer's twin-seeing glasses, now also known as "field glasses," soon featured larger, triplet objectives and eye lenses totaling six lenses per tube. There was even a clever design for folding glasses. While these improvements resulted in moderately wider fields of view, even by the century's end, these Galilean twin glasses continued to deliver minimal magnifications.

Discontented with the inadequacies of twin seeing glasses, innovators such as J. P. LeMaire (a.k.a. Lemiere) of Paris turned to a familiar and trusted optical system, the pairing of twin telescopes of Keplerian design to deliver increased magnification and brighter images. Each telescope tube consisted of an achromatic objective lens with Schyrle erecting lenses and either a rack and pinion apparatus or hinged mechanism providing interpupillary adjustment. Unfortunately, the device's length and weight were increased substantially beyond Voigtländer's twin glasses. Accompanying their higher magnifications and more complicated optical systems, they suffered the same problems that continued to haunt binocular device developers: poor alignment, mismatched magnifications, and imprecise focusing (Greivenkamp 2010, 7).

However, in time, with the advent of standardized manufacturing late in the 19th century, mechanical and optical technology had advanced markedly, and the impediment of weight was reduced by new, lightweight aluminum construction. The twin telescope had at last become a sophisticated optical system with magnifications from 5× to 20× (Greivenkamp 2010, 8–9). But, irony of ironies, after long years of dogged improvement, the instrument was soon rendered virtually obsolete by small, triangular-shaped objects of glass.

The optics design the binocular had long awaited arrived in 1854. Ignatio Porro invented the ingenious image erection system that bears his name. Each binocular tube was fitted with an offset optical alignment of two right-angle prisms situated in the light path between the objective lens and the laterally displaced eye lens. A pair of Porro prisms reflects an image four times before it reaches the eye lens, folding the optical path, result-

Keplerian design, 31 mm doublet objectives, 4-lens eyepieces, 16½ inches long, late 1800s, Univ. of Arizona College of Optical Sciences

ing in longer focal lengths, and producing erect images within a compact tube. There were initial prism performance difficulties, but Carl Zeiss and Otto Schott developed processes for producing higher quality prisms, and Ernst Abbe redesigned the prisms' alignment (Greivenkamp 2010, 10). The improved and revitalized Porro prism binocular made its grand debut in 1894, and rapidly occupied its niche alongside the telescope as an indispensable observing tool.

Several years later, binoculars incorporating roof-shaped prisms were introduced. Their size and weight make them excellent for handheld recreational use, and they're designed with optics of more moderate size to promote portability. Roof prism binoculars have a straight-through optical path and may be manufactured with one of three types of image-erecting prism systems available, Schmidt-Pechan being the most common. Detrimentally, each of these systems adds one or more additional reflecting surfaces than the Porro, possibly reducing the amount of light reaching the eye by up to 15% (Greivenkamp 2010, 11). Either binocular can be used in daylight or at night, but fully multicoated Porro binoculars offer larger apertures, higher magnifications, superior light transmission, and wider fields. In short, they are the perfect binoculars for astronomy.

Go out soon, stand under a star-filled sky, point your binocular overhead and see all things far away as if they were nearby.

References

Images courtesy of University of Arizona College of Optical Sciences or as indicated.

Greivenkamp, J.E. 2010. The 300-Year Quest for Binoculars. *International Optical Design Conference*. SPIE, The International Society for Optics & Photonics.

Zik, Y., and Hon, G. 2013. *Galileo's Knowledge of Optics and the Functioning of the Telescope – Revised*. University of Haifa.

Zuidervaart, H.J. 2010. *The 'True Inventor' of the Telescope, A Survey of 400 Years of Debate*. Royal Netherlands Academy of Arts & Sciences.

Acknowledgements

Daewook Kim, PhD., Associate Professor of Optical Sciences and Astronomy, University of Arizona

Emilee, Technical Services, Celestron Telescopes & Binoculars, Torrance, California

Binocular or Binoculars? A Lesson in Etymology

According to the *Oxford English Dictionary*, the original term for the optical device described in this article is binocular, "short for binocular glass," dating back to at least 1871. While today we more often see binoculars used (shorthand for a pair of binoculars), the singular is technically correct as well. There is no debate that as an adjective we use binocular, for example, in the League's Binocular Variable Star Observing Program. Check out all of the League's binocular observing programs at *www.astroleague.org/alphabeticobserving*.

—Kris Larsen

The League Loses a Lion

It is with great sadness that I report the passing of Ron Kramer on September 29, 2024. He was 75 years old.

Ron served as the 35th president of the Astronomical League from November 2018 to September 2020, choosing not to run in 2020 due to health issues. His prior service to the organization was extensive. He served as assistant editor of Reflector from 2010 to 2013, as editor from 2013 to 2018, and as managing editor after 2020. In 2016, he was elected Executive Secretary of the League and held that job until his election as League vice-president in 2018. Three months later, with the tragic loss of Bill Bogardus to cancer, Ron took over as president. He also served as president of the Astronomical Society of Las Cruces in 2011 and 2012, played a substantial role in developing the Leasburg Dam State Park Observatory, and engaged in public outreach through school presentations and the annual Renaissance Fair.

Ron was a decorated Air Force pilot who served in the Vietnam War. He enjoyed a career with the Philips Corporation and later ran his own publishing company. He was an expert in business management, marketing, operations, and logistics and brought that expertise to the League through his extensive work with Reflector and with our highly profitable sale of eclipse glasses in advance of the 2017 and 2024 total solar eclipses.

Proud of his rough Brooklyn upbringing, he would sometimes offer to "step outside" with anyone who disagreed with him…joking, of course, and always with a mischievous smile.

Ron will be sorely missed, and our deepest sympathies go out to his wife, Dena, and to his entire family.

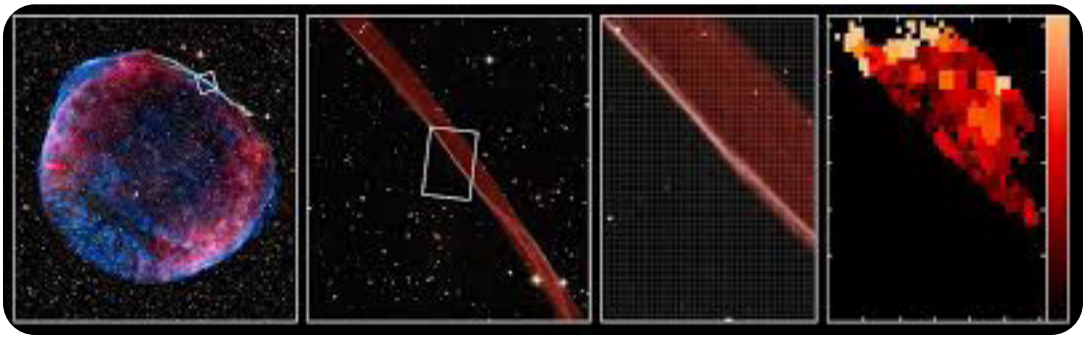
—Chuck Allen, AL President

The Brightest Star:
The Hunt to see Supernova Remnant 1006

By Dave Tosteson

A thousand years ago, the world was a different place. Parts of our planet had not been discovered, including Antarctica, New Zealand, and possibly Hawaii. Observers of the sky were chiefly interested in agriculture, and the few that recorded new events such as bright stars and comets tried, at their peril, to predict their significance for their leaders. When the brightest star that has ever been recorded in our night sky appeared in late April of 1006, science as we know it today did not exist. For twenty-first century astronomers interested in the history of our Universe, we are fortunate to have original observations to help study this "guest star" a millennium later.

On a 2017 trip to Chile, my goal was to see the extremely faint portion of this supernova remnant (SNR) still accessible in the visible spectrum.



The story of what is now called Supernova (SN) 1006 began at a time in the history of human culture that bisects ours from that of the first recorded supernova in 185 CE, noted only by the Chinese. Nearly a millennium later, at a time when more cultures were documenting events in the sky, another new star appeared, and this time it was very bright. Civilizations in Asia, the Middle East, Europe, and possibly the southwestern United States recorded a new star on the border of what are now Centaurus and Lupus.

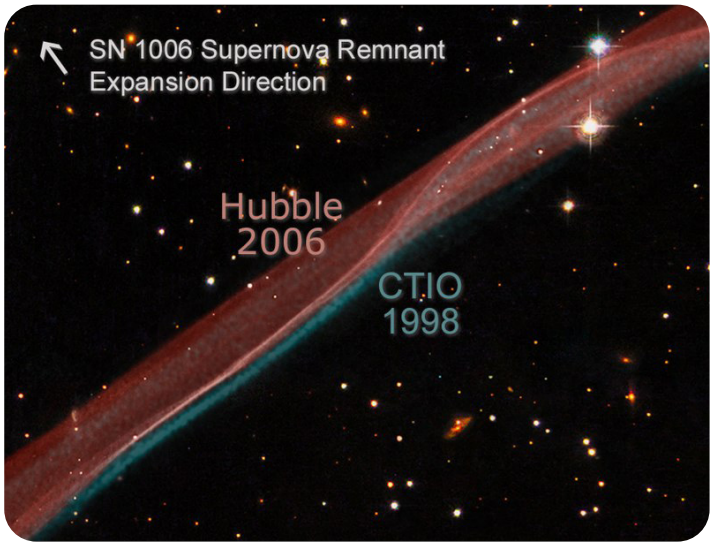
Islamic scientific and astronomical achievements were preeminent at the end of the first millennium, and their reports relay the most accurate observations of this nova. The Arab scholar Ibn Sina (also known as Avicenna) recorded sightings of this event in his *Book of Healing*. SN 1006 was reported by Ali ibn Ridwan to be "2.5–3 times as large as Venus" and have "a little more than the light of a Moon when 1/4th illuminated" (Ridwan, c. 1050). These and other accounts suggest it shone like a four-day-old Moon, and modern estimates of its maximum brightness center around magnitude –7.5, easily bright enough to allow reading at night. It was said to have been visible for weeks in the daytime, and was likely seen in the night sky for more than two years. The last literary reference to this new star was three and a half years after its sighting. Interestingly, though this was a southerly event (declination –41), no reports survive from the Southern Hemisphere.

After 1008–9 CE this supernova was lost to history until 1965, when Gardner and Milne (1965) identified the non-thermal radio shell PKS 1459-41 as its likely remnant. In that same year, Walter Baade unsuccessfully searched for its optical counterpart. A decade later, Sidney van den Bergh used the 4-meter telescope of the Cerro Tololo Inter-American Observatory in Chile to image the optical portion located at the northwest corner of the remnant, noting filaments 10 arcminutes in length that were 1–9 arcseconds wide and moving northwest at 0.3 arcseconds per year (van den Bergh 1976). The remnant is noticeably flattened in that section, and studies of other sections of the shell show slightly faster expansion. The theory is that increased resistance from denser interstellar hydrogen in the northwestern region slows and heats the material being swept up, causing it to fluoresce in visible light. van den Bergh commented its filaments resembled those of SNR 1572 and the "delicate wisps" of Simeis 147 in Taurus. Descriptions of the supernova's color evolution have been studied by modern scholars, including Germany's Ralph Neuhauser, and the effects of atmospheric refraction near the horizon have been offered as an influencing factor.

Astronomers classify supernovae into two general categories: Type I and Type II events, with the former lacking hydrogen in their spectra. Types II, Ib, and Ic supernovae derive from the end stage of massive stars, usually larger than eight times solar, where the core exhausts its energy and collapses in upon itself. The resulting shock wave rebounds outward to blow the outer layers toward space. The infall of material can create a neutron star or black hole at its center, which occurs only with Type II supernovae. Cas A and the Crab SNR (Messier 1) in Taurus are Type II remnants. The Crab is visible in binoculars, as its rotating neutron star, or pulsar, powers its outer layers. Type Ia events are caused when two white dwarfs merge, or by the destruction of white dwarf stars if mass transfer from a companion causes the primary to exceed the Chandrasekhar limit of 1.4 solar masses. Type Ia supernovae leave no dense remnants behind.

Of the two scenarios offered above, mass transfer was the dominant theory for decades, but several recent lines of evidence favor the binary-merger case. Studies in the ultraviolet and X-ray regions should detect radiation from an accretion disc around a white dwarf, and from material blown off a massive companion at the time of the supernova. That evidence is curiously lacking. A census of white dwarfs in the Milky Way suggests a binary companion merger rate of about one per century that interestingly matches the Type Ia supernova frequency in our galactic neighborhood. Taken together, these imply the merger scenario

may be more common than previously thought for Type Ia supernovae production, with one estimate putting it at twenty percent (Badenes & Maoz 2012). Were this true, it would have significant effects on measuring distances beyond 300 million light-years, as merged white dwarfs with masses between 1.4 and 2.8 solar would produce a broader range of supernova energy signatures, diminishing their use as standard candles.



Close-up of the expanding edge of the SNR 1006 remnant. Credit: Wikipedia

Modern study has given us the details of SNR 1006. It is located 7,200 light-years away, and its shell has expanded to 63 light-years in diameter. It is thought to be the closest Type Ia remnant, a factor contributing to it also having been the brightest supernova in recorded history. It is centered at approximately 15h 02m 55s, –41d 55m 30s, in Centaurus just west of the Lupus border, though it is often referred to as the Lupus SN/SNR. It is slightly oblate, with measurements of 32 arcminutes east-west by 30 arcminutes north-south. As discussed above, it is noticeably flattened on its northwestern border, the only portion seen in the visible spectrum. Areas on the edges at the north, northeast, and west show protrusions, or bulging, as though internal pressure was pushing through a relatively less dense area of interstellar medium at those points. Similar structures are seen in other SNRs mentioned in this article, though 1006 lacks the breakthrough "jet" seen in the northeastern section of Cas A. In 1995 evidence was first found in SNR 1006 that shock waves at the expanding edge of this structure were accelerating electrons to TeV energies, conclusively linking supernovae with cosmic rays (Vink et al. 2006).

My interest in viewing supernova remnants dates from the years after the turn of our millennium. In 2004, the quadricentennial year of its first sighting, I used my 25-inch f/5 reflector to view Kepler's SNR. The next year I upgraded to a 32-inch f/4 instrument, and used it to visually recover Cas A and SNR 1572, Tycho's object. Cas A exploded about the year 1680, when many astronomers should have been able to see it. Since no confirmed sightings from the original explosion have been found, theory suggests extruded layers of material thrown out near the end of the star's life absorbed the light of the explosion, hiding it from observers. The last supernova within the Milky Way, G1.9+0.3 in Sagittarius, occurred a little more than a century ago. It is obscured from our view by dust near our galaxy's center, and there is no visible remnant that I have found. I find it ironic that extragalactic observers with face-on views of our galaxy's disc may have better views of these events than plane-old Milky Wayans.

On July 1, 2008, NASA released a composite image of SNR 1006 composed of data in X-rays, radio, and visible light (*apod.nasa.gov/apod/ap080704.html*). Astronomy Picture of the Day (APOD) placed it as their Independence Day offering on July 4. Its coordinates on the Lupus-Centaurus border at –41 degrees would not normally deter me, as the area rises nineteen degrees above the horizon at culmination near midnight from the Texas Star Party. But this faint apparition of light, this last visible vestige from the brightest of explosions, was not even seen on my initial inspection of the POSS 2 red plate, my threshold of observation. I knew I would have to put this in my "southern file," for objects best or only seen from a Southern Hemisphere site.

I heard about a spring 2017 trip to Chile scheduled to include observing time with telescopes up to 25 inches in diameter that would also be spending time in the San Pedro de Atacama area. The northern Chilean Atacama Desert boasts clear, dry skies 340 nights a year and, at 8,000 feet elevation, offered what I considered the best Southern Hemisphere viewing site for my purposes. I had been in contact with Alain Maury, who ran tours and a rental service for interested amateurs. I asked him about his largest reflector, a 28-inch f/4.5 instrument, and had the opportunity to use this on the last night of our stay in San Pedro. The sky was not as pristine as those near the El Panque observatory south of Vicuña we visited earlier in the trip, where I spotted Centaurus A naked-eye but, as I started using the large reflector in the early hours of April 1, I knew some of my challenge targets were about to fall.

The first challenge object I turned to was SNR 1006. The area was just northeast of the triangle formed by the second-magnitude stars Alpha Lupi and Eta Centauri, and third-magnitude Kappa Lupi. The center of the expanding remnant was at 15h 02m 55s, –41d 55m 30s, about 2.5 arcminutes west of the

SNR 1006 in radio, x-rays, and visible light. Credit: NASA.

Lupus-Centaurus border. The most visible portion of the remnant, on the northwest section, was centered at 15h 02m 18s, –41d 44m 50s, approximately 13 arcminutes northwest of the center, and was easily found between two sets of reference stars southwest and northeast of the filament. Having the detailed chart from Megastar with 21st magnitude stars and the negative image from van den Bergh's paper were essential to locate this slight sliver. Supernova remnant observers must consider that these objects are moving, and sight accordingly. Comparing the POSS 2 red image with those taken recently with modern digital cameras clearly shows how the filaments have migrated 6–7 arcseconds to the northwest in twenty years. Adding the 1976 CTIO image from van den Bergh doubles the baseline of motion.

The optics of the 28-inch telescope were excellent, but the mechanics appear to had been neglected in favor of his domed robotic instruments used for digital imaging. Despite these limitations, I was able to observe the area of SNR 1006 for 30–35 minutes to be certain that the faint nebulosity along the filament was seen several times. This was some of the dimmest SNR structure I have recovered. The O-III filter with the 21 mm Ethos did not enhance the SNR; it made the field too dark. I used the 7 mm Type 6 Nagler to view it. My impression was that 3–4 sections along the 8- to 9-arcminute filament were intermittently visible for a few seconds, multiple times, only with averted vision and using no filter.

There is a nexus of connection with past observers when we recover light that has been traveling and expanding from such an historic explosion for so many years. I wonder how long into the present millennium SNR 1006 will remain visible to our eyes.

References:

Avicenna 1027, Book of Healing. *archive.org/details/avicenna-the-physics-of-the-healing-kitab-al-shifa-a-parallel-english-arabic-text-in-two-volumes/*.

Badenes, C., and Maoz, D. 2012, *ApJL* 749, L11.

Gardner, F. & Milne, D. 1965, *AJ* 70, 754.

Ridwan A. c. 1030–50, Commentary on the Tetrabiblos of Ptolemy. *penelope.uchicago.edu/Thayer/E/Roman/Texts/Ptolemy/Tetrabiblos/*.

van den Bergh, S. 1976, *ApJL* 208, L17.

Vink J. et al 2006, *ApJL* 648, L33

Dave Tosteson
Chisago City, Minnesota
djtost1@gmail.com

Your Astronomical League Just Gave Away Nine Library Telescopes

In 2024 the Astronomical League once again offered a free Library Telescope to a lucky Astronomical League club in each region, plus one to a member-at-large.

The Library Telescope consists of a 4.5-inch Dobsonian reflector fitted with an 8–24 mm zoom eyepiece. The value of this opportunity is approximately $400; the potential is enormous.

The Library Telescope Program was initiated more than fifteen years ago by the New Hampshire Astronomical Society and has grown into a nationwide presence. Clubs donate an easy-to-use portable telescope with both quality optics and a sturdy mount to their local library. Patrons can then check it out as they do books.

Thank you, Woodland Hills Camera and Telescope, for your help making this wonderful program possible!

Congratulations to these 2024 winners!

GLRAL – Evansville Astronomical Society
MERAL – Roanoke Valley Astronomical Society
SERAL – Birmingham Astronomical Society
MSRAL – Springfield Astronomical Society
NCRAL – Twin City Astronomers
NERAL – Skyscrapers, Inc.
NWRAL – Idaho Falls Astronomical Society
WRAL – Tucson Amateur Astronomy Association
MAL – Tiffany Nash Effinger

As many of you may have heard, the manufacturer of these telescopes (Orion Telescopes) is no longer in business, and the manufacturer of the substitute telescope (Celestron) is no longer offering it. At the moment, another suitable manufacturer has not been found.

How I turned our Monthly Meeting into a *Star Trek* Meeting

SLAS Elections, Star Date: 19 May 2017. I was elected vice president of the St. Louis Astronomical Society. My main responsibility was to book presenters for our monthly meetings. They occur on the third Friday of the month at Washington University, both in person and via Zoom. My main goal was to book three meetings I really want to have. My only restriction: they had to be space, astronomy, or science related – mostly astronomy.

1. *Star Trek*: I think I have accomplished this one (the subject of this article).
2. UFOs: A serious presentation on this topic, not one dedicated to "little green men." I might have achieved this by booking Harvard University Professor Avi Loeb for next April, speaking on "The Search for Interstellar Objects of Technological Origin."
3. Dinosaurs: We all have a dinosaur-loving twelve-year-old lurking inside us. Mine has an advantage, though: it has contacts and can book presentations! A possible topic could be the Chicxulub crater event. If anyone knows anyone who can talk about dinosaurs and this event, please, for all our inner twelve-year-olds, contact me!

Tim Russ delivering his talk via Zoom, with an appropriately attired Bradley R. Waller in foreground.

So off to the Final Frontier. In 2023, I turned sixty. Every year, over the first weekend in August, *Star Trek* holds its main convention in Las Vegas, attended by nearly every major character from all the TV series and the movies. Actors who played minor characters – perhaps only in one episode – also attend. Needless to say, I was excited beyond belief. As I checked the list of actors planning to attend, I saw my chance to have *Star Trek* at our monthly meeting: Tim Russ (Tuvok, *Star Trek: Voyager*). Why, you ask? During an interview with Mr. Russ on the Discovery Channel, he stated he was an amateur astronomer and loved stargazing. Since I was going to be at the Las Vegas convention and Mr. Russ was going to be there, all I had to do was to buy an autograph ticket, and I would have my chance to meet him. Easy-peasy, right? Unfortunately, they were sold out. What was I to do?

Trek conventions are mainly to meet fellow Trekkies, to get autographs, to buy cool merchandise, attend panels, and revel in the Federation. While in line for Nana Visitor (Kira Nerys, from *DS9*) I met Matt and Charolette Vilanova from Seymour, Connecticut, and explained my plight. They looked at each other and grinned. Charolette reached into her backpack and pulled out a Tim Russ autograph ticket! They had an extra – would I like it?

The line was relatively short, and when it was my turn for an autograph, I informed Mr. Russ that I was the vice president of the St. Louis Astronomical Society. He asked how many members we had. 250! I inquired, "Do you do presentations to astronomy clubs," and yes, he did! Yes! I gave him my SLAS business card. I knew he took it seriously when he put it into his wallet. When I got home, I contacted him via email, and booked his talk without delay: 15 December 2023 – "My Journey Through the Stars: Past and Present."

For my inner twelve-year-old, it was like waiting for Christmas all over again! Time to bust out my command gold uniform top! We boosted our Zoom account for the extra people attending. SLAS president Jim Small got into the spirit and opened the meeting with "hailing frequencies."

After a short five-minute presentation, Mr. Russ asked, "Any questions?" The floodgates burst open and for the next 90 minutes, Mr. Russ answered questions on what telescopes and lenses he uses, where he observes, and if he did any astrophotography. The evening went by at warp speed. What a night! Eventually, we had to stop, because Mr. Russ is a musician and lives in Los Angeles. For the past forty years, he and his band have played at local LA venues, and he had to join his bandmates for a gig an hour away. If you are interested, his CDs are available on Amazon.

Final Report, Star Date: 01 October 2024. If you are wondering, yes, there were a couple of *Star Trek* questions asked – good ones! "Did your *Voyager* cast members enjoy it when you brought your scope to a location, and do you know any other *Star Trek* actors who like astronomy?" He shared that they did enjoy the viewings, but he did not know anyone else in the cast who is into astronomy. I found out later that the Astronomical Society of Kansas City booked Mr. Russ for ALCon 2024. Thank you, Mr. Russ, for an absolutely awesome Trekkin' meeting. I can now cross off #1 on my list of meetings I want to have.

Note: While at the convention, I booked three other presenters for 2024:

19 January 2024 – David A. Williams, PhD, ASU: "ASU Explores the Solar System"

15 March 2024 – Tom Rathjen, NASA: "The Moon & Beyond"

15 November 2024 – Robert Zubrin, The Mars Society: "The Case for Mars"

Bradley R. Waller
Vice President, SLAS

ASTROCON 2025

BRYCE CANYON NATIONAL PARK

June 25 - June 28, 2025, Ruby's Inn, Bryce Canyon City, Utah

26 South Main Street • www.rubysinn.com

Sponsored by the MARS Region of the Astronomical League

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

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

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

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

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

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

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

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

- **Featured Workshops:**

Astrophotography / Digital Imaging - Novice
Astrophotography / Digital Imaging - Advanced
Observing: Personal Program / Journal
Observing: Tips & Ideas / Eyepieces / Filters
Observing: Charts / Books / Observing Lists
Sketching

Register now!

www.astrocon2025.org

2025 ASTROCON BRYCE CANYON•UTAH
DARK SKIES ROCK!!!

Galaxy Clusters: Abell's, Hickson's, and Palomar's (What They Are and How to Observe Them)

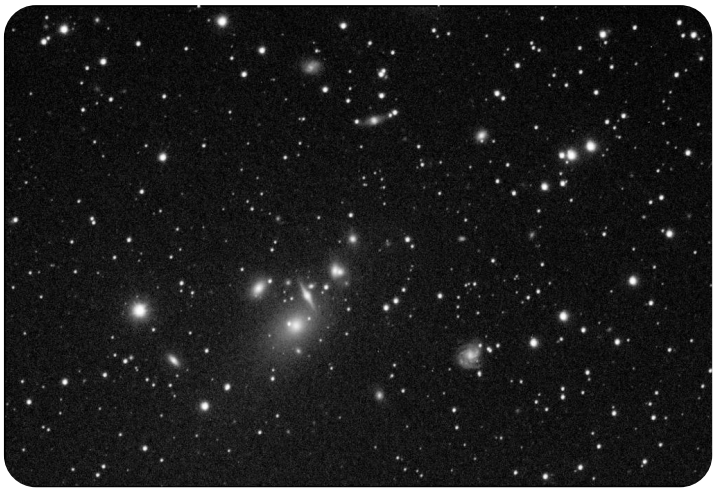
By Larry McHenry, *Stellar-journeys.org*

Many amateur astronomers love to observe galaxies, especially the large, bright showcase Messier and NGC galaxies that show plenty of spiral arm details or interactions with other nearby galaxies. But what about galaxy clusters?

A few years back, I became interested in observing Hickson compact galaxy clusters. That prompted me to begin a detailed examination of the larger-scale Abell clusters and the much smaller, fainter, and more compact Palomar clusters. It's been an interesting observational journey into the universe of galaxy clusters, macro to micro.

ABELL GALAXY CLUSTERS

Galaxies are scattered throughout the visible universe. The majority of galaxies are gravitationally clumped together in



groups – from a handful to a few dozens of galaxies, such as our "Local Group," to large clusters of hundreds of galaxies such as the Virgo galaxy cluster, to the larger Abell galaxy clusters of up to thousands of galaxies. These, in turn, are bound into giant superclusters of tens of thousands of galaxies. These huge structures are the fundamental building blocks of the universe (Jones 1981, 23). The individual galaxies in these groups vary in size and type, but most larger clusters contain one or more giant elliptical galaxies at their core.

American astrophysicist George Abell graduated in 1952 from the California Institute of Technology with a PhD in astronomy. Abell's first professional job as a Caltech astronomer was working on the National Geographic Society Palomar Observatory Sky Survey, created using the Palomar 48-inch Schmidt telescope. Abell's primary research was reviewing the Palomar Observatory Sky Survey photographic plates looking for galaxy clusters. Abell compiled a catalog of 2,712 clusters of galaxies, first published in 1958 as *The Distribution of Rich Clusters of Galaxies* and later called the Northern Survey (Kanipe & Webb 2019, 73).

Abell's qualifications for a galaxy cluster to be included in the catalog were 1) a minimum population of fifty members within a two-magnitude range of the third-brightest galaxy cluster member; 2) sufficiently compact that at least fifty of the cluster members lie within a radius of about two megaparsecs (Mpc) from the cluster's center; and 3) a redshift of between 0.02 and 0.2, corresponding to distances of between 85 and 850 Mpc.

Regions close to the galactic plane of the Milky Way were excluded from the study due to interstellar obscuration.

Abell's catalog continues to be relevant to today's professional astronomers and cosmologists in studies of large-scale three-dimensional structures across the universe. His work is considered to be the first step toward our understanding of the clustering of galaxies into filaments and voids (Kanipe & Webb 2019, 76).

HICKSON COMPACT GALAXY CLUSTERS

Canadian astrophysicist Paul Hickson graduated from the California Institute of Technology with a PhD in astrophysics in 1976. A few years later, he became a professor at the University of British Columbia in their Department of Physics and Astronomy. Using the Palomar Observatory Sky Survey, Hickson compiled a catalog of 100 faint, compact galaxy clusters, published in 1982.

To be included, a cluster had to 1) be a small, relatively isolated, system of at least 4 members (typically 4 to 8) in close proximity to one another; 2) not be part of a larger cluster of galaxies; 3) have a difference in magnitude between the brightest and faintest cluster member of not more than 3 magnitudes; and

4) be a compact group, and cluster members must have a similar radius of spacing.

Hickson's research goal in creating his catalog was to develop a uniform statistically significant sample to aid in studying galaxy evolution and any discordant red shifts between the individual members of these compact groups.

PALOMAR COMPACT GALAXY CLUSTERS

Using the Palomar Observatory Sky Survey, Italian astronomer Angela Iovino, of the Brera Astronomical Observatory in Milan, Italy, published a research catalog of compact galaxy clusters using tighter selection criteria than what had been used in previous catalogs (Iovino 2002, 2472).

Her criteria for inclusion in the catalog were 1) regions within 40° of the galactic plane of the Milky Way were excluded; 2) a galaxy cluster must have a minimum population of 4 members with only a two-magnitude range between the brightest and dimmest galaxy members; 3) the apparent size of a cluster must be less than one arcminute (smaller than the angular size of the planet Jupiter's disk!); and 4) the cluster must be at least three cluster-diameters away from any nearby galaxy.

In her 2023 paper "A New Sample of Distant Compact Groups from the Digitized Second Palomar Observatory Sky Survey," Dr. Iovino identified 459 compact galaxy groups using her selection criteria covering both the northern and southern hemisphere.

HOW TO OBSERVE GALAXY CLUSTERS

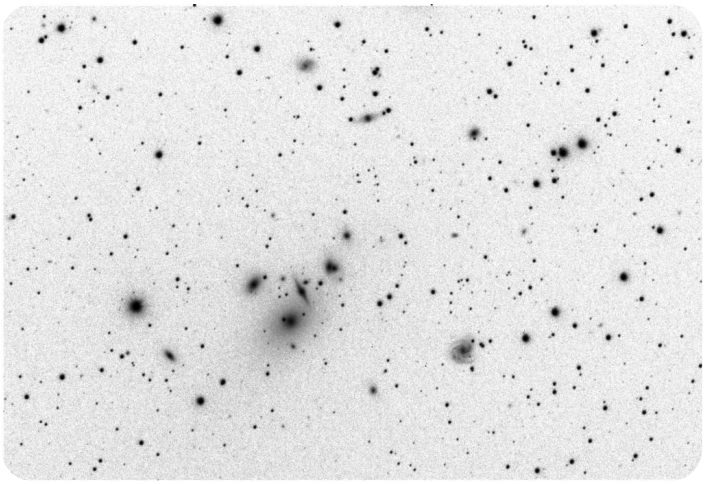
So, where can you find Abell, Hickson, and Palomar galaxy clusters and how do you observe them? Galaxies can generally be found away from the glowing band of light that we call the "Milky Way," whose gas, dust, and stars associated with the spiral arms tend to obscure the other galaxies we want to observe. With a few exceptions, most galaxy clusters are small and faint, and will require large-aperture telescopes or imaging setups, along with dark skies.

Although most galaxy clusters can be challenging to observe, this is what makes them interesting to find and attempt to see or image. Observing them visually requires maintaining dark adaptation, having good star charts, and using a large-aperture telescope with a good finderscope. Many galaxy clusters are very faint, and depending on what size telescope you are using, most of their member galaxies may not be visible. An observer is more likely to see the higher-contrast elliptical and lenticular galaxies and edge-on spirals than low-surface-brightness face-on spirals (Jones 1981, 45). But like any deep-sky object, half the fun is just successfully finding the galaxy cluster and knowing what it is that you are observing. If you need a tangible goal to motivate your search, check out the League's Galaxy Groups and Clusters Observing Program (*www.astroleague.org/galaxy-groups-clusters-observing-program*).

Galaxy clusters can also be challenging for imagers, due to their faintness or large scale, in that even an accurate go-to mount may not position the telescope squarely on the cluster framed the way you want it. Having a photographic atlas or picture of the galaxy cluster will help locate and identify the object and frame your image.

As I mentioned earlier, it's been an interesting observational journey among the universe of galaxy clusters, from the Abell clusters where the field of view overflows with numerous relatively nearby galaxies, to the intermediate Hickson clusters of compact groups of galaxies, and ultimately to the tiny, faint, very distant Palomar compact clusters where the galaxies look like a few little grains of sand.

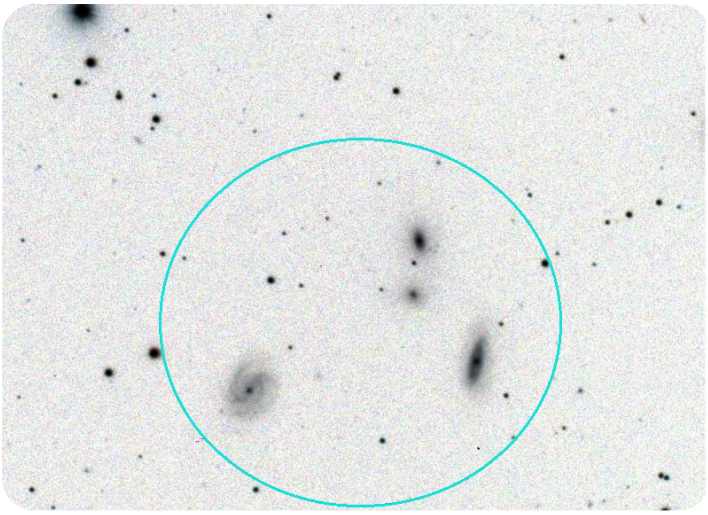
ABELL GALAXY CLUSTERS

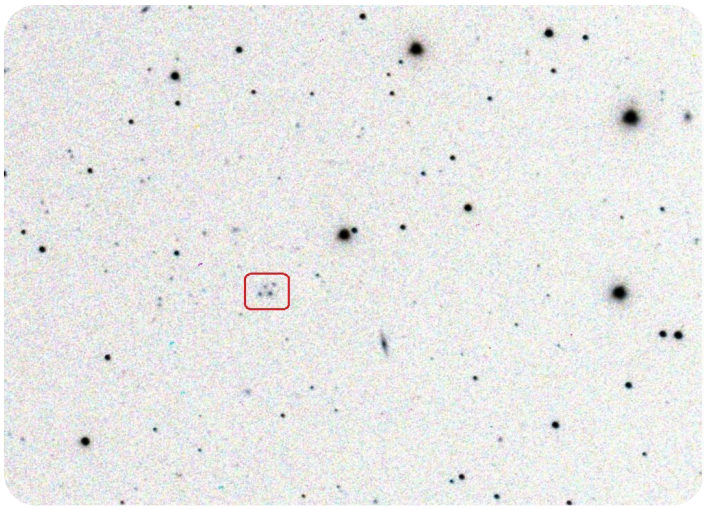


Abell's catalog is recognized as an excellent compilation of galaxy clusters for the observer with access to medium to large telescopes and dark skies. Although several clusters contain one or more relatively bright NGC or IC galaxies, the majority of the catalog is clusters of faint PGC, UGC, or MCG galaxies (12th magnitude or fainter). Many of the groups, officially designated as ACO, may have at least one member plotted in popular star atlases such as *Uranometria 2000.0* or the *Millennium Star Atlas*. For the most part, they can be difficult to observe, but broadband filters can be a big help, allowing the galaxies to pop from the star field.

HICKSON COMPACT GALAXY CLUSTERS

Hickson's catalog is another great source of challenging galaxy clusters for observers. The average galaxy member magnitude is





around 14. The faintest is HCG 20 in Aries at magnitude 17.2. Many of the groups have at least one member plotted in popular printed star atlases; they can also be found using various planetarium programs. All 100 catalog members have high enough declinations to be viewable by northern hemisphere observers.

PALOMAR COMPACT GALAXY CLUSTERS

The Palomar catalog is a list of very challenging galaxy clusters for the observer with access to large telescopes or imaging kits and dark skies. Due to their great distance, the majority of the catalog members are very faint galaxy clusters, 15th magnitude and fainter, and generally not plotted on star atlases or listed in planetarium programs. You will need to use the cluster's celestial coordinates to find the object. For the most part, Palomar clusters can be very difficult to observe visually, requiring 24-inch or larger telescopes along with dark skies. For imagers, 6- to 8-inch apertures will be required, and once again, broadband filters can be a big help.

Hopefully this has inspired you to seek out and explore these rewarding celestial objects, the fundamental building blocks of the universe!

References:

Hickson, P. 1982, *ApJ* 255, 382.

Iovino, A. 2002, *AJ* 124, 2471.

Iovino, A., et al. 2003, *AJ* 125, 1660.

Jones, K. 1981. *Webb Society Deep-Sky Observers Handbook, Vol. 7: Clusters of Galaxies*. Enslow Publishers

Kanipe, J. & Webb, D. 2019. *Annals of the Deep Sky, Vol. 7*. Willmann-Bell

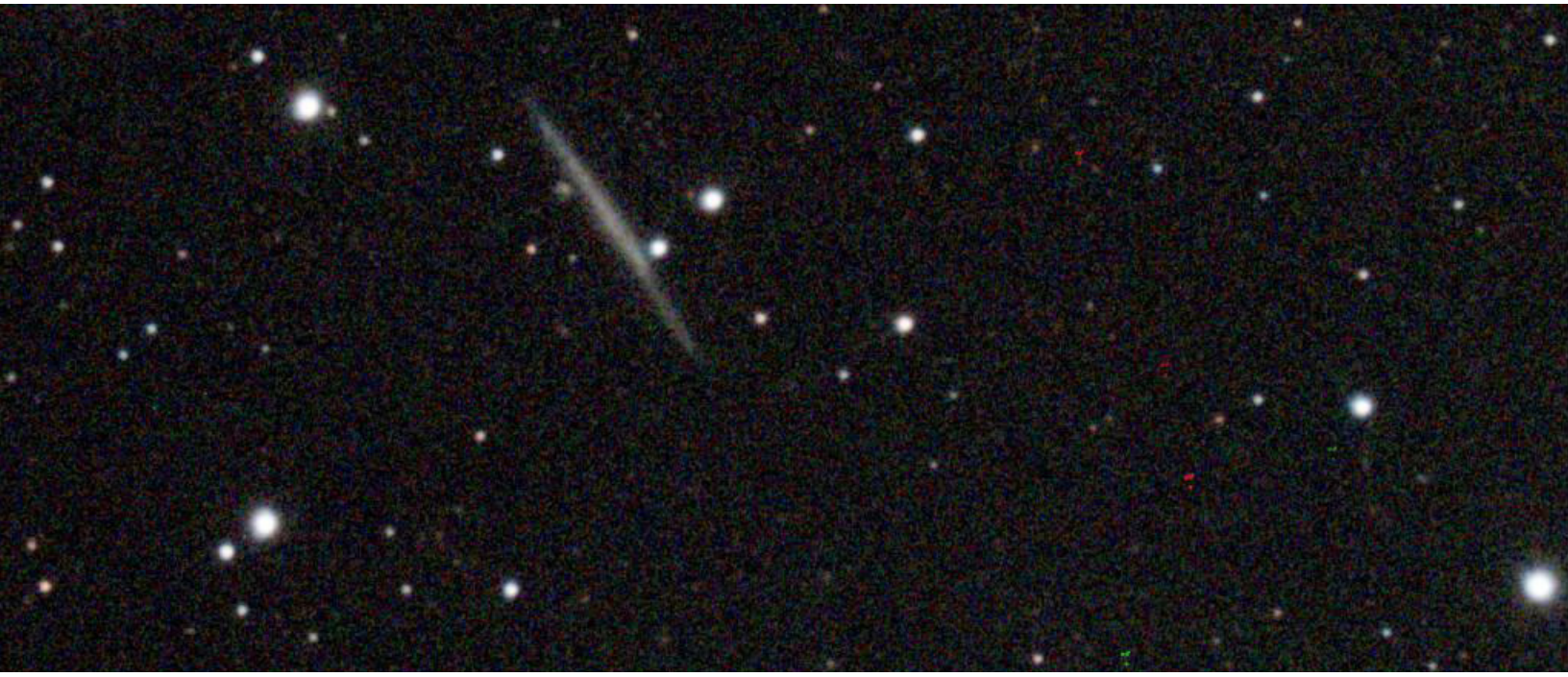
Further Reading:

Huey, A. "Hickson Group Observers Guide." FaintFuzzies.com, *www.faintfuzzies.com*

Huey, A. "Observing the Abell Galaxy Clusters." FaintFuzzies.com, *www.faintfuzzies.com*

Huey, A. "The Palomar Compact Galaxy Catalogue." FaintFuzzies.com, *www.faintfuzzies.com*

Kepple, G. & Sanner, G. 1998. *The Night Sky Observer's Guide Volume 1 & 2*. Willmann-Bell



Call for Award Submissions

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

LEAGUE YOUTH AWARDS

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

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

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

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

LEAGUE AWARDS

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

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

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

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

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

CALL FOR OFFICER NOMINATIONS

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

LIBRARY TELESCOPE GIVEAWAY

The League's annual Library Telescope giveaway drawing will take place in July. The League gives away up to 11 Library Telescopes (4.5-inch StarBlast reflectors), one to a club in each of its ten regions and one to a member-at-large. Winners then place the telescopes with local libraries. This is an excellent recruitment tool for new and younger members for winning clubs. Applications may be found on the League website (see link at bottom for Library Telescope Program). Applications must be received by May 30, 2025, a month earlier than normal due to the June convention.

Gallery

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

ABOVE: John Noble (Oakland Astronomy Club) captured this nine-panel mosaic image of Orion using a ZWO ASI2600MC Pro camera with a 135 mm lens at f/2.8 on top of a ZWO AM5 mount.

NEXT PAGE TOP: Paul Schulz (Desert Skygazers Astronomy Club) Comet C/2023 A3 Tsuchinshan-ATLAS. Captured this image shortly after perihelion from Safford, Arizona, using a Canon 6D Mark II and a 70-200 mm lens at 70 mm f/3.2. This image is the result of multiple images stacked.

NEXT PAGE BOTTOM: Gregg Ruppel (Tucson Amateur Astronomy Association) captured this image of NGC 6883 and 6878 (also designated as Biurakan 1 and2) from his remote observatory at DSNM in Animas, New Mexico, with an ASA 10N f/3.8 Astrograph with a SBIG STL-11000M CCD camera.

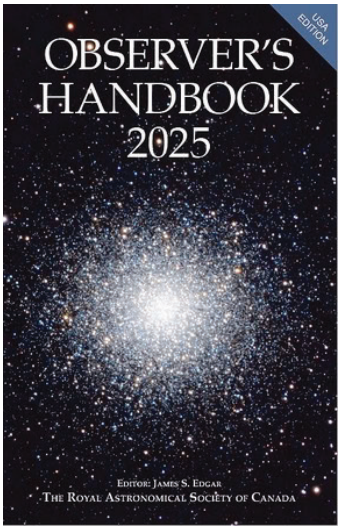
Gallery

Bernard Miller (East Valley Astronomy Club) captured this image of M63 with a PlaneWave 17-inch CDK with and a FLI 16803 CCD camera from his observatory in Animas, New Mexico.

Ernie Jacobs (Buffalo Astronomical Association) captured this image of NGC 4565 using a ZWO ASI533MC Pro camera with a Celestron 14-inch EdgeHD and AP1200 mount from his club's Beaver Meadow Observatory in North Java, New York.

ROYAL ASTRONOMICAL SOCIETY OF CANADA

BEST PRICES AROUND ON RASC OBSERVERS' RESOURCES!



OBSERVER'S HANDBOOK

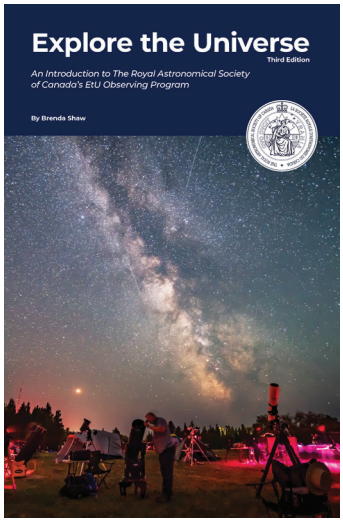
The popular 350–page classic in its 117th Year.
Special pricing for the 2025 USA edition!
Contents include • Basic Astro Data
• Planets • Optics and Observing
• The Sky Month by Month
• Eclipses • The Moon • Time (civil, astronomical, standards, & more) • The Sun
• Dwarf and Minor Planets • Meteors, Comets, and Dust • Stars • The Deep Sky

$27 EACH + $7 S+H
ORDERS OF 10 OR MORE:
$26 EACH WITH FREE SHIPPING!

EXPLORE THE UNIVERSE GUIDE

A PERFECT GUIDE FOR THOSE LEARNING THEIR WAY AROUND THE NIGHT SKY

$24 PLUS $7 S+H



STAR FINDER

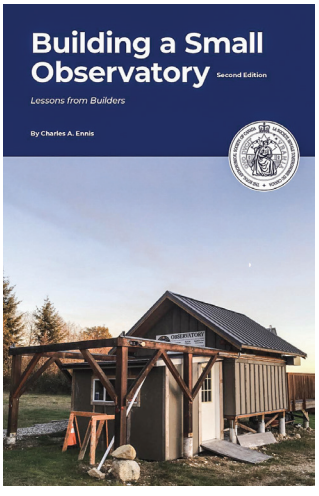
DISCOVER THE NIGHT SKY WITH THIS AFFORDABLE, EASY TO USE COMPACT PLANISPHERE

$2 PLUS $1 S+H

OBSERVER'S CALENDAR

A beautiful complement to the Handbook, filled with dates of notable celestial events – lunar and planetary conjunctions, eclipses, meteor showers and more.

$23 EACH + $7 S+H
ORDERS OF 6 OR MORE: $20 EACH WITH FREE SHIPPING!



BUILDING A SMALL OBSERVATORY

This book is the result of interviews with 140 small observatory owners to learn what it takes to fund, build, and operate a small observatory. It will help you maximize your chances of successfully creating a trouble-free installation, and help find the best site and equipment.

$24 PLUS $7 S+H

SECURE ONLINE ORDERING FROM STORE.ASTROLEAGUE.ORG

Or order by mail at Astronomical League Sales,
9201 Ward Parkway, Suite 100, Kansas City, MO 64114.
Enclose check for price and S+H charges as shown.
Questions? Call 816-DEEPSKY or email
leaguesales@astroleague.org

OBSERVING AWARDS

ACTIVE GALACTIC NUCLEI OBSERVING PROGRAM

No. 36-I, **Doug Neverman**, Minnesota Astronomical Society

ADVANCED BINOCULAR DOUBLE STAR OBSERVING PROGRAM

No. 64, **David Wickholm**, San Antonio Astronomical Association; No. 65, **Jenny Stein**, Houston Astronomical Society

ALTERNATE CONSTELLATION OBSERVING PROGRAM

No. 19, **Kevin McKeown**, Silver, Rio Rancho Astronomical Society

ARP PECULIAR GALAXIES NORTHERN OBSERVING PROGRAM

No. 125, **Brent Knight**, Escambia Amateur Astronomers Association; No. 126, **Kevin Nasal**, Minnesota Astronomical Society

ASTERISM OBSERVING PROGRAM

No. 80, **David Berish**, Greater Hazleton Area Astronomical Society; No. 81, **Gus Gomez**, Tucson Amateur Astronomy Association

ASTEROID OBSERVING PROGRAM

No. 80, **Viola Sanchez**, Gold, The Albuquerque Astronomical Society; No. 75, **Richard Wheeler**, Regular, Northeast Florida Astronomical Society

BAMBURY 600 CERTIFICATE

Terry Trees, Amateur Astronomers of Pittsburgh; **Michael A. Hotka**, Longmont Astronomical Society

BENNETT OBSERVING PROGRAM

No. 4, **Christian Weis**, Full List, Tucson Amateur Astronomy Association

BEYOND POLARIS OBSERVING PROGRAM

No. 74, **Brett Boller**, Prairie Astronomy Club; No. 75, **Brian McGuinness**, Northern Colorado Astronomical Society; No. 76, **Mary Barteau**, St. Louis Astronomical Society

BINOCULAR DOUBLE STAR OBSERVING PROGRAM

No. 216, **Mike McCabe**, South Shore Astronomical Society

BINOCULAR MESSIER OBSERVING PROGRAM

No. 1263, **Craig A. Akins**, Richmond Astronomical Society; No. 1264, **Richard H. Rhodes**, Indiana Astronomical Society; No. 1265, **DeVonna Ishmael**, Member-at-Large; No. 1266, **R. Dean Adams**, Vermont Astronomical Society; No. 1267, **Craig Endres**, Milwaukee Astronomical Society; No. 1268, **Nathan Endres**, Milwaukee Astronomical Society; No. 1269, **Bob Anderson**, Member-at-Large

BRIGHT NEBULA OBSERVING PROGRAM

No. 48, **Brad Payne**, Gold, Visual, Northern Virginia Astronomy Club; No. 49, **Tom Holman**, Gold, Imaging, Minnesota Astronomical Society

CALDWELL OBSERVING PROGRAM

No. 297, **Michael Blase**, Silver, Olympic Astronomical Society; No. 299, **Denise Terpstra**, Silver, Lifetime Member; No. 300, **Michael Stephens**, Silver, Member-at-Large

CARBON STAR OBSERVING PROGRAM

No. 161, **Michael Martin**, Roanoke Valley Astronomical Society; No. 162, **Robert Winterstein**, Member-at-Large

CITIZEN SCIENCE SPECIAL PROGRAM

Aaron Clevenson, Bronze, Active, Are We Alone in the Universe, North Houston Astronomy Club; **Aaron Clevenson**, Bronze, Active, Black Hole Hunters, North Houston Astronomy Club; **Aaron Clevenson**, Bronze, Active, Kilonova Seekers, North Houston Astronomy Club; **Aaron Clevenson**, Bronze, Active, Active Asteroids, North Houston Astronomy Club; **Aaron Clevenson**, Bronze, Active, Dark Energy Explorers, North Houston Astronomy Club; **Aaron Clevenson**, Bronze, Active, Cloud Spotting on Mars, North Houston Astronomy Club; **Aaron Clevenson**, Bronze, Active, The Daily Minor Planet, North Houston Astronomy Club; **Aaron Clevenson**, Bronze, Active, Sunspot Detectives, North Houston Astronomy Club; **Paul Harrington**, Silver, Observational, Variable Stars, Member-at-Large; **Al Lamperti**, Gold Class 342, Active, Active Asteroids, Delaware Valley Amateur Astronomers; **Al Lamperti**, Gold Class 16, Active, Cloud Spotting on Mars, Delaware Valley Amateur Astronomers; **Al Lamperti**, Gold Class 3, Active, Galaxy Zoo Euclid, Delaware Valley Amateur Astronomers; **Al Lamperti**, Gold Class 61, Active, Project Phaedra, Delaware Valley Amateur Astronomers; **W. Maynard Pittendreigh**, Bronze, Active, The Daily Minor Planet, Lifetime Member; **Thomas Schumann**, Bronze, Active, Backyard Worlds: Planet 9, Lifetime Member; **Brad Young**, Variable Stars, Observational, Gold Class 14, Astronomy Club of Tulsa; **Brad Young**, Variable Stars, Observational, Gold Class 15, Astronomy Club of Tulsa

COMET OBSERVING PROGRAM

No. 68, **Christian Weis**, Gold, Tucson Amateur Astronomy Association; No. 69, **Jamye Fraser**, Gold, Ancient City Astronomy Club; No. 141, **Jenny Stein**, Silver, Houston Astronomical Society; No. 142, **Robert Stein**, Silver, Houston Astronomical Society; No. 143, **Kevin McKeown**, Silver, Rio Rancho Astronomical Society

CONSTELLATION HUNTER NORTHERN SKIES OBSERVING PROGRAM

No. 322, **Marilyn Sameh**, Milwaukee Astronomical Society: No. 323, **John Wesley Hardin**, Colorado Springs Astronomical Society; No. 324, **John Lucian Hardin**, Colorado Springs Astronomical Society; No. 325, **Andrew Wolfe**, Member-at-Large

DARK SKY ADVOCATE OBSERVING PROGRAM

No. 19, **Marie Lott**, Atlanta Astronomy Club

DOUBLE STAR OBSERVING PROGRAM

No. 716, **Joe Fazio**, Cumberland Astronomy Club

FLAT GALAXY OBSERVING PROGRAM

No. 50-I, **Lauren Rogers**, Gold, Escambia Amateur Astronomers Association

GLOBULAR CLUSTER OBSERVING PROGRAM

No. 406, **Michael R. Martin**, Roanoke Valley Astronomical Society; No. 407-I, **Eric Edwards**, Lifetime Member; No. 408-I, **Rod Gallagher**, Oklahoma City Astronomy Club; No. 409, No. 410-I, **Brent Knight**, Escambia Amateur Astronomers Association; No. 411, **Jonathan Lawton**, The Astronomy Connection; No. 412, **David Berish**, Greater Hazleton Area Astronomical Society; No. 413-I, **Russell F. Pinizzotto**, Southern Maine Astronomers

HERSCHEL SOCIETY

Aaron Clevenson, Silver, North Houston Astronomy Club

HERSCHEL 400-NORTHERN OBSERVING PROGRAM

No. 667-I, **Thomas Blog**, The Albuquerque Astronomical Society

HERSCHEL 400-SORTHERN OBSERVING PROGRAM

No. 3, **Terry Trees**, Amateur Astronomers Association of Pittsburgh; No. 4-I, **Marie Lott**, Atlanta Astronomy Club

HERSCHEL II OBSERVING PROGRAM

No. 130, **Richard Wheeler**, Ancient City Astronomy Club

HYDROGEN ALPHA SOLAR OBSERVING PROGRAM

No. 71-I, **Viola Sanchez**, The Albuquerque Astronomical Society; No. 82, **Brian McGuinness**, Northern Colorado Astronomical Society; No. 83, **Laurie Ansorge**, Lifetime Member; No. 84, **John Jezak**, Astronomical Society of Kansas City; No. 85-I, **Edward Norton**, New Hampshire Astronomical Society; No. 86, **Jody Raney**, Shreveport-Bossier Astronomical Society; No. 87-I, **Brett Boller**, Prairie Astronomy Club

IMAGING – CALDWELL OBSERVING PROGRAM

No. 5, **Lauren Rogers**, Silver, Escambia Amateur Astronomers Association; No. 6, **Dean Herring**, Silver, Raleigh Astronomy Club; No. 7, **Susan Herring**, Silver, Raleigh Astronomy Club; No. 8, **Marie Lott**, Silver, Atlanta Astronomy Club; No. 9, **Laurie Ansorge**, Silver, Lifetime Member

IMAGING – MESSIER OBSERVING PROGRAM

No. 10, **Vladimir Afanasiev**, Tri-Valley Stargazers; No. 11, **Marie Lott**, Atlanta Astronomy Club; No. 12, **Brad Payne**, Northern Virginia Astronomy Club; No. 13, **Craig Akins**, Richmond Astronomical Society; No. 14, **Dan Crowson**, Astronomical Society of Eastern Missouri; No. 15, **Susan Herring**, Raleigh Astronomy Club; No. 16, **Dean F. Herring**, Raleigh Astronomy Club

LIBRARY TELESCOPE AWARD

No. 41, **Andy Walker**, Silver, Astronomical Society of Eastern Missouri; No. 42, **Tan Nguyen**, Silver, Astronomical Society of Eastern Missouri; No. 43, **Jim Roe**, Silver, Astronomical Society of Eastern Missouri; No. 44, **Yvonne Roe**, Silver, Astronomical Society of Eastern Missouri; No. 45, **Ed Frey**, Silver, Astronomical Society of Eastern Missouri; No. 46, **Mark Jones**, Silver & Gold, St. Louis Astronomical Society

LOCAL GALAXY GROUP & NEIGHBORHOOD OBSERVING PROGRAM

No. 67-I, **Rod Hughes**, Von Braun Astronomical Society; No. 68, **Christian Weis**, Tucson Amateur Astronomy Association

LUNAR OBSERVING PROGRAM

No. 1230, **Teresa Bippert-Plymate**, Regular, Binocular, Bear Valley Springs Astronomy Club; No. 1231, **Darcy Howard**, Regular, Central Arkansas Astronomical Society; No. 1232, **Aaron Clevenson**, Eyes-Only, North Houston Astronomy Club; No. 1233, **John Jezak**, Regular, Binocular, Eyes-Only, Astronomical Society of Kansas City; No. 1234, **James Anderson**, Regular, Binocular, Eyes-Only, Astronomical Society of Kansas City; No. 1235, **Trevor Raney**, Regular, Binocular, Eyes-Only, Member-at-Large; No. 1236, **DeVonna Ishmael**, Regular, Binocular, Eyes-Only, Member-at-Large

LUNAR EVOLUTION OBSERVING PROGRAM

No. 38, **Denise Terpstra**, Regular, Lifetime Member

MESSIER OBSERVING PROGRAM

No. 2930, **James D. Anderson**, Honorary, Astronomical Society of Kansas City; No. 2931, **Craig Akins**, Gold, Richmond Astronomical Society; No. 2932, **John Jezak**, Gold, Astronomical Society of Kansas City; No. 2933, **Matt Harbison**, Gold, Barnard Astronomical Society; No. 2934, **Michael McShan**, Gold, Oklahoma City Astronomy Club; No. 2935, **Michael Brock**, Gold, Alachua Astronomy Club; No. 2936, **Mohammad Adnan Asif**, Silver, Raleigh Astronomy Club

MULTIPLE STAR OBSERVING PROGRAM

No. 26, **Brian McGuiness**, Northern Colorado Astronomical Society; No 27-I, **Marie Lott**, Atlanta Astronomy Club; No. 28. **Denise Terpstra**, Lifetime Member

NASA OBSERVING CHALLENGE SPECIAL AWARD: PARKER SOLAR PROBE

Laurie Ansorge, Lifetime Member; **Lindsey Benson**, Member-at-Large; **Richard Benson**, Member-at-Large; **Steve Boerner**, Member-at-Large; **Scott Cadwallader**, Baton Rouge Astronomical Society; **Aaron Clevenson**, North Houston Astronomy Club; **Dan Crowson**, Astronomical Society of Eastern Missouri; **Susan Herring**, Raleigh Astronomy Club; **Tom Karnuta**, Member-at-Large; **James Keebaugh**, Colorado Springs Astronomical Society; **Will Keebaugh**, Colorado Springs Astronomical Society; **Krista Lemoine**, Salt Lake Astronomical Society; **Marie Lott**, Atlanta Astronomy Club; **Mike McCabe**, South Shore Astronomical Society; **Barton Meeks**,

Raleigh Astronomical Club; **Brittney Miller**, Atlanta Astronomy Club; **W. Maynard Pittendreigh**, Lifetime Member; **Andy Walker**, Astronomical Society of Eastern Missouri; **Nicole Walker**, Colorado Springs Astronomical Society; **Debra Wagner**, Member-at-Large; **David Warner**, Colorado Springs Astronomical Society; **David Whalen**, Atlanta Astronomy Club; **Brad Young**, Astronomy Club of Tulsa

OUTREACH PROGRAM

No. 738, **James Bruce McMath**, Stellar, Master, Central Arkansas Astronomical Society; No. 850, **Alicia Tristan**, Master, Fort Bend Astronomy Club; No. 1034, **Brett Boller**, Stellar, Master, Prairie Astronomy Club; No. 1128, **Kristin Hendershot**, Stellar, Northern Virginia Astronomy Club; No. 1292, **Wade Simmons**, Stellar, Flint River Astronomy Club; No. 1295, **Douglas L. Smith**, Stellar, Tucson Amateur Astronomy Association; No. 1319, **Lee Higgins**, Master, Outreach, Fort Bend Astronomy Club; No. 1346, **Karen Fajardo**, Stellar, River Bend Astronomy Club; No. 1373, **Alan Botts**, Master, Northeast Florida Astronomical Society; No. 1417, **Pearlie Harris**, Stellar, Northeast Florida Astronomical Society; No. 1445, **Mathurin Poteau**, Outreach, Fort Bend Astronomy Club; No. 1452, **Terry Ellis**, Stellar, Northeast Florida Astronomical Society; No. 1541, **Crystal Marie Kay**, Outreach, Seattle Astronomical Society; No. 1571, **Jeff Rodriguez**, Outreach, Stellar, Cincinnati Astronomical Society; No. 1572, **Andrew Rodionov**, Outreach, Omaha Astronomical Society; No. 1573, **Marshall Sweet**, Outreach, Raleigh Astronomy Club; No. 1574, **Jeffrey Dunn**, Outreach, Shoreline Astronomical Society; No. 1575, **Alejandro "Hoot" Baez**, Outreach, Member-at-Large; No. 1576, **Ravi Kota**, Outreach, Fort Bend Astronomy Club; No. 1577, **Lou Gehring**, Outreach, Fort Bend Astronomy Club; No. 1578, **Larry Denmark**, Outreach, Fort Bend Astronomy Club; No. 1579, **Joseph Ramos**, Outreach, Fort Bend Astronomy Club; No. 1580, **Hannah Lange**, Outreach, Fort Bend Astronomy Club; No. 1581, **Vasundhra Arulazi**, Outreach, Fort Bend Astronomy Club; No. 1582, **Arul Dhesiaseelan**, Outreach, Fort Bend Astronomy Club; No. 1583, **Ed Bartakovits**, Outreach, Chesmont Astronomical Society; No. 1584, **Blair Groden**, Outreach, Raleigh Astronomy Club; No. 1585, **Randy Gilbert**, Outreach, The Villages Astronomy Club; No. 1586, **Dan Cusak**, Outreach, Popular Astronomy Club; No. 1587, **Megan Warren**, Outreach, Popular Astronomy Club; No. 1588, **Diana Gonzales**, Outreach, Fort Bend Astronomy Club; No. 1589, **Sharon Ferguson**, Outreach, Fort Bend Astronomy Club; No. 1590, **Denise Terpstra**, Outreach, Stellar, Master, Lifetime Member; No. 1591, **Michael Gartland**, Outreach, Shoreline Astronomical Society; No. 1592, **Anders Derblom**, Outreach, Shoreline Astronomical Society; No. 1593, **Isabel Tilton**, Outreach, Cincinnati Astronomical Society

PLANETARY NEBULA OBSERVING PROGRAM

No. 26-I, **Lauren Rogers**, Gold, Escambia Amateur Astronomers Association; No. 27-I, **Ron Dilulio**, Gold, Shreveport-Bossier Astronomical Society; No. 28-I, **Robert Togni**, Gold, Central Arkansas Astronomical Society; No. 29-I, **Debra Wagner**, Gold, Member-at-Large

RADIO ASTRONOMY OBSERVING PROGRAM

No. 33, **W. Maynard Pittendreigh**, Silver, Lifetime Member; No. 34, **Michael J. Caba**, Silver, Rose City Astronomers; No. 47, **Dan Crowson**, Bronze, Astronomical Society of Eastern Missouri

SKETCHING PROGRAM

No. 68, **Denise Terpstra**, Lifetime Member; No. 69, **Christian Weis**, Tucson Amateur Astronomical Association

SKY PUPPY OBSERVING PROGRAM

No. 99, **Jacob Huelsmann**, River Bend Astronomy Club; No. 100, **Rachel Sweatt**, Fort Worth Astronomical Society; No. 101, **Rachel Tarney**, Independent; No. 102, **Abey Darmstetter**, Independent

SOLAR ECLIPSE OBSERVING CHALLENGE (2023)

Jeff Goldstein, Silver, Gold, Back Bay Amateur Astronomers; **Martiel Luther**, Silver, Houston Astronomical Society; **Tiffany Nash Effinger**, Gold, Member-at-Large

SOLAR ECLIPSE OBSERVING CHALLENGE (2024)

Jim Barbasso, Silver, Gold, North Houston Astronomy Club; **Keith Blanton**, Silver, Member-at-Large; **Ben Bratko**, Silve, Independentr; **Aaron Clevenson**, Gold, North Houston Astronomy Club; **Tiffany Nash Effinger**, Gold, Member-at-Large; **Jeff Goldstein**, Gold, Back Bay Amateur Astronomers; **Ken Gourley**, Silver, Member-at-Large; **Eddie Parris**, Silver, Back Bay Amateur Astronomers; **Samantha Pickard**, Gold, Raleigh Astronomy Club; **Russell Pinizzotto**, Gold, Southern Maine Astronomers; **Rob Ratkowski**, Gold, Haleakala Amateur Astronomers; **Michael Russo**, Silver, Back Bay Amateur Astronomers; **Debra Wagner**, Gold, Member-at-Large; **Brad Young**, Gold, Astronomy Club of Tulsa; **Jim Zappa**, Gold, Member-at-Large

SOLAR NEIGHBORHOOD OBSERVING PROGRAM

No. 20, **Paul Harrington**, Eyes-Only, Member-at-Large

SOLAR SYSTEM OBSERVING PROGRAM

No. 228, **Steve Riegel**, Regular, Colorado Springs Astronomical Society; No. 229, **Jeffrey Hiscock**, Binocular, Patron Member

SOUTHERN SKY TELESCOPIC OBSERVING PROGRAM

No. 70, **Peter Natscher**, Member-at-Large

TWO IN THE VIEW OBSERVING PROGRAM

No. 67, **Fred Gassert**, Visual, Kansas Astronomical Observers

SUNSPOTTER OBSERVING PROGRAM

No. 195-I, **David Whalen**, Atlanta Astronomy Club; No. 224-I, **Viola Sanchez**, The Albuquerque Astronomical Society; No. 248-I, **Dick Francini**, Neville Public Museum Astronomical Society; No. 249, **Brian McGuinness**, Northern Colorado Astronomical Society; No. 250, **Daniel Otte**, Southern Oregon Skywatchers; No. 251, **Andy Walker**, Astronomical Society of Eastern Missouri; No. 252, **Vincent Giovannone**, Lifetime Member

URBAN OBSERVING PROGRAM

No. 245, **Al Hamrick**, Raleigh Astronomy Club

VARIABLE STAR OBSERVING PROGRAM

No. 62, **Lauren Rogers**, Escambia Amateur Astronomers Association

MASTER OBSERVER PROGRESSION

FOR YOUR EYES ONLY AWARD

Aaron Clevenson, North Houston Astronomy Club; **Brad Young**, Astronomy Club of Tulsa

OBSERVER AWARD

Marc Machin, Member-at-Large; **Brian McGuinness,** Northern Colorado Astronomical Society

MASTER OBSERVER AWARD

No. 269, **Brian McGuinness**, Northern Colorado Astronomical Society; No. 270, **Bill Bond**, Omaha Astronomical Society

MASTER IMAGER AWARD

W. Maynard Pittendreigh, Lifetime Member

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

NON-PROFIT
ORGANIZATION
U.S. POSTAGE
PAID
Tucson, AZ
permit #271