Reflector

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TITLE PHOTOGRAPH: NGC 1850, THE DOUBLE CLUSTER; CREDIT: NASA, ESA, AND MARTINO ROMANIELLO (EUROPEAN SOUTHERN OBSERVATORY, GERMANY)

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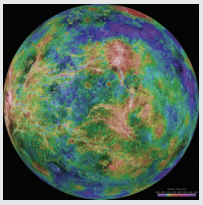

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Bob Kimball (Astronomical Society of Las Cruces) took this fine image of Barnard 72 (the Snake Nebula) from Rusty's RV Ranch in Rodeo, New Mexico, using a William Optics FLT 110 with a 0.8x focal reducer and an Atik 383L camera.

To our contributors: The copy and photo deadline for the December 2017 issue is October 1. Please send your stories and photos to our managing editor, **Ron Kramer** (*editor@astroleague.org*), by then.

The Astronomical League invites your comments regarding this magazine. How can we improve it and make it a more valuable resource for you, our members? Please respond to the editor's email address above.

Reflector

The Astronomical League Magazine

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A FEDERATION OF ASTRONOMICAL SOCIETIES
A NON-PROFIT ORGANIZATION

To promote the science of astronomy
- By fostering astronomical education,
- By providing incentives for astronomical observation and research, and
- By assisting communication among amateur astronomical societies.

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Reflector

QUARTERLY PUBLICATION OF THE ASTRONOMICAL LEAGUE

Issued by the Astronomical League in March, June, September, and December, the *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 the *Reflector* are available at the following subscription rates, payable to the League's national office.

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***Reflector* and Club Roster Deadlines**

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

TITLE PHOTOGRAPH: BIG LICK GALAXY GROUP; LYNN HILBORN; WHISTLE STOP OBSERVATORY; GRAFTON, ONTARIO, CANADA

On any clear night, in any big city: The Last Stargaze

"Grandfather, what is that funny flickering point of light in the sky?"

"That is called a star. The sky was once filled with them, some bright, many dim, but all twinkling—and all seemingly alive..."

"You mean there were a hundred stars?"

"When I was your age, my grandfather took me stargazing. We saw thousands!"

"Thousands of stars! Where are they? I only see one... Oh no, it's gone!"

"That's because the newest banks of security lights just came on."

"The security lights killed it?"

"No, not exactly. All the lights killed all the stars. There are no more. That was the last one."

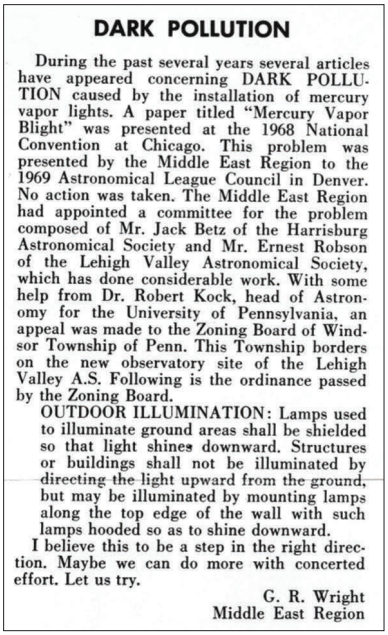
While this story at first may seem far-fetched, it is certainly not far from the truth on any clear night in any big city. Sadly, even in small towns, we have lost sight of numerous lesser stars.

Light pollution is a problem that affects everyone. It has been battled with growing vigor for years, yet remains a problem largely because most people are unconnected with the night sky. Most don't even realize what has already been lost, let alone what is being lost right now. They have no idea how the night sky should truly appear.

The people who care most, though, are those who appreciate looking deep into the starry realm and who contemplate what lies above. The amazing sights of shimmering star clusters, delicate nebulae, and distant galaxies are almost literally vanishing before their very eyes.

Yes, it is left largely up to us—from casual stargazers to avid amateur astronomers—to spotlight the problem, to speak up. Realistically, if we don't, who will?

Your Astronomical League has been increasingly involved in the issue ever since the "dark pollution" alarm was first sounded in the November 1970 *Reflector*.



DARK POLLUTION

During the past several years several articles have appeared concerning DARK POLLUTION caused by the installation of mercury vapor lights. A paper titled "Mercury Vapor Blight" was presented at the 1968 National Convention at Chicago. This problem was presented by the Middle East Region to the 1969 Astronomical League Council in Denver. No action was taken. The Middle East Region had appointed a committee for the problem composed of Mr. Jack Betz of the Harrisburg Astronomical Society and Mr. Ernest Robson of the Lehigh Valley Astronomical Society, which has done considerable work. With some help from Dr. Robert Kock, head of Astronomy for the University of Pennsylvania, an appeal was made to the Zoning Board of Windsor Township of Penn. This Township borders on the new observatory site of the Lehigh Valley A.S. Following is the ordinance passed by the Zoning Board.

OUTDOOR ILLUMINATION: Lamps used to illuminate ground areas shall be shielded so that light shines downward. Structures or buildings shall not be illuminated by directing the light upward from the ground, but may be illuminated by mounting lamps along the top edge of the wall with such lamps hooded so as to shine downward.

I believe this to be a step in the right direction. Maybe we can do more with concerted effort. Let us try.

G. R. Wright
Middle East Region

November 1970 article in the Reflector.

For over twenty years, every issue of the *Reflector* has contained an informative, page-long piece by IDA co-founder Tim Hunter that discusses some facet of the larger issue. The Dark Sky Advocate Observing Award, one of the League's many Observing Programs, encourages members to actively confront the problem using a positive approach.

The AL offers a handout, "Our Unnatural Night," through its Outreach Downloads program that illustrates the problem for the public in an interactive manner.

Each year the League responds to requests by individuals and organizations for letters of support in their fights against light pollution.

All of this is not enough; all of us need to do more.

JOHN GOSS

DAVE THOMAS

Which would you rather see? Light-polluted sky, top, or Sagittarius, bottom?

The Near Future: Imagine the Possibilities!

The Astronomical League is in a unique position in the world of amateur astronomy. It has nearly 17,000 members, all of whom stand to lose mightily if light pollution worsens. It has a network of clubs located in places from major population centers to rural regions across the United States. It has the ears of the manufacturers and retailers of astronomical merchandise.

Consider the progress that would be made if

Continued on page 27

TITLE PHOTOGRAPH: SEYFERT'S SEXTET, NASA GODDARD SPACE FLIGHT CENTER

Reflector Mail

To the Editor:

Just wanted to tell you how much I enjoyed Dr. Vrenios's article in the June *Reflector*! Have always had some curiosity about radio astronomy but have no expertise whatsoever in the field.

This article was an interesting summary of what amateurs can accomplish using basic equipment and online resources. The author's successes and failures in his efforts made for engaging reading.

Useful articles like this are what make each *Reflector* issue something I look forward to.

John H. McCammon
Member-at-Large

To the Editor:

My answer to the question "How Many Observing Pins Do You Have?," on page 24 of the June 2017 *Reflector*, is 48. The real question should have been "How Many Observing Program Certificates Do You Have?," for some programs don't issue pins. My answer to the latter question is 70.

Mike Hotka
Longmont and Denver Astronomical Societies

Dear Editor:

We had a great time yesterday at Earth Day in Veterans Memorial Park, Sierra Vista, Arizona. David Roemer, Nancy Hannaford, Ken Duncan, Rick Burke, Ted Forte, and I set up displays and telescopes. Ted had his NASA Space Place table set up, and I set up the Planetary Science Institute meteorite kit. Many visiting young astronomers were thrilled to be able to hold pieces of the Moon, Mars, and other rare space rocks.

We also gave out a number of IDA tri-folds about night sky preservation, and a number of people shared how much they enjoyed beautiful night skies. Ted and I estimated that we had well over 100 visitors.

Bob Gent
Member-at-Large

To the Editor:

For several years, with help from the Oglethorpe Astronomical Association of Savannah, Georgia, we hosted our local elementary school's 6th grade science class at our Rabbiteye Observatory.

It was work, but a good time was had by all.

Unfortunately, the paperwork required of the teachers has increased to the point they are no longer willing to do it. For the last event, they had twelve full-page forms and lesser ones for each of the 90+ children who came. The forms filled two 5-inch loose-leaf binders.

One little girl told her grandmother, who reported it to us, "I about froze my butt off, but it was worth it." We enjoyed every minute of it.

Lloyd Chapman
Oglethorpe Astronomical Association

BOB GENT

Sierra Vista: NASA Space Place display

BOB GENT

Sierra Vista: Since everyone else was observing the Sun, my scope was aimed at the Moon.

Oglethorpe: Appreciative 6th grade students and teachers, Arthur Williams Middle School, Jesup, Georgia

Oglethorpe: Heavenly astronomers, Rabbiteye Observatory, Chapman Blueberry Farm, Long County, Georgia (alphabetically, Kevin Bell, Dave Burrow, Lecia Burrow, Danette Chapman, Lloyd Chapman, Ben Freiberger, Bob McCrary, JoAnn McCrary, Kirk Meals, Damon Mick, and Bob Rose)

Flagstaff, Arizona: World's First International Dark Sky Place

Flagstaff, a city of 65,000 people, sits in beautiful northern Arizona, bordered by mountains to the north and surrounded by forest in all directions. It has an altitude of over 7,000 feet with cool summers and snow-packed winters. In Flagstaff there are activities for all seasons. In this part of Arizona there are many nearby national parks and monuments, including Grand Canyon National Park. Of interest to amateur and professional astronomers are the presence of Lowell Observatory and the Naval Observatory Flagstaff Station as well as nearby Meteor Crater. Northern Arizona University is in Flagstaff and contributes significantly to the cultural and educational flavor of Flagstaff.

The skies are dark in Flagstaff, with many locations having good seeing, though the cold winter nights are a bit challenging for observing. Flagstaff has a decades-old history of protecting its dark skies for astronomy, and it is most proud that it became the world's first International Dark Sky City on October 24, 2001. There is a strict lighting ordinance to protect Flagstaff's skies, but, like most places, the city is growing. There is always a push for more and brighter lights.

Does a lighting ordinance protect dark skies? Yes, if the ordinance is well conceived, well accepted by the public, and properly enforced. Just having laws in place does not stop crime. Just having a lighting ordinance may not protect dark skies. However, experience in Tucson and in Flagstaff shows lighting ordinances are effective. With respect to Flagstaff, an IDA news announcement (blog) on January 20, 2017, outlined how nighttime images show success for Flagstaff's dark-sky advocacy. Images of Flagstaff and other cities were taken by the National Park Service to better understand the differences between average American cities and Flagstaff. The images taken at night in the Flagstaff region were compared to images obtained from cities of similar size. This showed the light emitted at night in Flagstaff was approximately 14 times fainter than that in Cheyenne, Wyoming, which resembles Flagstaff in size. The light pollution effects in and around Flagstaff were found to be eight times smaller than those of Cheyenne.

Flagstaff enacted the world's first outdoor lighting ordinance in 1958. In May 2016, the National Park Service and IDA announced the Flagstaff area national monuments—Sunset Crater Volcano, Walnut Canyon, and Wupatki—were collectively designated an International Dark Sky Park showing the importance of dark-sky maintenance for Flagstaff and the surrounding region.

Cheyenne and the rest of Wyoming are grand places for visiting or living. Away from the city lights and mountain storms, the skies are superb in Wyoming. My guess is that Cheyenne, even though it is brighter than Flagstaff, probably has skies much darker than most urban areas in the United States. They could be even better and more like Flagstaff's with a bit of toning down the lights.

Most of the municipal lighting in Flagstaff is currently low-pressure sodium (LPS), which emits mainly in the yellow portion of the spectrum. I personally like LPS a lot, as I find it to have little glare, and I don't mind its bug-light yellow color. LPS, and high-pressure sodium (HPS), which has comprised most municipal lighting up to now, are becoming obsolete technologies and are rapidly being replaced by LED lighting. The challenge for Flagstaff is how to change over to this new technology without compromising its dark skies. By the way, though the skies are dark over Flagstaff, the nighttime lighting is more than adequate for recreation, safety, and security for business owners, pedestrians, drivers, homeowners, and tourists. I have driven and walked about Flagstaff many times at night, being an ordinary tourist rather than an amateur astronomer and always enjoyed the city with no problem reading signs and finding my way around in a safe, secure manner.

The leaders of Flagstaff have put a great deal of time and effort into protecting Flagstaff's nighttime skies. It is a big deal to them for many reasons—professional astronomy, astro-tourism, environmental concerns, quality of life, and pride. I suspect they will carefully replace their lighting system with well shielded LED fixtures having the right amount of light for the task at hand and having a "warm" (roughly 2,700–3,000 K) color. Hopefully, unnecessary lights will be removed and no light installed without a good purpose for it. I expect Flagstaff will a leading astronomical community for the indefinite future.

Tim Hunter, Co-founder, IDA
Phone: 520-293-3198; Fax: 520-293-3192
Email: *ida@darksky.org*;
www.darksky.org

TITLE PHOTOGRAPH: "RING GALAXY," AM 0644-741; CREDIT: NASA, ESA, AND THE HUBBLE HERITAGE TEAM (AURA/STSCI)

TITLE PHOTOGRAPH: M31; COMPLIMENTS OF TOM S. MARTINEZ, ASKC

Yale University, July 6, 2017— A cosmic barbecue: Researchers spot 60 new "hot Jupiter" candidates

New Haven, Connecticut—Yale researchers have identified 60 potential new "hot Jupiters"—highly irradiated worlds that glow like coals on a barbecue grill and are found orbiting only one percent of Sun-like stars.

Hot Jupiters constitute a class of gas giant planets located so close to their parent stars that they take less than a week to complete an orbit.

Second-year PhD student Sarah Millholland and astronomy professor Greg Laughlin identified the planet candidates via a novel application of big data techniques. They used a supervised machine learning algorithm—a sophisticated program that can be trained to recognize patterns in data and make predictions—to detect the tiny amplitude variations in observed light that result as an orbiting planet reflects rays of light from its host star.

"Sarah's work has given us what amounts to a 'class portrait' of extrasolar planets at their most alien," said Laughlin. "It's amazing how the latest techniques in machine learning, compounded with high-performance computing, are allowing us to mine classic data sets for extraordinary discoveries."

Millholland recently presented the research at a Kepler Science Conference at the NASA Ames Research Center in California. She and Laughlin are authors of a study about the research, which has been accepted for publication in the *Astronomical Journal*.

Millholland and Laughlin searched systematically for reflected light signals in the observations of more than 140,000 stars from four years of data from NASA's Kepler mission. The Kepler spacecraft is best known for enabling the detection of thousands of exoplanets that transit their host stars. During a transit, a planet passes in front of a star and causes a periodic dip in the observed starlight.

Reflected light signals can be difficult to distinguish from stellar or instrumental variability, the researchers said, but a big data approach enabled them to pull out the faint signals. They generated thousands of synthetic datasets and trained an algorithm to recognize the properties of the reflected light signals in comparison to those with other types of variability.

The Yale technique pioneers a new discovery method that identifies more planets from the publicly available Kepler data, said the researchers.

"I've been told by members of the Kepler science team that a search for reflected star-shine was part of the early renditions of the Kepler pipeline," Millholland said. "They called it the Reflected Light Search, or RLS module. In this sense, we're simply addressing one of the original intentions for the Kepler data."

The reflected light signals hold rich information about the planets' atmospheres, according to the researchers. They contain characteristics such as cloud existence, atmospheric composition, wind patterns, and day-night temperature contrasts.

The researchers also note that the 60 planet candidates will require follow-up observations for confirmation. This will come in the form of Doppler velocity measurements.

The Doppler velocity method is a well-established technique that enables the detection of wobbling motion in a star due to the gravitational influence of an orbiting planet. Since hot Jupiters are so massive and close to their stars, the stellar wobbles they induce are large and readily detectable.

A new, Yale-designed instrument known as EXPRES, which is being installed on the Discovery Channel Telescope in Arizona, may attempt to make confirmations later this year.

The research relied upon Yale's high-performance computing resources, in addition to computing clusters in the Yale Department of Astronomy. The National Science Foundation Graduate Research Fellowship Program also supported the research.

A 3-D manipulable diagram of a hot Jupiter in various phases of its orbit is available at *smillholland.github.io/Phase_Curve_Demo*.

The accepted version of the study may be found at *arxiv.org/abs/1706.06602*.

American Museum of Natural History, June 2017— Backyard Worlds volunteers make first discovery: A cold, close brown dwarf

New York—A new citizen-science tool released earlier this year to help astronomers pinpoint new worlds lurking in the outer reaches of our Solar System has already led to a discovery: a brown dwarf a little more than 100 light-years away from the Sun. Just six days after the launch of the *Backyard Worlds: Planet 9* website in February, four different users alerted the science team to the curious object, whose presence has since been confirmed via an infrared telescope. Details were recently published in the *Astrophysical Journal Letters*.

"I was so proud of our volunteers as I saw the data on this new cold world coming in," said Jackie Faherty, a senior scientist in the American Museum of Natural History's Department of Astrophysics and one of Backyard Worlds' researchers. "It was a feel-good moment for science."

The Backyard Worlds project lets anyone with a computer and an internet connection flip through images taken by NASA's Wide Field Infrared Survey Explorer (WISE) spacecraft. If an object is close enough to Earth, it will appear to "jump" when multiple images taken of the same spot in the sky a few years apart are compared. The goal for Backyard Worlds volunteers—of which there are more than 37,000—is to flag the moving objects they see in these digital flipbooks for further investigation by the science team. So far, volunteers have classified more than 4 million flipbooks.

Days after the Backyard Worlds website debuted on February 15, Bob Fletcher, a science teacher in Tasmania, identified a very faint object moving across the WISE images. It was soon also flagged by three other citizen scientists from Russia, Serbia, and the United States. After some initial investigation by the research team, which originally called the object "Bob's dwarf," Faherty was awarded time on NASA's Infrared Telescope Facility in Hawaii, where she confirmed that it was a previously unknown brown dwarf just a few hundred degrees warmer than Jupiter. The authors say that sky surveys had missed this object because it's too faint. All four volunteers are co-authors on the scientific paper announcing the discovery.

Brown dwarfs, sometimes called "failed stars," are spread throughout the Milky Way. They lack enough mass to sustain nuclear fusion but they are hot enough to glow in the infrared range of the light spectrum.

"Brown dwarfs are strikingly similar to Jupiter so we study their atmospheres in order to look at what weather on other worlds might look like," said Jonathan Gagné, a Backyard Worlds team member from the Carnegie Institution for Science.

Although the Backyard Worlds research team hopes to find the infamous Planet 9 hiding in our own Solar System, these brown dwarfs are also exciting discoveries.

"It's possible that there is a cold world closer than what we believe to be the closest star to the Sun," Faherty said. "Given enough time, I think our volunteers are going help to complete the map of our solar neighborhood."

The Backyard Worlds project was developed by scientists at NASA; Arizona State University; the University of California, Berkeley; the Space Telescope Science Institute in Baltimore; the science crowdsourcing site Zooniverse; and the American Museum of Natural History.

The *Astrophysical Journal Letters* paper: *iopscience.iop.org/article/10.3847/2041-8213/aa7200/meta*.

TITLE PHOTOGRAPH: DWARF GALAXY NGC 1569; ESA, NASA, AND P. ANDERS (GÖTTINGEN UNIVERSITY GALAXY EVOLUTION GROUP, GERMANY)

It is Monday, July 31. I think aloud, "E minus 21 days and counting," wondering whether the weather gods are pleased with all the sacrifices made in their names. My Navajo friends have already started their "anti-rain dances" and a few neighborhood Wiccans are casting spells and brewing potions to keep the clouds away on that special day, three weeks into the future.

There will be many hundreds of League members in Casper, Wyoming, on that day, most arriving in time for the AstroCon/ALCon being held the week before the big event. Casper, a town of some 55,000 mortals, will be host to perhaps 250,000 during the Great Eclipse of 2017.

Around the United States, the eclipse will be seen (weather permitting) by many millions. Some lucky ones will be in the path of totality, where the entire Sun's disk will be covered by our Moon. Others will lie off the centerline and will see a partial eclipse, still a rather rare event. Hopefully, all of the clear weather spells, sacrifices, and potions will work their magic, and we will all have a great view.

Of course, Murphy once again will rear his ugly head and it will rain or be cloudy at just the wrong moment at some locations and we'll have to wait until 2024 for the next total eclipse in the U.S.

By the time you read this, the eclipse will have passed. With luck, you had the opportunity to watch Nature's magic. If the weather is good in Casper, this will be my 15th total, to go along with two annulars. Each is unique and each is remarkable. We on Earth are most fortunate to have a natural satellite that is the same angular diameter as our home star.

On another note, I would like to announce the appointment of our new photo editor, **Dan Crowson**. Dan has been a very frequent contributor to this magazine, and is now responsible for selecting the front and back cover and Gallery images for all future issues. Send all submissions for consideration directly to Dan at *photoeditor@astroleague.org*. His biography is in the "From Around the League" section of this issue. Specifications for image submission can be found in the "Reflections" column of the June 2017 issue.

Finally, the League has made a special arrangement with the Royal Astronomical Society of Canada for several of their publications. Please see the ad elsewhere in this issue. I am certain you will find the pricing structure and products very attractive.

Ron Kramer, *Managing Editor*

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This benefit is made possible by the efforts of League volunteer Marilyn Unruh, proprietor of Star 'N Space Books. She is also an avid amateur astronomer. Like many of the League's members, she desires to help others enjoy our fascinating avocation. Marilyn notes, "This service allows me to give back to the astronomical community by doing something that I love to do—deal in books!"

For members who are looking to add to their library, the Book Service is definitely the place to go!

Continued on page 27

DEEP-SKY OBJECTS

THE ELEPHANT'S TRUNK NEBULA

By Dr. James R. Dire, Kauai Educational Association for Science & Astronomy

The 1,396th entry in John Dreyer's *Index Catalogue of Nebulae and Clusters of Stars* is associated with a galactic star cluster contained within a large region of faint nebulosity, and a smaller region within it called the Elephant's Trunk Nebula. In general, this entire region is referred to by the pachyderm proboscis phrase.

IC 1396 resides in the constellation Cepheus and is located 2,400 light-years from Earth. To find IC 1396, start at Alpha Cephei, a.k.a. Alderamin, and go five degrees southeast to the fourth-magnitude red star Mu Cephei. Mu Cephei goes by the Arabic name Erakis. It is also called Herschel's Garnet Star, after Sir William Herschel, who noted it was one of the deepest-red-colored stars in the sky. It is very hard to mistake Erakis in the eyepiece! The center of IC 1396 is 1.5 degrees south of Erakis.

My image of IC 1396 was taken with a William Optics Star 71 mm f/4.9 apochromatic refractor using an SBIG STF-8300C CCD camera. The exposure was 220 minutes. The image spans three degrees left to right (east to west), capturing most of the nebula. I just missed capturing Herschel's Garnet Star in the field of view. It would be located just above the top (north) of this image field about 20 percent of the way from left to right, located in the outer region of this vast emission nebula.

It's virtually impossible to see this entire nebula at once in a telescope. Smaller scopes that provide a wide enough field of view lack the light gathering power to see the nebula in an eyepiece. Larger reflectors, like my 14-inch Dob, can reveal the faint glow of the nebular gases, but the field of view captures only a small fraction of the entire nebula.

A magnitude 5.7 star, HR 8281, lies at the center of IC 1396. HR 8281 is a triple star that is easily resolved. The primary star, HR 8281 A, provides most of the light emitted by the system. The secondary (B) and tertiary (C) components are both magnitude 7.5 and lie 11 and 20 arcseconds away from A. HR 8281 A has two other components located 1.8 and 0.1 arcseconds from it that are too faint to be seen in amateur telescopes.

Another great star to check out in IC 1396 is the magnitude 7.4 star located 13 arcminutes northeast of HR 8281. It's the next brightest star to the upper left of HR 8281 in the image. This star, known as SAO 33652, is a binary star with components magnitude 7.4 and 8.6 located 12.7 arcseconds apart.

The final multiple star system I will point out in the image, easily resolved in most telescopes, is located at the 10 o'clock position from HR 8281, about two-thirds of the way from HR 8281 to the edge of the image. The star, SAO 33737, is just at the top edge of a small, propeller-shaped dark region. This triple star has components of magnitude 9.6, 10.2, and 12.9. The magnitude 12.9 star is 6.9 arcseconds from the primary while the magnitude 10.2 star is 19.8 arcseconds from the primary.

On the right edge of the nebula is a magnitude 7.4 star known as V429 Cephei. The dark lane in the image to the left of V429, extending three-fourths of the way to HR 8281, is the Elephant's Trunk Nebula. The left (east) edge of the trunk contains bright, hot, young stars, emission nebulae, reflection nebulae, and dark nebulae worth exploring with an 8-inch or larger telescope.

Other features that are an absolute must to check out in IC 1396 are the many dark nebulae. Probably the best is Barnard 161. This dark nebula is located 15 arcminutes north of SAO 33652. The nebula measures 5 by 2.5 arcminutes in size. The nebula is very dark. Myriad Milky Way stars surround the nebula, but none can be seen in this small patch of the sky.

Another notable dark nebula is Barnard 163, located one degree south-southeast of HR 8281. Barnard 163 is slightly larger than Barnard 161. Its cold gas and dust does an equally good job of blocking light from stars behind it! The third dark nebula I want to point out in IC 1396 is Barnard 367, which lies 50 arcminutes east-southeast of HR 8281. Spanning 5 arcminutes, Barnard 367 is not quite as dark as the other two dark nebulae. However, it is still an impressive sight in a telescope.

Panning around this large Milky Way object with any telescope reveals the hundreds of stars formed within it, myriad double star systems, and an uncountable number of more distant suns. The glow of the nebula appears as a faint background between the stars that is not as dark as the interstellar space outside of this region.

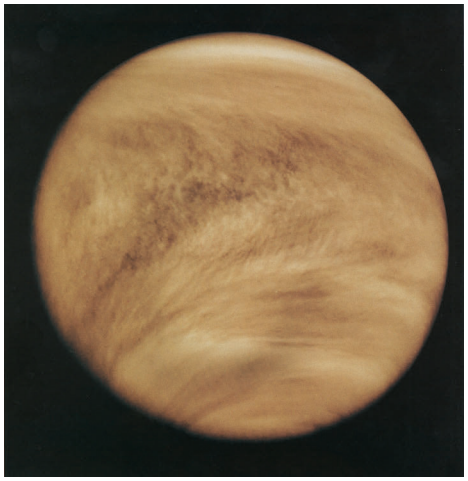
Wanderers in the Neighborhood

The Mysteries of Venus

By Berton Stevens

When amateur astronomers contemplate the planets, they often think about their visible aspects—the dark and light areas of Mars or the belts and zones on Jupiter and Uranus. A partial exception is Saturn and its rings, but still, the planet's disk displays substantial activity in amateur telescopes. The planets Mercury and Venus, being close to the Sun all the time, present a much greater challenge to observe detail on their surfaces or cloud tops. Venus especially is an infrequent target for observation.

In a telescope, this planet is blindingly bright and goes through phases like the Moon. There is very little detail to be seen on the disk, but some observers have reported seeing markings under almost perfect conditions. Observing in the daylight, when Venus is not so blindingly bright compared to its surroundings and it is much higher in the sky, is essential in making these observations.



Venus's ultraviolet cloud pattern was imaged by the Pioneer Venus orbiter on February 26, 1979. The dominant feature is the immense C- or Y-shaped pattern visible only in ultraviolet light. These features are actually short-lived, but they reform so often that they are considered a permanent part of the planet's atmosphere.

The brilliant white clouds of sulfuric acid that shroud Venus completely block our view of the surface in visible light. Ultraviolet light provides a view of the swirling clouds, moving faster along the equator than at higher latitudes. These clouds float in an atmosphere that is 96.5 percent carbon dioxide. Most of the remainder of the atmosphere is nitrogen with a little sulfur dioxide mixed in. The atmosphere is much denser than Earth's atmosphere, with ninety-three times the mass of our atmosphere pressing down on the surface. The surface is pressure is an amazing ninety-two times that of Earth on a planet that is just four hundred miles smaller in diameter.

Carbon dioxide is transparent to visible light, but opaque in infrared. Visible light filters through the atmosphere, warming the planet, but the infrared radiation that would normally return this energy into space is trapped in the atmosphere by the carbon dioxide. This is similar to what happens in a greenhouse, so this is called the greenhouse effect. Venus's surface is the hottest in our Solar System, over 850 degrees Fahrenheit.

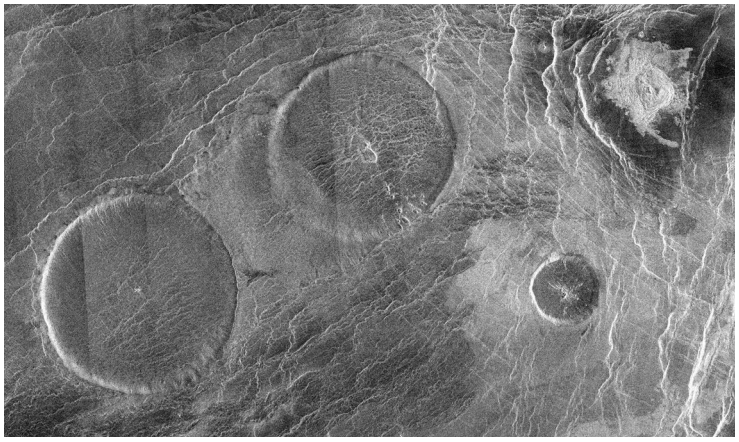
Venera 13 landed in the Phoebe Regio on Venus on March 1, 1982. This panorama covers about 170 degrees around the spacecraft using dark blue, green, and red filters. Venus's atmosphere filters out blue light, making the actual colors uncertain. The top image is the image as it was returned by Venera 13, while the bottom image has been corrected for the yellowish-orange color of the light on Venus. Part of the spacecraft is visible at the bottom of the images. Flat rock slabs and soil are visible off to the horizon. The camera's lens cover is visible at the bottom of the image. From solarviews.com/cap/venus/v13corr.htm, *image credit: Soviet Space Agency*

Since we cannot see the surface of Venus from space, we had no idea what it looked like until the former Soviet Union landed its Venera series of spacecraft on the surface. The first few gathered detailed information about conditions there that allowed the Soviets to build landers that could survive on the surface for a short period. While the earlier probes took environmental readings, it was not until the Venera 9 spacecraft landed on October 22, 1975, and took the first pictures of the surface that we could start to understand it. The pictures were returned to Earth, with the signal being relayed by the Venera 9 orbiter, which was the first spacecraft to orbit Venus.

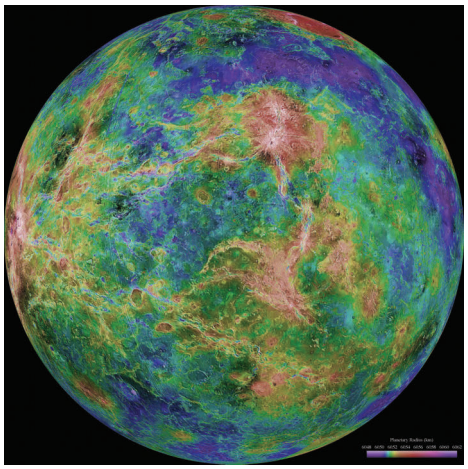
Cameras were located on both sides of the Venera landers, each covering nearly 180 degrees. The cameras were of an optical-mechanical design protected by a lens cover on the way down to the surface. On both Venera 9 and 10, the lens cap on one side did not come off, so they were only able to return 180-degree, rather than 360-degree, panoramas. The spacecraft were designed to withstand the tremendous temperature and pressure on the surface, but even so, their surface life was only between 53 and 127 minutes.

The atmosphere at the surface turned out to be clear and the Venera landers had good visibility clear to the horizon. The first panoramas were in black and white, but later Veneras carried color cameras that used dark blue, green, and red filters. The actual colors on Venus's surface are somewhat uncertain, since the atmosphere filters out blue light. The overall light intensity at the surface of Venus is similar to that of a cloudy day on Earth.

The surface is covered with rocks and soil, similar in composition to terrestrial basalt. There is no water on the surface, since the temperature is well above its boiling point. The Sun's energy has disassociated the hydrogen from the oxygen atoms in the atmospheric water vapor and the solar wind has carried away the hydrogen, which would have floated to the top of the atmosphere. This left



A pair of pancake domes (a form of slow volcano) in Eistla Regio on Venus. These two circular features are flat domes a little over a half mile high and 39 miles across. These domes are formed by the slow eruption of thick, viscous, silica-rich lava. The central pit or bowl on these features forms after the lava flow cools and volcanic gas is vented from the central pit. It is not the source of the lava. Together, the two domes are called Carmenta Farra. To the upper right is the impact crater Margarita. Image credit: NASA/JPL-Caltech



NASA's Magellan spacecraft took radar data from Venus orbit between 1990 and 1994. By combining that data with data from the Pioneer Venus mission, the Soviet Venera missions, and the Arecibo Radio Observatory in Puerto Rico, astronomers were able to create this full-disk view of Venus's surface. The colors show elevation and not the actual colors on Venus.The tan area above and right of center is Beta Regio; on the far left (west limb) is Atla Regio. Below center is Phoebe Regio and below that Themis Regio. Regio areas are highly deformed regions higher than the surrounding lava plains. The blue areas are lower elevation plains or planitia.

plenty of oxygen to combine with carbon to make the abundant carbon dioxide.

While there has never been a rover on Venus, orbiting spacecraft like the Veneras, NASA's Pioneer Venus, and, the most recent arrival in 2006, ESA's Venus Express, have surveyed the surface by radar to build maps of Venus's topography. While there are no water oceans on Venus, there are vast former "oceans" of lava that have cooled into smooth volcanic plains. The relative absence of impact craters demonstrates that the surface is only 300 to 500 million years old.

Embedded in the volcanic plains are two continents. In the northern hemisphere, Ishtar Terra is roughly the size of Australia. In the southern hemisphere, Aphrodite Terra is around the size of Africa. These are not tectonic-plate continents like here on Earth, but simply rough spots with typical topographic features like mountains, canyons, and trenches that remained above the surrounding lava plains when they flooded.

The source of the lava flood is somewhat of a mystery, with very few volcanoes on Venus as compared to Earth. Spacecraft observations showed a sudden increase in sulfur dioxide in the atmosphere in 1978, followed by a ten-fold decrease by 1986. This was followed by another increase in 2006 and another subsequent decline. In addition, there has been lightning detected in Venus's atmosphere by Venera. More recently, Venus Express detected "whistlers," very low frequency radio waves characteristic of lightning strikes. The lightning is believed to be from static electricity in the ash

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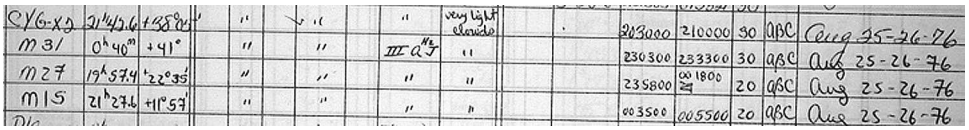
Harvard's Plate Project and Women Computers

Al Lamperti
Delaware Valley
Amateur Astronomers

Back in the Winter of 2013–2014, Carroll Iorg, then president of the Astronomical League, put out a request for volunteers to participate in the transcribing of logbooks from the Harvard Plate Project, called DASCH—Digital Access to a Sky Century at Harvard. At the time, Harvard was attempting to scan the nearly 500,000 glass photographic plates in their collection and make the digitized images accessible to anyone wishing information dating back nearly 100 years. However, before the plates could be scanned, the metadata for each plate needed to be digitized. This meant that the logbooks with information about each of these plates needed to be transcribed into digital form. This is where volunteers were needed.

Conference calls and online tutorials were led by David Sliski. After that the volunteers could access both scanned images of the logbooks and blank Excel transcription worksheets online. For each photographic plate, the following pieces of metadata were then transcribed: page number, date, plate number, any filters used, object name, right ascension, declination, start time, observing hour angle, observing declination of telescope, and stop time. Exposure times would be calculated later by Harvard. The transcribing process took nearly three years for many volunteers to complete.



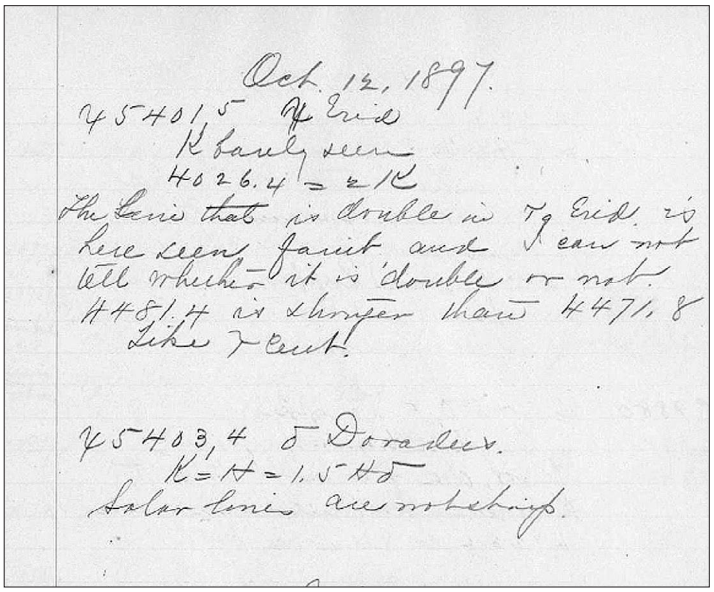
Screen capture of portion of DASCH logbook indicating data of photographic plates taken on August 25–26, 1976. Learn the identity of observer "ABC" by reading the accompanying text!

For this author, it was a true learning experience. Imagine reading notes from plates taken from 1889 through 1992 from telescopes throughout the world—Arequipa, Peru, to Cambridge, Massachusetts—and appreciating the immense astronomical history contained within them: comets, novae, spectroscopic binary discoveries. Among the more than 83,000 plates transcribed, there were six plates from 1976 that I took particular notice of. These were taken by a telescope operator with the initials "ABC" (top picture). On the bottom of that logbook page, the initials indicated that they belonged to Aaron B. Clevenson! What a coincidence that the Astronomical League's national Observing Program coordinator had a previous life at the Oak Ridge Observatory! I'm sure his memories of Comet West, Cygnus X-1, M31, M27, M15, and the BL Lacertae object B2 1308+326 are still quite vivid.

Many of these early historical plates were painstakingly analyzed by Harvard's women computers, including Annie Jump Cannon, Henrietta Leavitt, and Antonia Maury. Their perseverance and analytical acumen provided the scientific community with information that was previously unknown and is still referenced today. Moreover, it propelled science to new levels and truly expanded horizons. The recent book by Dava Sobel, *The Glass Universe: How the Ladies of the Harvard Observatory Took Measure of the Stars*, is a wonderful accounting of their lives and feats.

Now the next phase of volunteers is upon us. Project Phaedra (*altbibl.io/gazette/introducing-project-phaedra*) seeks transcribers of the actual notes of Annie Cannon and Henrietta Leavitt. The bottom picture shows a page of Annie Cannon's handwritten notes. Interested volunteers transcribe these notes via the Smithsonian Transcription Center, *transcription.si.edu*. In the process, one learns, among other things, how details of the spectra of stars on the plates led to the categorization of stars that we know today.

This project will help preserve the hard-earned data in electronic form for future generations to tap into. While we were touring the Harvard Observatory and its plate collection after Stellafane in 2014, my wife, the Astro-Widow, mentioned to the folks there that the sooner these handwritten notes and logbooks are transcribed to an electronic form, the better, because young people are no longer taught to read or write in cursive in school! So you can help preserve valuable astronomical history and join the group of volunteers. What better way to amuse oneself and help others now and in the future when the weather precludes observing!



Screen capture of a page from Annie Jump Cannon's 1897 notebook describing her interpretations of the spectra of Chi Eridani and Delta Doradus from plates taken with the 13-inch Boyden refractor in1893 from Arequipa, Peru.

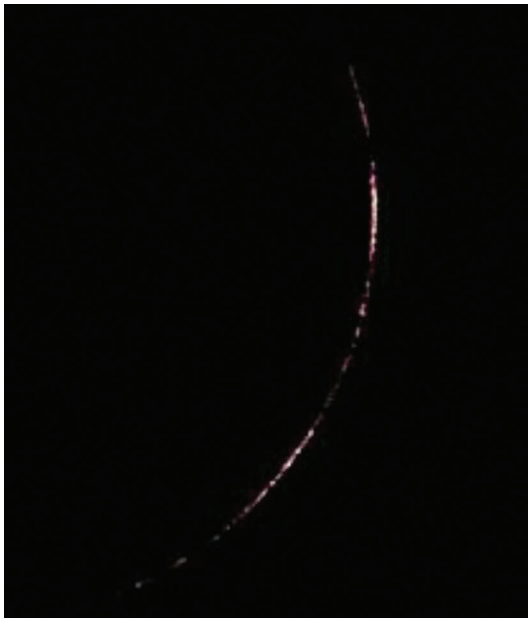
Extreme Lunar Crescent Hunting Tips

By Stephen Saber

The moonrise before and moonset after each new moon offer stargazers the opportunity to view the thinnest lunar crescents. There are many websites and apps that provide exact moonrise and moonset data for any location. Here are some additional tips to maximize your chances of sighting our very young (or old) moon.

Set up at a site with as much altitude as possible overlooking an unobstructed horizon.

Optimal sky transparency



allows the crescent to be detected and tracked down to, or up from, the horizon.

Using a telescope or binoculars (mounted binos are recommended), fine tune the focus on Venus, Jupiter, or one of the brighter stars beforehand.

For dusk attempts, have Sol's setting azimuth on hand—making note after sunset of a landmark at that position for reference—as well as Luna's alt-az position at sunset through moonset. Accordingly, for dawn attempts, have Luna's alt-az information for moonrise through sunrise.

As dawn slivers have the advantage of possible detection with dark-adapted eyes, wearing sunglasses during the day prior to sunset attempts is recommended for maximum "dusk" adaptation.

Once the crescent is acquired in binoculars, walk the binos down to the horizon or landmark noted earlier in consecutive fields of view for the approximate naked-eye alt-az.

A favorable elongation is important. In the 24 hours before or after new moon, Luna's angular separation from Sol can vary by several degrees. With a favorable ecliptic, net elongations (as altitude) of 6 degrees or more at sunset or moonrise offer the best window for detection.

Observers nearer to the equator than the poles enjoy a much greater frequency of steep ecliptics.

Illuminated fractions of same-age crescents within 24 hours of new moon can vary by 200 percent and by a full magnitude of brightness due to distance, libration, and sun angle. Slivers near perigee present a thicker and brighter lunar profile, which helps personal record crescent spotting.

Last but not least, don't always count out a shallow ecliptic. Occasionally our moon's extreme northern or southern declination will compensate for a less than favorable ecliptic angle.

Bracketing the slivers

Another rare and challenging notch is to catch the consecutive waning and waxing crescents within 24 hours on each side of new moon.

For example, the new moon before July 2008's full "Buck Moon" offered such an opportunity, as I was able to spot both the –16.5-hour illumination before sunrise on the 2nd and the +23.5-hour sliver just after sunset on July 3.

Clean horizons for both windows is a gift in itself.

Saber's Beads

The "holy grail" of extreme crescent hunting is to catch the segmented arc of illuminations occurring before and after the first and last complete crescent.

Personal research of 100+ sighted thin crescents (at 2 percent or less illumination) and several hundred simulations indicate additional favorable parameters to sight this aspect include that our moon ideally be revealing 1.4 percent or less illumination while traveling on a neutral or northern ecliptic declination, while also showing a strong south and east libration.

It's a rare alignment of cycles, but the visual aspect can now be more realistically simulated and predicted with the advancement of programs and apps derived from NASA's Lunar Reconnaissance Orbiter data.

On the plus side, the full necklace of Saber's Beads can be sighted on crescents within about 30 hours of new moon (within 20 to 24 hours generally provides the most beading observable in a darker, deep twilight sky).

Happy hunting!

[Excerpt from *Saber Does The Stars* by Stephen Saber]

c14isawesome.blogspot.com
saberdoesthestars.wordpress.com
saberscorpx.vidmeup.com

Stephen Saber is a member of the Peoria Astronomical Society in Rock Island, Illinois.

Video Astronomy: The Image Game Has Changed

By John Symborski

I've been an avid observer for over twenty years now—most of the time with a Newtonian telescope. I've had aperture fever, chased down ever more remote observing sites in search of darker skies, and have even redesigned and refigured a 16-inch beast to eke out the elusive details just beyond the reach of my averted vision (imagination?). But changing life circumstances and the effects of 63 years have worked against my efforts, with the result that my time under the stars has diminished along with some of my faculties.

The idea of delving into some sort of astro-imaging gradually took root in recent years. After all, many are taking advantage of improved technology to become involved in this rapidly growing segment of our hobby. To that end, I kept an eye out for a suitable mount, and eventually found one. Check out the new products in the July 2016 *Sky & Telescope* (page 38) for the iOptron AZ Mount Pro, an adequate cube now on the market. The June 2016 issue (page 60) reviews the Sky-Watcher AZ-EQ5 mount, also good for an 8-inch SCT or short-focus refractor, which are common instruments of choice for entry-level imaging and beyond. Longer or heavier tubes will take a much heavier mount (ugh).

Some time later I bought a venerable 8-inch SCT tube—although it had been stripped of anything formerly attached, and I had to send out the secondary mirror for re-aluminizing. With odds and ends gathered at swap tables over time, a "new" scope was completed at half the retail cost—the ATMer in me wouldn't have it any other way. And as luck would have it, the Ronchi test had beautifully straight lines, indicating good optics! But then I was clueless about how to get into the "shallow end" of the astrophotography pool.

Then I saw the article beginning on page 66 of the March 2016 issue of *Sky & Telescope* describing the current state of affordable astro-video gear. You can read that for yourself, so I won't repeat any of it here. My impression was that this could be a good way to "get into the game" without having any imaging experience, without having to undergo an extensive learning curve and, most importantly, without having to take out a home equity loan. Each captured screen image sure looked impressive, but was this too good to be true? I decided that if *S&T* vetted the technology, it must be at least close to the truth—close enough for me to drive to the nearest brick-and-mortar telescope store to inquire about the possibilities.

To my surprise, they had a kit in stock that wasn't among the three mentioned in the *S&T* article—the Revolution Imager. For a package price of $299, the soft case contained all the items needed (other than a telescope) to jump right into video astronomy, including cables, LCD monitor, and a lithium-ion battery and charger. Optional was a USB-to-video connector and the Celestron "Evo-Revo" hardware kit for mounting the monitor to an SCT optical tube. The store associate printed out a copy of additional online instructions, gave a hands-on demo of the assembly, and we took a daylight image of a communication tower that was nearly two miles away. The decision to acquire the camera was then an easy one to make.

Since that time, the original Revolution camera became unavailable due to a discontinuation of the chip, but they soon were able to supply a comparable unit with the kit at the same price. The new camera has different controlling software affording better gain control, while still having about the same sensitivity. The maximum exposure is not as long, but the new camera stacks 6 images versus the original's limit of 5.

From home, some observing was done under a nearly full moon to fully train my cube mount in altitude-azimuth operation—similar in operation to single- and dual-arm mounts without a wedge. To get the pointing accuracy needed, I learned how to use handbox in "high-precision" mode and I was surprised to get color video images of M42 and 43 by just fooling around with the settings. A few nights past the full moon, and after a reviewing both the instructions and tips gleaned from the Internet, I set up on my driveway in a moderately light-polluted suburb of Pottstown, Pennsylvania, right between the Philadelphia and Reading light-domes, with four carriage lights ablaze across the street. The scope was initialized with an eyepiece and star diagonal, both of which were then removed, and the camera (with 50 percent focal reducer) was put right into the visual back and was close to focus.

Once the video camera was set up and focused, I used a collimated right-angle finder with an illuminated reticle to roughly center each "high-precision" (or synced) reference star. Final centering was done on screen with a short exposure for nearly real-time output. Note that a stable mount is key for most astrophotography, and long tubes are *not* advisable. Yet the much shorter exposures afforded by the larger, more sensitive video camera pixels mean that an equatorial mount is not a requirement, or if one is used, the polar alignment need not be as precise as with high-resolution imaging. Bear in mind that the original camera is the one I happen to have, and the new camera's controls are different.

To keep it simple for test purposes, certain settings were saved as constants: gamma 1.0, sharpness 80, lens (exposure) auto, 3D high (5-frame stacking), and AGC (automatic gain control) at low. Black and white is best for faint galaxies and nebulae (with or without a filter), while color is good for most everything else except the Moon. The only two parameters left for me to play with were sense-up, which has exposure limits (x-factors) that can be raised or lowered, and brightness—a peculiar gain modifier that works with the firmware in a counterintuitive way. It seems that the lower the average pixel brightness a shot has (like diffuse nebulae), the lower the brightness number has to go to get the best image. When changing a setting, get in the habit of using "Save and Exit" under the Exit sub-menu, or the image will automatically revert to what was last saved. Keeping a record of the settings for your target is also a good idea, as trends will develop that can be good starting points for similar objects.

Going back to M42 and 43, pleasing views in color were had with the brightness between 20 and 40 and sense-up x128. To lessen the overexposure in the Trapezium area, sense-up was dropped to x64. I just couldn't get over how nice this bright nebula appeared on the LCD monitor. It was so good that I forgot to slew to the nearby "running man" nebulosity, which (at least) would have

needed the sense-up bumped higher. The monitor must be viewed with eyes about level with the screen, but there is wide side-to-side flexibility without dimming the image. All of the bright summer nebulae should be a pleasure to behold. The clusters of M103, NGC 663, and M35 were easy to image in color, and the stars were in decent focus with no coma, since the relatively small chip only images the central area of the telescope's light cone.

Black-and-white mode was used for Hubble's Variable Nebula (NGC 2261), with brightness at 20 and sense-up x512. M78 (a reflection nebula) was a little finicky, but looked pretty good in black-and-white when I shifted the AGC to mid, the sense-up at x512, and the brightness down to 5. More experienced imagers can do even better by varying everything manually, and higher-end video equipment allows them to do that with more finesse. But as an imaging newbie, I preferred to let the "autopilot" do most of the work. And it was thrilling to get so much out of it on my second night out. Instead of being defeated by light pollution (not that we should ever stop trying to mitigate it), there is now a way to work around it. Of course, should I take this equipment to a dark site, I'll shield the screen or be near the edge of the field out of courtesy towards other observers.

M51 was a wonderful surprise in spite of not being very high in the east, using black and white, AGC low, brightness 35, and sense-up x1024. All I could say was *wow!* Both spiral arms were shown going around the core one and a half revolutions, with one arm connected to the companion galaxy. It appeared as good as I've ever seen it with my 16-inch Newtonian at a dark site. M108 with the same settings showed more detail than I've ever seen in it. Now things got even better after I put on a UHC filter for M97 (the Owl Nebula) with brightness 20, AGC mid, and sense-up x512. I was thinking, "OMG—both 'eyes' are staring back at me!" I've never before perceived more than a hint of them, yet there they were—clear and unambiguous. Then I realized that this was the *best* observing night I'd experienced in years, hands down.

On my next night, I tested the unit on three successively fainter targets. The "running man" (around NGC 1973) required black and white, x512, brightness 20, gamma 0.60, and AGC low. The figure was easy to see on screen, and was a first for me. Tougher was the Flame Nebula (NGC 2024) that required a UHC filter, black and white, x1024, brightness 3, gamma 0.45, and AGC low. Yet there it was, with less contrast but clearly identifiable. The Horsehead Nebula (IC 434 and B33) needed a trained eye to make out using the same extreme settings, but I was gratified nonetheless. An H-beta filter and darker skies will improve the result.

Of course, these are not high-resolution images, but there are not many who can master (or afford) that sort of astrophotography. Small targets (other than individual stars) or planets require different cameras and telescopes. But from my standpoint, an astronomy video camera is a new kind of "eyepiece"—one that can "see through" light pollution as well as multiply a telescope's effective aperture. There is even an available Wi-Fi transmitter, so others can share images on their smartphones or iPods. One can also capture images on a laptop, and then further enhance them later. For public star parties and outreach events, video astronomy has everything going for it. For me, this has definitely rekindled the fire of discovery I felt in prior years, as I hope it will for many others.

Good luck and great viewing!

John Symborski is a member of the Delaware Valley Amateur Astronomers in Kimberton, Pennsylvania.

HAVE A SUCCESSFUL OBSERVING SESSION

By Jamey L. Jenkins

Clockwise we have the Sun, a conjunction of Regulus and Mars, the Moon, and the planet Venus. Images courtesy of Jamey Jenkins.

Shared experiences, such as this sol finding a mentor. Courtesy of Jamey

If you are like me, amateur astronomy is a rewarding pastime. I've found learning fun, and peering through a telescope to study the nighttime or daytime sky an edifying experience. Astronomy has become a lifelong hobby!

Over the years, numerous observing sessions taught me several beneficial lessons. Now, I'm not referring to selecting a telescope, or how to find a particular star cluster. Rather, I want to emphasize points that prepare you to be a more resilient observer; one that understands *how to keep your avocation a satisfying and rewarding pastime*.

Some time ago, Bill Pellerin of the Houston Astronomical Society brought to my attention several prescriptions regarding successful observing. He had spoken on this topic, formulating a short collection of recommendations to improve amateur observing habits. With his permission, I have adapted several of his proposals, added to the list, and offer an independent dialogue on each topic. The steps presented here consist of passion, preparation, programs, planning, perseverance, patience, and presentation—the seven Ps of a successful observing session.

• Step One: Know what interests you as an avocation.

Passion

Here is a word that sums up why we pursue any hobby, whether it is auto racing, painting, or what have you. Defined, passion is a powerful or compelling feeling of devotion. In simplest terms, think of it as your interest. For our discussion, ask yourself what area of astronomy interests you. Do you have a passion for lunar observing, variable star watching, or just a casual observing of everything? There is no right or wrong answer, there is just *your* answer. My point is that to have a satisfying (that is, successful) observing experience we must first identify our passions.

• Step Two: Find out as much as you can about your passion.

Preparation

When you bake a cake, do you check beforehand whether you have the correct recipe and necessary ingredients, or do you just dive in, and randomly start mixing eggs and flour only to find all the sugar has been loaned to your neighbor? That approach is a sure sign of failure in the kitchen. It's the same with astronomical observing: successful observations result from careful preparations.

Preparation for astronomical observations begins with developing an understanding of the subject. This requires us to do our homework, to study up on our celestial target. This is easy when your subject is also your passion. It becomes a fun activity. The Internet contains myriad resources forming a database of knowledge on any astronomical topic. The public library is another valuable source for books and magazines on numerous astronomical subjects.

Being a member of a local astronomical club or society can open doors of knowledge through friendships and acquaintances developed in the course of meetings or group observing sessions. National and international organizations serve the same purpose with their user groups, meetings, newsletters, and journals. The idea with this tactic is to find a mentor or group of mentors, and develop expertise from that relationship.

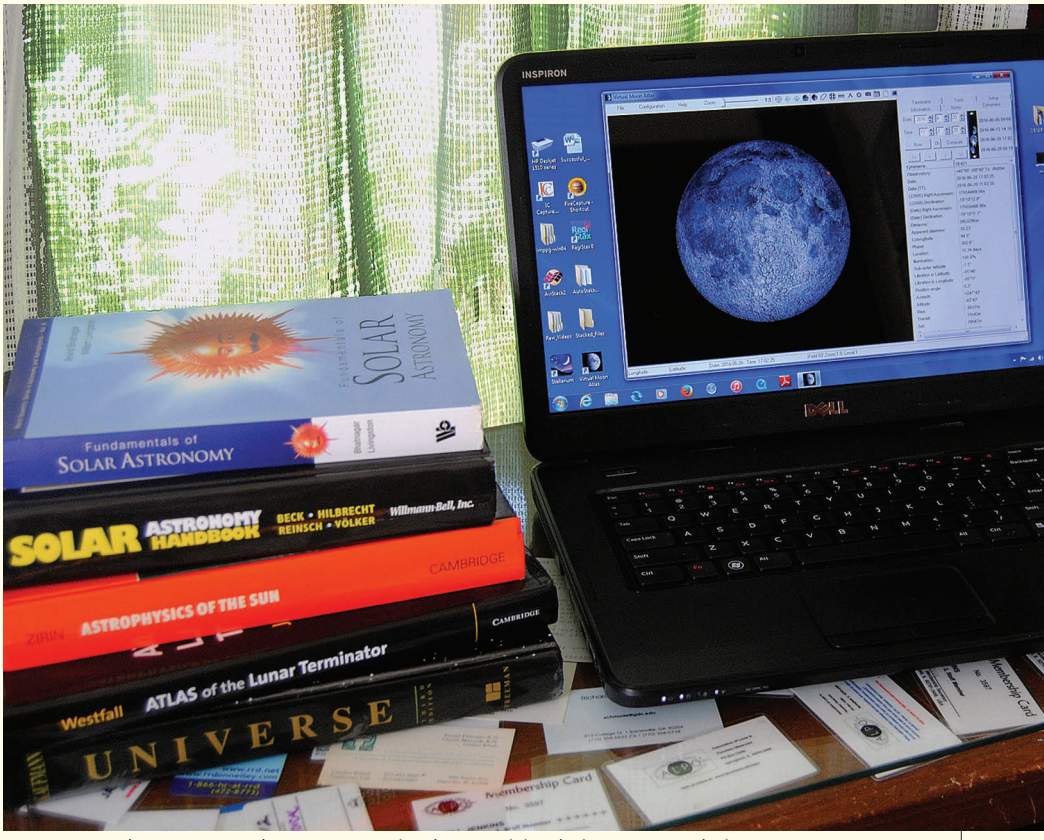
Focus on equipment needs for a particular passion, and how to effectively use that equipment. The tools the astronomer utilizes are critical for successful observations. Understand optimizing observing conditions: the importance of a dark-sky site, steady atmosphere, and when and where your object is best placed for observation are all considerations of the circumspect observer. All these facets prepare you to maximize enjoyment of your hobby.

• Step Three: Find a purpose to your observing.

Programs

This is one theme that I believe could be promoted to new and veteran observers alike. I like to call it "observing with a purpose," while others have referred to it as the observer's

ar observing gathering, will open the door to
y Jenkins.



Learn as much as you can about your passion by practicing being an "armchair astronomer."

goals. Participation in an astronomical program serves several functions. Primarily, it gives the observer a legitimate sense of direction, a reason to pursue his passion. Secondly, if the observer is working within an organization, their observations most certainly contribute to an ever-growing database.

Some programs are designed for personal enrichment. These programs are meant to help develop good observing habits, educate, and provide the amateur astronomer with an observing challenge.

Database-style observing programs are facilitated by the Association of Lunar and Planetary Observers, the American Association of Variable Star Observers, and the British Astronomical Association. The Astronomical League promotes a long list of self-enrichment programs for beginner-, intermediate-, and advanced-level observers.

• Step Four: Take time to plan your observing session, create a checklist, and prepare a "plan B."

Planning

The importance of a well-thought-out observing plan became evident to me after a transit of the planet Mercury in 1999. Last-minute decisions to record the event resulted in an entire series of images being exposed on a single frame of film. The film was not properly seated on the take-up spool of the camera, and consequently it failed to advance after each picture. The entire observing session didn't produce a single usable photo of the event, a result of poor planning.

Effective planning recognizes that observing time can be a rare commodity. Personal time for an individual may be infrequent, and celestial events are simply not reschedulable. These two factors necessitate working out a simple course of action for even the enjoyment of tracking down faint deep-sky

Continued on page 20

To validate observing milestones, the Astronomical League provides these certificates of achievement.

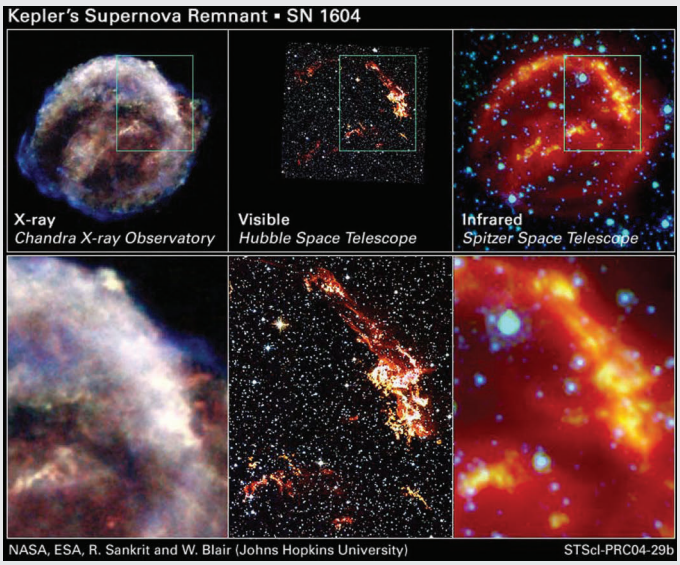
Award pins are distributed by the Astronomical League to honor achievement through the League's various Observing Programs.

Kepler's Supernova Remnant

As I write, less than two hours before New Horizon's epochal sweep through Pluto's system, a sense of history prevails. Future explorers may reflect on this milestone completion of the initial survey of the "classical" planets of the Solar System as an exordium of cultural expansion. In 1604, an event occurred that fostered similar curiosity in those equipped to probe the workings of the heavens. Four hundred eleven years ago a clarion call to the information age sounded loudly at the Serpent's foot, drawing together people who would change our perception of the Universe. Its remnant has been found visible to our eyes.

When he was nine, Johannes Kepler's naturalist mother Katarina showed him a lunar eclipse that sparked his interest in the sky. We might see his childhood, punctuated by illness including smallpox that left his sight diminished, as understanding affected orbits affecting orbits' understanding. To the benefit of future generations, what he was unable to observe with his eyes was replaced by an internal vision about planetary mechanics. Kepler is remembered for many accomplishments, most notably his three laws of planetary orbital motion. He developed a proof of logarithms that gave him and fellow mathematicians confidence in a tool of great efficiency to speed calculations. Kepler modified Galileo's optics by using two convex lenses, and produced the Rudolphine Tables of accurate star positions and predictions of planetary movement. He correctly described how the eye's lens inverts images, and that our brain compensates for the effect. In 1610 he coined the term "satellites" to describe Galileo's Jovian moons.

In the early seventeenth century there was vocational overlap between those now termed astrologers and astronomers. Most teachers interested in the workings of celestial bodies, including Kepler, made part of their living interpreting and predicting cosmic events for wealthy and powerful earthly ones. In ways both immediate, such as tides and seasons, and long-term (think dinosaurs), heavenly motions did influence proceedings on Earth. Prognosticators foretold a conjunction of Mars and Jupiter with Saturn nearby for October 8, 1604. They were off not just in their timing, but in failing to forecast one of the sky's rarest displays. The event overshadowing all others was not the one predicted, but another that would shatter preconceptions about the unchanging heavens dating to Aristotle. Hundreds of years later this supernova and its kin would enhance the budding science of astrophysics to inform the study of objects and processes Kepler and Galileo would have loved to understand: element synthesis, stellar evolution, shockwave-induced solar system formation, neutron stars, pulsars, microquasars, and black holes. On October 9, observers in Italy were the first to spot what they called a "nova," or new star, in southeastern Ophiuchus, four degrees southeast of the globular cluster Messier 9. The object that would be known as the last naked-eye Milky Way supernova for over four centuries brought together and intertwined the talents of the greatest celestial mechanic with the best pre- and post-telescopic observers of the time.



Multiwavelength image using X-ray, infrared, and optical data from three space telescopes.

The spectacular supernova came three years after the death of Tycho Brahe, who documented a similar event in 1572. Kepler had been accepted as Tycho's assistant after the latter read a copy of his *Mysterium Cosmographicum*, a treatise sent to the Dane attempting to explain the spacing of the planets. By the time of the supernova, Kepler had full access to Tycho's accurate database of stellar and planetary positions, and was using them in his "War with Mars" to understand idiosyncrasies in the Red Planet's orbit.

In Italy, Galileo was a professor of mathematics in Padua at the time of the 1604 supernova. In his 1978 study, *Galileo at Work*, Stillman Drake claimed that the future astronomer had shown no interest in visual observations of the sky before this event. Because the new object generated great public interest, Galileo was asked to give three public lectures about it, and some of his notes still exist. He had been informed about the new star soon after its discovery, but did not observe it until October 28. When asked why he waited so long, Galileo's reply was defensive, wondering how any astronomer could be expected to just watch the sky for a "new star" to appear. It's interesting to speculate what may have caused this delay—was it fostered by a belief in the paucity of novel events, despite the well documented "nova" of 1572 that occurred during his childhood? Did this new star of 1604 trigger a latent interest in Galileo about watching the sky, and prepare the ground for his later telescopic discoveries?

Aristotle's belief that the Universe was unchanging was an idea whose foundations were crumbling. Copernicus's theory of a sun-centered Solar System predated the 1543 publication of his treatise, and Tycho Brahe's carefully documented observations of the supernova of 1572 created doubt about the "immutability" of the heavens. Kepler, who would use Tycho's planetary positions to revolutionize orbital mechanics, was the most persistent Western documenter of the 1604 event, though he did not approach Tycho's level of detail. Chinese records of the time are also more complete than Kepler's, as their court astrologers were mandated to use interpretation of celestial occurrences to assist their emperor. Record keeping in the Far East was an important part of cultural continuity, and those involved did not risk one stigma faced by Western astronomers: disagreeing with millennia-old dogma. Kepler recorded his observations in his 1606 book, *On the New Star in Ophiuchus's Foot*.

The 1604 supernova appeared initially as bright as Mars, and within a few days surpassed Jupiter. At the time, Kepler was employed in Prague by Emperor Rudolph II. Kepler started observing it when weather allowed, eight days after it appeared, and monitored it for one year. He proposed several hypotheses as to its nature, including a "condensation" of matter in space, but ultimately called it a "new star." Visible in the daytime for about three weeks, it was followed until it dropped below naked-eye visibility in March 1606.

In 1941 Walter Baade used the 100-inch Hooker telescope at Mount Wilson Observatory to

recover the visible remnant of Kepler's supernova. He estimated the supernova's peak magnitude at –2.25. At about the same time, radio telescopes were beginning to search the sky for sources, and the 1604 supernova remnant was catalogued in the third Cambridge radio survey as 3C 358. The understanding of these stellar explosions was then in its early stage, but Baade speculated it to be a type Ia, an event we now think occurs from mass transfer between an evolved stellar remnant of a medium-mass star like our Sun, called a white dwarf, and a more massive star near enough to transfer material onto the white dwarf by tidal effects. The merging of two white dwarf stars is another method of producing this type of supernova. When the star reaches 1.4 solar masses, it can no longer support itself against a conflagration, and a type Ia supernova is born. Six decades after Baade, studies using the different wavelengths of three of the "Great Observatories" in space (Hubble, Spitzer, and Chandra) produced data explaining the nature of the event.

In 2013, Carles Badenes, of the University of Pittsburgh and NASA, published reports in the *Astrophysical Journal* confirming the object as a type Ia supernova. Data from the Japanese X-ray satellite Suzaku showed the remnant contained iron, chromium, manganese, and nickel, with a ratio of "heavy" elements three times higher than in our Sun. Kepler's supernova remnant is located 23,000 light-years from us, in the general direction of the Milky Way's central region, one explanation for its increased metallicity. James Kaler noted the remnant to be high above the galactic plane, a position likely caused by its progenitor receiving a propulsive "kick." Groups have estimated the age of the white dwarf star before the explosion at one billion years. The infrared Spitzer Space Telescope found that circumstellar dust from before the star had exploded was now shock-heated by the expanding supernova ejecta. Chandra discovered X-rays from similarly affected gas and material thrown from the star's explosion. The hottest region, with the highest energy X-rays, was seen right behind the shock wave expanding at a rate of 2,000 kilometers per second. In a February 10, 2013, ApJ paper, data from Chandra was used to determine that the companion star to the white dwarf was a red giant.

The year 2004 marked the quadricentennial anniversary of Kepler's supernova. In that year a conference was held in Padua, Italy

Location of Kepler's supernova remnant.

celebrating the event. That same year the Space Telescope Science Institute released a multiwavelength image revealing unprecedented detail using X-ray, infrared, and optical data from three space telescopes. These images, particularly from Hubble, caught my eye as I was planning a trip to the 2004 Texas Star Party. I wondered what might be visible to an observer, and thought it fitting to attempt its visual recovery four hundred years after it first appeared in our skies.

My starting point was Sidney van den Bergh's 1977 paper from the *Astrophysical Journal* (*ApJ* v. 218, p. 617–632), called "The Remnant of Kepler's Supernova." He quoted Kepler's prescient 1604 remark about whether this new star "signifies something of such exalted importance that it is beyond the grasp and understanding of any man." It was certainly beyond the grasp of early seventeenth-century technology and understanding! The invention and use of the telescope was several years off and may, as in the case of Galileo above, have been stimulated by it. The 1977 paper included plates from the 4-meter CTIO telescope in Chile. "Knots" of expanding remnant material are clearly seen in the paper's figure 2, with over two dozen designated. Correlating this image with a POSS 2 red plate centered on 17h 30m 41s, –21d 29m 11s, which approximates the center of the shells found later with the space telescopes, produces a small group of knots numbered 11 to 14 in van den Bergh's study. The densest and brightest knot seen on the POSS plate is 1.2 arcminutes to the west-northwest of that center and corresponds to the brightest section recovered in the HST image. It is curved, shaped like an upside-down Y, and contains fifteen identified knots with numbers from 1 to 26 in van den Bergh's paper. There are also several small, scattered knots around the field to the southeast, south, southwest, and north of the central region visible on the Hubble image.

At the 2004 Texas Star Party I used my 25-inch f/5 reflector with a 7 mm Nagler type 2 eyepiece to give 454 power. Between 2 and 3 a.m. on the morning of May 23, I was able to see the northwestern section easily, elongated as a string 30 arcseconds in length, proceeding northeast to southwest. The central section consisting of knots 11 to 14 was also visible as longer in the north-south direction, extending 10 to 15 arcseconds. Both were a few arcseconds wide. At the time of the observation in 2004 I had not included on my finder charts the smaller sections visible on the HST image, as they are not readily apparent on the POSS. They remind me of the wisps I have seen scattered across the Veil Nebula. My hope is to attempt them from my home during a late summer or fall session with my 32-inch f/4 reflector, as I continue my study of this fine object.

In the twenty-first century, we've become accustomed to daily reports of new discoveries in diverse fields, and accept our understanding of nature as incomplete. This familiarity may inure us to a perspective of events with paradigm-changing implications, such as the supernovae of 1572 and 1604. Whimsically, we may entertain such repetition within a generation as the heavens saying, "In case you didn't hear me the first time," but such sciento-cultural fortune seems all the more auspicious in retrospect as 1604 marked the last naked-eye supernova seen within our galaxy. Are there tides in times of change when fertile thoughts in a few minds flood a plain of preparedness, as in understanding relativity a century ago, quasars in 1963, and the accelerating expansion of the Universe revealed in 1998 by distant supernovae? Our stage seems awhirl with new ideas as the pace of discovery quickens. I write this on the day of announcement from the Large Hadron Collider describing a possible new state of matter, pentaquarks, threatened to upstage the New Horizons flyby of Pluto, and both competed with the signing of a multi-national treaty to contain and prevent a different type of supernova: nuclear proliferation. Conjunctions of people and events surrounding Brahe, Kepler, and Galileo appear focused by these historic supernovae and the telescopic and intellectual discoveries we associate with them. Few of our visual observations are likely to have the scientific impact of Kepler's 1604 event, but there will always be a thrill of connection to past observers to see with our own eyes objects that, centuries later, continue to inspire studies that deepen our appreciation of the Universe.

Dave Tosteson
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Observing/*from page 17*

fuzzies. Begin by identifying when you can observe, how that affects placement of your target, and estimate the amount of time you can devote to the observing session.

A timed event such as an eclipse or transit benefits from development of a spreadsheet. On your spreadsheet, detail the event and what you will do at specified times. Computer programs and apps exist that allow the observer to utilize interactive charts, observing guides for the planets, deep-sky catalogs, lunar ephemerides, and maps. Assemble the tools necessary to create a functional observing schedule and use them.

If you have a backyard observatory, that is all the better; however, not everyone does. In those cases, make a checklist of equipment to be packed for the trip to your chosen observing site. Are the batteries charged for your portable equipment? Items to include that are sometimes forgotten are bug spray, appropriate clothing for unexpected weather conditions, an observing stool, and a table to support laptops, charts, notebooks, and pencils. Provide a snack and water for break time.

Unfortunately, even the best made plans sometimes go awry. Clouds can intervene or unexpected misadventures can disrupt an observing session. Develop a backup plan in case the initial scheme fails to reach fruition. The key is to provide yourself an alternative that makes use of the precious time set aside for your recreation. Planning makes for an enjoyable observing session.

• Step Five: Develop a stick-to-it attitude regarding your observing ambitions.

Perseverance

The motto for perseverance is "never give up." If and when you find plans go topsy-turvy, save those plans for another day. Poor observing conditions can be waited out until they improve. If the problem is stubborn, put plan B into effect. If backup plans are impossible, embrace the perseverance motto, and aim for another day.

• Step Six: Accept that anything worthwhile sometimes requires time, and consequently patience.

Patience

Along with perseverance, an attitude of patience is invaluable for the successful astronomical observer. Many astronomical programs take time to complete. While the goal of all programs is the completion of the project, the effort expended is chiefly for enrichment and enjoyment—so enjoy it! Pace the observing when necessary—wearing ourselves out on an observing project is not conducive to satisfying experiences. Let's put it this way: it's not a job, it's a hobby. While some "citizen scientist" projects require producing scientific-quality data, remember that ultimately, we are hobbyists and not research scientists. If your observing session falls short of its goal, return to it another time. By relying on perseverance and patience, your observing program will be successful, and ultimately satisfying.

• Step Seven: Well-recorded observations create value, inspiration, and pride.

Presentation

Astronomers who develop a well-preserved, organized system of their observations understand the importance of presentation when it comes to their hobby. The outward appearance of the observing journal can reflect the energy put into a project by the observer. Quality presentations inspire fellow hobbyists, and, for the observer, generate personal satisfaction.

Take time to document your observing sessions thoughtfully. There will come a time when you reflect back on previous observing experiences. Images or drawings are invaluable when pertinent information is included.

To have a successful observing session certainly doesn't require an observer to follow all seven Ps to the letter. Many amateur astronomers find contentment in their own ways. If you are seeking a new avenue to embrace astronomy as a hobby, I recommend trying several of these suggestions, and seeing how it goes. Prepare and plan, find an observing program, but above all, enjoy your time under the stars for the awe-inspiring activity it is meant to be.

Jamey Jenkins is a member of the Twin Cities Amateur Astronomers in Bloomington, Illinois.

THANKSGIVING WITH THE STARS 2017

November 23 when midnight chimes
I glance towards east
As Orion climbs

M67 and the Beehive Cluster
Give all the light
The two can muster

The sons of Leda above us spin
Castor and Pollux
The heads of twins

Procyon sits in Canis Minor
Drop down and south
There's nothing finer

The Crab Nebula, Messier One
Poses for pictures
A supernova's son

Climb up with me to M37
Pass the Starfish
To the zenith of heaven

My favorite ladies aim to please
The Seven Sisters
Of the Pleiades

Known from antiquity to here and now
The sight forever
Causes wow

Then the jewel of the sky
Orion's glow
Fills the eye

Mintaka, Alnilam, and Alnitak
Their majesty
Takes me back

The Horsehead and the Flame
Nebulae
With equal fame

M42, Orion's best
The brightest one
Outshines the rest

Oh, Betelgeuse and Bellatrix
Atop them all
Above the mix

Moving west to Cetus A
A spiral galaxy
Has come to play

M77 is its name
It was first discovered
By Méchain

A close rival, M74
Just to the west
A treasure store

Pisces contains this galactic charm
Look real close
To see the arms

Uranus sits just below
Grab a star
Come on let's go

Triangulum Galaxy, Messier 33
Lurks about
So hard to see

The Little Dumbbell and M103
Invites a look
From you and me

Perseus holds Medusa's head
But leaves nothing
For us to dread

As Mirfak outshines Algol
Capella reigns
Outdoes them all

Don't forget the California Neb
Its wispy clouds
That form a web

Alpheratz in Pegasus
To see them both
Is a must

Andromeda, the Chained Lady
Outstretched arms
For all to see

M31, 32, and 110
The coolest trio
To view again

The Great Andromeda, M31
A spiral galaxy
Second to none

Up to Almach then M34
No time to rest
There's so much more

Cassiopeia holds Schedar, Caph, and Navi
And don't neglect
M103

Our patient friend Polaris waits
And guards our scopes
To the northern gates

Ursa Minor with Kochab
Through the darkness
Makes a stab

In Ursa Major M81
Found by Bode
Not just one

M108 and the Owl
Two big eyes
Just like a fowl

Thanksgiving Day
is now here
The things I've seen
I hold dear

I'm so thankful for the stars,
that's true
But am more thankful
For friends like you

Happy Astronomers' Thanksgiving!
DeWayne C. Bricker,
Shreveport-Bossier Astronomical Society

HOWL-EEN FUN

By Philip Sacco (Master Observer no. 11) and Bill Warren (Master Observer no. 4)

Astronomers aren't afraid of the dark. But maybe we should be, because Halloween is coming—a time for witches, ghosts, goblins, banshees, and things that go bump in the night. If you like scary things, this Halloween trick-or-treat list will be right up your alley. So fix yourself a hot cup of witches' brew, put on something to keep you warm when your blood runs cold, and take a trip with us to the "dark side" for a Howl-een good time!

Warmup Exercises: Since we're going to share this Fright Night with unearthly creatures and things that shriek and moan when the sun goes down, let's start with a few naked-eye creepy constellations to get us in the mood of the evening.

- Delphinus, the dolphin, lies high overhead by mid-evening. It's located just northeast of Aquila, the eagle. (We know, dolphins aren't scary—but Delphinus was once called "Job's coffin" due to its old-timey coffin shape. It needs to be laid to rest.) Finding the coffin will be an "undertaking" that won't let you down, heeheehee!
- Another warmup constellation lies just south of Pegasus, the flying horse: Cetus, the sea monster. (Okay, Cetus is a whale—but since whales are found in the ocean, a whale in the sky certainly qualifies as a monster!) On Halloween, this monster whale is a real "killer."
- Draco, the dragon, flies high in the northern sky. You'll be "Puff-ed" up with pride when you find this magic dragon—if, that is, it doesn't eat you first! Ha haah!
- Finally, there is Cerberus, the three-headed "hound of Hades." In Greek mythology, Cerberus guarded the gates of the underworld to keep the dead from leaving. Johannes Hevelius created this short-lived constellation, depicting it as three stars in the hand of Hercules, the strongman. (What should you do when you encounter this flesh-eating dog? Run like Hades!)

The Howl-een Hunt: Thirteen unlucky objects for an eerie October Evening:

If you began this trek with the warmup exercises around 9 p.m., you should now be approaching the "witching hour," so let's get to the good stuff. We'll start with two spooky stars.

1 and **2.** Located in the handle of the Big Dipper, Mizar and Alcor are the sky's most famous double star. Their names are Arabic for the horse and the rider, but on Halloween they double as the Headless Horseman—and he's searching for you! Bwahaha!

PHOTO COURTESY KRISTINE LARSEN

Copernican Observatory at Central Connecticut State University

Turn your attention to the constellation Perseus, the hero, and find the Demon Star, commonly known as Algol. This dreadful little demon is a short-term variable star that brightens and dims in a few days' time.

You'll need a telescope to find the rest of these menaces and monsters; after all, they would rather you didn't see them until it's too late for you to get away. They can be seen only in the dead of night.

3 and **4.** It wouldn't be Halloween without ghosts. Here are two boo!-tiful ghostly planetary nebulae: the Ghost of the Moon Nebula (NGC 6781) and the Phantom Streak (NGC 6741), both of them in Aquila. These specters will give you nightmares long after you've seen them.

5. Want more? Try Mirach's Ghost (NGC 404, a dwarf lenticular galaxy in Andromeda). This splendid spirit haunts the second-magnitude star Beta Andromedae (Mirach), thus its name.

6. Next, find the Cat's Eye Nebula (NGC 6543, a planetary nebula in Draco). It's a black cat, naturally; it lies under the first curl of the dragon's tail.

7 and **8.** Whooo doesn't like the eerie Owl Nebula (M97, a planetary nebula in Ursa Major), or the Owl Cluster (NGC 457 in Cassiopeia)? These owls fly high on Halloween; don't let them get their talons in you!

9. Watch out for the Skull Nebula (NGC 246, a planetary nebula in Cetus). Could it belong to the Headless Horseman?

10. Or how about the Veil Nebula (NGC 6960 and 6992–6995, a supernova remnant in Cygnus)? This slippery shroud slid off Job's coffin and floated northward.

11. Then there is the Blinking Planetary (NGC 6826 in Cygnus): now you see it, now you don't. This wraith-like planetary nebula blinks on when you use averted vision and off when you look straight at it. Don't look away too long, though: it may be creeping up on you, heeheehee!

12. Now that the evening is winding down, you'll want to see the Medusa Nebula (Abell 21, a planetary nebula in Gemini). But if you look at her, you'll turn to stone!

13. Finally, keep a wary eye out for the Witch Head Nebula (IC 2118, a reflection nebula in Orion). This wicked witch casts her spells and stirs her bubbling brew near Rigel during the predawn hours.

And there you have it: a haunted Howl-een Hunt that will have you singing "fangs for the memories" We hope you survived it; if not—well, you can't say you weren't warned!

Bwahahaha!

P.S.: Our tour of the terrifying has taken us to seventeen creepy critters and unsettling objects that can be seen on Halloween night, but there are others that cannot be seen. Three of them—the Ghost Ring (IC 5148) in Grus, and the Tarantula Nebula (30 Doradus) and the Ghost Head Nebula (NGC 2080), both of them in Dorado—are buried too deep to be seen at mid-northern to northern latitudes.

Other "Grus-some" grislies can be seen at other times of the year: the Sickle in Leo; Hamlet's Ghost (NGC 3628) in Leo; Hydra, the sea serpent; the Ghost of Jupiter (NGC 3242) in Hydra; Hagrid's Dragon (M48) in Hydra; Markarian's Chain of galaxies in Virgo and Coma Berenices; the Flying Witch Cluster (Melotte 111) in Coma Berenices; the Spider Galaxy (NGC 5829) in Bootes; the Little Ghost Nebula (NGC 6369) in Ophiuchus; the Red Spider Nebula (NGC 6537) in Sagittarius; and the Dragon Nebula (a.k.a. M8 or the Lagoon Nebula) in Sagittarius.

These deadly delights offer you enough thrills, chills, shocks, and screams throughout the year to curdle your blood—if our Howl-een Hunt hasn't already done that!

(Note: I had a howl of a good time reading this article. I hope you did too. —Ron Kramer, Editor)

Philip and Bill are members of the Flint River Astronomy Club in Griffin, Georgia. Bill is also vice president of that club.

FROM AROUND THE LEAGUE

Rodney Howe, 2017 Leslie C. Peltier Award Recipient

By Roger Kolman

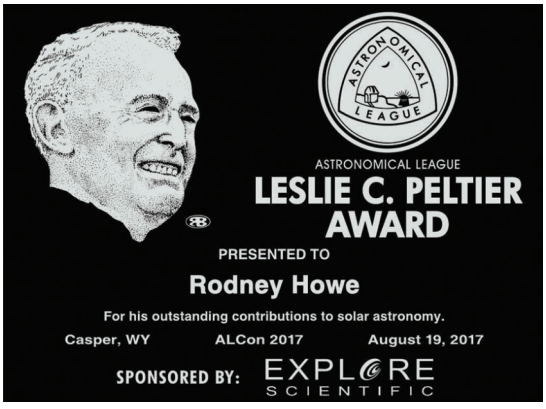
The Leslie C. Peltier Award of the Astronomical League was presented at the August 19 annual banquet at ALCon 2017 in Casper, Wyoming, just prior to the event of the century—the North American total solar eclipse.

It was fitting that the recipient of the award this year was Rodney Howe for his outstanding contributions to solar astronomy.

Rodney Howe

The heart of amateur astronomy is observing. We can read all we want about astronomical phenomena, but the real joy in astronomy is going out under the night sky and observing the objects about which we have read. But while most of us are casual observers of the sky, looking at the same few objects over and over, a few amateur astronomers develop their observing skills to the ultimate degree. They then use these skills to make careful observations of the sky and record them for scientific analysis.

Whether the observation is done with a photometer, CCD, spectroscope, or just the human eye, the ability to find an object and record scientifically useful detail is an uncommon trait. To recognize the amateur astronomer who is not only able to do this, but has contributed their observations to an ongoing observing program, the Astronomical League presents the Leslie C. Peltier Award. The Peltier Award was created in 1980 and first awarded in 1981.



The award is named after Leslie C. Peltier, the Delphos, Ohio, amateur astronomer who Harlow Shapley, one of the League's founders, referred to as "the world's greatest nonprofessional astronomer." Peltier, born January 2, 1900, discovered twelve new comets and four novae. But his real contribution was the over 132,000 variable star observations he made in his 62-year observing career. He also wrote many articles on astronomy and penned four books. To ease his observing, he built an enclosed "merry-go-round" observatory. Peltier died in 1980.

Rodney Howe has a master's degree in remote sensing and geographic information systems (GIS) and a bachelor's degree in computer science, both from Colorado State University. His job has been classifying Landsat and AVHRR satellite cropland images for the U.S. Department of Agriculture. He put his experience with photometry, data analysis, and image classification to use processing images of dense globular clusters, collected by AAVSOnet telescopes. He has been a member of AAVSO since 1999, when he began collecting very low frequency (VLF) radio data on gamma-ray bursts and sudden ionospheric disturbances (SIDs).

He is currently the *Solar Bulletin* editor and AAVSO Solar Section chair. He does the reporting for SID detections for the AAVSO Solar Section in the process of collecting and recording the VLF radio SID events caused by solar flares. SID event submissions come from observer locations around the world. In writing the *Solar Bulletin*, his group collects all visual observations of sunspot counts and stores these data in the SunEntry database. All sunspot data are submitted by observers who make daily optical and CCD observations and sunspot counts. In looking to the future, they now have observers who track the Solar Dynamic Observatory (SDO) satellite white light and magnetogram images. From these data they can estimate sunspot group counts and sunspot counts, which can be matched to visual observer counts.

Rodney has done what he can, since he became the Solar Section chair in 2010, to promote the AAVSO Solar Section's optical sunspot counts to solar scientists around the world, who are interested in the long-standing American Relative Sunspot Number. By participating in the last four Sunspot Number Workshops he has enabled the AAVSO solar sunspot number to become recognized as a published index. These workshops expose 30 or 40 solar scientists to how the AAVSO has collected and reported solar observations for the past 70 years as the American Relative Sunspot Number. The sunspot observations in the AAVSO SunEntry database come from over 70 visual observers around the world who do their best to count sunspots daily.

The range in ages and experience of participants in the program makes for a vibrant and robust data pool. What Rodney finds amazing is how many young folks (mostly high school) come for help in building VLF radios or counting sunspots, and how often they are interested in space weather. The Solar Section maintains a constant turnover rate in observers, which statistically means they will have few worries in keeping the American Relative Sunspot Number robust for the long-term.

Roger Kolman is the Peltier Observing Award chair and member of the Naperville Astronomical Association in Illinois.

Meet Dan Crowson, Our New Photo Editor

When not collecting photons on most clear nights from his driveway in a suburb of Saint Louis or from a remote telescope in

Animas, New Mexico, Dan Crowson is the head of IT for a national telecommunications equipment reseller headquartered in Chesterfield, Missouri. Dan's interest in astronomy started with a Tasco, which he can't ever remember seeing anything through. After a long hiatus, he took a couple of college classes on astronomy and purchased a telescope in 2011. After not being able to see much because of light pollution, he started taking images. Dan currently heads up the Imaging SIG for the Astronomical Society of Eastern Missouri and has over 160 images published.

Please send any images for the front or back cover or for the Gallery section to Dan at *photoeditor@astroleague.org*.

2017 Solar Eclipse Special Observing Award

For those that are undertaking the challenge of the 2017 Solar Eclipse Special Observing Award, remember the deadline for submission of your work is September 21, 2017. Your submission must be in the hands of the coordinator by that date. Please email it to Aaron Clevenson at *aaron@clevenson.org*. You will be sent an email confirmation. If you are mailing your submission, please be sure that it has time to arrive by the deadline. The rules are on the AL website. Note that you are attempting to measure the curvature of light around the Sun during the total eclipse. There are options for those who are unable to take their own images.

2016 George and Helen Hartzog Volunteer Service Award for Individual Service

League member John Goar (Olympic Astronomical Society) has been selected to receive this award. It is a tremendous honor to represent the nearly half million volunteers who serve in our national parks. He will travel to Washington, D.C, in August to receive the award. He volunteers in several capacities, but his primary concern is leading public telescope programs. This appears to be the first time an amateur astronomer has won this award. In 2017, for the eighth consecutive summer, John will lead free public telescope viewing at Hurricane Ridge, in Olympic National Park, 18 miles from Port Angeles, Washington.

More information can be found by Googling "Hertzog Award." Information about John's outreach program can be found at *www.olympictelescope.com*.

Call for League Officer Nominations

The two-year terms of the offices of president and vice president, and the three-year term of the office of treasurer end on August 31, 2018. The current office holders cannot run again for those same offices due to AL term limit restrictions. If you are interested in using your talents to serve in one of these important positions, we would like to hear from you. Please volunteer!

For specific information regarding the duties and responsibilities of these three offices, please refer to the League's bylaws, which can be accessed on the League website at *astroleague.org*.

Each candidate should send a background statement explaining why they are interested, along with a photo of himself or herself, to nominating committee chair Bryan Tobias at *secretary@astroleague.org*. Please limit all statements to approximately 250 words. All nomination materials must be submitted by March 15, 2018, so they can be included in the June *Reflector*, and so election ballots can be assembled.

The Astronomical League's Youth Awards 2018—Prepare Now!

Wouldn't it be great to be young again and to be entering amateur astronomy! Now is the time to start considering the Astronomical League's youth awards for 2018: the National Young Astronomer Award (NYAA), the two Jack Horkheimer Youth Service Awards, a Horkheimer Youth Imaging Award, and the Horkheimer/O'Meara Journalism Award.

If you know a young person who has been involved in an astronomy-related research project—either of his or her own doing or through an educational institution—please consider nominating that person for the National Young Astronomer Award. He or she must be between 14 and 19 years of age.

If you know a League member, 18 years or younger, who has brought amateur astronomy to your club or to the public through outreach, presentations, writing, or observing, please consider nominating that person for one of the four Horkheimer Awards.

The deadline for the National Young Astronomer Award is January 31, 2018, and for the suite of Horkheimer Awards is March 2018.

The 2018 NYAA winners and the 2018 Horkheimer/Smith Youth Service Award winner will be treated to a trip to ALCon 2018 in Minneapolis in July.

Now is the time for potential candidates to work on their projects and to participate in various astronomy activities.

If you are a club officer, nominate them.

If you don't, no one else will! Complete information about each award can be found at *www.astroleague.org/al/awards/awards.html*.

FROM AROUND THE LEAGUE

How You Can Help Amateur Astronomy

Our Universe is simply awe-inspiring with its vastness, beauty, and mystery that unfolds before us every time we gaze skyward. Observing is personal and its influence upon us can be profound; it is an activity that is tough to beat.

Support your Astronomical League! The League encourages the active pursuit of astronomy through its various member-directed programs. Your dues and contributions help fund its national recognition awards, the national convention (ALCon), the *Reflector*, the AL Book Service, and, of course, the many popular observing clubs.

If you enjoy the night sky and want others to discover its wonders, why not give a gift to the Astronomical League today? Mail your tax-deductible donation to the Astronomical League, 9201 Ward Parkway Suite 100, Kansas City, MO 64114.

The Astronomical League is a member-supported and member-driven 501(c)3 nonprofit organization. Because of people like you, the League can offer the programs and benefits that enhance your experience under the stars.

Why not give back to the avocation that has given so much to you? Help the Astronomical League help amateur astronomy!

Astronomical League Observing Programs

Active Galactic Nuclei Program
Advanced Binocular Double Star Observing Program
Analemma Observing Program
Arp Peculiar Galaxies Northern Observing Program
Arp Peculiar Galaxies Southern Observing Program
Asterism Observing Program
Asteroid Observing Program
Beyond Polaris
Binocular Double Star Observing Program
Binocular Messier Observing Program
Binocular Variable Star Observing Program
Bright Nebula Observing Program
Caldwell Observing Program
Carbon Star Observing Program
Comet Observing Program
Constellation Hunter Observing Program (Northern Skies)
Constellation Hunter Observing Program (Southern Skies)
Dark Nebulae Observing Program
Dark Sky Advocate Observing Award
Deep Sky Binocular Observing Program
Double Star Observing Program
Earth Orbiting Satellite Observing Program (EOSOC)
Flat Galaxy Observing Program
Galaxy Groups & Clusters Observing Program
Galileo Observing Program
Globular Cluster Observing Program
Herschel 400 Observing Program
Herschel II Observing Program
Hydrogen Alpha Solar Observing Program
Imaging Program
Local Galaxy Group & Galactic Neighborhood Observing Program
Lunar Observing Program
Lunar II Observing Program
Master Observer Award
Messier Observing Program
Meteor Observing Program
NEO Observing Program
Occultation Observing Program
Open Cluster Observing Program
Outreach Observing Award
Planetary Nebula Observing Program
Planetary Transit Special Observing Award
Radio Astronomy Observing Program
Sketching Observing Award
Sky Puppy Observing Program
Solar Eclipse Special Observing Award
Solar System Observing Program
Southern Skies Binocular Observing Program
Southern Sky Telescopic Observing Program
Stellar Evolution Observing Program
Sunspotters Observing Program
Two in the View Observing Program
Universe Sampler Observing Program
Urban Observing Program
Variable Star Observing Program

Celestial Savings Program—Your Discount Purchasing Program

The Astronomical League is excited to announce its new **Celestial Savings Program** where all League members qualify for special discounts at participating vendors when purchasing equipment, accessories, or books. Please note that discount amounts may vary by vendor and by items purchased.

See the Celestial Savings Program ad included in this issue of the *Reflector* to determine participating vendors.

If you are a current AL member, you may obtain the discount codes by first logging into your AL member account. If you do not already have an account (your member account is separate from your store account) you may obtain one by visiting *members.astroleague.org/request_account* and entering your email address. An email will be sent to you with instructions describing how to create an account.

Once you have an account established and log in to the AL website, you should select the "Members Website" tab. Next, click on "Celestial Savings." You will then see a listing of the participating vendors, the discounts they offer for their products, their current discount code numbers, their website URLs, and, if appropriate, telephone numbers. Simply provide the appropriate discount code number to the vendor's salesperson or include it in your website order.

We encourage you to share the existence of the Celestial Savings Program with your astronomy friends, AL members or not. However, please do not share discount codes with anyone.

You're not an AL member? Contact an AL member astronomy club in your area and join through them. You'll find AL dues to be very reasonable, and many local clubs pay them for you.

The Astronomical League also has a member-at-large program detailed at *www.astroleague.org/al/general/memblarg.html.*

For additional AL membership details and benefits, visit *www.astroleague.org* and click the "Join" tab.

Questions? Write to the Celestial Savings director at *celestialsavings@astroleague.org*.

League Regional Chairs

GLRAL (Great Lakes Region): Ron Whitehead, *executivesecretary@astroleague.org*
MARS (Mountain Astronomical Research Section): Wayne Green, *dxwayne@gmail.com*
MERAL (Mid-East Region): Terry Trees, *treest@comcast.net*
MSRAL (Mid-States Region): James Small, *webmaster@slasonline.org*
NCRAL (North-Central Region): Gerry Kocken, *gerryk@kockenwi.com*
NERAL (Northeast Region): Alan Rifkin, *alan@rifkin.com*
NWRAL (Northwest Region): Gene Dietzen, *gene.dietzen@gmail.com*
SERAL (Southeast Region): Richard Schmude, *schmude@gordonstate.edu*
SWRAL (Southwest Region): David Moody, *bicparker@mac.com*
WRAL (Western Region): Wayne Johnson, *mrgalaxy@juno.com*
IRAL (International Region): John Wagoner, *john@alintlregion.com*

Great Observing and, Reference Materials!

Royal Astronomical Society of Canada
Canada's Astronomy Club

League Sales is THE place to get your 2018 RASC Observer's Handbook and Calendar!

The RASC Observer's Handbook:

The popular 350 page classic in its 110th Year,

Special pricing for 2018, the first year of the new USA edition!

$24 each + shipping; for orders of 25 or more – $23 each with free shipping!

Contents include...

- Basic Astro Data
- Time
- Optics and Observing
- The Sky, Month by Month
- Eclipses
- The Moon
- The Sun
- Planets
- Dwarf and Minor Planets
- Meteors, Comets, and Dust
- Stars
- The Deep Sky

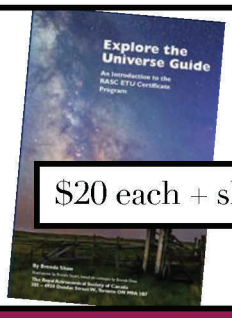
Accepting pre-orders now, Handbook and Calendar won't ship until December

$18 each + shipping; for orders of 12 or more – $17 each with free shipping!

The RASC 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.

Great RASC items available for immediate shipment!



$20 each + shipping

Explore the Universe Guide:

Perfect for those who are learning their way around the night sky.

$2 each + shipping

Affordable Star Finder

Discover the night sky with this easy to use, compact guide.

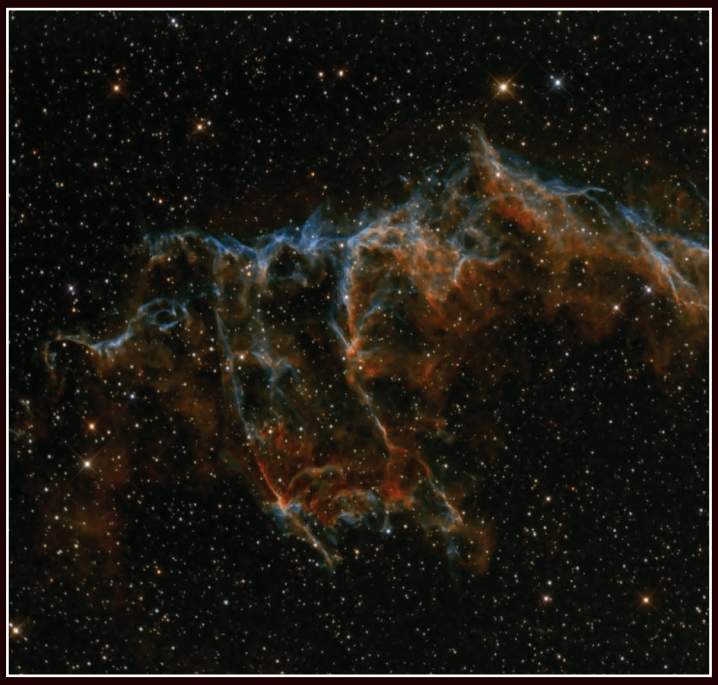
Place your order from League Sales https://store.astroleague.org

Gallery

TITLE PHOTO: NGC 2244; BRIAN KIMBALL

Jamey Jenkins (Twin City Amateur Astronomers, Bloomington, Illinois) took this detailed image of Mare Nectaris and Theophilus, Cyrillyus, and Catharina using a 125 mm f/18 refractor with a DMK 41 video camera on June 2, 2017.

Dan Crowson (Astronomical Society of Eastern Missouri) took this close-up view of M90 (Arp 76) from Dark Sky New Mexico near Animas using an Astro-Tech AT12RCT with a SBIG STF-8300M camera on a Paramount MX+ mount.



Jim Gibbs (Twin City Amateur Astronomers) created this nice narrowband image (16 hours of H-alpha and O III exposures) of NGC 6995 in Cygnus from the Sugar Grove Nature Center in McLean, Illinois, using an Astro-Tech AT8RC with a SBIG ST-8300M camera on an Orion Atlas mount.

Kirby Benson (Astronomical Society of Las Cruces) took this nice image of reflection nebulae IC 4604 and 4603 from Rusty's RV Ranch in Rodeo, New Mexico. Kirby used a Takahashi FSQ-85ED with an SBIG STF-8300M on a Takahashi EM-11 mount.

Wanderers/*from page 11*

clouds of volcanic eruptions.

Venus Express also detected transient infrared radiation from four "hot spots" in 2008 and 2009. Three of these were seen on more than one orbit in the Ganis Chasma rift zone near the Maat Mons shield volcano. These are thought to be lava freshly released by volcanic eruptions.

With no tectonic activity, volcanoes must form from cracks in the planet's surface that allow magma to flow up from the interior. Venus's surface is so hot, however, that its silicate surface slowly deforms and flows in response to stress rather than forming brittle cracks. Without the cracks, the magma cannot penetrate the crust to reach the surface in order to form more volcanoes. This limits the number of volcanoes on Venus.

Next time you look up at the morning or evening star, remember that Venus is similar to Lucifer—it is the brightest of all the planets, but with a surface much like the traditional description of Hades: scorchingly hot and dry with solid lava almost everywhere.

Bert Stevens is co-director of the Desert Moon Observatory, MPC #448, located in Las Cruces, New Mexico.

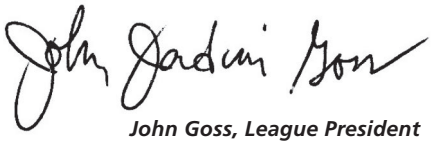
Field of View/*from page 4*

individuals, clubs, and other members of the astronomical community tackled the problem together. The exciting promise is that if we all spoke up, the problem would be beaten.

The whole issue of light pollution, understandably, can seem too vast to solve, government bureaucracies can seem too labyrinthine to deal with, and the time commitment needed to make real progress can seem overly burdensome. Wouldn't it be wonderful if the Astronomical League had a program guiding clubs on how to proceed, and what they can do to effectively confront this issue? After all, if clubs and individuals knew how to move forward, wouldn't they be more likely to take constructive action?

As further inducement, wouldn't it also be wonderful if astronomical manufacturers and retailers would fund an annual award program—call it the "Dark Sky Club Award"—recognizing and rewarding AL clubs for their achievements?

Imagine the possibilities! Rest assured that your Astronomical League sure does.



John Goss, League President

For those of you who are not aware of it, the Astronomical League is now on Facebook. We continue to build followers week by week, and we are becoming better known as the word spreads. We are also on Twitter: *@AstronomyLeague*.

Greetings from Canada!

It is my pleasure as the executive director of the Royal Astronomical Society of Canada to address the members of the Astronomical League.

Since 1868, the Royal Astronomical Society of Canada has been Canada's leading astronomy organization. Membership is over 5,000, made up of amateurs, educators, and professionals of all ages. Our 29 branches or "centres" offer both "in-reach" and outreach programming. In-reach education teaches members the basics of finding their way around the night sky, using binoculars and telescopes and advanced methods of observing and astrophotography. Public outreach includes lectures that are open and free to the public, and star parties, where members set up telescopes at night for members of the public to get clear views of the Moon, the planets, and other objects in the night sky. Some centres offer astronomy courses to the public and run nightly programs for youth groups (Cubs, Brownies, Guides, and Scouts) or school groups. Many centres partner with local museums, science centres, or planetaria.

Like the Astronomical League, we encourage our members to get out and observe—and achieve various observing designations.

The RASC has been producing two publications for over a century—the *Journal*, which for many years was a source of refereed scholarly papers from Canadian professional astronomers. The other is the *Observer's Handbook*, which is in its 109th year of publication.

In 2018, we will be producing two different versions of the handbook for the first time—a Canadian version and a U.S. version. The Astronomical League will be making the U.S. version available to members via its website.

The RASC will celebrate its 150th anniversary in 2018, and we plan to hold observing and astrophotography contests and other events to mark the occasion. Our annual meeting in late June/early July in Calgary should be quite a party. A full day has been set aside to look back at the long history of the RASC and the accomplishments of both its professional and amateur members.

American and Canadian astronomers—both professional and amateur—have a long history together. Many crossed the border to seek out their careers.

The RASC's first president, from 1868 to 1869, was **Daniel K. Winder** (1828–1897), an American amateur.

Simon Newcomb (1835–1909), a Canadian who worked entirely in the States, was a celestial mechanician who was director of the Nautical Almanac Office from 1877 to 1897.

Helen Sawyer Hogg, an American astronomer, spent her career in Toronto and worked at the David Dunlap Observatory.

R.K. Young, **Ralph E. Williamson**, **Bill Wehlau**, **Bev Oke**, and **Donald C. Morton** are examples of American and Canadian astronomers who spent most of their careers across their home country's borders.

Many of you will have heard of several Canadian amateurs who either lived in the United States or wrote for various U.S. publications: David Levy, Terence Dickinson, Gary Seronik, Jack Newton, Alan Dyer, Ken Hewitt-White, and Klaus Brasch. Many of these amateurs now work on *SkyNews*, the Canadian astronomy magazine owned by the RASC. Check it out at *www.skynews.ca*!

Many times in the past, the RASC has held joint meetings with various American associations, including the AAVSO and the ASP. We should certainly consider a joint meeting between our two groups in the future.

Clear Skies!, **Randy Attwood**
Executive Director, RASC

Observing Awards

Editor's Note: Congratulations to all these outstanding astronomical observers! All awards, except the Herschel 400, require current Astronomical League membership for eligibility. If you have questions about an award, please contact the corresponding Observing Program chair. Their contact information can be found on the Observing Program website at *www.astroleague.org/observing*. If further assistance is required please contact either of the national Observing Program coordinators.

Active Galactic Nuclei Program
No. 14-V, Kevin Mayock, Rose City Astronomers

Advanced Binocular Double Star Observing Program
19, Kevin McKeown, Albuquerque Astronomical Society; No. 20, Jack Fitzmier, Atlanta Astronomy Club; No. 21, Russell Pinizzotto, Southern Maine Astronomers

Analemma Observing Program
No. 15, Russell F. Pinizzotto, Southern Maine Astronomers

Arp Peculiar Galaxies Northern Observing Program
No. 88-C, Lee Buck, Member-at-Large

Asterism Observing Program
No. 42, David Whalen, Atlanta Astronomy Club

Beyond Polaris Observing Program
No. 1, W. Maynard Pittendreigh, Brevard Astronomical Society; No. 2, Michael A. Hotka, Longmont Astronomical Society; No. 3, Clay Ogles, Member-at-Large; No. 4, Nora Jean Chetnik, Member-at-Large; No. 5, Keith Norton, Minnesota Astronomical Society

Binocular Double Star Observing Program
No. 121, Tom Liles, Albuquerque Astronomical Society; No. 122, Douglas Smith, Tucson Amateur Astronomy Association; No. 123, Mark Colwell, Member-at-Large; No. 124, Gary Whelan, Member-at-Large; No. 125, Richard Brown, Texas Astronomical Society of Dallas

Binocular Messier Observing Program
No. 1105, Fred Keller, Indiana Astronomical Society; No. 1106, Gary Whelan, Member-at-Large; No. 1107, Joe Castor, Kansas Astronomical Observers; No. 1108, Mike Birch, Indiana Astronomical Society; No. 1109, Christopher Dix, Rose City Astronomers; No. 1110, Don Martin, Von Braun Astronomical Society; No. 1111, Jesse Roberts, North Houston Astronomy Club; No. 1112, Brook Belay, Atlanta Astronomy Club; No. 1113, Tom Liles, Albuquerque Astronomical Society; No. 1114, Joe Khalaf, Houston Astronomical Society; No. 1115, Daniel Otte, Southern Oregon Skywatchers

Carbon Star Observing Program
No. 81, David M. Douglas, East Valley Astronomy Club; No. 82, Lloyd Lashbrook, Texas Astronomical Society of Dallas

Constellation Hunter Observing Program (Northern Skies)
No. 186, Daniel Otte, Southern Oregon Skywatchers; No. 187, Steven Coltrin, Rio Rancho Astronomical Society; No. 188, Jean Napp, Iowa County Astronomers; No. 189, Bryan R. Tobias, San Antonio League of Sidewalk Astronomers; No. 190, Brian Chopp, Neville Public Museum Astronomical Society; No. 191, Larry Elsom, Member-at-Large

Constellation Hunter Observing Program (Southern Skies)
No. 10, William Bogardus, Amateur Observers' Society of New York

Dark Nebulae Observing Program
No. 26, Mark Simonson, Everett Astronomical Society

Deep Sky Binocular Observing Program
No. 388, Stephen Jones, Houston Astronomical Society; No. 389, Robert Primeaux, Austin Astronomical Society; No. 390, Doug Oines, Minnesota Astronomical Society

Double Star Observing Program
No. 596, Jean Napp, Iowa County Astronomers; No. 597, Joseph Nicosia, Central Pennsylvania Observers; No. 598, Bruno Pancorbo, Member-at-Large; No. 599, Carolyn Alter, Rose City Astronomers; No. 600, Juan Velasquez, Denver Astronomical Society; No. 601, Kristina Otenti, Member-at-Large

Flat Galaxy Observing Program
No. 31, Mark Johnston, Regular, The Astronomy Connection

Galileo Observing Program
No. 42, Kevin Carr, Minnesota Astronomical Society

Globular Cluster Observing Program
No. 303-V, Steve Holland, Tallahassee Astronomical Society; No. 304-V, Rene Scandone Gedaly, Houston Astronomical Society; No. 305-V, Paul Harrington, Member-at-Large

Herschel 400 Observing Program
No. 578, Raymond B. Howard, Eastbay Astronomical Society; No, 579, Fred Gassert, Kansas Astronomical Observers; No. 580, Jim Fordice, Albuquerque Astronomical Society; No. 581, Brian Chopp, Neville Public Museum Astronomical Society; No. 582, Edward Fraini, Houston Astronomical Society

Herschel II Observing Program
No. 101, Mark McCarthy, Manual, The Astronomy Connection

Lunar Observing Program
No. 989, Jack Mellott, Charlottesville Astronomical Society; No. 990, Ginger Mellott, Charlottesville Astronomical Society; No. 991, Steven White, Colorado Springs Astronomical Society; No. 992, Andy Flowers, Tallahassee Astronomical Society; No. 993, Alan Snook, Member-at-Large; No. 994, Richard Schiek, Albuquerque Astronomy Association; No. 995, Chuck Stewart, Rose City Astronomers; No. 996, David Jackson, Member-at-Large; No. 997, Margaret Mannchen, Member-at-Large; No. 998, Tim Brown, Austin Astronomical Society; No. 999, Kristopher Flory, Kansas Astronomical Observers

Lunar II Observing Program
No. 81, Kevin McKeown, Albuquerque Astronomical Society; No. 82, Jim Fordice, Albuquerque Astronomical Society; No. 83 Glenn Wolford, Member-at-Large

Messier Observing Program
No. 2759, Peter van Bavel, Honorary, Austin Astronomical Society; No. 2760, Dan Chrisman, Honorary, Roanoke Valley Astronomical Society; No. 2761, Rand H. Bowden, Honorary, Roanoke Valley Astronomical Society; No. 2762, Eddie Trevino, Honorary, Astronomical Society of Southeast Texas; No. 2763, Fernando Torres, Honorary, Albuquerque Astronomical Society; No. 2726, John Skillicorn, Honorary, Tucson Amateur Astronomy Association; No. 2764, Larry Mark Elsom, Honorary, Member-at-Large; No. 2765, Bill Steen, Honorary, Astronomy Club of Tulsa; No. 2606, Brad Payne, Honorary, Northern Virginia Astronomy Club

Meteor Observing Program
No. 183, Mark Colwell, 12 hours, Member-at-Large; No. 184, Paul Harrington, 12 hours, Member-at-Large

NEO Observing Program
No. 12, Michael A. Hotka, Advanced, Longmont Astronomical Society

Outreach Observing Award
No. 292-M, Gregory F. Rohde, Austin Astronomical Society; No. 339-S, Eddie Trevino, Astronomical Society of Southeast Texas; No. 565-S, Leonard Ward, Central Florida Astronomical Society; No. 614-S, Nancy Rauschenberg, Minnesota Astronomical Society; No. 624-S, Sonali Deshmukh, Omaha Astronomical Society; No. 657-S, Mark Simonson, Everett Astronomical Society; No. 720-S, Thomas Whalen, Atlanta Astronomy Club; No. 792-M, Michael R. Fredette, Fort Bend Astronomical Club; No. 793-M, Jim Verboon, Fort Bend Astronomy Club; No. 824-M, Clell (Mac) Hooton, Fort Bend Astronomy Club; No. 862-O, Joel Coker, Shreveport-Bossier Astronomical Society; No. 863-O, Clay Ogles, Member-at-Large; No. 864-O, Anika Patel, Fort Bend Astronomy Club; No. 865-O, Sanjiv Patel, Fort Bend Astronomy Club; No. 866-O, Thomas H. Burleston, Jr., Von Braun Astronomical Society; No. 867-O, Gena Crook, Von Braun Astronomical Society; No. 868-S, Jared Cassidy, Von Braun Astronomical Society; No. 869-O, Stephen C. Patrick, Von Braun Astronomical Society; No. 870-O, Richard Norman, Von Braun Astronomical Society; No. 871-S, Frank Schenck, Von Braun Astronomical Society; No. 872-M, Doug Horacek, Von Braun Astronomical Society; No. 873-O, Haley Rice, Von Braun Astronomical Society; No. 874-S, Sharon Rigsby, Astronomical Society of Southeast Texas; No. 875-O, Steven White, Colorado Springs Astronomical Society; No. 876-O, Steve Bell, Boise Astronomical Society; No. 877-O, Sierra E. Bradley, Roanoke Valley Astronomical Society; No. 878-O, John Garrett, Temecula Valley Astronomers; No. 879-S, Hal Jandorf, Ventura County Astronomical Society; No. 880-O, Renee Paulson, Ventura County Astronomical Society; No. 881-O, Gary Bostrup, Ventura County Astronomical Society; No. 882-O, David Williams, Ventura County Astronomical Society; No. 883-O, Nowell Niblett, Ventura County Astronomical Society; No. 884-O, Dennis Willet, Ventura County Astronomical Society; No. 885-O, Kurt Schreiber, Ventura County Astronomical Society; No. 886-O, Gerry Seck, Ventura County Astronomical Society; No. 887-O, Linda Seck, Ventura County Astronomical Society; No. 888-O, Keith Salvas, Ventura County Astronomical Society; No. 889-O, Dave Holland, Ventura County Astronomical Society; No. 890-O, Mike Lanska, Ventura County Astronomical Society; No. 891-O, Rene Rodriquez. Ventura County Astronomical Society; No. 892-O, John Cassidy, Ventura County Astronomical Society; No. 893-O, Julie Werner, Ventura County Astronomical Society; No. 894-O, James King, Houston Astronomical Society; No. 895-O, Edward Fraini, Houston Astronomical Society; No. 896-O, Steve Skinner, Omaha Astronomical Society; No. 897-O, Anthony Bryan, Evansville Astronomical Society; No. 898-S, Catherine Trevino, Astronomical Society of Southeast Texas; No. 899-S, Mark Shelton, St. George Astronomy Group; No. 900-

TITLE PHOTOGRAPH: M64, THE BLACK EYE GALAXY; NASA AND THE HUBBLE HERITAGE TEAM (AURA/STSCI)

O, Nels Johnson, Battle Point Astronomical Association; No. 901-M, Scott Azmus, Member-at-Large; No. 902-O, Michael Long, Shoreline Amateur Astronomical Association; No. 903-O, Dana Leary, Austin Astronomical Society; No. 904-O, Kevin C. Carr, Minnesota Astronomical Society; No. 905-O, Gerard Jones, Minnesota Astronomical Society; No. 906-O, Ethan Gregory, Olympic Astronomical Society; No. 907-S, Edward V. White, Astronomical Society of Eastern Missouri; No. 908-O, C.R. Ferguson, Astronomical Society of Southeast Texas

Planetary Nebula Observing Program
No. 69, Rodney R. Rynearson, Advanced, Manual, St. Louis Astronomical Society; No. 70, Mark McCarthy, Advanced, Manual, The Astronomy Connection

Radio Astronomy Observing Program
No. 22-B, Bryan R. Tobias, San Antonio League of Sidewalk Astronomers; No. 23-B, Loyd Overcash, North Houston Astronomy Club; No. 18-S, Bryan R. Tobias, San Antonio League of Sidewalk Astronomers; No. 8-G, Blair Hearth, Rockland Astronomy Club

Sketching Observing Award
No. 21, Jeff Hoffmeister, Olympic Astronomical Society; No. 22, Cliff Mygatt, Olympic Astronomical Society; No. 23, Kevin Mayock, Rose City Astronomers

Solar System Observing Program
No. 107, Marilyn Perry, Member-at-Large; No. 108, Stephen Jones, Houston Astronomical Society; No. 109, David M. Douglass, East Valley Astronomy Club

Southern Skies Binocular Observing Program
No. 98, Gordon Schaefering, Amateur Observers' Society of New York; No. 99, Alan Scott, Albuquerque Astronomical Society

Southern Sky Telescopic Observing Program
No. 55, Gordon Schaefering, Albuquerque Astronomical Society; No. 56, Alan Scott, Albuquerque Astronomical Society

Sunspotters Observing Program
No. 191, Bruno Pancorbo, Member-at-Large; No. 192, Bryan R. Tobias, San Antonio League of Sidewalk Astronomers; No. 193, Valorie Whalen, Atlanta Astronomy Club; No. 194, Zack Stockbridge, Member-at-Large

Two in the View Observing Program
No. 21, George Robert Kepple, Huachuca Astronomy Club; No. 22, Ted Forte, Huachuca Astronomy Club

Urban Observing Program
No. 184, Steve Boerner, Astronomical Society of Eastern Missouri; No. 185, Bryan R. Tobias, San Antonio League of Sidewalk Astronomers; No. 186, Scott Azmus, Member-at-Large

To have your star party or event listed, please send the details, including dates, sponsors and website, to *astrowagon@verizon.net*. Confirm dates and locations with event organizers.
—John Wagoner

Coming Events

September 12–17
Astroblast
Oil City, Pennsylvania
www.oras.org

September 14–18
Iowa Star Party
Whiterock Conservancy, Coon Rapids, Iowa
www.iowastarparty.com

September 15–17
Idaho Star Party
Bruneau Dunes State Park, Idaho
www.isp.boiseastro.org

September 16–24
Okie-Tex Star Party
Kenton, Oklahoma
Oklahoma City Astronomy Club
www.okie-tex.com

September 21–23
Illinois Dark Skies Star Party
Jim Edgar Panther Creek State Fish and Wildlife Area, Illinois
www.sas-sky.org

September 21–23
Great Basin National Park Astronomy Festival
Baker, Nevada
www.nps.gov/grba/planyourvisit/astronomy-festival.htm

September 21–24
Great Lakes Star Gaze
Gladwin, Michigan
www.greatlakesstargaze.com

September 21–24
Acadia Night Sky Festival
Mount Desert Island, Maine
www.acadianightskyfestival.com

September 21–24
Hidden Hollow Star Party
Hidden Hollow Camp, Mansfield, Ohio
wro.org/hidden-hollow-star-party

September 22–24
Connecticut Star Party
Edmund D. Strang Scout Reservation, Goshen, Connecticut
www.asnh.org

September 22–24
Black Forest Star Party
Cherry Springs State Park, Pennsylvania
bfsp.org

September 29–30
Astronomy at the Beach
Island Lake State Recreation Area, Michigan
www.glaac.org/astronomy-at-the-beach

September 30
Ventura County Astronomical Society—Astronomy Day
Charles Temple Observatory, Moorpark College, California
www.vcas.org

October 13–14
Kopernik AstroFest
Vestal, New York
kopernikastro.org/astrofest

October 15–22
Peach State Star Gaze
Deerlick Astronomy Village, Crawfordville, Georgia
www.atlantaastronomy.org/PSSG

October 15–22
OzSky Star Safari, a.k.a. the Deepest South Texas Star Safari
Coonabarabran, New South Wales, Australia
www.ozsky.org
Attendance is extremely limited.

October 16–21
Eldorado Star Party
X-Bar Ranch, Eldorado, Texas
www.eldoradostarparty.org

October 16-22
Staunton River Star Party
Scottsburg, Virginia
www.stauntonriver-starparty.org

October 17–21
Enchanted Skies Star Party
Socorro, New Mexico
www.enchantedskies.org

October 17–22
Deep South Star Gaze
Norwood, Louisiana
www.stargazing.net/dsrsg

October 19–22
Nightfall
Borrego Springs, California
nightfallstarparty.com

October 19–22
Heart of America Star Party
Butler, Missouri
www.hoasp.askc.org

October 19–22
SJAC Fall Star Party
Belleplain State Forest, New Jersey
www.sjac.us/starparty.html

October 20–22
Bays Mountain StarFest
Bays Mountain Park, Kingsport, Tennessee
www.baysmountain.com/astronomy/astronomy-club/?GTTabs=5

October 20–22
Chiefland Star Party
Chiefland, Florida
chieflandstarpartygroup.com

October 21
Virginia Association of Astronomical Societies
Back Bay Amateur Astronomers
backbayastro.org/VAAS

November 3–5
Custer Jamboree
Custer Institute, Southold, New York
custerobservatory.org

ADVERTISING RATES for the *REFLECTOR*

The following is a listing of the advertising rates for the *Reflector*. If you are interested in promoting your products, consider placing an ad with us. We offer a highly targeted market with a circulation of 16,000 astronomers.

Rates for the inside front cover, inside back cover, and back cover are negotiable.

Deadlines: March issue – January 1 June issue – April 1 September issue – July 1 December issue – October 1

Number of Issues	Full Page	1/2 Page	1/3 Page	1/6 Page	Mini Ad
H = Horizontal V = Vertical	7½" H x 10" V	7½" H x 5" V	5" H x 4⅞ " V or 2$^3/_8$" H x 10" V	2$^3/_8$" H x 5" V or 4⅞" H x 2$^3/_8$" V	2$^3/_8$" H x 2$^3/_8$" V
1	$1,000 B/W $1,100 Color	$500 B/W $550 Color	$400 B/W $440 Color	$200 B/W $220 Color	$150 B/W $165 Color
2	$900 B/W (each) $990 Color (each)	$450 B/W (each) $495 Color (each)	$350 B/W (each) $385 Color (each)	$175 B/W (each) $192.50 Color (each)	$125 B/W (each) $137.50 Color (each)
4	$800 B/W (each) $880 Color (each)	$400 B/W (each) $440 Color (each)	$300 B/W (each) $330 Color (each)	$150 B/W (each) $165 Color (each)	$100 B/W (each) $110 Color (each)

Note: Advertising pricing is subject to change without notice.

To submit advertisements or for further information, please contact: Carla Johns, Advertising Representative, at c.johns@icloud.com or 1-970-567-8878.

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League Sales are online!

The League's online store is available at the website, **www.astroleague.org**. Click on the link on the left side of the home page. The online store includes the latest shopping cart technology and accepts credit cards. Shipping & handling (S&H) is calculated at checkout. Merchandise is also available by mail order, payable by check. Please select your items, add the applicable S&H fee, and mail your order to:

Astronomical League Sales
9201 Ward Parkway, Suite 100
Kansas City, MO 64114

If you have questions about the merchandise, or discounts on bulk orders, please call the League office, 816-DEEP-SKY, or email **leaguesales@astroleague.org**.

Perfect Holiday Gifts!

RASC 2018 Observer's Handbook
Limited Quantities–Order Early
$24 plus $4.50 S&H

RASC 2018 Calendar
Limited Quantities–Order Early
$18 plus $7 S&H

2050 Sportsman Bucket Hat
Embroidered logo, one size; khaki only
$22, plus $5 S&H

Astronomical League travel mug
$10: plus $4.50 S&H

Coffee mug (ceramic)
$12 plus $6 S&H

VC600 Baseball Hat
Embroidered logo, adjustable;
Colors: royal, maroon, khaki, navy;
$16, plus $5 S&H

Astronomical League lapel pin (one-inch diameter)
$8 plus
$2 S&H

Astronomical League full color cloth patch (3" diameter)
$7 plus $1.50 S&H

Canvas tote bag–Royal
$16 plus
$6 S&H

Astronomical League blue and white cloth patch (3" diameter)
$6 plus $1.50 S&H

Globular Clusters
$14 plus
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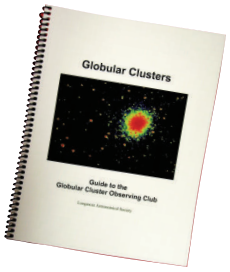
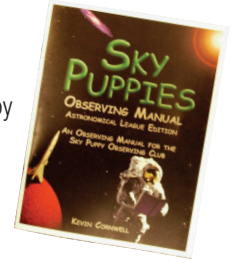
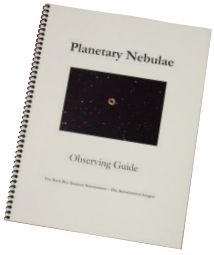


Seasonal Star Chart
$24 plus
$6 S&H

Sky Puppies Observing Manual–
For the Sky Puppy Observers Club
Regularly $15,
Sale price $8
plus $4 S&H



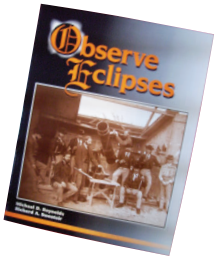
Planetary Nebulae
$14 plus
$3 S&H



Messier Objects: A Beginner's Guide
$8 plus
$2 S&H

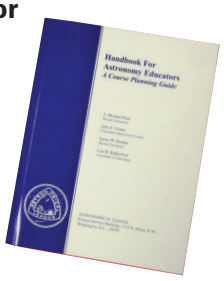
RASC Explore the Universe Guide
$20 plus
$4.50 S&H

Observe Eclipses
Regularly $18,
Sale price $9
plus $3 S&H



Universe Sampler
$10 plus
$3 S&H

Astronomy for Educators Handbook
A Course
Planning Guide
5.5" x 7.25"
Regularly $12,
Sale price $6
plus $2 S&H



Observe the Herschel Objects
$6 plus
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Math for Amateur Astronomers
$12 plus
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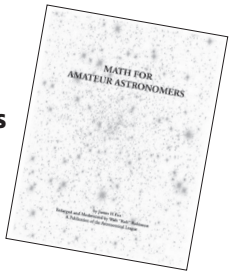

Carbon Stars
A guide to the Carbon Star Observing Club
$12 plus
$3 S&H

Bandana
$12 plus; $2 S&H
Natural or White

"Guide to the Stars" 16" Planisphere
$21 plus
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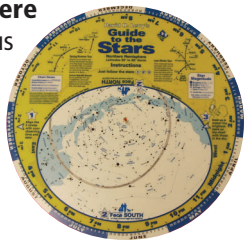

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Astronomical League
National Office
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