Reflector

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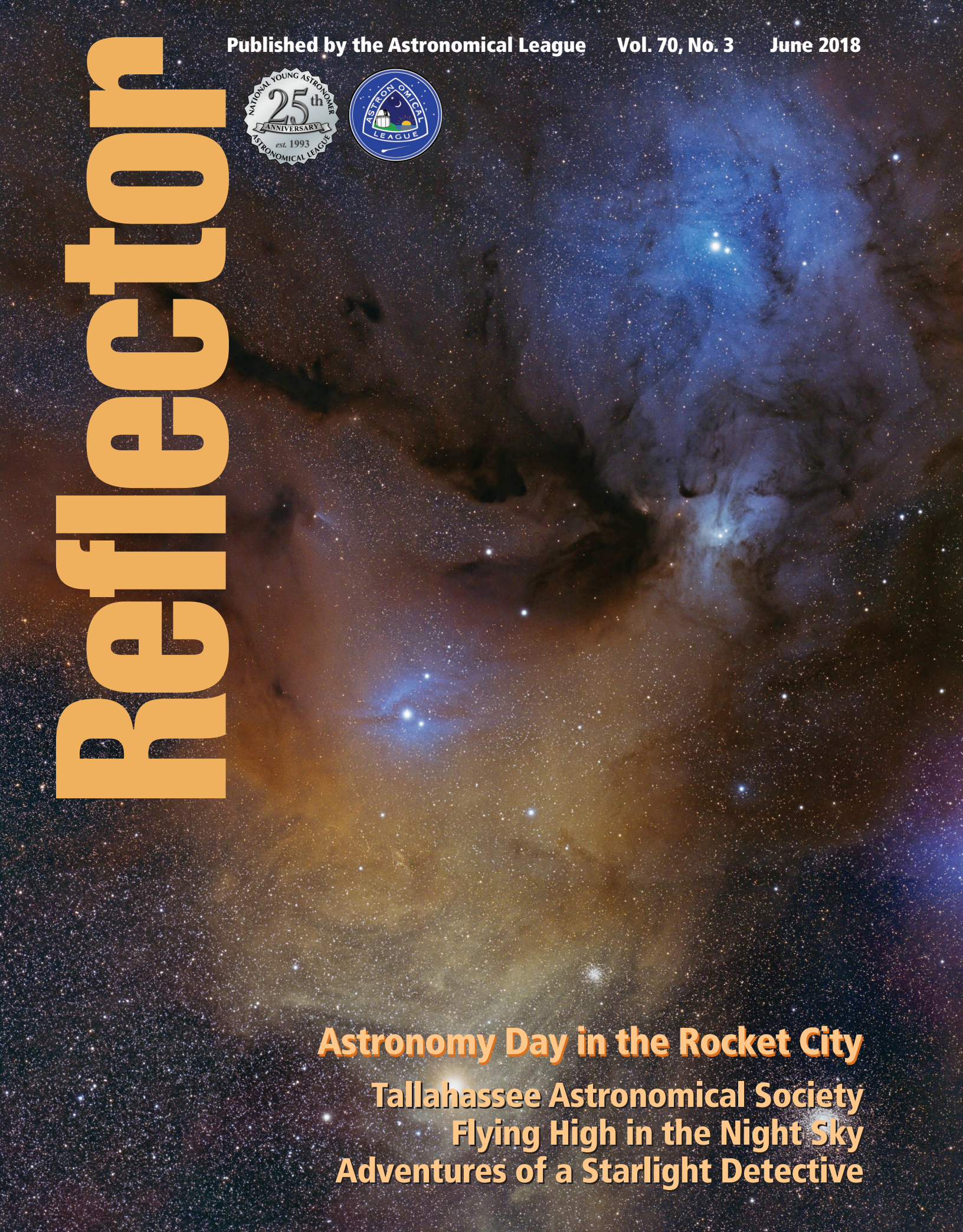

Astronomy Day in the Rocket City

Tallahassee Astronomical Society

Flying High in the Night Sky

Adventures of a Starlight Detective

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

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Terry Hancock (Western Colorado Astronomy Club) took this fantastic four-panel mosaic image of the Rho Ophiuchi region from his Grand Mesa Observatory using a Takahashi FSQ-130 with a QHY367C color CMOS camera.

To our contributors: The copy and photo deadline for the September 2018 issue is July 1. Please send your stories and photos to our managing editor, **Ron Kramer** (*managingeditor@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.

Astronomical League National Office:
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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**

Field of View

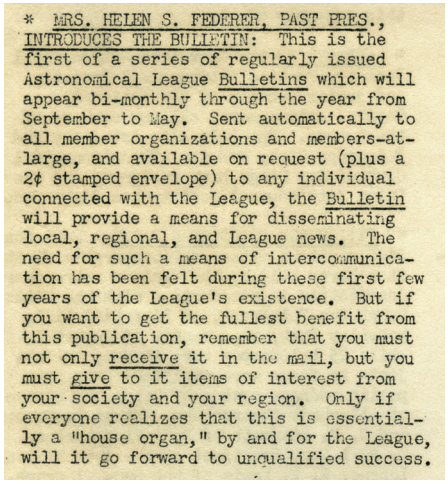
From the office of your president

Who We Are, What We Are

We are a lucky bunch of amateur astronomers. We have easy access to large-aperture scopes and can use fantastic imaging equipment, unheard of when the Astronomical League was in its infancy. Because of this, we surely must be affected differently by our avocation than were the first Astro-Leaguers.

Who is the Amateur Astronomers' League?

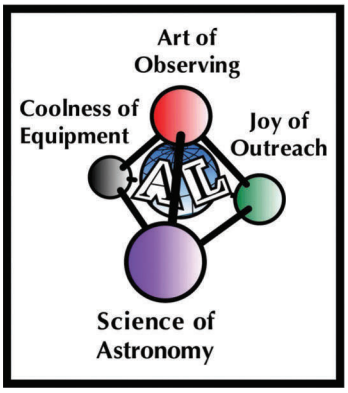
Judging, though, from articles and notices in early editions of the *Reflector*—or its precursor, the *Bulletin*—we still have the same fascination and wonder of the sky as amateur astronomers had in the late 1940s and throughout the 1950s. Deeper appreciation of the avocation—that is, the way it affects us personally—has not changed. Indeed, as French author and critic Jean-Baptiste Alphonse Karr philosophized in 1849, "The more things change, the more they stay the same."



* MRS. HELEN S. FEDERER, PAST PRES., INTRODUCES THE BULLETIN: This is the first of a series of regularly issued Astronomical League Bulletins which will appear bi-monthly through the year from September to May. Sent automatically to all member organizations and members-at-large, and available on request (plus a 2¢ stamped envelope) to any individual connected with the League, the Bulletin will provide a means for disseminating local, regional, and League news. The need for such a means of intercommunication has been felt during these first few years of the League's existence. But if you want to get the fullest benefit from this publication, remember that you must not only receive it in the mail, but you must give to it items of interest from your society and your region. Only if everyone realizes that this is essentially a "house organ," by and for the League, will it go forward to unqualified success.

First issue of the Reflector *(*the Bulletin*)*

Our equipment has certainly changed, the darkness of our skies has sadly changed, and the depth of our understanding of the universe has dramatically changed. But our interest in the four cornerstones of our avocation's foundation—the science of astronomy, the art of observing, the joy of outreach, and the coolness of well-crafted equipment—has not.



The cornerstones of amateur astronomy with the Astro-Leaguer nestled somewhere in the tetrahedral interstice

(One thread that has changed, and disturbingly so, is the near-complete disappearance of club sections for young astronomers. As a rule, young people, while still being very interested in the cosmos, aren't inclined to join groups with physical meet-ups such as amateur astronomy clubs. Instead, they are more likely to interact almost exclusively online in forums with other young people across the country.)

We are still the same Astro-Leaguers at heart as those folks who attended the 1947 founding convention when, at the beginning of that gathering, a name was proposed for a new national amateur astronomy organization, the "Amateur Astronomers' League." At the end of the convention and after a name change, the Astronomical League was born with $67.42 in its bank account and with 1,568 members spread across 31 societies.

What is the Astronomical League?

Much Astronomical League business during the ten years after its inception was devoted to cementing together the loosely knit national organization. First, a lot of attention was given to organizing and implementing regional meetings and the annual national convention. Second, the *Bulletin* was quickly established to provide needed "glue" for the young organization, keeping its members informed about local, regional, and national amateur astronomy news. Third, League officers held many discussions with member societies to discover how the League could better serve amateur astronomy.

Slowly but steadily, new benefits began appearing, which were designed to help people enjoy their experiences under the starry dome. Over the ensuing years, the Astronomical League grew and evolved as science and technology advanced.

The League in one way or another focused—and continues to focus—its efforts to address the four cornerstones of amateur astronomy:

- Think of how the annual meetings, the Book Service, and many *Reflector* articles have helped members learn the science behind what they see with their fantastically cool equipment.
- Think of how the complete array of Observing Programs, the Astronomics Sketching Award, the OPT Imaging Awards, and the Leslie Peltier Award have encouraged people to gaze skyward.
- Think of how the Horkheimer Library Telescope drawings, AstroNotes and Outreach Downloads, and the ten paths to our Youth Awards have encouraged people, especially the young, to enter the hobby.
- Think of how the Mabel Sterns Newsletter Editor Award, the Webmaster Award, and the Wright Service Award have helped stimulate all clubs by making them stronger and more relevant.

What will the Astronomical League be?

The Astronomical League may have a national reach, but it is still a small nonprofit organization. Its strengths and successes are directly tied to the efforts of its over 100 volunteers. Members who actively participate in the League have a great opportunity to influence the direction of how this nationally respected organization will continue to engage amateur astronomy.

As you learn about astronomy, share the sky with others, gaze upon an intriguing celestial object, or carefully inspect a new scope, please know that the League is here for you, the Astro-Leaguer, just as it was in 1947.

John Goss, League President

Notable dates in League History

First ALCon precursor: 1939; AL founding: 1947; AL incorporation: 1948; First *Bulletin*: 1949; First AL Award: 1951; Book Service: 1952; *Reflector*: 1957; Messier Club: 1967; AL Trust Fund: 1970; *Messier Manual*: 1970; Astronomy Day: 1973; League Sales: 1977; Peltier Award: 1980; Herschel 400: 1981; NYAA: 1993; Wright Award: 1985; Club liability insurance: 1991; AstroNotes: 1991; 10,000 members: 1992; Website: 1997; Mabel Sterns Award: 1998; Horkheimer Youth Service: 1998; Master Observer Program: 2001; National office: 2002; Webmaster Award: 2003; Master Observer Network: 2008; Outreach Downloads: 2010; Horkheimer Library Telescope: 2015; Sketching Award: 2015; Imaging Award: 2016; Celestial Savings Program: 2016; 10,000th Observing Certificate: 2016

Reflector Mail

Dear Editor:

Working down the stack of things to do, Bill Bogardus's article in the June 2017 *Reflector* popped out. With the upcoming solar eclipses in southern South America, there will likely be tour groups visiting some of the professional observatories. I do not get to visit high-altitude places nearly as often as I'd like, but there is an acclimatization protocol to follow to minimize the onset of altitude sickness. That, plus symptoms and treatment, are described at *www.webmd.com/a-to-z-guides/altitude-sickness*. Mild to moderate symptoms are reduced by going to a lower elevation and drinking extra water. Not drinking extra water and not shifting to a high-carbohydrate diet several days before going to a higher elevation are probably the two most common mistakes.

Severe symptoms require immediate evacuation to lower elevation and immediate medical treatment. Severe cases involve significant fluid accumulation: in the lungs, it is high altitude pulmonary edema (HAPE); in the brain, it is high altitude cerebral edema (HACE). Either is fatal if not treated immediately. A hiker died from HACE in Colorado in 2017 because detection was too late (neither the hiker nor others were familiar with the symptoms) and evacuation would have taken several hours.

Anyone with cardiac or pulmonary conditions must check with their physician or specialist for their recommended maximum altitude. This also applies to pregnant women and young children who do not live at high elevation, usually defined as 2400 meters above sea level.

Mr. Bogardus made two brief statements about his experiences that I find alarming. He states that "breathing was difficult [at 2200 meters]" and that he endured "three days of altitude sickness [at Lake Titicaca, 3600 meters]." I venture to guess that the difficult breathing meant one had to breathe extra deeply and more frequently in moderate exertion. More than a few hours of even moderate altitude sickness is a life-threatening condition. Mr. Bogardus is "lucky."

James Fullerton
Member-at-Large

Bill Bogardus responds:

James makes all good points. Reviewing his source, I recognize my Bolivia experience as symptoms of Acute Mountain Sickness (AMS). Fortunately for me, I was with experts providing supplemental oxygen, advice, local remedies, medication and constant monitoring during my three day acclimation. Anyone planning to visit high altitudes can benefit from preparation. It made a complete difference for the ALMA experience.

To the Editor:

Once again, I am wondering about a word in the high-quality, artful astronomy essay ("Imagine Incite") on page 16, column 2, line 6 of the March 2018 *Reflector*: "apropoetic." It doesn't appear in my good Greek dictionary unless it is your neologistic blend word. In Greek it would be "not-before-making (a poem)," and it doesn't seem to be an error for "apopoetic" (as if "away from or beyond poetic"). Are you trying to say "appropriately poetic" or "regarding poetic?" If I am puzzled, there'd be others also puzzled. Please clarify!

Carl Masthay, *retired medical editor, linguist, Algonquianist*
838 Larkin Ave., Creve Coeur (St. Louis), MO 63141-7758
cmasthay@juno.com

***The author replies**: The word "apropoetic" in the article is indeed a blended word, combining apropos and poetic.*

International Dark-Sky Association

Making Their Mark: Women Leaders in the Fight Against Light Pollution

The January-February issue of *Sky's Up* magazine (*view.joomag.com/skys-up-january–february-2018/0999470001513909897*) is devoted to "a celebration of women in astronomy." I highly recommend you download and read all the issues of *Sky's Up*, and particularly the January–February issue. This fine journal is published by the AstronomyOutreach network (*www.astronomyoutreach.net*) and edited by my very good friend David Levy.

The present IDA column borders on plagiarism from the *Sky's Up* issue I mentioned. That issue highlights Carolyn Shoemaker, Terry Mann (former president of the League), Linda Spilker, Jill Tarter, Christina Richey, Jean Mueller (a longtime friend), and Connie Walker, as well as several other famous women astronomers from the past and present.

I want to concentrate on three women who are world leaders in the fight to protect and restore dark skies: Connie Walker, Diana Umpierre, and Kim Patten, who are or were members of the board of directors of IDA. It is always problematic to write about someone you know or have met, because you worry about getting facts mixed up or making terrible errors. You also worry about neglecting other important persons who you should have mentioned. Since this column space is limited, I will briefly mention the outstanding contributions of these three women.

I call Connie Walker indefatigable because of her endless energy and many undertakings. Connie is a scientist at the National Optical Astronomy Observatory (NOAO) Office of Education and Public Outreach. For years she has been a prominent leader in astronomy public outreach and a strong advocate for combatting light pollution. She won IDA's prestigious Hoag-Robinson Award in 2011 and just completed serving for six years on IDA's board of directors, her second term on the board. Connie is the driving force behind Globe at Night (*www.globeatnight.org*), an international citizen-science project that enables participants to observe specific constellations and log night-sky brightness data for their own communities. She has also developed the Quality Lighting Teaching Kit. Connie has an undergraduate degree in astronomy and physics, a master's degree in electrical engineering, and a PhD in astronomy.

Diana Umpierre is the current vice president and immediate past president of the IDA board. She has extensive experience in urban planning, geography, and geoscience in the public and private sectors. Currently, she works as a grassroots organizer for the Sierra Club. Diana is a Certified Planner and a Certified Geographic Information Systems (GIS) Professional. She has a bachelor's degree in geology from Cornell University. Diana is, like Connie Walker, an incredible bundle of energy and ideas, being named IDA's Volunteer of the Year in 2013. It is hard to keep up with her.

Kim Patten has been associated with IDA for many years, having had a formal leadership position in IDA management in the past. It is great to now have her on the IDA board. Kim has an MS in environmental planning from the University of Arizona. Her experience includes managing and conducting research on a more than $30 million portfolio, including co-principal investigator on a $3.6 million National Science Foundation cooperative agreement and project manager of a $22 million U.S. Department of Energy funded project. How about that for accomplishments?

In addition to Diana Umpierre and Kim Patten, there are six other outstanding women on IDA's board of directors: Jessica Dwyer (USA), secretary of the board; Laurel Alyn-Forest (USA); Darcie Chinnis (USA); Krissa Glasgow (USA); Diane Knutson (USA); and Kellie Pendoley (Australia). They all have incredible backgrounds, long lists of accomplishments, and important ongoing projects. I should mention that the men on the IDA board—Ken Kattner (USA), president; Jim Dougherty, former president (USA); and Alejandro Sanchez Miguel (Spain)—are no slouches either. Check them all out on the IDA Board website (*www.darksky.org/about/board-of-directors*).

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

All Things Astronomical

New Haven, Connecticut, April 24, 2018

Milky Way's Supermassive Black Hole May Have "Unseen" Siblings

Astronomers are beginning to understand what happens when black holes get the urge to roam the Milky Way.

Typically, a supermassive black hole (SMBH) exists at the core of a massive galaxy. But sometimes SMBHs may "wander" throughout their host galaxy, remaining far from the center in regions such as the stellar halo, a nearly spherical area of stars and gas that surrounds the main section of the galaxy.

Astronomers theorize that this phenomenon often occurs as a result of mergers between galaxies in an expanding universe. A smaller galaxy will join with a larger, main galaxy, depositing its own, central SMBH onto a wide orbit within the new host.

In a new study published in the *Astrophysical Journal Letters*, researchers from Yale, the University of Washington, Institut d'Astrophysique de Paris, and University College London predict that galaxies with a mass similar to the Milky Way should host several supermassive black holes.

The team used a new, state-of-the-art cosmological simulation, Romulus, to predict the dynamics of SMBHs within galaxies with better accuracy than previous simulation programs.

"It is extremely unlikely that any wandering supermassive black hole will come close enough to our Sun to have any impact on our Solar System," said lead author Michael Tremmel, a postdoctoral fellow at the Yale Center for Astronomy and Astrophysics. "We estimate that a close approach of one of these wanderers that is able to affect our Solar System should occur every 100 billion years or so, or nearly 10 times the age of the universe."

Tremmel said that since wandering SMBHs are predicted to exist far from the centers of galaxies and outside of galactic disks, they are unlikely to accrete more gas—making them effectively invisible. "We are currently working to better quantify how we might be able to infer their presence indirectly," Tremmel said.

Co-authors of the study are Fabio Governato, Marta Volonteri, Andrew Pontzen, and Thomas Quinn.

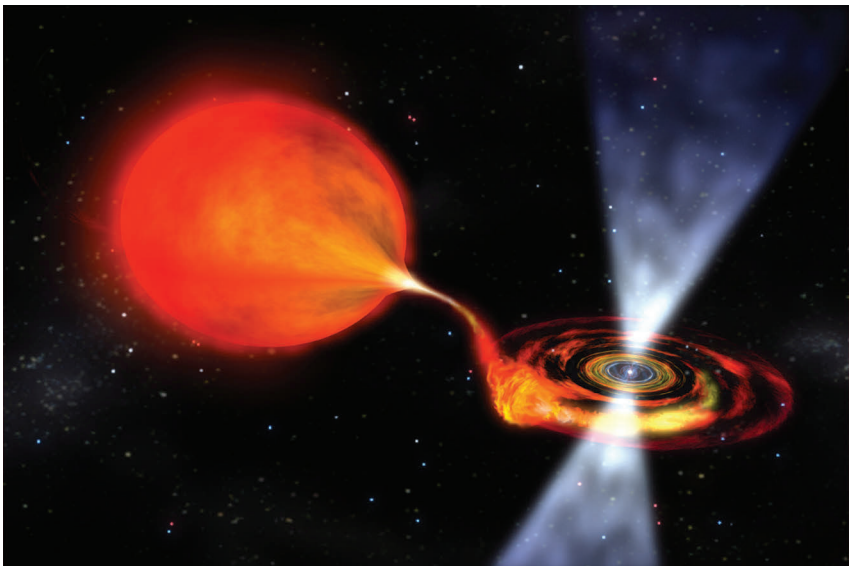
The study is part of the Blue Waters computing project supported by the National Science Foundation and the University of Illinois.

Watch a video featuring Tremmel talking about the new study at *www.youtube.com/watch?v=38QFWFk0x1k*.

University of Southampton, England, May 8, 2018

Bursting Pulsar Found to "Hiccup" During Crucial Stage of Its Lifecycle

Researchers at the University of Southampton have discovered that the unique "Bursting Pulsar"—a neutron star which steals matter from a low-mass stellar neighbor—may also be the slowest known "transitional pulsar" in existence. Transitional pulsars are a rare class of neutron stars, which alternate between showing X-ray and radio pulsations over timescales of years.



About 20 km across, the dense neutron star attracts matter from a companion star (image credit: University of Southampton)

Jamie Court, postgraduate researcher in Astronomy at Southampton, has also found for the first time ever that the Bursting Pulsar (GRO J1744-28) has a tendency to "hiccup" as it strips matter from a nearby giant star onto its surface. The observations feature in a new paper published in the *Monthly Notices of the Royal Astronomical Society: Letters* co-authored by Court with Southampton Principal Research Fellow Dr. Diego Altamirano and Dr. Andrea Sanna at the University of Cagliari in Italy.

Using archived data from NASA's orbiting RXTE observatory, which fell back to Earth on April 30, Court and his colleagues have discovered that this object may also be the slowest known transitional pulsar with a magnetic field 100 times stronger than any other.

"In a transitional pulsar system, a neutron star pulls matter off of a nearby sunlike star onto its surface,"Court explains. "This colossal river of star matter spins up the neutron star like an engine, leading to this city-sized object with twice the mass of the Sun spinning hundreds of times per second. Friction forces in this stream also heat it up to millions of degrees, causing it to glow brightly in X-rays which we can see from the Earth."

This flow of matter can't last forever, and as the neutron star's companion is slowly stripped away, the flow does not end neatly.

"It is now believed that, in neutron stars near the end of this process, this flow can sometimes switch on and off, causing the X-rays to slowly sputter out like a dying engine," Court continues. "Even when the flow is present, it stops being smooth; a constantly shifting fight between the infalling gas and the magnetic field causes matter instead to be swallowed in discrete 'gulps' or 'hiccups.' These hiccups are the telltale signs that we have discovered in the neutron star known as the Bursting Pulsar.

"But the Bursting Pulsar is unusual in a number of ways," Court adds. "The neutron star only spins about twice a second; while this may seem fast for something 20 km across, this is about 100 times slower than the other transitional pulsars discovered so far, suggesting that the matter-flow engine somehow failed to spin the neutron star up as much as it should have. This in turn suggests that there is still much we do not understand about how these incredibly dense stars evolve over time.

"In addition to this, the neutron star in this system has an incredibly strong magnetic field; more than 100 billion times that of the Earth, and 100 times as strong as any other known transitional pulsar," he concludes. "This exciting discovery will allow us to explore the messy physics of these cosmic hiccups in a more extreme environment than ever before. It shows that, even six years after being decommissioned, the RXTE satellite is still helping us to do great new science!"

"A great and humble man"

I had been expecting this phone call for several years when it finally arrived late one evening in March. My friend Ian, a Londoner, called to inform me that "a great and humble man has died." After a bit of small talk between two friends, I heard the line go quiet and just sat at my desk. It was many minutes later when I arose, took a deep breath, and for the first time gave serious thought to the call.

I had met Stephen Hawking several times in the past, usually at seminars. A brilliant man, to be sure, but there was something else about him. He was not widely known as a humorous individual, but to me he seemed to possess a very dry wit.

In 1988, a business trip took me to the University of Cambridge. I purchased a copy of Hawking's new book, *A Brief History of Time*, planning to read it on my return trip. While walking down the halls of one of the buildings, I saw someone pushing a wheelchair towards me. As we neared, I recognized Stephen. We stopped and chatted for a short time. He was on the way to give a lecture and I mentioned that I always wished I could take his class. He saw the book in my hands and told me to go to room 102 and start reading the book in 10 minutes. His lecture was to be in room 202.

So, there you have it folks. The words of someone who has studied under the great Dr. Hawking.

Summer's on the way, with Venus and Jupiter already making grand appearances. ALCon 2018 is almost here and I don't expect Minneapolis will ever be the same again.

It's almost League election day. This year we have candidates for president, vice president (two), and treasurer. Read about the candidates in this issue's "From Around the League" section. Don't forget to vote.

We need more images. Imagine the bragging rights when your astrophoto appears on the front cover of the *Reflector* or in the Gallery. The accolades will pour in from around the globe. You'll be so famous you will have to hire an agent or secretary to take all the calls and offers. (Greatness does come at a price.) Send your photos, in high-resolution JPEG or TIFF format (at least 3 megabytes) to Dan Crowson, *photoeditor@astroleague.org*.

Also, don't forget your article submissions should be sent as Microsoft Word or similar files with images as separate JPEG files of at least 500 kilobytes. We sometimes receive PDF article submissions with embedded images, but these are rather difficult to convert into editable documents. Articles should be from 1,000 to 3,500 words plus images (with captions and credits). Articles also need a title. You'd be surprised how many submissions we get without a title, author, or affiliation. Send your articles to *editor@astroleague.org*.

Deep-Sky Objects

The Eagle Nebula

By James R. Dire
Kauai Educational Association for Science and Astronomy

The Eagle Nebula (M16 or IC 4703) is perhaps the best deep-space object located in the constellation Serpens. The nebula is located approximately 15 degrees north of the Teapot asterism in Sagittarius and 2.5 degrees north of the Swan Nebula (M17). Both M16 and M17 are located near the boundaries of the constellations Sagittarius, Scutum, and Serpens. Both also lie on the west edge of the summer Milky Way. There are no bright stars in the vicinity of M16. However, the 4th magnitude optical double star Gamma Scuti forms an equilateral triangle with M16 and M17. Star-hopping to M16 can be accomplished starting at Altair. Follow a line through Delta Aquilae and Lambda Aquilae to Gamma Scuti and then jump 2.5 degrees west to M16.

The Swiss astronomer Philippe Loys de Chéseaux recorded seeing M16 in the year 1746. He is thought to be the first astronomer to have found the object. Charles Messier recorded it in June 1764. He described it as a small cluster enmeshed in a "faint light." Edward Emerson Barnard gets credit for being the first to photograph the nebula, in 1895 from the Yerkes Observatory.

The Eagle Nebula gets its name from the eagle shape of the nebula. Although it's not known who first used the name, Robert Burnham Jr. called it the Star Queen Nebula. The nebula is roughly 35 by 28 arcminutes in size and can be seen in small telescopes. Through an 8-inch telescope, the nebula is an impressive object and its namesake eagle shape becomes apparent.

The Eagle Nebula is a massive star-forming region. Embedded within the nebula is the open star cluster NGC 6611. With an overall magnitude of 6.4 and a diameter of 7 arcminutes, NGC 6611 contains scores of stars brighter than 12th magnitude. Most of the brighter stars are hot, massive O and B stars that are blue to white in color. The brightest star is SAO 106303, which shines at magnitude 8.24. The star cluster, like the Eagle Nebula, is approximately 7,000 light-years away.

My image of M16 was taken with a William Optics Fluorostar 132 mm f/7 refractor using a 0.8x focal reducer/field flattener. The effective focal length was 740 mm at f/5.6 and the exposure was two hours. In the image, north is up and east is to the left. The red color in the nebula comes from hydrogen gas emissions at 656.3 nm. Although the camera picks up the color, our eyes only see gray tones through a telescope.

In the center of the image lies a trio of huge clouds dubbed the Pillars of Creation after the famous Hubble Space Telescope image of that region. These trunks of interstellar gas and dust appear in silhouette against the brighter emission nebulae surrounding them. The gas and dust are in the process of creating new stars.

M16's star cluster NGC 6611 lies chiefly in the northwest portion of the nebula, or to the upper right of the center on the accompanying image. The southernmost of the two brightest stars near the center of the cluster is the aforementioned SAO 161303. The other star in the pair is magnitude 8.75 SAO 161302, the second brightest star in NGC 6611. These stars are easily resolved in 7x50 binoculars under dark, steady skies.

The brightest star in the image, near the top center, is a magnitude 8.00 star of spectral classification K. Near the bottom center of the nebula is the second brightest star in the image, a magnitude 8.23 yellow star; a white star to the east (left) of it shines at magnitude 8.25. These three stars are foreground objects not associated with M16 or NGC 6611.

The Eagle Nebula is a splendid summer Milky Way object to explore in any sized telescope. Its emission nebulae, dark nebulae, and myriad stars provide fascinating variety for deep-space exploration.

Wanderers in the Neighborhood

The Trojan War

By Berton Stevens

In ancient Greek mythology, the Trojan War pitted the Greeks against the Trojans, one of the most important events in this mythology. Helen, the queen of Mycenaean Greece, was spirited away to Troy by Paris after the Greek goddess Aphrodite caused Helen to fall in love with him. The Greek army followed them and besieged Troy for ten years. After many heroes on both sides died, the siege ended when the Greeks employed the Trojan Horse ruse to take the city. The victorious Greeks slaughtered the Trojans and took the women and children as slaves. They also desecrated the temples to the gods, angering the deities, who prevented most of the Greeks from ever returning home. This epic story was detailed in Homer's *Iliad*.

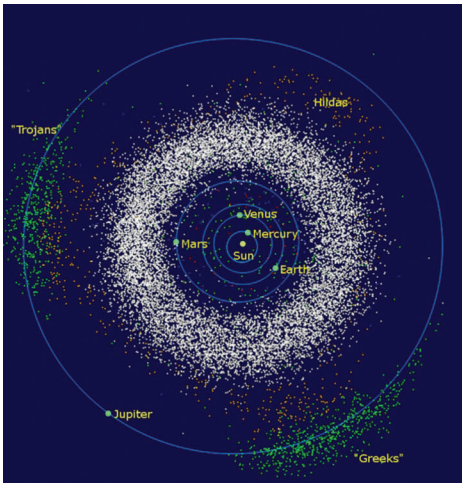
There is a battle going on in our Solar System as well. This battle is not between armies using arrows and swords, but between the bodies of the Solar System via gravity. The soldiers in the war are the Sun and the planets, while the innocent victims are the minor planets that pass through their gravitational fields. Sometimes a major planet's gravity will fling a minor planet in toward the Sun, sometimes out into space. Most of the time, gravity simply changes the minor planet's orbit.

Even as the war is continuing, there are regions of gravitational neutrality where minor planets can have stable orbits even as they remain under the influence of the gravitational field of a major planet like Jupiter. In the 1700s, astronomers used Newtonian physics to understand orbits by investigating the gravitational interaction of three bodies in space. This became known as the three-body problem. The largest body (like the Sun) was at the center of the system, while the second largest (like Jupiter) orbited it in a circular orbit. The third object was small and also orbiting the Sun (like a minor planet).

It was discovered that there are five positions where the small object can be in a stable orbit. In 1767, Swiss mathematician Leonhard Euler demonstrated three of the five points. These three are along the line connecting the Sun and Jupiter. One was on the sunward side of Jupiter, one on the opposite side of Jupiter, and the third on the far side of the Sun from Jupiter. The final two were uncovered in 1772 by Italian-French mathematician and astronomer Joseph-Louis Lagrange. He determined that there were also stable points sixty degrees ahead of and behind Jupiter in its orbit.

All five points have been given the name Lagrangian points, places where gravity of the two largest bodies in the system provide the conditions for a stable orbit. They are named L1 through L5. L1 (between Jupiter and the Sun), L2 (opposition point near Jupiter) and L3 (far side of the Sun from Jupiter) are points of unstable equilibrium. In a perfect three-body system, a minor planet could orbit there, but in a real Solar System, the gravity of the other planets destabilizes the objects in these areas and they drift away from the Lagrangian point.

L4 and L5 are points of stable equilibrium, where the gravity of the other planets is counteracted by the gravity of Jupiter. If the gravity of another planet starts to pull the asteroid away from L4 or L5, Jupiter pulls it back. This results in the asteroid following a kidney-bean-shaped orbit around the Lagrangian point. Since these asteroids do not have to be exactly at L4 or L5 to be stable, the asteroids in these stable orbits cover an arc along Jupiter's orbit.



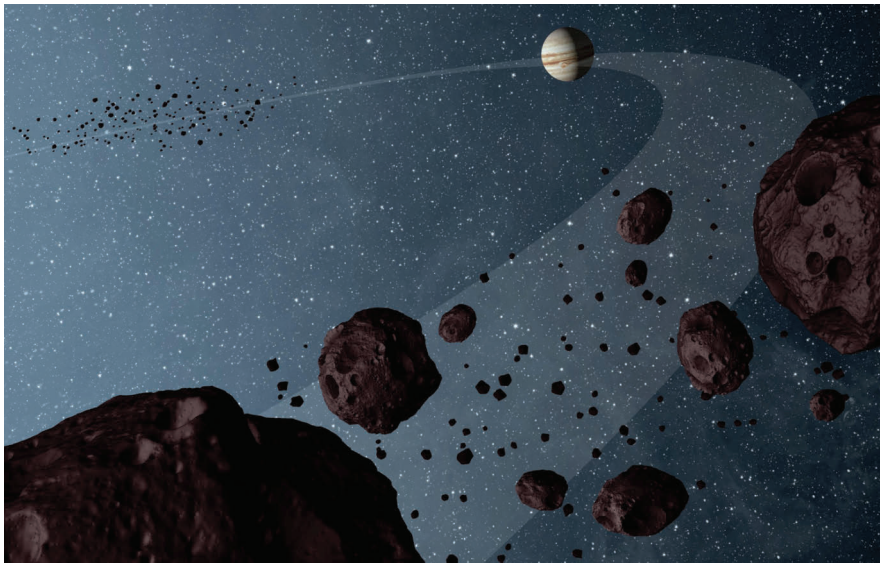
While we think of the inner Solar System as the inner five planets, hundreds of thousands of known minor planets occupy this area as well. In this plot, the main belt asteroids are shown in white and the Hilda group is shown in orange. Near-Earth objects are in red. The Jupiter Trojans are shown in green, orbiting the preceding and trailing Lagrangian points (L4 and L5). The Hilda group is in a 3:2 orbital resonance with Jupiter, with their furthest distance from the Sun opposite Jupiter at L3. Credit: Mdf, en.wikipedia.org/wiki/Hilda_group#/media/File:InnerSolarSystem-en.png.

The first asteroid to be discovered at one of Jupiter's Lagrangian points was 588 Achilles, named after one of the Greek heroes killed in the Trojan War. The discoverer, German astronomer Max Wolf, found it in 1906 and within a few months its unique orbit was determined. As new asteroids in the L4 and L5 points were found, the precedent set by Wolf was followed, naming each newly discovered asteroid in the L4 and L5 areas after one of the mythological characters mentioned in the *Iliad*. Since this myth detailed the events of the Trojan War, this group of asteroids was dubbed the Trojans.

To differentiate those at the L4 node from those at the L5 node, the asteroids in the area of the L4 node are named after the Greek heroes in the *Iliad*, while those at the L5 node are named after the heroes of Troy. Minor planet 617 Patroclus was discovered before the Greece/Troy precedent and it is on the Troy side, even though Patroclus was a Greek hero. The Greek side also has an interloper, 624 Hektor, named after a Trojan hero.

It is estimated that there are as many Jupiter Trojan asteroids as there are asteroids in the main belt, roughly a million each. The term Trojan no longer just refers to the asteroids on either side of Jupiter. It now refers to any object that that is at the L4 or L5 point of a planet. Neptune has at least seventeen Trojans. Uranus has two known Trojan asteroids. Venus has one as well. Mars has nine known Trojans. Even the Earth has one, known as 2010 TK_7. Strangely, Saturn does not have any known Trojan asteroids.

Two of Mars's Trojans have recently been studied in greater detail. These two are members of the Eureka group in the L5 (trailing) region where eight of this planet's Trojans are found; the ninth one resides in the L4 region. These asteroids are rich in the mineral olivine, a magnesium iron silicate that is found in the Earth's mantle. Olivine forms when a planetesimal becomes large enough to differentiate into a crust, mantle, and core. The olivine that astronomers found on the surface would only be visible if the planetesimal had been broken up by collisions with other planetesimals.



NASA's Wide-Field Infrared Survey Explorer (WISE) took measurements of Jupiter's Trojans, depicted here from near the trailing (Trojan) location showing the leading pack (the Greeks) in the distance. These observations show that they are uniformly dark with a slight burgundy coloration. They have a matte surface, reflecting little sunlight. The uniformity indicates that they have a common composition and probably a common origin. Credit: NASA/JPL-Caltech www.jpl.nasa.gov/spaceimages/details.php?id=PIA16211

Since there have not been rogue planetesimals since early in the Solar System's history, these Mars Trojans must have become locked in their stable orbits in the young Solar System and have been there ever since. This is probably true for the other Trojans in the Solar System as well. By studying them we will learn more about the primitive material that eventually formed the terrestrial planets of our Solar System. NASA hopes to launch the Lucy mission to study Jupiter's Trojans in both the L4 and L5 regions in 2021, giving us a close-up view of these fascinating objects.

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How Local Clubs Can Grow Through Nurturing the Novice

By W. Maynard Pittendreigh

The growth of our local clubs is built on three steps: reaching out to the community to introduce people to astronomy, encouraging new people to join our local club, and nurturing the novice to become an experienced and skilled astronomer.

Many clubs do an incredible job of reaching out into the community to introduce astronomy to the public. Members of the Fort Bend Astronomy Club in Texas have earned over 150 Outreach Awards. Flint River Astronomy Club has more than 70 awards. North Houston Astronomy Club has more than 60. Since the inception of the Outreach Award Program in 2001, the submissions for these awards reflect over 65,000 volunteer hours in outreach. These submissions record a total of over 2.9 million participants!

We are doing an outstanding job with step one: reaching out to the community to introduce people to astronomy. The next step is more challenging: encouraging people to join our local club. Not all who come to an outreach event will join our clubs. Many attend an outreach event out of mild curiosity, looking forward to their first glimpse through a telescope. Others may prefer astronomy as an activity of solitude, while others are busy with work, family, and other concerns and have no room for one more activity. Some, however, will want to join our local clubs. Every outreach opportunity needs to provide easy access to information about when and where your club meets. A simple handout is all it takes.

You will find that as people join your local club, these newcomers are of two varieties: experienced and novice. The experienced astronomer will speak our lingo and have a good familiarity with the sky and telescope skills. That is the kind of member that will help lead programs, participate in outreach events, perhaps take leadership roles, and will become a paying member for years to come.

The novice, however, will not understand terms like "declination and right ascension angle," "globular cluster," or "magnitude." Novices do not know enough to help lead a program and may not even understand the programs and presentations in the club meetings. They become frustrated and stop coming after a meeting or two. They will not continue as members of your club.

The future of your local club is built on welcoming both the experienced and the novice member. Novice members will need your special attention if they are to become continuing members, attending meetings month after month and paying dues year after year. Novices will come to your meetings not looking for how they can contribute to your club, but how your club can help them become better, more knowledgeable astronomers. Don't let them down!

The Astronomical League offers two programs that are perfect for your local club to use to nurture the novice astronomer. One is for youth and one is for people of any age. For the youth, we have the Sky Puppies program. To qualify for the Sky Puppies Observing Program, a person must be age 10 or younger. A manual is available that is age appropriate for the young astronomer. Basic terms are taught. Simple skills with the unaided eye, binoculars, or a small telescope are developed. This program is designed to nurture the young person for a lifetime of interest and activity in astronomy.

The Sky Puppy program began in 2003. One does not have to be a member of the Astronomical League to earn this award. This is one of our very few programs open to non-members. You may be a Cub Scout leader who might want to use this program in your local pack. You may have a niece or nephew with a budding interest in the stars. The young person simply needs to have a mentor who is a member of the Astronomical League.

For adults, we have the Beyond Polaris program. This program was introduced in 2017 and was designed by three members of the Mason Star Gazers in Mason, Texas: Bridget Langdale, Suzanne Bjork, and Wendy Hastings.

Beyond Polaris can become an important component of your local club, providing you with a process for taking the inexperienced, but interested, novice astronomer into a more fulfilling relationship with the stars. The main focus is to understand the constellations, star party etiquette, simple star-hopping, how to use a planisphere, and how to find Polaris. The program does not use binoculars or a telescope.

Promoting these two introductory programs can be helpful to nurturing and retaining membership. Clubs may find it helpful to give a discount to the next year's membership dues of 10 percent, 50 percent, or even 100 percent for those who earn the Beyond Polaris Award. Your club's future, after all, depends on members who are active participants. Nurturing novices to become experienced astronomers will nurture your club's future.

More information about Sky Puppy and Beyond Polaris can be found on the Astronomical League's web page, *www.astroleague.org.*

Maynard is the coordinator of the Outreach, Sky Puppy, and Beyond Polaris programs. He can be reached at *maynard@pittendreigh.net.*

Adventures of a Starlight Detective

By Jamey Jenkins
Twin Cities Amateur Astronomers

My first school science project was the construction of a simple spectroscope. Built as a foot-long box with an entrance slit of razor blades and dispersion provided by an Edmund Scientific replica grating, remarkable terrestrial spectra were visible. Over the years, as my astronomy interests developed, I was sensitive to the importance of spectroscopy—the study of spectrum analysis—yet I never considered investigating that mysterious realm of astrophysics. This type of work was seemingly beyond the abilities and talents of the average amateur astronomer.

Recently, an online acquaintance made me aware that an amateur observer can provide useful scientific data in several fields: astrometry, photometry, and spectroscopy. Through these areas, amateurs are making dramatic progress assisting professionals with research projects. What if I could develop the technical skill to become a so-called citizen scientist? The possibility is intriguing to me. Anticipating future retirement, I've taken up the calling to develop that skill, and then conceivably pursue an astronomical passion—to observe with a purpose, contributing to the body of astronomical knowledge. This article will briefly describe my initial efforts exploring what I find to be a spellbinding activity.

Getting Started

It seems to me the best opportunity for the typical astronomy buff wishing to do science is in the field of stellar photometry, the measurement of light intensity as a function of wavelength. Asteroids and stars make numerous targets, while organizations like the AAVSO provide the necessary database and can mentor an inspired observer. Although a lifelong amateur astronomer, I see myself as a raw beginner in these technical areas. For me, having a firm foundation and proficiency is essential to any worthy project, so rather than diving directly into photometry, I have set about using a hands-on approach to educate myself on the fundamental properties of stars. Photometry will follow.

Low-resolution spectroscopy is the means I've selected to begin my astrophysical journey. This type of work is accomplished inexpensively, while providing a deep well of knowledge regarding stellar composition, evolution, temperature, and star color.

Recording spectra requires appropriate tools for the task. A *converging beam slitless spectrograph* can be created by attaching a screw-in transmission grating in front of a camera—a design reminiscent of my earlier science project. The camera and grating are inserted into the converging light beam of a telescope as if doing prime focus photography; only now a spectrum is formed some distance away on the CCD chip. This is the arrangement used with my existing equipment, a 102 mm f/7 ED refractor and DMK41 monochrome camera.

The Shelyak Instruments Star Analyser 100 is a popular grating for the beginning spectroscopist; it is the grating I utilize. The SA100 is a high-efficiency, 100 lines/mm transmission grating, blazed in the first order. First order blazing in this case means that the rulings of the grating are engineered so the bulk of star light is diffracted into the first of multiple spectra that the grating produces.

A simple converging beam slitless spectrograph can be created by attaching a screw-in transmission grating in front of a camera.

First Light

Trial and error is one way to see what works well and what might not. The first piece of business with this type of spectrograph is to properly orient the grating. The idea is to position the grating's rulings parallel to the pixel array of the camera, eliminating the introduction of artifacts into the imaged spectrum. Because the grating attaches to the nosepiece of the camera like a standard 1.25-inch eyepiece filter, it is a matter of rotating the grating cell on its threads until it is aligned, then locking it in position. Once aligned, I use a small piece of tape to hold the cell in place.

Facilitating the alignment requires locating a star, finding focus, checking alignment on the monitor screen, removing the camera, tweaking the rotation of the cell, retaping, reinserting the camera, reacquiring the star, and so on. This, for me, is a tedious affair at best. Then I stumbled upon a tip on how to quickly align the SA100 grating to a CCD. Looking down the barrel of the camera nosepiece, watch the reflection of the CCD on the back side of the grating (you will see two chips). Rotate the grating until both CCD chips superimpose; now the grating rulings are parallel to the pixels! Perfection in one fell swoop and done in the light, not the dark.

Generally speaking, a greater separation between diffraction grating and CCD produces a higher dispersion of the spectrum. However, the more a spectrum is spread out, the dimmer it becomes. The best arrangement for a novice is a separation that places the zero-order target image just inside the frame of the camera (left side) and the first-order spectrum totally visible near the center field of view. Depending on the physical size of the CCD, the separation may be in the 40 to 55 mm range. Additional spacers can be used if needed to increase the separation between the grating and CCD. Again, trial and error is one way of finding optimal separation for a given telescope, grating, and camera.

Capture the Spectrum

Creating an image of a spectrum (called a spectrogram) is a bit like deep-sky imaging, except the target may be only a single star. Focus and exposure will be geared for recording the first-order spectrum, not the zero-order stars. Ideally, during exposure,

The lower image shows the appearance of a raw spectrum (Denebola) as recorded with the DMK41 camera. Zero-order is the target star; the first-order spectrum is to its right. Spectra do not have to be recorded in color; in fact, monochrome images have better resolution. The blue wavelengths are on the left, the red to the right. A strip spectrum can be formed by drifting the spectrum at the telescope during exposure, or by digitally stretching the spectrum during processing.

the brightest part of the spectrum should be just below the saturation point of the pixels. Depending on the analyzing software, spectra may be captured as either a video, a single frame, or as a live monitor view. My technique has been to capture a 10–30 frame AVI video clip, from which to either extract individual frames, stack selected frames, or average frames in the analyzing program. The top right figure shows a typical spectrogram as obtained with the 102 mm f/7 refractor and SA100 grating.

In the converging beam slitless spectrograph, a spectrum is created as a series of overlapping images of the zero-order stars. The resolution of the spectrum is therefore dependent on the size of the Airy disk formed by the telescope, as well as on the seeing conditions. Short-focus, low focal ratio instruments work best because of the small disk formed; many experienced observers say that an f/5 focal ratio is about ideal. The focal ratio can be native or obtained with a focal reducer. Poor seeing conditions will expand the Airy disk of the target star, resulting in a loss of resolution and smearing of fine spectrum detail.

Processing the Spectrum

After a spectrum is captured, the next step is to process it. Processing can include extracting or combining superior camera frames, applying various corrections, and using mild sharpening to improve the visibility of spectral features. Calibration of the spectrum for wavelength is also necessary at this point.

The next image is a graph illustrating spectral intensity versus wavelength of the magnitude –1.46 star Sirius, called a calibrated raw profile. Sirius is a bright, spectral class A1V, main sequence star, a great first target because of its strong hydrogen Balmer lines. Spectral calibration can be accomplished by locating the position of a feature and assigning its wavelength relative to the zero-order image; the easily identified hydrogen lines are ideal for calibrating.

Several freeware programs are available for analyzing spectra; however, I found it advantageous to spend a few dollars and invest in the Rspec software developed by Tom Field. Rspec is powerful, educational, and supported by an extensive how-to library, user group forum, and an online website with a direct line to the developer. For my circumstances, Rspec is a perfect fit!

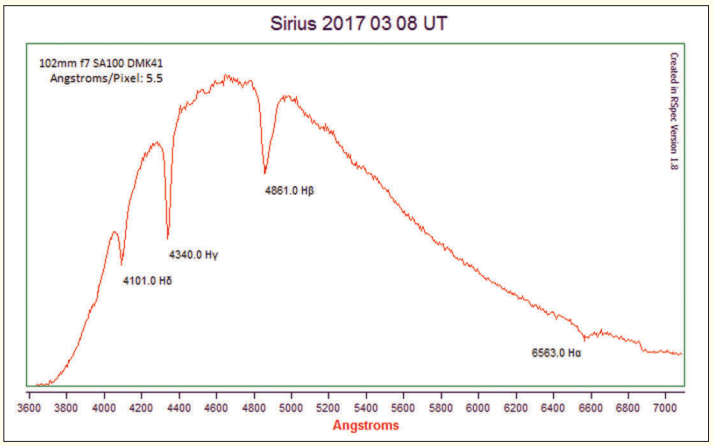
Spectral Analysis

Work in spectroscopy is accomplished in three stages: capture, processing, and lastly the detective work of identifying spectral lines. I've found the last phase to be a challenging, but edifying, experience. If you enjoy solving riddles or working puzzles, this activity would be invigorating for you.

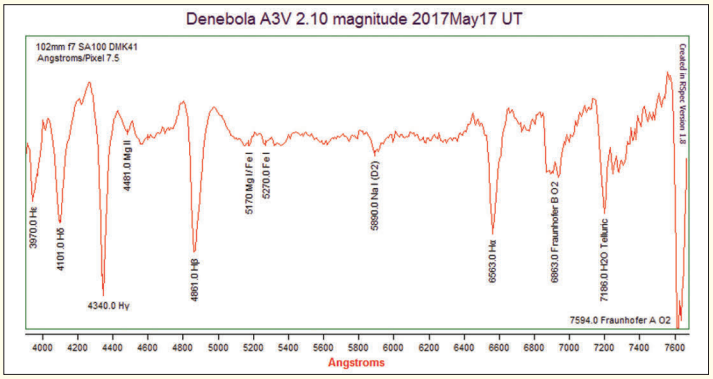
To the uninitiated, a spectral profile doesn't look like much more than a lot of wiggly lines. But to a spectroscopist, the dips, peaks, and widths represent locations and intensities of dark absorption and/or bright emission lines. Careful examination of even low-resolution spectra can give clues to a star's spectral classification (OBAFGKM), chemical composition, temperature, and, in some instances, Doppler shifts. At the time of this writing, I have barely scratched the surface of observational possibilities, continuing to focus my efforts on the identification of spectral lines and developing an understanding of the differing stellar classes. Line identification is facilitated by the built-in reference features of Rspec, published spectroscopic atlases, online references, and the annotated spectral profiles of professional and amateur spectroscopists.

A low-resolution spectrum as formed by my equipment requires careful and cautious examination of its features. Noise in the spectrogram, such as that created by the electronic camera, adds spurious wiggles among legitimate features, confusing identification. Light pollution and atmospheric absorption do the same. The signal-to-noise ratio of a spectrogram can be improved by limiting background illumination and using dark frames to control camera noise. With low-resolution spectrographs, several closely spaced spectral lines may blend to form a single line; sorting out these anomalies adds to the detective nature of this work.

Data presentation is a report of your findings. The last figure shows an intensity-normalized spectral profile of the class A3V, 2.1-magnitude star Denebola (Beta Leonis). Normalization is a process applied to a raw profile to equalize the spectrum, which helps to make features readily visible but does not preserve the expected blackbody radiation curve. Cropped to 4000–7600 angstroms, we see absorption lines annotated with wavelengths and element names. The features are typical of a class A star. Notice the deep dips of the hydrogen lines—this element's lines dominate in A stars, showing boldest in class A0. A few ionized metals (Fe and Mg) are faintly visible, while in the deep red to near-infrared we find the Fraunhofer A and B atmospheric oxygen and the telluric H_2O contamination (Earth's water molecules) at 7186 angstroms.



Raw profile of Sirius. The hump in the graph is the result of the star's color and the spectral sensitivity of the camera. The primary hydrogen Balmer lines are labeled.



A raw profile of Denebola has been processed through a technique called normalization, which removes the hump and equalizes the spectral intensities. A variety of absorption lines are identified.

Find Out More

If this activity seems interesting, let me give you fair warning! Spectroscopy can be a habit-forming endeavor that prompts the observer to keep searching deeper. When the spectro-bug bites, it bites hard, but be assured you'll have a rewarding and fascinating experience.

There are a number of websites with volumes of information regarding low- and high-resolution spectroscopy. Material abounds on the subject, but if you are like me—a novice to this branch of astronomy—locate and read the article "A Spectroscopy Primer for the Amateur Astronomer" by David Doctor in the March 2014 issue of the *Reflector*. This treatise is a wonderful place to start, as David clearly explains many of the fine points of astronomical spectroscopy. From there, search out online and hardcopy material; user group forums also offer guidance from experienced amateurs and connect you with like-minded observers—detectives to help answer the riddles found in the stars.

Jamey Jenkins has been an avid observer of the Sun for many years and a sometimes author. His most recent book is **Observing the Sun: A Pocket Field Guide**, *published by Springer, 2013.*

ASTRONOM
THE ROCI

By Naveen Vetcha
Contributors: Don Reed and Mitzi Adams

The Von Braun Astronomical Society (VBAS, *www.vbas.org*) located in Huntsville, Alabama, was originally founded in 1954 as the Rocket City Astronomical Association (RCAA) through the efforts of a group of high school students interested in astronomy led by Sammy Pruitt.

VBAS Astronomy Day billboard featuring the "right" colors to minimize light pollution

With the help and influence of Dr. Wernher Von Braun, for whom the Society was later renamed, the Society is still active 60 years after its inception. The VBAS organizes and presents planetarium shows, STEAM activities, and astronomy outreach events in the Tennessee Valley area.

On October 22, 2017, VBAS celebrated Astronomy Day at the society's facilities in Monte Sano State Park. The theme was "Bringing Astronomy to the People." Event planning started in the spring of 2016. The planning committee used tips from the Astronomical League's free *Astronomy Day Handbook* for planning and execution, which resulted in a very successful event with more than 350 attendees. Lockheed Martin sponsored the event. In addition, Chick-fil-A provided free kids meal coupons to support the event.

VBAS used various means of communication to publicize the event throughout the Tennessee Valley. Event information was circulated online (VBAS website, Facebook, local blogs) and through public radio public service announcements, local event calendars, and printed flyers. For the first time, VBAS also advertised the event on billboards. As VBAS is a promoter of dark-sky-friendly lighting, we worked with the designer to choose the "right" colors to minimize light pollution.

VBAS wanted to present an opportunity for kids and adults to not only look through the telescopes, but also to learn about various aerospace technologies to spark an interest in science, technology, engineering, art, and mathematics (STEAM). We invited various local similar-minded societies, museums, and organizations to participate in the event and to exhibit. As a result, the American Institute of Aeronautics and Astronautics (AIAA), the Huntsville Alabama L5 Society (HAL5, local chapter of the National Space Society), the U.S. Space and Rocket Center (USSRC), Lockheed Martin, and NASA/Marshall Space Flight Center joined the event with booths and exhibits.

Astronomy Day included both daytime and nighttime activities. Daytime activities kicked off at 1 p.m. VBAS astronomers invited the attendees to look at sunspots and solar prominences through a variety of solar telescopes. Astronomers provided a short and simple description of sunspots and solar prominences while people were looking through the telescopes.

AIAA provided an opportunity for the kids to assemble paper gliders and learn about the four forces of flight. HAL5 volunteers helped kids prepare paper rockets and launch them using a compressed air launcher. HAL5 also provided the opportunity for kids to learn how a rocket engine works by demonstrating the principles using a suitcase rocket that was fired periodically throughout the day. Kids also learned about International Space Station (ISS) by assembling model parts of the ISS.

USSRC volunteers organized the science activity "scaling the Solar System" where participants had to measure the distances between the inflatable Sun and planets arranged in the observing field. Attendees also experienced extravehicular activity on Mars using 3-D virtual reality glasses provided by Lockheed Martin. NASA provided a Moon rock and a lava rock that helped attendees learn the geological differences between the Moon and the Earth. NASA also provided various giveaways in the form of posters, stickers, lithos, and bookmarks with information about NASA missions. An astronomy van that has a mobile multimedia astronomy exhibit kept many participants occupied. Attendees learned about comets through a dry ice comet

MY DAY IN KET CITY

demonstration. Kids enthusiastically participated in this activity by putting on their lab gloves and safety glasses and pouring the dirt, pebbles, and ice cream (yummy) into the mixing bowl.

While the outdoor activities kept the attendees busy, hourly planetarium shows attracted those who wanted a break from the outdoor events. Planetarium show participants learned about the history of space flight, the 2017 solar eclipse, and how to buy a first telescope. Every planetarium talk included a tour of the night sky projected on the planetarium dome through VBAS's Spitz A3P projector.

VBAS gave away door prizes that included astronomy-related paraphernalia. The grand prize was a 3.5-inch desktop telescope. Kids were encouraged to color an astronomy picture to be eligible for this grand prize. A ten-year-old female astronomy enthusiast won the grand prize, which was announced towards the end of the daytime activities.

As the Sun set, the daytime activities concluded at 5 p.m. Nighttime activities kicked off with a telescope workshop in which VBAS astronomers taught people how to set up a telescope. Attendees were encouraged to bring their own telescopes so that they could learn everything about their scopes and get the maximum benefit from the workshop. VBAS's stellar instructors (trained high school and middle school interns) gave tours of the Swanson Observatory, which houses the 21-inch telescope. They also gave tours of the night sky by pointing out several constellations and sharing stories associated with those constellations.

Upper left: Attendees looking through the solar telescopes; Left: Demonstration of a rocket engine using a suitcase rocket; Above, top: Dry ice comet making demonstration; Above: Some of the "color an astronomy picture" entries submitted by kids.

Astronaut "Hoot" Gibson speaking to Astronomy Day attendees

Astronomy Day attendees who stayed into the evening had a chance to listen to VBAS's special guest, Robert L. "Hoot" Gibson, a former NASA astronaut. Hoot shared his spaceflight experiences and kept children and adults entertained with his charming style of storytelling. He encouraged the students in the audience to pursue their education in a STEAM field and emphasized the important role astronomy played in the successful completion of his missions.

Several telescopes were set up in the observing field showing various deep-sky objects. Visitors got to see globular clusters, double stars, galaxies, and nebulae. The darkness of the night was filled with exclamations like "wow," "amazing," and "beautiful" from the public who were viewing these objects through the eyepieces, perhaps for the first time. The enthusiasm of the public gave the VBAS volunteers the extra energy to keep going after a long day.

In addition to the viewing, the VBAS imaging team conducted a real-time astrophotography demonstration. Our team explained each piece of hardware, its purpose, and how it is used. Using an 11-inch Schmidt-Cassegrain optical tube mounted on a German equatorial mount, the team demonstrated how to set up, polar align, and slew the telescope to various deep-sky objects for photography. While one team member operated the telescope, other team members explained to the crowd the actions the operator was taking to obtain the images. Using software available to amateur astronomers, the VBAS imaging team explained the intricacies of telescope and camera control. With the equipment and software in place, the team took real-time photos of the Hercules Globular Cluster (M13) and the Andromeda Galaxy (M31). Visitors were quite amazed during the demonstration and asked several engaging questions.

The Von Braun Astronomical Society organized an amazing Astronomy Day, during which participants experienced the beauty of the universe and had an opportunity to understand it using science, technology, engineering, art, and mathematics.

The author with the 14-inch Celestron; Photo courtesy Bill Skelley

Our planetarium show; Photo courtesy Challenger Learning Center)

The Tallahassee Astronomical Society: A well-rounded amateur astronomy club

2017 Great American Eclipse; Photo courtesy Challenger Learning Center

By Ken Kopczynski

Some clubs rate themselves on how many Astronomical League pins they have been awarded, some on how many outreach events they have participated in, and others on programs they have created. While these measures are equally valid, and their members should be proud of their accomplishments, the Tallahassee Astronomical Society (TAS) prides itself on being a mixture of all three of these club characteristics.

TAS members have received over 100 awards from the Astronomical League since 1991 and among those members are three Master Observers (including this author). We encourage our members to participate in these programs to further their enjoyment of observing the night sky. TAS holds monthly observing sessions at our dark site and our more experienced members help the newer members and members of the public who show up.

The club has recorded over 36,000 outreach contacts with the public, logging over 1,000 hours, reaching over 60 people per event on average during the last ten years. These contacts were through our sidewalk astronomy at locations throughout Tallahassee and the surrounding area; public viewing at our dark site, the Cypress Landings Astronomy Park (a county park); annual participation in the High Magnetic Field Lab open house; the Florida Caverns Star Party; Leon County Parks Appreciation Day; and our free monthly planetarium show at the Challenger Learning Center.

We had about 2,000 people attend our August 21, 2017, Great American Eclipse event outside the Challenger. In the lead up to the eclipse, TAS handed out over 4,000 solar glasses for free to the public. TAS received great press before and after the event.

One of our members, Joe Haley (one of the original members of TAS), organized the county library's telescope loaner program, in which the general public can borrow a small telescope. Currently, prospective borrowers are put on a waiting list because of the program's popularity.

The monthly hour-long free planetarium show is a collaborative effort of TAS and the Challenger Learning Center (full disclosure: the author is on the board of the Challenger). Our members, particularly our current vice president, Bill Skelley, have been producing and presenting these shows for ten years now. We think our shows stack up with the best of them.

One of our observing sessions; Photo courtesy Bill Skelley

Bill has also put together programs for the Boy Scouts, Cub Scouts, Brownies, and Junior Girl Scouts. TAS also has programs for older folks through the Osher Lifelong Learning Institute at Florida State University.

The show always starts with an overview of the morning and evening skies over Tallahassee, followed by a "test" on what was presented. Folks learn about constellations in our "learning constellations" segment. We do both a non-zodiac and a zodiac constellation, so if you come to all 12 shows in the year you will have learned about each classical zodiac constellation. We include a binocular object and a Messier object of the month, finishing off the show with an astronomy topic, such as "Polaris: the North Star," or "the celestial sphere."

Our shows have become so successful that we sometimes run a second show for folks who could not get into the first one.

On top of all that, for ten years, this author has been writing a monthly "Sky Guy" column in the local paper highlighting an astronomy topic, news, or event, and what astronomical events in the sky to look forward to during the month ahead.

TAS is also the "go-to" organization for whenever there is an astronomical event such as the 2017 total solar eclipse, a lunar eclipse, or a supermoon.

There are many ways clubs can engage members and the public in the appreciation of astronomy. We encourage clubs to think outside of what they think their limits are and try something new and different. There were many naysayers when we talked about doing a monthly column or building an observatory, but once we put our minds to it, we did.

When we decided to build an observatory to replace the one we had (the land was sold), we approached two Leon County Commissioners, Bob Rackleff and Cliff Thaell. They said we should look around at county parks and see which one suited our needs. After visiting many parks, we chose Cypress Landing Boat Launch in eastern Leon County, about 20 miles from downtown Tallahassee.

The park was secluded and very dark. Also, Lake Miccosukee is at the eastern edge, so we won't have to worry about development in that direction. The only drawback is that we share the park with boaters who occasionally flash their headlights into our observing site as they put in or take out their boats.

TAS worked with County staff and obtained a memorandum of understanding for a 60-foot by 40-foot piece of land on which we built a 30-foot by 20-foot crushed oyster shell pad and a 10-foot by 10-foot dome observatory. The observatory houses our 14-inch Celestron on a Titan Losmandy mount.

Make your club a part of the local community—an organization community members can turn to for information about the sky or an answer to an astronomy question.

The Tallahassee Astronomical Society is an integral part of the local community. Through our members' participation in Astronomical League programs we've become resident experts on the sky. By doing outreach we've turned hundreds of people on to astronomy and increased their interest in what's going on up there.

Flying High in the Night Sky

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

Let's face it: the night sky is for the birds! So, let's talk turkey.

We don't mean the turkeys and dodos who turn on white lights or play heavy-metal rock at 140 decibels at star parties; we're talking about the birds and other winged animals and flying objects that prowl the celestial sphere. Some are easy to find, others less so—but they're everywhere, scattered throughout the sky and the four seasons. So, let's get started. (We've *italicized* the constellation targets and **boldfaced** the others.)

What better way to begin than with everyone's favorite non-avian aviator, the **International Space Station**? It's up there year-round, orbiting the Earth every ninety minutes. If you're quick enough to follow its flight in a telescope, it looks like a dragonfly in flight.

Spring

For starters, consider *Corvus*, the crow. At night its raspy voice can "caws" nightmares! (And while we're on the subject: would a female Corvus be a Corvette?)

• Then there's *Boötes*, which resembles a kite, not a herdsman.

• If you give a hoot, look for the **Owl Nebula** (M97), a planetary nebula in Ursa Major.

• Or maybe you'd prefer to chase down the **Running Chicken Nebula** (IC 2944) in Centaurus. So, here's the question: which came first, the Chicken or the **Egg Nebula** (IC 2944) in Cygnus? (Answer: the Chicken. The Egg is a summer target.)

• The **Beehive Cluster** (M44) awaits you in Cancer. (We know, beehives can't fly—but their residents certainly can, as you'll know if you've ever been chased by a swarm of bees!)

• The **Fly and the Fly Swatter** consist of nine stars in Hydra that form a handle and swatter poised above its target, the unfortunate carbon star U Hydrae.

Summer

You won't need the eyes of an eagle to find *Aquila*, or the **Eagle Nebula** (M16) in Serpens; just hope that they don't find you first! These "talon-ted" birds of prey will have you thinking you've been attacked by Santa Claws!

• The **Pelican Nebula** (IC 5067 and 5070) in Cygnus is near the **North America Nebula** (NGC 7000). The poet Dixon Lanier Merritt (sometimes misattributed to humorist Ogden Nash) wrote of the pelican, "His bill will hold more than his bellican." That's bad news for Pisces, the fish.

• Jimmy Buffet fans will appreciate the **Parrot Head Nebula** (B87), a dark nebula wasting away in Sagittarius, not Margaritaville.

• On summer evenings, *Cygnus,* the swan, can be seen soaring gracefully across the northern sky, with the **Swan Nebula** (M17) swimming below it on the Milky Way in Sagittarius.

• Don't forget the **Wild Duck Cluster** (M11) in Scutum: its sharply defined edges reminded Admiral Smythe of a flock of wild ducks in flight. We see it as a box of quackers.

• Once upon a time, there was a goose up there, too—but it wasn't the constellation *Grus* (although "*Grus*, the goose" would have been an interesting name). Grus, the crane, is too far south for us to see it.

• No, the goose was in *Vulpecula*, the fox, whose original name was *Vulpecula et Anser.* (Johann Hevelius saw the constellation as a fox chasing a goose). Obviously, the missing goose flew the coop—or else it ended up on the fox's lunch menu.

• The **Red-Necked Emu** (Phil Harrington's STAR 26) is another flightless bird, this one in Cygnus.

• The **Butterfly Cluster** (M6) flits around on summer evenings in Scorpius. But some observers have also seen a butterfly in the two arcs of stars that form the little open cluster **M29** in Cygnus.

• There are also two summertime butterfly planetary nebulae: **NGC 6302** in Scorpius and **Minkowski's Butterfly** (Minkowski 2-9) in Ophiuchus. And for those who, like us, can't always tell the difference between a butterfly and a moth, there's the **Moth Nebula** (Sh 1-89), a planetary nebula in Aquila.

• As for constellations, well, there's *Draco*, the dragon, and *Sagitta*, the arrow. Get the point?

• Finally, if you accept drifting in the wind as a form of flight, there's the **Dandelion Puffball** (NGC 6751), a planetary nebula in Aquila.

Fall

Here's our autumn "owl-ly bird special": the **Owl Cluster** (NGC 457), a lovely open cluster in Cassiopeia. (This asterism is sometime seen as the ET Cluster. Phone home if you find it.)

There used to be yet another owl in the night sky—a constellation called *Noctua*, the night owl—but it flew away.

• *Pegasus,* the flying horse. Need we say more? No. (Or should we say "neigh?")

• The **Airplane** asterism (STAR 12) offers a first-class flight fit for a queen (Cassiopeia).

• Both the **Queen's Kite** (STAR 13) and **Kemble's Kite** (STAR 15) fly high in Cassiopeia. You'll find them easily, with no strings attached.

Winter

You'll "shore-ly" like the **Seagull Nebula** (IC 2177) in Monoceros. And while you're in the area, take a look at the Orion Nebula (M42) and tell us: do you see it as a seagull in flight? If so, M43 is a food morsel tossed to it by a tourist.

• Observers in southern Georgia and north Florida like to think of *Eridanus*, the river, as the "Swan-ee" River.

• Want to net yet another **Butterfly Nebula**? Try NGC 2346 in Monoceros.

• You won't see the constellation *Musca*, the fly, from northern latitudes—but you *can* see the **Northern Fly**, composed of the stars 35, 39, and 40 Arietis.

• Like Musca, *Volans*, the flying fish, is too far south to be seen from northern latitudes—but you *can* see Phil Harrington's delightful STAR 4 asterism, the **Flying Minnow**, in Auriga.

• If your interests are really far out, you'll like the **UFO Galaxy** (NGC 2683) in Lynx.

Going South

Not all of the things that fly in the night sky are visible at northern latitudes, of course. In addition to the winged constellations already cited, there are: *Apus*, the bird of paradise; *Columba*, the dove; *Pavo*, the peacock; *Phoenix* (the bird in Greek mythology that died in flames and arose from its own ashes); and *Tucana*, the toucan. They don't fly south for the winter; they're already there!

And there you have it: a year's worth of fascinating flying fowls and airborne objects to look for next time you venture out under the stars. But don't forget the late **Jack Horkheimer**'s parting reminder to his viewers, "Keep Looking Up!"—especially if you're observing at the beach while the seagulls are taking target practice!

FROM AROUND THE LEAGUE

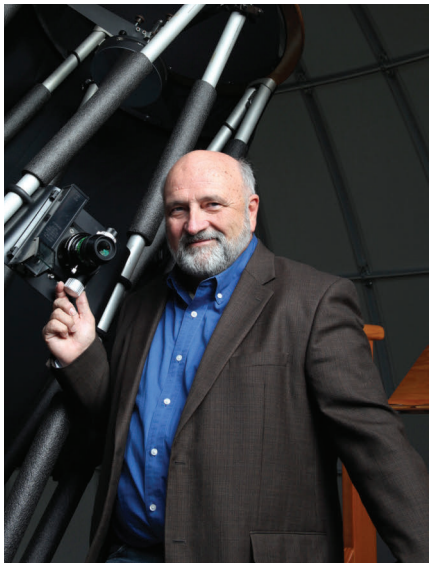
Elections are Coming

Following are the biographies for candidates in the upcoming elections. Don't forget to vote. This year we have elections for president, vice president (two candidates), and treasurer.

President Candidate's Statement

William Bogardus

Throughout the last three years, it has been my pleasure to work with the other officers and League participants as vice president and be a part of the leadership of the League. It has also been a privilege. During that time, it has been my delight to make contact with many fellow amateur astronomers and make dozens of new friends. The League is a valuable asset and I would like to be able to continue my involvement as president of the L eague.



My astronomical interest has been a journey though AL Observing Programs, earning the title of Master Observer (#53). Personal adventures and travels have been to observe eclipses all over the world, trips to the Southern Hemisphere skies, to north of the Arctic Circle to view auroras, to star parties and conventions all over the United States and Canada to and participate in ALCons since 2006.

Three clubs have contributed to my experience: the RASC Ottawa Chapter, the Amateur Observers' Society of New York, and the Custer Institute. I've held several offices including president in AOS and Custer. That involvement and leadership included serving as ALCon 2009 chair. I also created the Radio Astronomy and more recently the Celestial Sphere Observing Programs. In 2016, I was honored to be selected for the Astronomy in Chile Educator Ambassador Program and have continued to be a liaison to that project.

Retiring from a career that included being a secondary school principal, science department chair, and physics teacher, I was first elected League secretary in 2009. In 2013, I was awarded the League's G.R. Wright Award for Outstanding Service to Astronomy. Now, after serving two terms as vice president, I am asking for your support to continue that service as AL president.

Vice President Candidate's Statement

Dr. W. Maynard Pittendreigh

I was seven years old when I made my first, and only, astronomical discovery. With a telescope that barely qualified as a toy, I spotted a mysterious object. I called for my father and he didn't know what it was either. A few days later we realized we had "discovered" the Orion Nebula. Within weeks I was the proud owner of a 4-inch reflector from Edmund Scientific, which led to an 8-inch reflector a few years later, then a Questar, a NexStar, and a 14-inch Dob. When my wife asked, "How many telescopes does one person need?" I could simply answer, "I'll know when I get there."

The AL has deepened my enjoyment of astronomy. I have particularly enjoyed our observing programs and have earned 48 observing certificates, including Master Observer, Silver Level.

I decided a few years ago that it was time to be give back to the League. I became the coordinator of the Outreach Award Program in 2015. I also coordinate the Sky Puppies and Beyond Polaris programs. I would like to be of greater service to the League and I offer myself as a nominee for office. I have served as an officer in several organizations and offer skills in administration and public speaking. My greatest asset to offer the League is my passion for our organization and our hobby.

Vice President Candidate's Statement

Ron J. Kramer

The Astronomical League is a thriving business. With members scattered globally, we offer a central location for information, literature, observing programs and awards, outreach, conventions, and a host of other material that benefits amateur astronomers and their associated organizations. We have been doing this for more than 50 years!

Some say astronomy is a dying hobby, that youth

have little to no interest, and meaningful discoveries or research can only be done at the university level, or by amateurs with very deep pockets. I disagree.

We frequently read about amateurs who have discovered exoplanets and new nebulae, who work in pro–am cooperative programs, and who perform significant research. Many of these amateurs are members of your League. New technology in imaging equipment, telescopes, computers, eyepieces, and drive systems offers amateurs capabilities that were unheard of only 25 years ago. Just look at some of the astroimages within the pages of this issue of the *Reflector*.

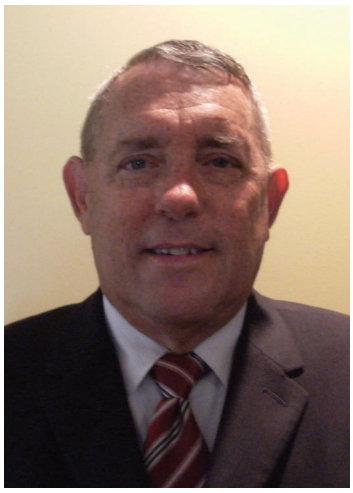
My experience with the League has been relatively short (eight years). During that time, I have been the *Reflector* assistant editor, editor, and managing editor; executive secretary; and ALCon 2015 host. It is time for me to do more.

As vice president, my goals will be to work very closely with the officers and executive council of the League to develop additional programs for amateurs, address additional funding resources that will allow us to improve all phases of operations, and use my experience of 30-plus years in business management, marketing, operations, and logistics to make the League the primary source of information for amateur astronomers.

Treasurer Candidate's Statement

William C. Dillon

After 42 years of working, living, and struggling to enjoy observational astronomy in heavily light-polluted skies near New York City, Chicago, Atlanta, and northern Virginia, my wife of 48 years and I retired in 2014. We moved to southwest Virginia where the skies are dark enough that I need not go any further than my back yard for viewing the night sky with the telescope, binoculars, or the naked eye.



During those 42 years, I've been fortunate to have held senior executive positions in accounting, finance, and general management with, among others, Macy's, Target, and the U.S. Marine Corps. My foundational education includes an undergraduate degree in accounting from Villanova University and a master's degree in finance from DePaul University.

Since retirement I have involved myself as a volunteer in local organizations and currently serve as chairman of my church pastoral council, as well as a member of the board of directors and treasurer of a Roanoke, Virginia, assisted living facility. I have also recently completed a two-year term as secretary of the Roanoke Valley Astronomical Society, where I've been an active member for the past four years. In addition to observing the night skies, I enjoy collecting and reading antique books on astronomy and physics.

I am truly honored and humbled to be considered for the position of treasurer of the Astronomical League, and, if elected, I commit to carrying out my duties professionally and with honor and integrity.

FROM AROUND THE LEAGUE

Attention Master Observers

The officers of the League would like to again give special recognition to Master Observers who attend ALCon 2018 in Minneapolis–St. Paul, Minnesota.

At the awards banquet on Saturday evening a special wall plaque will be presented in commemoration of your accomplishment. It does not matter what year you became an MO. We only require that you be present at the banquet to receive this recognition–and have not received the award at an earlier ALCon ceremony.

Over the last three years we have presented Master Observers with special plaques and it will be our pleasure to repeat the honor again, as well as at future ALCons. If you will be attending, please contact vice president William Bogardus at *wfbogardus@yahoo.com* before June 11, 2018.

Your Astronomical League is Giving Away up to Eleven Library Telescopes!

Through the vision of the Horkheimer Charitable Fund, the Astronomical League is again offering a free Library Telescope to a lucky Astronomical League club in each of the ten AL regions and to a member-at-large.

This wonderful program consists of an Orion 4.5-inch StarBlast Dobsonian (or equivalent), a Celestron 8–24 mm zoom eyepiece (or equivalent), and a name plate commemorating the late Jack Horkheimer. The value of this opportunity is approximately $300; the potential of the program is enormous.

Submit your completed entry form so that the Astronomical League national office receives it by June 30, 2018. If mailed, the entry must be postmarked no later than June 30, 2018. The winning entry for each region will be announced at the annual Astronomical League business meeting held at

ALCon 2018 in Minneapolis about July 14. Full details of this wonderful program can be found at *www.astroleague.org/content/library-telescope-program*.

The Library Telescope Program is a great club project, one that brings members together while benefiting their community. Indeed, it is the perfect outreach program!

Jim Fox Has an Asteroid

The International Astronomical Unit has officially designated asteroid 2000 EN_{138} as 50717 Jimfox. Fox is a past president of the Astronomical League and recipient of the League's 2014 Leslie C. Peltier award. Congratulations, Jim!

Outreach Award Milestone

The **Outreach Award** program reached an important milestone recently, presenting its 1000th award to **Sim Picheloup**. Sim is a member of the Fort Bend Astronomy Club in Texas and is one of 77 in that club who have earned one or more levels of the Outreach Award. Pictured on the left is **Tony Wiese**, a member of the club's board, making the presentation to Sim.

In September, the **Virginia (Minnesota) Public Library** was presented a new telescope due to the efforts of League member-at-large **Dr. Joseph Caulfield**. From left to right in the picture are **Caulfield**, library director **Nancy Maxwel**, and reference and adult services librarian **Susan Hoppe**.

Observing Awards

Cliff Mygatt, president of the Olympic Astronomical Society in Port Orchard, Washington, is League Co-Observing Program director with Aaron Clevenson and author of the Lunar II Program. "Although there's a marvelous variety of programs and the tasks to be completed within each program are different, the basic structure of the programs is pretty similar," he says. "Each program has an introduction or overview, a section on the nature of the objects to be observed, an object list, a requirements section, and information on how to submit your observing log for review. These programs are a phenomenal tool for amateur astronomers of virtually any age and experience level. Even if members don't want to begin a program right now, they can take advantage of the resources available on the League website. In fact, you don't even have to be a member to use these resources. There's in-depth information about virtually any class of object, accompanied by a select list of the best objects in their class, such as double stars, globular clusters, planetary nebulae, and lots more. Many programs can be done visually or through imaging. There really is something for everyone."

Astronomical League Observing Programs

Active Galactic Nuclei
Advanced Binocular Double Stars
Analemma
Northern and Southern Arp Peculiar Galaxy
Asterism
Asteroid
Beyond Polaris
Binocular Double Star
Binocular Master Observer
Binocular Messier
Binocular Variable Star
Bright Nebula
Caldwell
Carbon Star
Celestial Sphere Observing Program (New!)
Comet
Constellation Hunter
Dark Nebula
Dark Sky Advocate
Deep Sky Binocular
Double Star
Earth Orbiting Satellite
Flat Galaxy
Galaxy Groups & Clusters
Galileo
Globular Cluster
Herschel 400
Herschel II
Hydrogen Alpha Solar
Local Galaxy Groups
Lunar
Lunar II
Mars
Master Observer Progression:
- Observer
- Advanced Observer
- Master Observer
- Master Observer: Silver
- Master Observer: Gold
- Master Observer; Platinum

Messier
Meteor
Near Earth Objects
Occultation
Open Cluster
Outreach
Planetary Nebula
Planetary Transit
Radio Astronomy
Sketching
Sky Puppies
Solar System
Southern Skies Binocular
Southern Skies Telescopic
Stellar Evolution
Sun-spotters
Two in the View
Universe Sampler
Urban
Variable Stars

League Laser Policy

Astronomical League Laser Safety Rules and Recommendations

The Astronomical League advocates the safe and responsible use of green laser pointers.

Laser Safety Rules

1. A laser pointer must only be used in accordance with laws of the state or municipality in which it is used.
2. Laser pointers should be transported with batteries removed.
3. Laser pointers used for astronomy should have an activation button which goes to off automatically when not being utilized.
4. Before activating a laser, users should check that no person, animal, motor vehicle, or aircraft is in the general vicinity of where the laser is pointed.
5. When not being used to point out objects, lasers should be safely stored in a pocket or container or have a protective cap placed over the aperture.
6. In the absence of adult supervision, lasers should always be safely stored away from children in a secure location.

Laser use guidelines and recommendations:

The most commonly used laser pointer currently used by astronomers is the neodymium diode laser which emits a green beam at a wavelength of 532 nanometers. Note that in terms of eye injury hazards, the color does not matter. More milliwatts mean a greater potential eye hazard, no matter what the beam color. (This is for visible lasers; for infrared or ultraviolet lasers, the primary injury area is the cornea and not the retina.) For star pointing, green is best. The human eye sees green much better than the same amount of red or blue, so a 5-milliwatt green laser appears to be 5 to 10 times brighter than a 5-milliwatt red laser. Looking at a green beam in the sky should not adversely affect night vision. To keep your night vision, avoid looking directly at the laser dot on a nearby or light-colored surface.

1) Laser pointers can be valuable tools for outreach with those new to the hobby. For solo or small group use for pointing out objects in the sky, a 5-milliwatt green laser is completely adequate. It is considered a class IIIa laser and is recommended for stargazing purposes. For a larger group, or where the air is especially clean and dry, slightly higher power, such as 10 to 25 milliwatts, will be better. The absolute limit for this application should be about 50 milliwatts. There is no reason to use more than 50 milliwatts for astronomical pointing applications.

Higher-class lasers are usually unnecessary and carry more potent warnings from the U.S. Food and Drug Administration (FDA). The League does not encourage use of higher-wattage, higher-class lasers for stargazing. In some places, handheld laser pointers with an output greater than 1 milliwatt (classes IIIb and IV) are considered prohibited weapons. According to the FDA, promotion of lasers above 5 milliwatts "for pointing and amusement" violates FDA requirements and U.S. law. A caveat: many lasers have been found to be mislabeled or misrated, causing confusion and misjudgment.

2) Never point a laser at an aircraft, no matter how distant. Laser pointers, although low power, are highly collimated, maintain focus and can be harmful if not illegal for such use. U.S. law signed by President Obama in February 2012 makes it illegal to knowingly aim a laser pointer beam at an aircraft or at the flight path of an aircraft. A slow-moving, distant aircraft can look like a star. If you are doing astronomy pointing at a "star talk," use the laser pointer to circle unknown or faint objects. Don't point directly at an object unless you are sure it is a star (like the familiar bright stars in Orion's belt or the Big Dipper).

3) Use sparingly—only long enough to point out an object. Once the object is identified, turn the laser off.

4) Star parties often have rules for laser use. Attendees should check the policy at each event, and event organizers should have a policy as to where and when lasers may or may not be used.

5) Since astrophotography is an ever more popular activity with which lasers interfere, constant-on lasers used for telescope pointing are not recommended for use at events such as star parties. Such use should be reserved for solo observing.

Engage the Young: Offer the Moon

Next July marks fifty years since the first Moon landing. Why not turn that historic milestone into public observing opportunities featuring the Moon? Make it so that they engage the interested public – especially the young – by giving them something they can " take home."

Set up a telescope at a popular community location and center it on the Moon. How many people—again, especially how many young people—can you entice to use their camera phones to capture the Moon directly through the telescope?

(Note: You might not want to use your best eyepiece for these sessions, since the camera phones will likely be bumping against it. Also, in both a reflector and a Schmidt–Cassegrain telescope, the issue of the secondary mirror will come into play because of the noticeable shadow it creates. The Moon will need to be kept away from the center of the field of view during imaging.)

The 5.2-day-old Moon imaged through an 8-inch f/4 Newtonian reflector with an iPhone 6.

These activities are meant to be fun, easy —and quick. Camera phone–eyepiece adapters are commercially available and will prove useful for obtaining the sharpest images, but they also require proper set up, which takes time. Instead, many people will opt to just hold the phone to the eyepiece and click away. They may not capture a prize-contending shot, but they will certainly obtain images of a memorable experience.

As they then move to the side, how many people will message or email their newly acquired image to family and friends? How many of them will show a new interest in what the sky offers? You will have engaged the public.

—John Goss,
League President

Full STEAM Ahead

By Peggy Walker

WE MUST KEEP THE "A"

Within hours of the March *Reflector* issue posting, I received an email from someone stating that the (A) does not belong in astronomy STE(A)M. They added that astronomy STEM is all about the designing of the next great telescope. Says who? Most people are more than one thing and are involved in multiple interests. Our greatest historical scientists clearly were great polymaths who impacted the sciences of botany, biology, physics, anatomy, physiology, and geography, in addition to music, mathematics, philosophy, and theology.

If one looks at Leonardo da Vinci, one could call him the master STEAM embodiment. After all, he was involved in designing inventions, painting masterpieces, sculpting huge works, drawing architectural plans, as well as his love and involvement in science, music, mathematics, engineering, literature, anatomy, geology, astronomy, botany, writing, history, and cartography. What astronomer does not know about Galileo's drawings and sketches of Moon phases, lunar craters, sunspots, phases of Venus, Jupiter's four largest moons, and, of course, the first ever rendering of Saturn? Galileo was involved in astronomy, physics, engineering, mathematics, and natural science; hence, he was called the "Father of Science."

Let's add that great musician and composer who is better known for his amateur astronomy contributions than for music, William Herschel. With the help of his sister Caroline, they mapped the Milky Way band structure, which led to the conclusion that the galaxy was shaped like a disk. Mathematician, astronomer, astrologer, and natural scientist, Johannes Kepler, found a geometric connection to the Solar System. In 1596, Kepler sketched the Mysterium Cosmographicum, a diagram of platonic solids representing each planet, showing their spatial relationships to each other, their sizes relative to each other, and why they have the orbital periods that they do. It's a phenomenal sketch of multiple geometric solids.

Ironically, as I was researching this article, I came across the International Association of Astronomical Artists (IAAA), a guild of professional artists founded in 1982. Currently, they have 130 people from 20 nations. Although the artists have various styles and viewpoints, they always aim to inspire the science of astronomy and space exploration. They use personal computers and NASA photographs, but confer with (and even are) field geologists, space scientists, astronomers, astrophysicists, science writers, and travel agents. They may find themselves in a simulator at Johnson Space Center, in the crater of an active volcano, examining erosion patterns in national parks, or talking to Apollo astronauts about the lunar terrain.

Their website, *www.iaaa.org*, shows that their mission is to implement and participate in astronomical and space art projects. They promote education about astronomical art and foster international cooperation in artistic work inspired by the exploration of the universe. It is a membership organization and they have quite a list of partnering organizations, such as Astronomers Without Borders, the American Astronomical Society, *Astronomy* magazine, the Planetary Society, *Scientific American* magazine, and *Sky & Telescope* magazine. When I was on staff with Astronomers Without Borders, we implemented the Astro Art Program for Global Astronomy Month in April. AWB and IAAA work in tandem to encourage other astronomy and space artists by hosting live events featuring IAAA artists and their artwork. A good place to go is the Tucson Chapter of IAAA on Facebook, *www.facebook.com/IAAATucson*.

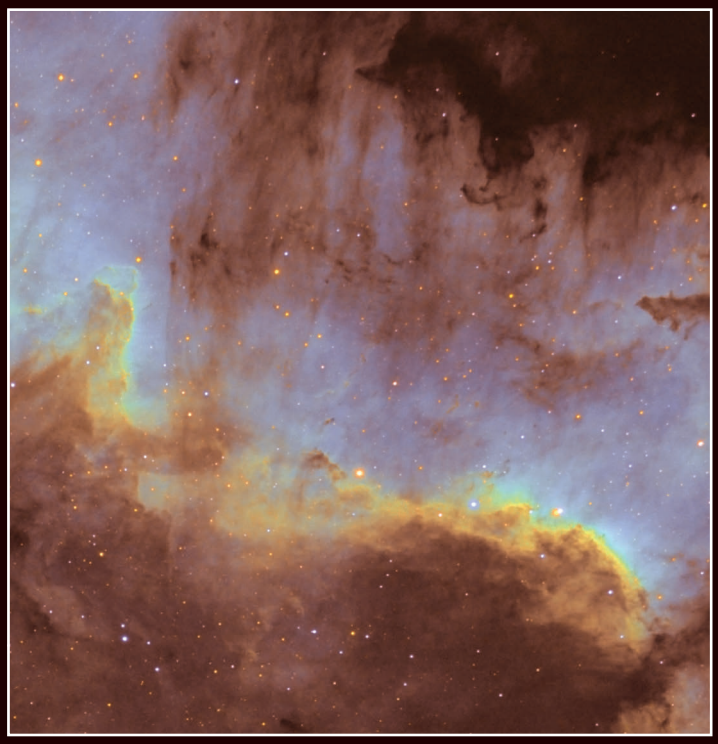
The point is, art is a pivotal part of science, and let's not forget that the Astronomical League has awards for sketching, one of which I was honored to receive—second place last year at ALCon 2017 in Casper, Wyoming.

Gallery

TITLE PHOTO: NGC 2244; BRIAN KIMBALL

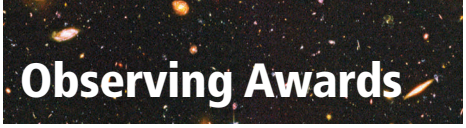
Steven Bellavia (Amateur Observers' Society of New York) created this image of the Rosette Nebula using a Stellarvue 80 mm Triplet (reduced to f/4.8, 384 mm) with a Canon EOS Rebel SL1 digital camera.

Gregg Ruppel (Astronomical Society of Eastern Missouri) took this image of Sharpless 311 in Puppis from his remote observatory in Animas, New Mexico, with an ASA 10N f/3.8 Astrograph with a SBIG STL-11000M CCD camera.



Madhup Rathi (Richmond Astronomical Society) took this narrow-field image of NGC 7000 from his remote observatory in Animas, New Mexico, with a 10-inch AG Optical telescope with a QSI 683wsg CCD camera.

Andrew Klinger (Texas Astronomical Society) took this image of the Jellyfish Nebula using 58 hours of exposures through narrowband filters using a William Optics GT81 (reduced to f/4.7, 382 mm) with a ZWO ASI1600MM-Cool CMOS camera.



Observing Awards

Editor's Note: Congratulations to all these outstanding astronomical observers! All awards, except for the Herschel 400 and Sky Puppies, 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. 16-I, Mark L. Spearman, Brazos Valley Astronomy Club

Asterism Observing Program
No. 46, Marilyn Perry, Member-at-Large

Asteroid Observing Program
No. 51, Brian Chopp, Regular, Neville Public Museum Astronomical Society; No. 61, Dennis Wilde, Gold, Amateur Observers' Society of New York

Beyond Polaris
No. 12, Glenn Wolford, Member-at-Large; No. 13, Valorie Whalen, Charlie Elliott Chapter of Atlanta Astronomy Club; No. 14, Aaron Clevenson, North Houston Astronomy Club

Binocular Double Star Observing Program
No. 135, Rakhal Kincaid, Haleakala Amateur Astronomers

Binocular Messier Observing Program
No. 1129, Alfred Schovanez III, Astronomical Society of Eastern Missouri; No. 1130, Rich Krahling, Richland Astronomical Society; No. 1131, Darin Templet, Rio Rancho Astronomical Society; No. 1132, Michael Worthy, Shoals Astronomy Club; No. 1133, Paula Hagan, Ancient City Astronomy Club; No. 1134, Bill Hennessy, Neville Public Museum Astronomical Society

Caldwell Observing Program
Silver Awards
No. 239, Rakhal Kincaid, Haleakala Amateur Astronomers; No. 240, Scott Azmus, Member-at-Large; No. 241, Gordon Schaefering, Amateur Observers' Society of New York; No. 242, Jeff Baldwin, Stockton Astronomical Society; No. 243, Terry N. Trees, Amateur Astronomers Association of Pittsburg; No. 244, Nancy Rauschenberg, Minnesota Astronomical Society; No. 245, Lisa Wentzel, Twin City Amateur Astronomers; No. 246, Fernando Torres, Albuquerque Astronomical Society; No. 247, Raymond B. Howard, Patron Member; No. 248, Richard Luecke, Member-at-Large
Gold Awards
No. 28, Al Hamrick, Raleigh Astronomy Club; No. 29, Fernando Torres, Albuquerque Astronomical Society

Carbon Star Observing Program
No. 90, Richard Loslo, Member-at-Large; No. 91, Paul Harrington, Member-at-Large; No. 92, Danny Lineberger, Greensboro Astronomy Club; No. 93, Steve Boerner, Member-at-Large

Comet Observing Program
No. 39, Vincent Michael Bournique, Gold, Lifetime Member-at-Large; No. 98, Nora Jean Chetnik, Silver, Member-at-Large

Constellation Hunter Observing Program (Northern Skies)
No. 196, Carol Smith, Boise Astronomical Society; No. 197, James Granahan, Northern Virginia Astronomy Club; No. 198, Rakhal Kincaid, Haleakala Amateur Astronomers; No. 199, Amanda K. Myers, Amateur Astronomers Association of Pittsburgh; No. 200, Cynthia Culver, Atlanta Astronomy Club; No. 201, Daniel Culver, Atlanta Astronomy Club; No. 202, Richard Dickson, Atlanta Astronomy Club; No. 203, Stephanie Dickson, Atlanta Astronomy Club; No. 204, Michael Shaw, Sr., Atlanta Astronomy Club; No. 204, Terrie Shaw, Atlanta Astronomy Club

Dark Sky Advocate Observing Award
No. 11, John L. Goar, Olympic Astronomical Society

Double Star Observing Program
No. 607, Joe Timmerman, Minnesota Astronomical Society; No. 608, Robert J. Olsen, Member-At-Large

Flat Galaxy Observing Program
No. 32, John Skillicorn, Honorary, Tucson Amateur Astronomy Association

Galileo Observing Program
No. 43-T, Rakhal Kincaid, Haleakala Amateur Astronomers; No. 44-T, Rodney R. Rynearson, St. Louis Astronomical Society; No. 45-T, James Pryal, Seattle Astronomical Society

Globular Cluster Observing Program
No. 312-V, Scott H. Pellet, Birmingham Astronomical Society

Herschel 400 Observing Program
No 586, Stephen Jones, Houston Astronomical Society

Herschel II Observing Program
No. 104, Jeff Baldwin, Manual, Stockton Astronomical Society

Hydrogen Alpha Solar Observing Program
No. 40, Preston Pendergraft, Member-at-Large

Lunar Observing Program
No. 1017, Michael Long, The Shoreline Amateur Astronomical Association; No. 1024, Ozgar Aktas, Tri-Valley Stargazers; No. 1025, John Cassidy, Ventura County Astronomical Society; No. 1026, Keith Norton, Minnesota Astronomical Society; No. 1027, Bruno Pancorbo, Member-at-Large; No. 1028, Reba Cain, Museum Astronomy Research Society; No. 1029, David Novotny, Rose City Astronomers

Lunar II Observing Program
No. 85, David M. Douglass, East Valley Astronomy Club; No. 86, Robert Scott, Island County Astronomical Society

Master Observer Award
Observer Award
David M. Douglas, East Valley Astronomy Club; Denise Terpstra, Member-at-Large; Rakhal Kincaid, Member-at-Large; Douglas L. Smith, Tucson Amateur Astronomy Association
Master Observer Award
No. 206, Jim Kvasnicka, Prairie Astronomy Club; No. 207, Bob Kacvinsky, Prairie Astronomy Club; No. 208, Stephen Jones, Houston Astronomical Society
Advanced Observer Award
David M. Douglas, East Valley Astronomy Club; Paul Harrington, Member-at-Large; Denise Terpstra, Member-at-Large; Marie Lott, Atlanta Astronomy Club

Master Binocular Observer Award
Michael A. Hotka, Longmont Astronomical Society

Messier Observing Program
No. 2777, Richard Loslo, Honorary, Member-at-Large; No. 2778, Richard Henderson, Regular, Astronomical Society of Kansas City; No. 2779, Gary McDaniel, Honorary, Astronomical Society of Kansas City; No. 2780, Michelle Bakken, Honorary, Spokane Astronomical Society; No. 2781, Yvonne Bakken, Honorary, Spokane Astronomical Society; No. 2782, Larry Grimes, Honorary, Stockton Astronomical Society

Meteor Observing Program
No. 187, Pamela Lubkans, 24 hours, Member-at-Large; No. 190, Fred Schumacher, 6 hours, Member-at-Large

NEO Observing Program
No. 15, Marie Lott, Advanced, Atlanta Astronomical Society

Outreach Observing Award
No. 728-S, Rich Krahling, Richland Astronomical Society; No. 745-M, Amelia Goldberg, Houston Astronomical Society and Fort Bend Astronomy Club; No. 765-S, Dan A. Chrisman, Jr., Roanoke Valley Astronomical Society; No. 806-S, Barbara Hassett, Fort Bend Astronomy Club; No. 807-S, Scott Hassett, Fort Bend Astronomy Club; No. 836-S, Raymond L. Bradley, Roanoke Valley Astronomical Society; No. 878-S, John Garrett, Temecula Valley Astronomers; No. 948-O, Michael Neal, Echo Ridge Astronomical Society; No. 949-M, Ian Hewitt, Raleigh Astronomy Club; No. 950-O, Doug Dornier, Astronomical Society of Southeast Texas; No. 951-O, Lynda Schweikert, Iowa County Astronomers; No. 952-S, Alfred Schovanez, Astronomical Society of Eastern Missouri; No. 953-O, David Collings, Echo Ridge Astronomical Society; No. 954-O, Sherry Adlof, Shoreline Amateur Astronomical Association; No. 955-O, Ben Adlof, Shoreline Amateur Astronomical Association; No. 956-O, Dennis A. Eaton, Prescott Astronomy Club; No. 957-O, Mark Gibson, Raleigh Astronomy Club; No. 958-O, Makayla Rink, Central Florida Astronomical Society; No. 959-O, Elaine Stachowiak, Flint River Astronomy Club; No. 960-O, Moises Ramirez, Fort Bend Astronomy Club; No. 961-O, Alfred Anzaldua, Tucson Amateur Astronomy Association; No. 962-M, Don Cain, Tucson Amateur Astronomy Association; No. 963-O, John Carter, Prescott Astronomy Club; No. 964-O, Edward Foley, Tucson Amateur Astronomy Association; No. 965-O, Rob Hallberg, Tucson Amateur Astronomy Association; No. 966-M, Chuck Hendricks, Tucson Amateur Astronomy Association; No. 967-S, Joe Jakoby, Tucson Amateur Astronomy Association; No. 968-S, Ralph Jensen, Tucson Amateur Astronomy Association; No. 969-S, Dean Ketelsen, Tucson Amateur Astronomy Association; No. 970-O, Allen Klus, Tucson Amateur Astronomy Association; No. 971-M, Jim Knoll, Tucson Amateur Astronomy Association; No. 972-M, Susan Knoll, Tucson Amateur Astronomy Association; No. 973-S, Tom Layte, Tucson Amateur Astronomy Association; No. 974-M, William Lofquist, Tucson Amateur Astronomy Association; No. 975-M, Paul Lorenz, Tucson Amateur Astronomy Association; No. 976-O, Dennis McMacken, Tucson Amateur Astronomy Association; No. 977-O, Mary McMaken, Tucson Amateur Astronomy Association; No. 978-S, Elaine Miller, Tucson Amateur Astronomy Association; No. 979-S, Jim Miller, Tucson Amateur Astronomy Association; No. 980-S, John Occhuizzo, Tucson Amateur Astronomy Association; No. 981-M, Jim O'Connor, Tucson Amateur Astronomy Association; No. 982-M, Byron, Skinner, Tucson Amateur Astronomy Association; No. 983-S, Carter Smith, Tucson Amateur Astronomy Association; No. 984-S, Joe Statkevicus, Tucson Amateur Astronomy Association; No. 985-M, Bernie Stinger, Tucson Amateur Astronomy Association; No. 986-O, Paul Trittenbach, Tucson Amateur Astronomy Association; No. 987-M, Mary Turner, Tucson Amateur Astronomy Association; No. 988-M, Michael Turner, Tucson Amateur Astronomy Association; No. 989-O, Steve MacKenzie, St.

George Astronomy Group; No. 990-S, Lynn Young, East Valley Astronomy Club; No. 991-O, Kathleen M. Eaton, Prescott Astronomy Club; No. 992-O, John Baesemann, Prescott Astronomy Club; No. 993-O, Donald Beaman, Prescott Astronomy Club; No. 994-O, Douglas Tilley, Prescott Astronomy Club; No. 995-O, Patrick Birck, Prescott Astronomy Club; No. 996-O, Neil Stockton, Prescott Astronomy Club; No. 997-O, David Viscio, Prescott Astronomy Club; No. 998-O, Jerry Shaw, Prescott Astronomy Club; No. 999-O, Joel Cohen, Prescott Astronomy Club; No. 1000-M, Sim Picheloup, Fort Bend Astronomy Club; No. 1001-O, Rakhal Kincaid, Haleakla Amateur Astronomers; No. 1002-M, David A. Werth, Northern Virginia Astronomy Club

Planetary Nebula Observing Program

No. 33, Kevin McKeown, Basic, Albuquerque Astronomical Society; No. 34, Jim Dixon, Basic, Central Arkansas Astronomical Society; No. 72, Peter R. Natscher, Advanced, Manual, The Astronomy Connection

Radio Astronomy Observing Program

Bronze Level

No. 25-B, Lee Sikstrom, Member-at-Large

Sketching Observing Award

No. 25, Melinda Hopper, Astronomical Society of Kansas City

Solar Eclipse Special Observing Award

Level 1

Thor Olson, Minnesota Astronomical Society; W. Maynard Pittendreigh, Brevard Astronomical Society; Rob Ratkowski, Haleakala Amateur Astronomers; Mark Simonson, Everett Astronomical Society; Robert Trebilcock, Delaware Valley Amateur Astronomers;

Level 2

Robert R. Beuerlein, Back Bay Amateur Astronomers; Corrie Ann Delgado, Echo Ridge Astronomical Society; Steven Powell, Houston Astronomical Society

Level 3

Aaron Clevenson, North Houston Astronomy Club; Brad Young, Astronomy Club of Tulsa; Bradford Wilson, Member-at-Large; Branden Pursinger, Member-at-Large; Brett Boller, Prairie Astronomy Club; Carlos Gramajo, North Houston Astronomy Club; David Collings, Echo Ridge Astronomical Society; Dino Giangregorio, Back Bay Amateur Astronomers; James Zappa, Member-at-Large; Jay E. Levy, Houston Astronomical Society; Jeff Goldstein, Back Bay Amateur Astronomers; Jessica Weinreich, Des Moines Astronomical Society; Jim Barbasso, North Houston Astronomy Club; Jonathan Poppele, Minnesota Astronomical Society; Justin Modra, Denver Astronomical Society; Lawrence Taylor, Back Bay Amateur Astronomers; Louis Dorland, Omaha Astronomical Society; Michael A. Hotka, Longmont Astronomical Society; Michael Neal, Echo Ridge Astronomical Society; Michael Webster, Back Bay Amateur Astronomers; Nancy Rauschenberg, Minnesota Astronomical Society; Russell F. Pinizzotto, Southern Maine Astronomers; Seth Watts, Member-at-Large; Trevor McGuire, Richmond Astronomical Society; William T. Geertsen, South West Florida Astronomical Society

Two in the View Observing Program

No. 29, Jeff Hoffmiester, Olympic Astronomical Society

Universe Sampler Observing Program

No. 132, Douglas L. Smith, Telescope, Tucson Amateur Astronomy Association; No. 133, William Bogardus, Telescope, Amateur Observers' Society of New York

Urban Observing Program

No. 192, Larry Elsom, Member-At-Large

Coming Events

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

June 9
48th Annual Apollo Rendezvous
The Boonshoft Museum of Discovery
Dayton, Ohio
www.mvas.org

June 9–16
2018 Grand Canyon Star Party
South Rim: Tucson Amateur Astronomy Association
Grand Canyon National Park, Arizona
North Rim: Saguaro Astronomy Club of Phoenix, Fredonia, Arizona
www.nps.gov/grca/planyourvisit/grand-canyon-star-party.htm

June 12–15
Wisconsin Observers Weekend
Hartman Creek State Park, Waupaca, Wisconsin
www.new-star.org/index.php?option=com_content&view=category&layout=blog&id=38&Itemid=82

June 13–17
Rocky Mountain Star Stare 2018
Colorado Springs Astronomical Society, Gardner, Colorado
www.rmss.org

June 13–17
Brothers Star Party for Oregon Observatory
Brothers, Oregon
www.mbsp.org

June 14–17
Cherry Springs Star Party
Cherry Springs State Park, Pennsylvania
www.cherrysprings.org

June 22–24
MSRAL 2018 Convention
Explore Scientific, Arkansas
www.msral.org

July 10–15
Indiana Family Star Party
Camp Cullom, Frankfort, Indiana
www.indianastars.com/starparty

July 11–14
Green Bank Star Quest XV
Green Bank National Radio Observatory, West Virginia
www.greenbankstarquest.org

July 11–14
Astronomical League Convention
Minneapolis, Minnesota
alcon2018.astroleague.org

July 11–15
Golden State Star Party
Frosty Acres Ranch, Adin, California
www.goldenstatestarparty.org

July 13–14
Connecticut River Valley Astronomers Conjunction
Northfield Mountain Recreation and Environmental Center, Massachusetts
www.philharrington.net/astroconjunction

August 5–10
Nebraska Star Party
Merritt Reservoir, Valentine, Nebraska
www.nebraskastarparty.org

August 7–11
Table Mountain Star Party
Eden Valley Ranch, Oroville, Washington
www.tmspa.com

August 7–12
Oregon Star Party
Ochoco National Forest. Prineville, Oregon
www.oregonstarparty.org

August 9–11
Julian Starfest (POSTPONED)
Menghini Winery, Julian, California
www.julianstarfest.com

August 9–12
Stellafane
Breezy Hill, Springfield, Vermont
stellafane.org/stellafane-main/convention

August 10, 17, 24, and 31
Maine State Star Party
Cobscook Bay State Park, Edmunds, Maine
www.facebook.com/events/1083499411792157

August 30–September 3
Iowa Star Party
Whiterock Conservancy's Whiterock Resort, Coon Rapids, Iowa
www.iowastarparty.com

September 5–9
Northern Nights Star Fest
Long Lake Conservation Center, Minnesota
www.mnastro.org/NNSF

September 5–9
Acadia Night Sky Festival
Acadia National Park, Bar Harbor, Maine
www.acadianightskyfestival.org

September 6–9
2018 Bootleg Astronomy Star Party
Green River Conservation Area, Harmon, Illinois
www.bootlegastronomy.com

September 7–9
Black Forest Star Party
Cherry Springs State Park, Pennsylvania
www.bfsp.org

September 7–11
Almost Heaven Star Party
Spruce Knob, West Virginia
www.ahsp.org

October 6–14
Okie-Tex Star Party
Kenton, Oklahoma
www.okie-tex.com

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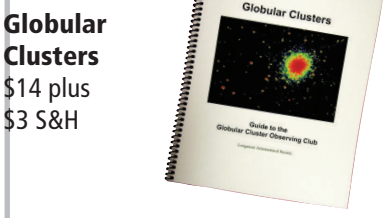

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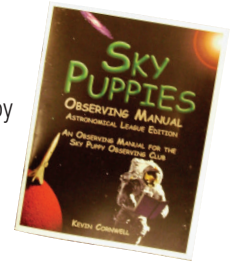

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For the Sky Puppy Observers Club
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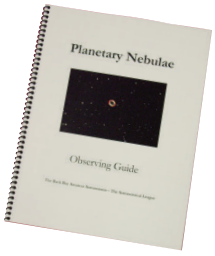

Planetary Nebulae
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Messier Objects: A Beginner's Guide
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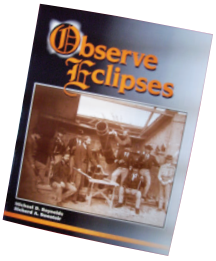

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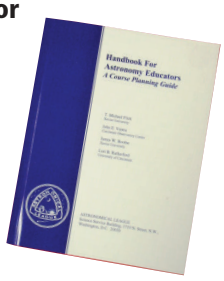

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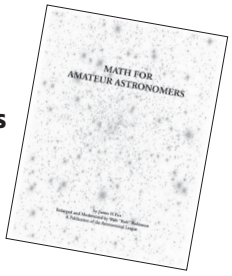

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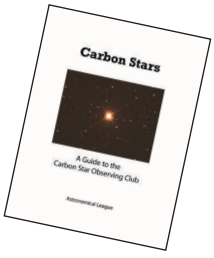

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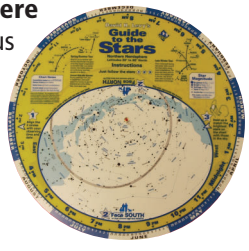

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