Reflector

Published by the Astronomical League Vol. 67, No. 2 March 2015

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An Antenna With an Historical Past

The Open Cluster Observing Program

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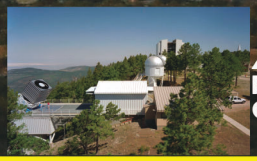

APACHE POINT OBSERVATORY

DUNN SOLAR TELESCOPE

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

Contents

At about 400-light years distant, the **Pleiades cluster** is a great visual and imaging object. Our front cover shows an image taken by **Aubrey Brickhouse**, president of the Central Texas Astronomical Society, on September 26, 2014, while he was at the Okie–Tex Star Party in Kenton, Oklahoma. Excellent viewing and 4,500 feet elevation were ideal conditions for this 2.0-hour (total) exposure with LRGB Baader filters and an SBIG STF-8300 CCD camera on an Astro-Tech AT106 triplet refractor. It was processed using MaxIm DL and Photoshop CS5.

To our contributors: The copy and photo deadline for the June 2015 issue is April 1. Please send your stories and photos to our magazine editor, **Ron Kramer** (*editor@astroleague.org*), by then.

The Astronomical League invites your comments regarding the 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* is mailed directly 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 $2.00 each or as an $8.00 per year subscription through the League national office. ISSN: 0034-2963.

***Reflector* and Club Roster Deadlines**

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

Give back to amateur astronomy

Imagine how your time spent exploring this wondrous universe—whether through casual stargazing, binocular sweeping, or dark-sky telescopic observing—is enriched in some manner by the Astronomical League.

Think of all the celestial wonders you have yet to see and how the League's many observing programs help you discover them.

Think of all the people who regularly—and often without fanfare—bring astronomy to your club and to your community, and how the League's annual recognition awards help thank them for all that they do.

Think of how precious the night sky is, and how the Astronomical League promotes dark-sky advocacy.

Think of how incredible our avocation truly is, and how the League encourages its membership to reach out to the public in general, and to the young in particular.

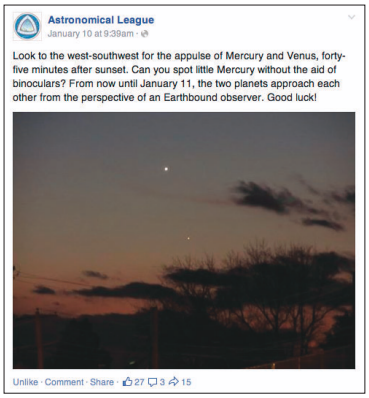
Think of how vast our universe is, and how the Astronomical League Book Service provides materials that help you understand and explore the night sky.

Think of how rewarding it is to meet those who make astronomy happen, and how the Astronomical League brings together people of all expertise levels at gatherings such as ALCon.

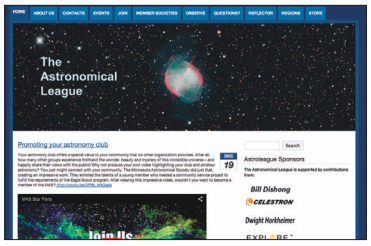
Think of how important it is to communicate valued information to the amateur astronomical community, and how the League's website and Facebook page bring relevant news to you.

Think of how learning from the experiences of others can help you enjoy more of what lies above, and how the pages of this magazine bring some of those people and their stories to you. All of this—all of the Observing Programs, all of the awards programs, all of the struggles against light pollution, all of the "Youth in Astronomy" efforts, all of the planning and implementation of the annual regional and national conventions, all of the books and materials shipped through the League Book Service, all of the information conveyed on the League's website and Facebook page, and all of the content included in this *Reflector*—is due to the efforts of volunteers. All of it.

Next, imagine the many regional star parties and meetings that occur across the country every year. Think about the people who organize them, committing their time and expertise all the while juggling their responsibilities at home and work. All volunteers. All of them.



League's Facebook page



League's website

Because of all the League volunteers—the nearly forty Observing Program administrators, the dozen judges for the award competitions, the *Reflector* staff, the ALCon organizers, the Astronomy Day coordinators, the Trust Fund trustees, the Web Team, the publications chair, the historian, the nearly forty regional officers and the five national officers, and each of the 300 Astronomical League correspondents (ALCors)—the Astronomical League is able to offer the services that it does, the services that directly benefit your experience under the starry dome. Without their dedicated participation, none of this would be possible.

Imagine of all these common club activities: hosting telescope sessions, offering informative monthly meetings, producing newsletters, and maintaining websites. Think about who makes an

Continued on page 25

Think of putting telescopes in the hands of the interested public through the Library Telescope Program (see the AL website), and how the Astronomical League promotes worthy club efforts.

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

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

IDA Fixture Seal of Approval (FSA) Program

The International Dark-Sky Association is an authoritative voice on light pollution and light trespass. The best way to accomplish IDA's goal of protecting and restoring the natural night environment and dark skies is through quality outdoor lighting. Use a light only when necessary, use the right amount of light, direct the light to the ground where it is needed, and turn the light off when not needed. IDA's **Fixture Seal of Approval (FSA)** program provides an objective, third-party certification for luminaires that minimize glare, reduce light trespass, and don't degrade the night sky.

Initially, the FSA program criteria specified shielding and lighting distribution. In 2010, IDA published a white paper (available for download on the IDA website as a PDF) outlining the potential hazards of blue-rich white light, which nowadays is particularly applicable to many of the LED luminaires being installed. Blue-rich white light tends to produce more discomfort, glare, circadian rhythm disruption, light scattering, sky glow, and possible biological system disruption in wildlife.

A lamp's or LED's color is often described by its correlated color temperature (CCT). Blue CCTs above 4000 K are called "colder," and CCTs below about 3500 K called "warmer" as they have more red and yellow. The terms "warm" and "cold" are really misnomers—the LEDs and bulbs with higher temperatures are actually bluer to the eye and appear "colder," though in effect they are actually warmer from a blackbody physics point of view. The LEDs and bulbs with lower temperatures are actually more yellow or reddish and appear "warmer," as we think of warm as red, as in glowing heating coils or burning logs. In fact, the "warmer" emitters have less emission and lower temperatures from the blackbody physics point of view.

In any event, according to the IDA website, "the IDA Fixture Seal of Approval Program will now only accept products that offer a listed correlated color temperature (CCT) configuration of 3000 K and lower (up to 3220 K actual measured value—ANSI C78.377). Recently approved products in a configuration of 4100 K CCT and below (IDA's previous CCT criteria) will have one year to comply with the new standard."

This change in the IDA FSA is most important, and was made to address the coming LED revolution—the anticipated widespread replacement of the standard high-pressure sodium and metal halide luminaires by LED luminaires. Several initial installations of LED streetlight systems in scattered cities have produced very poor results with considerable glare and cold, harsh lighting, because the CCT of those systems was 5000 K or higher. IDA wants to prevent widespread installation of such luminaires. There are now LED luminaires in the 3000 K range that are cost- and energy-competitive with luminaires having high CCTs. These lower-CCT luminaires produce more pleasing light, less glare, less potential light pollution, and fewer possible harmful biological effects.

For more detailed information about the IDA Fixture Seal of Approval Program, see *www.darksky.org/ida-fixture-seal-of-approval/about-fsa*.

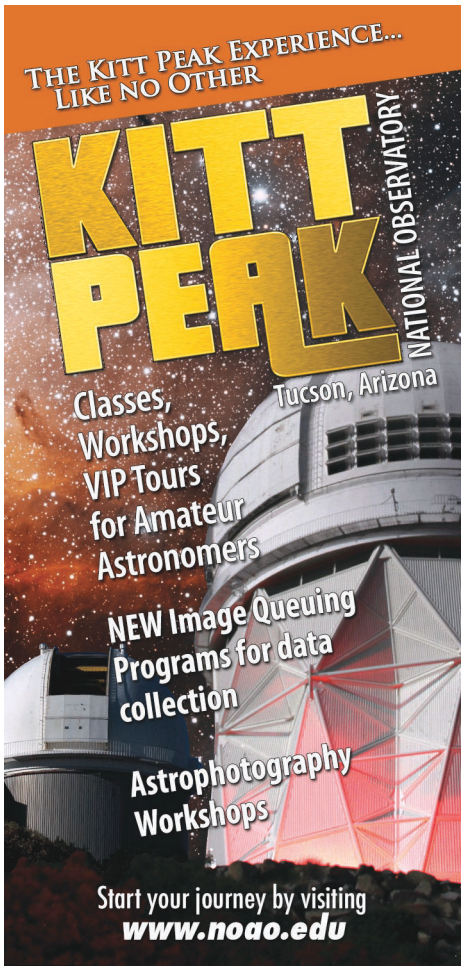
Tim Hunter, *Co-founder, IDA*
The International Dark-Sky Association, Inc. (IDA)
3223 N. First Avenue
Tucson, Arizona 85719-2103
Phone: 520-293-3198; Fax: 520-293-3192
Email: *ida@darksky.org; www.darksky.org.*

Call for League officer nominations

The two-year term of the office of secretary and the three-year term of the office of treasurer both end on August 31, 2015. If you are interested in using your talents to serve in one of these important positions, we would like to hear from you. Please volunteer!

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

Candidates should send background statements explaining why they are interested, along with a photo of themselves for publication in the *Reflector*, to Nominating Committee Chair Bill Bogardus, *vicepresident@astroleague.org*. Please limit all statements to approximately 250 words. All nomination materials must be submitted by March 15, 2015.



To the Editor:

I am replying to the request for views on the digital vs. paper dilemma for the magazine.

I am new to the AL, having joined in July following the articles in *Sky & Telescope* magazine, which I have subscribed to for nearly 20 years. I am an overseas member living in England.

It seems to me that the digital vs. paper thing is a generation thing. My son was astonished that my new member pack was sent across continents by air. I think his comment was along the lines of "they spent $12.60 sending you paper?"

We've had the same dilemma in our local astronomy club. A lot of effort went into producing a paper magazine every 2 or 3 months and mailing it out. Members also received an occasional email update, reminders about meetings and celestial events typically. The combination of effort needed and the increasing costs (both production and mailing) led to questions being asked. There was a strong rearguard action to keep it going, largely on the grounds that some members didn't have email. However the printed magazine has withered. The latest one is dated March 2014, and there is no sign of a new edition. Meanwhile, the emailed newsletter has expanded and now contains mostly images. Written articles are unusual.

Now here is the rub: when the email newsletter arrives, I reckon I spend about a minute skimming through it. Endless amateur images of common objects don't hold my attention, and as someone averse to microchips, the technical details do not interest me. The paper magazine I was able to read in the bath, outside at the picnic table, or in bed before sleep. I am damned if I am going to take my laptop into the bedroom.

Alan Snook

To the Editor:

I just finished reading Tim Hunter's article on LED fixtures.

In the city that I live in, Ottawa, Ontario, Canada, they started a pilot project of LED light fixtures on a major street not far from my house. Usually when my city does a pilot project, nine out of ten times they go ahead with it anyway.

I went to check out the LED light fixtures and found the light to be very bright compared to the sodium fixtures in front of my house.

This past July, I went to a lecture by Robert Dick titled "LEDs, the Good, the Bad and Ugly." Mr. Dick discussed the same things that Mr. Hunter did. Mr. Dick said that there is no problem if it is done properly. Mr. Dick also lives near the pilot project and is an advocate for preventing light pollution. He has met with city officials to discuss about doing it properly, but they do not seem to care.

Mark Narwa, *Member-at-Large*
Ottawa, Ontario, Canada

Ron and Astronomical League:

Thank you very much for printing my "Sun in Cloud" picture on the back page of the September 2014 issue of the *Reflector* magazine. It was very exciting to see it there when I opened my mail last weekend. I have been receiving many nice emails from the Howard Astronomical League and others outside of my local club. I also enjoyed the article by Vincent S. Foster. Not only was it informative, but I also like the fact that it started out with warnings regarding safe solar viewing.

In all the "public" events that I attend with my hydrogen-alpha and white light telescopes, I repeat over and over again cautions to children and adults alike the safety precautions necessary for when doing solar observing. If it does not already exist, I think it would be very helpful to the community at large if the Astronomical League could produce a standardized set of safe solar observing habits that can be printed and shared. I would personally laminate them and put them on a sign alongside my telescope.

Thanks again.

Phil Whitebloom
philwhitebloom@yahoo.com

Spectroscopy Outreach Activity

One of the more unusual outreach activities I do is to introduce spectroscopy using a small telescope and a transmission grating. I use a 3-inch f/10 reflector, an 18 mm eyepiece, and a Star Analyser SA-100 threaded into the eyepiece like a filter. This combination does not allow the viewer to see absorption lines, but it does a good job showing the star's continuous blackbody radiation. Antares, Arcturus, Vega, and Albireo are chosen for their temperature variety and brightness. As I go from star to

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SEYFERT'S SEXTET; NASA GODDARD SPACE FLIGHT CENTER

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

Reflections

With some 16,000 readers, the *Reflector* is now the third largest astronomy magazine by printed circulation in the United States.

The preparation and production of this magazine is a complicated process. It takes many people and many hours to get the material necessary to produce a great product.

Much of the credit for this achievement goes to you, the reader. Without your support of the Astronomical League, this journal could not be made. The quality of the magazine itself is also due to the hard-working volunteers who write the articles and monthly columns, collect the materials, edit the submissions, lay out the formatting, and get the pages to the printing company. For those of you who are unfamiliar with the process, I thought it might be a good idea to offer some details of what is involved.

Most of the articles and information in each issue are written by League members. Various organizations offer additional material to the editorial staff for consideration and inclusion. Each submission is reviewed by the editor, sent to the assistant editors for editing and proofreading (the staff is listed on page 4), and then returned to the editor, who does a final review. The electronic files are then sent to design/production, who puts all the material, including advertisements, into a format that the printer then turns into paper copies. In the future, the high-resolution file we send to the printing company will also be sent to the digital recipients, up to a week or two before the print version is available.

Here are two examples of the process in action:

There are about 50 different Observing Programs and Awards, with some 35 different people submitting information on them for inclusion in the *Reflector*. This information comes in different formats (Word files, Excel files, etc.), with different fonts (Arial, Calibri, Times New Roman, etc.), and in varying font sizes (9 to 12 point). Each file needs to be converted into a standard font (Arial), font size (11), and format (Word .doc). Each entry needs to end with a semicolon, with commas separating the award number, name of recipient, society affiliation, etc. There are typically 150 Observing Award recipients per issue and each has to be formatted correctly (for consistency and readability), name spelling has to be verified (yes, we get multiple entries—same person, different spellings), consistent society affiliation, etc. Plus the colorful headings for each award must be added. All of this takes about four hours for this page, before it is sent to the assistant editors for review.

An article is submitted, in a Word .doc format, with the images embedded in the Word document, or a link to an image. The article is proofed by the editor before sending it along to the assistants. The author has to be contacted to provide separate JPEG images (the resolution of embedded images is usually inadequate for printing presses) or links must be found and downloaded. When necessary, images must be converted to JPEG or TIFF files. The assistant editors check the science (yes, sometimes the science is wrong), consistency (names spelled the same everywhere), word flow (making certain the paragraphs and sentences are readable), and formulae (yep, we've seen a few of these). In addition, they correct links to websites, punctuation, grammar, spelling, etc. The assistants ensure that the material has not already been published in another magazine. Generally, previously published materials are not accepted without extensive rewriting. They also check whether the images have been credited correctly. The edited file is then returned to the editor for final review. Each article takes several hours on all sides (one editor, two assistant editors), plus the pre-prep work. It is forwarded to design/production along with the appropriate images and captions.

Once design/production receives the material, it is laid out, along with the images, advertisements, notices, blurbs, table of contents, page numbers, etc., so that the final product is readable, is easy on the eyes, and looks like a professional publication. Adjustments are made so each article or column fits in the allocated space. The formatted and laid-out PDF files are then returned to the editor, assistant editors, League officers, etc., for a final read-through. Necessary changes are made, and a "final" PDF is sent to the same people.

Assuming there are no further changes, blessings are given and the high-resolution files get sent to the printing company for production and distribution. In all, the

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DEEP-SKY OBJECTS

TWO IN THE VIEW IN URSA MAJOR

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

In the last *Reflector*, Bob Scott introduced a new Astronomical League observing program called "**Two in the View**." Coincidentally, my Deep-Sky Objects article in that issue covered one of the 109 pairs on this new observing list: M35 and NGC 2158. This month, I will intentionally cover another Two in the View pair: M97 and M108. This pair is not on the official Two in the View list. However, the rules of the list allow for 15 viewer-specified pairs under any of five categories. M97 (NGC 3587) and M108 (NGC 3556) fall under the category of two NGC objects, and these are two I would recommend that anyone working on this list observe.

M97 and M108 are located just below the cup of the Big Dipper, near the star Merak. Specifically, M97 is approximately two-and-a-quarter degrees southeast of Merak. M108 is located 48 arcminutes north-northwest of M97. Therefore, any telescope–eyepiece combination with a one-degree field of view simultaneously captures both of these Messier objects. I have spied them in the same field of view using a 102 mm f/7.9 Apo with a 12 mm TeleVue Nagler eyepiece, a 6-inch f/4 Newtonian using a 15 mm Plössl eyepiece, and a 14-inch f/6 Dobsonian using a 26 mm TeleVue Nagler eyepiece!

M97, also known as the Owl Nebula, is a splendid planetary nebula. The French astronomer Pierre François Andrè Mèchain discovered the nebula in the year 1781. His friend Charles Messier added it to his list soon thereafter. The nebula shines at magnitude 9.8 and is fairly round with a diameter of 3.3 arcminutes. The Anglo-Irish astronomer William Parsons (also known as Lord Rosse) viewed M97 in 1848 and thought the two dark perforations within the nebula resembled the face of an owl. M97 has been called the Owl Nebula ever since!

The accompanying image of this splendid celestial pair was taken with a Stellarvue ST-102T apochromatic refractor with a TeleVue 0.8x focal reducer/field flattener to give an effective focal ratio of 6.3. The exposure was 120 minutes using an SBIG ST-2000XCM CCD camera.

Small telescopes in the 4- to 6-inch range reveal the planetary nebula nature of M97, but do not provide much detail. The Owl Nebula is best viewed with an 8-inch or larger telescope. Under the best observing conditions, an 8-inch scope could deliver views of the owl's eyes. However, I would recommend at least a 12- to 14-inch telescope to see variations in the grey nebulosity of the nebula.

Three stars are visible within the Owl Nebula on the accompanying image. They form an equilateral triangle around one of the eyes. The nebula's central star is the brightest of the three. Estimates of this star's magnitude range from 14 to 16. Based on how difficult this star is to see in a large Dobsonian, I'd say its magnitude is closer to 16 than 14. The other two stars are roughly one magnitude fainter.

The exact distance to M97 is not well known. Historical estimations ranged from 1,300 to 12,000 light-years. Recent calculations have narrowed its distance to somewhere between 1,700 and 2,000 light-years. There are numerous background galaxies within a half-degree of M97. On a 90-minute exposure image I took of the Owl Nebula using a 190 mm f/5.3 Maksutov–Newtonian, I counted two-dozen galaxies between magnitude 12.5 and 18.7.

M108 is a fine 10th magnitude spiral galaxy. The galaxy is nearly edge-on, making it much easier to see than a 10th magnitude face-on galaxy. M108 is 4 arcminutes long and 1.7 arcminutes wide. With a 4- to 6-inch telescope, the elongated shape of this galaxy is readily apparent. M108 is a barred spiral galaxy. However, its many dust lanes and oval shape give it the appearance of an irregular galaxy. Many of these details are discernable in 8- to 10-inch telescopes.

Pierre Mèchain discovered M108 the year after he discovered M97. Although Charles Messier was aware of it, Messier did not publish it as part of his catalog. It was added to his list in 1960 along with M109. The galaxy is located 45 million light-years away and has a mass of approximately 125 billion suns. The galaxy may have 290 globular clusters and has many active H-II regions and X-ray sources.

The contrast between a resident Milky Way planetary nebula and a distant galaxy make this celestial pair an outstanding set to study simultaneously in the same field of view. While moving to higher power eyepieces will allow only one of these objects to be seen at a time, the increased detail will be worth the effort.

GREEN BANK STAR QUEST XII

June 17, 18, 19, 20

The Dream Continues

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GREEN BANK STAR QUEST XII

JUNE 17, 18, 19, 20

2015 Line-up of Speakers and Presenters:

Saturday Night Keynote Talk

"Exoplanets Across Time and Space"

John Debes is an ESA/AURA astronomer at the Space Telescope Science Institute.

"The Milky Way and Beyond"

Dr. Felix James "Jay" Lockman
The Green Bank Telescope Principle Scientist.

"Nuclear Astrophysics Research"

Dr. Michelle Shinn - Chief Optical Scientist at Thomas Jefferson National Accelerator Facility

"The Last Days of Messenger / New Horizons Mission"

Mark "Indy" Kockte - John Hopkins Applied Physics Lab

Terry Trees - Observing the Solar System's Minor Moons
Robert Royce "Over the Moon" - practical advice on Lunar Observing
John Goss - President of the Astronomy League National headquarters
Caitlin Ahrens - "Minerals in Space"
Sue Ann Heatherly - NRAO Education Program Director (Introduction to Radio Astronomy)
Brent Maynard - Astrophotographer (Hands on Astrophotography with a DSLR camera)
Michael Rosolina - Astrosketching with a Hands On Workshop
Bob Hendricks - The Future of Space Travel
Roger Carpenter - Evening Sky Orientation
Jimmy O'Dell Carroll - One of the Original Rocket Boys
John Taylor - Introduction to Optical Astronomy for the Beginner
Tom Crowley - Hands on using a 40 ft. Radio Telescope
Bob Dutilly with Phil Whitebloom - Our Dynamic Star, Solar Atrophotohraphy
Dave Holden - "The Meteorite Guy" (How to find Meteroites)

For other registration options, and details visit our web-site www.greenbankstarquest.org

Green Bank Star Quest, PO BOX 1862, CLARKSBURG, WV 26302-1862

For questions only call: (304) 669-3555

New Astronomical League Sketching Observing Award

Have you ever noticed that the longer you look at an object the more details you begin to see? This is what occurs when sketching astronomical objects as well. The Astronomical League is now introducing the new Sketching Observing Award.

The object list was created by members of the Haleakala Amateur Astronomers of Maui, Hawaii, and includes lunar and planetary targets, double stars, nebulae, open and globular clusters, and more. The list contains 114 objects, and sketches of 75 of these are required to complete the award. Some of the objects are very simple, while others are more challenging to record.

Before some of you say, "but I can't sketch," understand that the Sketching Observing Award was not created for artists. It is for everyone, regardless of the level of observing experience or artistic ability. If you can put a pencil to paper and make a smudge with your finger, you have the ability to complete this award. The main focus of the program is not to make artists out of amateur astronomers, but to help slow down the observing process and improve observing skills over time.

The process of sketching can be intimidating to some that have never attempted it, but with some patience and practice you will be surprised that over time your ability to record what you observe will improve. Links to informative tutorials and other resources recommended for those new to sketching astronomical objects are listed on the Astronomical League's Sketching Observing Award webpage, *www.astroleague.org/programs/sketching-observing-award*. There are also advanced tips for more detailed sketching and for those with more experience.

We hope this award will help you gain a greater appreciation for sketching astronomical objects and enhance your skills in recording the details of your observations.

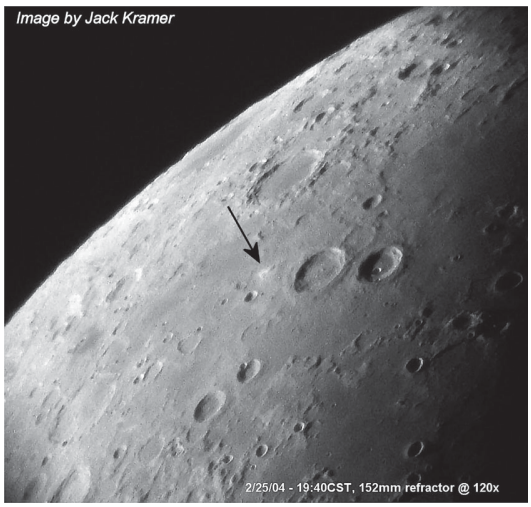
—Cindy L. Krach
Sketching Observing Award Coordinator

A Curious Lunar Spot

By Jack Kramer

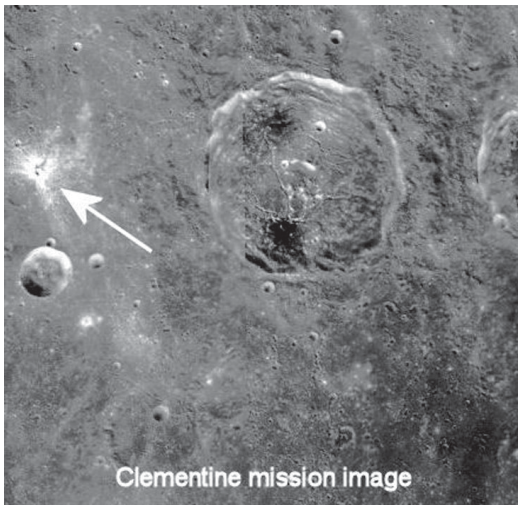
There is an interesting bright spot near the large crater Atlas, close to the northeastern limb of the Moon. Small features like this are nothing special, except that this one doesn't appear in some lunar atlases. It came to my attention several years ago via a call for observations of it from the American Lunar Society. It appears on an image that I had taken in 2004 through a 6-inch refractor.

A search of various sources shows this is not a named feature, nor have I found any information about an object at this spot. A good image is one taken by the Clementine lunar mapping mission, which portrays features in the straight-on view from a spacecraft rather than the foreshortened view we get when observing from Earth.



It turns out to be a very small crater with a bright collar of ejecta and an unusual ray pattern. There also appears to be an oblong, upraised area extending to one side. That is probably a dune, which on the Moon is a low ridge of loose rock formed during the ejection of material from an impact crater. That seems to fit the case here. The Clementine image prompts a mental picture of a meteoroid striking the Moon at an oblique angle, scattering debris in a pattern commensurate with the angle of impact. The ejecta blanket is very bright, indicating relatively fresh material. Considering that the crater is so small, the amount of ejecta is surprisingly large—other small craters in the area show little or no ejecta.

Since the feature's appearance varies in different images, I began observing it regularly to determine how it appears visually at different phases. In my scopes, the tiny crater was not visible at all, due to its small size and the foreshortened view that we have near the limb. Observation of the young moon at high power does show the dune as a short, thin black line. The ejecta is visible even at low power. I couldn't detect the dune later in the lunar month during gibbous phases, but the unique spray pattern of ejecta became brighter and more detailed at that time, even in a telescope as small as four inches. By the time of full moon, the ejecta seemed to have faded somewhat. Further observation, especially under the best seeing conditions, may reveal more aspects.



Close to full phase, two neighboring features take on some added interest. The larger dark spot adjacent to the inside rim of the crater Atlas becomes very prominent at this time, appearing as a pitch-black circle. (It shows up well in the Clementine image.) Apparently this is an area of especially dark lava that welled up within the crater. Also, the largest crater within adjacent Hercules becomes very bright.

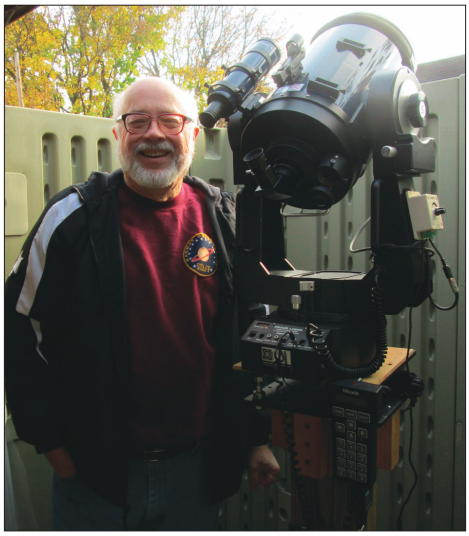
This shows that, as familiar as the Moon's terrain may be, now and then we do come across a feature that prompts more than just a passing glance.

Kramer is a member of the Fox Valley (Illinois) Astronomical Society. This article was previously published in the July 2012 Fox Valley Astronomical Society Newsletter.

GRINDING THROUGH THE OPEN CLUSTER OBSERVING PROGRAM

By Terry N. Trees, PhD
MERAL Chair • Urban Observing Program Chair
TreesT@Comcast.net

I live about a half hour's drive from downtown Pittsburgh, Pennsylvania, and have an 8-inch Meade LX-200 in my backyard observatory. It doesn't get used much. Nearby houses and large trees that restrict the horizon are major detriments. The city lights—in particular, both our next-door neighbors' floodlights—are another. They can have floodlights on at all hours for no apparent reason and the lights discourage me from viewing much other than



Our 8-inch Meade LX-200 and me in our small backyard observatory.

the Moon, some double stars or the brighter planets. The sky itself is simply "bright." Not New York City bright, but still, bright. You can see what has happened to it over just the past ten years or so here: *www.celestial-imaging.com/?p=1782*. Click on the lower image, give it a minute to load, and watch as it blinks between the past and the present.

In an attempt to get more use out of our observatory, about eight years ago I searched the Astronomical League's website for a suitable observing project. I settled on the Open Cluster Observing Program. I believed that open clusters could stand up to the challenge of my city environment and small telescope. I based that conclusion on a stunning binocular view of M44 that I experienced under the dark skies of the Texas Star Party. It is still one of the more amazing things I have ever seen. I thought the effect of binoculars and dark skies might be approximated by a telescope under bright skies. Well, while some clusters held up, many did not. Many that looked quite nice in our larger scopes under dark skies simply showed a few dim stars in our 8-inch at our house.

Back in the 1950s and 1960s, you'd frequently see movies advertised as "two years in the making!" or "3 years in the making!" Of course, this was meant to show that the coming movie was a big deal—cast of thousands, etc. However, if you were to see the off-and-on dates in my logs and look at my weak drawings—spanning eight years or so—you wouldn't be impressed. Observing was a real chore and it wasn't the Open Cluster Program's fault. This was a slow process, one difficult to force myself to complete. As I said, because of the light pollution, many clusters didn't hold up well. I saw limited details, which produced little satisfaction, and, thus, periodic waning interest. I saw little from my backyard that compared to what I have seen out west under dark skies and the few reviews that I did of my attempted Trumpler classifications showed many inaccuracies. Again, this is not a reflection on the quality of the Open Cluster Program; it is the result of my small scope, my aging eyes and, especially, the light pollution. Pittsburgh averages just 59 clear days per year. I swear that 95% of them occur at full moon. Okay, that is an exaggeration, but cloudy nights at dark-sky times, coupled with schedule restrictions, also decreased my interest because I couldn't stay active with the project. Nevertheless, I periodically overcame my frustrations and observed additional objects. I'm glad I did. I now have more than 100 observed and 25 drawn. And, while the rewards have been limited, some observations were well worth the effort.

M7, M44, and M45 viewed through binoculars from a dark-sky site certainly are some-thing to behold. When I viewed Collinder 378 from my backyard, I thought its stars looked like two equilateral triangles embedded in a larger equilateral triangle. It reminded me of the Cracker Barrel peg game. Berkeley 82 showed me a dim equilateral triangle next to a somewhat brighter hockey stick. I saw many "Y" shapes, crosses, equilateral triangles, matching isosceles triangles, and even some near-perfect pentagons as I worked my way through the observing list. Maybe a wild imagination is a prerequisite to seeing such things, or perhaps the light pollution suppressing dimmer stars allows the patterns of brighter stars to be more easily observed; whichever, this leads me to believe these examples of why I enjoyed some of the open clusters can be summarized as: 1) impressive views of bright, beautiful objects and 2), interesting, sometimes complex, star patterns. Certainly not all, but many of the objects included in this observing project met those criteria, even in my light-polluted home environment. See what you think of M44 or M7 seen through city lights. See if you can find a scythe with a curved handle in Collinder 463.

As I said, my goal was to fight through this in my backyard. Over about eight years, I completed the basic certificate program. Several times I really had to force myself to restart. Now that there are only 25 more observations required and 25 more drawings to complete for the advanced program, I really need to get going again. It's been seemingly more difficult than the Herschel 400, which I completed at various dark-sky sites in the United States and Canada, and, overall, it has certainly been much less entertaining. But I do want to meet my original goal of accomplishing the challenge from my backyard.

Our neighbors just to the south have indirect illumination that lights their entire back porch ceiling and 2 sets of floodlights mounted to the exterior of the back porch.

Someday I'll try the Open Cluster Observing Program again from dark-sky sites with either our 12.5-inch or 17.5-inch Dobsonian and actually get to see why these objects are considered to be worthwhile. That should be both entertaining and rewarding.

DISCOVERING ASTRONOMY:
An Exploratory Series from the Adirondack Public Observatory
Part 1–Space: Our New Frontier

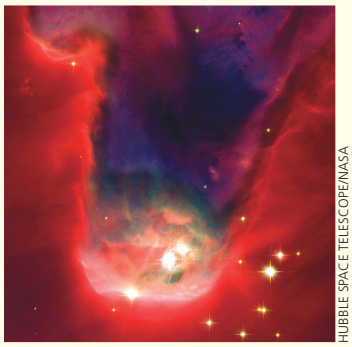
By Lee Gaillard

Frontiers: borderlines between the known and the unknown. I realize how young our country is when history books list 1890 as the year the census bureau declared our "frontier" closed: my grandmother was then 12, and only 43 states formed the Union. She died in 1956, just one year before we all embarked on a vast new adventure, one that opened a new and exciting frontier that replaced the passing of the Old West: on October 4, 1957, the Soviet Union launched Sputnik, the world's first artificial Earth satellite, a gleaming 184-pound sphere whose transmitted beeps announced the opening of the Space Age. When, on April 12, 1961, Vostok I lofted cosmonaut Yuri Gagarin into orbit, humankind took its first step in leaving our planet.

Space? Early pioneers marveled at the vast expanses of open space on our western plains, flat buffalo-dotted green-yellow grasslands stretching toward the horizon till they lapped against the foothills of the Rockies. Today we marvel at a galaxy-flecked darkness of space that extends from Earth 13.8 billion light-years in all directions. This is our new frontier, and if we are going to explore it, then we must turn to astronomy for a foundation of understanding.

Following this first in a series of articles sponsored by the Adirondack Public Observatory, we will probe that new frontier, looking to astronomy for an update on what we already know about neighboring planets in our solar system, about the Sun and other stars, and about whirling galaxies scattered in billions across the depth of the universe. Let's start with early satellites, near-space probes sent to the Moon and beyond, followed by more sophisticated spacecraft that have reached other planets and returned detailed photos and unprecedented volumes of information. Then we'll see how astronomy actually involves all the major sciences—physics, chemistry, biology, and geology. Even art.

Next we'll touch on some cutting edge technologies employed in astronomy—from advanced telescopes (earthbound and space-based) to the International Space Station, from automated probes to thundering booster rockets and the Curiosity rover now on Mars. How have these technologies helped to expand our knowledge? We'll also meet some of astronomy's early visionaries and more recent heroes. We'll finish with a look at the beauty and magic of astronomy, concluding with speculation about the origin of the universe in what we now call the Big Bang, that mysterious moment when the cosmos suddenly came into being roughly 13.8 billion years ago—an instant that itself may form the final frontier between science and philosophy.



HUBBLE SPACE TELESCOPE/NASA

Early Satellites and Near-Space Probes

Those were heady days, back in the Cold War, when each new launch generated its own excitement. With America's first satellite atop the Vanguard launch vehicle, viewers watching their TV screens on December 6, 1957, saw the rocket lift briefly off its pad at Cape Canaveral only to collapse slowly back through its own exhaust plume, exploding in a massive yellow ball of fire. But on January 31, 1958, Explorer I, mounted on a converted army Redstone missile, blasted into orbit. This time, rather than just emitting Sputnik-like beeps proclaiming its existence, it returned valuable information: its instruments had discovered the Van Allen radiation belts, evidence of Earth's magnetic field lines protecting us from torrents of charged particles that bombard us from the Sun.

The rate of launches increased: early communication satellites, weather satellites, Discoverer and Cosmos and KH-11 spy satellites; the Mercury and Gemini programs sent astronauts into orbit in preparation for Apollo Moon flights. But near-space unmanned probes also reached out—to the Moon and beyond. The Soviets' Luna 2 impacted the Moon in September 1959; early in the 1960s, America's Ranger series provided lunar reconnaissance, its probes crashing into the Moon's surface after taking and transmitting photos of potential landing sites to Earth as they approached; Surveyor, Zond, and others continued the process.

Some Threats

While frontiers spark excitement, they can also harbor danger. With failure as the occasional price of success, threats go with the territory as you test your limits against the unknown. Of the explorers and pioneers who made discoveries, many also paid with their lives. Lewis and Clark opened our West, not to mention Kit Carson and others. But George Mallory lost his life in 1924 trying to be the first to conquer Mount Everest; Marie Curie died in 1934 from aplastic anemia resulting from manipulating, with her bare hands, concentrated radioactive pitchblende ore from which she extracted radium; Mel Apt died in 1956 when inertial coupling sent his X-2 rocket research plane out of control at Mach 3. The year 1967 claimed more lives: Vladimir Kamarov in the crash of Soyuz 1, known in advance for its shoddy construction; then three Apollo crew members who died in an oxygen-fueled capsule fire. Fourteen Space Shuttle crew members also perished—seven in the 1986 explosion of Challenger's solid rocket booster shortly after liftoff and seven more when Columbia's launch-damaged thermal protection tiles triggered her disintegration as she returned from orbit in 2003. There were others, too.

Threats also lurk in the black emptiness of that space wilderness. The dinosaurs never saw it coming, that asteroid that hurtled toward Earth 65 million years ago and smashed into the tip of the Yucatan peninsula. Debris and particulates blasted into the Earth's atmosphere, causing massive global cooling, blocking out sunlight, and initiating widespread extinction of plant life and many animal species depending on it, including the dinosaurs. Or the meteorite that hit Arizona 50,000 years ago and left a crater three-quarters of a mile in diameter. Witness 1908, when Siberia suffered the equivalent of a roughly 5-megaton nuclear blast as an

asteroid or comet tore into our atmosphere and exploded, leveling roughly 830 square miles of forest near the Tunguska River. In 2013, another asteroid disintegrated in the atmosphere 14 miles above Chelyabinsk, Russia, its flash visible for hundreds of miles and its blast effects damaging over 7,000 buildings, injuring more than 1,000 people. Its approach had gone undetected.

Several years ago, I spoke briefly with Sergei Khrushchev, a guest on Philadelphia's WHYY "Radio Times." Formerly a key contributor to Soviet strategic missile programs, Professor Khrushchev held the post of senior fellow at Brown University's Watson Institute for International Studies. I asked him, given his dual U.S.–Russian citizenship, how he felt about U.S. anti-ballistic missile (ABM) development: protected (as a U.S. citizen), or threatened (as a Russian citizen), by a program that seemed to hearken back to the Cold War.

The gist of his reply: ABM efforts are an impractical waste of money. It would be far better that the U.S. and Russia join forces in developing, as soon as possible, the capability to detect and intercept any small asteroid (or comet) that poses a threat to Earth. He said the threat was real—and no one was doing anything about it.

Recent events confirm his response.

In launching these early satellites and unmanned near-space probes, we developed booster rocket technologies, began our microminiaturization transition from transistors to integrated circuits, and improved our orbital navigation and lunar reconnaissance capabilities. In the process, we discovered dangers that lurked in space and others that could strike either on the ascent to, or in the flaming return from, orbit. We were ready. The Moon would be next.

Continued in the June issue

10, 25, and 50 Years of the Astronomical League's Newsletter

By Mike Stewart, Astronomical League Historian

April 1965

Lehigh Valley Lunar Program in Coopersburg, Pa.

Despite the cold 15° temperature, 26 members of the Lehigh Valley Amateur Astronomical Society participated in the Society's lunar eclipse program last Dec. 18th, 1964. This program included the timing of occultations prior to the eclipse. The eclipse was recorded both visually and photographically. Timings made of the passage of the umbral shadow have been forwarded to ALPO. The photographic venture included three 35mm SLR [single-lens reflex] cameras mounted on the Society's 6" refractor in their observatory. Color slides were made of:

1-eclipse series taken at the prime focus (f-15)
2-elipsed [sic] moon and star fields through a 7X scope-camera
3-Long exposure, wide field views of the moon at totality to capture star fields.

There are two total lunar eclipses in 2015. Fortunately, the temperatures are likely to be somewhat warmer than the 15 degrees reported by the Pennsylvania observers. One occurs on April 4, and the second on September 28.


REFLECTOR

OFFICIAL PUBLICATION of the ASTRONOMICAL LEAGUE

Yerkes Highlights League Convention

February 1990

The Houston Museum of Natural Science opened the doors of the largest aperture telescope devoted to public viewing on October 12, 1989. Since then, hundreds of people have flocked to Brazos Bend State Park, an hour's drive southwest from downtown Houston, Texas, each Saturday evening to admire the facility and the stellar views it provides. The 1.2 million dollar George Observatory Is largely funded by a $770,000 grant from the George Foundation of Fort Bend County. Its central 36-foot dome houses a 36-inch research-grade Ritchey–Chretien purchased from Louisiana State University for $150,000. The 12-ton telescope is a twin of an instrument at Kitt Peak National observatory. Included in the price-tag are a spectrograph, a plate camera, and an off-axis guider, as well as a hydraulic floor. Flanking the major dome are two smaller domes which serve the amateur community and researchers when not in use for public nights.

Houston-area amateur astronomy groups, including the Fort Bend Astronomy Club, the Houston Astronomical Society, and the Johnson Space Center Astronomical Society, were involved in the planning and fund-raising necessary to bring this project to first light. You can get more information about public viewing opportunities from the Houston Museum of Natural Science's website, www.hmns.org.


REFLECTOR

The Astronomical League Newsletter

Houston's George Observatory

New 36" Public Telescope Invades Alligators

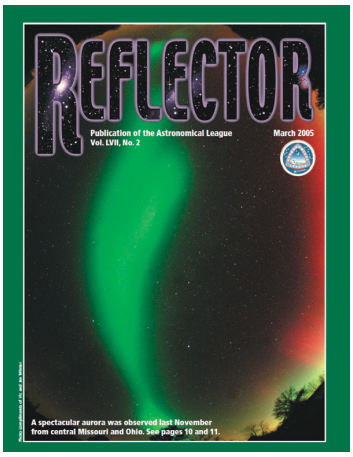
March 2005

Aurora Sunday

It began as a trip to haul out the trash my normal Sunday evening activity as it gets dark.

The bright glow in our usually pitch-black northern sky east of Kansas City, Missouri, was the first clue that something wasn't quite right. I [Vic Winter] recalled seeing images of a major flare on Friday, November 5, 2004, and that put the impact of all that energy arriving at just about at that moment.

The auroral activity started with a blue-green glow 15 to 20 degrees above the northern horizon. It quickly elevated to 30 to 40 degrees with pulses and curtains of green. White spikes higher than Polaris scattered from northeast to northwest. A fainter glow of red was then seen in the northeast. Pockets of odd shaped cloud-like features were forming almost due east at about 6:30 p.m. The clouds were blue-green and quickly expanded westward. Within 10 minutes a solid band went from the eastern horizon to the zenith and back down to the western horizon. Thank goodness for a fisheye lens!



The cloud changed shape, wiggled and squirmed and slowly drifted south past the zenith and into the southern sky before fading about 15 minutes later. The green color was vivid; digital images showed it to be bright green. The next few hours had a red glow above 20 to 30 degrees of green, fading in and out with small spikes 30 to 40 degrees in length. From about 10 p.m. to midnight there was little red seen, just a huge bow-wave shaped arc of green across the complete northern horizon. It extended upward about 30 degrees in the middle under Polaris.

The late Vic Winter's photo of the November 7–8, 2004, aurora made the cover of the March 2005 Reflector. *Jeffrey J. Green of the Cincinnati Astronomical Society also captured images of the aurora from his site in Ohio. The details of Mr. Green's techniques can be found in the March 2005 issue. With access to solar weather information, such as that provided by NOAA or SpaceWeather, observers can now get real-time alerts of aurora.*

AN ANTENNA WITH A

By Jeffrey M. Lichtman,

About eight years ago, I became acquainted with a very gifted person, **Dr. Rene Lee** of New Mexico. Over the years, Dr. Lee has been involved in many areas of science and technology.

Some years back, Dr. Lee acquired a 32-foot D.S. Kennedy dish antenna from a fellow New Mexico resident who rescued it from **White Sands Proving Ground** in New Mexico. D.S. Kennedy was one of the supreme antenna manufacturers in the 1960s and 70s. The antenna was a player in the U.S. space program and was used to receive telemetry from spacecraft missions.

Dr. Lee has stored this antenna in an enclosure to protect it. The antenna is still in excellent condition, right down to its reflector surface and gray finish. Original plans were to build a mount and use it for radio astronomy.

In November 2012, a good friend of mine, Franco Cappiello of Milan, Italy, visited us. While here, we took a road trip to the **Very Large Array** in New Mexico. Franco is a radio astronomy enthusiast and owns a **SpectraCyber** radio telescope.

While on our trip, I told Franco of my friend, Dr. Lee, and the 32-foot antenna. His eyes lit up! Franco immediately thought how great it would be to acquire this antenna and have it shipped to Italy for doing real science. He then told me about a group of friends that he meets with and their interest in radio astronomy. Franco also mentioned that he teaches at a local university and owns an engineering company. In addition, his resources include a full machine shop with all the tools and expertise required to construct a mount for the antenna.

So, it has come to pass that the dream will be coming true. This wonderful piece of American ingenuity with a great past will find itself on the other side of the world and perhaps once again play a role in radio astronomy research.

Franco plans to use the new MFRT Fiber Optic Radio Telescope from Radio Astronomy Supplies on his new 28-foot antenna.

Shipping: the Rest of the Story

It is now thirteen months since we started on the path to send this antenna to Italy. We figured this would be a bit of a task, but it has been one

This original ad shows a much larger version of the antenna described in this piece.

Twenty-eight antenna in A

Rental truck in Las Cruces, New Mexico

Dr. Lee, Jesse Cynthia Licht

Dish frames

Dish Pedals being loade and Raphael

N HISTORICAL PAST

Radio Astronomy Supplies

t-foot D.S. Kennedy ustralia

Franco and his 3-meter antenna on his roof deck in Milan

, Jesus and man

Jesus and Jesse loading the antenna panels

d by Terressa

Darius sealing it up

disappointment after another. Just finding an ocean shipper who was competent and would understand and agree to the job was a nightmare. One company even backed out at the eleventh hour after money had already changed hands. Finally, we went with Ocean Star International of Florida.

On December 17, 2013, we left to supervise the loading of the antenna. The next day, a container truck was scheduled to pick up the antenna in Deming, New Mexico. My wife Cynthia and I drove to Deming, an eleven-hour drive in a rented Hyundai Sonata with a lot of play in the steering. We drove through beautiful areas on I-20 until we got to the Midland–Odessa part of Texas. That area is flat and is loaded with oil wells pumping away, as far as the eye can see. No rest stops, food, or anything—just oil wells. We finally arrived at our Days Inn in Las Cruces, New Mexico, where we collapsed into bed. Cynthia did all the driving, as I do not drive since my stroke in 2008.

The following morning, we headed 50 miles west on I-10 to Deming, where we met Jesse and Jesus from Manpower, the people we hired to load the container. We drove to Dr. Lee's home, but when we arrived, there was no container. I called the trucker in Las Cruces, who first told me of one truck being down and another that was on its way to El Paso to get a 20-foot truck from the yard, resulting in a delay of 4 hours. After lunch, I received a call from the ocean shipper explaining that the steamship company had overbooked and there would be no container!

So, what do we do now? Cynthia did some quick calculations and we decided that another back-and-forth trip was impractical. We rented a 26-foot Budget truck for the next day. Jesse and Jesus met us again and loaded the truck.

Cynthia got in the driver's seat of this diesel truck and off we went, back to Texas, 800 miles. Rain, cold, and a long drive ahead greeted us when we awoke the next morning in Van Horn, Texas. We arrived back at home around 9 p.m., exhausted, and went right to bed, with visions of antennas and tumbleweeds dancing in our heads.

We eventually heard that the ocean shipper would pick up the antenna right after New Year's, 2014. We were hopeful, but wary.

The Final Goodbye

On the morning of January 7, 2014, a truck arrived at our home in Whitesboro, Texas, with a 20-foot container. The morning of loading day, we received a 6 a.m. call from our friend, saying that he had the flu. We immediately got dressed and headed out to see whom we could find to help us load before the truck's arrival at 10:30. Fortunately, our friend's husband and 21-year-old daughter came to the rescue.

The antenna was loaded on a rail car for a trip to Houston where it would be loaded on the container ship for its voyage to the port of Genoa, Italy. Arrival would be on or about February 8.

Arrival in Italy

On February 14, 2014, the antenna was offloaded in Genoa and transported to its storage location in Milan. Since the antenna's arrival, Franco has designed a very solid motorized mount. In addition, he has acquired a small piece of land on which to place the antenna.

For those of you who want to follow the continuing story, you can contact Franco at *franco.cappiello@gmail.com* or Jeff Lichtman at *jeff@radioastronomysupplies.com*.

The author, Jeffrey M. Lichtman, is the founder and owner of Radio Astronomy Supplies, *www.radioastronomysupplies.com* and founder emeritus of the Society of Amateur Radio Astronomers.

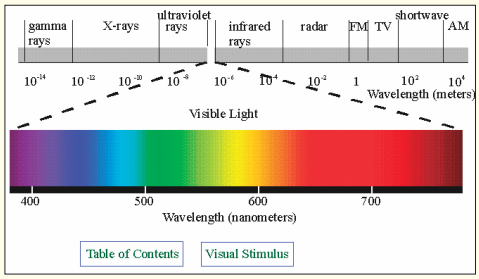
A SPECTROSCOPY PRIMER FOR THE AMATEUR ASTRONOMER

By David Doctor,
Astronomical Society of Las Cruces, New Mexico

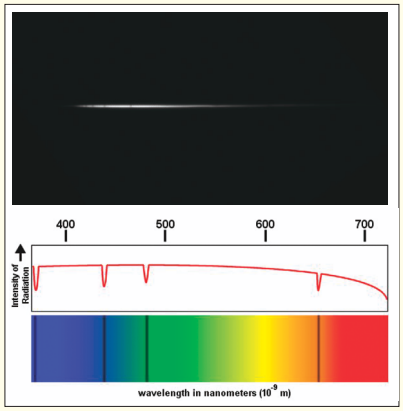
Most of what we know about the universe and how it works is the result of astronomical discoveries made by spectroscopy.

Spectroscopy is the analysis of the light we receive from an object. The dispersion of the light from the object into its component colors (or wavelengths) enables astronomers to infer many physical properties of that object, including temperature, velocity, composition, and distance.

For our purposes we will focus on visible light. The violet end of the visible spectrum has a wavelength of around 400 nanometers (nm). The red end has a wavelength of about 740 nm. Although the visible spectrum runs from red to violet, the short wavelength end is often called the "blue end" of the spectrum. Think primary colors. When starlight falls onto a grating or spectrograph, it produces a spectrum—a rainbow band of light. If you plot the intensity of the light in that band (y-axis) against the wavelength (x-axis, blue to the left and red to the right), you generate a curve that is the main component of what you see in a typical spectral plot. The curve typically has a peak (the wavelength corresponding to maximum intensity) somewhere in the range of wavelengths recorded. However, most of what we learn about the objects we observe comes from discrete spectral lines within the spectrum.



The electromagnetic spectrum and the very small region we call visible light



Images above show a typical spectrum from an amateur grating (Star Analyser). Note the absorption lines on the left. The second image shows a plot of intensity vs. wavelength. The "dips" in the graph represent absorption lines, which are seen in the spectrum below as discrete dark lines.

Let's briefly discuss the three types of spectra, which will shed light on the source of the actual lines we see in them.

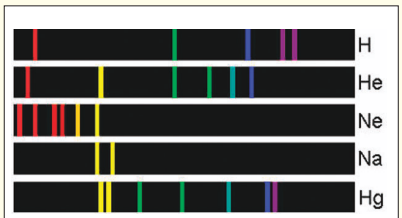
1) Continuous spectrum: This includes all wavelengths of visible light and shows all the colors of the rainbow. It's produced by a dense, opaque, hot object, for example, the "surface," or photosphere, of a star. This type of spectrum has no separate lines in it! The image at the very top of this article showing the visible light spectrum is an example of a continuous spectrum.

2) Emission line spectrum: This consists of discrete bright lines at specific wavelengths. These can only be produced by a hot, low-density gas. The specific lines are determined by the type of gas. For example, hydrogen, when heated, will emit radiation only at specific wavelengths, which are different than the wavelengths of radiation emitted by other gases.

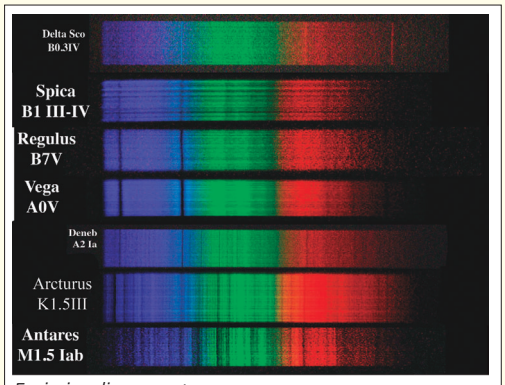
3) Absorption line spectrum: Absorption lines can be thought of as the opposite of emission lines. While emission lines add light of specific wavelengths to a spectrum, absorption lines subtract it. Therefore, absorption lines can only be seen when they are superimposed on a continuous spectrum.

How, then, are these different types of spectra produced in stars? The continuous spectrum originates from the dense, opaque photosphere of the star. This light next passes through a thin, slightly cooler layer of gas at the top of the star's photosphere (between the stellar surface and you, the observer). The result is that the gas in the cooler upper atmosphere of the star absorbs some light from the star's surface before it reaches you, and consequently "subtracts" the specific wavelengths unique to that atmospheric gas, giving rise to the absorption lines!

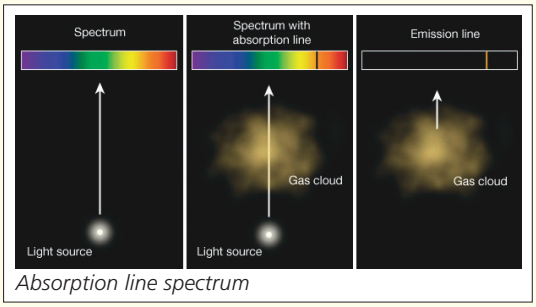
Different types of gas produce different patterns and strengths of lines. Emission and absorption lines are typically named after the elements responsible for them as well as the element's "ionization state." The atoms of elements have electrons that move between energy states, "up and down", to simplify things, depending on whether they are absorbing or releasing energy (in the form of a specific wavelength of light). When absorbing light they will move up to a higher level and produce an absorption line. When they release energy, they move down to a lower level and produce an emission line. The wavelength of emission and absorption is the same for a



Continuous spectrum



Emission line spectrum



Absorption line spectrum

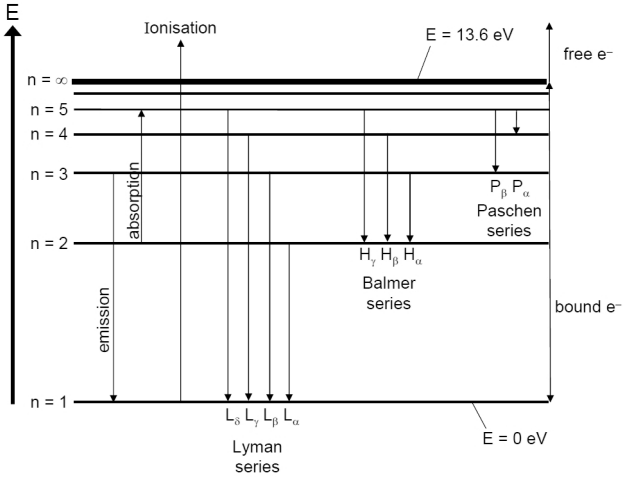
specific element in a specific ionization state. But what, exactly, is an ionization state?

Remember that atoms have electrons, and you need electrons to produce spectral lines! If a gas is heated to a high enough temperature, an electron could absorb enough energy that it escapes from the atom. When an atom loses one or more of its electrons, it is said to be "ionized." Losing electrons changes the wavelengths of the emission and absorption lines that are possible for that element, so it is important to know the ionization state. Typically a Roman numeral suffix will indicate the state, where higher numbers mean higher ionization states. For example Na I would be non-ionized or neutral sodium, Ca II would be singly ionized calcium, and so on. Hotter gases are more highly ionized. Historically, some common spectral lines have unique names, in particular those of hydrogen, which is the most abundant element in the universe. "Ly alpha" is one of the "Lyman" series (named for Theodore Lyman) of absorption lines in the ultraviolet region of the spectrum produced by neutral hydrogen. In the visible part of the spectrum you have the Balmer series (H-alpha, H-beta, and H-gamma), named for Johann Balmer.

But why does each element have unique spectral lines, and for that matter, why are there many lines per element? In the early 20th century, Niels Bohr proposed his model of the atom: a positively charged nucleus surrounded by electrons traveling around the nucleus in circular orbits. Specifically, electrons in the atom orbit the nucleus at discrete distances from the nucleus, and these orbital distances are associated with energies referred to as "energy levels." Electrons gain or lose energy by moving from one allowed orbit to another. In this process they absorb or emit electromagnetic radiation with a frequency determined by the energy difference between levels: $E(2) - E(1) = h\nu$, where ν is frequency and h is a constant number known as Planck's constant. For light, the greater the frequency, the shorter the associated wavelength, and vice versa.

The above diagram illustrates the Bohr model of the H (hydrogen) atom, which predicted the basic hydrogen atom spectrum. When an electron in an atom absorbs electromagnetic radiation it jumps to a higher orbit (energy level). The electron cannot be measured to be in between energy levels—it must be found in one of the energy levels (n = 1, 2, 3...) or else it must have left the atom altogether in the process of ionization, leaving behind a H+ ion (proton). The further the orbit is from the atomic nucleus (the higher the value of n) in the Bohr model, the higher the energy of the electron. To move out from, say, n = 1 to n = 3, the electron must absorb a packet of energy equal to the energy it must gain to complete the orbital transition, which is the energy difference between the orbits, or $E(3) - E(1)$. This energy can come from a photon (a particle of light—yes, like in *Star Trek*) of the correct wavelength and frequency. As it goes from one level to another, the emission or absorption of light by the electron corresponding to the specific required energy (and hence specific wavelength and frequency) produces the spectral lines we see!

Hydrogen energy-level diagram



The first three spectral series (Lyman, Balmer and Paschen) are shown in emission. Note that we can talk about electron orbitals as energy levels, with th energy α n.

The electronvolt, eV, is a unit of energy,

$1\ eV = 1.602 \times 10^{-19}\ J$

where the Joule (J) is the SI unit of energy and is the preferred unit in A-level, however, the eV is more convenient when talking about atoms! SI units now ccept the eV as a unit.

For example, the Balmer series of spectral lines are produced when electrons move from levels 3, 4, and 5 down to level 2. For the transition n = 3 to n = 2, the resulting wavelength produced is 656.3nm. The transition from n = 4 to n = 2 corresponds to 486.1 nm and n = 5 to n = 2 to 434.0 nm. These three wavelengths are historically referred to as H-alpha, H-beta and H-gamma.

Spectral classification and what we observe

The first spectral analysis was done at the eyepiece about 150 years ago, using a prism, the human eye and an artistic hand to show the results. Just over a century ago, astronomers were able to record the spectra of stars using photographic plates! Initially a classification was based on the strength of the hydrogen lines, but after it was realized that the key differences between the spectra seen in different stars were principally due to temperature, the classification was changed to the format you see now, OBAFGKM and more recently L, T, and Y. Spectral class O represents the hottest stars, decreasing from there through the rest of the classes. The kinds of spectral lines we see strongly depend on a star's temperature. In super-hot stars, hydrogen will be fully ionized, meaning it has no electrons in it. Since there are no electrons, no spectral lines can be produced. Therefore hot O-class stars will show weak hydrogen lines. As the temperature decreases and electrons stay attached to the atom, you will see the lines start to get stronger. B, A, and F stars will show stronger hydrogen lines, and, in particular, A stars show the strongest hydrogen lines. At lower temperatures, the hydrogen gas isn't as easily excited, thus the Balmer lines aren't as strong in G and K stars, and are barely present at all in M stars.

Metals are easier to ionize than hydrogen and helium, and therefore don't require such high temperatures. Thus spectral lines from ionized metals (for example, Fe II and Mg II) are common in stars of moderate temperatures (roughly 5,000 to 9,000 K), including the Sun. Metals produce many more spectral lines than hydrogen and helium because they have more electrons. In general the cooler the star, the more metal lines it will have. The lines of Ca II at the wavelengths of 393.3 and 396.8 nm (known as the "Calcium K" and "Calcium H"

Class	Temperature[8] (Kelvin)	Conventional color	Apparent color [9][10][11]	Mass[8] (solar masses)	Radius[8] (solar radii)	Luminosity[8] (bolometric)	Hydrogen lines	Fraction of all main sequence stars[12]
O	≥ 30,000 K	blue	blue	≥ 16 M_{sun}	≥ 6.6 R_{sun}	≥ 30,000 L_{sun}	Weak	~0.00003%
B	10,000 - 30,000 K	blue to blue white	blue white	2.1 - 16 M_{sun}	1.8 - 6.6 R_{sun}	25 - 30,000 L_{sun}	Medium	0.13%
A	7,500 - 10,000 K	white	white to blue white	1.4 - 2.1 M_{sun}	1.4 - 1.8 R_{sun}	5 - 25 L_{sun}	Strong	0.6%
F	6,000 - 7,500 K	yellowish white	white	1.04 - 1.4 M_{sun}	1.15 - 1.4 R_{sun}	1.5 - 5 L_{sun}	Medium	3%
G	5,200 - 6,000 K	yellow	yellowish white	0.8 - 1.04 M_{sun}	0.96 - 1.15 R_{sun}	0.6 - 1.5 L_{sun}	Weak	7.6%
K	3,700 - 5,200 K	orange	yellow orange	0.45 - 0.8 M_{sun}	0.7 - 0.96 R_{sun}	0.08 - 0.6 L_{sun}	Very weak	12.1%
M	≤ 3,700 K	red	orange red	≤ 0.45 M_{sun}	≤ 0.7 R_{sun}	≤ 0.08 L_{sun}	Very weak	76.45%

lines, respectively) are a particularly strong set of lines seen in cooler stars. In F-class and cooler stars, the Ca-II lines are stronger than the Balmer lines. In the cool G and K stars, lines from ionized metals are less abundant and lines from neutral metals are more common. In the very cool M stars, their atmospheres are cool enough to have molecules, which produce wide absorption "bands," much wider than the atomic spectral lines discussed earlier.

To reflect the fact that there is a continuous range of temperatures among stars, the spectral classes have subdivisions. Each class is divided into 10 groups, with larger numbers indicating lower temperatures. For example, an A0 ("A-zero") star lies at the hot end of the A class, with a temperature of close to 10,000 K, while A9 is at the cool end near 7,500 K. An A9 star is therefore more like an F0 star than an A0, even though an A9 and F0 are technically in different spectral classes, A and F.

Basic spectral classes and their properties

Now putting it all together, we see below a typical "squiggly graph" of the spectrum of Sirius. You now understand that this is a plot of intensity vs. wavelength, and that all the dips correspond to absorption lines at specific wavelengths created by the gases in Sirius's atmosphere. These absorption lines can be detected because they are superimposed on the background continuous spectrum of Sirius's surface.

I think we'll stop here! Hopefully this provides a suitable basic foundation for understanding the science, specifically, of this fascinating branch of our hobby!

Data provided by Iowa Robotic Observatories *(astro.physics.uiowa.edu).*

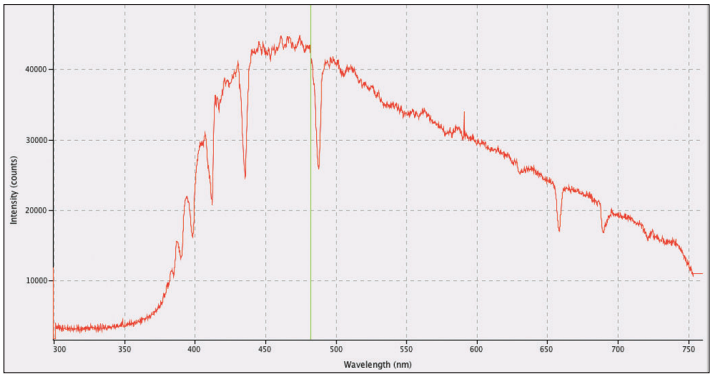
References:

Astronomical Spectroscopy for Amateurs, Ken M Harrison, 2011, Springer Science and Business Media, 256 p.

"Stellar Spectroscopy—the Message of Starlight" *www.astro.washington.edu/users/anamunn/Astro101/Project1/stellar_spectroscopy_introduction.html.*

"What is Spectroscopy" *loke.as.arizona.edu/~ckulesa/camp/spectroscopy_intro.html.*

"Analysis and Interpretation of Stellar Spectra," Richard Walker, *www.ursusmajor.ch/astrospektroskopie/richard-walkers-page/index.html.*



2015 Webmaster Award: Time is Running Out!

The deadline for submissions for the Astronomical League's **Webmaster Award** is April 1, 2015.

The **Webmaster Award** recognizes the efforts of those individuals who produce the vibrant, informative websites that are so essential to the growth and vitality of astronomy clubs.

The Astronomical League's **Webmaster Award** is presented each year to the webmaster of the best club website. A website is an important asset to any astronomy club, and this award acknowledges the winning webmaster's outstanding job of website design and administration.

Websites are judged based on:

- Technical and visual design and organization
- Content, including club activities and club calendar, educational content, and links
- Outreach
- Administration and timeliness of content

Club presidents, please send webmaster nominations and the club's website address, no later than April 1, to *webmasteraward@astroleague.org* or to Mike Rao, Astronomical League Webmaster Award Administrator, 2328 Naomi Street, Houston, TX, 77054 (please note that this is a new mailing address).

Deadline Approaches for the Mabel Sterns Newsletter Editor Award

The **Mabel Sterns Newsletter Editor Award** recognizes the work of club newsletter editors across the country. The deadline for submissions is March 31, 2015.

The nomination package should contain a letter from the club president or vice president explaining why their newsletter editor should be considered for the award, a recent issue of the newsletter, and a photo of the newsletter editor (preferably in an astronomical setting). Listing the URL of the club's website where electronic copies of past newsletters are posted would also be helpful. In addition, the postal address of the newsletter editor should be included. The names of both the newsletter editor and the nominating club officer must appear on the general membership roster of the Astronomical League.

The newsletter nomination materials may be submitted by any of these three methods:

The preferable method is emailing the materials. The supporting club letter and an issue of the newsletter should be attached in Adobe PDF format, although Microsoft Word format is acceptable. The editor's photograph should be attached as a high-resolution JPEG. Please email entries to *SternsNewsletter@astroleague.org*.

If electronic submission is not possible, paper copies may be mailed to the League's national office. Four copies of the letter of recommendation and four copies of the newsletter are required. Only one copy of the photograph is needed.

If the newsletter is available on the club's website, then its web address should be given, along with any password required to access it. The editor's photograph (JPEG) and club recommendation letter (PDF) can be submitted in an email as instructed in method 1.

It is strongly recommended that the Astronomical League's logo be prominently displayed in the newsletter, preferably on the front page.

For complete information about the 2015 Mabel Sterns Award program, please see *www.astroleague.org/al/awards/sterns/sternss.html.*

Recognize Youth Accomplishments: The Astronomical League's Horkheimer Awards 2015!

Now is the time to submit nominations for the Astronomical League's three **Jack Horkheimer Youth Service Awards** and the **Horkheimer/O'Meara Journalism Award**.

If you know an Astronomical League member, 18 years old or younger, who has brought amateur astronomy to your club or to the public through outreach, presentations, writing, or observing, please consider nominating that person for the three **Horkheimer Service Awards**: **Horkheimer/Smith, Horkheimer/Parker**, and **Horkheimer/D'Auria Awards**.

Another youth award is more specialized than the others: the **Horkheimer/O'Meara Journalism Award**. It requires a person who is 8 to 14 years of age to compose a 300- to 500-word essay on any science-related topic.

Since the deadline for the **Horkheimer Service and Horkheimer/O'Meara Journalism Awards** is March 31, 2015, now is the time for potential candidates to gather their nomination materials and to complete their requirements.

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

Diversity Makes the Dome Go Around!

By Gail Davidson

It's sometimes said that amateur astronomy groups are composed predominantly of older, Caucasian males. But in the high mountain Gunnison Valley of Colorado, it's diversity in age and gender that makes the dome of the Gunnison Valley Observatory go around!

The observatory, located under pollution-free, clear night skies at over 7,700 feet in elevation, contains the largest publicly owned and accessible telescope in Colorado. The Observatory was built in 2006 through a collaboration between Gunnison County, the City of Gunnison, Gunnison Valley Astronomical Society, many local businesses, individual citizens, non-profit organizations, service organizations, and private donors. A classroom and sky wall enhance the dome-housed 30-inch Dall–Kirkham Cassegrain telescope. First light took place in June 2008.

Since that time, thousands of visitors, including school and youth groups, have explored the night sky during private star parties, educational events, and the public viewing sessions held on Friday and Saturday nights from early June through late September.

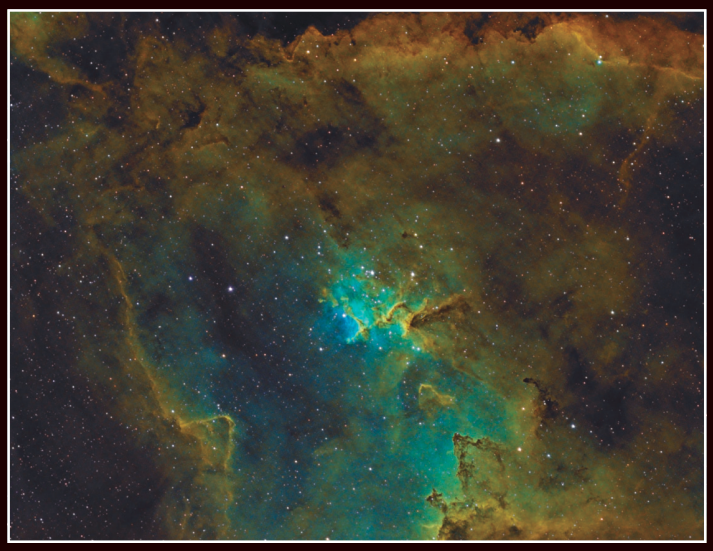
The observatory is overseen by a non-profit board of directors consisting of representatives from the business community, Western State Colorado University, local government, the Gunnison Regional School District, and the Gunnison Valley Astronomical Society.

But it's the diverse group of dedicated volunteers that keep the observatory doors open to the public. Volunteers—female and male, teens to seniors—include local amateur astronomers, science educators, building contractors, retirees and full-time working folks, a PhD in physics at WSCU, summer seasonal residents from other states. Non-astronomy-oriented volunteers greet visitors, run the gift shop, and publicize the programs and events, and a handful of energetic local university and high school students operate the telescopes, both in the dome and outside the facility during public viewing sessions. The GVO strives to encourage and educate young people to learn about the wonders of astronomy through hands-on, practical experience. They are the future of astronomy.

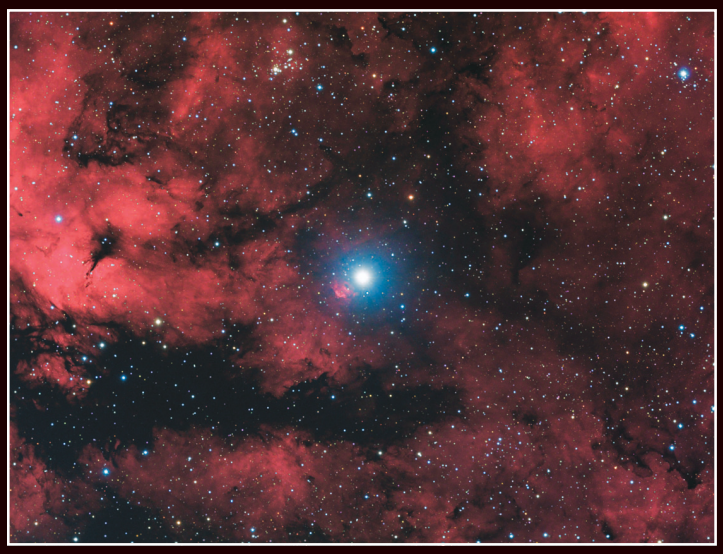
Working together, this group of dedicated and diverse volunteers creates a welcoming and educational public astronomy facility that allows young and old visitors to *carpe noctem*—seize the night.

Gallery

TITLE PHOTO: NGC 2244; BRIAN KIMBALL



This amazing image of IC 1805 was taken by Jaspal Chadha, from the light-polluted skies of London, England, using a Sky-Watcher Esprit 100ED telescope, QSI 690 CCD, and iOptron CEM60 mount, in H-alpha light (9 x 1200 seconds), S-II (3 x 1200 seconds), and O-III (3 x 1200 seconds). For further images, visit *www.jkobservatory.net*.

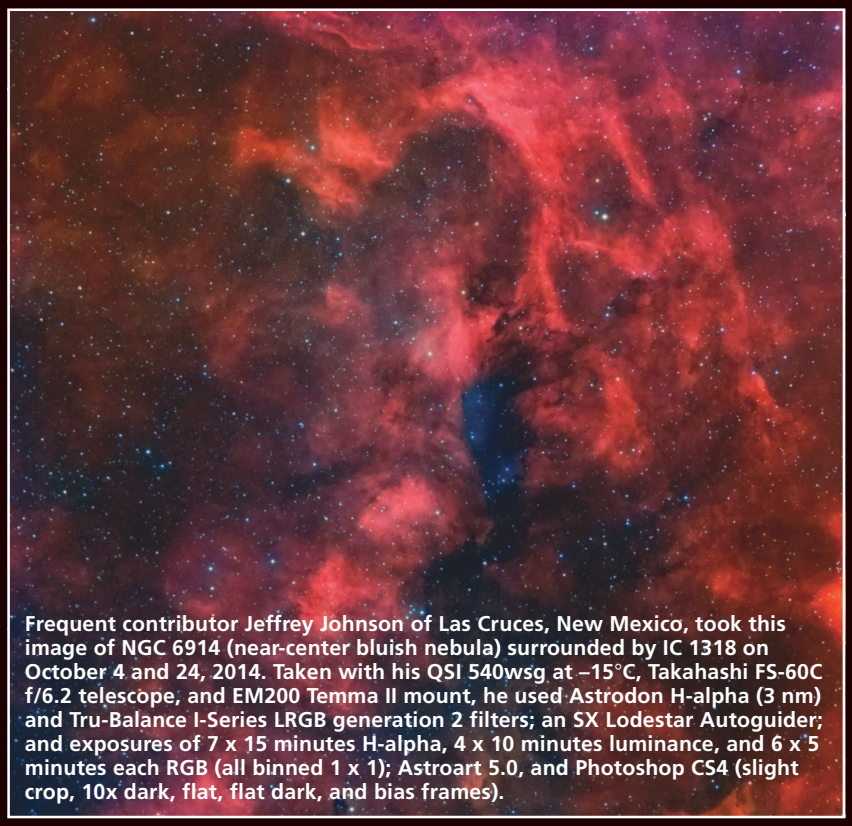


Sharpless 2-108 has many other names, including DWB 63, but it is probably best known as IC 1318 or the Butterfly Nebula. It is located approximately 4,900 light-years distant in the constellation of Cygnus. Larger than 1.7 x 1.3 degrees, this image, by Dan Crowson of Dardenne Prairie, Missouri, is centered on the 2.2-magnitude star Sadr (Gamma Cygni). Dan used a SBIG ST-8300M on an Astro-Tech AT90EDT at f/6.7, with exposures in H-alpha of 12 x 1800 seconds binned 1 x 1 and RGB of 8 x 300 seconds each binned 2 x 2, taken over four nights in August and September 2014. For further information, visit *www.crowson.com*.

M31 (the Andromeda Galaxy) is a very popular subject amongst imagers. The spiral galaxy, at a distance of 2.5 million light-years, the nearest to our own Milky Way, appears 6 times the width of the Moon in our sky. This image is a four-panel mosaic, taken by Jason Tackett on October 26, 2014, at the Staunton River Star Party in Virginia, hosted by the Chapel Hill Astronomical and Observational Society. Total exposure time is 3 hours (36 x 300 seconds at ISO 800), split between the four panels, using a Canon EOS 550D DSLR through an Explore Scientific 127ED apochromatic refractor on a Losmandy G-11 mount, processed with PixInsight. Jason is a member of the Back Bay Amateur Astronomers of Hampton Roads, Virginia.

On September 27, 2014, Mike Sager, a member of the TriState Astronomers in Hagerstown, Maryland, and the Cumberland Astronomy Club in Cumberland, Maryland, took this image in Canaan Valley, West Virginia, near Blackwater Falls State Park. This was his first attempt at nighttime photography. He used settings of 25 seconds, f/2.8, and ISO 1600 on a Canon EOS Rebel T4i with a Tokina AT-X 116 Pro DX-II lens at 11 mm, a ProMaster Professional XC525 tripod, and Vello Wireless ShutterBoss. Post-processing was done with Photoshop Camera Raw 6.7 in Photoshop CC 2014.

This colorful region of nebulosity, located about 5,800 light-years away in Sagittarius, is NGC 6559. Imaged by Bob Runyan, a member of the Platte Valley (Nebraska) Astronomical Observers, over a total of 6 hours, this two-frame mosaic was obtained using an Astro-Tech AT6RC 6-inch Ritchey–Chrétien, Orion EON 120 mm refractor, and SBIG ST-8i, autoguided by an Orion StarShoot AutoGuider. Software was MaxIm DL/CCD, Photoshop, Astronomy Tools, and RegiStar. It was taken from his AstroAsylum ExploraDome Observatory, located in Shelton, Nebraska.



Frequent contributor Jeffrey Johnson of Las Cruces, New Mexico, took this image of NGC 6914 (near-center bluish nebula) surrounded by IC 1318 on October 4 and 24, 2014. Taken with his QSI 540wsg at –15°C, Takahashi FS-60C f/6.2 telescope, and EM200 Temma II mount, he used Astrodon H-alpha (3 nm) and Tru-Balance I-Series LRGB generation 2 filters; an SX Lodestar Autoguider; and exposures of 7 x 15 minutes H-alpha, 4 x 10 minutes luminance, and 6 x 5 minutes each RGB (all binned 1 x 1); Astroart 5.0, and Photoshop CS4 (slight crop, 10x dark, flat, flat dark, and bias frames).

When the Moon Came to Eagle Lake Observatory

By Bob Kerr

The 400+ members of the Minnesota Astronomical Society (MAS) have long been committed to sharing the wonders of the night sky through outreach programs. The resources and location of our well-equipped Eagle Lake Observatory (ELO) site are ideally suited for this purpose. The observatory grounds are part of a popular county park, campground, and recreational lake located about an hour's drive southwest of Minneapolis–St. Paul.

Many equipment and facilities upgrades have been made over the last several years, principally the new Sylvia A. Casby Observatory with its 8-inch TMB refractor and, to keep members and visitors comfortable in Minnesota's challenging climate, the heated and air conditioned HotSpot classroom and activity center.

For the past seven summers, our major outreach event has been "Camping with the Stars," during which visitors can pitch tents adjacent to the observatories. In addition to extended nighttime observing, we provide daytime presentations and activities that are interesting and informative.

Since this year marked the 45th anniversary of the Apollo lunar landings, we knew an event centered on that theme would generate considerable interest. I had heard about NASA's public lunar sample display loan program and mentioned it to MAS president Dave Falkner and ELO director Merle Hiltner. We decided to investigate whether we would qualify for participation in the program.

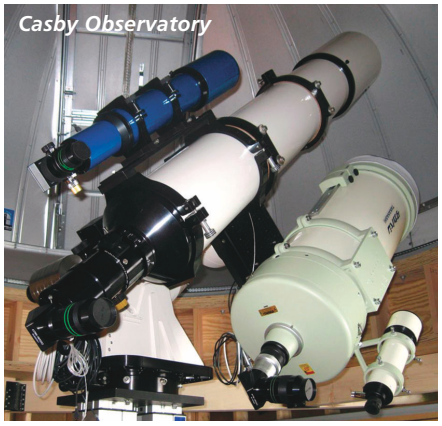
As stated on their website, "NASA provides for a limited number of [Apollo] rock samples to be used for either short-term or long-term displays at museums, planetariums, expositions, or professional events that are open to the public." Under these guidelines, we weren't sure whether NASA would consider Eagle Lake Observatory for a short-term loan, but we submitted our request and were very pleased to learn that if we could meet their standard requirements, chiefly pertaining to security, NASA would agree to loan us a lunar rock sample.

In the end, we found ourselves approved, and a 3.3-billion-year-old basalt specimen from the Apollo 15 mission to Hadley Rille was reserved in our name. One of NASA's provisions is that the sample must be picked up and returned in person at the Curation and Exhibits office at the Johnson Space Center in Houston. Merle took the responsibility for this job.

After 45 years, we realized many attendees would be unfamiliar with the Apollo program. MAS members designed and built an exhibit of mission photos, maps, and illustrations to document and interpret the landings. This was accompanied by presentations about Apollo, as well as night sky orientations and how to make planispheres. No doubt, though, the major attraction everyone wanted to see was the Moon rock.

Judging by the record attendance and the overwhelming positive response, the event was a huge success. Many of our members worked long hours on a variety of jobs to pull this all together, but the result was definitely worth it. We were able to make a lasting impression on a new generation who now has a better appreciation for what was achieved 45 years ago. MAS extends its deepest thanks to NASA for making it possible for us to bring a piece of the Moon to Eagle Lake Observatory.


Lunar rock returned by Apollo 15


Casby Observatory


Visitors enjoy the Apollo exhibit


Onan Observatory


Replica Bootprint


An adventure to remember

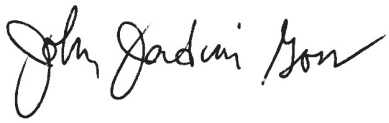
Field of View/ *Continued from page 4*

astronomy club successful: the officers, the speakers, the educators, the meeting facilitators, and the observers. All of these people are volunteers. All of them.

Before volunteering, they all saw a need to help people experience the wonder, beauty, and mystery of the celestial realm. After volunteering, they felt a sense of altruistic satisfaction knowing that they affected how others view the universe.

Finally, think of the Astronomical League as a member-supported and member-driven national organization. How can you help improve it, and help others in their appreciation of the night sky?

Participate. Discover. Volunteer.



Reflector Mail/ *Continued from page 6*

star, people notice differences in the spectra. I explain about absorption lines that show which elements are present in a star's atmosphere. I use emission lines to verify for them the reality of absorption lines. Usually there is a mercury-vapor lamp in the distance that I can train the telescope on to show the emission lines characteristic of mercury. While they observe a star's continuous spectra with few questions, they are surprised by the spectrum of the mercury lamp, with its distinct emission lines. This is a good time to talk about the quantum nature of electron energy levels and how electron energy transitions can cause light to be emitted at distinct wavelengths, and, conversely, absorbed at distinct wavelengths.

Because this demonstration takes about ten minutes, I reserve it for when only a few people are observing. A little patience in explanation can yield great conversation and a detailed learning experience.

Ken Clayton
Texas Astronomical Society of Dallas

Reflections/ *Continued from page 7*

entire process, from start to finish (including production and distribution), takes about six weeks for a 24-page issue and about eight weeks for a 32-page issue. Since future issues will be 32 pages, we have moved the deadline for submission up by two weeks, to ensure there is adequate time to get the printed issues to our readers by the first week of the month of issue. Of course, we cannot dictate the delivery schedule of the United States Postal Service, so some issues can arrive later than what we aim for.

The new submission dates are listed on page 4 as well as on the advertising rate sheet in each issue.

We all strive for 100% accuracy on all articles, notices and announcements. If an error is made, we print a correction or a retraction in the following issue. Please do not hesitate to tell us if we did something wrong. Better yet, tell us if we do something right. Your letters are always welcome. Address them to *editor@astroleague.org*.

Oh, one more thing. ALCon 2015 will be held in Las Cruces, New Mexico, "America's Dark Sky Paradise," this July. Check out the website at *ALCon2015.astroleague.org* for more information. Hope to see you there.

ALL THINGS ASTRONOMICAL

The Texas Star Party

The Texas Star Party is offering a telescope and observing workshop—the AstroLearn Workshop—where attendees who specifically register for the workshop can learn about amateur telescopes and observing. This will help folks who already have a telescope but are uncertain as to how to use it, as well as those who have yet to purchase a telescope. Please see their notice in the Coming Events section of this *Reflector*.

***Reflector* Staff**

An Ode to the Vanishing Dark Skies

The dark-sky officer of the Amateur Observers' Society of New York, Gary Citro, has written and recorded a song about light pollution, with an accompanying video, which is available on YouTube at *www.youtube.com/watch?v=KjE9DDNVkzg*. He'd be pleased to have it used to help astronomers in their quest to save the night sky.

Gary Citro, a public school music teacher, has also been an amateur astronomer for about 20 years. He says, "I've been wanting to write what is at once a love song to the night sky and a hate song about light pollution for some time, and I finally got around to it last summer. My friend Matt Dimakos helped me record it professionally and we collaborated on a great YouTube video for it. I hope it is used to educate and motivate, because that is what it's all about. We are looking into turning it into a children's book as well. I'm actually a classical pianist and rock keyboardist, but the recording is me playing folk guitar and singing both vocal tracks. The special guest voice at the end is my daughter Susan Citro, who turned 12 on August 9, 2014."

Gary lives on Long Island in New York and has watched the night sky degrade to the point where the average person probably could no longer find the Big Dipper from his or her front porch. Gary has been working for over a decade at the local and state levels to try to reduce light pollution in New York. He was part of a small group that managed to get LIPA, the local utility, to switch over their leased night-lighting program and power plant lighting to more sky-friendly full cutoff lights. Several times the state legislature has passed lighting ordinances only to have the governor let them expire.

"We are winning small local battles and will never give up, even if we have to fight one person at a time. We hope you can use this song and video in your quest for dark skies as we are in ours."

Sue Rose
President,
Amateur Observers' Society of New York

Offer the Night Sky for Your Favorite Charitable Organization

"The celestial wonders in our night sky are owned by no one. Truly, they are for us all." Amateur astronomers across the nation follow that credo and enjoy giving free telescope sessions to the public. Taking money is not a consideration; however, here is an instance where amateurs may change their minds.

Charity auctions are a common way for non-profit organizations to raise much-needed funds. The amateur astronomer can help his or her favorite group by offering a personalized session at the telescope for the highest bidder. Who wouldn't jump at the chance to see the moons of Jupiter, the rings of Saturn, or the craters on the Moon, up close and personal? Toss in a few globular clusters, nebulae, and galaxies and the winning bidder will have a memorable evening! Everyone wins—the worthy organization acquires needed cash, the winning bidder has an enjoyable experience, and the amateur comes away with a good feeling.

MAKE PERSONAL OBSERVING GOALS

By Mike Hotka

Years ago, I learned of someone's goal of observing 5,000 unique objects in the universe. I thought this was a commendable goal, so I adopted it for myself. To date, I have observed over 3,500 unique objects towards my goal.

This single goal drives my thirst to find new objects each time I go out observing. I never tire of old Messier favorites, but am always looking for objects off the beaten path. While completing 37 of the Astronomical League's observing programs, I was presented with list after list of objects I had never seen. There are generally more objects on an observing program list than the number required for the certificate, thus providing me with additional objects to observe once I complete the certificate. These "extra" objects contribute to my goal of 5,000 unique objects observed.

When looking for observing programs to do, I look for those programs that are of interest to me. Recently, two new programs were added that caught my eye: the Hydrogen Alpha Solar Observing Program and the Bright Nebulae Observing Program.

After reading the requirements of the Hydrogen Alpha Program, I realized observing the Sun this way was something I had wanted to do for years. But I didn't have my own H-alpha solar telescope, a must for this program. Spending almost $500 for a Coronado Personal Solar Telescope was not in my budget, so after making a couple of inquiries, I found my local astronomy club had one that I could check out and use to complete this program.

I have always liked looking at bright nebulae and the Bright Nebulae Observing Program gave me the push I needed to start observing more of these beautiful objects. My 8-inch f/6 Newtonian, with eyepieces giving magnifications of 51x, 81x, and 122x, along with my UHC and O-III filters, were sufficient for me to complete the required 100 observations.

When not working on observing programs, I observe double stars, and also Herschel objects, those objects that William Herschel looked at in the late 18th century. After reading the article "The Herschel Project" by Robert Naeye in the June 2012 *Sky & Telescope* magazine, I was hooked on observing these objects. I have read books about William and Caroline Herschel, which adds to my viewing enjoyment. All these new double stars and Herschel objects will add to my goal of 5,000 unique objects observed.

I really appreciate the Astronomical League and all that it does for us amateur astronomers. Their observing programs are a great resource, for not only do they take you off the beaten Messier path, but you learn new observing techniques with every program you attempt—techniques that will allow you to see fainter objects with your telescope, introduce you to where useful astronomical resources exist, teach you to study the objects in your eyepiece, and give you experience observing a breadth of different kinds of objects, just to name a few.

Set your first goal to complete the Messier Program. Once you complete this program, you will have a good command of the sky and be able to navigate amongst the constellations. While looking at the Messier objects, note which ones you like the best. Your next goal should be to see more of these kinds of objects. The League has an observing program that will help you achieve this next goal. If you liked galaxies, choose the Herschel 400 and Herschel II Programs; planetary nebulae, choose the Planetary Nebula Program; globular clusters, choose the Globular Cluster Program; open clusters, choose the Open Cluster Program; bright nebulae, choose the Bright Nebula Observing Program. Don't forget about our Moon, where there are two programs dedicated to lunar observing. The Lunar Program will show you objects on the Moon I would not have thought possible to observe with my telescope.

Set some personal observing goals and then look to the Astronomical League's observing programs to help you achieve those goals.

Mike has been an Astronomical League member since 1986 and has completed 37 of the League's observing programs. His website, mikehotka.com*, contains a wealth of observing information. Email questions to Mike by using the link at the bottom of the League's webpage,* www.astroleague.org/al/general/contact.html.

THE MODIFIED FUTTERMAN SUNRISE SCALE

By John Symborski, Astronomical League Mid-Atlantic Region representative

Have you noticed the number of astronomy presentations that begin with a sunset slide, or at least having a sunset picture somewhere within the presentation? When in the field, many among us tend to set up our astronomy gear in the late afternoon while one can still see everything clearly. Then we have to wait until the Sun sets, let our equipment cool down, and check collimation and other operational features—like judging if the battery will last more than an hour or two, considering that it may not have been recharged after the last outing. While pondering what didn't get put in the car during the rush to pack, I like to pause and appreciate whatever sunset scene unfolds.

Of course, sunsets can be magical, especially with the equipment silhouetted, which is why those pictures get into the abovementioned presentations. But how often do we fail to stay up the entire night due to sleep deprivation, a work-night observing session, a non-camping site, getting "dewed out," or whatever. This is unfortunate, because sunrises can sometimes outdo their late-day brethren in brilliance and surprise, especially spring through fall. Having seen a range of sunrises over the years, most often due to either insomnia or a pesky prostate, I've often wondered how to "rate" them in an organized fashion. What follows is a modification of the "Futterman" scale, broadcast some time ago on WHYY public radio by Richard James of the Schuylkill Valley Center for Environmental Education in my fair state of Pennsylvania.

1. Complete overcast, no colors, gradual brightening. Of no interest to astronomers, but perhaps to insomniacs, recent parolees and lower life forms with little photosynthetic capability. Astronomers have long since departed due to relatively poor transparency (that is, none to speak of) or are asleep in their tents.

2. Mostly overcast, occasional thin areas. Not much color other than dull red or ochre lasting a few minutes. Gradual brightening. Occasional stirring in the underbrush. Perhaps a damp breeze. No change in the behavior of astronomers from #1 above.

3. Thin overcast, gray tones vary. Color limited to minor reds and yellows with some blues. Birds show some interest. Graveyards seem cheery. Vampires are worried. Astronomers who wake in time to see this realize that they could have done some planetary observing.

4. Spotty, thin overcast with some high clouds visible. Colors range into pinks and oranges. Pleasant but unremarkable. More energetic birds take flight. The first appearance of shadows and pale sunbeams. Astronomers begin to take notice as they rub their eyes.

5.Thin high clouds and scattered low clouds. Colors range through pastels with occasional electric oranges accompanied by pink and yellow rays. Larks are heard and whole flocks of wrens take to the skies. Heightened activity can be heard in the bushes. Distant violins can be half-heard. Phototropic leaves start to incline toward the sunrise. Many astronomers promise to get up and enjoy the dawn more often.

6. Crisp air with cartoon animals in the clouds amid a background of cerulean blues and aquamarines. Sunbeams spring from every cloud. Positively aromatic breeze. Grazing cows stop and look up. Birds harmonize with cats. People stop and stare as a bouncy violin quartet may be heard even indoors. Sensitive astronomers feel a little faint and have to sit down.

7. Clouds billow with multicolored or pulsating lace fringes as the sunbeams dance and sparkle. First cherubs appear around loftier buildups. Great sense of well-being. Golden horns sounding from above are backed up by a chamber orchestra. Fragrance of ambrosia quite pronounced. Bluebirds and robins fly in sweeping formations and nocturnal bats remain aloft. Other animals are dumbfounded. Some astronomers swoon if looking directly into sunrise. Astrophotographers and artists drop like flies.

8. Clouds resemble classical sculptures. The hues are almost indescribable as the entire celestial vault throbs, sending out wave after wave of shimmering color. Cherubs fly everywhere. Cupid may be seen darting between great trumpets. Music swells incredibly, approaching a climactic crescendo, drowning out pandemonium in the bushes and audible even in deep coal mines. Few astronomers remain standing and many pass out, even those indoors and not directly illuminated. Breeze overpoweringly fragrant and carries all known species of birds skyward. Only one out of twenty poets still conscious.

9. Details sketchy. Only three such sunrises reported and only one verified. Eyewitnesses limited to hardened criminals who saw it reflected from security glass, and one astronomer who happened to be holding narrow band filters over his eyes. One theory is that a #9.5 sunrise caused the extinction of dinosaurs.

10. Theoretically possible, but subject to much speculation and disagreement among experts (now isn't that usually the case?). A high probability of either causing a general "rapture" among species (except astronomers), or possibly fatal to most life forms, even those with little photosynthetic capability.

Staff Change at the National Office

After four years of dedicated service to the Astronomical League, **Joe Alburty** has resigned as national office coordinator. Joe handled member-at-large membership processing and the general operations of the national office. He also attended three ALCons, presented status reports at the Council meetings, helped League Sales, and gave other assistance where needed.

Joe has found full-time employment in the Kansas City area, but will still remain an active member in the Astronomical Society of Kansas City. Let's all wish him well!

Replacing Joe is Mike Stoakes, who will continue working as part-time operations manager at the Burroughs Audubon Nature Center and Bird Sanctuary in Blue Springs, Missouri. His knowledge of non-profit operations will serve him well as the Astronomical League's national office coordinator. Please take the opportunity to welcome Mike!

Attention Astronomical League Master Observers!

In recognition of your accomplishment of reaching the level of Master Observer, the Astronomical League would like to honor you at the next ALCon convention that you are able to attend. This recognition will occur at the awards banquet traditionally held on Saturday evening at the conclusion of the convention. It is our intention to celebrate the occasion with a proclamation of each Master Observer and with the presentation of a wall plaque for each Master Observer attending.

All that is required is for you to contact the vice president, *vicepresident@astro league.org*, at least 30 days before the opening of that year's convention to indicate your intention to attend ALCon. In 2015, the deadline is June 6.

—Bill Bogardus, Vice President

Digital vs. Paper

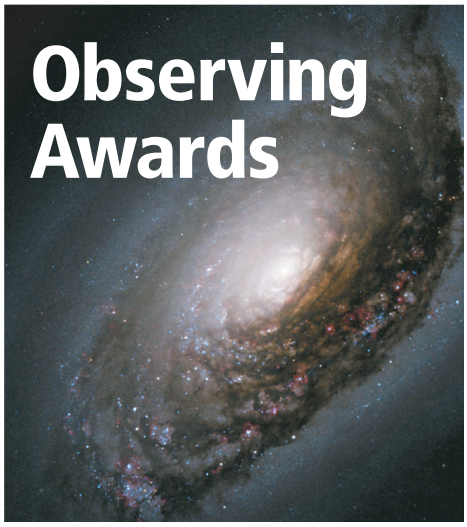
As astronomers, we all have an obligation to be "green," which means we do what we can to avoid the waste of our precious natural resources. We are all aware of the pollution of our air, water, dark skies, etc.

In keeping with our "green" policy, we are investigating the possibility of offering either print or digital copies of the *Reflector* to all of our members. As such, we would like any feedback, comments or questions regarding this issue.

Essentially, our members would have the choice of receiving the *Reflector* as a paper copy, which they presently do, having a PDF file available for download, or both. Digital subscribers would receive an email when the next issue is available, along with an access password for that issue. The file would be about 50 megabytes in size, and would take less than two minutes to download on a broadband Internet connection. The image and text quality will be much better than the existing PDF file on our website.

Please send any comments to *editor@astro league.org*, including whether you would prefer the digital or print version. We would like any comments before April 30.

Observing Awards



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

Advanced Binocular Double Star Observing Program
No. 1, Bob Kerr, Minnesota Astronomical Society; No. 2, William Clarke, Tucson Astronomy Association; No. 3, Scott G. Kranz, Astronomical Society of Kansas City; No. 4, Rob Ratkowski, Haleakala Amateur Astronomers; No. 5, Brad Young, Astronomy Club of Tulsa; No. 6, Michael A. Hotka, Longmont Astronomical Society; No. 7, Al Lamperti, Delaware Valley Amateur Astronomers

Analemma Observing Program
No. 7, James V. Zappa, Member-at-Large

Arp Peculiar Galaxy Observing Program
No 29-C, Brad Gilman, Denver Astronomical Society; No. 81-V, Roy Troxel, Member-at-Large; No. 30-C, Hilary Jones, Tri-Valley Stargazers; No. 31-C, David M. Douglass, East Valley Astronomy Club

Asterism Observing Program
No. 16, Grant Mills, Member-at-Large; No. 17, James C. Sanders, Smoky Mountain Astronomical Society

Asteroid Observing Program
No. 42, Regular, Richard Owens, Astronomical Society of Kansas City

Binocular Double Star Observing Program
No. 78, Coy Wagoner, Shreveport–Bossier Astronomical Society; No. 79, Fred Schumacher, Member-at-Large; No. 80, Jeff Haidet, Toledo Astronomical Association

Binocular Messier Observing Program
No. 1034, Dee Friesen, Albuquerque Astronomical Society; No. 1035, Jason Furman, Colorado Springs Astronomical Society; No. 1036, Steve Siedentop, Atlanta Astronomy Club; No. 1037, Jim Fordice, Albuquerque Astronomical Society; No. 1038, Vincent Michael Bournique, Member-at-Large; No. 1039, Lowell Martin, Fort Worth Astronomical Society; No. 1040, David M. Douglass, East Valley Astronomy Club; No. 1041, Dan Crowson, Astronomical Society of Eastern Missouri; No. 1042, John Whisenhunt, San Antonio League of Sidewalk Astronomers; No. 1043, Christian Weis, Tucson Amateur Astronomy Association; No. 1044, Paul Harrington, Member-at-Large; No. 1045, Zack Stockbridge, Member-at-Large; No. 1046, Adam S. Yore, Member-at-Large

Caldwell Observing Program
No. 214, Dan Delzell, Silver, Prairie Astronomy Club of Lincoln

Comet Observing Program
No. 77, Tim Tomljanovich, Silver, Northwest Suburban Amateurs; No. 78, David Hoover, Silver, Seattle Astronomical Society

Constellation Hunter Observing Program
No. 147, Dan Chrisman, Roanoke Valley Astronomical Society; No. 148, Stephen Tzikas, Northern Virginia Astronomy Club

Dark Nebula Observing Program
No. 19, Cindy Krach, Haleakala Amateur Astronomers

Deep Sky Binocular Observing Program
No. 358, Kevin McKeown, Albuquerque Astronomical Society; No. 359, Kevin Carr, Member-at-Large; No. 360, Edward Fraini, Houston Astronomical Society

Double Star Observing Program
No 534, Kevin McKeown, Albuquerque Astronomical Society; No. 535, Al Schlafli, Colorado Springs Astronomical Society; No. 536, Roland Albers, Tri-Valley Stargazers; No. 537, David M. Douglass, East Valley Astronomy Club; No. 538, Karlis Lubkans, Member-at-Large

Flat Galaxy Observing Program
No. 23, Wyatt Sanford, Honorary, Jackson Astronomical Association

Galaxy Groups & Clusters Observing Program
No. 38-DA, David M. Douglass, East Valley Astronomy Club; No. 39-DA, Denis G. Janky, Seattle Astronomical Society

Globular Cluster Observing Program
No. 264, John R. Sayers, Member-at-Large; No. 265, Debi Wadel, Astronomical Society of Kansas City; No. 266, Nora Jean Chetnik, Member-at-Large; No. 267, Andrew Edelen, Astronomical Association of Southern Illinois; No. 268, Linda Hoffmeister, Olympic Astronomical Society

Herschel 400 Observing Program
No. 517, Eric Steinberg, Phoenix Astronomical Society; No. 518, David E. Cooper, TAC-AL; No. 519, Lynn Chetwynd, Member-at-Large; No. 520, Harold Williams, New Jersey Astronomical Society; No. 521, Nina Chevalier, San Antonio League of Sidewalk Astronomers; No. 522, John R. Benham, Olympic Astronomical Society; No. 523, Keith Kleinstick, Member-at-Large; No. 524, Les Rudy, Member-at-Large; No. 525, Rex L. Kindell, Stillwater Stargazers; No. 526, Paul Scheele, Denver Astronomical Society

Lunar II Observing Program
No. 61, Nora Jean Chetnik, Member-at-Large; No. 62, John Sayers, Member-at-Large; No. 63, Kevin Carr, Member-at-Large

Lunar Observing Program
No. 874, Coy F. Wagoner, Shreveport–Bossier Astronomical Society; No. 875, Stephen Andrews, Kern Astronomical Society; No. 876, Laura Hintz-Keller, Indiana Astronomical Society; No. 877, Stephen A. Tzikas, Northern Virginia Astronomy Club; No. 878, Robert C. Pettengill, Jr., Austin Astronomical Society; No. 879, Rakhal Kincaid, Haleakala Amateur Astronomers; No. 880, Mark Bailey, Member-at-Large; No. 881, Valorie Whalen, Atlanta Astronomy Club; No. 882, Marie Lott, Atlanta Astronomy Club; No. 883, Kevin C. Carr, Member-at-Large; No. 884, David Whalen, Atlanta Astronomy Club; No. 885, Linda Huffman, Member-at-Large; No. 886, Chad Thibodeaux, Baton Rouge Astronomical Society; No. 887, David M. Douglass, East Valley Astronomy Club; No. 888, Jonathan L. Schuchardt, Delaware Valley Amateur Astronomers; No. 889, Richard D. Shoemaker-Moyle, Member-at-Large; No. 890, Scott Azmus, Member-at-Large; No. 891, Bernard Venasse, Member-at-Large; No. 892, Grant Mills, Member-at-Large; No. 893, Zack Stockbridge, Member-at-Large; No. 894, David W. Powell, Member-at-Large; No. 895, Paul Harrington, Member-at-Large; No. 896, Jake Corrigan, Minnesota Astronomical Society; No. 897, Juan Velasquez, Member-at-Large; No. 898, Mike Fowler, Atlanta Astronomy Club; No. 899, Andrew Shapton, Member-at-Large; No. 900, Dan Posey, Austin Astronomical Society; No. 901, David Furry, Southern Colorado Astronomical Society

Master Observer Award
No. 159, William Carney, Twin City Amateur Astronomers; No. 160, Martin Dukeshire, Yakima Astronomical Society; No. 161, Nina Chevalier, San Antonio League of Sidewalk Astronomers; No. 162, Stephen L. Snider, Albuquerque Astronomical Society; No. 163, John R. Sayers, Member-at-Large; No. 164, Rex L. Kindell, Stillwater Stargazers

Messier Observing Program
No. 2668, Raymond B Howard, Honorary, Patron Member; No. 2682, Ben Toman, Regular, Baton Rouge Astronomical Society; No. 2683, Steve Siedentop, Honorary, Atlanta Astronomy Club; No. 2684, Barbara Hanning, Honorary, Rochester Astronomy Club

Meteor Observing Program
No. 168, Nora Jean Chetnik, 24 hours, Member-at-Large; No. 170, Kenneth Larry Jones, 18 hours, Barnard Astronomical Society

NEO Observing Program
No. 5, Scott Donnell, Colorado Springs Astronomical Society

Outreach Observing Award
No. 67-S, W. Maynard Pittendreigh, Member-at-Large; No. 300-S, Kenneth Clayton, Texas Astronomical Society of Dallas; No. 413-M, Joyce Lynch, Austin Astronomical Society; No. 443-M, Cal Powell, Northern Virginia Astronomy Club; No. 445-M, Willie K. Yee, Amateur Observers Society of New York; No. 487-M, Jim Kaminski, Member-at-Large; No. 498-S, Steve Layman, Charlottesville Astronomical Society; No. 500-M, Rob Ratkowski, Haleakala Amateur Astronomers; No. 532-S, John Whisenhunt, San Antonio League of Sidewalk Astronomers; No. 580-S, Larry Martin, Austin Astronomical Society; No. 610-M, Lisa Judd, Denver Astronomical Society; No. 611-O, Katie Raney, Austin Astronomical Society; No. 612-O, James V. Zappa, Member-at-Large; No. 613-O, Matt Lochansky, Raleigh Astronomy Club; No. 614-O, Nancy Rauschenberg, Minnesota Astronomical Society; No. 615-S, Alan Knight, Southern Colorado Astronomical Society; No. 616-O, Trey Anding, Baton Rouge Astronomical Society; No. 617-S, Mark C. DiVecchio, Temecula Valley Astronomers; No. 618-O, Jeff Boggs, Albuquerque Astronomical Society; No. 619-O, Asis Carlos, Albuquerque Astronomical Society; No. 620-O, Scott Lookabill, Central Arkansas Astronomical

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

Society; No. 621-S, Thaddeus LaCoursiere, Albuquerque Astronomical Society; No. 622-O, Anthony Martinez, Albuquerque Astronomical Society; No. 623-O, David Ray, Albuquerque Astronomical Society; No. 624-O, Sonali Deshmukh, Omaha Astronomical Society; No. 625-M, Roger W. Kennedy, Albuquerque Astronomical Society; No. 626-S, Linda P. Kennedy, Albuquerque Astronomical Society; No. 627-S, Paul Kreitz, Temecula Valley Astronomers; No. 628-S, Irais Olvera-Strong, Albuquerque Astronomical Society; No. 629-S, John R. Nagle, Baton Rouge Astronomical Society; No. 630-O, Andy Hasluem, Flint River Astronomy Club; No 631-O, Brendon O'Keeffee, Flint River Astronomy Club; No. 632-O, Bernard Venasse, Member-at-Large

Radio Astronomy Observing Program
No. 1-B, Scott Lookabill, Central Arkansas Astronomical Society

Sky Puppy Observing Program
No. 41, Nora Payne, Northern Virginia Astronomy Club

Southern Skies Dark Nebula Observing Program
No. 19, Cindy Krach, Haleakala Amateur Astronomers

Sunspotters Observing Program
No. 170, Stephen Andrews, Kern Astronomical Society; No. 171, Jim Kaminski, Member-at-Large; No. 172, Jake Hairrell, Minnesota Astronomical Society; No. 173, Richard Loslo, Member-at-Large

Urban Observing Program
No. 159, Bruce Bookout, Colorado Springs Astronomical Society

Correction: In the December 2014 issue, under Open Cluster Observing Program, No. 64, Dr. Terry Trees, Basic, was listed as Member-at-Large. In reality, Mr. Trees is a member of the Amateur Astronomers Association of Pittsburgh.

Attention ALCors

Please watch for the annual dues statements to be emailed in April from our national office, *leagueoffice@astroleague.com*. Payment is due on June 30, 2015.

The League greatly appreciates your support and cooperation!

Up to ten Astronomical League clubs will win a "Library Telescope"

A lucky club in each of the ten regions of the Astronomical League will win an Orion 4.5-inch StarBlast Dobsonian telescope and an accompanying zoom eyepiece so they can participate in the Library Telescope Program. Full details coming in the June *Reflector*. *www.astroleague.org/content/library-telescope-program*

New at League Sales!

Get your solar eclipse glasses for the 2017 Total Eclipse visible across much of the USA—solar safe-viewing glasses suitable for direct viewing of the Sun and solar eclipses. The Astronomical League is offering these in anticipation of the 2017 total eclipse, and with League clubs in mind! The pricing structure will be designed to allow clubs to purchase these glasses at very low rates. Glasses should be available in March. Check the League Sales web store at *www.astroleague.org/store* for pricing, availability, and more info. Discounts will be available for various quantities, starting for as few as 10 and for as many as 1000. Stock up early for all your outreach and viewing events!

Coming Events

Compiled by John Wagoner. To have your star party or event listed, please send the details, including dates, sponsors and website, to *astrowagon@verizon.net.*

March 7
Tri-Star 2015
Guilford Technical Community College, Jamestown, North Carolina
Greensboro Astronomy Club and the Cline Observatory
www.gtcc.edu/observatory/tristar.aspx

March 18–22
Hodges Gardens Star Party
Baton Rouge Astronomical Society, Louisiana
www.brastro.org/hgsp.html

March 19–22
Staunton River Star Party
South Boston, Virginia
www.chaosastro.com/starparty/index.html

March 19–22
Fifteenth Annual Mid-Atlantic Mirror Making Seminar
Delmarva Star Gazers
www.delmarvastargazers.org/archive/mw15/index.html

March 21
All-Arizona Messier Marathon
Salome Emergency Airfield, Arizona
(south of I-10 at Exit 53)
www.saguaroastro.org/content/messier2015.htm

April 9–12
Southern Star Astronomy Convention
Charlotte Amateur Astronomers Club,

Little Switzerland, North Carolina
www.charlotteastronomers.org/southernstar

April 15–18
Mid-South Stargaze
Rainwater Observatory, French Camp, Mississippi
www.rainwaterobservatory.org/rainwater/index.cfm/information/upcoming-events/mid-south-star-gaze

April 16–17
Northeast Astro-Imaging Conference
Rockland Astronomy Club, Suffern, New York
www.rocklandastronomy.com/NEAIC.html

April 16–19
South Jersey Astronomy Club Spring Star Party
Belleplain, New Jersey
www.sjac.us/starparty.html

April 17–24
Twelfth Annual OzSky Star Safari (a.k.a. Deepest South Texas Star Safari)
Coonabarabran, New South Wales, Australia
www.ozsky.org

April 18–19
Northeast Astronomy Forum and Solar Star Party
Rockland Astronomy Club, Suffern, New York
www.rocklandastronomy.com/NEAF/index.html

April 24–25
North Carolina Statewide Star Party
40+ public sky-watching sessions from the North Carolina mountains to the coast
www.ncsciencefestival.org/special-opportunities/starparty

April 25
Astronomy Day
Kern Astronomical Society, William M. Thomas Planetarium, Bakersfield, California
clpowers@bak.rr.com (see ad)

May 10–17
Texas Star Party and AstroLearn Workshop
Prude Ranch, Fort Davis, Texas
www.texasstarparty.org

May 14–17
Two Rivers Spring Star Party
Heaven's Gate Farm, Barry, Illinois
www.freewebs.com/tworiversstarparty

May 15
Southwest Region of the Astronomical League Annual Meeting
Texas Star Party, Prude Ranch, Fort Davis, Texas
www.texasstarparty.org

May 15–17
Tennessee Spring Star Party
Fall Creek Falls State Park, Tennessee
www.cumberlandastronomicalsociety.org

May 15–17
2015 Bootleg Astronomy Star Party
Green River Conservation Area, Harmon, Illinois
www.bootlegastronomy.com

May 21–25
RTMC Astronomy Expo
YMCA Camp Oakes, Big Bear City, California
www.rtmcastronomyexpo.org

May 29–31
MSRAL 2015 Convention
Central Arkansas Astronomical Society
Little Rock, Arkansas
msral2015.caasastro.org

June 11–13
Symposium on Telescope Science
Ontario Airport Hotel, Ontario, California
www.socastrosci.org/symposium.html

June 11–14
Wisconsin Observers' Weekend
Hartman Creek State Park, just west of Waupaca, Wisconsin
www.new-star.org/index.php?option=com_content&view=category&layout=blog&id=38&Itemid=82

June 12–13
Craters of the Moon Star Party
Craters of the Moon National Monument, Arco, Idaho
www.ifastro.org

June 13–20
Grand Canyon Star Party
North Rim, Grand Canyon National Park, Arizona
www.saguaroastro.org/content/2014GrandCanyonStarPartyNorthRim.htm

June 17–20
Green Bank Star Quest 12
National Radio Observatory, Green Bank, West Virginia
www.greenbankstarquest.org

July 6–11
ALCon 2015
Astronomical Society of Las Cruces
Las Cruces, New Mexico
ALCon2015.astroleague.org

July 12–17
Nebraska Star Party
Merritt Reservoir, Valentine, Nebraska
www.nebraskastarparty.org

August 11–16
Oregon Star Party
Indian Trail Spring, Ochoco National Forest, Oregon
www.oregonstarparty.org

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

TITLE PHOTOGRAPH: "CONE NEBULA"; CREDIT: NASA, H. FORD (JHU), G. ILLINGWORTH (UCSC/LO), M. CLAMPIN (STSCI), THE ACS SCIENCE TEAM, AND ESA.

League Sales are online!

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

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

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

Trucker Hat
Printed logo, adjustable, navy only;
$12, plus $5 S&H

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

2100 Baseball Hat
Embroidered logo, adjustable; "Sandwich" bill; Colors: sage w/stone trim, stone w/navy trim, navy w/stone trim;
$20, plus $5 S&H

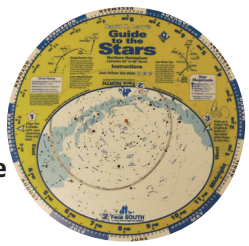
2050 Sportsman Bucket Hat
Embroidered logo, one size; khaki only
$22, plus $5 S&H

Astronomical League travel mug
$10: travel mug plus $1.50 S&H

Astronomical League full color cloth patch (three-inch diameter)
$7 plus $1.05 S&H

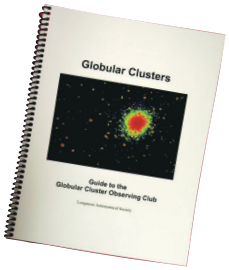
Astronomical League blue and white cloth patch (three-inch diameter)
$6 plus $1.05 S&H

Astronomical League lapel pin (one-inch diameter)
$8 plus $1.20 S&H



"Guide to the Stars" 16" Planisphere
$21 plus $3.15 S&H

Globular Clusters
$14 plus
$2.10 S&H



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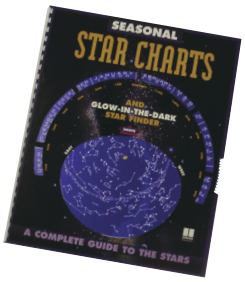

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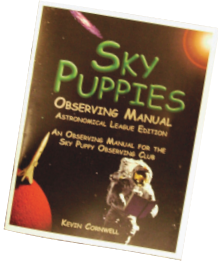

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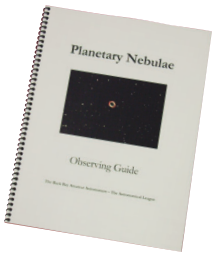

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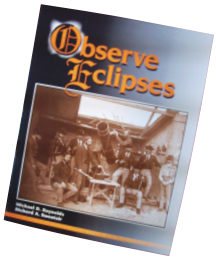

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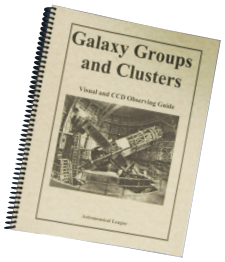

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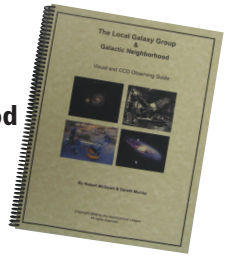

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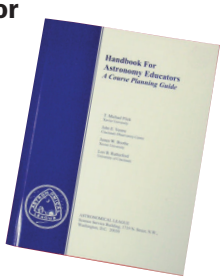

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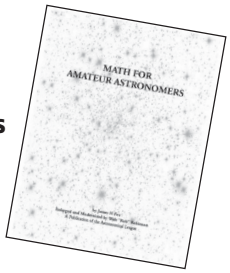

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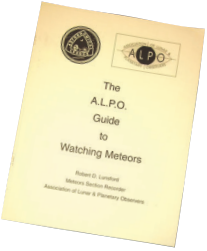

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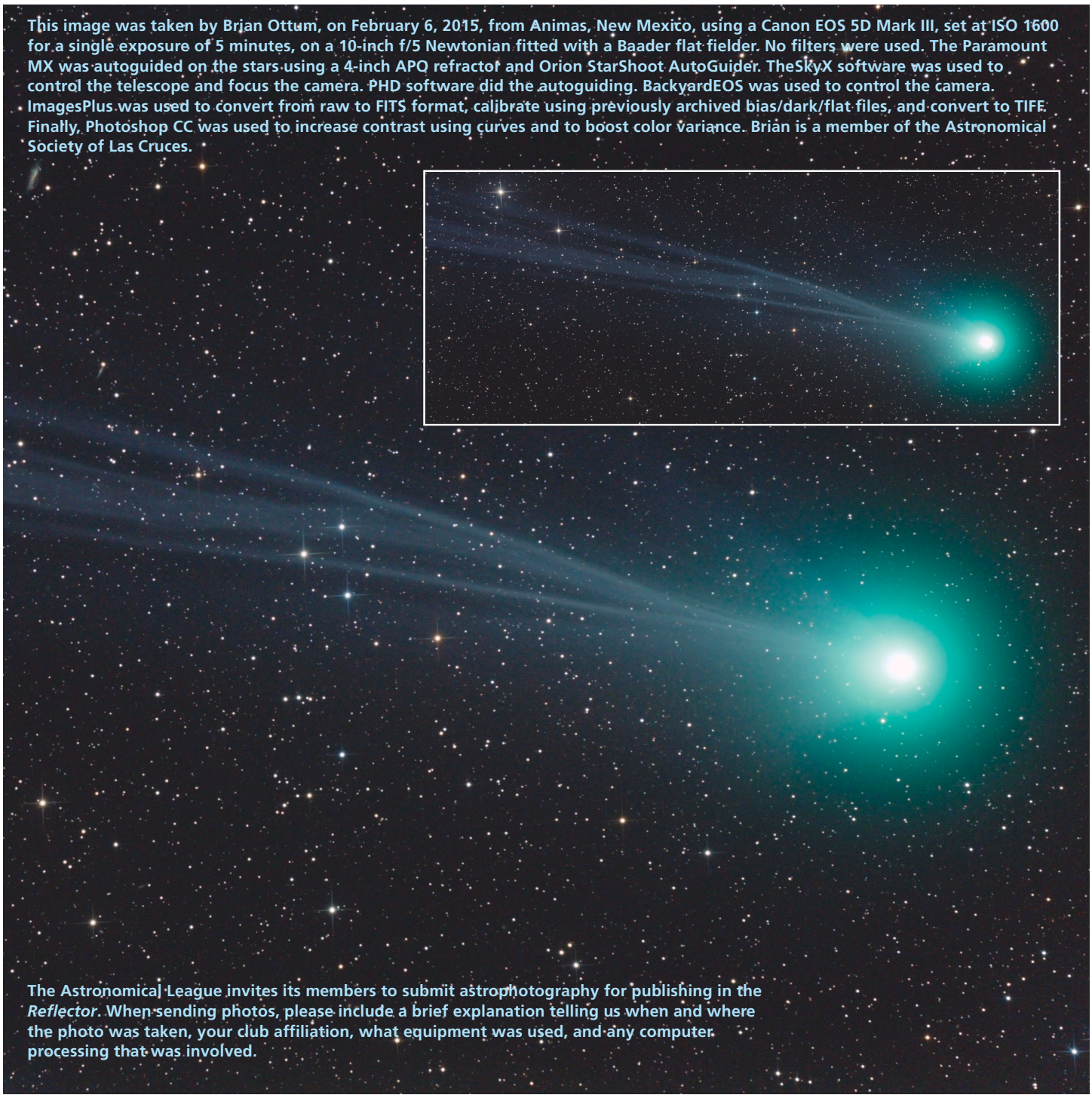

This image was taken by Brian Ottum, on February 6, 2015, from Animas, New Mexico, using a Canon EOS 5D Mark III, set at ISO 1600 for a single exposure of 5 minutes, on a 10-inch f/5 Newtonian fitted with a Baader flat fielder. No filters were used. The Paramount MX was autoguided on the stars using a 4-inch APO refractor and Orion StarShoot AutoGuider. TheSkyX software was used to control the telescope and focus the camera. PHD software did the autoguiding. BackyardEOS was used to control the camera. ImagesPlus was used to convert from raw to FITS format, calibrate using previously archived bias/dark/flat files, and convert to TIFF. Finally, Photoshop CC was used to increase contrast using curves and to boost color variance. Brian is a member of the Astronomical Society of Las Cruces.

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