Imagine Incite: A Few of My Favorite Things

Size of the Sun

ALCon 2018 – Minneapolis

Let the Standing Stones Rise Once Again
Astronomical League National Office: 9201 Ward Parkway, Suite 100, Kansas City, MO 64114

To our contributors: The copy and photo deadlines for the June 2018 issue is April 1. Please send your stories and photos to our managing editor, Ron Kramer (managingeditor@astroleague.org), by then. The Astronomical League invites your comments regarding this magazine. How can we improve it and make it a more valuable resource for you, our members? Please respond to the editor’s email address above.

Bill Neubert (Astronomical Society of Eastern Missouri) took this image of M78 from Buford Mountain Conservation Area using a Stellarvue 80 mm Triplet (reduced to f/4.8—384 mm) with a QSI 683wsg-8 camera. 

To navigate the website www.globeatnight.org, you can use your mobile device or your desktop computer. You can also download the Globe at Night app for Android and iOS devices.

GLOBE AT NIGHT
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Get Out and Observe the Night Sky!
Engage people worldwide in observing the nighttime sky.
Encourage students and families to participate in citizen-science with a hands-on learning activity.
Gather light pollution data from an international perspective to monitor sky brightness and its effects.
Can you see the stars?

2018
January 6 – 15
February 5 – 14
March 8 – 17
April 6 – 15
May 5 – 14
June 4 – 13
July 4 – 13
August 2 – 11
September 1 – 10
October 1 – 10
November 29 – Dec 8

REFLECTOR
The Astronomical League Magazine
Vol. 70, No. 2 • ISSN: 0034-2963 • March 2018

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,
• By assisting communication among amateur astronomical societies.

Astronomical League National Office: 9201 Ward Parkway, Suite 100, Kansas City, MO 64114
We frequently engage concepts and values that, whether we realize it or not, may not understand them, we confront every time we ponder the implications of “Astronomical Numbers.”

The public senses much of this desire, too. How often have you been part of a group gathering, even a simple dinner party, and then found yourself discussing the formation of a ringed world? When talking about the formation of our solar system, the question is always raised, “Who benefits?” Unfortunately, people don’t know what to make of the nature of the Andromeda Galaxy! How many people in the crowd really understood the significance of the incredible numbers we commonly recite during outreach sessions? Quite often, the public sees us as an authority on all things astronomical, trusting our knowledge and wisdom without question. And, indeed, we have just as much of an inner sense of awe as we do. We keep this amazement of our universe contained just below our projected confidence that, even unknowingly, describe the night sky.

1. We want to see the universe for ourselves. We stand poised skyward with our binoculars, telescopes, and cameras. We want to see with our own eyes.

2. We want to share the excitement of the outer world.

3. We want to provide an adequate time period to come to many League activities.

4. We want to support, and provide to our every word. In reality, we have just as much an inner sense of awe as we do. We keep this amazement of our universe contained just below our projected confidence that, even unknowingly, describe the night sky.

5. We want a personal experience. Standing quietly under the celestial expanse, thinking deep thoughts, one final number frequently comes to mind—a number that truly describes the universe.

M13: The vast distance to the Andromeda Galaxy staggers our imagination. It is a 3.5 million-light-year journey from our solar system to the plane of Mars, in the constellation of the Great Bear. This number is a figure always in the back of our minds when we gaze at it. Thus, it is true. If we could put ourselves even further away—say, into a galaxy 100,000 light-years across the diameter of the Milky Way—what would we see? Is this what we do it for? Do we understand the universe?

The impetus for this effort is the egregious use and abuse of stadium lighting which lowers the quality of life for anyone within miles of the source, but the proposed legislation does not only concern itself with stadium lighting. There are numerous examples by the state where business owners and individuals cite their property rights to justify their unearthing use of floodlighting on their property, often in disregard for anyone who might be negatively affected by it. One restaurant in Decatur must close its blinds at night when the car lot next door turns on their security floodlight.

This legislative effort will obviously be opposed by well-funded interests. If anyone within miles of the source, but the proposed legislation does not only concern itself with stadium lighting. There are numerous examples by the state where business owners and individuals cite their property rights to justify their unearthing use of floodlighting on their property, often in disregard for anyone who might be negatively affected by it. One restaurant in Decatur must close its blinds at night when the car lot next door turns on their security floodlight.

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Nighttime outdoor lighting uses a lot of energy, but it is a small player in total electricity use, and it should be designed to minimize light pollution and light trespass.

A study is a struggle to meet electricity demand on hot summer evenings with many air conditioners running. More generating capacity may need to be brought online or more expensive power purchased on the grid. Wasting additional energy on unneeded or poorly designed nighttime lighting is foolish and counterproductive. Energy savings from proper nighttime lighting also helps forestalled needed expansion of local or regional power plants. The same logic may be applied to cold winter nights when there is an unusually small power requirement because of cold temperatures. It is not wise to want to sell electricity and increase their profits.

Power companies surely want to sell electricity, but the electricity marketplace is quite complex and dynamic. The electrical grid in North America is vast and covers large regions. Electricity is frequently generated in one state and quickly sold to another distant state. There is a sophisticated market for buying and selling electricity, shifting it around from one place to another. Let us next on a moment’s notice if needs vary. A region with excess power from nuclear power plant may see some of its power sold at night to a region that requires the power during the day. It is not uncommon for the local power company to own the streetlights in a community and charge them based on their usage, clearly a situation that would discourage energy conservation and reduction of light pollution. The opposite scenario occurs when the community or neighborhood owns the streetlights and pays directly for their energy use and upkeep—then, there is a greater incentive to conserve energy, to turn off unnecessary lights, and to tone-down light pollution and light trespass.

Tim Hunter. Co-founder. BIA Phone: 520-293-3190. Fax: 520-293-3192 Email: tdb@darksky.org

This image illustrates the “multi-messenger” emission from a gigantic reservoir of energy cosmic rays. The extremely high-energy cosmic rays are detected in the IceCube neutrino observatory in Antarctica. The ultra-high-energy cosmic rays and high-energy gamma rays are produced in the magnetized environments that serve as a reservoir of cosmic rays. The high-energy neutrinos and gamma rays are produced in the magnetized environment during their confinement and in the intergalactic space during their propagation. The ultrahigh-energy cosmic rays, high-energy neutrinos, and gamma rays eventually reach the Earth, where they can give us a unified picture of all three cumulative fluxes of the cosmic particles.
Reflections

As I watched the recent launch of the Falcon Heavy and its Tesla payload, my thoughts drifted back to the 1960s when the U.S. and Russian space programs were on the minds of most people around the world. Cumnulating in the first manned lunar landing on July 20, 1969, we were very proud of Neil Armstrong and his crew, as well as the NASA engineers and others who made the landing possible.

To be sure, the past few decades have been filled with exciting space news. From the Hubble Space Telescope and other major space observatories to the ISS, an international collaborative effort of all things astronomical has increased greatly. Spacecraft sent to the outer planets has added to this knowledge and will continue to do so.

But this launch was different. For the first time in nearly 50 years, I really feel we are getting serious about human space travel. Our earlier dreams of walking, once again, on the Moon will soon become a reality. Mars landings, while probably ten years (or longer) down the road, will also happen. Humankind will have finally started exploring our Solar System with people, not just robots. Settlements should not be far behind.

Don’t get me wrong—robots, landers and orbital machines do a great job, but sentinels do incredible results. But there is still something unique about an astronaut picking up a satellite or Mars rock, placing it in a sterilized box, and returning it to Earth, where a complete laboratory analysis can provide many more details than a robotic lab can. That is the day I am looking forward to.

I would appreciate any comments on this subject. Please send them to editor@astroleague.org.

For some down-to-earth subjects.

Check Brecher, responsible for the design and production of the Reflector for the past 14 years, is retiring. Check has done an exceptional job of creating exciting issues of our quarterly magazine, and he will be sorely missed.

Of course, we now need a replacement. Further details of the requirements for this position are in the “From Around the League” section of this issue, but briefly, we need someone with experience in the Adobe suite of programs, with emphasis on InDesign, Photoshop, and Acrobat, on either a PC or Mac platform. Prior publishing knowledge would be an advantage, and a résumé is required.

Please send this information to managingeditor@astroleague.org as soon as possible. Check is traveling through the September issue, and the sooner we can bring someone on board, the sooner the magazine can be spent in the transfer of knowledge.

A MEMBER BENEFIT FROM McDONALD OBSERVATORY

Sterling, the monthly publication of the nonprofit McDonald Observatory, is offering our members a 25% discount. Their magazine provides easy-to-read articles on the latest astronomy research, breakthroughs, the history of astronomy, and many other topics. Sterling also offers subscriptions for each month, an e-calendar, and Merline’s answers to reader questions. The discounted rate is $19.95 for continental USA, $22 for Canada, and $30 to other foreign countries. Members of large social groups should send their check (payable to the Astro League) to:

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For personal use, the operating person in each club should gather the subscriptions, and send the appropriate amount to Sterling Magazine, c/o Paul Crifasi, 4601 Mark Rose Blvd., Austin, TX 78745.

You can read more about Sterling at www.sterling.org. If you have any questions, please contact the League’s National Office at leaguesoffices@astroleague.org.

M. Craig O’Conor, Editor

Deep-Sky Objects

Two Globes in Berenice’s Hair

James R. Dircs

Kauai Educational Association for Science and Astronomy

The constellation Cuma Berenices (Berenice’s Hair) dates back to the third century B.C., when Ptolemy III Euergetes ruled Egypt. His wife, Berenice, queen of Cyrene, was proud of her hair and vowed to sacrifice it if Ptolemy III was successful in battle against the Assyrians. Her hair disappeared from Aphrodite’s temple, where she had placed it. The Greek astronomer Conon of Samos explained that Aphrodite had placed Berenice’s hair among the stars, thus the constellation Cuma Berenices came into existence. Cuma Berenices is a small, northerly constellation lying between Ursa Major and Leo. Located away from the plane of the Milky Way galaxy, this faint constellation has no stars brighter than magnitude 10.5, and is thus the constellation Coma Berenices contains two globular clusters brighter than magnitude 10. They are known as M53 and NGC 5053. They are two of the east-west direction of objects to find in the constellation. M53 can be found in the degree northeast of the star Alpha Comae Berenices, while NGC 5053 is one and a half degrees due south of M53. Normally, Alpha is the brightest star in a constellation, with Beta the second brightest. In Cuma Berenices, Alpha and Beta are too close in brightness to be differentiated from each other. However, photometry has determined that Beta is slightly brighter. Alonzo Ebertt described M53 on February 3, 1775. Charles Messier rediscovered it two years later and added it to his catalog. Both Ebertt and Messier described it as a nebulous object. William Herschel was the first to resolve it into stars.

M53 is one of the most distant globular clusters in our galaxy. It lies 60,000 light-years from the galactic center and 58,000 light-years away from Earth. It has a total luminosity equivalent to 200,000 suns. Visually, M53 has fairly even brightness throughout its 13.5-arcminute diameter. Its brightest star, a red giant, is magnitude 13.8. The integrated magnitude of the cluster is 7.6, easily within the reach of binoculars. However, an 8-inch or larger telescope is required to resolve it into countless stars.

NGC 5053 is a very loose globular star cluster located one degree southeast of M53. The cluster is magnitude 9.5. The cluster is oval shaped with its longest dimension in the east–west direction, extending 13.7 arcminutes. NGC 5053 is located at approximately the same distance as M53, which means these two globular star clusters are actually seen each other in the galactic halo. NGC 5053 does not have a densly packed core like M53, so for a long time, astronomers did not classify it as a globular cluster. However, spectroscopic studies of the cluster confirm its true nature. William Herschel discovered NGC 5053 in 1784. The accompanying image of the two clusters was taken with a 70 mm f/4 apochromatic refractor with a focal reducer and field flattener using an SBIG ST7-R CCD camera. The exposure was 5 minutes. North is up and the image is oriented left to right. The image spans three degrees from left to right. The brightest star is Alpha Comae Berenices, while NGC 5053 nicely forms a triangle with M53, which is centered in the image. All three can be spied with small telescopes or even with a high-power, wide-angle eyepiece. The closest object to the trio is a beautiful chain of yellow and orange stars all between 6th and 7th magnitude. The chain is named for the late astronomer Charles Messier and extends from northeast to southwest.

The most recent image with the yellow border is a higher-resolution shot of M53 taken with an 8-inch f/6 Ritchey–Chrétien telescope using an SBIG STF-2000MC CCD camera with a 40-minute exposure. In the image, note a great pair of stars just above M53, one rod red and the other blue-white. These stars are magnitudes 9 and 10, respectively. While Cuma Berenices is not outstanding in its myriad galaxies, when viewing the constellation this spring, don’t pass up its splendid colorful stars and globular star clusters!
every day, the Sun appears in our sky and, with a proper solar filter to protect the eyes, it appears perfectly round. the edges of the Sun’s disk appear sharp and clearly defined. at a distance of 93 million miles, small deviations from its perfection are only barely visible.

the Sun is composed of gas, mostly hydrogen and helium. its temperature is so high that some or all of the electrons orbiting the atoms are stripped away, making them positively charged ions. as ions, they can be influenced by magnetic fields, whereas neutral atoms are insensitive to these fields. when the ions move, as do they constantly, they produce their own magnetic fields. this ionized gas is called plasma.

near the visible surface, heat from the Sun’s core is transferred upward by convection. the hotter plasma deeper in the Sun is less dense than the surrounding cooler plasma. this gives a hotter plasma cell added buoyancy that lifts it upward, though it may be more accurate to say that the cooler plasma surrounding it pushes it toward the surface. there, it bubbles up above the surface, appearing as granulation. the hotter center of the granule is surrounded by cooler plasma that is sinking back into the Sun. these granules can last up to seven minutes before cooling off and dropping back below the surface. this makes the Sun’s surface lumpy and not smooth.

to further complicate matters, if you look at the Sun with a hydrogen-alpha filter, prominences and spicules on the limb are readily visible. while spicules look tiny, these tubes of magnetic force transport solar plasma at up to 60 miles per second and they can be up to six thousand miles long, three-quarters the diameter of the Earth. with thousands of spicules punctuating the limb of the Sun, the Sun’s surface is even harder to define.

the Earth’s atmosphere begins at the Earth’s hard, rocky surface. a gas ball like the Sun does not have a hard surface. however, deep in the Sun, photons cannot travel very far before being absorbed. this prevents us from seeing the inside of the Sun. at the visible surface of the Sun, the energy is transported by convection, with hot plasma bubbling up to the Sun’s surface. above that, the energy is transported by radiation upward through the radiative zone.

as the Sun’s core where all the nuclear fusion occurs, energy from the core is transported by radiation upward through the radiative zone.

Inside the dark lanes, small white spots with intense magnetic fields provide a window into the interior of the Sun. Granulation is visible in amateur telescopes, during periods of good seeing. For scale, the white bar at the lower left corresponds to 3,107 miles across. this narrowband image was taken in september 2007 using the Swedish solar telescope at la palma, canary islands, Spain.

the hybrid eclipse of november 3, 2013, was total near the middle of the eclipse path and annular at the ends where the Moon was farther away and hence smaller. even near the middle of the path, the Sun and Moon were both almost the same size. the Moon covers all of the photosphere, but leaves the chromosphere visible. this image by alson wong taken in Uganda shows the last arc of the photosphere disappearing at second contact while the chromosphere remains visible around the entire eastern limb of the Moon.

the corona extends out into the solar system in the form of the solar wind that induces auroras on many of the planets, including the Earth.

while we think of the Sun as a stable star, we have only known it over a short interval in its long life. life on the Earth depends on the Sun having a stable energy output. if it starts emitting just a little more energy, the Earth may warm too much for human kind to survive. a similar result would occur if it cooled. we have already had an era when the Earth cooled slightly, from the 16th to the 19th centuries, called the little ice age. the cause of the cooling is still a topic of great debate.

however, the Maunder Minimum (1645–1715) occurred in the middle of the little Ice Age. During the Maunder Minimum, almost no spots appeared in the Sun's photosphere, but a good number of sunspots have already had an era when the Earth cooled slightly, from the 16th to the 19th centuries, called the little ice age. the cause of the cooling is still a topic of great debate.

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Continued on page 26

Gloves of the Solar System . . . and Beyond!

Celestial Globe

Sky & Telescope’s Celestial Globe is a state-of-the-art representation of the entire celestial sphere. this 12-inch sphere is the clearest and most comprehensive portrayal of the night sky available in globe form that uses 3D’s unique constellation patterns with an “inside-out” perspective that matches what you see in the sky.

Mars Globe

Even the Hubble Space Telescope can’t show you all the details found on this updated edition of our classic Mars globe. Created from more than 6,000 images taken by the Viking orbiters, our 12-inch globe approximates the planet’s true color. produced in cooperation with NASA and the U.S. Geological Survey, the globe includes official names for 140 features.

Moon Globe

A beautifully and accurately globe of the Moon. Unlike previous Moon globes based on artistic renderings, this globe is a mosaic of digital photos taken at high resolution by the Lunar Reconnaissance Orbiter. the globe shows the Moon’s surface in glorious detail, and how the nearside actually appears when viewed through a telescope.

Mercury Globe

To create this dramatic portrayal, the editors of Sky & Telescope worked with scientists on NASA’s Messenger mission to produce the globe’s custom base map. Special image processing has preserved the natural light and dark shading of Mercury’s surface while allowing the labels to stand out clearly. the names of more than 350 craters and other features are shown.

888-253-0230 shopsky.com
As I battled my way back to the refuge of my waiting SUV, I was caught off balance by a gust of wind in the icy terrain and tumbled into the ground unexpectedly like a bag of potatoes tossed into the bed of a flatbed truck. I must have been an amusing sight, rolling around like an oversized snowball in my bulky garb. Strangely, even under the circumstance, I still found humor in the situation. I chuckled to myself; I could see the headlines now: "Local researcher found frozen 50 feet from moving vehicle. Creature looks like snowball due to accidental deviation into abnormally high amount of poor planning."

The snow that had fallen earlier in the season had melted and refrozen, forming tiny solid ice crystals now resembling small shards of broken glass. As the sun began to illuminate the stands, a figure with black, rotting fingers came to mind.

The standing stones in the circle are a circle of smaller river rocks. This formed the observation gallery where the solstices and equinoxes are marked on the circle. Enclosed by the standing stones would rise from the earth. In time, standing stones would rise from the earth. They had come to the right place. In time, standing stones would rise from the earth. What I can assure you is that all astronomical observations were made with the naked eye and their locations were noted with temporary markers until the permanent standing stones could be erected. Distances were measured using a simple tape measure and roll of twine. This calendar had an accuracy as it should have been used in recent times. No, certainly not, but in its simplicity and flaws its function was perfect.

I had dressed for the freezing, subarctic conditions of the high plains of the Heavenly Cities. Spring Always. As the architect, I would see to that, but I'm not going to mislead you—I was lost in the mist of my reverie. I headed now to renovate at least one of them to take photographs. This perhaps wasn't the best of ideas considering the temperature was well below zero gusting to 25 miles per hour. I had succeeded at capturing the standing stone calendar site before sunrise. To make astronomical observations, I had neglected to bring the proper gloves to operate the camera for miliarizing cold. While my heavily insulated mittens would provide heat, I now new needed to renovate at least one of them to take photographs. This perhaps wasn't the best of ideas considering the temperature was well below zero gusting to 25 miles per hour.

As my enthusiasm for the impending project grew, my mind raced ahead to computer-generated models with animations of the Sun sweeping across the sky in the winter solstice and the placement of stones with laser precision. As a retired engineer, I could not help myself—I was lost in the mist of technology, enchanced by the stars' all of handheld devices, and mesmerized by a seemingly endless number of easy-to-use applications. I realized to my iPad and downloaded an app to turn my device into the perfect way to get my invention back in working order. I had succeeded at capturing the moment in time with my camera and marked the rising Sun's location on the calendar with a grapefruit-sized stone, but what price would I pay for my stupidity?

Let the Standing Stones Once Again

By Russ Ergenbright

The ancient astronomers from the British Isles who perhaps had stood before a standing stone calendar much like the one I was considering building. Who were these people and how did they live? What mystery did they create around what they were seeing in the sky? Only their stones remain to answer my questions. As the first rays of sunlight illuminated the circle and my shadow stretched out across the field, I knew in an instant that I had come to the right place. In time, standing stones would rise from the earth. Those who would visit here would have the opportunity, in some small way, to touch the distant past. On that morning, I

The goal of the Southern Colorado Astronomical Society, SCAS, is to help each other, our members of our community, and anyone interested, gain a better understanding of the universe we live in. What better way could there be than to call upon the Southern Colorado Astronomical Society at the闱 at the University of Minnesota. For more information, contact Russ Ergenbright with the Southern Colorado Astronomical Society at ergenbright@gmail.com
Tell a child of a planet with rings and they imagine it's wonder. Show a child of a planet with rings and they imagine it's wonder. Astronomy is such a great hobby. I've enjoyed it all my life. But it really came alive to me one evening when someone got their first glimpse of the Moon, or Saturn, or the Orion Nebula, through a telescope, exclaim in delight and then the gratifying reward is a gasp of wonder."

"I saw Saturn—I saw the rings as the disks around a planet for the first time. I was so excited and so thrilled. I had never seen anything like it before."

"When someone gets their first glimpses of the Moon, or Saturn, or the Orion Nebula, that's a moment that they will never forget."

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Starlight touches us. Each time I view an object through my telescope I feel a connection with what I’ve seen. And literally, there is. Light from astronomical bodies has traveled between 1.29 seconds and 12.9 billion years to enter my eye. A physical interaction produces changes in my eye and brain that allow perception in both a concrete sense, and an abstract, emotive way. The essence of travel is to experience something of historic or cultural value not available without going there. As observers, this process is reversed, and the light comes to us. Most who have journeyed to the Grand Canyon, the Great Wall of China, the Mona Lisa, or Henri Matisse’s Garden of Cimiez will agree the experience of physical proximity inspires and produces connections of more lasting significance than we were to just see through their pictures. The French artist Henri Matisse worked in the first half of the twentieth century, and was both “very accessible and surprisingly complex” for his balanced treatment of form and subject. His book, Matisse in the Cone Collection. The Portraits of Ixion, Flam explains that the artist confronted the world before his eyes, what he could visually perceive, with questions of how to extract meaning. Amateur and professional astronomers make similar attempts in viewing groundbreaking objects and images, such as those of the Hubble Deep Fields, galaxies on Enceladus, or gravitational arcs surrounding rich clusters of galaxies. Flam derives his title from the way Matisse “rein- vented what he saw as part of the process of trying to perceive and record in a meaningful way the poetics of vision.” The “aproposité” connection between form and visual receptor was not unperturbed.

I spent over a decade researching and attempting to observe certain types of astronomical objects to establish such a personal connection, including brown dwarfs and gravitational arcs, with many failures along the way. My non-astronomical friends misread this determination as a type of unrepressed obsession not appreciating the thrill and significance of seeing one of the first to see something with our own eye. Those who have gazed upon some of the most beautiful objects visible to us likely agree. In 1978, this theory was recon- firmed by the discovery of the first gravitational lens, quasar Q0957+561 in Ursa Major. Its two images, of magnitudes 16.5 and 16.7, split by 32 arcseconds apart. The details can be appreciated in a 16-inch telescope under good conditions, but what is seen are modest aperture tele- scopes. After the Hubble Space Telescope was placed in orbit in the mid-1990s that these celestial beacons were the cores of galaxies embedded near detail in a few examples. Several of their sur- rounding galaxies, called quasar “quasars,” were visible in my 25-inch reflector. The par 32 of 327. Through the view of almost all these cosmic lighthouses appear stellar, with careful study using reveal details. Einstein predicted in 1915 that the gravity of massive objects could lens light, and, in 1919, using the precessions of the planets in the solar system, using calculations estimated the Earth’s deflection angle of rays of light from the Sun. I know the history of this object, with its conception and discovery, is what greatly enhances its view in the telescope.

For the next quarter century all seventy or so lensed quasars discovered were contained within the same category: dark matter theories, and the authors suggested following up to do dedicated searches for lensed arcs surrounding the galaxy cluster to further test the models. They also predicted similar lenses were lurking within the SDSS data. Searching for new objects and types of objects to observe within the popular and professional journals, I came across SDSS J1004+1122 in 2004 and placed it on my list to view from a dark site. Though possible to observe from my home, I felt it better to try for this 15 magnitude object from the dry mountain skies of west Texas. During the 2005 Texas Star Party, using my 25-inch f/6 reflector, I was able to spot the A and C components. With my 32-inch f/4 the original quasar, I would likely be visible, including the faintest, D, at magnitude 20.

Ongoing interest in this system sparked further imaging using Hubble and other large instru- ments. In 2007, the finding correlated to the slight offset of the other four lenses reported in the discovery paper. SDSS J1004+1122 enhanced the circumferential infrared arcs extending from the original lensed image. Very close examination of the deep ACS exposures showed myriad faint, short arcs rubbing, the cluster, testament to the tremendous gravity subverting the architectural integrity of the obvious light splitting, and height- ening us about dark, dark matters. Careful inspection of Hubble images revealed it a lensed galaxy arc at the cluster’s core.

Layers of galaxies appear at various depths, those nearer to us than the cluster and those behind it. The overall shape show disruption from “ram stripping” as they blow through the dense intracluster medium. Forced to form numerous the Large galaxy cluster, they are aging prematurely. The “strong” lensing of large clusters is a rare treat. Stretched images of background galaxies stream around the cluster, accompanied by the visually stunning “weak” gravitational lensing. 

Imagine Inc.

The separation record, but in the seeing did not allow it to happen. All six components were seen within the 32-inch scope, but the seeing was much too poor to be able to observe both a lensed quasar and galaxy arc within the same cluster. Observing such things within images both beautiful and important allow these apices of discovery to offer poetry and meaning to our vision.
A cropped photo of 61 Cygni taken using my 120 mm f/7.5 reflector (exposure time 20 seconds at ISO 800). Immediately adjacent to the upper star 61 Cygni A is the 10.7 magnitude star TYC-3168-590-1, which is a convenient point of reference for measuring the motion of 61 Cygni.

Although its motion is extremely large in comparison to other stars, over the course of a year or more it is still small by visual standards—but tracking the movement of this pair from year to year is a fun and rewarding exercise. Measurements of this order of magnitude are routinely made by double star observers using an illuminated reticle eyepiece, which shows a calibrated ruled scale against the visual magnified image. Due to 61 Cygni’s proximity to the 10.7-magnitude star TYC-3168-590-1 it is a simple matter to measure its separation from this star year-to-year using a reticle eyepiece. Its current separation from this star is approximately 25 arcseconds and will be increasing by 5.2 arcseconds per year. Should you wish to position more precisely, simply take measurements from one or more additional background stars and triangulate its position on a photocopy of a star chart enlarged to a suitable scale.

Photography is the best way to note and record 61 Cygni’s movement over time and has the advantage of preserving a permanent record of its travels. You could take a digital photo that makes it a relatively easy photographic subject. If you attempt to photograph it, you may find that it is extremely large in comparison to any telescope, but to an even the lowest magnifications. Many double-star enthusiasts feel that the lower power that enables you to get a clean split system the most pleasing view.

This nuddy orange-red pair stands out against the stellar background and is a beautiful sight to the scope of any aperture and focal ratio. Its dual nature is evident in even the lowest magnifications. Many double-star enthusiasts feel that the lower power that enables you to get a clean split system the most pleasing view. As you can see in the above image, it is a truly beautiful sight to the scope of any aperture and focal ratio.

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will notice that 61 Cygni has three icons associated with it: for each individual star of the pair and a central icon that gives the combined magnitude for the pair. If you click the star identifier under “Main ID” in the lower information bar, a new window will open displaying the full SIMBAD data page for that star.

Since we are interested in the proper motions, Aladin can display proper motion vectors for the cataloged stars. Start with a clean screen displaying only the DSS photo of 61 Cygni, and then select the SIMBAD catalog. Once the SIMBAD catalog has loaded, select “Filter” from the right-side menu, which will bring up a new window. Select “Draw proper motions of stars” and click “Apply.” Zoom out a bit and you should see several proper motion vectors (arrows) displayed for many of the stars. Each vector points in its star’s direction of motion; the length of the vector is proportional to its rate of movement. As you can see, the motion of 61 Cygni far outstrips that of any other star in the field of view.

Another feature is the epoch slider located just below the image stack. With the SIMBAD layer selected, this slider allows you to look at the position of the star forward or backward in time (the epoch). I have set the slider in the image to 1756, near the time of 61 Cygni’s discovery, and you can see from this point of origin how far it has moved in the intervening years.

Now that you are somewhat familiar with a few of the capabilities of Aladin, we are ready to load our photo into Aladin. From the “Files” menu choose “Open local file” and select your plate-solved photo. The photo will be loaded as an additional layer and a selection of coordinates is displayed. You can then adjust the visibility slider for your photo to obtain an image similar to the one on page 19. Zooming in on 61 Cygni, the image of 61 Cygni is significantly displaced. You can position the cursor to obtain its current celestial coordinates as well as use the distance tool to measure its movement.

One problem with using the DSS photos is that the images were taken over a considerable timespan, so it is not possible to precisely associate a time with many of them. However, Aladin has many other images in its database with specific dates. To retrieve other cataloged images, first click on the location of 61 Cygni to load its coordinates into the image header, and then click on the file folder icon on the left side of the top menu bar which will open the “Aladin Image Server” window. Choose “Aladin Images” from the left-hand menu and a selection of images that cover the target coordinates are listed. I have chosen a J-band (near-infrared) image covering 13 by 13 arcminutes that was taken on September 6, 1989. When you click “Submit,” it will be loaded onto the image stack. Delete or inactive the DSS image so that only your photo and the new J-band photo are displayed. Using the layer sliders and the pixel menu you can adjust the contrast to suit your needs. Using the “dist” tool we can then measure the distance from the September 1989 image to my September 2016 image, which comes out to 2.282 arcminutes. If we do the math, 2.282 arcminutes (139.52 arcseconds) in 27 years equals 5.07 arcseconds per year, which is close to the catalog value of 5.33 arcseconds per year.

This little exercise with 61 Cygni shows that by using these readily available tools and simple techniques we can track and measure the movements of high-proper-motion stars. These tools can also be applied to tracking or identifying other celestial objects such as Pluto and the outer planets, asteroids, and even comets and can illustrate just how dynamic the seemingly static sky is really is.


Steve is a proud member of the Denver Astronomical Society.
answer, “I’ll know when I get there.”

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

I decided a few years ago that it was time to give back to the League. I became the coordinator of the Outreach Award Program in 2015. I also coordinate the Sky Puppies and Beyond Polaris programs.

I would like to be of greater service to the League and I offer myself as a nominee for office. I have served as an officer in several organizations and offer skills in administration and public speaking. My greatest asset to offer the League is my passion for our organization and our hobby.

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

Some say astronomy is a dying hobby, that youth have little to no interest, and meaningful discoveries or research can only be done at the university level, or by amateurs with very deep pockets. I disagree.

We frequently read about amateurs who have discovered exoplanets and new nebulae, who work in pro–am cooperative programs and perform significant research. Many of these amateurs are members of your League.

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

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

The Astronomical League/OPT Imaging Awards

Oceanside Photo and Telescope has always been a good friend to amateur astronomy and to the Astronomical League. They have now generously agreed to sponsor a new AL award program, the OPT Imaging Awards.

This year the AL will recognize the efforts of imagers with a program where they can submit their best work in four separate categories:

1. Solar System (such as the Moon, Sun, planets, and comets);
2. Deep-sky (such as open clusters, globular clusters, nebulae, and galaxies);
3. Wide-field (such as constellations, the Milky Way, planetary groupings, aurorae, and meteors); and
4. Video or time-lapse imaging showing movement in the heavens.

Each of the four categories will have a first, second, and third place award. Each first place winner will receive a $250 gift certificate from OPT, second place a $125 gift certificate, and third place a $75 gift certificate.

Please see www.astroleague.org/awards/OPT-Imaging-Awards-Program for complete details of this wonderful program.

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

The Astronomical League’s Astronomics Sketching Award

Sketching is the imitation of a celestial scene allows an observer to see more detail and to better enjoy our amazing avocation. Why not try your hand at sketching tonight?

The Astronomical League offers an award program for sketchers: the Astronomics Sketching Award. First place sketcher receives a cash prize of $250, second place $125, and third place $75.

For all the exciting details, please visit the Astronomical League awards page, www.astroleague.org/al/awards/awards.html.

This program is made possible through the vision and generosity of Astronomics!

Astronomical League Webmaster Award

The Astronomical League’s Webmaster Award acknowledges the club webmaster who does an outstanding job of website design and administration.

• The webmaster of any astronomy club that is a current member of the Astronomical League is eligible.

• The website will be judged on its content, ease of navigation, and ability to attract people.

• Club presidents, please send webmaster nominations and the club’s website address no later than April 1 to WebmasterAward@astroleague.org.

The Astronomical League is giving away up to eleven Library Telescopes!

Through the vision of the Horkheimer Charitable Fund, the Astronomical League is again offering a free Library Telescope to a lucky Astronomical League club in each of the ten AL regions. This year a new category is launched, one for members-at-large! Full details of this wonderful program can be found at www.astroleague.org/content/library-telescope-program.

Celestial Savings Program—Your Discount Purchasing Program

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

Questions? Write to the Celestial Savings Director at celestialsavings@astroleague.org. For more information, see www.astroleague.org/content/celestial-savings-program—your-discount-purchasing-program.

Volunteer to be the Chair of the Astronomical League Webmaster Award!

The Astronomical League is seeking a qualified individual who would like to chair the Webmaster Award. Duties for this position include: placing announcements in the Reflector and in social media, assembling a team of judges, collecting the nominations, reviewing the eligibility of the nominees, sending the nomination materials to the judges, tallying the results, notifying the winner, writing a brief announcement for the Reflector and social media, and ordering and mailing the award plaque.

This is your chance to help the Astronomical League help amateur astronomy by recognizing some of those individuals who make astronomy happen. Interested? Please contact either AL president John Goss, president@astroleague.org, or vice president Bill Bogardus, vicepresident@astroleague.org.

2017 Astronomy Day Report
By Gary Tomlinson, Astronomy Day Coordinator

Every year since 1973, hundreds of locations across the globe celebrate and educate the public about astronomy. The year 2017 marked the 45th such celebration, and as we head towards the 50th Astronomy Day, here is what you can do:

• Start planning for 2018 (April 21 and October 13, 2018).

• Download the Astronomy Day Handbook from the League’s website (www.astroleague.org).

• Enter the 2018 Astronomy Day Award (due June 13, 2018; Fall Astronomy Day events enter the next year’s award).

The Astronomy Day Handbook was recently updated due in large part to League members Maynard Pittendrigh, Al Lamperti, and Bryan Tobias, as well as Sky & Telescope’s senior editor J. Kelly Beatty. The 76-page Handbook is chock full of helpful ideas and suggestions for hosting successful Astronomy Day events. If you think your club is too small, think again. One of last year’s winning events was organized by one individual who persuaded his friends and students to staff the event, which was held on the sidewalk outside an amusement park.

Budgets for Astronomy Day events range from zero to thousands of dollars. The Kalamazoo Astronomical Society received a grant to fund speakers on the eclipse, like Fred Espenak and Jay Anderson. These wonderful presentations took place within an hour’s drive from me; unfortunately, I was out of state at the time. And at a small museum in Connecticut, fifth-grade students staffed Astronomy Day displays on their rainy-day event.

So clubs big and small can hold events utilizing the resources in their own backyard. “Bring Astronomy to the People.” The Astronomy Day Award winners for 2017 are:

Best Event by Population Category:

• Dhiren Mesthvaniya, India (large)

• Kalamazoo Astronomical Society (medium)

• Travelers Science Dome at the Gangras Planetarym (small)

Best New Idea:

• Travelers Science Dome at the Gangras Planetarym (involve fifth-grade students as student experts)

FROM AROUND THE LEAGUE

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What's new on the League's Facebook page?

How about two downloadable guides to help you enjoy the night sky?
1. "Navigating the Night Sky," a brief, monthly tour of the heavens he may gasp and exhibit a toothy grin because of the occasional brilliant meteor he may observe during his life.
2. "If you can see one celestial event this month, a discussion of a fascinating event that is occurring!"

These materials make great outreach handouts and beginning celestial guides for club newsletters.

Want to join the staff of the Reflectors magazine?
We have a great opportunity for the right person. Our design and production manager, Chuck Beucher, has decided to resign after 14 years of designing, and producing our quarterly magazine. September will be his last issue and we need a qualified person to take his place. Experience with Adobe InDesign or PageMaker, Illustrator, and Photoshop, on Apple or PC, is required. Must be able to work with and produce files for a commercial web offset printer.

We would prefer to bring the candidate on immediately, so she or he can work with Chuck over the next two issues to gain valuable experience. Please contact managingeditor@astroleague.org with your résumé. Please submit samples of your prior work, if available.

League Observing Programs and Awards

Comet Observer’s Club

In observing the wonders of the universe, there are perhaps no more wondrous and beautiful objects as comets. Since the invention of the telescope hundreds of years ago, astronomers have continually searched for new comets, and in the process, have discovered novae, supernovae, galaxies and more. Comets are important members of our solar system, and their study is important to mankind. We hope you enjoy your quest!

Full STEAM Ahead

By Peggy Walker

The Minnesota Astronomical League is excited to announce its new grant program to help stop the graying of amateur astronomy. An Honorary certificate and lapel pin are given to amateur astronomy club members who complete 10,000 observations. Let’s all help them achieve their goal of over 15,000 data points!”

In the last ten years, the program has expanded, providing observation opportunities for all twelve counties of the state. Participating is easy and is a great way to build your observation skills.

The Messier Program has a first-level certificate after observing 70 of the Messier objects. An Honorary certificate and lapel pin are given when the full catalog has been observed.
sunspots were observed, and when a sunspot did appear, it generated many scientific papers. A sensitive indicator of the energy output of the Sun is its diameter, since the diameter of a star is related to its energy output—the larger a star’s diameter, the more energy it emits. The equatorial diameter of the Sun is 865,278 miles, while its polar diameter is 865,271 miles. This makes it the roundest object in the Solar System, thanks to its tremendous gravity and relatively slow rotational period of 25 to 35 days, depending on latitude. Curiously, the surface of the Sun not only varies due to its rotation, but also due to local magnetic fields near the surface that can lift or depress it.

Computing the Sun’s actual diameter can be done once the angular diameter once the distance to the Sun is known. The first attempt at measuring the Sun’s diameter was performed by Greek mathematician Eratosthenes (276–194 BCE), who first measured the circumference of the Earth using geometry, but the distance to the Moon by (310–230 BCE) was able to measure the Earth’s diameter using total solar eclipses. If the diameter of the Sun should change, the times of the Earth’s shadow and the limits of totality will also change. A bigger Sun will shrink the path width, while a smaller Sun will enlarge it. The path width can be a very sensitive measure of the Sun’s diameter that can be made from here on Earth during an eclipse. At the beginning and end of totality, Bailey’s beads form as the bright solar photosphere shines through valleys on the lunar edge. Lunar-observing spacecraft have produced very accurate maps of the heights and depths of the lunar limb that can be used to predict exactly where Bailey’s beads will occur. Conversely, observations of Bailey’s beads can be used to compute the exact location of the totality limit line. Observations are made from just inside the predicted limit line using a telescope, GPS time inserter, and a video recorder. A GPS time inserter adds the precise time that a video frame is recorded based on the GPS time standard. A display showing the exact time it is added at the bottom of the frame. If a time inserter is unavailable, recording a shortwave time signal such as WWV or WWWh will suffice.

IOTA’s eclipse edge observations have indicated that the solar radius was 0.4 arcseconds smaller in 1979 than in the total solar eclipse of 1975. A solar eclipse in Rome, Italy, on April 9, 1967, should have been total, but Jesuit astronomer Christopher Davies reported as annular, pointing to the possibility that the Sun was even bigger then. If you would like to join this effort, the United States will see another total solar eclipse crossing the eastern half of the country, from Texas to New England, in 2024. This would be a perfect opportunity to contribute your observations to this important project. For more information on how to make these observations, see the IOTA Eclipse 2017 website (occultations.org/eclipse2017) and chapter 11 in the free IOTA Observer’s Manual (www.pointandzoom.com/ IOTAManual/Preview.html).
CAROLINA "Space Books. She is also an avid amateur astronomer.

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