The ECLIPSE

The Newsletter of the Barnard-Seyfert Astronomical Society

June 2022

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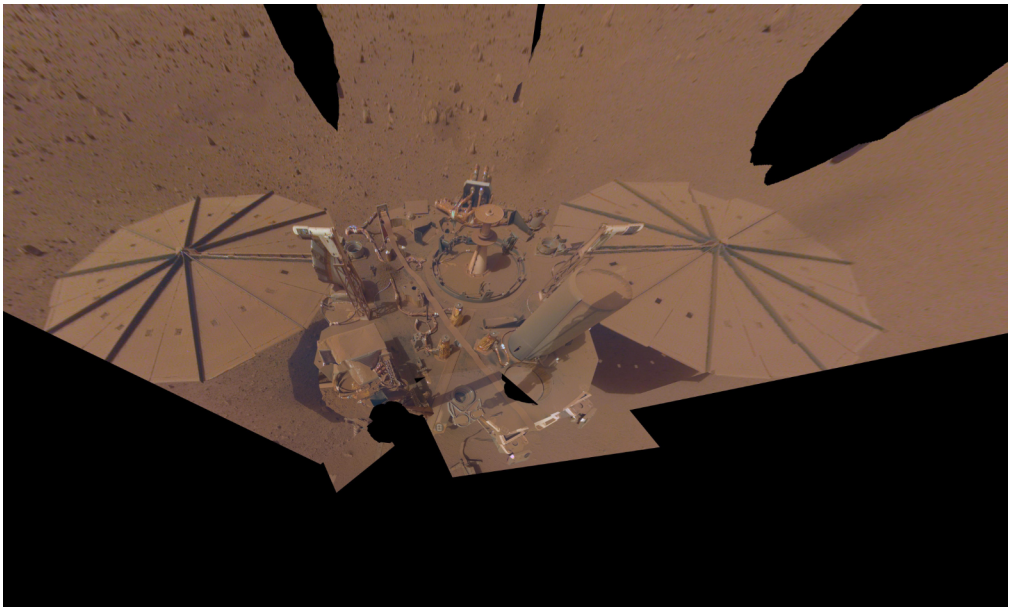
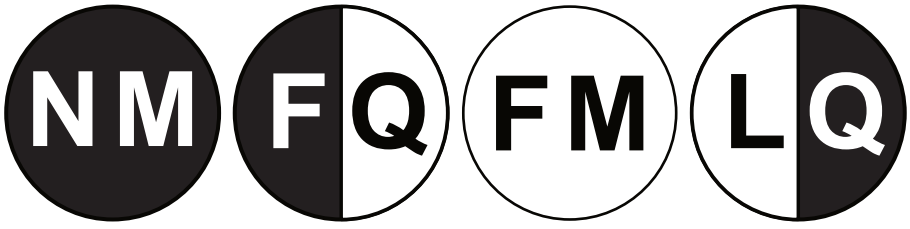


NASA's InSight Mars lander took this final selfie on April 24, 2022, the 1,211th Martian day, or sol, of the mission. The lander is covered with far more dust than it was in its first selfie, taken in December 2018, not long after landing – or in its second selfie, composed of images taken in March and April 2019.

The arm needs to move several times in order to capture a full selfie. Because InSight's dusty solar panels are producing less power, the team will soon put the lander's robotic arm in its resting position (called the "retirement pose") for the last time in May of 2022.

Credit: NASA/JPL-Caltech



Jun 28
July 28

Jun 7
July 6

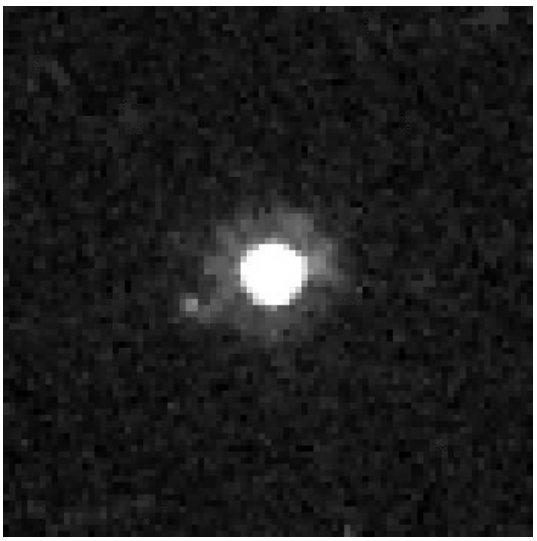
Jun 14
July 13

Jun 20
July 20

Happy Discovery Anniversary Quaoar
By Robin Byrne

This month, we celebrate the anniversary of the first discovery that put into question Pluto's planetary status. Chad Trujillo and Michael Brown were working at the Mount Palomar Observatory as part of the Caltech Wide Area Sky Survey. Their objective was to find brighter objects in the Kuiper Belt, a region just past the orbit of Neptune. On June 4, 2002, Trujillo imaged an area near the constellation Ophiuchus. Looking at the pictures the next day, he noticed a very faint object that changed position relative to the stars. Based on its brightness, at magnitude 18.6, and estimated distance based on the rate of motion, this object could end up being as large as Pluto.

The first step was to establish the orbit of this new solar system body. Brown and Trujillo began by searching archival photographs to see if it had been imaged before. Looking through the Near-Earth Asteroid Tracking Survey photographic plates taken between 1996 and 2002 revealed several pictures of the object. Two other images were found from 1983 that were part of a search for a planet beyond Pluto, plus one plate from the Palomar Sky Survey that was taken in 1954. The combination of all of these observations allowed Brown and Trujillo to determine that the new object is located an average of 43.7 Astronomical Units (AU) from the Sun, just a little more distant than Pluto. At that distance, it takes almost 289 years to complete one orbit. The orbit is very close to being circular in shape, but is tilted almost 8° to the plane of the solar system, which is more similar to how smaller bodies in the Kuiper Belt orbit (larger Kuiper Belt Objects, like Pluto, have orbits that are more elongated and more tilted).



Quaoar and its moon Weywot imaged by the Hubble Space Telescope in 2006

Before going public, Brown wanted to confirm the discovery with some more observations. However, because he wanted the announcement to be a surprise, he had to be very secretive about what he was doing. In order to get data using the Hubble Space Telescope, instead of making a formal proposal, he went directly to one of the telescope operators and requested observing time. The operator complied, giving him a brief window to use the Hubble. Brown had already been given observing time to study a few of the moons of Uranus using one of the Keck telescopes. However, instead, he used the allocated time to observe the new Kuiper Belt Object.

So, it wasn't until October 7, 2002 that a public announcement was made in the Minor Planet Electronic Circular. The object was given a provisional name of 2002 LM60. That same day, at the American Astronomical Society's Division for Planetary Sciences, Brown and Trujillo reported their discovery and subsequent findings to their colleagues and the press. In addition to the orbital parameters, they had an initial estimate of its size as being the largest Kuiper Belt Object yet found, other than Pluto. (Since then, even larger objects have been found, including: Eris, Haumea, Makemake, and Gonggong.)

Although it had not been formally approved, it was during the announcement of its discovery that Brown first referred to this new body as “Quaoar.” The International Astronomical Union (IAU) has rules for naming new discoveries. In this case, non-resonant Kuiper Belt Objects are named after creation deities. Brown and Trujillo wanted to honor the Tongva peoples, who were the first inhabitants of the region where Mount Palomar is located. Through their research, they discovered the story of “Kwawar,” the creation force of the universe, who sang into existence the sky, Earth, and Sun deities. Brown and Trujillo then met with a tribal historian to request permission to use the name. The historian approved of the name, but suggested the preferred spelling of “Quaoar.” Despite their breach of procedure, by announcing a name before it had been approved by the appropriate IAU committee, the name of Quaoar did become the official designation the following month.

On February 14, 2006, Michael Brown and T.A. Suer discovered, using the Hubble Space Telescope, that Quaoar has a moon that orbits 14,500 kilometers (km) from Quaoar. Estimates for its size range from 74 to 170 km in diameter. It most likely is the result of a large object colliding with Quaoar. The Tongva people were given the opportunity to name the moon. They chose the name Weywot, who is the son of Quaoar in their mythology.

As astronomers continue to study Quaoar, more is learned about its nature. Its surface may be similar to the moons of Uranus and Neptune, with a very low reflectivity, indicating that there is no fresh ice on the surface. Like other Kuiper Belt Objects, its surface seems to have a reddish-color. Spectroscopic studies reveal the presence of methane, which imply a possible atmosphere. However, observations of Quaoar as it occulted stars indicate that if it has an atmosphere, it is not very substantial at all, with a pressure about one-billionth of Earth’s atmospheric pressure.

Thanks to Weywot, it was relatively easy to determine Quaoar’s mass of 1.6 x 1021 kilograms, which is similar to the mass of Pluto’s moon Charon. The occultations of stars helped determine Quaoar’s diameter to be approximately 1100 kilometers, making it half as big as Pluto and similar in size to Charon. The occultations also confirmed that Quaoar is very close to being spherical in shape, with just a slight flattening. Although not yet officially designated as a dwarf planet, Quaoar appears to have all of the qualifications to eventually be added to their ranks.

In 2004, David Jewitt and Jane Luu discovered possible evidence for some form of geologic activity on Quaoar. At a distance of almost 44 AU, Quaoar would not be expected to get much warmer than -223˚C (-369˚F). At such a cold temperature, ice crystals should not have any structure. Using infrared imaging, Jewitt and Luu found that the ice has a crystalline pattern. For that pattern to occur in ice, the temperature at some point had to be warmer than -163˚C (-261˚F). So, how did it get so warm? With an almost circular orbit, the distance to the Sun doesn’t change enough to account for such a large temperature difference. The current thought is that radioactive decay of elements, such as uranium, in Quaoar’s interior generated the heat. And if that much heat is present, then there’s also the possibility that Quaoar could have cryogenic volcanoes, causing gas, liquid, and ice to erupt from Quaoar’s interior onto the surface.

While Quaoar was the first of the larger Kuiper Belt Objects discovered since Pluto, it wasn’t the last. Those discoveries began the discussion of whether they should be called planets or

not. Ultimately, the decision was made that since they are in a belt of objects, they would fall into the new category of “Dwarf Planets.” However, this new definition also meant that Pluto would fall into the dwarf planet category, since it, too, orbits in the Kuiper Belt.

While the dwarf planets in the Kuiper Belt have fairly stable orbits around the Sun, objects that are smaller can easily get redirected onto paths that bring them into the inner solar system. When that happens, we get the opportunity to observe a short-period comet, which are comets that orbit the Sun every 200 years or less. With as many as 70,000 objects with diameters of 100 kilometers (60 miles) or more, the Kuiper Belt has the potential to treat us to many great comets in the years to come. When the next short-period comet comes around, take a moment to think about the fact that it originated in the Kuiper Belt and was a neighbor to a variety of dwarf planets, including this month’s honoree, Quaoar.

References:

50000 Quaoar - Wikipedia

The Dwarf Planet Quaoar - Universe Today

Chilly Quaoar had a warmer past by Mark Peplow - Nature, 12/8/04

On the Cover: The muted red tones of the globular cluster Liller 1 are partially obscured in this image by a dense scattering of piercingly blue stars. In fact, it is thanks to Hubble’s Wide Field Camera 3 (WFC3) that we are able to see Liller 1 so clearly in this image, because the WFC3 is sensitive to wavelengths of light that the human eye can’t detect. Liller 1 is only 30,000 light-years from Earth – relatively neighborly in astronomical terms – but it lies within the Milky Way’s ‘bulge’, the dense and dusty region at our galaxy’s center. Because of that, Liller 1 is heavily obscured from view by interstellar dust, which scatters visible light (particularly blue light) very effectively. Fortunately, some infrared and red visible light can pass through these dusty regions. WFC3 is sensitive to both visible and near-infrared (infrared that is close to the visible) wavelengths, allowing us to see through the obscuring clouds of dust, and providing this spectacular view of Liller 1.

Liller 1 is a particularly interesting globular cluster, because unlike most of its kind, it contains a mix of very young and very old stars. Globular clusters typically house only old stars, some nearly as old as the universe itself. Liller 1 instead contains at least two distinct stellar populations with remarkably different ages: the oldest one is 12 billion years old, and the youngest component is just 1-2 billion years old. This led astronomers to conclude that this stellar system was able to form stars over an extraordinarily long period of time.

Image credit: ESA/Hubble & NASA, F. Ferraro

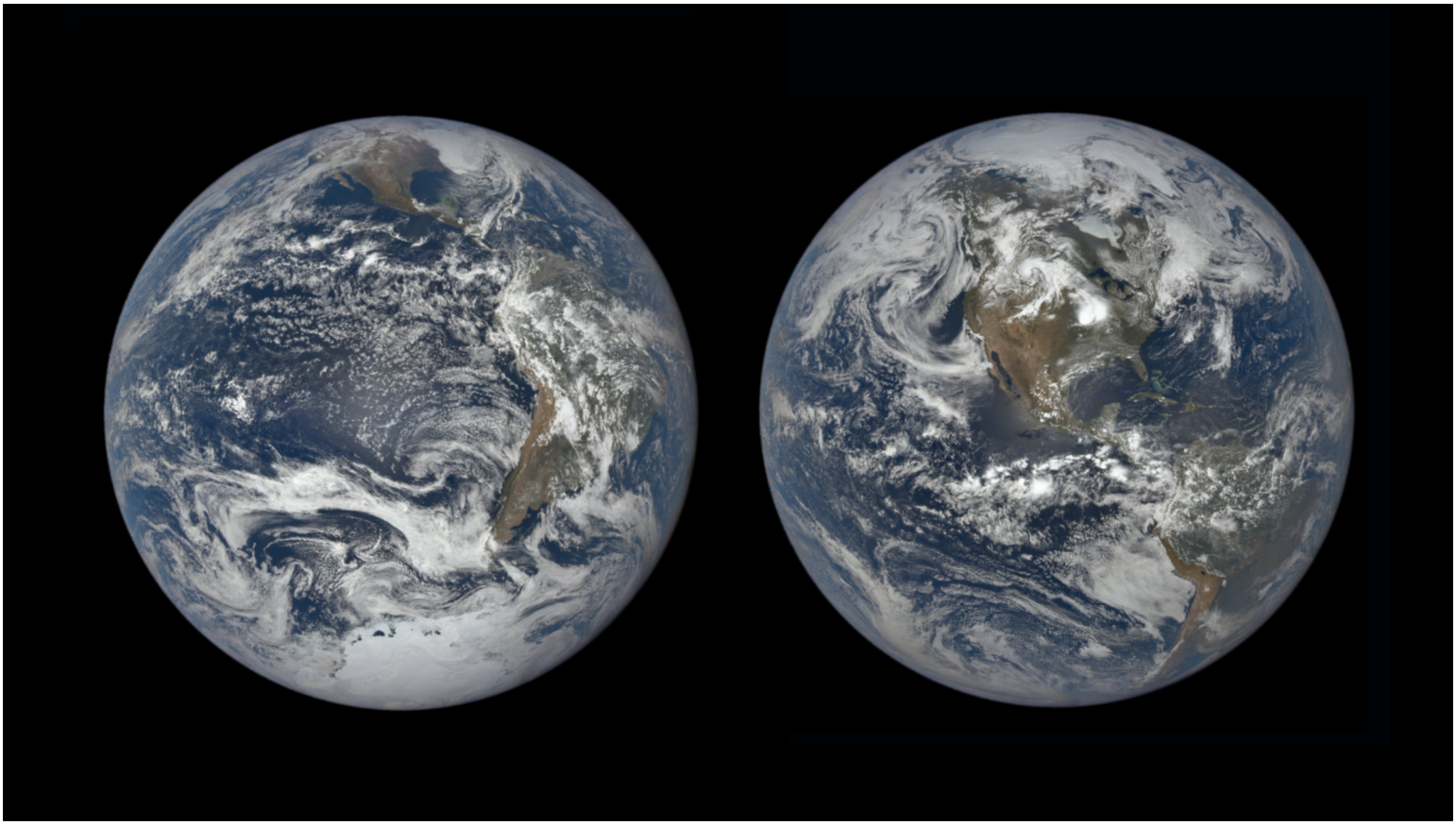
xkcd

	REGULAR ____SCOPE	ELECTRON ____SCOPE	RADIO ____SCOPE
MICRO	LOOK AT SMALL STUFF	LOOK AT *REALLY* SMALL STUFF	FIGURE OUT WHY YOUR RADIO BROKE
TELE	LOOK AT STUFF THAT'S FAR AWAY	DETECT COSMIC RAYS	LOOK AT DISTANT HIGH-ENERGY STUFF
PERI	LOOK FOR ENEMY SHIPS	EXAMINE THE HULL OF AN ENEMY SHIP FOR STRUCTURAL FLAWS	LET THE CREW OF YOUR SUBMARINE LISTEN TO NPR
STETHO	LISTEN TO A PATIENT'S CHEST	BURN A PATIENT'S SKIN	PLAY THE NOISES FROM A PATIENT'S CHEST ON NPR
KALEIDO	SEE COOL SHAPES AND COLORS	SEE COOL BREMSSTRAHLUNG	ANOTHER WORD FOR THE "SCAN" BUTTON
GYRO	BALANCE BY SPINNING	ANOTHER WORD FOR ELECTROMAGNET	ANOTHER WORD FOR TURNTABLE
HORO	GET RANDOM LIFE ADVICE	PREDICT A PARTICLE'S QUANTUM STATE	GET RANDOM LIFE ADVICE FROM EXPLODING GALAXIES

Solstice Shadows
By David Prosper

Solstices mark the changing of seasons, occur twice a year, and feature the year's shortest and longest daylight hours - depending on your hemisphere. These extremes in the length of day and night make solstice days more noticeable to many observers than the subtle equality of day and night experienced during equinoxes. Solstices were some of our earliest astronomical observations, celebrated throughout history via many summer and winter celebrations.

Solstices occur twice yearly, and in 2022 they arrive on June 21 at 5:13 am EDT (9:13 UTC), and December 21 at 4:48pm EST (21:48 UTC). The June solstice marks the moment when the Sun is at its northernmost position in relation to Earth's equator, and the December solstice marks its southernmost position. The summer solstice occurs on the day when the Sun reaches its highest point at solar noon for regions outside of the tropics, and those observers experience the longest amount of daylight for the year.



These images from NASA's DSCOVR mission shows the Sun-facing side of Earth during the December 2018 solstice (left) and June 2019 solstice (right). Notice how much of each hemisphere is visible in each photo; December's solstice heavily favors the Southern Hemisphere and shows all of South America and much of Antarctica and the South Pole, but only some of North America. June's solstice, in contrast, heavily favors the Northern Hemisphere and shows the North Pole and the entirety of North America, but only some of South America.

Credit: NASA/DSCOVR EPIC

Conversely, during the winter solstice, the Sun is at its lowest point at solar noon for the year and observers outside of the tropics experience the least amount of daylight- and the longest night – of the year. The June solstice marks the beginning of summer for folks in the Northern Hemisphere and winter for Southern Hemisphere folks, and in December the opposite is true, as a result of the tilt of Earth's axis of rotation. For example, this means that the Northern Hemisphere receives more direct light from the Sun than the Southern Hemisphere during the June solstice. Earth's tilt is enough that northern polar regions experience 24-hour sunlight during the June solstice, while southern polar regions experience 24-hour night, deep in Earth's shadow. That same tilt means that the Earth's polar regions also experience a reversal of light and shadow half a year later in December, with 24 hours of night in the north and 24 hours of daylight in the south. Depending on how close you are to the poles, these extreme lighting conditions can last for many months, their duration deepening the closer you are to the poles.

A presenter from the San Antonio Astronomy Club in Puerto Rico demonstrating some Earth-Sun geometry to a group during a "Zero Shadow Day" event. As Puerto Rico lies a few degrees south of the Tropic of Cancer, their two zero shadow days arrive just a few weeks before and after the June solstice. Globes are a handy and practical way to help visualize solstices and equinoxes for large outdoor groups, especially outdoors during sunny days!

Credit & Source: Juan Velázquez / San Antonio Astronomy Club

While solstice days are very noticeable to observers in mid to high latitudes, that's not the case for observers in the tropics - areas of Earth found between the Tropic of Cancer and the Tropic of Capricorn. Instead, individuals experience two "zero shadow" days per year. On these days, with the sun directly overhead at solar noon, objects cast a minimal shadow compared to the rest of the year. If you want to see your own shadow at that moment, you have to jump! The exact date for zero shadow days depends on latitude; observers on the Tropic of Cancer (23.5° north of the equator) experience a zero shadow day on the June solstice, and observers on the Tropic of Capricorn (23.5° south of the equator) get their zero shadow day

on December's solstice. Observers on the equator experience two zero shadow days, being exactly in between these two lines of latitude; equatorial zero shadow days fall on the March and September equinoxes.

There is some serious science that can be done by carefully observing solstice shadows. In approximately 200 BC, Eratosthenes is said to have observed sunlight shining straight down the shaft of a well during high noon on the solstice, near the modern-day Egyptian city of Aswan. Inspired, he compared measurements of solstice shadows between that location and measurements taken north, in the city of Alexandria. By calculating the difference in the lengths of these shadows, along with the distance between the two cities, Eratosthenes calculated a rough early estimate for the circumference of Earth – and also provided further evidence that the Earth is a sphere!

Are you having difficulty visualizing solstice lighting and geometry? You can build a "Suntrack" model that helps demonstrate the path the Sun takes through the sky during the seasons; find instructions at stanford.io/3FY4mBm. You can find more fun activities and resources like this model on NASA Wavelength: science.nasa.gov/learners/wavelength. And of course, discover the latest NASA science at nasa.gov.

This article is distributed by NASA Night Sky Network. The Night Sky Network program supports astronomy clubs across the USA dedicated to astronomy outreach. Visit nightsky.jpl.nasa.gov to find local clubs, events, and more! You can catch up on all of NASA's current and future missions at nasa.gov. With articles, activities and games NASA Space Place encourages everyone to get excited about science and technology. Visit spaceplace.nasa.gov to explore space and Earth science!

Next Membership Meeting:

Wednesday June 15, 7:30 pm

Cumberland Valley
Girl Scout Council Building
4522 Granny White Pike

Barnard-Seyfert Astronomical Society
Minutes of a Regular Meeting of the Board of Directors
Held On Wednesday, May 4, 2022

The regular meeting of the Board of Directors of the Barnard-Seyfert Astronomical Society was held May 4, 2022, online, Dr. Tom Beckermann presiding. Logged in were Bud Hamblen, Keith Rainey, Tom Beckermann, Tony Drinkwine, Cory Buckner, Theo Wellington and Chip Crossman. An on-line quorum being present, Tom called the meeting to order at 7:30 PM.

Tom asked for a motion to adopt the minutes of the board meeting on April 13, 2022, as printed in the May, 2022 edition of the Eclipse. Chip so moved, Theo seconded, and the minutes were adopted unanymously.

Treasurer's Report: Theo reported that the Truist account balance was $11,858.26 ($4,578.07 in the equipment fund and $7,280.19 in the general fund). $624.25 had been transfered from the PayPal account to the Truist account. The current PayPal balance was $33.29. Upcoming expenses included the post office box renewal and the dues for the Astronomical League.

Social media report: The Facebook page was liked by 2,017 and followed by 2,152. Twitter (@BSASNashville) had 299 followers.

Star parties: The weather was expected to be "iffy" for May 7 and "OK" for May 15.

Meetings and programs: The May program is planned to be a "What's Up?". The June meeting is planned to be a discussion of the Astronomical League observing programs. Will see whether Dr Billy Teets may be available for a presentation. Webb space telescope first light is expected in July.

There being no further business, the meeting adjourned at 8:30 PM.

Respectfully submitted,

Bud Hamblen
Secretary

There was no membership meeting in May 2022.

In honor of the club's 90th anniversary we partnered with Hatch Show Print to create a unique poster that would honor the achievement of the club. For those who don't know Hatch Show has been making posters for a variety of events and concerts for 140 years. In all that time we are their first astronomy club.

On the poster at the center is the moon. This was made from a wood grained stencil that the shop has used for over 50 years. To contrast that the telescope that the people are using is a brand new stencil made for our poster. The poster has three colors. First the pale yellow color of the moon was applied. Next the small stars, circles, and figures at the bottom were colored in metallic gold. The third color is a blue for the night sky. Where it overlaps with the metallic gold it creates a darker blue leaving the figures at the bottom looking like silhouettes. This was a one time printing so the 100 that we have are all that will be printed.

The prints are approximately 13 3/4” x 22 1/4” and are available for $20 at our membership meetings, or $25 with shipping by ordering through bsasnashville.com. Frame not included.

Barnard-Seyfert Astronomical Society

Become a Member of BSAS! Visit bsasnashville.com to join online.

All memberships have a vote in BSAS elections and other membership votes. Also included are subscriptions to the BSAS and Astronomical League newsletters.

Annual dues:

Regular: $25
Family: $35
Senior/Senior family: $20
Student*: $15

* To qualify as a student, you must be enrolled full time in an accredited institution or home schooled.

About BSAS

Organized in 1928, the Barnard-Seyfert Astronomical Society is an association of amateur and professional astronomers who have joined to share our knowledge and our love of the sky.

The BSAS meets on the third Wednesday of each month at the Cumberland Valley Girl Scout Building at the intersection of Granny White Pike and Harding Place in Nashville. Experienced members or guest speakers talk about some aspect of astronomy or observing. Subjects range from how the universe first formed to how to build your own telescope. The meetings are informal and time is allotted for fellowship. You do not have to be a member to attend the meetings.

Membership entitles you to subscriptions to Astronomy and Sky & Telescope at reduced rates; the club's newsletter, the *Eclipse*, is sent to members monthly. BSAS members also receive membership in the Astronomical League, receiving their quarterly newsletter, the Reflector, discounts on all astronomical books, and many other benefits.

In addition to the meetings, BSAS also sponsors many public events, such as star parties and Astronomy Day; we go into the schools on occasion to hold star parties for the children and their parents. Often the public star parties are centered on a special astronomical event, such as a lunar eclipse or a planetary opposition.

Most information about BSAS and our activities may be found at bsasnashville.com. If you need more information, write to us at info@bsasnashville.com.

Free Telescope Offer

Did someone say free telescope? Yes, you did read that correctly. The BSAS Equipment & Facilities Committee has free telescopes ranging in size from 2.6" to 8" that current members can actually have to use for up to 60 days at a time. We also have some other items in the loaner program such as a photometer, H-alpha solar telescope, educational CDs, tapes, DVDs, and books. Some restrictions apply. A waiting list is applicable in some cases. The BSAS Equipment Committee will not be held responsible for lost sleep or other problems arising from use of this excellent astronomy gear. For information on what equipment is currently available, contact info@bsasnashville.com.