## The Bays Mountain Astronomy Club Newsletter

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## **Cosmic Reflections** Greg Penner - BMAC Interim Chair

ello fellow astronomy enthusiasts! The month of March is upon us and that means the spectacular Total Solar Eclipse is only one month away.

Remember, we will NOT have a club meeting in April to allow people to travel for the eclipse. If you haven't made plans yet to get in the path of totality, now is the time. Remember, at our club meeting in June we would like everyone to share stories about their experiences viewing the eclipse. So as you're making plans, think about what types of experiences you can share and how. I have seen articles about how the natural world (i.e. animals) react during totality. Do the crickets start chirping in the middle of the day? What are the birds or other wildlife doing? What about your own pet animals? Do dogs and cats respond in some way to the sudden onset of totality? Something else to watch for during totality is which astronomical bodies can you see that you normally can't see during the day? In the January "Stellar Observations" article in our newsletter, I included an image from Stellarium showing which Solar System bodies will be in the vicinity of the Sun

during totality. Let's all do our best to use journals, photos, videos, drawings, whatever you are comfortable with to record your experience and share with the club in June.

At this month's March meeting I will be giving a presentation that I call "A Scenic Walk Through the Solar System." We will meet at the usual place in the planetarium theater and I will share with everyone a unique experience I had many years ago "walking through the Solar System" in a very scenic setting. Along the way you might learn a few things about some of our Solar System bodies, and perhaps get inspired to take a similar walk yourself. After my presentation, we will open up the floor for anyone to present a show-and-tell project or item of interest. As a club of astronomy enthusiasts of many different backgrounds, I'm sure we can all learn from each other. If there is some astronomy or space exploration news that you find interesting, please share with the club. So much information exists among the various media outlets, so please share what interests you!

Looking forward to see everyone in March!

## **BMAC** Notes

## BMAC Meeting - February 2, 2024



ur February meeting went very well. We had guest speaker Dr. Richard Ignace from ETSU. We also had some Show & Tell. BMAC member Michael Hopkins

shared his amazing model of the small helicopter on Mars, Ingenuity. He used a 3D printer and a lot of brain power to complete the model and make it accurate. He stated that much of the model online was either incorrect or non-existent.



Dr. Richard Ignace is on the left. Adam is seen holding up the Sun with his hot little hands. Image by Robin Byrne.



Michael Hopkins is seen on the right pointing out the path the Ingenuity craft took. Greg is seen on the left holding Michael's model. Image by Robin Byrne.



The Ingenuity model Michael Hopkins created. Image by Robin Byrne.

## Ingenuity Model Craft



Michael.

MAC member Michael Hopkins outdid himself creating this model. No, it doesn't fly, but it is to scale. Michael is a retired helicopter pilot, so this was a special project for him. The following four images are by







## Sky News from the Astronomical League

Τ

he Astronomical League has a plethora of educational content to help you learn and enjoy the night sky more. The following inserts are just a tiny

bit of what they provide.

### Navigating the mid to late March Night Sky



#### Navigating the March night sky: Simply start with what you know or with what you can easily find.

- 1 Above the northeast horizon rises the Big Dipper. Draw a line from its two end bowl stars upwards to the North Star. Its top bowl stars point west to Capella in Auriga, nearly overhead. Leo reclines below the Dipper's bowl.
- **2** From Capella jump northwestward along the Milky Way to Perseus, then to the "W" of Cassiopeia. Next jump southeastward from Capella to the twin stars of Castor and Pollux in Gemini.
- 3 Directly south of Capella stands the constellation of Orion with its three Belt Stars, its bright red star Betelgeuse, and its bright blue-white star Rigel.
- **4** Use Orion's three Belt stars to point northwest to the red star Aldebaran and the Hyades star cluster, then to the Pleiades star cluster. Travel southeast from the Belt stars to the brightest star in the night sky, Sirius. It is a member of the Winter Triangle.

#### **Binocular Highlights**

**A:** Between the "W" of Cassiopeia and Perseus lies the Double Cluster. **B:** Examine the stars of the Pleiades and Hyades, two naked eye star clusters. **C:** M42 in Orion is a star forming nebula. **D:** Look south of Sirius for the star cluster M41. **E:** M44, a star cluster barely visible to the naked eye, lies to the southeast of Pollux. **F:** Look high in the east for the loose star cluster of Coma Berenices.



Astronomical League www.astroleague.org/outreach; duplication is allowed and encouraged for all free distribution.

### Navegando por el cielo nocturno de Marzo



para ver el cúmulo de estrellas perdidas de Cabellera de Berenice.
Liga Astronómica www.astroleague.org/outreach; Duplicación permitida y fomentada para toda distribución gratuita Traducción al español por Dr. Salvador Aguirre

M44, un cúmulo de estrellas apenas perceptible a simple vista, se encuentra al sureste de Pólux. F: Mira alto en el este



#### Mercury's best evening apparition of 2024!

- From 40 to 60 minutes after sunset after March 15th, look to the west for a point of light shining low above the horizon.
- Outstretch your arm and make a fist. Place one side at the true horizon. At it its other side should be Mercury.
- Over the next week, the little planet rises slightly higher each evening into the darker twilight while brightening, making it easier to spot.
- On the 24th, Mercury appears as far from the set sun as it will be. This point in its orbit is called Greatest Eastern Elongation. Just three nights later as it descends in the twilight, it will become much more difficult to spot.

### **ASTRONOMICAL LEAGUE Double Star Activity**



Said to be one of the eeriest sights encountered in galaxy observing.

# ORDER PUNG PROGRES

### NGC 4435 & 4438



### "The Eyes"-Two Spiral Lenticular Galaxies

### Navigate to NGC 4435 & 4438

- 1. Find Beta Leonis (Denebola) and Epsilon Virginis (Vindemiatrix).
- 2. Draw a line from Beta to Epsilon.
- 3. M84 and M86 lie at the mid point of that line.
- 4. NGC 4435 & 4438 glow about 40 minutes east of M86.
- 5. In a 40 minute field, they appear as two eyes staring back in the blackness of space.

#### **Bonus Galaxies:**

The region abounds in galaxies: M84, M86, M87, and many fainter ones.

#### **Recommended Aperture:**

Not less than 10 inches. The larger, the better.

Yes, they do resemble two eyes staring at you from the blackness of space!

#### **Published Characteristics for NGC 4435**

Integrated magnitude: 11.7 Size: 2.8 min x 2.0 min Surface brightness: 13.7 mag./min<sup>2</sup>, 22.6 mag./sec<sup>2</sup> Position Angle: 10° Distance: 52 million light-years

#### **Published Characteristics for NGC 4438**

Integrated magnitude: 10.6 Size: 8.6 min x 3.2 min (bright core, faint tails) Surface brightness: 15.0 mag./min<sup>2</sup>, 24.0 mag./sec<sup>2</sup> Position Angle: 20°

Distance: 52 million light-years



www.astroleague.org/outreach



#### **Eyepiece Impressions:**

**NGC 4435:** Very small, elusive. Uniform brightness. Use averted vision. Near NGC 4438 and located 25' east of M86. (6-inch Cass.; ACAC) 10 inch f/10 SCT, 125x: "NGC 4435 is slightly elongated with a bright center." JG

**NGC 4438:** Extremely elongated, uniform brightness, very large. Use averted vision. Located 4' south of NGC 4435. (6-inch Cass.; ACAC) 10 inch f/10 SCT, 125x:"NGC 4438 is elongated with a brigth center. Under careful observation, wispy outer regions are noticed." JG



encouraged for all free distribution.

The Eyes – NGC 4435 & 4438

## Star Party @ the Gazebo at Natural Tunnel State Park

ere's a note about a star party that BMACers are invited to attend. Ray O'Connor is hosting this viewing at Natural Tunnel State Park on May 11, 2024. It will be at the Gazebo and start at sunset. Feel free to bring your observing equipment for a night of stargazing.

Contact Ray O'Connor for more information. 276-248-1712

## Stellar Observations

Greg Penner

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## An Extra Jewel in the Northern Crown



t our February BMAC meeting, I shared with the club about an article in the March Sky & Telescope magazine regarding the predicted flare-up of recurrent nova T Coronae Borealis (T CrB). This will be such a unique once-in-a-lifetime event that it deserves more attention in this month's article.



Artist's Conception of a Recurrent Nova (RS Ophiuchi), which would be similar to T CrB. Credit: David A. Hardy

T CrB last erupted in 1946 when the normally 10th magnitude star brightened to its peak 2nd magnitude, remaining at peak for about 12 hours and then naked-eye visibility for about one week. So what is the true nature of novae, and T CrB in particular, that would cause this behavior? The answer was a complete unknown until the late 1950s, when astronomers Merle Walker and Robert Kraft discovered that novae are close binary systems in which an ordinary star is orbiting a white dwarf. Gas from the ordinary star transfers to the white dwarf, and when enough material has accreted, the rising temperature triggers a thermonuclear reaction that blows up the white dwarf's surface layer causing sudden brightening. As the ejected material expands outward, the white dwarf cools and fades back to the pre-eruption level and the cycle starts over again. For most novae, the cycle takes up to a million years. For a small number of novae the recurrence time is only one year to one century. The systems with recurrence less than 100 years are classified as recurrent novae (RNe). There are only 10 RNe

with two or more known eruptions in the Milky Way, and T CrB is one of them.



T CrB Light Curve from 1944 - 1946 showing the pre-eruption dip, eruption to peak brightness, and sub-peak a few months later. Graph made on AAVSO website.

The first "official" scientific observation of a T CrB eruption was in 1866 by John Birmingham, observing from western Ireland. He recorded a new 2nd magnitude star in Corona Borealis, whereas just a few hours earlier at the National Observatory in Athens, Julius Schmidt had noted nothing of the sort in the same area. News spread quickly and British astronomer William Huggins became the first person to examine a nova's light spectroscopically. After this eruption, the existence of novae became well known and for many decades T CrB was observed to glow around 10th magnitude, with chaotic variability of about 0.5 magnitude. Well-known amateur astronomer Leslie Peltier was a persistent observer for 25 years starting in 1920. He was convinced that the star would erupt again even though the concept of a recurrent nova was unknown at that time. In 1945 Peltier noted that the star was suddenly fading and concluded that an outburst was imminent. The rest of the story is best told in his own words.

Then, one night in February 1946 it stirred, slowly opened its eyes, then quickly threw aside the draperies of its couch and rose! And where was I, its selfappointed guardian on that once-in-a-lifetime night when it awoke? I was asleep! Self-pity comes easy at 2:30 on a cold February morning so I went back to my warm bed with the comforting thought that I owed it to my family, at least, to take care of my health.

The observations of the 1866 and 1946 eruptions provide some key insights into understanding why astronomers anticipate an

imminent eruption sometime in 2024. Dr. Bradley Schaefer, author of the S&T article, notes three distinct phases from analyzing the light curves of these eruptions. First, after it erupted and returned to its quiet state for more than two months, it had a second outburst, rising to 8.0 magnitude for about 100 days. Second, in the year leading up to the main eruption, the star dipped up to two magnitudes. Third, for the 20 years centered on the main outburst, T CrB's brightness plateaued at nearly one magnitude brighter than in its quiescent state. The light curves for 1866 and 1946 are identical, exhibiting all three phases.

From 1955 to 2015 the star maintained its dimmer state around magnitude 10.3. Suddenly, in 2015 it brightened to magnitude 9.8, beginning the plateau phase similar to its behavior in 1935. The next harbinger of an eruption would be the pre-eruption brightness dip, which for the 1945 event started 1.1 years prior. In March of 2023 observations showed a pronounced dip in magnitude. Assuming the current cycle follows the previous two, the eruption should occur roughly 1.1 years after that dip. Sometime between right now and September 2024 we will very likely be witnesses to a once-in-a-lifetime nova!



AAVSO B and V light curve for T CrB 2021.0--2023.5

In the first week of March, the constellation Corona Borealis (aka the Northern Crown) rises high enough above the horizon to be easily visible around midnight. Daylight Saving Time kicks in the second week of March, which will keep that part of the sky at a midnight or later observation mid-month. By the end of March, observing T CrB will start getting easier by being earlier in the evening. Throughout the rest of the spring and summer months, Corona Borealis is easily placed high in the sky for nightly viewing all the way through September and early October. Keep in mind the experience of Leslie Peltier when he missed the sudden brightening of T CrB after diligently watching it for 25 years. The peak brightness will come suddenly and last for only about 12 hours, so let's all be on the lookout for the extra jewel in the Northern Crown!



Corona Borealis location in late March at midnight. Stellarium



T CrB finder chart showing a pattern of 7th - 8th magnitude stars in the vicinity of T CrB to help locate the 10th magnitude star. When it erupts, T CrB will rival the brightest star in Corona Borealis, Alphecca at magnitude 2.2. From Stellarium, annotated by Greg Penner.

Note: Much of the information in this article comes from Dr. Bradley Schaefer's article in the March, 2024 issue of Sky & Telescope.

## The Queen Speaks

### Robin Byrne

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## Happy Birthday Nicolas-Louis de Lacaille

his month we celebrate the life of a man who is responsible for naming many of the constellations we can't see from here. Nicolas-Louis de Lacaille was born on March 15, 1713 in Rumigny, France. While his mother gave birth to a total of 4 sons and 6 daughters, Nicolas was the only son to survive, and only three of his sisters lived, all of whom later became nuns. Their father, Charles, was retired from the military and well educated, so he took charge of educating Nicolas. Charles' interest in mechanical devices likely influenced what Nicolas was taught, and that definitely had an impact on Nicolas' later life.



Abbé Nicolas-Louis de Lacaille - 1762 Stoyan R. et al. Atlas of the Messier Objects: Highlights of the Deep Sky. – Cambridge: Cambridge University Press, 2008. – P. 20 by Melle Le Jeuneux Nicolas left home to study at the Collège de Mantes-sur-Seine, not far from Paris. In 1729, after receiving a scholarship, he moved to the Parisian Collège de Lisieux. Here, Nicolas studied philosophy and rhetoric. In 1732, Nicolas entered the Collège de Navarre with the intention of becoming a priest, to honor his father's dying wish. It was here that his interests took a turn in a different direction after reading Euclid's Elements. Lacaille taught himself geometry and started studying astronomy in his spare time. Lacaille decided to devote his life to astronomy and mathematics, but not without becoming a deacon first.

After graduation, Lacaille, with the help of Paris Observatory Director Jacques Cassini, was hired to survey the coast of France. He then joined Cassini at the Paris Observatory as Cassini's assistant. In 1739, he was tasked with remeasuring the French meridian arc. In recognition of his two years of effort in this endeavor, a pyramid was erected in his honor in the town of Juvisy-sur-Orge. Lacaille was also honored with admission to the Royal Academy of Sciences and hired as a Professor of Mathematics at the University of Paris. While at the university, Lacaille had a small observatory built.

One of Lacaille's passions was to find a way of measuring the distances to the planets using trigonometry. To make this attempt, he proposed an expedition to the Cape of Good Hope, where he could have a large baseline between observations made in Paris and in the Cape. In 1750, the expedition was approved and funded by the Academy of Sciences, but with the primary task being to catalog the southern sky. A year later, Lacaille arrived at his destination. At the Cape, Lacaille constructed an observatory, where, over the course of two years, he observed and catalogued over 10,000 stars and 42 nebulous objects. But because his personal goal was to measure the parallax of the Moon, he observed it at the same time as a colleague observed the Moon in Europe. Their results were successful enough to establish the distance to the Moon.

While at the Cape of Good Hope, Lacaille decided to create additional constellations to the ones that had been devised by

Portuguese and Dutch navigators. Lacaille subdivided some of the larger constellations, as well as creating precise boundaries for all of the southern constellations. The constellations he created are: Antlia (the Air Pump), Caelum (the Engraving Tool), Circinus (the Drawing Compass), Fornax (the Furnace), Horologium (the Clock), Mensa (the Table Mountain), Microscopium (the Microscope), Norma (the Carpenter's Square), Octans (the Octant), Pictor (the Painter's Easel), Pyxis (the Mariner's Compass), Reticulum (the Reticule), Sculptor (the Sculptor), and Telescopium (the Telescope). Obviously, his interest in the sciences and mechanical devices influenced many of his choices of imagery.

Also while at the Cape, Lacaille made measurements to determine Earth's radius in the southern hemisphere, to see if Earth was oblate or not. His results indicated that Earth was more flattened towards the south pole than the north. It was later determined that nearby Table Mountain influenced his measurements by gravitationally deflecting the plumb bob used while determining local zenith. In 1753, Lacaille left the Cape, but with a detour to two islands, Mauritius and Reunion, on orders to determine their precise longitudes. It took 10 months to complete, and Lacaille found the work tedious and boring, but once completed, he finally was able to head home.

His long journey across the ocean made Lacaille aware of how difficult it is to determine longitude at sea. With that in mind, he set about creating tables with accurate positions of the Moon, to be used for navigational purposes. Lacaille continued working in Paris, with projects such as developing a method to determine the orbits of comets (and in the process was the one who suggested naming one comet in particular as Halley's Comet), studies of astronomical refraction, and creating logarithmic tables and ephemerides. In 1757 he self-published a book of the 400 brightest stars, called Fundamental Astronomy, which he didn't sell, but instead gave away for free to anyone who had an interest in using it.

In 1762, Lacaille took ill, possibly from overwork, gout, or both. He ultimately succumbed on March 21st of that year. He was only 49 years old, and had not yet published the majority of his own observations. Lacaille's southern constellations were published the year after his death, but it wasn't until 1847 that Francis Baily assembled all of Lacaille's Cape of Good Hope observations into a catalogue, which was published by the British Association. Lacaille's name lives on in the form of a crater on the Moon, as well as an asteroid that was named for him.

Nicolas Lacaille did an amazing amount of work for such a short life. While many of his accomplishments aren't as relevant today, by far his most lasting contribution, the creation of fourteen constellations, is one that will forever be remembered. While we may not see them in our skies, perhaps a trip south of the Equator (or at the very least, a trip to the planetarium) will provide an opportunity to view these stellar pictures that came from the mind of this month's honoree - Nicolas Lacaille.

### References:

Nicolas-Louis de Lacaille - Wikipedia

Nicolas-Louis de Lacaille; Written by I J Falconer, J G Mena, J J

O'Connor, T S C Peres, E F Robertson, University of St Andrew

Lacaille 250 years on by Brain Warner; Astronomy & Geophysics, Volume 43, Issue 2, April 2002

## The Space Place MASA Nigh Network

Kat Troche

The Bays Mountain Astronomy Club Newsletter

## Constant Companions: Circumpolar Constellations, Part II

s the seasons shift from winter to spring, heralding in the promise of warmer weather here in the northern hemisphere, our circumpolar constellations remain the same. Depending on your latitude, you will be able to see up to nine circumpolar constellations. This month, we'll focus on: Lynx, Camelopardalis and Perseus. The objects within these constellations can all be spotted with a pair of binoculars or a small to medium-sized telescope, depending on your <u>Bortle</u> <u>Scale</u> - the darkness of your night skies.



In the appearance of left to right: constellations Perseus, Camelopardalis, and Lynx in the night sky. Also featured: Cassiopeia as a guide constellation, and various guide stars. Credit: Stellarium Web

### Double Stars:

The area that comprises the constellation Lynx is famous for its multiple star systems, all of which can be separated with a telescope under dark skies. Some of the notable stars in Lynx are the following:

- 12 Lyncis a triple star that can be resolved with a medium-sized telescope.
- 10 Ursae Majoris a double star that was once a part of Ursa Major.
- 38 Lyncis a double star that is described as blue-white and lilac.

### Kemble's Cascade:

This <u>asterism</u> located in Camelopardalis, has over 20 stars, ranging in visible magnitude (brightness) and temperature. The stars give the appearance of flowing in a straight line leading to the Jolly Roger Cluster (NGC 1502). On the opposite side of this constellation, you find the asterism Kemble's Kite. All three objects can be spotted with a pair of binoculars or a telescope and require moderate dark skies.

### DOUBLE CLUSTER IN PERSEUS



A ground-based image from the Digitized Sky Survey (DSS) in the upper left shows Caldwell 14, the Double Cluster in Perseus, with an outline of the region imaged by Hubble's Wide Field and Planetary Camera 2 (WFPC2). Ground-based image: Digitized Sky Survey (DSS); Hubble image: NASA, ESA,

and S. Casertano (Space Telescope Science Institute); Processing: Gladys Kober (NASA/Catholic University of America)

### Double Cluster:

The constellation Perseus contains the beautiful Double Cluster, two open star clusters (NGC 869 and 884) approximately 7,500 light-years from Earth. This object can be spotted with a small telescope or binoculars and is photographed by amateur and professional photographers alike. It can even be seen with the naked eye in very dark skies. Also in Perseus lies Algol, the Demon Star. Algol is a triple-star system that contains an eclipsing binary, meaning two of its three stars constantly orbit each other. Because of this orbit, you can watch the brightness dim every two days, 20 hours, 49 minutes - for 10-hour periods at a time. For a visual representation of this, revisit NASA's What's Up: November 2019.

From constellations you can see all year to a once in a lifetime event! Up next, find out how you can partner with NASA volunteers for the April 8, 2024, total solar eclipse with our upcoming mid-month article on the <u>Night Sky Network</u> page through NASA's website!

### 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 <u>nightsky</u> to find local clubs, events, and more!

# BMAC Calendar & More

## Calendar:



### **MAC Meetings:**

- Friday, March 1, 2024 7p BMAC chair, Greg Penner will share a very unique excursion he made a few years ago "traveling" through the Solar System (or at least a scale model of one!). He'll present "A Scenic Walk Through the Solar System." Show & Tell will follow.
- No April meeting due to eclipse.
- Friday, May 3, 2024 7p Student presentations.
- Friday, June 7, 2024 7p Eclipse stories.
- Friday, August 2, 2024 7p Topic TBA.
- Friday, September 6, 2024 7p Topic TBA.
- Friday, October 3, 2024 7p Topic TBA.
- Friday, December 6, 2024 7p Topic TBA.
- Friday, February 7, 2025 7p Topic TBA.



- Every clear Saturday & Sunday 3p-3:30p March-October By the Dam
  - View the Sun safely with a white-light view if clear.; Free.
  - You must have completed the Park Volunteer Program in order to help with the public program. If you have, and have been trained, please show up at least 30 minutes prior to the official start time.



### tarWatch:

- March 2 & 9, 2024 7p
- March 16, 23 & 30, 2024 8p
- April 6, 13, 20 & 27, 2024 8:30p
  - View the night sky with large telescopes at the observatories. If poor weather, an alternate live tour of the night sky will be held in the planetarium theater. Free.
  - You must have completed the Park Volunteer Program in order to help with the public program. If you have, and have been trained, please show up at least 30 minutes prior to the official start time.



### • Astronomy Day - May 18, 2024 - 1p-4p; 8:30p-9:30p

 Come help share the fun of astronomy with the public. There will be tables with different themed topics plus solar and night viewing.

### • Annual Club Picnic - July 2024

 Date and site location will be sent directly to full BMAC members.
 BMACers and their families are welcome to enjoy an evening of astronomy-themed games and activities along with a potluck dinner and observing.

### • StarFest 2024 - November 1-3, 2024

- Our 39th annual astronomy convention / star gathering for the Southeast United States. Three days of astronomy fun, 5 meals, 4 keynote speakers, unique T-shirt and more!
- Pre-registration by Oct. 2024 with full payment is mandatory for attendance. Sorry, no walk-ins nor "visits."
- Link for all the StarFest info including registration and hotel reservation links.

### • BMAC Dinner - January 2025

• This event is for members and their families. Look for an e-mail in January with all the information.

## **Regular Contributors:**



Greg Penner



Robin Byrne



Adam Thanz

**G** reg Penner is a semi-retired architect living in the Tri-Cities area since 2018. He has enjoyed astronomy since childhood when he received a "department store telescope" and viewed Saturn for the first time. He has been a member since 2018.

obin Byrne has been writing the science history column since 1992 and was chair in 1997. She is an Associate Professor of Astronomy & Physics at Northeast State Community College (NSCC).

dam Thanz has been the BMAC Newsletter Editor for all but a small number of issues since 1992. He is the Planetarium Director at Bays Mountain Park and an astronomy adjunct instructor at NSCC since 2000.

### **Connection:**

B ays Mountain Astronomy Club:

- 853 Bays Mountain Park Road; Kingsport, TN 37650
- (423) 229-9447 Park Site Club Site
- Newsletter edited by Adam Thanz



- Dues are highly supplemented by the Bays Mountain Park Association and volunteerism by the club. As such, our dues are kept at an extremely low cost.
- \$16 / person / year
- \$6 / each additional family member
- Note: if you are a Park Member (which incurs a separate, additional fee), then a 50% reduction in BMAC dues are applied.
- Dues can be paid in many ways. The easiest way is to pay via the CivicRec online portal. If you are a current member, please log in with your e-mail address and reset your password if you have not already done so. You can then update your membership. Here's the direct <u>link</u>. If you want to add family members, then add them via the internal link. You can also pay at the gift shop, by mail or over the phone.

## Chapter Background Image Credits:

- Cover image of Southern Milky Way by Adam Thanz.
  - Sony A7ii with Zeiss Batis 2.8/18 lens, f/2.8, 8 sec., ISO 6,400, August 9, 2020.
- Table of Contents image of Comet NEOWISE (C/2020 F3) by Adam Thanz
  - Sony A7ii with Sony FE 2.8/90 Macro G OSS lens, f/2.8, 8 sec., ISO 4,000, July 15, 2020.
- Cosmic Reflections image of the Summer Triangle area of the Milky Way by William Troxel.
  - Image captured July 23, 2016.
- BMAC Notes painting of the Moon with moon glow by Christa Cartwright.
  - Painting based on a photograph of the Moon Christa captured July 2020.
- Stellar Observations image of Crescent Nebula by David Reagan.
  - This image was taken with a 140mm refractor in his suburban backyard using an AstroPhysics 900 mount, 8.7 hours of 5 minute Ha and OIII subexposures, combined in AstroPixelProcessor as an HOO image and processed in Lightroom and Photoshop. Image captured in 2022.
- The Queen Speaks image of a solar halo by Robin Byrne.
  - iPhone 7, June 8, 2020.
- The Space Place NASA Night Sky Network image of the Rho Ophiuchi cloud complex by Brandon Stroupe.
  - Canon 6D with Canon 2.8/70-200mm lens, f/2.8 @200mm, 20 x 120 sec. exposures, ISO 1,000, stacked in Deepsky Stacker, processed in Adobe Photoshop CC, Skywatcher Star Adventure mount, September 19, 2015.
- BMAC Calendar & More image of the Moon by Greg Penner.
  - *iPhone shooting through a 9mm eyepiece and 12.5*" Truss Tube Dobsonian @212x.
- All background images used with permission by their authors.