The Prairie Astronomer

December 2020 Volume 61, Issue #12

December Program:

Dr. Carter Emmert from the American Museum Hayden Planetarium

The Blue Ring Nebula

The Newsletter of the Prairie Astronomy Club

The Prairie Astronomer

NEXT MEETING AND PROGRAM

December 29, 7:30pm: Demo of Open Space - via Zoom

Dr. Carter Emmert from the American Museum Hayden Planetarium. His presentation is a spacewalk using Open Space technology and the enhanced images from the New Horizon spacecraft's close flyby of Pluto.

The Zoom link will be emailed to all club members the day before the meeting.

FUTURE PROGRAMS

To be announced

CONTENTS

Cover:The Blue Ring Nebula was discovered in 2004 by NASA's Galaxy Evolution Explorer (GALEX) mission. Astronomers think the nebula was created by the merger of two stars, and that we are seeing the system a few thousand years after the merger, when evidence of the collision is still apparent. See page 11.

CALENDAR

PAC Meeting
Tuesday, December 29, 2020, 7:30pm via Zoom

PAC Meeting
Tuesday, January 26, 2021, 7:30pm via Zoom

PAC Meeting
Tuesday, February 23, 2021, 7:30pm via Zoom

2021 STAR PARTY DATES

	Date	Date
January	8	**15**
February	5	**12**
March	5	**12**
April	2	**9**
May	7	**14**
June	4	**11**
July	2	**9**
August	Jul 30	**6**
September	Aug 27	**3**
October	1	**8**
November	Oct 29	**5**
December	Nov 26	**3**

Dates in **BOLD** are closest to the New Moon.

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Night Sky Network

www.prairieastronomyclub.org

The President's Message

Bob Kacvinsky

Merry Christmas, Happy Holidays and Happy New Year to you and your families. As we gather during this Holiday Season and reflect over 2020 it can be said that it has been one for the record books. So many activities, Star parties, Outreach events canceled. We all learned new terms like social distancing, quarantining, Zoom gatherings, and levels of sanitation that even grandmother would be put to shame. Yet, we also have found unique ways to share ideas, gather for club star parties, found great meeting program speakers, and even connected with the Lincoln Astronomical Society in the United Kingdom.

As vaccines begin to arrive, we look forward to some time during the upcoming springtime to be able to gather once again to observe, study, learn, and share the wonders of the space around us. I thank all of PAC for your patience as we have navigated these difficult times. One bright spot is we have had the opportunity to explore different meeting program offerings and especially speakers that we could never have been able to attract without the technology of Zoom meetings. Our Board will be evaluating how we might be able to continue use of the technology once we are able to gather again face to face.

Our next PAC meeting is Tuesday, Dec 29th at 7:30 PM via Zoom. Our special program speaker will be Dr. Carter Emmert from the American Museum Hayden Planetarium. His presentation is a spacewalk using Open Space technology and the enhanced images from the New Horizon spacecraft's close flyby of Pluto. We will be watching a video of his presentation from November to the Midwest Astronomy Club. Jack Dunn helped arrange for his program and our access to the presentation. Thanks Jack.

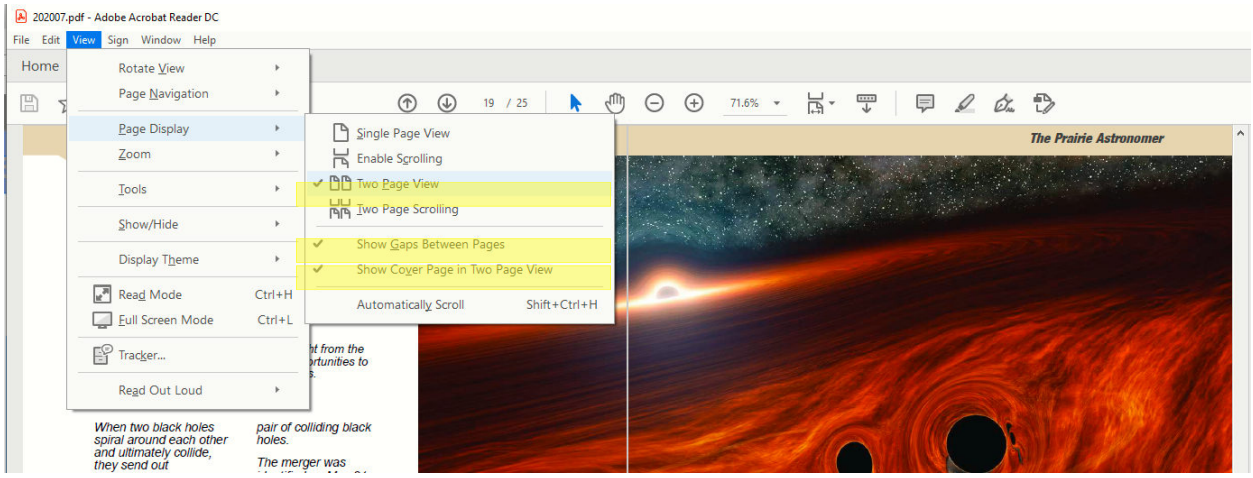
I hope some of you were able to get out Sunday evening, Dec 13th, and view the meteor shower between the clouds. At 10:30 PM there were about a dozen viewed in a 10-minute window. On Dec 21st, the Bethlehem Star conjunction of Jupiter and Saturn is a once in a lifetime opportunity that as of this writing I hope you have nice clear skies to view. This is the closest conjunction of the giant planets in 822 years and over 400 years till the next, so for most of us this is a once in a lifetime event.

Wishing everyone a safe and healthy 2021. We are all looking forward to getting back out and experiencing the wonders of the skies, especially for our newer PAC Members who have recently purchased telescopes. If you have any suggestions, ideas, or program recommendations please pass them along to one of your PAC Board members or post it on the PAC website comment area.

Clear Dark Skies to you,
kacvinskyb@yahoo.com
402-840-0084

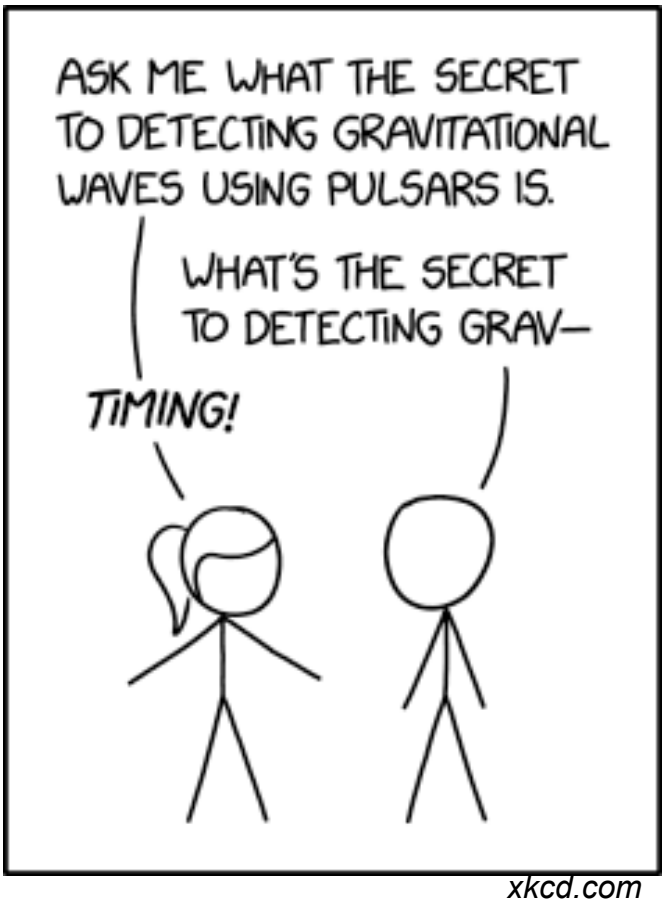
New Newsletter Format

How to Adjust Adobe Acrobat Settings for Two Page View



*To view this newsletter in magazine spread format in Acrobat, select **View ->Page Display->Two Page View**. Acrobat will then show two pages side by side. Also make sure the checkboxes "Show Cover Page in Two Page View" and "Show Gaps Between Pages" are checked.*

If you have it setup correctly, the cover page will be displayed by itself and subsequent pages will be side by side with the odd numbered pages on the left.



xkcd.com

Meeting Minutes

Bill Lohrberg

PAC meeting minutes November 24, 2020 as recorded by Bill Lohrberg

Bob Kacvinsky hosted the Zoom meeting which began at 7:34pm welcoming approximately 13 in attendance and a few others joining as meeting progressed.

Jim Kvasnicka presented the December observing report (details can be found in newsletter)

- Club star party dates were announced for Dec 11 & Dec 18 locations to be determined
- Highlight for Dec 21 will be a rare Jupiter and Saturn conjunction
- Geminids meteor shower peaks Dec 13 & 14 estimated 100 per hour

Bob shared some news of interest

- Europa glows due to high energy radiation from Jupiter.
- Mars rover Perseverance 86 days out (as of Nov 24).

Schedules and other announcements

- Bob reported on results of survey from members asking for suggestions to improve meetings. One idea was to do a meeting feature each month along the lines of "observing made easier". More experienced observers can share tips and tools and essentials to help beginners in the hobby. Bob called for volunteers to do short 3 to 5 minute presentations at future meetings. As an example, Bob shared resources for sky maps and charts, red dot finders which was a common theme of questions asked by newer club members and beginners at recent star party.
- Bob also suggested if any of the newer members are looking for filter sets there are some left over from the Jim Raines donation and to contact him for details if interested.
- Hyde observatory remains on hold, but upgrades to AV are in process.
- December meeting the 29th, program will be a video from Dr. Carter Emmart on Pluto and New Horizon
- Discounts for Sky & Telescope subscriptions can be negotiated if you call them and ask. (Bob sent an email detailing this)

Club Treasurer John Reinert gave a brief report

- Membership renewals are being updated and collected with membership at around 60
- Bob adds that December is the month we do clean up of accounts so please update your dues as soon as you can.

Other business:

- Brian Sivill announced Branched Oak Observatory is closed through end of year. Club members are welcome for Dec 11th or 18th but as a precaution to keep at 10 or less people on site…Bob suggests setting up on the separated small 6 x 6 ft cement pads works well to maintain social distancing etc. also to wear masks. Watch for announcements in case circumstances change.

At 7:54pm the meeting was concluded with no further business. The program "Planet 9 from outer space" video lecture presented by Konstantin Batygin.

Astrophotos

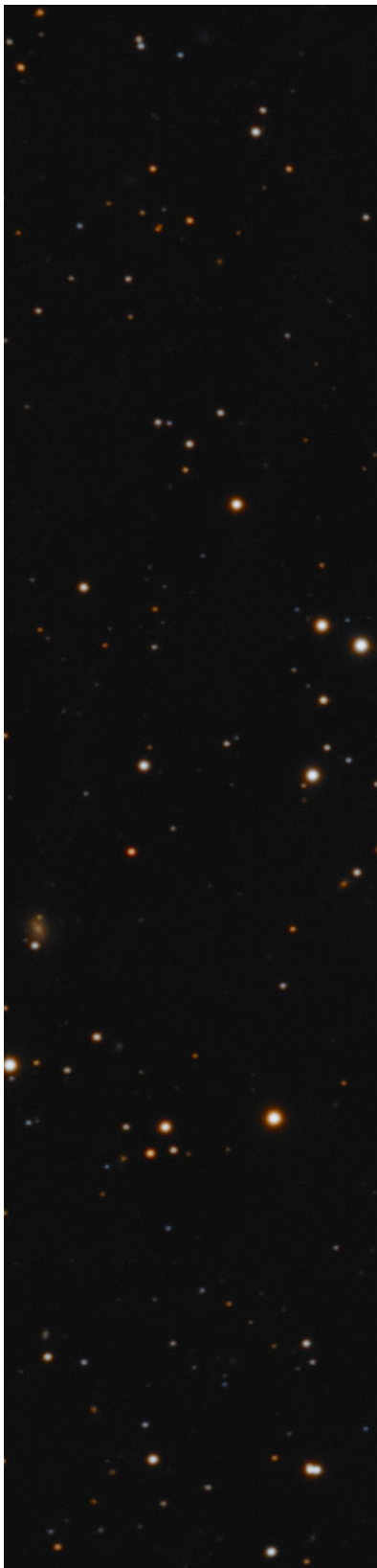
M27
by Jason O'Flaherty

In November I was able to capture M27 - Dumbbell Nebula. I took 60 photos between 1930 and 2200 (after which the horizon got too bright), but due to the wind, I was only able to use 11 for this stack.

11 Frame Stack - Dark Median Algorithm
120 sec at f/8.0 560mm (784 full frame equiv.)
ISO 1000
Fujifilm XT-4 XF100-400mmf4.5-5.6 +1.4xTC

ARP 25

Rick Johnson

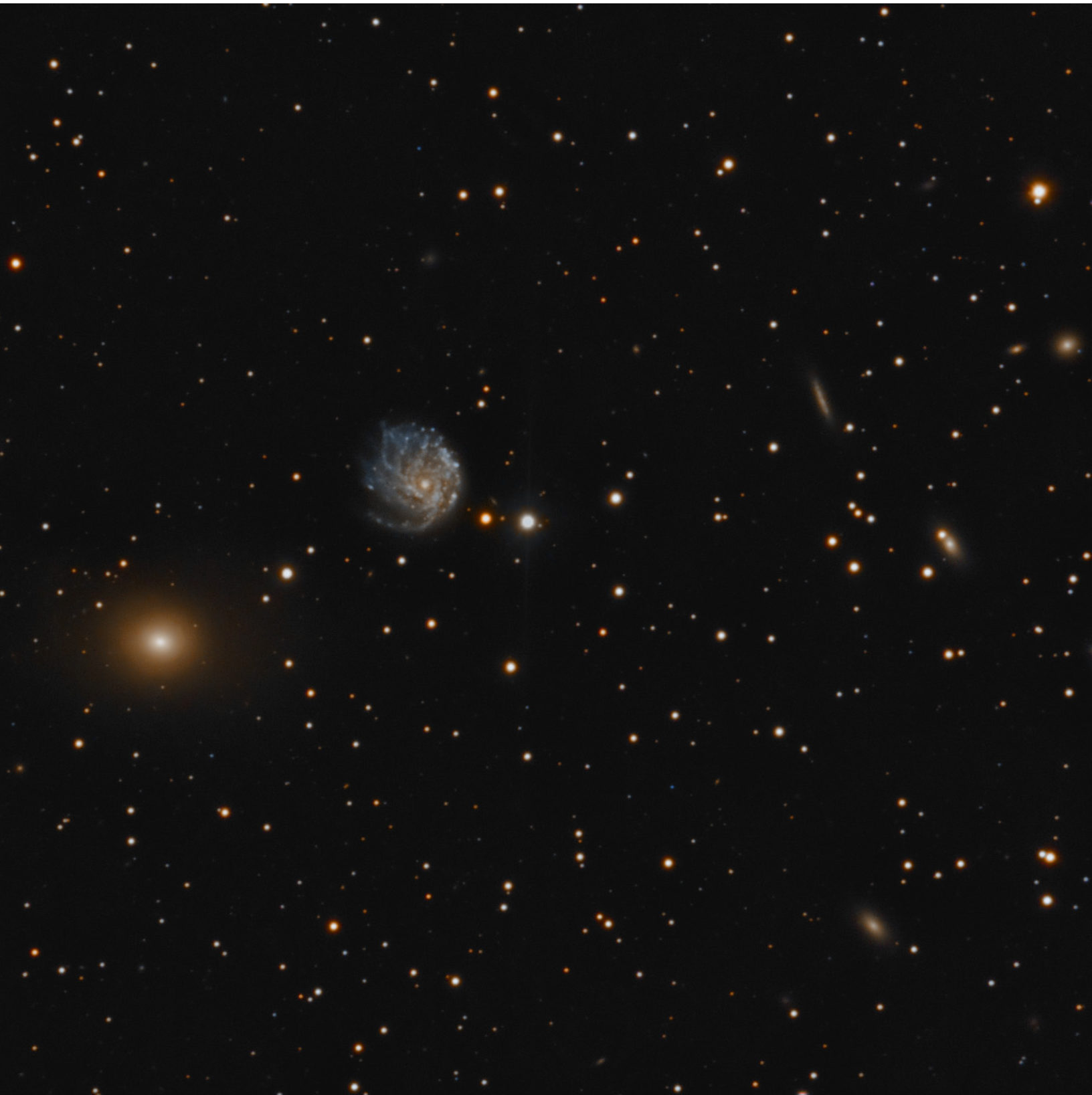


Arp 25/NGC 2276 is an interesting, many armed face on spiral. Arp put it in his category for spiral galaxies with one heavy arm. The most famous member of this category is M101. The galaxy is located in Cepheus. The distance is a bit vague. Redshift puts it at 110 million light-years. A single Tully Fisher measurement at NED says 120 million light years and a post at the HST website says 150 million light-years. Quite a difference. Arp's comment on this one under Arp 25's entry reads: "See also 114. Tubular arm, straight at first, then bent. Secondary arm from straight portion." Obviously, this refers to the southern arm that is somewhat separated from the rest of the galaxy and points in the general direction of NGC 2300. It's hard to write about Arp 25 without including nearby NGC 2300. So hard in fact that Arp made a second entry for NGC 2276 to include NGC 2300. Arp 25 was discovered by August Winnecke on June 26, 1876. Hubble image of part of NGC 2276 including the arm is at http://upload.wikimedia.org/wikipedia/commons/2/25/NGC_2276_Hubble_WikiSky.jpg

Arp 114 consists of NGC 2276 (Arp 25) and NGC 2300 and is in his category for elliptical and elliptical-like galaxies close to and perturbing spirals. Here Arp's comment concerns only NGC 2276 and ignores NGC 2300! It reads: "Spiral somewhat pec., may be perturbed. See No 25." While it is in a category assuming it is perturbed the comment says only it may be perturbed. For once I agree, it may be but that isn't all that certain. I see arguments either way. The big one that they aren't related is their redshift. By that measurement, NGC 2300 is some 24 million light-years closer than NGC 2276. But there are many non-redshift measurements of its distance that range from 101 to 134 million light-years and average out to about 115 million light-years. Then there's the above-mentioned 150 million light-year distance at the HST website. These would make them more likely to be true companions. But look at the redshift distances on the annotated image. They

The Mantrap Skies Image Catalog

Rick Johnson, a founding member of the Prairie Astronomy Club, passed away in January, 2019. His legacy lives on through his comprehensive catalog of over 1600 images at www.mantrapskies.com.



ARP25, continued.

seem to fall into two groups. One that fits NGC 2276 at about 110 million light years and one that matches NGC 2300 much closer distance. But with a sample size of 2 and 3, this is far from deciding the issue!

The HST site argues strongly for interaction with this post: http://www.spacetelescope.org/images/opo9305a/ This shows a huge enveloping cloud of hot gas seen in in X-rays around NGC 2300. It extends to NGC 2276. One possible explanation is an interaction between the two. But it certainly isn't required for this to occur.

NED classes NGC 2276 as SAB(rs)c, the NGC Project says simply Sc I. NED says of NGC 2300 it is SA0^0^ while the NGC Project says simply that it is an elliptical. Few sources I found agree with the elliptical classification. Most consider it a S0 type galaxy as NED suggests. This because some structure is seen in the outer halo of the galaxy. I am puzzled by the strong red color I got. While I found few color images of NGC 2300 on the net, the few I did find have it as nearly white. It was discovered by Alphonse Borrelly in 1871. I can't pin down the exact date.

Check Your Sky's Quality with Orion!

David Prosper

Have you ever wondered how many stars you can see at night? From a perfect dark sky location, free from any light pollution, a person with excellent vision may observe a few thousand stars in the sky at one time! Sadly, most people don't enjoy pristine dark skies – and knowing your sky's brightness will help you navigate the night sky.

The brightness of planets and stars is measured in terms of apparent magnitude, or how bright they appear from Earth. Most visible stars range in brightness from 1st to 6th magnitude, with the lower number being brighter. A star at magnitude 1 appears 100 times brighter than a star at magnitude 6. A few stars and planets shine even brighter than first magnitude, like brilliant Sirius at -1.46 magnitude, or Venus, which can shine brighter than -4 magnitude! Very bright planets and stars can still be seen from bright cities with lots of light pollution. Given perfect skies, an observer may be able to see stars as dim as 6.5 magnitude, but such fantastic conditions are very rare; in much of the world, human-made light pollution drastically limits what people can see at night.

Your sky's limiting magnitude is, simply enough, the measure of the dimmest stars you can see when looking straight up. So, if the dimmest star you can see from your backyard is magnitude 5, then your limiting magnitude is 5. Easy, right? But why would you want to know your limiting magnitude? It can help you plan your observing! For example, if you have a bright sky and your limiting magnitude is at 3, watching a meteor shower or looking for dimmer stars and objects may be a wasted effort. But if your sky is dark and the limit is 5, you should be able to see meteors and the Milky Way. Knowing this figure can help you measure light pollution in your area and determine if it's getting better or worse over time. And regardless of location, be it backyard,

balcony, or dark sky park, light pollution is a concern to all stargazers!

How do you figure out the limiting magnitude in your area? While you can use smartphone apps or dedicated devices like a Sky Quality Meter, you can also use your own eyes and charts of bright constellations! The Night Sky Network offers a free printable Dark Sky Wheel, featuring the stars of Orion on one side and Scorpius on the other, here: bit.ly/darkskywheel. Each wheel contains six "wedges" showing the stars of the constellation, limited from 1-6 magnitude. Find the wedge containing the faintest stars you can see from your area; you now know your limiting magnitude! For maximum accuracy, use the wheel when the constellation is high in the sky well after sunset. Compare the difference when the Moon is at full phase, versus new. Before you start, let your eyes adjust for twenty minutes to ensure your night vision is at its best. A red light can help preserve your night vision while comparing stars in the printout.

Did you have fun? Contribute to science with monthly observing programs from Globe at Night's website (globeatnight.org), and check out the latest NASA's science on the stars you can - and can't - see, 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!

The Dark Sky Wheel, showing the constellation Orion at six different limiting magnitudes (right), and a photo of Orion (left). What is the limiting magnitude of the photo? For most observing locations, the Orion side works best on evenings from January-March, and the Scorpius side from June-August.

January Observing

Jim Kvasnicka

This is a partial list of objects visible for the upcoming month.

Planets

Mars: The disk of Mars falls below 10" for the first time since June.

Jupiter, Saturn, and Mercury: The three form a triangle low in the WSW on the evening of January 9th. They may be difficult to see because of how low they are.

Uranus: On January 20th Mars is just 1½° SSE of Mars.

Neptune: In Aquarius.

Venus: Shines at magnitude -3.9 in the morning. On January 20th the thin crescent Moon will be 4° to the right of Venus.

Messier List

M33: The Pinwheel Galaxy in Triangulum.

M34: Open cluster in Perseus.

M52: Open cluster in Cassiopeia.

M74: Galaxy in Pisces.

M76: The Little Dumbbell in Perseus.

M77: Galaxy in Cetus.

M103: Open cluster in Cassiopeia.

Last Month: M2, M15, M29, M31, M32, M39, M110

Next Month: M1, M35, M36, M37, M38, M42, M43, M45, M78, M79

NGC and other Deep Sky Objects

NGC 1406: Galaxy in Fornax.

NGC 1425: Galaxy in Fornax.

NGC 1857: Open cluster in Auriga.

NGC 1907: Open cluster in Auriga.

NGC 1980: Emission nebula and open cluster in Orion just south of M42.

NGC 2169: The "37" Cluster in Orion.

Double Star Program List

Beta Orionis: Rigel, bright white and dim blue stars.

Delta Orionis: Mintaka, white and blue pair.

Struve 747: White pair of stars.

Lambda Orionis: White stars.

Theta 1 Orionis: The Trapezium.

Iota Orionis: White primary with a blue secondary.

Theta 2 Orionis: Three white stars.

Sigma Orionis: White primary with three pale blue stars.

Zeta Orionis: Bright white primary with two white secondary stars.

Challenge Object

B33: The Horsehead Nebula in Orion. Use a Hydrogen-Beta filter.

Focus on Observing

Lunar II Observing Program

Jim Kvasnicka

Many avid lunar observers have voiced their desire for a second, more challenging program to follow the popular Lunar Observing Program. In response the Astronomical League created a program for experienced lunar observers called the Lunar II Observing Program. The new program will require you to make at least 100 observations of the Moon. It is designed to improve your observing skills and expand your knowledge of the visible lunar surface. Prominent features will be revisited, observing them in greater detail and in varied sunlight. Some new lunar targets have been added. Some of the observations will be easy and some will be challenging and require greater observing skill. Participants will also be required to create a small, basic map of the visible face of the Moon.

To qualify for the Astronomical League Lunar II Program certificate and pin you need to:

1. Previously completed all of the Lunar Observing Program requirements.
2. Complete 100 or more of the observing tasks from the Lunar II target list.
   a. Several targets must be observed twice, in different light and shadow conditions.
   b. Several optional observing tasks are available, allowing you to make substitutions.
3. Keep a detailed log of your observations.
   a. The log should be similar to logs required by other observing programs.
   b. Notes should include the following:
      i. Target name and/or number.
      ii. Date and time.
      iii. Location including Latitude and longitude.
      iv. Seeing conditions.
      v. Equipment used.
      vi. Lunar phase.
4. Locate, identify, and observe individual lunar features.

Go To telescopes are allowed.

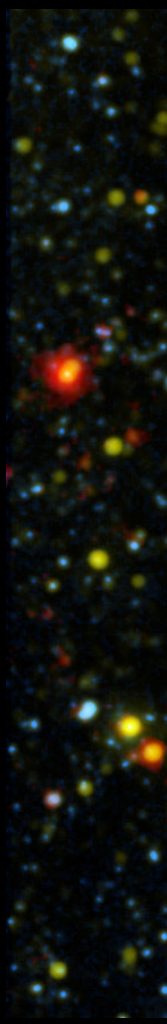
It helps to have a good lunar map to use when doing the Lunar II Program. There are some good maps you can purchase or you can find some on line to download. The list of Lunar II targets can be downloaded from the Astronomical League website.

When you complete the Lunar II Program you will need to submit a copy of your observing logs to me for review. If your logs are accurate and complete I will submit your name to the Lunar II Program chair for approval. The chair will mail to me your Lunar II certificate and pin which I will present to you at our monthly PAC meeting.

If you have any questions regarding the Lunar II Program or need help getting started please contact me and I will be glad to help.

16-Year-Old Cosmic Mystery Solved, Revealing Stellar Missing Link

The Blue Ring Nebula, which perplexed scientists for over a decade, appears to be the youngest known example of two stars merged into one.



In 2004, scientists with NASA's space-based Galaxy Evolution Explorer (GALEX) spotted an object unlike any they'd seen before in our Milky Way galaxy: a large, faint blob of gas with a star at its center. In the GALEX images, the blob appeared blue - though it doesn't actually emit light visible to the human eye - and subsequent observations revealed a thick ring structure within it. So the team nicknamed it the Blue Ring Nebula. Over the next 16 years, they studied it with multiple Earth- and space-based telescopes, but the more they learned, the more mysterious it seemed.

A new study published online on Nov. 18 in the journal Nature may have cracked the case. By applying cutting-edge theoretical models to the slew of data that has been collected on this object, the authors posit the nebula - a cloud of gas in space - is likely composed of debris from two stars that collided and merged into a single star.

While merged star systems are thought to be fairly common, they are nearly impossible to study immediately after they form because they're obscured by debris the collision kicks up. Once the debris has cleared - at least hundreds of thousands of years later - they're challenging to identify because they resemble non-merged stars. The Blue Ring Nebula appears to be the missing link: Astronomers are seeing the star system only a few thousand years after the merger, when evidence of the union is still plentiful. It appears to be the first known example of a merged star system at this stage.

Operated between 2003 and 2013 and managed by NASA's Jet Propulsion Laboratory in Southern California, GALEX was designed to help study the history of star formation throughout most of the universe by taking a census of young star populations in other galaxies. To do this, the mission observed both near-UV light (wavelengths slightly shorter than visible light) and far-UV. Most objects seen by GALEX radiated both near-UV (represented as yellow in GALEX images) and far-UV (represented as blue), but the Blue Ring Nebula stood out because it emitted only far-UV light.

The object's size was similar to that of a supernova remnant, which forms when a massive star runs out of fuel and explodes, or a planetary nebula, the puffed-up remains of a star the size of our Sun. But the Blue Ring Nebula had a living star at its center. What's more, supernova remnants and planetary

The Blue Ring Nebula consists of two expanding cones of gas ejected into space by a stellar merger. As the gas cools, it forms hydrogen molecules that collide with particles in interstellar space, causing them to radiate far-ultraviolet light. Invisible to the human eye, it is shown here as blue. Credit: NASA/JPL-Caltech/M. Seibert (Carnegie Institution for Science)/K. Hoadley (Caltech)/GALEX Team

nebulas radiate in multiple light wavelengths outside the UV range, while further research showed that the Blue Ring Nebula did not.

Phantom Planet

In 2006, the GALEX team looked at the nebula with the 200-inch (5.1-meter) Hale telescope at the Palomar Observatory in San Diego County, California, and then with the even more powerful 10-meter (33-foot) telescopes at the W.M. Keck Observatory in Hawaii. They found evidence of a shockwave in the nebula, suggesting the gas composing the Blue Ring Nebula had indeed been expelled by some kind of violent event around the central star. Keck data also suggested the star was pulling a large amount of material onto its surface. But where was the material coming from?

"For quite a long time we thought that maybe there was a planet several times the mass of Jupiter being torn apart by the star, and that was throwing all that gas out of the system," said Mark Seibert, an astrophysicist with the Carnegie Institution for Science and a member of the GALEX team at Caltech, which manages JPL.

But the team wanted more data. In 2012, using the first full-sky survey from NASA's Wide-field Infrared Survey Explorer (WISE), a space

Stellar Mystery, continued.

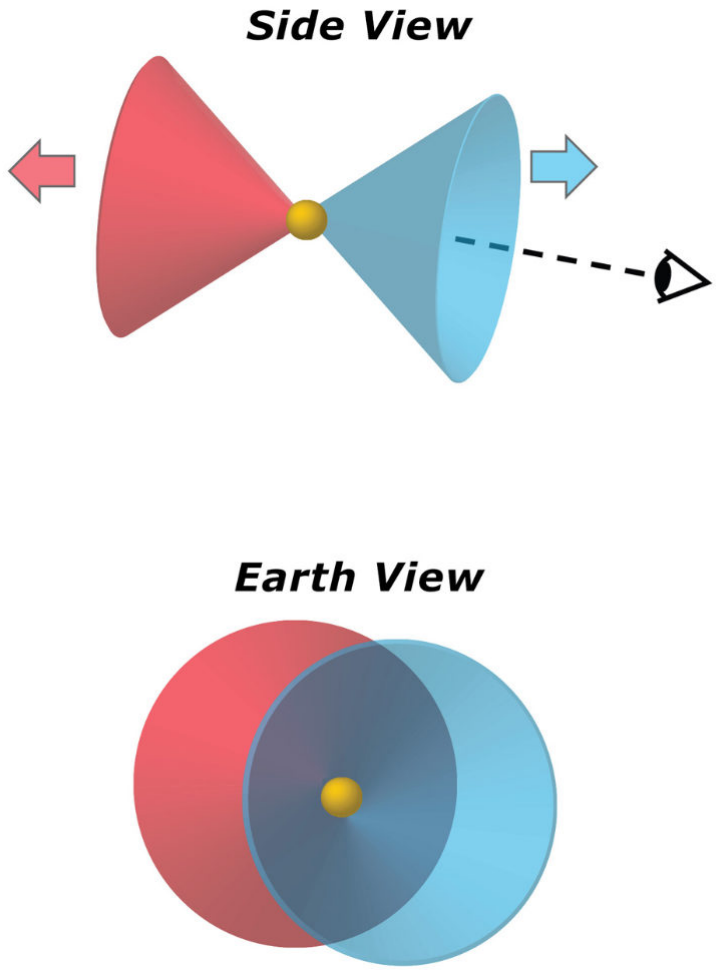
telescope that studied the sky in infrared light, the GALEX team identified a disk of dust orbiting closely around the star. (WISE was reactivated in 2013 as the asteroid-hunting NEOWISE mission.) Archival data from three other infrared observatories, including NASA's Spitzer Space Telescope, also spotted the disk. The finding didn't rule out the possibility that a planet was also orbiting the star, but eventually the team would show that the disk and the material expelled into space came from something larger than even a giant planet. Then in 2017, the Habitable Zone Planet Finder on the Hobby-Eberly Telescope in Texas confirmed there was no compact object orbiting the star.

More than a decade after discovering the Blue Ring Nebula, the team had gathered data on the system from four space telescopes, four ground-based telescopes, historical observations of the star going back to 1895 (in order to look for changes in its brightness over time), and with the help of citizen scientists through the American Association of Variable Star Observers (AAVSO). But an explanation for what had created the nebula still eluded them.

Stellar Sleuthing

By the time Keri Hoadley began working with the GALEX science team in 2017, "the group had kind of hit a wall" with the Blue Ring Nebula, she said.

But Hoadley, an astrophysicist at Caltech, was fascinated by the object and its bizarre features, so she accepted the challenge of trying to solve the mystery. It seemed likely that the solution would not come from more observations of



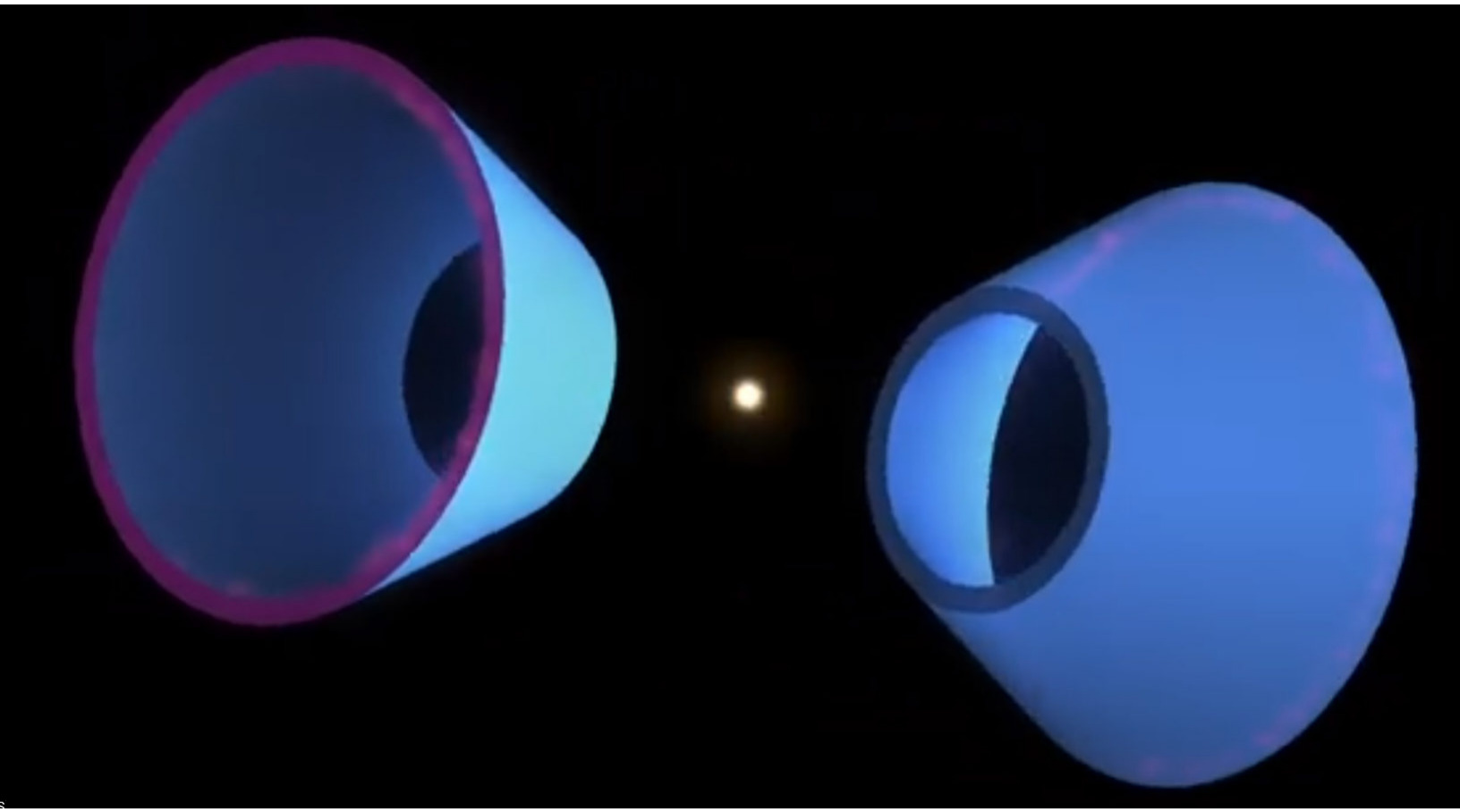
The Blue Ring Nebula consists of two hollow, cone-shaped clouds of debris moving in opposite directions away from the central star. The base of one cone is traveling almost directly toward Earth. As a result, astronomers looking at the nebula see two circles that partially overlap. Credit: Mark Seibert

the system, but from cutting-edge theories that could make sense of the existing data. So Chris Martin, principal investigator for GALEX at Caltech, reached out to Brian Metzger of Columbia University for help.

As a theoretical astrophysicist, Metzger makes mathematical and computational models of cosmic phenomena, which can be used to predict how those phenomena will look and behave. He specializes in cosmic mergers - collisions between a variety of objects, whether they be planets and stars or two black holes. With Metzger on board and Hoadley shepherding the work, things progressed quickly.

"It wasn't just that Brian could explain the data we were seeing; he was essentially predicting what we had observed before he saw it," said Hoadley. "He'd say, 'If this is a stellar merger, then you should see X,' and it was like, 'Yes! We see that!'"

The team concluded that the nebula was the product of a relatively fresh stellar merger that likely occurred between a star similar to our Sun and another star only about one-tenth that size (or about 100 times the mass of Jupiter). Nearing the end of its life, the Sun-like star began to swell, creeping closer to its companion. Eventually, the smaller star fell into a downward spiral toward its larger companion. Along the way, the larger star tore the smaller star apart, wrapping itself in a ring of debris before swallowing the smaller star entirely.



Click to play video. The Blue Ring Nebula consists of two expanding cones of debris. The base of one cone is moving toward Earth. Both bases are outlined in magenta, revealing shockwaves created as the debris races through space. Blue represents material behind the shockwave and is visible only where the cones overlap. Credit: NASA/JPL-Caltech/R. Hurt

Stellar Mystery, continued.

This was the violent event that led to the formation of the Blue Ring Nebula. The merger launched a cloud of hot debris into space that was sliced in two by the gas disk. This created two cone-shaped debris clouds, their bases moving away from the star in opposite directions and getting wider as they travel outward. The base of one cone is coming almost directly toward Earth and the other almost directly away. They are too faint to see alone, but the area where the cones overlap (as seen from Earth) forms the central blue ring GALEX observed.

Millennia passed. The expanding debris cloud cooled and formed molecules and dust, including hydrogen molecules that collided with the interstellar medium, the sparse collection of atoms and energetic particles that fill the space between stars. The collisions excited the hydrogen molecules, causing them to radiate in a specific wavelength of far-UV light. Over time, the glow became just bright enough for GALEX to see.

Stellar mergers may occur as often as once every 10 years in our Milky Way galaxy, meaning it's possible that a sizeable population of the stars we see in the sky were once two.

"We see plenty of two-star systems that might merge some day, and we think we've identified stars that merged maybe millions of years ago. But we have almost no data on what happens in between," said Metzger. "We think there are probably plenty of young remnants of stellar mergers in our galaxy, and the Blue Ring Nebula might show us what they look like so we can identify more of them."

Though this is likely the conclusion of a 16-year-old mystery, it may also be the beginning of a new chapter in the study of stellar mergers.

"It's amazing that GALEX was able to find this really faint object that we weren't looking for but that turns out to be something really interesting to astronomers," said Seibert. "It just reiterates that when you look at the universe in a new wavelength or in a new way, you find things you never imagined you would."

JPL, a division of Caltech, managed the GALEX mission for NASA's Science Mission Directorate. The mission was developed by NASA's Goddard Space Flight Center in Greenbelt, Maryland, under the Explorers Program. JPL also managed the Spitzer and WISE missions, and manages the NEOWISE mission. For more information about the GALEX mission visit:

http://www.galex.caltech.edu/index.html

https://www.jpl.nasa.gov/missions/galaxy-evolution-explorer-galex/

What's Up: December

NASA/JPL

This is a portion of the transcript for JPL's December video:

Jupiter and Saturn have been traveling across the sky together all year, but this month, get ready for them to really put on a show. Over the first three weeks of December, watch each evening as the two planets get closer in the sky than they've appeared in two decades. Look for them low in the southwest in the hour after sunset. And on December 21st, the two giant planets will appear just a tenth of a degree apart - that's about the thickness of a dime held at arm's length! This means the two planets and their moons will be visible in the same field of view through binoculars or a small telescope. In fact, Saturn will appear as close to Jupiter as some of Jupiter's moons.

This event is called a "great conjunction." These occur every 20 years this century as the orbits of Earth, Jupiter, and Saturn periodically align making these two outer planets appear close together in our nighttime sky. Even so, this is the "greatest" great conjunction between Jupiter and Saturn for the next 60 years, with the two planets not appearing this close in the sky until 2080.

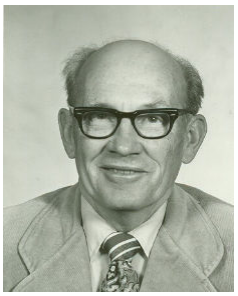
The 21st is also the date of the December solstice, which is the winter solstice in the Northern Hemisphere and the summer solstice in the Southern Hemisphere. On the December solstice, the Sun reaches its southernmost position in the sky, no matter where on Earth you happen to be.

In the Northern hemisphere, the Sun travels its lowest, shortest path across the sky on that day. Thus, in the north, the winter solstice brings the shortest day of the year, in terms of hours of sunlight.

Now the Sun's changing height in the sky throughout the year is caused by Earth's tilt as it orbits our local star. The tilt causes the amount of sunlight each hemisphere receives to go up and down in the annual cycle of the seasons.

Here are the phases of the Moon for December. You can catch up on all of NASA's missions to explore the solar system and beyond at nasa.gov. I'm Preston Dyches from NASA's Jet Propulsion Laboratory, and that's What's Up for this month.

VIDEO



From the Archives

December, 1996

RIP Carroll Moore,
October 7, 1917 -
December 3, 1996

CARROLL MOORE: a personal remembrance
By Rick Johnson

December 3, 1996 is when the Prairie Astronomy Club and Hyde Observatory lost their father. These two astronomical groups were certainly two of his many children. He fathered both, guided them for a short while, then let them go out on their own. A most difficult task indeed, watching your children stand on their own.

I first met Carroll shortly after he joined Nebraska Wesleyan University in 1955. Before that, he was a student, then faculty member of Doane College in Crete. I had just built my first telescope; a 6" f/l2 far larger than me. My folks were out of town and I had a live-in baby sitter - I was only 10 or 11 at the time. She (Mrs. Frost) took me to see Carroll for some tips on using the telescope. Here I expected to see some giant astronomer (at least this is how I imagined him from Mrs. Frost's description). But instead here was this little fellow not much bigger than me. I asked a few very dumb questions, but Carroll acted as if they were of major importance. He had a sign-up sheet, which he asked anyone interested in joining an astronomy club to sign, so I added my name to the list. I left feeling like I now knew everything there was to know about astronomy! The following year my folks went away again (Dad was president of the American Institute of CPAs and had to attend the national meetings) and, again Mrs. Frost took me to see Carroll. Each year he got shorter and shorter, balder and balder. I always entered his office full of dumb questions and left feeling like I was a genius. Carroll always had a way of working with kids that to this day amazes me. Each time he had that sign-up sheet and each time I signed it. This continued for several years through the fall of 1959, I was in junior high by this time and still signing that blasted sheet of paper.

Carroll announced the newly reworked observatory at Wesleyan with its 6" refractor would be open to the public for viewing the transit of Mercury (November 7th, 1960). I vowed to skip school and be there for the event. My dad agreed and got me excused from school. We went to the Wesleyan Observatory where Carroll had the 6" refractor set up to project a 6" sun on a card and there was the black dot of Mercury! I was now in an "official" observatory doing "real" astronomy. At least that is the impression Carroll left me with. You guessed it, I again signed that blasted sheet of paper, though for the last time, but I didn't know that at the time. After the transit he now had enough names that an astronomy club looked possible. A preliminary meeting was held sometime in late 1960, but I couldn't attend. The first official meeting was held in April, 1961 and nothing could keep me away. The Prairie Astronomy Club was a reality! I was now at Southeast High. Carroll never let me forget that the sign-up sheet said at the top to sign up only once and I had signed up more than a dozen times; nine more than anyone else (at least someone else couldn't read either). Like a good father, Carroll provided guidance from the background. He never took part as a working officer, but was always there with advice and a program when nothing

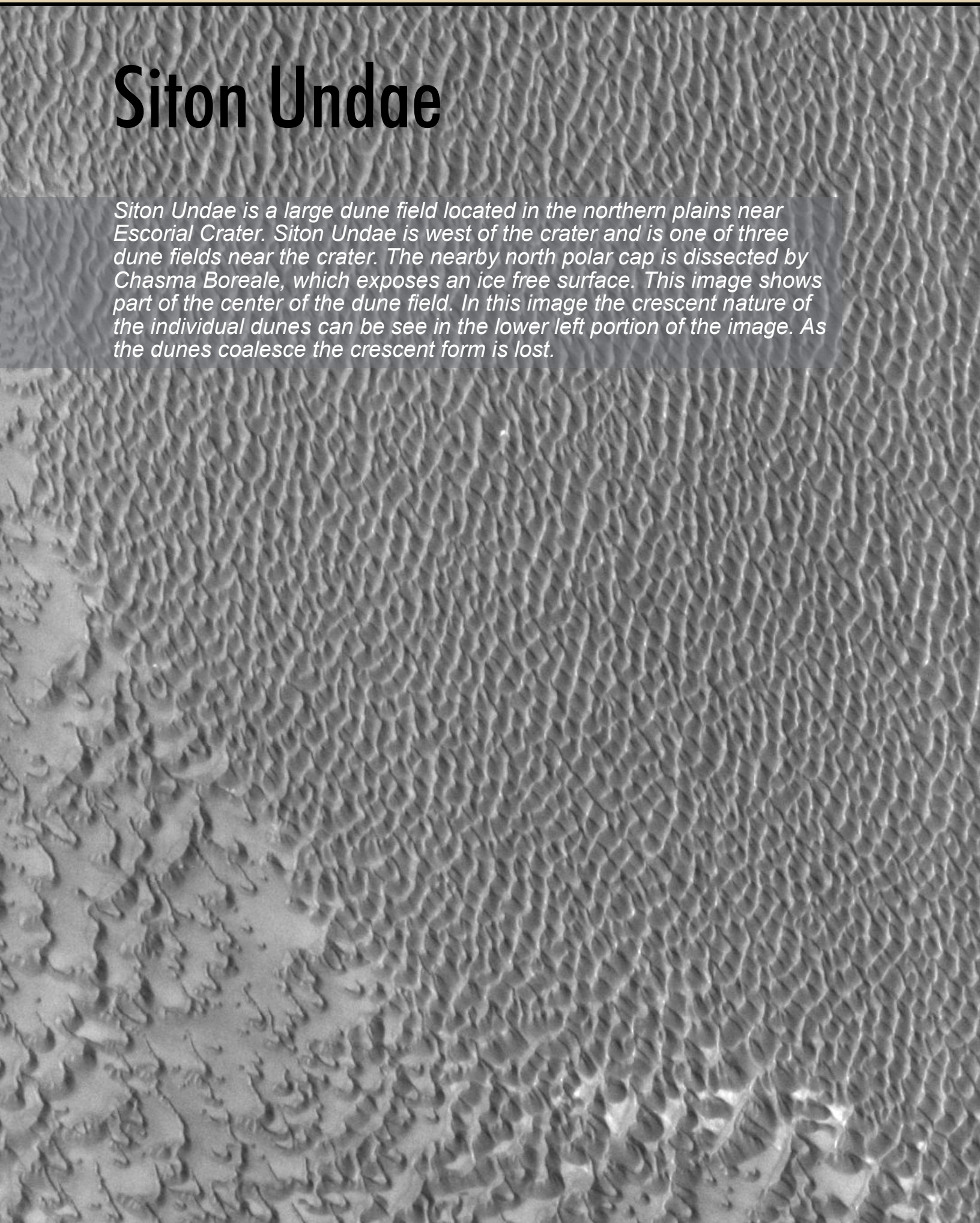
else was available. He provided the meeting place; a very old, rickety, science building on the Wesleyan campus and watched as his child slowly grew and grew, always taking a special interest in the young members.
One of our founding members was another Southeast High student, Pete Schultz. Carroll took a special interest in Pete for two reasons. First, Pete wanted to be a professional astronomer and secondly, as long as Pete was a member, Carroll wasn't the shortest member of the club! Like Pete, Carroll was no whiz at math (even though, at Doane he was listed as a math and science professor). Pete was worried this would prevent him from ever getting anywhere in astronomy. In fact, even after placing high in the Westinghouse science contest, Pete was sure he'd never make the grade, but Carroll never let him give up. Often, with a foot planted firmly on Pete's backside, he kept Pete on track. Pete is now a well respected planetary geologist who has appeared on PBS science specials, thanks to abilities he didn't know he had and Carroll's foot! Carroll booted him on into the professional world even though it meant Carroll was again the shortest member of the club; a sacrifice he never let Pete forget!

At this time Carroll only had a bachelor's degree and needed a master's degree. He had to take leave from Wesleyan to get his degree from the University of Nebraska and thus, we lost our meeting place and mentor. The club did just fine, moving from one home to the next. In fact, we even felt strong enough to try and start a public observatory. I remember going onto more than one morning show (I'm not a morning person) to plug for it. We fell flat on our face not understanding the complexities that were involved, nor the money needed. But we were young and foolish, so what the heck! Finally, Carroll completed his work and Wesleyan had a brand new state-of-the-art science building. We had a new home. This one didn't make you feel like you were going to fall through the stairs any second. The club really began to grow and attract young members again. This time we could hold our business meetings upstairs in the lecture hall, while Carroll gave a planetarium show to the kids and any adult who wasn't interested in the business side of the meeting. Each kid was expected to learn enough to provide a 15 minute program once a year to the main group. Boy, were they scared, but they learned astronomy! Carroll made sure of that.

Carroll picked up our botched idea for a public observatory and turned it into a reality. He almost gave up as the task of gathering interesting enough people (people with money, that is) seemed impossible. But to the shortest club member, nothing was impossible - heck he was guard on the Doane College football team! Carroll put together a team of people from all walks of life and before long, but not before one heck of a lot of work, Hyde Memorial Observatory was a reality in November, 1977 and the Prairie Astronomy Club had a new home. Carroll took the reins of the Hyde steering committee the first years, then passed them on to the other supervisors. The last few years he was content to just watch his children fly on their own and come to the meetings wearing fuzzy dinosaur shoes that growled with each step, when he wasn't chasing another solar eclipse, that is. Carroll, you should have told us you were a huge professional wrestling fan. I would have introduced you to "The Claw" who now runs a tourist curio shop only a few miles from my cabin in Minnesota.

Thank you Carroll, for giving us our wings. You always said you were the shortest club member, but you were one of the biggest men I ever knew.

Siton Undae



Siton Undae is a large dune field located in the northern plains near Escorial Crater. Siton Undae is west of the crater and is one of three dune fields near the crater. The nearby north polar cap is dissected by Chasma Boreale, which exposes an ice free surface. This image shows part of the center of the dune field. In this image the crescent nature of the individual dunes can be see in the lower left portion of the image. As the dunes coalesce the crescent form is lost.

CLUB MEMBERSHIP INFO

REGULAR MEMBER - $30.00 per year. Includes club newsletter, and 1 vote at club meetings, plus all other standard club privileges.

FAMILY MEMBER - $35.00 per year. Same as regular member except gets 2 votes at club meetings.

STUDENT MEMBER - $10.00 per year with volunteer requirement.

If you renew your membership prior to your annual renewal date, you will receive a 10% discount.

Club members are also eligible for special subscription discounts on Sky & Telescope Magazine.

CLUB TELESCOPES

To check out one of the club telescopes, please contact a club officer. Scopes can be checked out at a regular club meeting and kept for one month. Checkout can be extended for another month if there are no other requests for the telescope, but you must notify a club officer in advance.

100mm Orion refractor: Available
10 inch Meade Starfinder Dobsonian: Available
13 inch Truss Dobsonian: Needs repair
10 inch Zhumell: Needs mount

Buy the book! The Prairie Astronomy Club: Fifty Years of Amateur Astronomy. Order online from Amazon or lulu.com.

ADDRESS

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The Prairie Astronomer is published monthly by the Prairie Astronomy Club, Inc. Membership expiration date is listed on the mailing label. Membership dues are: **Regular $30/yr, Family $35/yr**. Address all new memberships and renewals to: **The Prairie Astronomy Club, Inc., PO Box 5585, Lincoln, NE 68505-0585**. For other club information, please contact one of the club officers listed to the right. Newsletter comments and articles should be submitted to: **Mark Dahmke, P. O. Box 5585, Lincoln, NE 68505 or** mark@dahmke.com**,** no less than ten days prior to the club meeting. The Prairie Astronomy Club meets the last Tuesday of each month at Hyde Memorial Observatory in Lincoln, NE.