

# *The Prairie Astronomer*

February 2019 Volume 60, Issue #2

*Farewell  
Opportunity*



**Night Sky Network**



The Newsletter of the Prairie Astronomy Club

# ***The Prairie Astronomer***

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## **NEXT PAC MEETING: February 26 at 7:30pm at Hyde Observatory**

### **PROGRAM**

Our Special program will be from Nebraska NET as they share some of the videos they took last summer during the Nebraska Star Party. They also will update the club on the 360 video productions and plans going forward. The focus on their program is light pollution.


### **FUTURE PROGRAMS (Tentative)**

March: Outreach Tips  
April: Binocular Observing  
May: Annual Club Dinner  
June: Solar Star Party  
July: Beginning Astrophotography  
August: NSP Review  
September: to be determined  
October: Club Viewing Night  
November: How to Buy a Telescope  
December: Club Holiday Gathering

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*Cover: The dramatic image of NASA's Mars Exploration Rover Opportunity's shadow was taken on sol 180 (July 26, 2004), by the rover's front hazard-avoidance camera as the rover moved farther into Endurance Crater in the Meridiani Planum region of Mars. Credit: NASA/JPL-Caltech. was taken on sol 180 (July 26, 2004), by the rover's front hazard-avoidance camera as the rover moved farther into Endurance Crater in the Meridiani Planum region of Mars. Credit: NASA/JPL-Caltech.*



The Prairie Astronomy Club:  
Fifty Years of Amateur Astronomy

**Buy the book! The Prairie Astronomy Club: Fifty Years of Amateur Astronomy.**  
Order online from [Amazon](https://www.amazon.com) or [lulu.com](https://www.lulu.com).

COMPILED AND EDITED BY MARK DAHMKE

# EVENTS



PAC Meeting  
 Tuesday February 26, 2019, 7:30pm  
 Program: Nebraska NET

PAC Meeting  
 Tuesday March 26, 2019, 7:30pm  
 Program: Outreach Tips

PAC Meeting  
 Tuesday April 30, 2018, 7:30pm  
 Program: Binocular Observing

PAC Meeting  
 Tuesday May 28, 2019, 7:30pm  
 Annual Club Dinner

## 2019 STAR PARTY DATES



Photo by Brian Sivill

	Star Party Date	Star Party Date
January	Dec 28	<b>Jan 4</b>
February	Jan 25	<b>Feb 1</b>
March	Mar 1	<b>Mar 8</b>
April	Mar 29	<b>Apr 5</b>
May	Apr 26	<b>May 31</b>
June	Jun 21	<b>Jun 28</b>
July	Jul 26	<b>Aug 2</b>
NSP	<b>July 28 - Aug 2</b>	
August	Aug 23	<b>Aug 30</b>
September	Sep 20	<b>Sep 27</b>
October	Oct 18	<b>Oct 25</b>
November	Nov 22	<b>Nov 29</b>
December	Dec 20	<b>Dec 27</b>

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



## PAC E-MAIL:

[info@prairieastronomyclub.org](mailto:info@prairieastronomyclub.org)

## PAC-LIST:

Subscribe through [GoogleGroups](#).  
 To post messages to the list, send to the address:

[pac-list@googlegroups.com](mailto:pac-list@googlegroups.com)

## ADDRESS

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## WEBSITES

- [www.prairieastronomyclub.org](http://www.prairieastronomyclub.org)
- <https://nightsky.jpl.nasa.gov>
- [www.hydeobservatory.info](http://www.hydeobservatory.info)
- [www.nebraskastarparty.org](http://www.nebraskastarparty.org)
- [www.OmahaAstro.com](http://www.OmahaAstro.com)
- [Panhandleastronomyclub.com](http://Panhandleastronomyclub.com)
- [www.universetoday.com/](http://www.universetoday.com/)
- [www.planetary.org/home/](http://www.planetary.org/home/)
- <http://www.darksky.org/>



**Night Sky Network**

## Meeting Minutes

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PAC meeting minutes Jan 29, 2019

Approximately 20 members present, 5 guests present, started with one scope for help and another joined the meeting in progress.

Assortment of cookies served.

Bob Kacvinsky called the meeting to order at 7:30pm, noting the low turnout of guests with telescopes likely due to the extremely cold weather, as we were originally expecting about 10 others. Bob suggested the possibility of extending the "how to use your telescope" program for next month's meeting.

Jim Kvasnicka presented the observing report: Starting with announcement that due to snow and ground conditions the scheduled start party for February 1<sup>st</sup> will be moved from Cortland site to the Branched Oak Observatory site, pending similar conditions there.

February Observing:

- Evening planets: Mercury too low in west until Feb 12<sup>th</sup>, Uranus Feb 12<sup>th</sup> visible 1 degree south of Mars.
- Morning planets: Jupiter rises in Southeast at about 3:30am to start the month, 2am to end the month, Venus 30 minutes after Jupiter, Feb 18<sup>th</sup> Saturn and Venus will be 1 degree apart in the predawn sky.
- Messiers for February include M1 the crab nebula in Taurus, M35 open cluster in Gemini, M36, M37 and M38 open clusters in Auriga, M42 and M43 nebulae in Orion, M78 reflection nebula also in Orion, M45 Pleiades, and M79 globular cluster in Lepus
- Other deep sky objects NGC 2264 AKA the Christmas tree star cluster and Cone nebula, open cluster NGC 2266 in Gemini, NGC 2362, NGC2392 the eskimo nebula , and galaxy NGC2403

Review of notable recent events:

- Lunar eclipse occurred January 20<sup>th</sup>. Lincoln area was mostly clouded out especially for the period during totality. But many images and video were available to capture the event.
- A bright flash from a presumed meteorite impact was observed south of the crater Byrgius during the eclipse and later confirmed at approximately 10:41pm central time. This is the first such recorded sighting during a lunar eclipse event.
- On January 1, New Horizons spacecraft completed its epic flyby of Kuiper belt object Ultima Thule MU69 collecting images and data to be processed.
- InSight Mars mission lander began surface operations and preparations for science data collection.
- With data collected from Cassini it was discovered that Saturn's rings were formed relatively recently (10 – 100 million years old), a short discussion ensues about what caused the rings to form.
- China made history with its first successful soft landing on the far side of the moon Jan 2. With its lander Chang'e 4 and Yutu-2 rover, both have been exploring the lunar surface inside Von Karman crater.
- John Lammers presented a bit of news - how amateur astronomers were able to discover planetesimal with 11" scopes imaging about 12,000 stars and timing occultations, the planetesimal object is estimated to be 1.3 Kilometers across, and about 32 AU distant (about Pluto's distance). This serves to remind us that important and significant discoveries in astronomy are still being made by amateurs.

Other announcements:

- Mid States Regional Astronomical League (MSRAL) will be at Rockhurst University in Kansas City, Missouri this year. June 14<sup>th</sup> through June 16<sup>th</sup>. It would be great to get a good group of PAC members to attend.
- Nebraska Star Party (NSP) 2019 at Merritt Reservoir will be July 28<sup>th</sup> through August 2<sup>nd</sup>.
- The condition of Hyde observatory roof was discussed. Currently the roof is stuck, possibly due to cold weather. Per Brian Sivil – engineers have looked and ideas to replace or repair are currently being discussed. As to

the question of whether supervisors should attempt to open, do so at your own risk, as you might not get it closed. Also do not attempt to climb up and fix as the city will not be held liable for injury.

- Reminder to watch NET series “Nebraska Stories” for airing of the featurette recorded at the 2018 NSP. Shows are Thursdays on NET starting 8pm. Brett will check on specific dates but also notes the full, less-edited feature will be available to us as well.

Meeting adjourned to the program “How to use your telescope” approximately 8:05pm.

## **President’s Message**

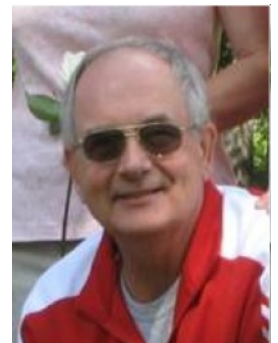
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Welcome everyone to February, just one more month closer to warmer and hopefully clearer skies. I’m sure we are all wishing for better weather just as the public looks forward to finally having the telescopes out at Hyde. Our next club star party is March 1<sup>st</sup> at Branched Oak Observing field. I’m look forward to finally getting a chance to test out observing on the new cement pad. Hope you can join in.

Please plan to attend the February Club Meeting on Tuesday, February 26<sup>th</sup> at 7:30. Our Special program will be from Nebraska NET as they share some of the videos they took last summer during the Nebraska Star Party. They also will update the club on the 360 video productions and plans going forward. The focus on their program was light pollution which we all can appreciate.

If you have any suggestions or ideas for programs you would like to see at upcoming meetings, please let Christine Parkyn or any of the club officers know. We are always looking for subjects of interest and ideas of topics you would like to learn more about.

I thought you might be interested that each month we get a few inquiries from people wanting to know more about astronomy, where to find/buy a telescope, and general “help me” type requests. We also have already received several requests for Outreach



activities during the upcoming summer months. If you would like to help out please let our Outreach Coordinator Mike Kearns know. Many activities do not take a lot of time or preparation, and if you are not sure you “are qualified” please remember that your audience typically has much less knowledge and we will always make sure you get paired up with a more experienced person. If you have ever experienced the “WOW” reaction of a 6 year old for the first time seeing Saturn, you know how rewarding the experience can also be for you.

Dark “and clear” Skies to You,  
Bob Kacvinsky

*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](http://www.mantrapskies.com).*



Arp 2 is an SB dwarf galaxy of the Magellenic class. Arp classed it as Spiral galaxy: low surface brightness. It is indeed. I used twice my normal exposure time on this object and it was still exceedingly difficult to pull out of the noise. This is one challenging object needing very dark skies.

It is also known as UGC 10310 and is thought to be about 15.8 megaparsecs away or about 50 million light-years away. Though redshift alone would indicate a closer distance of 10.5 megaparsecs or 34 million light years. But at this close distance redshift alone is often a very poor distance indicator. One note at NED is shown below.

"This magellanic barred spiral has rather poor H $\alpha$  emission, but exhibits a very bright giant HII region to the SE. Some emission can be seen in the north part of the bar and in the spiral arms starting at both ends. The scarcity of the



emission makes the drawing of isovelocity lines difficult. It is also hard to derive a reliable rotation curve, although both sides are in fairly good agreement and suggest that a maximum around  $70 \text{ km s}^{-1}$  is reached at about 50 arcsec from the center. The WHISP HI data show that the neutral gas is mainly concentrated in the two spiral arms. Our H $\alpha$  velocities are consistent with the HI velocity field, as confirmed by the good agreement between our rotation curve and the HI curve derived by Swaters (1999)."

Some of that weak H alpha emission at the north part of the bar may be why the upper end of the galaxy has a slightly reddish hue. The HII region to the SE is very obvious in my image as the blue blob. Stretching the image has greatly increased its size same as a star gets increased. In the original data stars in the image have an FWHM of 2.8" (better than

average for my location) but this "star" was 4.6" FWHM showing it wasn't a star at all. Arp made the following comment about the galaxy and this object: "Low surface brightness dwarf. Large bright knot in arm appears almost stellar." Some of the other blue "stars" may also be HII regions in the galaxy. Their distribution would seem to suggest this is the case.

Annotated image shows galaxies, two quasars and a quasar candidate's distance in billions of light years. One galaxy cluster, MaxBCG J243.92214+47.16785 at about 2.5 billion light years it has the core galaxy marked as GC. NED says it has 14 members. No diameter is given but I assume most if not all the reddened galaxies in this part of the image belong to the cluster. Only the 2 marked galaxies have a redshift given, however. Oddly they result in a distance of 2.4 billion light years. This may be the

more accurate figure. So that is what I used.

To give an indication of how deep this image goes I've marked the magnitude of one star on the SDSS survey they list at 22.1 magnitude. Oddly the galaxy beside it isn't listed! I see this quite often but don't know the reason.

There was a horrid flare from a star just out of frame at the southwest corner. While I reduced it, it likely covered up several distant galaxies. This is why that corner is rather bare of features.

Arp's image:  
[http://ned.ipac.caltech.edu/level5/Arp/Figures/big\\_arp2.jpeg](http://ned.ipac.caltech.edu/level5/Arp/Figures/big_arp2.jpeg)

14" LX200R @ f/10, L=8x10'  
RGb=4x10', STL-11000XM,  
Paramount ME, image scale 1"  
per pixel.

## **Help Wanted: Newsletter Editor**

*By Mark Dahmke*

I took over editing the PAC newsletter in December, 2001. This is my 188<sup>th</sup> newsletter, over 25% of all PAC newsletters ever published. I enjoy working on it, but feel that it's time to find a new editor.

It usually takes from two to three hours per month to build a newsletter, depending on how much material is sent to me and if there are any press releases of interest on NASA websites. You'll need to have some experience with desktop publishing, graphics, image editing and page layout. I use Serif's Page Plus, but you could use Adobe Illustrator or equivalent desktop publishing package. MS Word is not sufficient because it lacks many of the capabilities needed for desktop publishing. PAC has a license for Page Plus. Prior newsletter editing experience would be helpful. If you're interested, please contact me.

## **NASA's Opportunity Rover Mission on Mars Comes to End**

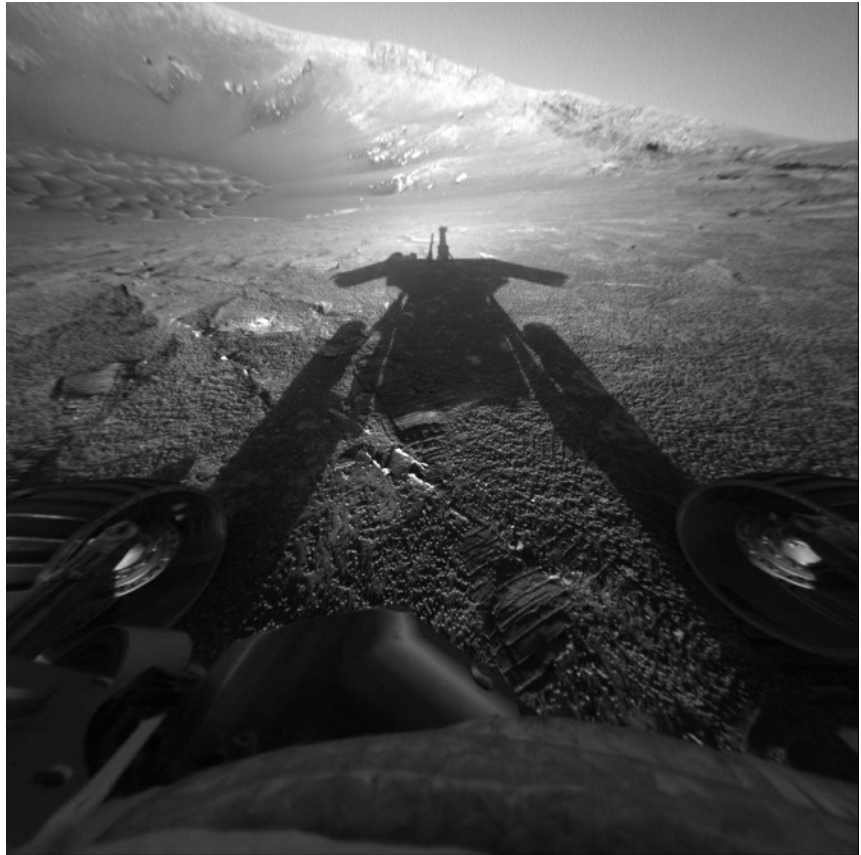
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One of the most successful and enduring feats of interplanetary exploration, NASA's Opportunity rover mission is at an end after almost 15 years exploring the surface of Mars and helping lay the groundwork for NASA's return to the Red Planet.

The Opportunity rover stopped communicating with Earth when a severe Mars-wide dust storm blanketed its location in June 2018. After more than a thousand commands to restore contact, engineers in the Space Flight Operations Facility at NASA's Jet Propulsion Laboratory (JPL) made their last attempt to revive Opportunity Tuesday, to no avail. The solar-powered rover's final communication was received June 10.

"It is because of trailblazing missions such as Opportunity that there will come a day when our brave astronauts walk on the surface of Mars," said NASA Administrator Jim Bridenstine. "And when that day arrives, some portion of that first footprint will be owned by the men and women of Opportunity, and a little rover that defied the odds and did so much in the name of exploration."

Designed to last just 90 Martian days and travel 1,100 yards (1,000 meters), Opportunity vastly surpassed



*This self-portrait of NASA's Mars Exploration Rover Opportunity comes courtesy of the Sun and the rover's front hazard-avoidance camera. The dramatic snapshot of Opportunity's shadow was taken as the rover continues to move farther into "Endurance Crater." The image was taken on sol 180 (July 26, 2004), a date that marks achievement of fully double the rover's primary 90-sol mission.*

all expectations in its endurance, scientific value and longevity. In addition to exceeding its life expectancy by 60 times, the rover traveled more than 28 miles (45 kilometers) by the time it reached its most appropriate final resting spot on Mars - Perseverance Valley.

"For more than a decade, Opportunity has been an icon in the field of planetary

exploration, teaching us about Mars' ancient past as a wet, potentially habitable planet, and revealing uncharted Martian landscapes," said Thomas Zurbuchen, associate administrator for NASA's Science Mission Directorate. "Whatever loss we feel now must be tempered with the knowledge that the legacy



of Opportunity continues - both on the surface of Mars with the Curiosity rover and InSight lander - and in the clean rooms of JPL, where the upcoming Mars 2020 rover is taking shape."

The final transmission, sent via the 70-meter Mars Station antenna at NASA's Goldstone Deep Space Complex in California, ended a multifaceted, eight-month recovery strategy in an attempt to compel the rover to communicate.

"We have made every reasonable engineering effort to try to recover Opportunity and have determined that the likelihood of receiving a signal is far too low to continue recovery efforts," said John Callas, manager of the Mars Exploration Rover (MER) project at JPL.

Opportunity landed in the Meridiani Planum region of Mars on Jan. 24, 2004, seven months after its launch from Cape Canaveral Air Force Station in Florida. Its twin rover, Spirit, landed 20 days earlier in the 103-mile-wide (166-kilometer-wide) Gusev Crater on the other side of Mars. Spirit logged almost 5 miles (8 kilometers) before its mission wrapped up in May 2011.

From the day Opportunity landed, a team of mission engineers, rover drivers and scientists on Earth

collaborated to overcome challenges and get the rover from one geologic site on Mars to the next. They plotted workable avenues over rugged terrain so that the 384-pound (174-kilogram) Martian explorer could maneuver around and, at times, over rocks and boulders, climb gravel-strewn slopes as steep as 32-degrees (an off-Earth record), probe crater floors, summit hills and traverse possible dry riverbeds. Its final venture brought it to the western limb of Perseverance Valley.

"I cannot think of a more appropriate place for Opportunity to endure on the surface of Mars than one called Perseverance Valley," said Michael Watkins, director of JPL. "The records, discoveries and sheer tenacity of this intrepid little rover is testament to the ingenuity, dedication, and perseverance of the people who built and guided her."

#### More Opportunity Achievements

Set a one-day Mars driving record March 20, 2005, when it traveled 721 feet (220 meters).

Returned more than 217,000 images, including 15 360-degree color panoramas.

Exposed the surfaces of 52 rocks to reveal fresh mineral surfaces for analysis and

cleared 72 additional targets with a brush to prepare them for inspection with spectrometers and a microscopic imager.

Found hematite, a mineral that forms in water, at its landing site.

Discovered strong indications at Endeavour Crater of the action of ancient water similar to the drinkable water of a pond or lake on Earth.

All of the off-roading and on-location scientific analyses were in service of the Mars Exploration Rovers' primary objective: To seek out historical evidence of the Red Planet's climate and water at sites where conditions may once have been favorable for life. Because liquid water is required for life, as we know it, Opportunity's discoveries implied that conditions at Meridiani Planum may have been habitable for some period of time in Martian history.

"From the get-go, Opportunity delivered on our search for evidence regarding water," said Steve Squyres, principal investigator of the rovers' science payload at Cornell University. "And when you combine the discoveries of Opportunity and Spirit, they showed

us that ancient Mars was a very different place from Mars today, which is a cold, dry, desolate world. But if you look to its ancient past, you find compelling evidence for liquid water below the surface and liquid water at the surface."

All those accomplishments were not without the occasional extraterrestrial impediment. In 2005 alone, Opportunity lost steering to one of its front wheels, a stuck heater threatened to severely limit the rover's available power, and a Martian sand ripple almost trapped it for good. Two years later, a two-month dust storm imperiled the rover before relenting. In 2015, Opportunity lost use of its 256-megabyte flash memory and, in 2017, it lost steering to its other front wheel.

Each time the rover faced an obstacle, Opportunity's team on Earth found and implemented a solution that

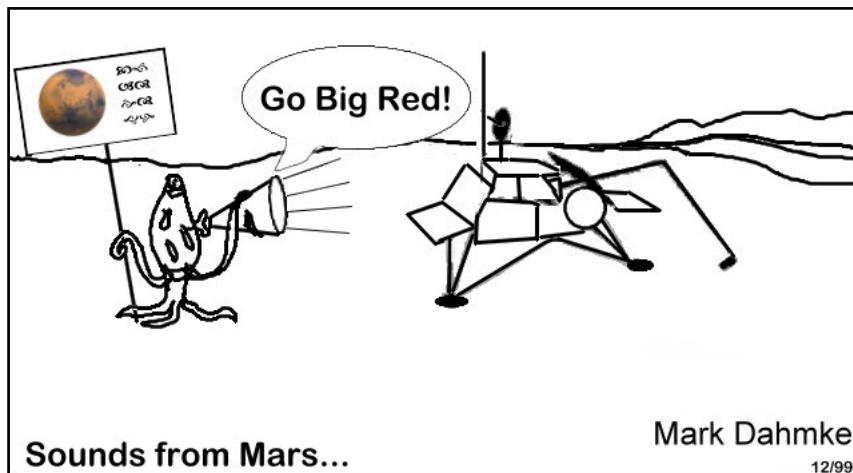
enabled the rover to bounce back. However, the massive dust storm that took shape in the summer of 2018 proved too much for history's most senior Mars explorer.

"When I think of Opportunity, I will recall that place on Mars where our intrepid rover far exceeded everyone's expectations," Callas said. "But what I suppose I'll cherish most is the impact Opportunity had on us here on Earth. It's the accomplished exploration and phenomenal discoveries. It's the generation of young scientists and engineers who became space explorers with this mission. It's the public that followed along with our every step. And it's the technical legacy of the Mars Exploration Rovers, which is carried aboard Curiosity and the upcoming Mars 2020 mission. Farewell, Opportunity, and well done."

Mars exploration continues unabated. NASA's InSight lander, which touched down on Nov. 26, is just beginning its scientific investigations. The Curiosity rover has been exploring Gale Crater for more than six years. And, NASA's Mars 2020 rover and the European Space Agency's ExoMars rover both will launch in July 2020, becoming the first rover missions designed to seek signs of past microbial life on the Red Planet.

JPL managed the Mars Exploration Rovers Opportunity and Spirit for NASA's Science Mission Directorate in Washington. For more information about the agency's Mars Exploration program, visit:

<https://www.nasa.gov/mars>



*Since we now have the ability to listen to sounds on Mars courtesy the ultra-sensitive seismometer on InSight, I thought I'd include my old Polar Lander cartoon.*

*Mars Polar Lander had a microphone, but the spacecraft crash landed. It's hard to believe that was 20 years ago!*

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

### Planets

**Mercury:** Visible low in the west until around March 6<sup>th</sup>.

**Mars:** Sets near midnight.

**Neptune:** In conjunction with the Sun and not visible.

**Uranus:** Can be viewed low in the western twilight.

**Jupiter:** Rises around 2:00 am at magnitude -2.3 with a disk 40" wide.

**Venus:** Rises about 2 hours before the Sun.

**Saturn:** Rises 2 hours after Jupiter.

### Messier List

**M41:** Open cluster in Canis Major.

**M44:** The Beehive Cluster in Cancer.

**M45/M47:** Open clusters in Puppis.

**M48:** Open cluster in Hydra.

**M50:** Open cluster in Monoceros.

**M67:** Open cluster in Cancer.

**M81/M82:** Galaxy pair in Ursa Major.

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

**Next Month:** M40, M65, M66, M95, M96, M105, M106, M108, M109

### NGC and other Deep Sky Objects

**NGC 2438:** Planetary nebula in Puppis, foreground object in M46.

**NGC 2440:** Planetary nebula in Puppis.

**NGC 2477:** Open cluster in Puppis.

**NGC 2539:** Open cluster in Puppis.

**NGC 2683:** Galaxy in Lynx.

**NGC 2775:** Galaxy in Cancer.

### Double Star Program List

#### **Epsilon Canis Majoris:**

White and bluish white stars.

**Delta Geminorum:** Yellow and rose colored stars.

**Alpha Geminorum:** White primary with a yellow secondary.

**12 Lyncis:** Close pair of yellow-white stars.

**19 Lyncis:** White pair.

**38 Lyncis:** White and yellow stars.

**Zeta Cancri:** Yellow and pale yellow stars.

**Iota Cancri:** Yellow primary with a pale blue secondary.



### Challenge Object

**Abell 779 Galaxy Group:** NGC 2832 is the brightest member that also includes NGC 2830, NGC 2831, and NGC 2834.

## The Messier Observing Program

Jim Kvasnicka

There are over 50 observing programs offered by the Astronomical League that PAC members can choose from. These programs range in experience level from beginning, intermediate, and advanced observer.

The first observing program I will focus on is the most popular, the Messier Observing Program. All amateur astronomers become aware of the Messier Catalog soon after they get into the hobby of astronomy. The Messier list contains 110 objects to observe. The objects cover a variety of Deep Sky Objects. Observations must be made using manual methods to find the objects. The use of GOTO or PUSH TO telescopes is not allowed. The Astronomical League offers special recognition in the form of a Messier Program Certificate for those who observed at least 70 of the Messier objects. They offer an Honorary Messier Certificate along with a Messier Pin for those who have observed all 110 objects.

When you complete the Messier Observing Program you will need to provide a copy of your observing logs to me for review. If the logs are accurate and complete I will submit your name to the Messier Observing Program chair for approval. The chair will send to me your

certificate and pin which I will present to you at our monthly PAC meeting.

In my monthly observing report that I include in the newsletter and present at the club meeting I go over a monthly Messier list. If you observe and log these Messier objects each month you can complete the Messier Observing Program in 12 months.

If you need help getting started or have questions regarding the Messier Observing Program you can ask me, I would be glad to help.

### Objects in the Messier Observing Program

Star Cloud – 1

Nebulae – 7

Asterism – 1

Open Clusters – 26

Double Star – 1

Globular Clusters – 29

Supernova Remnant – 1

Galaxies – 40

Planetary Nebulae – 4

Total Objects - 110



M101 by Rick Johnson



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 The Night Sky Network program supports astronomy clubs across the USA dedicated to astronomy outreach. Visit [nightsky.jpl.nasa.org](http://nightsky.jpl.nasa.org) to find local clubs, events, and more!

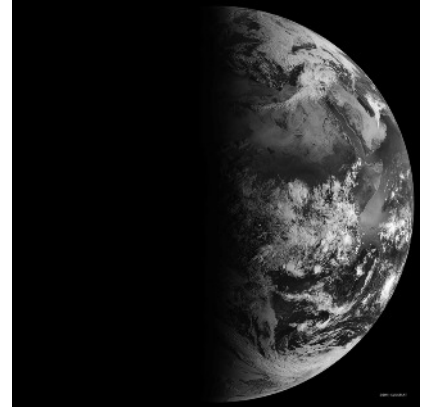
March brings longer days for Northern Hemisphere observers, especially by the time of the equinox. Early risers are treated to the majority of the bright planets dancing in the morning skies, with the Moon passing between them at the beginning and end of the month.

The **vernal equinox** occurs on **March 20**, marking the official beginning of spring for the Northern Hemisphere. Our Sun shines equally on the Northern and Southern Hemispheres during the moment of equinox, which is why the March and September equinoxes are the only times of the year when the Earth's north and south poles are simultaneously lit by sunlight. Exacting astronomers will note that the length of day and night on the equinox are not *precisely* equal; the date when they are closest to equal depends on your latitude, and may occur a few days earlier or later than the equinox itself. One complicating factor is that the Sun isn't a point light source, but a disc. Its edge is refracted by our atmosphere as it rises and sets, which adds several minutes of light to every day. The Sun doesn't neatly wink on and off at sunrise and sunset like a light bulb, and so there isn't a perfect split of day

and night on the equinox - but it's very close!

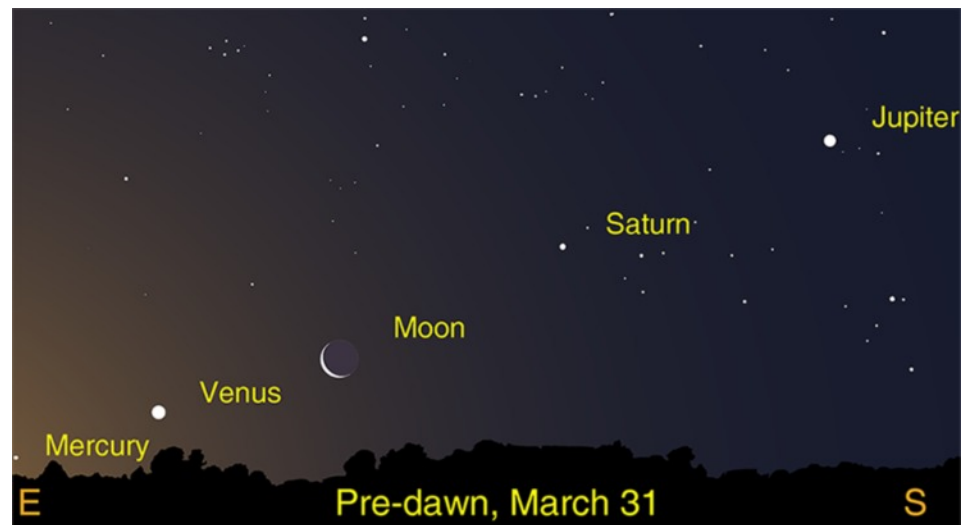
Ruddy **Mars** still shines in the west after sunset. Mars scoots across the early evening skies from Aries towards Taurus and meets the sparkling Pleiades star cluster by month's end.

March opens with the morning planets of **Jupiter, Saturn, and Venus** spread out over the southeastern horizon before sunrise. A crescent **Moon** comes very close to Saturn on the 1<sup>st</sup> and occults the ringed planet during the daytime. Lucky observers may be able to spot **Mercury** by the end of the month. March 31 opens with a beautiful set of planets and a crescent Moon strung diagonally across the early



*Earth from orbit on the March equinox, as viewed by EUMETSAT. Notice how the terminator – the line*

morning sky. Start with bright Jupiter, almost due south shortly before dawn. Then slide down and east towards Saturn, prominent but not nearly as bright as Jupiter. Continue east to the Moon, and then towards



*The morning planets on March 31. Image created with Tassistance from [Stellarium](http://Stellarium).*

**Continued on page 15.**

## NASA's InSight Prepares to Take Mars' Temperature

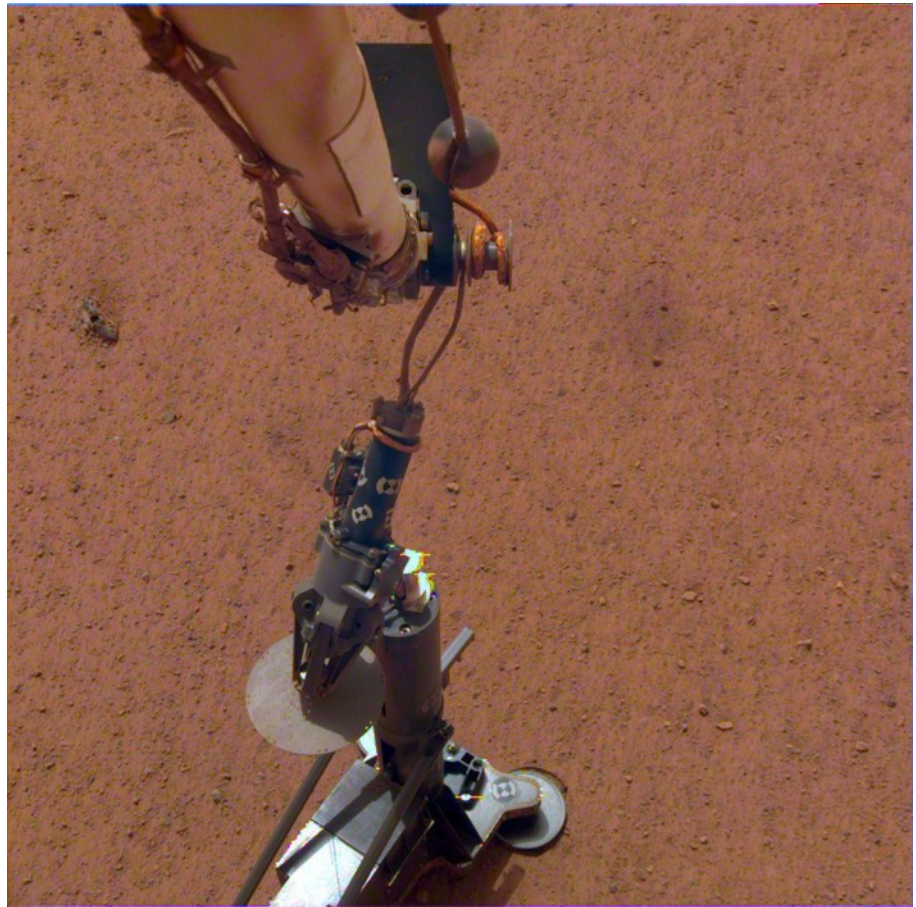
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NASA's InSight lander has placed its second instrument on the Martian surface. New images confirm that the Heat Flow and Physical Properties Package, or HP3, was successfully deployed on Feb. 12 about 3 feet (1 meter) from InSight's seismometer, which the lander recently covered with a protective shield. HP3 measures heat moving through Mars' subsurface and can help scientists figure out how much energy it takes to build a rocky world.

Equipped with a self-hammering spike, mole, the instrument will burrow up to 16 feet (5 meters) below the surface, deeper than any previous mission to the Red Planet. For comparison, NASA's Viking 1 lander scooped 8.6 inches (22 centimeters) down. The agency's Phoenix lander, a cousin of InSight, scooped 7 inches (18 centimeters) down.

"We're looking forward to breaking some records on Mars," said HP3 Principal Investigator Tilman Spohn of the German Aerospace Center (DLR), which provided the heat probe for the InSight mission. "Within a few days, we'll finally break ground using a part of our instrument we call the mole."

HP3 looks a bit like an automobile jack but with a vertical metal tube up front to hold the 16-inch-long (40-



*NASA's InSight lander set its heat probe, called the Heat and Physical Properties Package (HP3), on the Martian surface on Feb. 12. Credit: NASA/JPL-Caltech/DLR*

centimeter-long) mole. A tether connects HP3's support structure to the lander, while a tether attached to the top of the mole features heat sensors to measure the temperature of the Martian subsurface. Meanwhile, heat sensors in the mole itself will measure the soil's thermal conductivity - how easily heat moves through the subsurface.

"Our probe is designed to measure heat coming from the inside of Mars," said InSight Deputy Principal Investigator

Sue Smrekar of NASA's Jet Propulsion Laboratory in Pasadena, California. "That's why we want to get it belowground. Temperature changes on the surface, both from the seasons and the day-night cycle, could add 'noise' to our data."

The mole will stop every 19 inches (50 centimeters) to take a thermal conductivity measurement of the soil. Because hammering creates friction and releases heat, the mole is first allowed to

cool down for a good two days. Then it will be heated up by about 50 degrees Fahrenheit (10 degrees Celsius) over 24 hours. Temperature sensors within the mole measure how rapidly this happens, which tells scientists the conductivity of the soil.

If the mole encounters a large rock before reaching at least 10 feet (3 meters) down, the team will need a full Martian year (two Earth years) to filter noise out of their data. This is one reason the team carefully selected a landing site with few rocks and why it spent weeks choosing where to place the instrument.

"We picked the ideal landing site, with almost no rocks at the surface," said JPL's Troy Hudson, a scientist and engineer who helped design HP3. "That gives us reason to believe there aren't many large rocks in the subsurface. But we have to wait and see what we'll encounter underground."

However deep it gets, there's no debating that the mole is a feat of engineering.

"That thing weighs less than a pair of shoes, uses less power

than a Wi-Fi router and has to dig at least 10 feet [3 meters] on another planet," Hudson said. "It took so much work to get a version that could make tens of thousands of hammer strokes without tearing itself apart; some early versions failed before making it to 16 feet [5 meters], but the version we sent to Mars has proven its robustness time and again."

#### About InSight

JPL manages InSight for NASA's Science Mission Directorate. InSight is part of NASA's Discovery Program, managed by the agency's Marshall Space Flight Center in Huntsville, Alabama. Lockheed Martin Space in Denver built the InSight spacecraft, including its cruise stage and lander, and supports spacecraft operations for the mission.

A number of European partners, including France's Centre National d'Études Spatiales (CNES) and the German Aerospace Center (DLR), are supporting the InSight mission. CNES and the Institut de Physique du Globe de Paris (IPGP) provided the Seismic Experiment for Interior

Structure (SEIS) instrument, with significant contributions from the Max Planck Institute for Solar System Research (MPS) in Germany; the Swiss Federal Institute of Technology (ETH Zurich) in Zurich, Switzerland; Imperial College London and Oxford University in the United Kingdom; and JPL. DLR provided the Heat Flow and Physical Properties Package instrument, with significant contributions from the Space Research Center (CBK) of the Polish Academy of Sciences and Astronika in Poland. Spain's Centro de Astrobiología (CAB) supplied the wind sensors.

For more information about InSight, visit:

<https://mars.nasa.gov/insight/>

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### ***Springtime Planet Party - continued from page 13.***

the beacon that is Venus, its gleam piercing through the early morning light. End with a challenge: can you find elusive Mercury above the eastern horizon? Binoculars may be

needed to spot the closest planet to the Sun as it will be low and obscured by dawn's encroaching glow. What a way to close out March!

Discover all of NASA's current and future missions at [nasa.gov](https://nasa.gov)

## **Yet Another Solar System Scale**

By Rick Johnson

In my years of taking school kids through Hlyde Memorial Observatory I have tried many different ways of getting across to the kids the true scale of the universe. I tried all the various ways I found in texts but none seemed to be getting across the vast empty void of space. Finally one evening about 8 years ago I came up with a new scale that has worked for me ever since. One of our members thought the club members might find it useful, so here goes.

First I came up with a new unit of measurement. Light years are just too big for the kids to comprehend and don't work in the solar system anyway. So I came up with the unit of an Astronaut Year. It is based on the average speed the lunar astronauts traveled when they went to the moon. I used round values through out so settled on the time of three days to reach the moon. Based on multiplying this by  $3/365.24$  I came up with the distance a hypothetical astronaut would travel in one year.

Now for the odd coincidence. It turns out that if you scale the universe by a factor of 2 trillion an Astronaut year equals almost precisely 1 inch. So now I had both a scale that would fit the

solar system into the Hyde classroom and would also show about how long it would take an astronaut traveling at the rate we went to the moon, to reach each object. It is the coupling of both distance and time that seems to get across the emptiness of space.

When the scale is used the sun becomes a speck of dust .027" across that the kids could just see with difficulty. The planets become invisible dust specks. The Earth is only .00025" across. Next I borrow 10 kids to use as pointers to the invisible solar system. Each holds up a finger to represent where the dust speck is for each object. On this scale Mercury is 1 inch from the sun, Venus 2", Earth 3" and Mars 4.5" so now you have quite a close knit group of kids in the middle of the room. Jupiter, Saturn, Uranus and Pluto are 16 inches, 29 inches, 5 feet and 12 feet away respectively. For Pluto I use the tallest kid and have him hold his hand way up in the air to show that Pluto is not in the same plane as the rest of the planets. Of course now Pluto is closer to the sun than Neptune so I then walk "Pluto" to the current position of 7.3 feet from the sun making sure his finger pointing to Pluto's dust speck stays well above Neptune so they can't collide.

Next I ask them how long it would take to reach Pluto traveling one inch a year. Now

they get the message of why the astronauts haven't visited Pluto or the other planets for that matter. Also I point out how if they looked into the room and it had hanging in it 10 dust specks the size of these representing the solar system that they would consider the room empty as they would see nothing without very close inspection. The idea of how small the solar system's inhabitants are begins to sink in. The next question really hits them hard. I ask where to put an 11th kid representing the closest star besides the sun. Most are under the impression that all the stars are inside the solar system! Since the schools start with the solar system the kids are under the impression that it is the universe that contains everything. Some teachers seem to be under this impression also! Many therefore want to put the stars in the gap between the bunch of kids representing the inner solar system from the outer solar system. Finally they get the idea the 11th kid will be outside the building. Some will even vote for as far away as the bus in the parking lot. One will usually go for "across the lake." So far no one has gotten the right answer which is 5 miles beyond the airport (nearly 13 total miles!). At one inch a year the vast distance to the stars begins to sink in.



Sirius is the nearest naked eye star visible from Nebraska and its distance on this scale would be nearly 30 miles or about the distance from Lincoln to Wahoo. That's a lot of Astronaut Years.

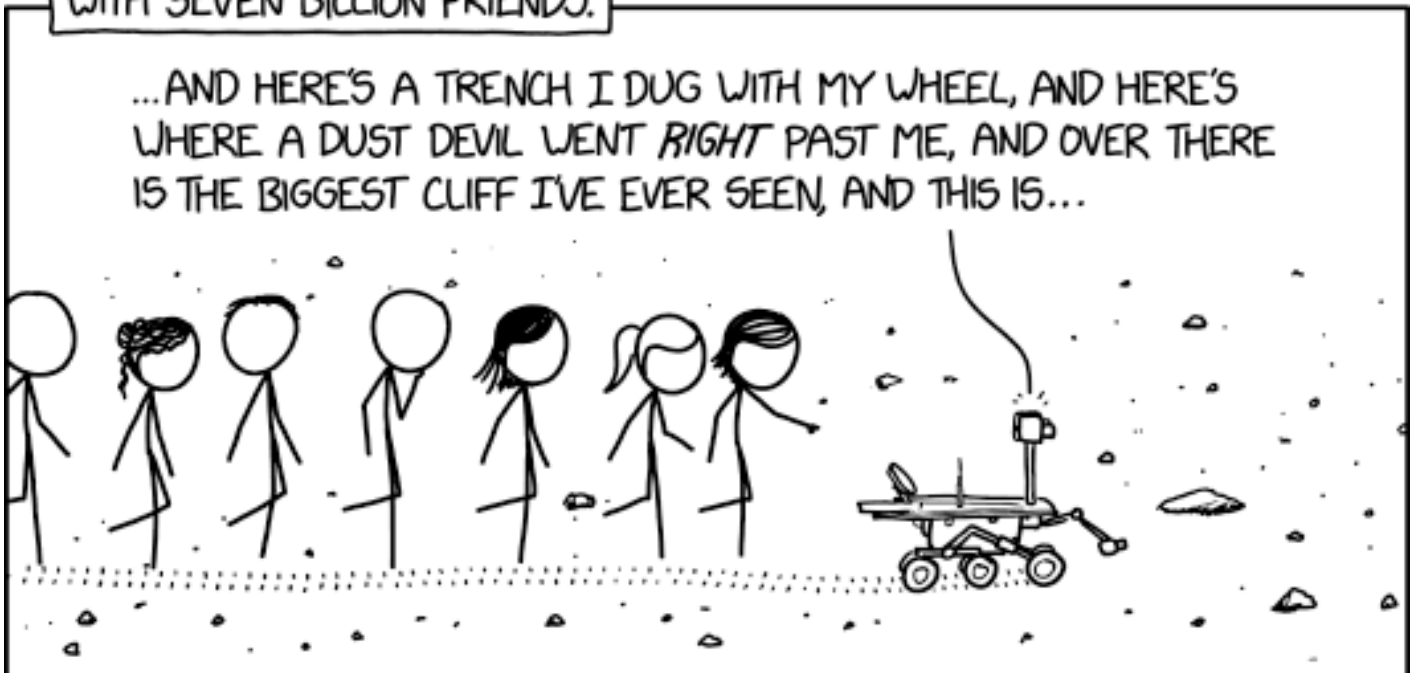
Now they can start to appreciate the distance a light year really is; 3 miles on this scale (6 trillion miles / 2 trillion) or 190,000 Ay. At this point they are so blown

away it is time to start a slide show.

I hope you find this scale as useful as I have.



WITH SEVEN BILLION FRIENDS.



xkcd.com

## 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 Dobsonian: Lee Taylor  
13 inch Truss Dobsonian: Available

## CLUB APPAREL



Order club apparel from [cafepress.com](http://cafepress.com):



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