President's Message

Welcome to February. This month has begun to shape up with a more positive note. According to urban legend we will have six more weeks of winter if the groundhog sees his shadow; regardless, we all know the seasons and we’ll have six more weeks of winter.

Winter brings clear and bright skies when we venture out. That said we have two star parties this month, and because of the time of year, we will meet at Dedication Point for each one. The first will be on Saturday the 6th and the second will be on Saturday the 13th. While we have had unusually warm weather in the daytime for this time of the year, the nighttime temps are dipping down to freezing with a wind chill. Dress accordingly. Leif will post the “Go/No-Go” for both star parties at around Noon on the day of the event.

If you plan on attending the star parties please follow social distancing guidelines and wear a mask, since a mask will also keep your face warm.

Our monthly board meeting will happen on Wednesday the 10th of February at 7:00 pm via Zoom teleconference.

Our monthly membership meeting will happen on Friday the 12th at 7:00 pm via Zoom. Our guest speaker will be Prof. Paul Hickson, Dept of Astronomy & Physics, University of British Columbia-Vancouver in Canada. The topic will be twofold with time divided between compact group galaxies (most famous is Stephen’s Quintet) and liquid mirror telescope projects.

Hopefully by the meeting we will have an update for the Idaho Star Party™ that will hopefully happen in September.

Our webmaster, Bailey, would like some astrophotos from club members who have them. Please contact her via the website with your submissions, and her contact info is listed at left with the other board members.

Until next month, clear skies.

David Olsen, President
Boise Astronomical Society

Would you like to JOIN the Boise Astronomical Society? See Last Page!
## February 2021 Calendar

<table>
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<tr>
<th>Sun</th>
<th>Mon</th>
<th>Tue</th>
<th>Wed</th>
<th>Thu</th>
<th>Fri</th>
<th>Sat</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
</tbody>
</table>
|     |     |     | **BAS Board Meeting**  
7:00 pm via Zoom  
Last Quarter Moon  
Visible: 53% ↓  
Age: 21.88 Days  
**BSU 1st Friday Astronomy**  
see Calendar of Events below  
Star Party  
Dedication Point  
confirm on Groups.io  
Be Safe MASK, distancing |
|     | 7   | 8   | 9   | 10  | 11  | 12  |
|     |     |     |     | **New Moon**  
Visible 0%  
Age: 29.25 Days  
**BAS General Mtg**  
7:00 pm via Zoom  
see Calendar of Events below  
**Star Party**  
Dedication Point  
Confirm on Groups.io  
Be Safe MASK, distancing |
|     | 14  | 15  | 16  | 17  | 18  | 19  |
|     |     |     | **Mars → Perseverance Landing →**  
see Calendar of Events below  
**BSU Dept of Physics Virtual Planetarium Show**  
see Calendar of Events below  
**First Quarter Moon**  
Visible 47% ↑  
Age: 7.13 Days  
**Snow Moon**  
1:19 am  
Visible 100% |
|     | 21  | 22  | 23  | 24  | 25  | 26  |
|     |     |     |     |     |     |     |
|     | 27  |     |     |     |     |     |

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<td>Dave Mitsky’s Celestial Calendar</td>
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<td>5</td>
<td>13</td>
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<td>Space History</td>
<td>Last Word</td>
</tr>
<tr>
<td>6</td>
<td>17</td>
</tr>
</tbody>
</table>
Friday, February 5  
**Boise State Physics First Friday Astronomy**

“How to Talk Science so Journalists Will Listen” by Lisa Grossman, Science News (www.sciencenews.org)  
Online Lecture begins 7:30 pm (MT)  
http://www.astrojack.com/ffa-science-journalists

If you missed this presentation, you can view it and other previous lectures online at http://www.astrojack.com:

- Jan 1, 2021  The Discovery of Neptune  
  by Prof Brian Jackson, Dept of Physics, Boise State University
- Dec 4, 2020  NASA’s Lucy Mission  
  by Dr. Cathy Olkin, Southwest Research Inst.
- Nov 6, 2020  A Practical Guide to Time Travel  
  by Prof Barbara Ryden, Dept of Astronomy, The Ohio State University
- Oct 2, 2020  The Solar System Laboratory: A Testbed for Exoplanet Studies  
  by Dr. Laura Mayorga, Space Telescope Science Institute

Scheduled for Mar 5, 2021:  
Psyche: Journey to a Metallic World  
by Prof Lindy Elkins-Tanton, School of Earth & Space Exploration, Arizona State Univ.

Friday, Feb 12  
**BAS General Meeting** guest speaker – Prof Paul Hickson

Join us for our General Meeting and hear our guest speaker, Prof Paul Hickson, Department of Physics and Astronomy, University of British Columbia-Vancouver. In 1982, he published a list of 100 compact galaxy groups that is so well known that the Jan 31st Star Date podcast “Hickson Compact Groups” describes how to find groups 16 and 92 in our current night sky! He’s also part of research groups working on a Liquid Mirror telescopes and the Thirty Meter Telescope. This will be an amazing evening! Please be sure to attend.

Thursday, Feb 18  
**BSU Dept of Physics presents a Virtual Planetarium show**

This evening’s program will be hosted by the Department of Physics and will start at 7:30 pm. Participation is FREE but you must register to attend. Navigate to http://boi.st/thirdthursday to sign up, and you may leave a question for the moderator. You will be contacted the week before the event and provided with the Zoom link.

Thursday, Feb 18  
**NASA’s Mars Perseverance Landing**

Today will be a real nail-biter. The Mars Perseverance Lander, which launched less than a year ago on July 30th, is expected to land on the red planet today. This month’s NASA Night Sky Notes is all about Perseverance. And our own Prof. Brian Jackson has written about the lander for ‘Currents in Space’. This NASA website covers the mission. If you’re reading this before February 18th, be sure to scroll through the various ‘banners’ of information at the top of the webpage. One of them is “Where is Perseverance?” and includes mileage counters.

Friday, Feb 27  
**Full Snow Moon**

“As the snowiest month in the United States, February’s full moon is commonly known as the Full Snow Moon in Native American cultures. These ancient tribes named this month after the way trees cracked in the cold, or how people had to sit shoulder to shoulder around the fire for warmth. Even the Celts called it the Moon of Ice. As expected of the coldest month in the year, the Full Snow Moon is also known by more sinister names, such as the Bone Moon.”

Read the complete story of the Snow Moon here.
Welcome to our New BAS Members!!

This is a new feature. Each month, we’ll welcome those folks who have joined the Boise Astronomical Society recently. Today we extend a warm welcome to Mark J. Bart H. and family.

As new members, there are many ways to participate in the BAS. Please be sure to join our social media accounts: Groups.io, our Facebook group, and follow our Twitter account. Detailed instructions for joining our Groups.io account are on the last page of this newsletter.

Upcoming Club Events

<table>
<thead>
<tr>
<th>Month</th>
<th>Event Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feb</td>
<td>Monthly Star Parties</td>
</tr>
<tr>
<td>Mar</td>
<td>Monthly Star Parties</td>
</tr>
<tr>
<td>Apr</td>
<td>Monthly Star Parties</td>
</tr>
<tr>
<td>May</td>
<td>Monthly Star Parties</td>
</tr>
<tr>
<td>June</td>
<td>Monthly Star Parties</td>
</tr>
<tr>
<td>July</td>
<td>Monthly Star Parties, Pizza &amp; Ice Cream Social</td>
</tr>
<tr>
<td>Aug</td>
<td>Monthly Star Parties</td>
</tr>
<tr>
<td>Sept</td>
<td>Idaho Star Party™ (Bruneau Dunes State Park)</td>
</tr>
<tr>
<td>Oct</td>
<td>Monthly Star Parties</td>
</tr>
<tr>
<td>Nov</td>
<td>Monthly Star Parties</td>
</tr>
<tr>
<td>Dec</td>
<td>Monthly Star Parties, Holiday Party</td>
</tr>
</tbody>
</table>

Coming in 2022

“COSMIC PURSUITS” for FEBRUARY

I highly encourage you to check out Brian Ventrudo’s Cosmic Pursuits for February, where you’ll find this image and more.

“The Moon near the star Antares in the southeastern sky before sunrise on Feb. 6, 2021.”


4
On February 18, NASA will give the world a belated Valentine - the Mars 2020 rover, nicknamed “Perseverance”, will land on the northwestern rim of Jezero Crater, an ancient lakebed. Perseverance will search for signs of Martian life, whether still living or long extinct. It will employ a suite of instruments to probe the remains of a vast river delta. But this rover has more than an exciting geological toolkit up its sleeve -- Perseverance carries an automated helicopter named “Ingenuity”, which will allow scientists to fly on another planet for the first time ever.

A Delta is the Desert’s Memory of a River
Dump a bucket of water on the present-day surface of Mars, and you’ll get a short-lived puff of vapor and ice. That’s because the atmospheric pressure is too low for water to remain liquid on the surface. However, 3.0 billion years ago water flowed frequently, and sometimes catastrophically, across the surface of Mars, as evidenced by many geological features including large river deltas. As on Earth today, these Martian deltas were laid down in places where rivers met a large body of water and deposited their sediment loads. These deltas, therefore, record the story of Mars’ ancient hydrosphere and may possibly harbor signs of Martian life, past or present. Mars 2020’s landing site, Jezero Crater, was once a large lake fed by a river that flowed for perhaps 10 million years. Long ago (nobody knows exactly when or why), Mars dried up and Jezero Lake emptied out, the 1-kilometer high delta remained.

The MOXIE of Mars 2020
When the Mars 2020 Perseverance rover lands on February 18, it brings a whole sci-fi novel of instruments. Among them, the SuperCam, an 18-Watt laser that will fry rocks from more than 7 meters away and chemically characterize the mineral vapor that forms (it even includes a microphone that will let scientists listen to the ‘pop’ sound). Like other rovers, Perseverance also has a long arm it can use to investigate rocks up close, this time using the SHERLOC (Scanning Habitable Environments with Raman & Luminescence for Organics & Chemicals) instrument, which is essentially a digital magnifying glass to see fine detail in the Martian rocks. SHERLOC will be guided toward its targets by a wide-angle camera, WATSON (Wide Angle Topographic Sensor for Operations and eNgineering). In addition, Perseverance carries an experiment called MOXIE (Mars Oxygen In-Situ Resource Utilization Experiment) to test how easily the Martian air can be coaxed (or in this case, catalyzed) into forming molecular oxygen, a technology key to future human exploration.

The Ingenuity of Icarus
But perhaps the most exciting experiment on Perseverance is the Ingenuity drone. Ingenuity is a two-rotor (two blades each), autonomous helicopter with a 1.2-meter wingspan and a mass of about 2 kg, not much bigger than a guinea pig. These dimensions are required to achieve lift on a planet with an atmosphere 1% of Earth’s. With maximum lateral flight, Ingenuity may only fly about 300 meters at a time, and it is only scheduled to fly about five times during the mission. However, its importance lies not in its flight capabilities but rather in its capability to fly at all. Ingenuity will help NASA understand how to operate a flying drone on another planet, potentially opening a new chapter in planetary exploration. Currently, NASA’s rovers are severely limited in their abilities to traverse rough terrain, and weeks or months of testing and planning accompanies every approach to a steep outcrop or craggy ledge. If a mission could instead fly up to an outcrop without worrying about its footing, vast swaths of terrain would be open to exploration. Ingenuity is also an important rehearsal for NASA’s more ambitious Dragonfly mission, a nuclear-powered octocopter that will explore the hazy skies of Saturn’s moon Titan in the 2030s.

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NASA TV will host a live broadcast starting at 10:30 am MST on February 18 to report on Mars 2020’s landing -- https://mars.nasa.gov/mars2020/timeline/landing/watch-online/. Fingers crossed for a safe but exciting touchdown.
MARS – THE ROBOT PLANET
by Loretta J Cannon

We began our look at the exploration of Mars, as the only planet in our system inhabited solely by robots, back in October 2020. The table below summarizes what we’ve learned so far, what we’ll learn about today, and what we’ll learn next month. Interestingly, the first launch of a Mars probe was not in 1964, but rather in October 1960 when the Soviets launched both Marsnik 1 and Marsnik 2, though neither probe was able to achieve Earth orbit and either burned up or fell back to Earth. Including these attempts, humankind has been attempting (and mostly succeeding) to explore Mars for the last 60 years.

Of the 21 spacecraft listed, 16 were successful, 5 are still ongoing, and 1 should arrive at Mars this month. Only 4 failed. This is impressive. It is worth noting that these are only the NASA (U.S.) Mars missions. Other countries have sent spacecraft. Between 1960 and 1988, the Soviets launched 18 spacecraft to Mars, only 4½ succeeded. France has had 2 failed missions. Japan sent a successful orbiter in 1998. The European Space Agency (ESA) has had 2 successful orbiter-with-lander missions. India sent a successful orbiter in 2013. China’s first orbiter failed in 2011; their 2020 orbiter-with-lander succeeded. The United Arab Emirates launched a successful orbiter in 2020. All of which increases the total number of robot inhabitants on and around Mars.

<table>
<thead>
<tr>
<th>Mission Name</th>
<th>Mission Type</th>
<th>Launch Date</th>
<th>Arrival Date</th>
<th>End Date</th>
<th>Of note</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mariner 3</td>
<td>flybys</td>
<td>Fall 1964</td>
<td>---</td>
<td>Dec 1967</td>
<td>Failed to reach Mars; First photos of another world from space</td>
</tr>
<tr>
<td>- 4</td>
<td></td>
<td></td>
<td>July 1965</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mariner 6</td>
<td>flybys</td>
<td>Feb 1969</td>
<td>31 July 1969</td>
<td>~July 1971</td>
<td>After successful flyby, entered heliocentric orbit; Mariner 7 ended successfully as Mariner 6 did</td>
</tr>
<tr>
<td>Mariner 8</td>
<td>flyby</td>
<td>9 May 1971</td>
<td>14 Nov 1971</td>
<td>27 Oct 1972</td>
<td>Launch Failure; First spacecraft to orbit Mars</td>
</tr>
<tr>
<td>- 9</td>
<td>orbiter</td>
<td>30 May 1971</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Viking 1</td>
<td>orbiter</td>
<td>20 Aug 1975</td>
<td>19 June 1975</td>
<td>11 Nov 1982</td>
<td>Believed to have found life, but not confirmed</td>
</tr>
<tr>
<td>- 2</td>
<td>landers</td>
<td>9 Sept 1975</td>
<td>7 Aug 1976</td>
<td>12 Apr 1980</td>
<td>Between both orbiters, mapped 97% of surface</td>
</tr>
<tr>
<td>M. Global Surveyor</td>
<td>orbiter</td>
<td>7 Nov 1996</td>
<td>12 Sept 1997</td>
<td>21 Nov 2006</td>
<td>1st 3D profiles of North Pole; more images than any previous mission; Mars Surveyor Program #1</td>
</tr>
<tr>
<td>M. Pathfinder and Sojourner</td>
<td>lander</td>
<td>4 Dec 1996</td>
<td>4 July 1997</td>
<td>27 Sept 1997</td>
<td>First (and very successful) lander + rover; first bouncy castle landing</td>
</tr>
<tr>
<td>M. Climate Orbiter</td>
<td>orbiter</td>
<td>11 Dec 1998</td>
<td>23 Sept 1999</td>
<td>---</td>
<td>Mars Surveyor Program #2; Lost contact after it began its orbital insertion maneuver at Mars</td>
</tr>
<tr>
<td>M. Polar Lander</td>
<td>lander</td>
<td>3 Jan 1999</td>
<td>3 Dec 1999</td>
<td>---</td>
<td>Mars Surveyor Program #3; Lost contact as it entered Mars’ orbit; no evidence of crashed craft</td>
</tr>
<tr>
<td>and Deep Space 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M. Odyssey</td>
<td>orbiter</td>
<td>7 Apr 2001</td>
<td>24 Oct 2001</td>
<td></td>
<td>Holds record for longest continuously active orbiter around a non-Earth world</td>
</tr>
<tr>
<td>(MER) Spirit and Opportunity</td>
<td>rovers</td>
<td>10 June 2003</td>
<td>4 Jan 2004</td>
<td>25 May 2011</td>
<td>But for the Martian dust, these might still be operating, having achieved many goals &amp; firsts</td>
</tr>
<tr>
<td>8 July 2003</td>
<td>25 Jan 2004</td>
<td>13 Feb 2019</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M. Reconnaissance</td>
<td>orbiter</td>
<td>12 Aug 2005</td>
<td>11 Sept 2006</td>
<td>Mission Elapsed Time (as of Feb 4, 2021) 15 yrs 5 mos 23 days 14 hrs</td>
<td></td>
</tr>
<tr>
<td>Curiosity (Mars Science Lab)</td>
<td>rover</td>
<td>26 Nov 2011</td>
<td>6 Aug 2012</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maven</td>
<td>orbiter</td>
<td>18 Nov 2013</td>
<td>21 Sept 2014</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Insight</td>
<td>lander</td>
<td>5 May 2018</td>
<td>26 Nov 2018</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MarCO - WALL E - EVE</td>
<td>CubeSat</td>
<td>5 May 2018</td>
<td>26 Nov 2018</td>
<td>4 Jan 2019</td>
<td>Successful technology demo - comm relay for Insight mission landing status</td>
</tr>
<tr>
<td>Perseverance</td>
<td>rover</td>
<td>30 July 2020</td>
<td>18 Feb 2021</td>
<td>see CURRENTS IN SPACE for article by Prof Brian Jackson, Physics Dept, BSU</td>
<td></td>
</tr>
<tr>
<td>and Ingenuity</td>
<td>helicopter</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>
SPIRIT and OPPORTUNITY ROVERS

Launched in 2003 and arriving in 2004, these twin workhorses achieved so much. Mission goals for Spirit and Opportunity (Mars Exploration Rovers) included studying areas where climate and geographic evidence might indicate water (and life) may have once existed. Both rovers far exceeded their planned life expectancies of 90 days.

<table>
<thead>
<tr>
<th>ROVER</th>
<th>MISSION TIME</th>
<th>ROVER TIME</th>
<th>DISTANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spirit</td>
<td>7 yrs, 11 mos</td>
<td>6 yrs, 2 mos</td>
<td>4.8 miles</td>
</tr>
<tr>
<td>Opportunity</td>
<td>14 yrs, 11 mos</td>
<td>undetermined</td>
<td>28.0 miles</td>
</tr>
</tbody>
</table>

No bigger than golf carts, these rovers each weigh an impressive 405 lbs and each have five instruments on a robotic arm including a Mossbauer Spectrometer (MB), an Alpha Particle X-ray Spectrometer (APXS), Microscopic Imager (MI), Rock Abrasion Tool (RAT), and magnets. The panoramic mast assembly houses two cameras and a mini thermal emission spectrometer. These instrument packages would prove successful analyzing various rocks and soils on Mars.

The two rovers were sent to opposite sides of the red planet, to areas where (based on previous robotic studies) there may have been liquid water previously. Spirit's lander package hit the planet at a velocity of almost 46 feet per second, bounced 28 times (remember the description of Pathfinder's airbag landing), and came to rest inside the Gusev crater, a mere eight miles from the target landing site. Opportunity's lander bounced 26 times and came to rest in Meridiani Planum's Eagle crater, only nine miles from the target site. Both final resting sites were renamed to honor lives lost in Space Shuttle accidents, respectively, Columbia Memorial Station and Challenger Memorial Station.

Over the course of their years' long exploratory efforts, many discoveries were made, some by accident. In 2005, Spirit's cameras captured movies of dust devils, the best evidence then of Martian wind effects. In early 2007, one of Spirit's front wheels stopped turning and scraped off enough top soil to reveal an area of almost pure silica, strong evidence for a wet ancient Mars with possible steam vents or hot springs. The movie at right covers Opportunity's trip and some accomplishments (credit: NASA-JPL). During its time on Mars, Opportunity broke records: longest continuous operation on the surface of Mars; farthest distance travelled by any vehicle on another celestial body; driving at steepest tilt on slope of 32 degrees.

Though both rovers periodically had their solar cells cleared of dust by strong Martian winds (increasing rover power), it was dust that disabled them both in the end. Spirit became mired in soft soil in May 2009; by Jan 2010 it was designated a stationary science platform, and in March, they lost contact. When the mission was 'called' in May 2011, the cause was attributed to excessive cold overwhelming its internal heaters. In 2018, an historic planet-wide dust storm finally took out Opportunity, obscuring its solar panels. The last signal came through on June 10th.

MARS RECONNAISSANCE ORBITER (MRO)

This intrepid orbiter left Earth in Aug 2005 and achieved its operational, polar orbit in September 2006. Though originally planned for only a 24-month mission, the MRO is still operational today alongside the Odyssey orbiter. Whereas Odyssey carries only three instruments, the MRO has ten, including "the most powerful telescopc camera ever flown to another planet" (according to a NASA Fact sheet). The High-Resolution Imaging Science Experiment (HiRISE) camera can resolve an object as small as 3-feet across and has produced some of the most amazing images of Mars, including weather features, potential future landing sites, and also keeping
an eye on the other robot inhabitants of the planet. Above is a swirling dust devil (credit: NASA/JPL-Caltech/UoAZ). The image at Right is the Jezero Crater as seen in Nov 2018, where Mars 2020 Perseverance will land on Feb 18th (credit: NASA/JPL-Caltech/MSSS/JHU-APL). At Left, the rover Opportunity was spotted traversing the Perseverance Valley in Sept 2018 (credit: NASA/JPL-Caltech/UoAZ). Scientists produced a fascinating animation of HiRISE watching the Curiosity rover trek across a clay unit. When you watch, the rover is first seen near the top center of the image and ends up at the bottom center, and you can see rover tracks.

Previous Mars missions have identified multiple locations where flowing water existed in the planet’s past. With that in mind, in addition to a comprehensive study of Martian weather, the MRO has been conducting a detailed historical study of water across the planet. Among the MRO instruments that are performing these studies are: CRISM (Compact Reconnaissance Imaging Spectrometer for Mars), which has been identifying water-related surface minerals, and SHARAD (Shallow Subsurface Radar), which can penetrate up to 1/3 mile below the surface looking at rock, ice, and melted water. The CTX (Context Camera) was used in 2016 for a crowd-sourced experiment in which 10,000 individuals viewed images of Mars’ south pole to identify targets for HiRISE; all of which led to a more thorough understanding of seasonal carbon dioxide ice and the ‘spider’ feature seen on sheets of CO₂ ice (see image at Right, credit: NASA/JPL-Caltech/UoAZ).

PHOENIX LANDER

Launched in Aug 2007, this small and short-lived lander, the first in NASA’s Mars Scout Program, landed in May 2008 farther north on Mars than any other lander, at Vastitas Borealis in the Martian arctic. What was interesting, as Phoenix approached Mars, the three spacecraft currently orbiting the planet (Odyssey, MRO, and Mars Express¹) had their trajectories adjusted so they could observe, and MRO’s HiRISE not only scouted the landing area but also took the image at Left (note the inset) of Phoenix hanging from its parachute (credit: NASA/JPL-Caltech/UoAZ). This was the first successful stationary soft-landing since Viking 2 in 1976.

Can you guess what the mission goals were? That’s right – search for signs of life and study Mars’ climate and geology with an eye towards future human exploration. And though Phoenix only operated on the surface for a little over five months, it performed some remarkable science experiments. NASA announced experimental evidence for water on Mars in July (collaborating data from MRO). In August, perchlorates were identified, not definitive proof for life, but the controversial experiments from the Viking landers were re-examined. I reported on the Viking experiments last October and how, quite recently, a pharmacology professor wanted to see the data, but NASA had to first digitize the information from original microfilm. A new scoop of soil was analyzed in September, and preliminary results indicated perchlorate again plus salts, sodium, magnesium, chloride, and potassium.

By October, Phoenix automatically went into ‘safe’ mode (instruments turn off to conserve energy) due to bad weather and reduced sunlight – winter had come. The lander continued to communicate with Earth daily until November 2nd, then nothing. NASA concluded that CO₂ ice had more than likely built up on and damaged the solar panels, that the ice may have been up to 7 inches thick. By May 2010, images from MRO showed the solar panels had been severely damaged by weather.

This saga will conclude in March, and we will review the landing and first days of Perseverance and Ingenuity !!

¹ Mars Express is a joint ESA-NASA orbiter that launched June 2003.
Landing on Mars: A Tricky Feat!

by David Prosper

The Perseverance rover and Ingenuity helicopter will land in Mars’s Jezero crater on February 18, 2021, NASA’s latest mission to explore the red planet. Landing on Mars is an incredibly difficult feat that has challenged engineers for decades: while missions like Curiosity have succeeded, its surface is littered with the wreckage of many failures as well. Why is landing on Mars so difficult?

Mars presents a unique problem to potential landers as it possesses a relatively large mass and a thin, but not insubstantial, atmosphere. The atmosphere is thick enough that spacecraft are stuffed inside a streamlined aeroshell sporting a protective heat shield to prevent burning up upon entry - but that same atmosphere is not thick enough to rely on parachutes alone for a safe landing, since they can’t catch sufficient air to slow down quickly enough. This is even worse for larger explorers like Perseverance, weighing in at 2,260 lbs (1,025 kg). Fortunately, engineers have crafted some ingenious landing methods over the decades to allow their spacecraft to survive what is called Entry, Descent, and Landing (EDL).

The Viking landers touched down on Mars in 1976 using heat shields, parachutes, and retrorockets. Despite using large parachutes, the large Viking landers fired retrorockets at the end to land at a safe speed. This complex combination has been followed by almost every mission since, but subsequent missions have innovated in the landing segment. The 1997 Mars Pathfinder mission added airbags in conjunction with parachutes and retrorockets to safely bounce its way to a landing on the Martian surface. Then three sturdy “petals” ensured the lander was pushed into an upright position after landing on an ancient floodplain. The Opportunity and Spirit missions used a very similar method to place their rovers on the Martian surface in 2004. Phoenix (2008) and Insight (2018) actually utilized Viking-style landings. The large and heavy Curiosity rover required extra power at the end to safely land the car-sized rover, and so the daring “Sky Crane” deployment system was successfully used in 2012. After an initial descent using a massive heat shield and parachute, powerful retrorockets finished slowing down the spacecraft to about 2 miles per hour. The Sky Crane then safely lowered the rover down to the Martian surface using a strong cable. Its job done, the Sky Crane then flew off and crash-landed a safe distance away. Having proved the efficacy of the Sky Crane system, NASA will use this same method to attempt a safe landing for Perseverance this month!


Despite the wide gap between these missions in terms of technology, they both performed their landing maneuvers automatically, since our planets are too far apart to allow Earth-based engineers to control them in real time! You can watch coverage of the Mars Perseverance landing starting at 11:00 AM PST (2:00 PM EST) on February 18 at nasa.gov/nasalive. Touchdown is expected around 12:55 PM PST (3:55 PM EST). NASA has great resources about the Perseverance Rover and accompanying Ingenuity helicopter on mars.nasa.gov/mars2020. And of course, find out how we plan to land on many different worlds at nasa.gov.
M46 in Puppis is one of my favorite open clusters and a striking sight through just about any telescope. More than 500 stars are crammed into an area just a Moon’s diameter across, creating one of the most jam-packed throngs in the winter sky.

M46 was discovered by Charles Messier on February 19, 1771, only three days after he had published the first edition of his catalog covering M’s 1 through 45. Of his new catch, Messier wrote “A cluster of very small stars, between the head of the Great Dog and the two hind feet of the Unicorn; one cannot see these stars but with a good refractor.” But when William Herschel gazed upon M46 through his 18.7-inch reflector on March 19, 1786, he saw something else, something Messier apparently had missed or overlooked, floating among the cluster stars north of the group’s center. He probably thought to himself, “That’s not a star at all. That's a tiny disk of light.” Herschel included his find as H-IV-39, the 39th planetary nebula in his catalog, but today, we know it best as NGC 2438.
While NGC 2438 may look like it belongs to M46, in reality it is much closer to Earth. The most recent study of the distance to NGC 2438 came last year. In a paper entitled Searching for central stars of planetary nebulae in Gaia DR2 [Astronomy & Astrophysics. 616], authors N. Chornay and N. A. Walton examined the Gaia spacecraft’s Data Release 2. Gaia is the European Space Agency’s astrometric spacecraft designed to accurately measure positions, distances and motions of stars with unparalleled accuracy. Their study pegged the distance to NGC 2438 at 1,376 light years.

In a 2013 study, The Open Cluster NGC 2437 (Messier 46) [Publications of the Astronomical Society of the Pacific, Volume 125, Number 924], author T.J. Davidge placed M46 at 4,660 light years from Earth. Earlier studies that led to same conclusion of different distances compared the spectra of the planetary with those of stars in M46. These showed that both M46 and NGC 2438 were moving away from the solar system, but at two different speeds. Were the planetary and cluster physically associated, they would be moving through space at the same speed.

Incidentally, you will also find another open cluster, M47, at the triangle’s western tip, just 1½° west of M46. Both clusters make a spectacular couple in binoculars and rich-field telescopes. Again, however, they are nowhere near each other in space. M47 is 1,624 light years away.

As striking as that low-power view is, NGC 2438 will take at least 150x to tell it apart from just another cluster star. Focus your attention on the stars in the northern part of the cluster, keeping an eye out for a tiny, softly glowing disk of greenish light. That will be the 11th-magnitude planetary. Through my 8-inch (20cm) reflector at 203x and with an oxygen-III filter in place, the nebula’s ring shape is clearly evident and appears very slightly oval. Removing the filter and using averted vision adds a 13th-magnitude star within the ring, just slightly offset to the northwest of center. Don't be fooled into thinking that you are seeing the nebula's forbearer, however. NGC 2438's actual central star barely cracks 18th magnitude. The dim sun we are seeing is most likely a distant member of M46. Another of M46's stars, an 11th-magnitude point, appears to just brush the nebula's southeastern edge.
NGC 2438 appears to float among stars of M46 in this rendering of the view through the author’s 8-inch (20cm) reflector at 203x.

Good luck! And be sure to post your results in this column’s online discussion forum (Phil Harrington’s February cosmic challenge forum).

Until next month, remember that half of the fun is the thrill of the chase. Game on!

About the Author: Phil Harrington writes the monthly Binocular Universe column in Astronomy magazine and is the author of 9 books on astronomy, including Cosmic Challenge: The Ultimate Observing List for Amateurs. Visit www.philharrington.net to learn more.

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Dave Mitsky’s Celestial Calendar

All times, unless otherwise noted, are UT (subtract 7 hours and, when appropriate, 1 calendar day for MDT)

2/1 Mars is at eastern quadrature (90 degrees from the Sun) at 10:00
2/2 Asteroid 18 Melpomene (magnitude +9.4) is at opposition in Cancer at 7:00
2/3 The astronomical cross-quarter day (i.e., a day half way between a solstice and an equinox) known as Imbolc, Candlemas, or Groundhog Day occurs today; the Moon is 6.2 degrees north-northeast of the first-magnitude star Spica (Alpha Virginis) at 6:00; the Moon is at perigee, subtending 32' 17" from a distance of 370,116 kilometers (229,980 miles), at 19:03
2/4 Last Quarter Moon occurs at 17:37
2/5 The Curtiss Cross, an X-shaped clair-obscur illumination effect located between the craters Parry and Gambart, is predicted to be visible at 21:42
2/6 Venus (magnitude -3.9) is 0.4 degrees southeast of Saturn (magnitude +0.7) at 8:00; Venus, Jupiter, and Saturn lie within a circle with a diameter of 5.4 degrees at 9:00; the Moon is 5.3 degrees north-northeast of the first-magnitude star Antares (Alpha Scorpii) at 12:00
2/7 The Moon is at the descending node (longitude 258.2 degrees) at 1:00; the Martian northern hemisphere vernal equinox occurs at 11:00
2/8 Mercury is at its northernmost latitude from the ecliptic plane (7.0 degrees) at 7:00; Mercury is at inferior conjunction with the Sun (0.652 astronomical units from Earth, latitude 7.0 degrees) at 14:00
2/9 Asteroid 2 Pallas is in conjunction with the Sun at 20:00
2/10 The Moon is 3.0 degrees south of Saturn at 11:00; the Moon, Venus, and Saturn lie within a circle with a diameter of 5.2 degrees at 16:00; the Moon is 3.0 degrees south of Venus at 20:00; the Moon, Venus, and Jupiter lie within a circle with a diameter of 3.6 degrees at 23:00
2/11 The Moon is 3.6 degrees southeast of Jupiter at 0:00; the equation of time, the difference between mean solar time (as indicated by clocks) and apparent solar time (as indicated by sundials), is at a minimum of -14.23 minutes at 3:00; the Moon is 8.0 degrees southeast of Mercury at 8:00; Venus is 0.4 degrees south of Jupiter at 12:00; New Moon (lunation 1214) occurs at 19:06
2/13 Mercury (magnitude +2.7) is 4.6 degrees north-northwest of Venus (magnitude -3.9) at 10:00; Mercury, Venus, and Jupiter lie within a circle with a diameter of 4.6 degrees at 11:00; the Moon is 4.0 degrees south of Neptune at 17:00; Mercury is 4.0 degrees north of Jupiter at 19:00
2/15 Mercury (magnitude +2.0) is 3.9 degrees north-northwest of Jupiter (magnitude -2.0) at 14:00
2/16 The Sun enters Aquarius (longitude 327.9 degrees on the ecliptic) at 9:00
2/17 The Moon is 2.8 degrees southeast of Uranus at 19:00
2/18 The Moon is at apogee, subtending 29' 32" from a distance of 404,467 kilometers (251,324 miles), at 10:22; the Sun's longitude is 258.2 degrees at 11:00
2/19 The Lunar X (the Purbach or Werner Cross), an X-shaped clair-obscur illumination effect involving various rims and ridges between the craters La Caille, Blanchinus, and Purbach, is predicted to be fully formed at 8:30; the Moon is 5.5 degrees southeast of the bright open cluster M45 (the Pleiades or Subaru) in Taurus at 18:00; First Quarter Moon occurs at 18:47
2/20 Venus is at aphelion (0.7282 astronomical units from the Sun) at 8:00; the Moon is 4.9 degrees north of Aldebaran at 12:00; Mercury is stationary, with prograde or direct (eastward) motion to commence, at 13:00
2/22 The Moon is 0.4 degrees north of the bright open cluster M35 in Gemini at 8:00; asteroid 29 Amphitrite (magnitude +9.2) is at opposition in Leo at 16:00
2/23 Mercury is 4.1 degrees northeast of Saturn at 8:00; the Moon is 7.3 degrees south of the first-magnitude star Castor (Alpha Geminorum) at 21:00
2/24 The Moon is 3.7 degrees south of the first-magnitude star Pollux (Beta Geminorum) at 2:00
2/25 The Moon is 2.6 degrees north-northeast of the bright open cluster M44 (the Beehive Cluster or Praesepe) in Cancer at 3:00
2/26 The Moon is 4.3 degrees north-northeast of the first-magnitude star Regulus (Alpha Leonis) at 18:00
2/27 The Full Moon (known as the Hunger, Snow, or Storm Moon) occurs at 8:17

Happy Birthdays in February

Feb 4th Clyde Tombaugh (1906-1997)  Feb 7th William Huggins (1824-1910)
Feb 13th John Dreyer (1852-1926)  Feb 15th Galileo Galilei (1564-1642)
Feb 18th Jacques Cassini (1677-1756)  Feb 19th Nicolas Copernicus (1473-1543)
Feb 20th George Smoot (1945-now)  Feb 27th Bernard Lyot (1897-1952)

[Added George Smoot - your Editor]
On this date in history . . .

Feb 3, 1775: Johann Bode discovered the globular cluster M53 in Coma Berenices.

Feb 7, 1785: William Herschel discovered the face-on barred spiral galaxy NGC 4027 in Corvus.

Feb 11, 1752: Nicolas Louis de Lacaille discovered the open cluster NGC 3228 in Vela.

Feb 16, 1781: The planetary nebula M97 in Ursa Major was discovered by Pierre François André Méchain.

Feb 16, 1948: Gerald Kuiper discovered the Uranian satellite Miranda (magnitude +15.8).

Feb 18, 1930: Clyde Tombaugh discovered Pluto.

Feb 19, 1787: William Herschel’s 40-foot-focal-length telescope saw first light.

Feb 23, 1752: Nicolas Louis de Lacaille discovered the face-on barred spiral galaxy M83 in Hydra.

Feb 23, 1987: Supernova 1987A was discovered by Ian Shelton, Oscar Duhalde, and Albert Jones.

Feb 24, 1967: The first pulsar, PSR B1919+21, was discovered by Jocelyn Bell Burnell and Antony Hewish.

Feb 26, 1783: Caroline Herschel discovered the open cluster NGC 2360 in Canis Major.

Feb 27, 1942: James Hey detected radio waves emitted by the Sun.

The Sun, the Moon, & the Planets

The Sun is located in the constellation of Capricornus on February 1st. It enters Aquarius on February 16th.

The Moon is 18.6 days old, is illuminated 89.4%, subtends 32.0', and is located in the constellation of Virgo at 0:00 UT on February 1st. The Moon attains its greatest northern declination (+25.1 degrees) for the month on February 23rd and its greatest southern declination (-24.9 degrees) on February 9th. Longitudinal libration is at a maximum of +4.6 degrees on February 12th and at a minimum of -6.3 degrees on February 24th. Latitudinal libration is at a maximum of +6.6 degrees on February 14th and a minimum of -6.6 degrees on December 1st and -6.5 degrees on February 28th. Favorable librations for the following lunar features occur on the indicated dates: Crater Hausen on February 1st, Crater Le Gentil on February 2nd, Crater Cabeus on February 3rd, and Crater Hayn on February 15th. New Moon occurs on February 11th. The Moon is at perigee (a distance of 58.03 Earth-radii) on February 3rd and is at apogee (a distance of 63.41 Earth-radii) on February 18th. The Curtiss Cross occurs on February 5th and the Lunar X on February 19th. The Moon will occult the fourth-magnitude star Omega Ophiuchi on the morning of February 6th, the bright open cluster M35 on the morning of February 22nd, and the fourth-magnitude star Kappa Geminorum on the evening of February 23rd, as described on page 50 of the February issue of Sky & Telescope.

Mercury is inferior conjunction on February 8th. It also attains its greatest heliocentric latitude north on that day. Mercury returns to the morning sky in the second half of February. It's positioned three degrees west of Jupiter on the morning of February 28th. Saturn lies 5.5 degrees to the west of Mercury on that date. This will be the best morning apparition of the speediest planet for southern hemisphere observers this year.

Venus changes little in apparent size or brightness this month. Venus passes 0.4 degrees south of Saturn on February 6th and 0.4 degrees south of Jupiter on February 11th.

Mars is at eastern quadrature on February 1st. As the distance between the Earth and Mars increases, observing surface features becomes very hard. Syrtis Major, the most prominent albedo feature, may be visible with difficulty until local midnight during the first five days of the month. The vernal equinox occurs in the Martian northern hemisphere on February 7th. Mars enters Taurus on February 23rd. The Red Planet passes approximately three degrees southwest of
the bright open cluster M45 on February 28th. On the same date, Mars is almost 1.5 astronomical units from the Earth and subtends only 6.4 arc seconds, while shining at just magnitude +0.9.

**Jupiter** emerges into morning twilight as a naked-eye object around February 19th. Jupiter (magnitude -2.0) forms an isosceles triangle with Mercury (magnitude +0.3) and Saturn (magnitude +0.7) low in the east-southeast 30 minutes before sunrise on February 25th.

The **Ringed Planet** reenters the dawn sky around the middle of the month. When Venus passes 0.4 degrees south of Saturn on February 6th, the two planets are just 11 degrees from the Sun. On the morning of February 20th, Saturn and Mercury are separated by 4.4 degrees as the two planets rise. Jupiter forms a triangle with those two planets and is 7.7 degrees east of Saturn when it rises some 22 minutes later.

**Uranus** is located about 10.5 degrees south of the second-magnitude star Hamal (Alpha Arietis). Uranus and Mars are separated by approximately 6.5 degrees as February begins. A waxing crescent Moon passes three degrees south of Uranus on February 17th. Visit [http://www.nakedeyep....com/uranus.htm](http://www.nakedeyep....com/uranus.htm) for a finder chart.

**Neptune** lies about two degrees northeast of the fourth-magnitude star Phi Aquarii on February 1st. A slender waxing crescent Moon passes four degrees south of Neptune on February 13th. The eighth planet disappears from view by the middle of the month.

The dwarf planet **Pluto** is not visible this month.

**Mars and Uranus** can be seen in the southwest and **Neptune** in the west in the evening sky. **Mars** is in the west at midnight. In the morning sky, **Mercury, Venus, Jupiter, and Saturn** lie in the east.

During February, four planets converge in the east at morning twilight. **Venus, Jupiter, and Saturn** lie within a circle with a diameter of 5.4 degrees on February 6th. On February 10th, the **Moon, Venus, and Saturn** lie within a circle with a diameter of 5.2 degrees and the **Moon, Venus, and Jupiter** lie within a circle with a diameter of 3.6 degrees. **Mercury, Venus, and Jupiter** lie within a circle with a diameter of 4.6 degrees on February 13th.

For more on the planets and how to locate them, browse [Naked Planets](http://www.nakedeyep....com/uranus.htm).

Information on passes of the ISS, the USAF’s X-37B, the HST, Starlink, and other satellites can be found at [Heavens Above](http://www.nakedeyep....com/uranus.htm).

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**Comet C/2021 A2 (NEOWISE)** travels northwestward from Puppis to Auriga during February. The faint periodic comet 88P/Howell heads northeastward through Aquarius and Pisces. It enters Cetus at the end of February. Two other faint periodic comets, 17P/Holmes and 141P/Machholz 2, lie nearby in the vicinity of the Circlet of Pisces and Cetus respectively. For more information on comets visible this month, browse the [Comet Chasing site](http://www.nakedeyep....com/uranus.htm). A historical list of the closest cometary approaches to Earth is posted on [Cometography](http://www.nakedeyep....com/uranus.htm).

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**Asteroids** 18 Melpomene and 60 Echo travel northwestward through southern Cancer this month on roughly parallel trajectories. Asteroid 10 Echo passes just south of the open cluster M67 from February 5th through February 8th. Asteroid 18 Melpomene lies about one degree north of M67 during that period. Asteroids brighter than magnitude +11.0 that reach opposition this month include 60 Echo (magnitude +10.3) on February 1st, 18 Melpomene (magnitude +9.4) on February 2nd, and 29 Amphitrite (magnitude +9.2) on February 21st. Finder charts for 18 Melpomene and 29 Amphitrite be found on page 49 of the February 2021 issue of *Sky & Telescope*.

You are welcome to access the Cloudy Nights site for many more details from Dave Mitsky. [https://www.cloudynights.com/topic/753929-february-2021-celestial-calendar/](https://www.cloudynights.com/topic/753929-february-2021-celestial-calendar/)

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Dear Readers,

I hope you enjoyed the article by our Prof. Brian Jackson on the soon-to-land Mars 2020 mission – Perseverance rover and Ingenuity helicopter. I do apologize that I stopped our story of ‘Mars the Robot Planet’ with the Phoenix lander. I did not want our February issue to be too long. In our March issue, we’ll finish our Mars story and talk about the Mars 2020 mission’s early accomplishments.

Also Coming in March: our new AL-Cor, Carol Smith, will introduce some Observation Certification Programs that I know many of you will enjoy!

The image at right is the Cat’s Eye nebula, Caldwell 6. [Credits: NASA, ESA, HEIC, and the Hubble Heritage Team (STScI/AURA); Acknowledgment: R. Corradi (Isaac Newton Group of Telescopes, Spain) and Z. Tsvetanov (NASA)].

I’ve recently discovered the wonderful world of podcasts! The folks at Star Date have a delightful, though short, daily podcast, usually about 3 minutes each. NASA Cast produced a great podcast on January 25th all about Perseverance titled “Small Steps, Giant Leaps: Episode 52, Mars Perseverance Rover Science” with Deputy Project Scientist Katie Stack Morgan. She is a geologist, so you don’t have to be a physicist to work on missions to space!

NASA has another podcast, NASA’s Curious Universe, that is also worth checking out!

Don’t forget the Sky & Telescope site. On their main page you will find their “This Week’s Sky at a Glance” feature and a Sky Tour podcast for February on ‘The Hare and the Unicorn’.

A feature story for February 3rd is about the Solar Heliospheric Observatory, by Bob King. “With the help of the Solar Heliospheric Observatory you can not only keep track of the planets in the daytime but maybe even discover a comet.” [https://skyandtelescope.org/astronomy-news/planets-and-comets-cant-hide-from-sohos-eye/]

A story from February 1st by Daniel Johnson is all about observing Castor – six stars in one.

Please, please continue to Stay Safe,

Loretta

The End
Join the Boise Astronomical Society – Membership has its privileges

link: https://www.boiseastro.org/

Hello and welcome to our club! We hope you enjoyed our newsletter, from current news and celestial events to a cosmic challenge, and often a bit of space history. As a member, your contributions are welcomed and encouraged, either photos of the night sky or an article on astronomy. Contact the newsletter Editor (BASnews42<a>gmail.com).

Membership entitles you to attend all monthly BAS Star Parties, educational outreach programs and, monthly membership meetings (often with a guest speaker). Owning a telescope is NOT a requirement of joining our club. Membership also includes, but is not limited to:

1. Membership in the Astronomical League (www.astroleague.org)
2. Discounts on subscriptions to both Astronomy and Sky & Telescope magazines
3. Star Party volunteer opportunities
4. Camping Star Party opportunities
5. First pick for campsite reservations at the annual Idaho State Party™
6. Field trips to area planetariums

Our membership meetings are normally held on the 2nd Friday of each month and, due to Covid-19, we now meet virtually via Zoom. Meetings often feature an interesting program or presentation, and the opportunity to spend time with other astronomy enthusiasts. Guests are welcome at our monthly Star Parties and meetings. We are always hoping they will become a member after attending our meetings.

A Star Party is a gathering of amateur astronomers for the purpose of observing the sky

Observing the night sky is always an exciting journey but having others to share the experience with makes it even better. We typically have two Star Parties each month around the New Moon; refer to the calendar on page 2 of this newsletter or join our online Group (see below) for scheduled dates. We usually meet up at Dedication Point, which is on Swan Falls Road, about 16 miles south of Kuna. During the summer months, we often move to a dark sky site at Granite Creek, near Idaho City. These events are free and you don’t have to bring your own telescope. Those who do bring a telescope are more than happy to share their views. Star Parties may be planned around a specific celestial event or just on a clear, moonless night. Either way, observing together gives everyone an opportunity to share knowledge, meet new people, and gain experience in stargazing that otherwise may not have been possible.

How to Join the Boise Astronomical Society

Annual dues are $25 per Household (includes all family members living at the same address) for the calendar year running from January 1 to December 31. Click HERE to print the membership application form.

Mail your application and check to us at: (please make checks payable to Boise Astronomical Society)

Boise Astronomical Society
PO Box 7002
Boise, Idaho 83707

NEW - Join & Pay Online   Click HERE  ($25 + $1 process fee)

Join us on Groups.io

We encourage you to join our online Group as this is how we communicate between our monthly meetings. It’s easy and it’s free. To start, use this link to create an account: https://groups.io/register. Of the (3) account-creation methods shown, we recommend that you enter your current email address and create a password; this will ensure that you’ll get real-time ‘Go/No-Go’ notices for Star Parties. The link to our group is https://groups.io/g/BoiseAstro. Please keep all postings on BAS-related topics. Please ensure all conversations follow civil discourse and are related to astronomy.

You are also most welcome to join our Facebook group, whether you are a member or not. Please keep conversations and postings (including sales) to a civil discourse and be related to astronomy. Also, we are now using Twitter, although sparingly, @boiseastro