<table>
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<th>2019 Club Officers</th>
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<tr>
<td>President - David Olsen</td>
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<td>Vice-President - Jim McMillian</td>
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<td>Secretary - Pamela Olsen</td>
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<td>Treasurer - Tamara Hunter</td>
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<td>Education Liaison – Ciera Partyka-Worley, Co-Chair</td>
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<td>Alcor - Dr. Irwin Horowitz, PhD</td>
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<td>Public Relations - Carol Smith</td>
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<td>Webmaster - Bailey Nielsen</td>
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<td>Newsletter Editor - David Olsen</td>
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<td>ISP Coordinator - Jeffrey Creed</td>
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<td>Members-at-Large: Randy Holst</td>
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<td>Boise State University Liaison Dr. Brian Jackson</td>
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<td><a href="http://www.boiseastro.org">www.boiseastro.org</a></td>
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**President’s Message**

June 2019

Bruneau Dunes Observatory is officially open, as always, **we need volunteers**. You may sign-up to volunteer, provided you have completed the background check, the form for the background check is available in the BAS1 yahoo group files section. To volunteer please call the park directly at (208) 366-7919. When you call please make sure they need you for the evening and the weather looks good. You will also need to log your hours with the observatory in the BAS logbook.

The monthly board meeting will be on Wednesday, the 5th of June at Anser Charter School. We will be holding our Idaho Star Party™ pre-planning session beginning at 6:30pm and then the regular board meeting at 7:00pm.

**On Friday, the 14th**, of June, the monthly meeting will be held at 7:00pm at Anser Charter School located at 202 E. 42nd St. in Garden City. Our speaker this month is Dr. Kathryn Devine from the College of Idaho in Caldwell. Prior to the regular meeting we will be hosting the Beginning with the Basics class also at Anser Charter School, which starts at 6:00pm. This is the last class this year for the Beginning with the Basics group.

During the year and throughout the nation libraries have adopted the theme of “A Universe of Stories” and some local libraries are no exception. There has been some requests to the Education Co-Chairs asking for volunteers to provide outreach to the requesting libraries. If you would like to help out with an education request please contact our education co-chairs, Ciera Partyka-Worley, or Brian Jackson. Other opportunities to volunteer for educational outreach are available as well.

We have a star party scheduled for June 1st in Idaho City and one on June 8th at Dedication Point. As always a GO / NO-GO message will post on BAS1 Yahoo group and on facebook letting you know if you would like to attend.

If anyone might be interested, the Idaho Falls Astronomical Society is holding their semi-annual Craters of the Moon Star Party at the Caves area parking lot at the Monument during the weekend of June 28th and 29th. More information can be found on their website [IFAS events](http://www.astrojack.com/).

Until next month, enjoy the night sky when you can.

David Olsen, President

BAS
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<td>BAS Star Party Idaho City Granite Ck. Dark Sky Site</td>
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<td>New Moon Lunation 1193 1% Visible ↑ Age: 0.07 Days</td>
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<td>BAS Board Meeting and ISP Planning Committee at 6:30pm</td>
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<td>BAS Star Party Dedication Point Dark Sky Site</td>
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<td>First Quarter Moon Visible: 54% ↑ Age: 7.67 days</td>
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<td>Flag Day BAS General Meeting at 7:00pm BSU Campus Beginning w/ Basics at 6pm</td>
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<td>Father’s Day Full Moon 100% Visible Age: 14.90 Days</td>
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<td>Last Quarter Visible 48% ↓ Age: 22.43 Days</td>
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Be Safe – Get Out There – Explore Your Universe
June Celestial Calendar by Dave Mitsky

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

6/1 The Moon is 3.1 degrees south-southeast of Venus at 21:00
6/2 The Moon is 7.9 degrees south-southeast of the bright open cluster M45 (the Pleiades or Subaru) in Taurus at 13:00
6/3 Mercury is at its greatest heliocentric latitude north today; asteroid 2 Pallas is stationary at 2:00; the Moon is 2.3 degrees north of the first-magnitude star Aldebaran (Alpha Tauri) at 6:00; New Moon (lunation 1193) occurs at 10:02
6/4 The Moon is 3.7 degrees south of Mercury at 17:00
6/5 A double Galilean satellite shadow transit (Ganymede’s shadow precedes Io’s) begins at 0:29; the Moon is 1.6 degrees south of Mars at 15:00; the Moon is at the ascending node (longitude 107.9 degrees) at 23:00
6/6 Mercury is 1.2 degrees north of the bright open cluster M35 in Gemini at 1:00; the Moon is 6.2 degrees south of the first-magnitude star Pollux (Beta Geminorum) at 10:00
6/7 The Moon makes a close approach to the bright open cluster M44 (the Beehive Cluster or Praesepe) in Cancer at 8:00; the Moon is at perigee, subtending 32' 26" from a distance of 368,504 kilometers (228,978 miles), at 23:15
6/8 The Moon is 3.0 degrees north-northeast of the first-magnitude star Regulus (Alpha Leonis) at 22:00
6/9 Venus is 5.1 degrees south-southeast of the bright open cluster M45 at 5:00
6/10 The Purbach Cross or Lunar X, an X-shaped illumination effect involving various rims and ridges between the craters La Caille, Blanchinus, and Purbach, is predicted to be visible at 4:17; First Quarter Moon occurs at 5:59; Jupiter (magnitude -2.5, apparent size 46.0") is at opposition at 16:00
6/12 A double Galilean satellite shadow transit (Io’s shadow precedes Ganymede’s) begins at 3:33; the Moon is 7.3 degrees north-northeast of the first-magnitude star Spica (Alpha Virginis) at 18:00
6/13 The equation of time, which yields the difference between mean solar time and apparent solar time, equals 0 at 10a
6/14 The earliest sunrise of the year at latitude 40 degrees north occurs today
6/15 The Moon is 0.9 degree north of dwarf planet/asteroid 1 Ceres, with an occultation taking place in Japan, northern and eastern China, northeastern Kazakhstan, and central and eastern Russia, at 15:00
6/16 The Moon is 7.8 degrees north-northeast of the first-magnitude star Antares (Alpha Scorpii) at 5:00; the Moon is 2.0 degrees north-northeast of Jupiter at 20:00
6/17 The earliest morning twilight of the year at latitude 40 degrees north occurs today; Full Moon, known as the Rose or Strawberry Moon, occurs at 8:31; Venus is 5.0 degrees north of the first-magnitude star Aldebaran (Alpha Tauri) at 21:00
6/18 Mercury (magnitude +0.2) is 0.2 degree north of Mars (magnitude +1.8) at 14:00
6/19 The Moon is at the descending node (longitude 287.6 degrees) at 2:00; the Moon is 0.4 degree south of Saturn, with an occultation taking place in southern Africa, the Antarctic Peninsula, southern South America, and Easter Island, at 4:00; the Moon is 0.1 degree south of Pluto, with an occultation taking place in western South America, Central America, southern Polynesia, southern Micronesia, northeastern Australia, and Melanesia, at 11:00; Mercury is 5.4 degrees south-southwest of Pollux at 14:00
6/21 Mars is 5.5 degrees south of Pollux at 8:00; the Sun reaches an ecliptic longitude of 90 degrees and the northern hemisphere summer solstice occurs at 15:56
6/22 The Sun enters Gemini, at longitude 90.43 degrees on the ecliptic, at 3:00; Neptune is stationary at 4:00
6/23 The Moon is at apogee, subtending 29' 32" from a distance of 404,548 kilometers (251,375 miles), at 7:50; Mercury is at greatest eastern elongation (25 degrees) at 23:00
6/24 The latest evening twilight of the year at latitude 40 degrees north occurs today; the Moon is 3.6 degrees south-southeast of Neptune at 4:00
6/25 Last Quarter Moon occurs at 9:47
6/26 Mercury is at the descending node today; the Curtiss Cross, an X-shaped illumination effect located between the craters Parry and Gambart, is predicted to be visible at 6:33
6/27 The latest sunset of the year at latitude 40 degrees north occurs today
6/28 The Moon is 4.5 degrees south-southeast of Uranus at 2:00
6/29 The Moon is 7.9 degrees south-southeast of the bright open cluster M45 at 23:00
6/30 The Moon is 2.3 degrees north of Aldebaran at 15:00

Giovanni Cassini (1625-1712), John Dollond (1706-1761), Charles Messier (1730-1817), William Lassell (1799-1880), George Ellery Hale (1868-1938), and Carolyn Shoemaker (1929) were born this month.
The Sun, the Moon, & the Planets

The Moon is 26.9 days old, is illuminated 7.6%, subtends 30.3 arc minutes, and is located in Cetus on June 1st at 0:00 UT. The June lunar month is 29 days 09 hours 14 minutes in length. The Moon is at its greatest northern declination of +22.2 degrees on June 6th and at its greatest southern declination of -22.3 degrees on June 19th. Longitudinal libration is at a maximum of +5.1 degrees on June 16th and a minimum of -5.2 degrees on June 2nd and -6.1 degrees on June 29th. Latitudinal libration is at a maximum of +6.8 degrees on June 27th and a minimum of -6.7 degrees on June 12th. New Moon occurs on June 3rd. On June 7th, the Moon passes very near the bright open cluster M44. The Moon is at perigee on June 7th (distance 57.78 Earth-radial) and at apogee on June 23rd (distance 63.43 Earth-radial). The Moon occults 1 Ceres on June 15th and Saturn and Pluto on June 19th from certain parts of the world. See http://www.lunar-occultations.com/iota/iotandx.htm for information on lunar occultations taking place this month. Visit http://saberdoesthestars.wordpress.com/2011/07/05/saber-does-the-stars/ for tips on spotting extreme crescent Moons. Click on http://www.calendar-12.com/moon_calendar/2019/june for a lunar phase calendar. Times and dates for the lunar light rays predicted to occur this month are available at http://www.lunar-occultations.com/rlo/rays/rays.htm

The Sun is located in Taurus on June 1st. It enters Gemini on June 22nd. The Sun reaches its farthest position north for the year on June 21st. There are 15 hours and one minute of daylight at latitude 40 degrees north on June 21st, the day of the summer solstice. At latitude 40 degrees north, the earliest sunrise occurs on June 14th and the latest sunset on June 27th. For an explanation of why this occurs, click on https://earthsky.org/?p=4027

Brightness, apparent size, illumination, distance from the Earth in astronomical units, and location data for the planets and Pluto on June 1st: Mercury (-1.1, 5.5", 87% illuminated, 1.23 a.u., Taurus), Venus (magnitude -3.8, 10.5", 94% illuminated, 1.59 a.u., Aries), Mars (magnitude +1.8, 3.9", 98% illuminated, 2.43 a.u., Gemini), Jupiter (magnitude -2.6, 45.8", 100% illuminated, 4.30 a.u., Ophiuchus), Saturn (magnitude +0.3, 18.0", 100% illuminated, 9.25 a.u., Sagittarius), Uranus on June 16th (magnitude +5.9, 3.4", 100% illuminated, 20.49 a.u., Aries), Neptune on June 16th (magnitude +7.9, 2.3", 100% illuminated, 29.82 a.u., Aquarius), and Pluto on June 16th (magnitude +14.2, 0.1", 100% illuminated, 32.93 a.u., Sagittarius).

Mercury and Mars are in the northwest and Jupiter is in the southeast in the evening sky. At midnight, Jupiter lies in the south and Saturn lies in the southeast. Venus in the northeast, Jupiter and Saturn can be found in the southwest, Uranus in the east, and Neptune in the southeast at dawn.

Mercury grows in apparent size from 5.5 to 9.2 arc seconds but decreases in magnitude from -1.1 to +0.9. Mercury reaches its highest heliocentric latitude on June 3rd. On June 4th, a very thin two-day-old waxing crescent Moon passes four degrees south of the planet at sunset. Mercury is located 1.2 degrees north of the bright open cluster M35 on June 8th. Mercury and Mars are separated by 28 arc minutes on June 17th and just 18 arc minutes during their closest conjunction in 13 years on June 18th. Mercury shines at magnitude +0.2, which is five times brighter than the Red Planet, and subtends 7.4 arc seconds, which is twice the apparent size of Mars at the time. As June progresses, Mercury climbs higher into the sky and Mars loses altitude. The speediest planet reaches its greatest eastern elongation on June 23rd, when it is located at an altitude of 11 degrees 30 minutes after sunset.

Brilliant Venus and the waning crescent Moon lie six degrees apart and six degrees above the horizon 30 minutes before sunrise on June 1st. The planet is at an elongation of 20 degrees at the time. Aldebaran is approximately five degrees to the right of Venus on the morning of June 18th. Venus is just three degrees above the horizon one half-hour before the Sun rises on June 30th.

During June, Mars shines faintly at magnitude +1.8 and shrinks to 3.7 arc seconds, just three arc seconds larger than Uranus. The waxing crescent Moon passes 1.6 degrees south of Mars on June 5th. Mars and Mercury undergo a very close conjunction on June 18th.

**Saturn** rises at about 11:00 p.m. local daylight time on June 1st. The planet shines at magnitude +0.2 and subtends 18.2 arc seconds at its equator, while its rings span 41 arc seconds and are inclined 24 degrees. The waxing gibbous Moon passes less than one degree south of Saturn, with an occultation occurring in some parts of the world, on June 19th. Eighth-magnitude Titan passes north of Saturn on the mornings of June 13th and June 29th and south of the planet on the mornings of June 5th and June 21st. For information on Saturn’s satellites, browse [http://www.skyandtelescope.com/observing/interactive-sky-watching-tools/](http://www.skyandtelescope.com/observing/interactive-sky-watching-tools/).

By the end of the month, **Uranus** rises at about 2:00 a.m. local daylight time. The ice giant is situated in southern Aries, some ten degrees south of the first-magnitude star Hamal (Alpha Arietis) and 2.4 degrees south of the sixth-magnitude star 19 Arietis. The waxing gibbous Moon passes five degrees north of Uranus on June 27th. Visit [http://www.bluewaterastronomy.info/resources/Maps/Charts-2019/09uranus_2019_1.pdf](http://www.bluewaterastronomy.info/resources/Maps/Charts-2019/09uranus_2019_1.pdf) and [http://www.nakedeyeplanets.com/uranus.htm#finderchart](http://www.nakedeyeplanets.com/uranus.htm#finderchart) for finder charts.

**Neptune** rises shortly after 1:00 a.m. local daylight time by mid-June. The eighth planet lies 1.2 degree east-northeast of the fourth-magnitude star Phi Aquarii on June 1st. Neptune reaches its first stationary point on June 22nd, when it will be less than 1.5 degrees northeast of Phi Aquarii and less than 0.5 degree south of the sixth-magnitude star 96 Aquarii. The waning gibbous Moon passes four degrees south of Neptune on June 24. Browse [https://s22380.pcdn.co/wp-content/uploads/UrNep-2019-2020.pdf](https://s22380.pcdn.co/wp-content/uploads/UrNep-2019-2020.pdf) and [http://www.nakedeyeplanets.com/neptune.htm#finderchart](http://www.nakedeyeplanets.com/neptune.htm#finderchart) for finder charts.


**Pluto** resides in northeastern Sagittarius. The waxing gibbous Moon passes 0.1 degree south of Pluto, with an occultation occurring in some parts of the world, on June 19th. Finder charts can be found at [http://www.bluewaterastronomy.info/resources/Maps/Charts-2019/Pluto2019.jpg](http://www.bluewaterastronomy.info/resources/Maps/Charts-2019/Pluto2019.jpg) and on pages 48 and 49 of the July 2019 issue of Sky & Telescope and page 243 of the RASC Observer’s Handbook 2019.

For more on the planets and how to locate them, browse [http://www.nakedeyeplanets.com/](http://www.nakedeyeplanets.com/)

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**Asteroids**

Shining at ninth magnitude, asteroid 2 Pallas glides southeastward through eastern Coma Berenices this month. It lies about two degrees to the west of the sixth-magnitude star 2 Boötes on June 21st. The main belt asteroid passes very close to similarly bright stars on June 12th and June 26th. Asteroids brighter than magnitude +11.0 that reach opposition this month include 410 Chloris (magnitude +10.3) on June 14th, 22 Kalliope (magnitude +10.8) on June 15th, and 914 Palisana (magnitude +10.8) on June 28th. Information on asteroid occultations taking place this month is available at [http://www.asteroidoccultation.com/2019_06_si.htm](http://www.asteroidoccultation.com/2019_06_si.htm)

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**Carbon Star**

Notable carbon star for June: V Coronae Borealis Right Ascension: 15h 49m 31.31093s Declination: +39° 34′ 17.9111″

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**Comets**

Comet C/2018 N2 (ASASSN) travels northeastward through northeastern Cetus during June. The faint comet lies about 1.5 degrees to the east of the fourth-magnitude star Xi Ceti on June 30th. Visit [http://cometchasing.skyhound.com/](http://cometchasing.skyhound.com/) and [http://www.aerith.net/comet/future-n.html](http://www.aerith.net/comet/future-n.html) for information on comets visible this month.
The minor Boötid meteor shower (5 per hour) peaks on the morning of June 27th. The source of Boötid meteors is the periodic comet 7P/Pons-Winnecke. The radiant lies in northern Boötes at right ascension 14 hours 56 minutes, declination 48 degrees. Browse http://www.spaceweather.com/meteors/junebootids.html for additional information.

Information on Iridium flares and passes of the ISS, the Tiangong-2, the USAF’s X-37B, the HST, and other satellites can be found at http://www.heavens-above.com/. Satellite information with ISS Live HD streaming https://www.n2yo.com

Satellite information with ISS Live HD streaming https://www.n2yo.com

Information on the celestial events transpiring each week can be found at http://astronomy.com/skythisweek and http://www.skyandtelescope.com/observing/sky-at-a-glance/

A wealth of current information on solar system celestial bodies is posted at http://www.curtrenz.com/astronomy.html and http://nineplanets.org/ Various events taking place within our solar system are discussed at http://www.bluewaterastronomy.info/styled-4/index.html

Information on the celestial events transpiring each week can be found at http://astronomy.com/skythisweek and http://www.skyandtelescope.com/observing/sky-at-a-glance/


The famous eclipsing variable star Algol (Beta Persei) is at a minimum, decreasing in magnitude from 2.1 to 3.4, on April 2nd, 5th, 8th, 11th, 14th, 16th, 19th, 22nd, 25th, and 28th. A favorable date for observing Algol at mid-eclipse from the eastern United States is on April 10th at 11:49 p.m. EDT or 3:49 UT on April 11th. For more on Algol, see http://stars.astro.i.../sow/Algol.html and http://www.solstation...rs2/algol3.htm

Data on current supernovae can be found at http://www.rochesterastronomy.org/snimages/

It is possible to observe all 109 (or 110) Messier objects during a single night around the time of the vernal equinox, if the Moon phase and local latitude are favorable. For information on running a so-called Messier Marathon, browse http://messier.seds.org/xtra/marathon/marathon.html and http://www.richardbell.net/marathon.html
Information on observing some of the more prominent Messier galaxies is available at http://www.cloudynights.com/topic/358295-how-to-locate-some-of-the-major-messier-galaxies-and-helpful-advice-for-novice-amateur-astronomers/


Telrad finder charts for the Messier Catalog and the SAC's 110 Best of the NGC are posted at http://www.astrom.com/messier/messier_finder_charts/map1.pdf and http://www.saguarastro.org/content/db/Book110BestNGC.pdf respectively.


The Moon, Mercury, and Mars line up in the west-northwestern evening sky after sunset on June 5, 2019.
The British astronomer Edmund Halley discovered M13 on June 1, 1714. The French astronomer Nicolas Louis de Lacaille discovered the globular cluster M55 on June 16, 1752. A transit of the Sun by Venus was observed by Austrian, British, and French astronomers from various parts of the world on June 6, 1761. The French astronomer Charles Messier discovered the globular cluster M14 on June 1st, 1764, the emission and reflection nebula M20 (the Trifid Nebula) on June 5, 1764, and the open cluster M23 on June 20, 1764. The globular cluster M62 was discovered by Charles Messier on June 7, 1771. The French astronomer Pierre Méchain discovered his first deep-sky object, the spiral galaxy M63 (the Sunflower Galaxy), on June 14, 1779. The German/English astronomer William Herschel discovered the globular cluster NGC 6288 on June 24, 1784. Neptune was independently discovered by the British astronomer John Couch Adams on June 5, 1846. The Italian astronomer Giovanni Battista Donati discovered Comet C/1858 L1 (Donati), the first comet to be photographed, on June 2, 1858. A large storm on Saturn was observed by the American astronomer E. E. Barnard. The Tunguska event occurred on June 30, 1908. The largest known solar flare was recorded on June 27, 1984. The Georgian astronomer Givi Kimeridze discovered a Type Ia supernova in the spiral galaxy M58 on June 28, 1989. Namaka, a satellite of the dwarf planet Haumea, was discovered on June 30, 2005. Kerberos, Pluto’s fourth satellite, was discovered by the Hubble Space Telescope team on June 28, 2011.
The Voyager Odyssey
Chapter 3: The Saturn flyby & the planet-moon Titan
by Loretta J Cannon

“We were looking at the shadow of Saturn on the rings, and it was clearly from this wild, crazy angle. Wow, holy cow, we’re on the other side of Saturn.”
- Rich Terrile, Imaging Science Team
quoted in documentary The Farthest Voyager in Space (2017)

The Voyager spacecrafts made their closest approaches to Saturn almost 40 years ago, in November 1980 for Voyager 1 and August 1981 for Voyager 2. These flybys were no less fascinating and eye-opening than the Jupiter flybys. Among the mission goals at Saturn were: examine the moon Titan, examine the ring system up close, examine Saturn’s atmosphere.

Titan was identified by Huygens in 1655, the first of Saturn’s moons to be discovered. By 1944, astronomers had observed an atmosphere on this planet-sized moon. [For Star Wars fans, think of the Rebel base on the 4th moon of the gas giant planet Yavin, only the Rebel moon had green plants and breathable air.] Pioneer 11 data in 1979 indicated a thick atmosphere composed of organic compounds, e.g., methane etc. It was theorized that this small world may just be a model for the early earth, before oxygen-producing life existed. Thus, it was a very high priority for the Voyagers, so high that if Voyager 1 had failed to gather data at Titan, then Voyager 2 would have been re-directed to encounter Titan and we would have lost the ability to go on to Uranus and Neptune. Remember from Chapter 2, the graphic showing the trajectories of the two spacecraft out of the solar system. In order to get close enough to study Titan, Voyager 1’s path would take it ‘up’ out of the solar system’s plane, with no hope of going to the outer planets.

The good news is that Voyager 1 was successful at Titan! We were able to measure the moon’s size and mass and learned that it’s a world of both ice and rock, with a frigid surface temperature of -300 F. In addition to methane, the atmosphere is composed of nitrogen, ethane, ethylene, acetylene and hydrogen cyanide. Compounds that could be liquid, gas or solid at the temperatures and pressures on this planet-moon.

The mission engineers programmed Voyager 2 to examine Saturn’s atmosphere while flying very close to the planet, skimming close to a ring, and moving around behind the planet. During this maneuver, Voyager would observe sunlight passing through the atmosphere, and Voyager’s radio signals would pass through the atmosphere to be observed-analyzed on earth. This is a useful phenomena known as occultation. One body passes in front of another body and blocks a light source from reaching the second body; the detectable halo or outline of light around the second body, for planetary studies, provides valuable information. For the Voyager mission, this would be a great opportunity to observe: close-ups of the moons Tethys and Enceladus, the rings edge-on, Saturn’s southern hemisphere, and analyze the molecular makeup of the atmosphere.

It’s important to note here that Voyager was flying close to 10 miles per second as it moved behind the planet, and it was expected to accelerate close to 15 miles per second coming out the curve. The scan platform on which the cameras and some of the instruments are housed has small motors to re-position said cameras and instruments. Further, while moving behind the planet (in relation to earth & the sun), temperatures will be much colder. As such, the engineers had to program the cameras and instruments to move quite rapidly to get the needed pictures (in focus) and required data in a very short time. And while all this amazing data was being acquired, Voyager 2 would be out of contact with Earth for almost two hours.
As Voyager 2 began transmitting data again, the jubilation that the spacecraft was still ‘alive’ was short-lived. The images coming through were black. Something was seriously wrong. The biggest concern was that the spacecraft was hit by something during the ring crossing. The plasma wave subsystem scientist reported extremely high energy levels during ring crossing, suspected to have been caused by impacts from thousands of very small dust grains. This author searched for a copy of this recording on the NASA website to no avail. Here’s a file claiming to be a Voyager recording of the sounds of Saturn’s rings: https://www.youtube.com/watch?v=eVfkW9oxhlk. It is faint so you’ll want to listen in a quiet room with the speakers turned up; authenticity unknown.

Eventually, the most likely scenario was that the scan platform froze up due to the fast and complicated machinations it was asked to do while going behind Saturn. Instructions were sent that had the platform making small, slow movements back and forth which seemed to get the gears moving normally. Yay, the cameras and instruments were fine and the scan platform was functioning again. Other than a disappointing loss of data, the mission could continue.

From both Voyagers, we learned that Saturn’s atmosphere is only 7% helium as compared to Jupiter’s 11%. It was thought that the helium may be sinking through the atmospheric hydrogen, which process may be involved in the heat radiated by Saturn (more than what’s received from the Sun). As at Jupiter, winds move at high speeds, up to 1100 miles per hour; further, some winds may be moving north to south deep within the planet while surface winds are moving mostly eastwards. Auroras and auroral activity were imaged both at mid-latitudes and near the poles.

The most interesting fun fact identified was this: unlike all other planets in our solar system, Saturn is less dense than water. If a ginormous bowl of water could be imagined, the planet would float on the surface.

Our exploration of Saturn and Jupiter continued long after the Voyager mission left the planets. In the Jan 18, 2019 issue of Science (vol 363, issue 6424, pp. 214-5), there’s a brief report on the results of the Cassini probe that explored Saturn and the Juno probe that explored Jupiter. Cassini found that Saturn’s core may have a mass 15-18 times bigger than the Earth. In addition, the probe “was tugged by something deep within Saturn that could not be explained by the winds”, something that was not experienced by Juno at Jupiter! But that’s not the really interesting discovery. (Now remember, Voyager found that Saturn is not as dense as water.) Cassini found that Saturn vibrates, the whole planet! And these vibrations affect the rings “like the trace on a seismograph” and are being used to study and explain forces deep within the planet.

This amazing image of Titan was compiled by data from the Cassini probe, which looked beneath the thick haze with radar and spectrometers. The dark areas are believed to be lakes of liquid methane and ethane.

The Voyager mission laid a good foundation for planetary science. Imagine, in 1977 when the spacecraft were launched, we knew so little about Saturn, and neither professional nor amateur astronomers had seen much detail beyond a striated gas giant with three rings and ten moons. To date, not only have we identified seven ring groups but over 50 moons.

For the next chapter, we’ll explore the early days of the Voyager mission. How an assignment given to a graduate student in aerodynamics at Caltech in the mid-1960s, regarding a maybe-someday exploration of the outer planets, became The mission in astrophysics in the 1980s.

[NOTE - Information Found: Voyager 1, which left the plane of the solar system first, is headed for the constellation Camelopardalis, to pass by star AC+79-3888. Perhaps you all could point a telescope in that direction at an upcoming star party and take a picture to share in an upcoming newsletter?]
Between July 1969 and December 1972, six teams of United States astronauts ventured across the gap between Earth and Moon to land and walk on that distant world. Have you ever visited their landing sites? If not, let’s do so now.

<table>
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<th>Target</th>
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Image reduced to fit newsletter format - Editor
We begin with Apollo 11, “Tranquility Base.” The dark gray outline of Mare Tranquilitatis (the Sea of Tranquility) looks almost perfectly round from our earthly vantage point. The best time to view Mare Tranquilitatis is during the waxing crescent phases, about 5.5 to 6 days after New Moon. This month, that will be (at least here in North America) on the evening of June 9. Apollo 11 touched down near the southwestern shore, east-southeast of the craters Ritter and Sabine, fifty years ago next month, on July 20, 1969. “The Eagle [nickname of the mission’s Lunar Module] has landed!”

Of course, the primary mission objective of Apollo 11 is obvious; in the words of the late President John F. Kennedy: to “land a man on the Moon and return him safely to the Earth.” But there were also science goals, as well. Clearly, the first goal was to collect samples of the lunar surface. Astronauts Neil Armstrong and Edwin Aldrin collected 49 pounds (22 kg) of rock and soil samples during their single 2.5-hour moonwalk, or EVA (Extra-Vehicular Activity), as well as deployed Apollo Lunar Surface Experiments Package (ALSEP) instruments to check the composition of the solar wind, measure seismic activity, and determine the exact distance to the Moon. The latter, called the Laser Ranging Retroreflector, is still in use today, as are similar packages left by Apollo’s 14 and 15. During the exploration, the astronauts also extensively photographed the lunar terrain.

Apollo 12 landed on Oceanus Procellarum (the Ocean of Storms) in November 1969. Dominating the waxing gibbous phases, the Ocean of Storms covers more than one million square miles of lunar terrain. The mission's exact landing site lies southeast of the crater Lansberg, which in turn is south-southwest of the prominent crater Copernicus. The area sees sunrise two nights after First Quarter. This month, that’s on June 12. Watch as sunlight first bathes Copernicus’ sharply defined walls, catching the strong central mountain peak before sliding down to the crater floor. Mark your calendar to come back in a few nights when the brilliant ray system of Copernicus explodes into view against the darker background of the mare. Its starburst pattern is unmistakable through even the most modest binoculars.

While Apollo 11’s touchdown point was about four miles downrange from the predicted site, Apollo 12’s landing crew, Pete Conrad and Alan Bean, really hit the mark. They landed the Lunar Module, “Intrepid,” just 53 feet away from the Surveyor 3 unmanned spacecraft that the United States sent 2.5 years earlier. Beyond collecting more lunar samples, one key mission objective was to bring back components of that spacecraft. This enabled engineers and materials scientists to study the effect that the harsh lunar environment had on those parts. Incidentally, there’s a long-lived urban legend that researchers examining Surveyor 3’s camera, which was one component returned for study, discovered evidence of microorganisms inside the camera that had apparently stowed away before the 1966 launch. Even though that “fake news” persists on-line, it turns out that the microorganisms, Streptococcus Mitis, contaminated the camera after its return to Earth by Apollo 12, as this archived study reports. (Click on the “++ -- Description Continues” to read a capsule summary, where it states “may be the result of accidental contamination of the material after it was returned to Earth.”)

After the nearly catastrophic mission of Apollo 13 in April 1970, we returned to the Moon 10 months later with the mission of Apollo 14. Its landing site was the hilly region known as Fra Mauro. Fra Mauro is found near the southeastern shore of the Ocean of Storms, to the east of Apollo 12. Fra Mauro experiences sunrise a night earlier, on June 11.

That location was chosen because it is believed to have been formed from debris left over from the impact that formed Mare Imbrium. The samples returned by Apollo 14 showed that Mare Imbrium is no more than about 4.25 billion years old. Apollo 14 featured the return to space by America’s first astronaut, Alan B. Shepard Jr. Shephard had piloted the first Mercury mission, a suborbital flight known as Freedom 7, almost exactly a decade earlier. Serving as Apollo 14 commander, Shepard and Lunar Module pilot Edgar Mitchell, landed on February 5, 1971. While on the surface, Shepard famously hit a golf ball using a makeshift club made from a Wilson Staff 6-iron head attached to the “contingency return sample collector” he was to use on the Moon.

July 30, 1971 saw Apollo 15 astronauts David Scott and James Irwin touch down next to Hadley Rille and the Apennine Mountains. The lunar Apennines mark the southeastern edge of Mare Imbrium (the Sea of Rains), just south of the prominent triangle of craters formed by Aristillus, Autolycus, and Archimedes. All three craters lie near the Moon’s terminator, or sunrise line, on the night after First Quarter. Take a look on June 10, or a night or two later if it’s cloudy.

Apollo 15 used a second-generation Lunar Module to bring along the first Lunar Rover. During their three EVAs, Scott and Irwin drove the Rover a total of 17.5 miles. In the process, they gathered over 170 pounds of lunar samples, including a core sample from about 10 feet beneath the lunar surface, and set up their mission’s ALSEP instruments. One of the rocks returned became known as the Genesis Rock, one of the oldest samples returned at an estimated age of 4.1 billion years.

Piloted by Commander John Young and Lunar Module Pilot Charles Duke, Apollo 16 landed just north of the crater Descartes in the highlands south of Mare Tranquilitatis on April 20, 1972. The craters Theophilus and Cyrillus are to the east of the landing site, while Albategnius is roughly an equal distance to its west. June 9, the night before First Quarter is perfect for viewing this area. Just west of Albategnius, three more striking craters that almost touch each other’s borders – Ptolemaeus, Alphonsus, and Arzachel – see sunrise the following evening.
Apollo 16’s landing site in the lunar highlands was chosen so that the astronauts could gather geologically older lunar material than in the lunar Maria landing sites of Apollo’s 11, 12, and 15. Young and Duke drove the second Lunar Rover 16.6 miles (26.7 km) during their three EVAs. Along the way, they gathered 211 pounds (95.8 kg) of lunar samples for return to Earth. Those samples proved that the area was not volcanic in origin, as had been previously believed.

Apollo 17’s landing on December 1972 signaled an end to the Apollo era. We find its site near the Taurus Mountains, which form the eastern rim of Mare Serenitatis (the Sea of Serenity). The best time to view this area is during the waxing crescent phases on June 7 and for a few nights thereafter. The mission’s Taurus-Littrow landing site was selected because it offered the best of both worlds, a combination of mountainous highlands and valley lowlands.

Mission Commander Eugene Cernan and Harrison Schmitt explored the region with the third Lunar Rover, covering 22.3 miles (35.9 km) in three EVAs. In the process, they gathered a record 243.7 pounds (110.5 kg) of samples. Schmitt knew especially what to look for, as he was the only trained geologist ever to walk on the lunar surface.

Cernan became the last man to walk on the Moon when he left its surface on December 14, 1972. Before climbing the ladder back into the Lunar Module, his last words from the surface were “…as I take man’s last step from the surface, back home for some time to come - but we believe not too long into the future - I'd like to just [say] what I believe history will record. That America’s challenge of today has forged man's destiny of tomorrow. And, as we leave the Moon at Taurus-Littrow, we leave as we came and, God willing, as we shall return, with peace and hope for all mankind. Godspeed the crew of Apollo 17.”

I find it very sad that Eugene Cernan is still the last man on the Moon nearly half a century later. When will we return to the Moon? Who will be the next visitor on the surface to walk in the shadows of our Apollo heroes? Only time will tell. But even as we remain confined to our planet for the foreseeable future, we can retrace the history of the Apollo program this month as we get ready to commemorate the half-century anniversary of Apollo 11 in July. Visit each of the landing sites from your own yard this month. And then get ready, because next month, we return to explore in greater detail the Apollo 11 landing site and three commemoratively named craters that lie nearby.

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

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First step on the Moon by Astronaut Neil A. Armstrong
Added to the article by the Editor

About the Author: Phil Harrington writes the monthly Binocular Universe column in Astronomy magazine and is the author of 9 books on astronomy. Visit his web site at www.philharrington.net to learn more.

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Jupiter Shines in June
By David Prosper

Jupiter stakes its claim as the king of the planets in June, shining bright all night. Jupiter is visible almost the entire evening this month. Earth will be between Jupiter and the Sun on June 10, meaning Jupiter is at opposition. On that date, Jupiter rises in the east as the Sun sets in the west, remaining visible the entire night. Jupiter will be one of the brightest objects in the night sky, shining at magnitude -2.6. Its four largest moons and cloud bands are easily spotted with even a small telescope.

What if your sky is cloudy or you don’t have a telescope? See far more of Jupiter than we can observe from Earth with NASA’s Juno mission! Juno has been orbiting Jupiter since 2016, swooping mere thousands of miles above its cloud tops in its extremely elliptical polar orbits, which take the probe over 5 million miles away at its furthest point! These extreme orbits minimize Juno’s exposure to Jupiter’s powerful radiation as it studies the gas giant’s internal structure, especially its intense magnetic fields. Juno’s hardy JunoCam instrument takes incredible photos of Jupiter’s raging storms during its flybys. All of the images are available to the public, and citizen scientists are doing amazing things with them. You can too! Find out more at bit.ly/JunoCam. Discover more about NASA’s current and future missions at nasa.gov.
You’re invited to star gaze at the Bruneau Dunes Observatory! See the night sky as you’ve never seen it before. Observatory tours and solar viewing (through a specially adapted telescope) begin one hour before sunset, and are free of cost. Following that, visitors can view short orientation program and then have the chance to survey the heavens through the observatory’s collection of telescopes. There is a viewing fee of $3 per person (children 5 and under are free of cost) for this. The observatory is open to the public from early April through mid-October on Friday and Saturday nights only, weather permitting. For presentation times, call 208-366-7919, or check the kiosk when you arrive at the park.

See our video: https://www.youtube.com/watch?v=v_TnnWx75k0&t=226

Whittenberger Planetarium – Caldwell, Idaho

CSI Centennial Observatory / Faulkner Planetarium Herrett Center

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College of Southern Idaho Campus Twin Falls, ID
Faulkner Planetarium / Show Times
http://herrett.csi.edu/astronomy/planetarium/showtimes.asp
Join the Boise Astronomical Society Membership has its privileges

Hello and welcome to the club. We hope you have a good time, enjoy the hobby and bring good skies with you. We hold indoor meetings each month (see our website for the day) at the Anser Charter School in Garden City (for a map and directions please visit our website). There will always be a very interesting program, class or presentation at these meetings, as well as good fellowship. There is always something new to learn.

We typically have two star parties each month around New Moon, except on months that have special events going on (see Star Dates). The star parties are usually held at Dedication Point which is on Swan Falls Road, about 16 miles South of Kuna. During the summer months we move to a dark sky site at Granite Creek near Idaho City, Idaho. These events are free and you don’t have to bring your own telescope. Everyone with a telescope is more than willing to let you look. This is one of the best ways to see what kinds of telescopes are available if you’re thinking of getting one. Star Parties begin at dusk.

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. Meet fellow astronomers by attending a local star party. Star parties may be planned around a specific celestial event or just on a clear night. Either way, observing together gives everyone an opportunity share knowledge, meet new people and gain experience in stargazing that otherwise may not have been possible.

How to Join the Boise Astronomical Society (BAS)

You may access and print an application for membership here: http://boiseastro.org/application.pdf Annual dues are $25 per household and runs from January 1 to December 31. This includes all family members living at the same address:

Please make checks payable to:
Boise Astronomical Society
PO Box 7002
Boise, Idaho 83707

Membership entitles you to attend all club star parties, educational outreach programs and indoor membership/guest speaker meetings. Your literary contributions are welcomed and encouraged. Owning a telescope is NOT a requirement of joining the club. Membership in BAS also includes, but not limited to:

2. Discounts on subscriptions to Astronomy and Sky & Telescope magazines.
3. Volunteer star party opportunities.
4. Camping and star party opportunities.
5. First opportunity at ISP campsite reservations.
6. Field trips to area planetariums.

Join BAS1 Yahoo Group

We suggest you join the Yahoo Group “BAS1” https://groups.yahoo.com/neo/groups/BAS1/info. This is how we communicate between monthly meetings. It’s easy and it’s free. All you need is a Yahoo ID, also free. The link for our group is on the front page of the newsletter. We recommend that you use the individual email setting so that you get the real-time “Go / No-Go” notices for club star parties. Please keep all postings on BAS related topics. No sales allowed. All conversations must follow civil discourse and be related to astronomy.

You may also join our facebook group. All are welcome and encouraged to join this page. Both BAS members and non-members alike. Please keep conversations and postings (including sales) to a civil discourse and be related to astronomy. Also we are now using Twitter, although sparingly.