Galactic Observer
John J. McCarthy Observatory

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Holiday Theme Park

See page 19 for more information

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It is through their efforts that the McCarthy Observatory has established itself as a significant educational and recreational resource within the western Connecticut community.

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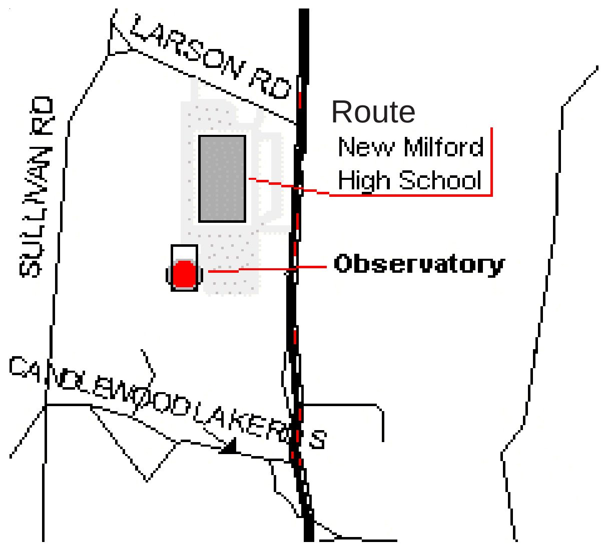

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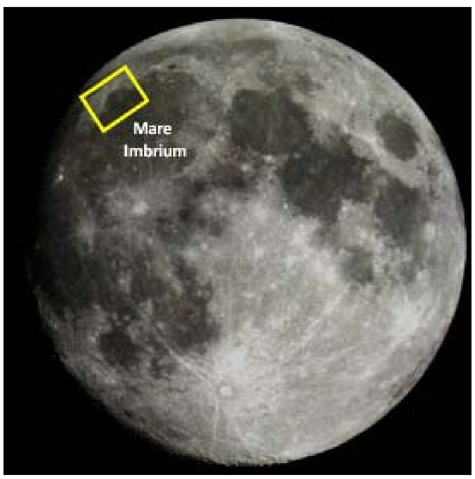
New Milford, CT

December Astronomy Calendar and Space Exploration Almanac

100 years after "first light" for the 100-inch telescope, a brush fire threatened the historic Mt. Wilson observatory in California

(Credits: Observatory: Bill Cloutier, Wildfire: KTLA)

IT’S BEEN 45 YEARS since we left the last footprint on the dusty lunar surface. Sadly, as a nation founded on exploration and the conquest of new frontiers, we appear to have lost our will to lead as a space-faring nation. But, what if the average citizen had the means to visit our only natural satellite; what would they see out the window of their spacecraft as they entered orbit around the Moon? This column may provide some thoughts to ponder when planning your visit (if only in your imagination).

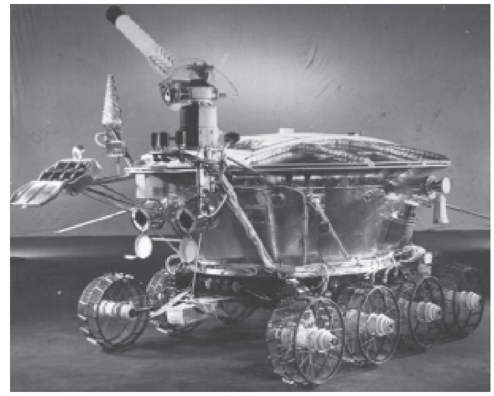


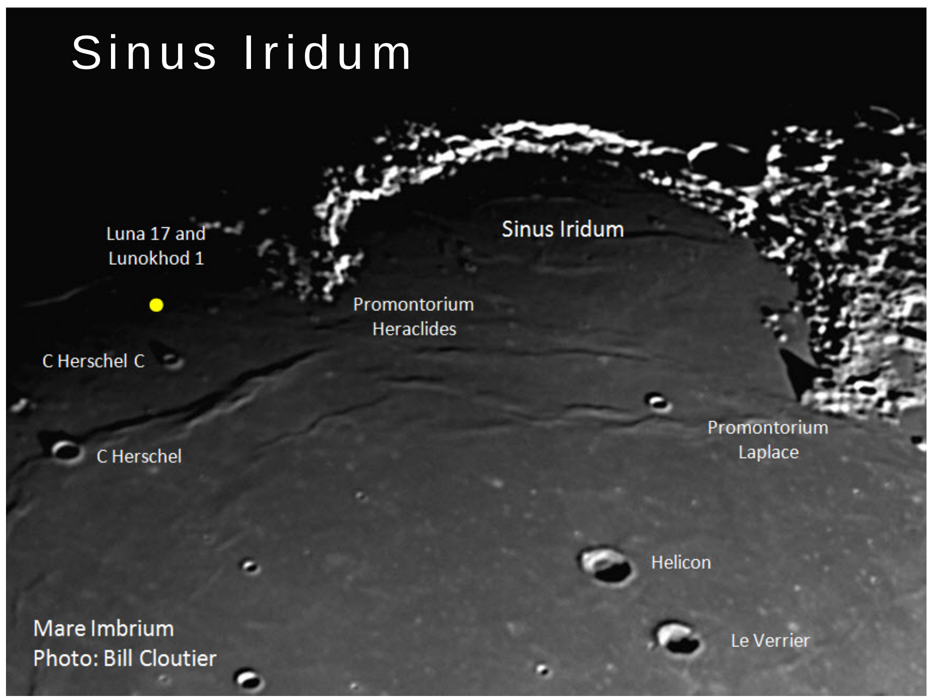
Lunar seas are actually expansive low-lying plains formed by ancient lava flows

The Soviet lander, Luna 17, touched down on the lunar surface along the northwestern rim of Mare Imbrium (Sea of Showers) on November 17, 1970. Aboard was the eight wheeled, remote controlled rover Lunokhod 1. The 2,000 pound rover operated for ten Earth months, driving by lunar day for a total of 6.5 miles (10.5 km). During the two-week long lunar nights, the rover’s instrumentation was kept warm by a radioisotope-powered heater.

Lunokhod 1 was equipped with an X-ray telescope and cosmic ray detector, a television camera, an X-ray spectrometer and a cone penetrometer to analyze the chemical and physical properties of the lunar regolith. A French-built laser retroreflector was mounted on the front of the rover, just below the cone-shaped low gain antenna.

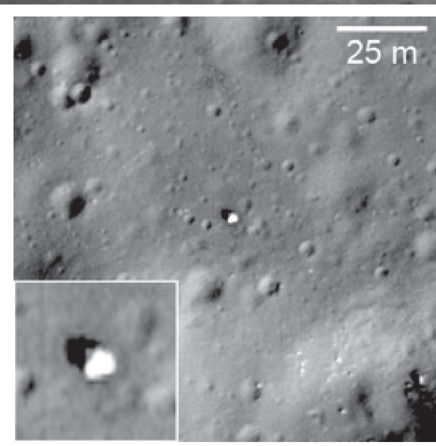
Soviet operators lost contact with the rover on October 4, 1971 after 11 lunar days/nights (322 Earth days). Forty years later, on November 9, 2011, NASA’s Lunar Reconnaissance Orbiter’s Narrow Angle Camera captured the rover, as well as the lander, during a low altitude (20.5 mile or 33 km) pass over Mare Imbrium. The rover was parked just 1.4 miles (2.3 kilometers) north of the lander.





Luna 17 landed just west of Sinus Iridum (Bay of Rainbows). Once the rover was located, its laser retroflector (comprised of fourteen corner cubes) was targeted by the laser at the Apache Point Observatory.

Lunar laser ranging (timing the return of laser pulses from the retroflector) provides precise measurements in distance, speed of rotation, axial variations and small libration effects, improving our understanding of the internal structure of the Moon.



Lunokhod 1 rover from orbit
Credit: NASA/GSFC/Arizona State University

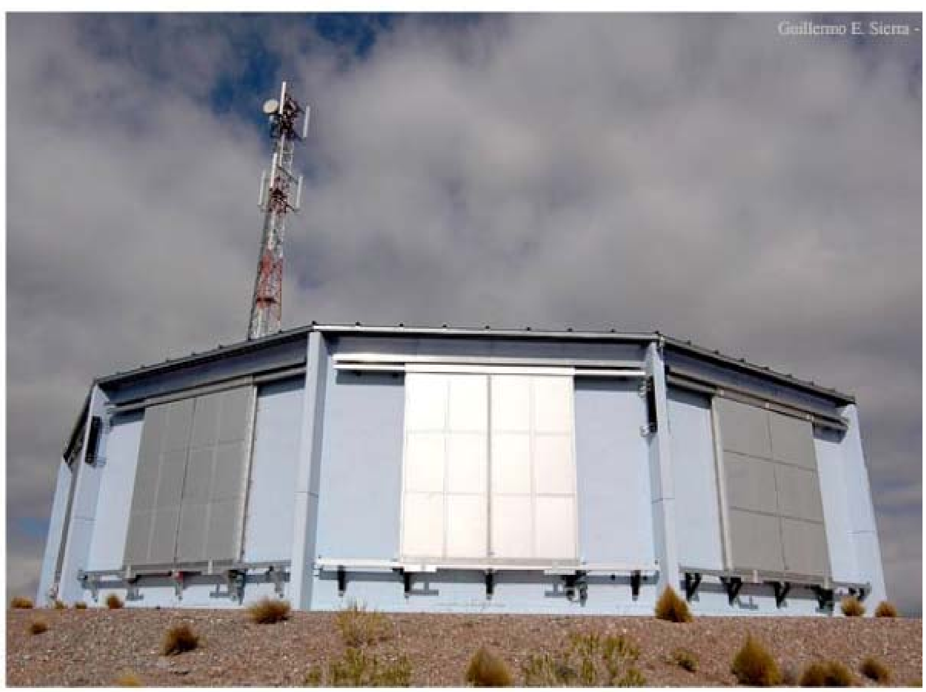
Cosmic rays shower the Earth from many sources, both nearby and distant, and are comprised of charged particles that can be accelerated to near light speed from violent events, such as the destruction of stars (i.e., supernovas). Low energy rays (from solar flares or coronal mass ejections) are effectively stopped by the Earth's magnetic field. Higher energy cosmic rays (comprised of heavier elements like the nuclei of iron) interact with other nuclei in the Earth's atmosphere to produce a cascade of atomic particles including electrons, photons and muons which we can detect at the surface.

In an article published in the journal Science in September, the Pierre Auger Observatory in Argentina reported the detection of cosmic rays from outside the Milky Way Galaxy. The direction from which the highest energy cosmic ray arrive will allow researchers to pinpoint the source(s), which may reveal the triggering event.

The observatory is comprised of 1,600 detectors (plastic tanks) distributed over an area comparable to the state of Rhode Island. Each detector contains 3,000 gallons (12,000 liters) of highly purified waste and 3 photomultipliers to record the energy (Cherenkov light) released from the interaction of the cosmic ray with the water. A GPS device provides the timing for the event(s) which when compared to other detectors can be used to determine the trajectory (and possible source) of the ray.

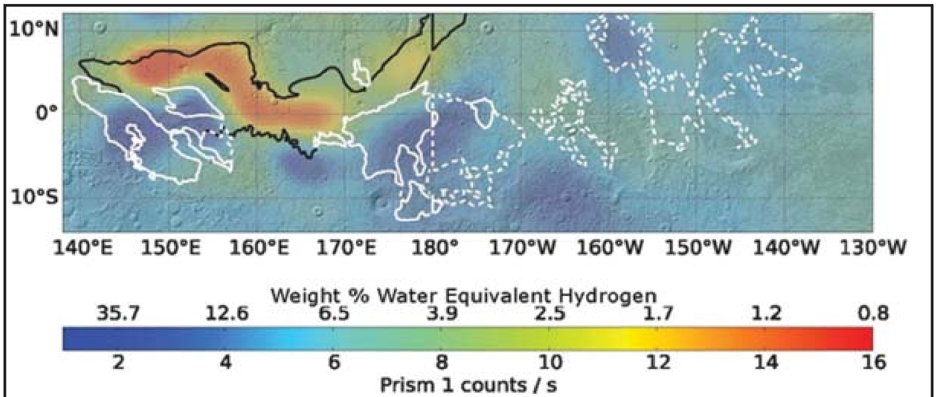
The observatory is also equipped with 27 fluorescence detectors in four locations. As charged particles interact with nitrogen molecules in the atmosphere, they cause the nitrogen molecules to emit ultraviolet light or fluoresce (the fluorescence detectors only work on moonless nights). The detectors are able to quantify the total energy of the shower which is equivalent to the total energy of the primary cosmic ray. Working together, the two detectors (air and ground) increase the accuracy of the total system.

Cosmic Ray Surface Detector (above) and Fluorescence Detector (below) Credit Pierre Auger Observatory



Equatorial Ice on Mars?

When researchers revisited and reprocessed data collected by NASA's Mars Odyssey spacecraft between 2002 and 2009, they found unexpectedly high concentrations of hydrogen in several locations around the Martian equator. A similar signature found at higher latitudes on the Red Planet was subsequently confirmed by NASA's Phoenix Mars Lander in 2008 to be buried water ice.



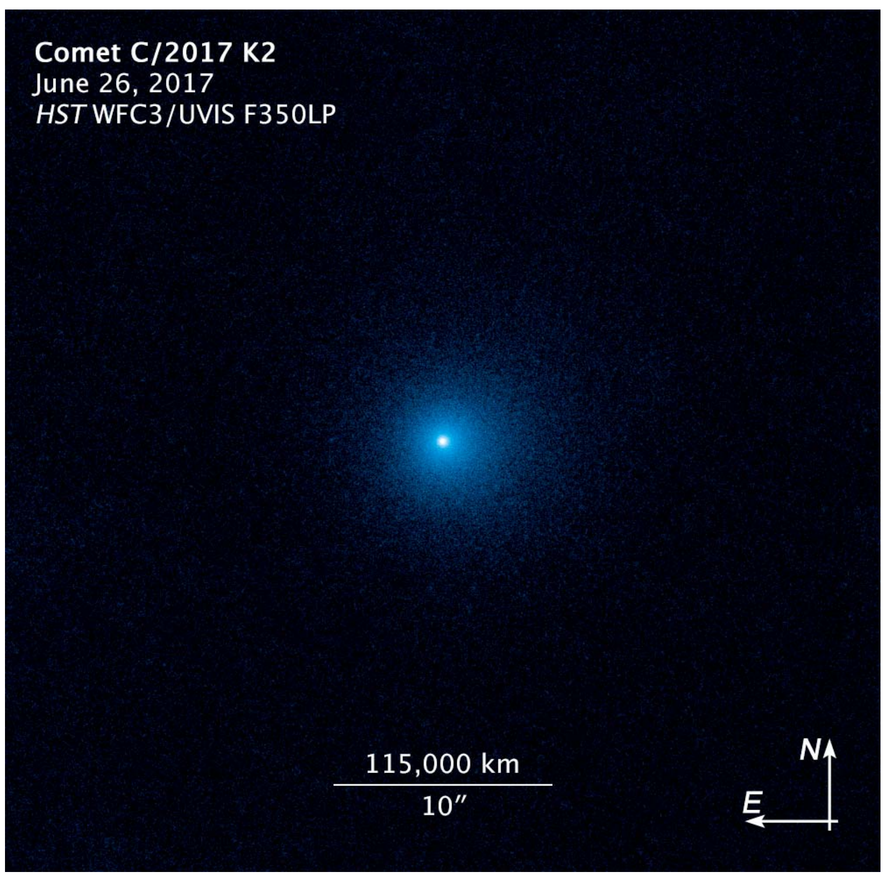
Credit: NASA/JPL-Caltech/University of Arizona

Today, the axial tilt of Mars (25°) is very similar to Earth's, but scientists believe that Mars has experienced much more extreme deviations (between 13° and 40°) over periods of 10 to 20 million years (the Earth's large moon stabilizes its tilt). At extreme tilts, the Martian polar ice cap(s) would sublimate and refreeze at lower altitudes. However, it was not expected that the ice would persist, even if insulated by blowing dust, once the poles returned to their present orientation.

The white outlined areas (above) are part of a formation called Medusae Fossae that boarders the Martian equator, The deposits that comprise the formation are thought to date back to the earliest geological era (Amazonian) and may be associated with the eruptions of the nearby Tharsis volcanoes. The data collected by the Mars Odyssey's Neutron Spectrometer is expressed in the weight percent of water, assuming that all the hydrogen is in the form of water. Certain areas of Medusae Fossae exhibit the highest concentrations (dark blue), equivalent to more than 30 weight-percent water. If buried ice exists in the equatorial region of Mars (or liquid water in subsurface aquifers), it could provide the raw materials for future exploration, i.e., a local source for fuel, drinking water, radiation shielding, and oxygen.

Visitor from the Oort Cloud

A distant comet, discovered in May by the Panoramic Survey Telescope and Rapid Response System (Pan-STARRS) in Hawaii, was subsequently imaged by the Hubble Space Telescope. At the time of the Hubble images, the comet (called C/2017 K2 (PANSTARRS) or "K2") was beyond Saturn's orbit, approximately 1.5 billion miles (2.4 billion km) from the Sun. Even at this great distance, signs of activity were evident with K2's nucleus (estimated to be less than 12 miles across) surrounded by a large 80,000 mile wide coma or shroud of tenuous gas. The gas, once part of the comet's frozen surface, sublimated (changed from a solid directly into a gaseous state) from the Sun's warmth.



K2 is the most distant, active comet to be observed on its inbound trip and may be the most primitive (most comets are discovered much closer to the Sun and have already gone through an initial transformation whereby the most volatile gases that coat the surface of the comet are lost). Based upon the comet's orbit, it is likely that K2 is from the Oort Cloud, a distant spherical cloud that extends almost half way to the nearest star, containing material left over from the solar system's formation 4.6 billion years ago. Archival images from past sky surveys show that K2 has been active for several years (although it wasn't noticed), with signs of a faint coma when the comet was out beyond the orbit of Uranus.

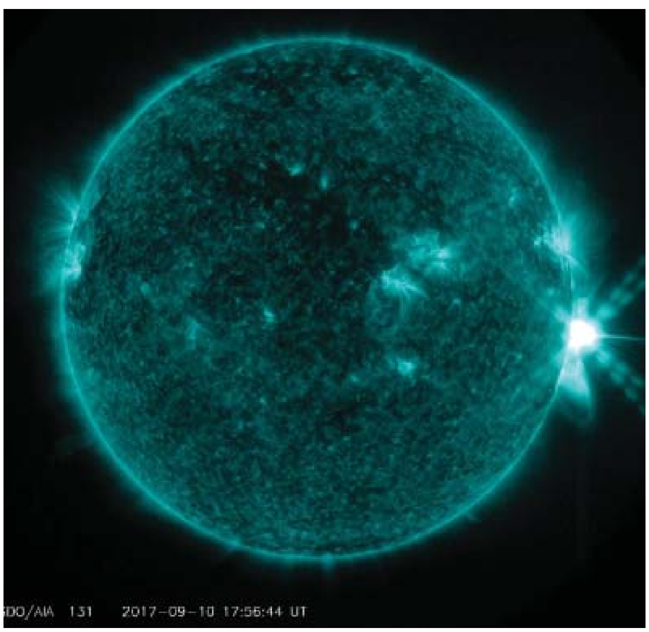
K2 will be closest to the Sun in 2022 when it will be just beyond the orbit of Mars.

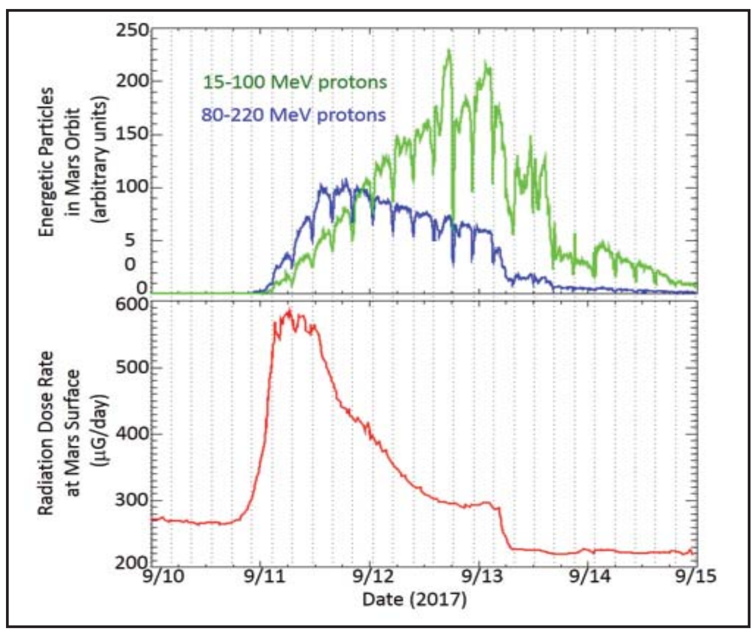
Radiation Storm

On September 10th, sunspot AR 2673 erupted, generating a high-energy solar flare and sending a torrent of high-speed protons across the solar system. While the blast produced bright aurora at high latitudes, the Earth's magnetic field absorbed most of the blow. Mars was not so fortunate. Without a planetary magnetic field, the event sparked a global aurora. NASA's Mars Atmosphere and Volatile Evolution, or MAVEN orbiter, recorded aurora 25 time brighter than had been seen since its arrival in 2004. NASA's Mars Science Laboratory's Radiation Assessment Detector, or RAD, registered radiation levels on the surface that were twice as high as previously recorded over its five years exploring Mars.

The storm was unexpected, with the Sun approaching a minimum level of activity in its periodic 11-year cycle. If astronauts had been on the surface of Mars, or in transit, they would have had to immediately seek shelter from the storm (the high radiation levels persisted for more than two days).

The storm was also detected by instruments on other orbiters including NASA's Mars Odyssey orbiter and Mars Reconnaissance Orbiter and the European Space Agency's Mars Express orbiter. Data collected by MAVEN suggests that these solar storms had a role in stripping away Mars' atmosphere, transforming a once wet and warm climate to the dry and cold conditions seen today.



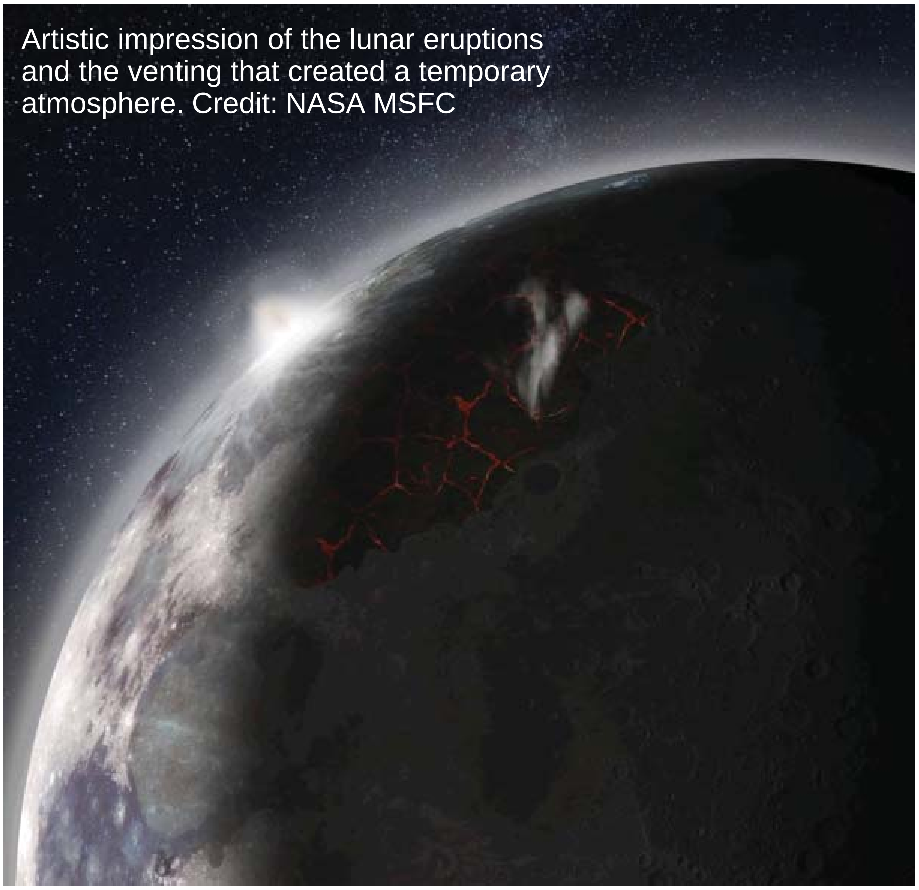


Energetic particles recorded by the MAVEN orbiter (top) and dose rate in micrograys per day seen by the Mars Science Laboratory (bottom). Credit: NASA / GSFC / JPL-Caltech / Univ. of Colorado / SwRI-Boulder / UC Berkeley

Lunar Resource

A study published in the journal *Earth and Planetary Science Letters* suggests that the Moon had an ancient atmosphere 3 to 4 billion years ago during the period of intense volcanism. Based upon analysis of the gases trapped in the rock and volcanic glass samples returned by the Apollo astronauts, the volcanic eruptions would have released bursts of carbon monoxide, sulfur, water and other gases that created a thin, temporary atmosphere, thicker than the current atmosphere on Mars. The atmosphere, recharged by periodic eruptions, remained for tens of millions of years before escaping off into space.

The study has implications for future exploration of the Moon, if only a small percentage of the



Artistic impression of the lunar eruptions and the venting that created a temporary atmosphere. Credit: NASA MSFC

water released during this time period migrated to the colder, permanently shadowed poles where ice has been detected by orbiting spacecraft. Water-ice on the Moon could be a local source for fuel, drinking water, radiation shielding for future colonists.

Dark Energy Survey

Not only is the universe expanding, the rate of expansion is accelerating. The source of the force driving the expansion (commonly referred to as "dark energy") has not, as yet, been determined, although there are two leading theories. The first theory hypothesizes that the vacuum of space is providing the force for expansion, while the second theory assumes that gravity itself is the perpetrator.

Mayall Dome
Photo: Bill Cloutier

As our tools for observing the cosmos have become more sophisticated, the various models and theories on the age and structure of the universe have been put to the test. Reconciliation of observations and theory appears to require the force imparted by dark energy to vary as the universe expanded.

In the search for evidence of a variation in the force, astronomers will be conducting a Dark Energy Spectroscopic Instrument (DESI) Survey. The multi-object spectrograph will be installed on the Mayall 4-meter telescope at the Kitt Peak National Observatory outside of Tucson, Arizona. Starting in 2018 the instrument will observe 35 million galaxies and quasars. The optical spectra from DESI will be used to construct a 3-dimensional model of the universe and measure the effect of the dark energy on the expansion of the universe over the past 10 billion years.

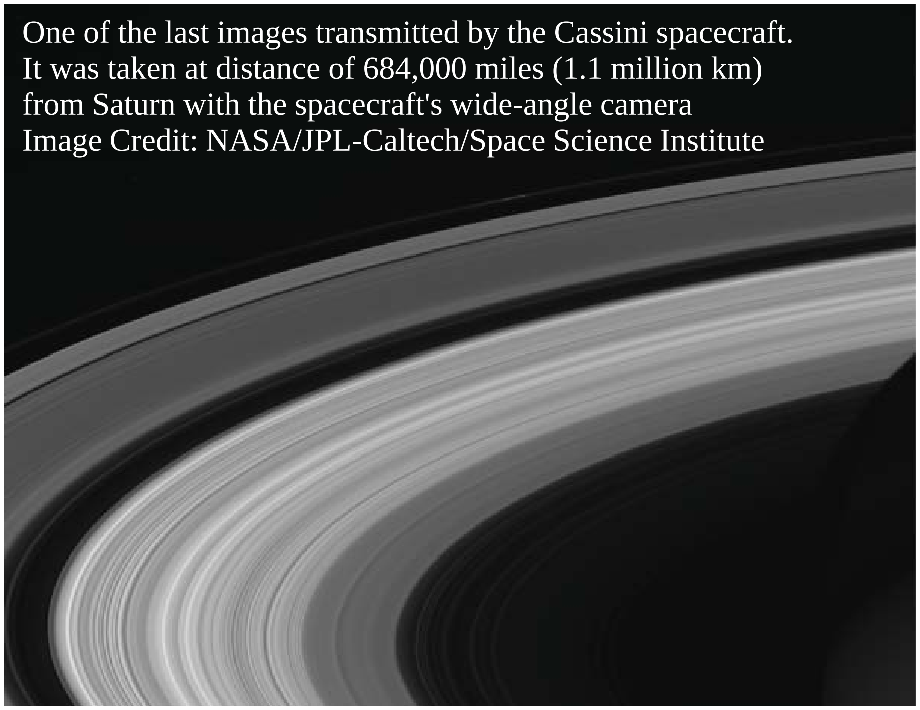
Cassini's Legacy

Although NASA/ESA's Cassini mission officially ended on September 15th with the destruction of the spacecraft, analysis of the data collected from 13 years of exploring the Saturnian system continues to provide researchers with new insights into the evolution of the gas giant, its ring system and diverse collection of moons. The final orbits that culminated in fiery demise also provided scientists with their first samples of the material in the planet's ring gap and upper atmosphere.

Some of the findings included evidence of molecules from the rings raining down on the upper atmosphere. While water was expected, since the rings are primarily composed of water ice, the spacecraft's Ion and Neutral Mass Spectrometer detected methane, a volatile molecule that was not anticipated to be found in either the rings or upper atmosphere.

Researchers are still trying to understand how Saturn is able to generate a magnetic field with the close alignment of the planet's rotational axis and magnetic field (conventional theory offers that a dynamo requires an axial offset to generate a magnetic field, so there must be some other mechanism at play inside Saturn). However, the close proximity to the planet in the final orbit increased the sensitivity of the spacecraft's magnetometer fourfold, so if there is even a small offset, it should be apparent in the data received.

The age of Saturn's rings may also be resolved from the data collected by Cassini. Theoretical modeling shows that the rings would disperse over hundreds of millions of years without a force acting to confine the particles. From the high resolution images of the rings captured by Cassini, it appears that the rings are kept in check by a population of small moons. Scientists now believe that the moon Mimas keeps the inner B-Ring from encroaching into the


One of the last images transmitted by the Cassini spacecraft. It was taken at distance of 684,000 miles (1.1 million km) from Saturn with the spacecraft's wide-angle camera
Image Credit: NASA/JPL-Caltech/Space Science Institute

Cassini Division with the moons Pan, Atlas, Prometheus, Pandora, Janus, Epimetheus and Mimas containing and suppressing the outward movement of the outer A-Ring particles.

Spaceship Earth and the Blue Marble

On December 7, 1972, the crew of Apollo 17 captured this iconic image of the receding Earth. Christened the "Blue Marble," the image underscored the fragility of humanity's only sanctuary. The photo, taken at a distance of 28,000 miles (45,000 km), provides a view extending from the Mediterranean Sea, across the African continent, to the south polar ice cap.


Apollo 17 crew members Schmitt, Evans and Cernan a with a Lunar Roving Vehicle (LRV) trainer during the rollout of the Apollo 17 rocket. Source: NASA.


Credit: NASA

DURING THE HOLIDAYS it's not uncommon to see parents and grandparents carrying around a telescope that they just picked up at the mall or warehouse store for their budding astronomer. Unfortunately, too many of these thoughtful gifts end up in a basement or attic after one or two uses. All too often, telescope manufacturers prey on consumer's expectations, which are often out of line with the capabilities of the product, resulting in frustration and disillusionment. However, even a crudely constructed telescope can be coaxed to produce acceptable images, if the observer understands the limitations of his or her instrument.

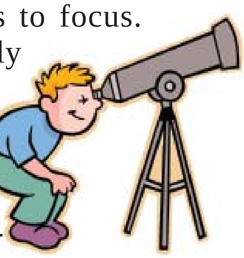
There is no perfect telescope for everyone. An inexpensive, mass-produced telescope that gets carted out of the house and set up every clear night, stimulates the users' imagination and encourages them to push the instrument's capabilities to its limits is far more valuable than the most highly crafted optical masterpiece that spends its nights in a closet.

There are several types of telescopes available to the general consumer. Each has advantages and disadvantages, and with a little education, a consumer can find a telescope that fits his or her needs and lifestyle. Again, if you don't use it, a telescope is about as useful as a garden gnome and not as cute.

Types of Telescopes

There are three basic types of telescopes: refractors, reflectors and compound or catadioptric telescopes.

Refractors have been around for 400 years and use a series of lenses to bring the light rays from distant objects to focus. They are highly regarded for their unobstructed and high-contrast images. The optical tubes are sealed and generally more rugged that other designs. As such, the optics rarely need to be adjusted (realigned) which makes the refractor a good choice as a travel telescope. Refractors are an excellent choice for planetary and lunar viewing and for double stars, but generally do not have the large light gathering capacity needed for faint objects such as nebula and galaxies. The disadvantages of refractors include: the potential for different wavelengths of light to diverge from a common focus as they pass through the glass (producing color "fringing" around bright objects), the position of the eyepiece at the rear of the optical tube (requiring the telescope to be mounted fairly high off the ground for comfortable viewing), the closed tube that can take some time to cool down, and the price (highest cost per inch of aperture of the basic telescopes designs).



Reflectors have been around for almost as long as refractors, but use mirrors instead of lenses to bring light to the observer's eye. A large mirror located at the closed end of the optical tube reflects light back up the tube to a smaller mirror mounted near the open end and out to an eyepiece. Mirrors are much easier and less expensive to manufacture than lenses with only an optical curve required on the front of the mirror. With mirrors, the light never passes through the glass, so there is no divergence of the light rays. However, since the optical tube is open to the atmosphere, mirrors will require periodic cleaning, adjustment and, eventually, recoating. Reflectors offer the best value, particularly for larger apertures.

The most popular compound or catadioptric telescopes combine a large, rear spherical mirror with a front corrector lens to create a very compact optical tube. Companies such as Meade and Celestron built their businesses on the Schmidt-Cassegrain design. While generally more expensive than reflectors, the compound telescope offers a very portable alterative for large aperture telescopes. Disadvantages include cool down time (since the optical tubes are sealed), and a relatively large secondary mirror that degrades the image of high contrast objects (planets or the Moon). The front corrector plate is also susceptible to dew formation although this can be managed with a dew shield or corrector plate heater.

There are several terms that are used in the sales promotion of telescopes. Some of the common ones are discussed below:

Aperture

Aperture refers to the size of the largest lens or mirror in the telescope, for example, the primary mirror in an 8-inch reflector is 8-inches in diameter. As a general rule, bigger is better, as light gathering and resolution increase with the size of the optics. However, as with everything else, there are other considerations that limit the practical size of a particular instrument. Alvan Clark & Sons figured the 40-inch lens for the Yerkes

Observatory's refractor, delivering the lens in 1897. More than 100 years later, it is still the world's largest working refractor. Why? The weight of the glass and the complexities in supporting a large lens by its edge and the absorption of light passing through the glass were factors; however, the refractor was ultimately done in by Sir Isaac Newton when he built the first reflecting telescope in 1668. Mirrors, unlike lenses, can be completely supported from the back. Since light does not pass through the glass, reflected images do not suffer from "chromatic aberration." Today single mirrors are routinely produced with diameters exceeding 28 feet and telescopes are constructed combining multiple mirrors to achieve even larger light gathering capabilities. So what size is good for you? Before you answer, you may want to consider:

• Are you planning on setting up your telescope in a permanent installation, e.g., backyard observatory, or will you be moving it in and out of your home every time you plan on observing. If the latter, then weight, portability and ease of set up are important considerations. Due to its size and weight, my telescope saw very little use until I invested in a wheeled platform that allows me to easily roll the fully assembled telescope in and out of my garage in minutes.

• Are you planning on taking your telescope on the road, with you on vacation or planning to travel some distance to find truly dark skies or observe a "once in a lifetime event?" Whether by train, plane or automobile, care must be taken to protect your telescope and ensure that it arrives at its destination in working order (mechanically and optically). If this is important to you, a smaller and simpler design such as a refractor may be a good choice.

• What are you interested in looking at? Spectacular views of the Sun, Moon and planets can be acquired with a relatively modest instrument. However, if your passion is hunting down the more elusive and distant residents our the Milky Way Galaxy or exploring other galaxies far, far, away, it will require a much larger aperture to capture those meager photons.

Magnification

Magnification is likely the most overrated measure of a telescope's capabilities. Magnification is a function of the eyepiece placed in the path of the incoming light and in front of the observer's eye; the observer can change the magnification by simply selecting a different eyepiece. As such, it shouldn't be a criterion in selecting a telescope.

The limiting useful magnification is approximately 50 times the diameter of the objective lens or primary mirror. For example, a small refracting telescope with a 4-inch objective lens can be pushed to a magnification of 200 times; however, only under the best observing conditions and, in general, only on bright objects such as the Moon and planets. Most astronomers prefer the views that lower magnification provides with a wider field and brighter image. So, the next time you are captured by the stunning views of the universe on the packaging of a modest instrument, remember that the potential of most telescopes is rarely realized, particularly if you reside in the light polluted skies of the northeast. A higher power eyepiece magnifies not only the telescope's intended target but also the side-effects of living under 20 miles of Earth's atmosphere.

Mounts

While generally not at the top of the list as far as features, the telescope's mounting system and construction is key to its ease of use and the stability of the image. A poorly designed mount or one with flimsy construction can be just as frustrating to deal with as poor optics. An altitude-azimuth or alt-az mount is the simplest type of telescope mount and generally the easiest to set up. In this arrangement, the mount allows the telescope to move left and right while pivoting up and down. It is commonly found on Dobsonian* telescopes, is user friendly and can be mechanized to track celestial objects across the sky.

Another common mount design is the equatorial mount. In this design, one axis is aligned with the celestial pole, requiring only the movement around this axis to follow objects across the sky. It is the easiest configuration for tracking and is generally preferred for astrophotography. Some alt-az mounts can be converted to an equatorial configuration with the addition of an "equatorial wedge." Equatorial mounts, however, can be heavier than their alt-az counterparts.

* Dobsonian telescopes are reflectors on a simple, swivel mount. They offer a low-cost solution for those on a limited budget with aperture fever (an insatiable desire for a larger telescope).

Go-To

Essentially a computer controlled pointing system, "go-to" allows the user to select an object from a data base and command the drive motors on the mount to move the telescope to the object's location in the sky. This presupposes that the telescope user has properly set up the telescope and successfully navigated through the alignment process (a process by which the telescope's computer determines where it's pointed, the local time, and its position on the Earth). Most "go-to" telescopes come with a large database, some of which can be modified (supplemented) by the user. While "go-to" capability is extremely convenient and can take you to thousands of objects in its database in a blink of an eye, it doesn't necessarily mean that you will be able to see the object. Depending upon the size of your telescope (see Aperture), many objects in these databases are just too dim to see with the equipment provided. CCD cameras are much more sensitive than your eye and can accumulate light for long durations. So, if you are planning on using your telescope primarily as a camera lens, then some of the disadvantage of a small aperture can be overcome. However, if you plan on doing most of your observing at the eyepiece, you may want to consider spending the money on a larger aperture rather than on "go-to" electronics.

What to Do

If you are seriously considering acquiring a telescope, a little bit of research can go a long way in enjoying your final purchase. If possible, try to observe through the telescope(s) that you are considering. The McCarthy Observatory has a monthly open house. When the skies are clear, up to a dozen telescopes can be found on the premises (including refractors, reflectors, a Dobsonian, and several Schmidt-Cassegrains). Compare the same celestial objects through different scopes, talk to the owners about portability, ease of setup and operation. Check out product reviews in trade magazines such as Sky and Telescope and Astronomy and on their websites. Contact reputable dealers and visit trade shows such as the Northeast Astronomical Forum where you can pick the brains of industry experts.

December History

1968 was a year of turmoil. The United States was entangled in a war that even the Secretary of Defense concluded could not be won and he resigned from office. The My Lai massacre was one of many atrocities of the Vietnam War perpetrated by both sides during this year. Major U.S. cities were the target of race riots and anti-war protests. Chicago police violently clashed with protesters at the Democratic National Convention and civil rights leader Martin Luther King and presidential candidate Robert Kennedy were assassinated in 1968. To many Americans, the only heartening event in this otherwise horrific year was the reading from the Book of Genesis by the crew of Apollo 8 as they orbited the Moon on Christmas Eve.

The race to beat the Soviets to the Moon took a dramatic turn in 1968 and saw the United States take its first lead by year's end. Apollo 7 was launched in October 1968 into Earth orbit. A week or so later, the Soviets launched two Soyuz space craft into Earth orbit (one manned and one unmanned for a planned rendezvous). In November, another unmanned Zond flew around the Moon and photographed the unseen far side. The United States expected that the Soviets would attempt another moon shot in early December when the launch window for the Baikonur space center in Kazakhstan reopened (a Zond stood poised on the launching pad). Curiously, the opportunity passed without any activity. Cosmonaut Alexei Leonov would later attribute the Soviet's loss of initiative and resolve to the premature death of Sergei Korolev, the "Chief Designer" of the Soviet space program as well as the design complexities of their Moon rocket (the N1).

While Apollo 7 had been a successful maiden voyage of the completely redesigned command module (after the Apollo 1 fire), the United States had yet to leave Earth orbit. NASA's original plan was to launch a series of increasingly complex missions to near-Earth orbit before attempting a lunar excursion. Development of the lunar lander was behind schedule and violent vibrations in the Saturn rocket's main stage needed to be corrected before NASA felt confident of sending men to the Moon. However, the apparent progress by the Soviets threatened to upstage the United States once again. It was a proposal by a quiet engineering genius, George Low, (Manager of the Apollo Spacecraft Program Office) to send the Apollo 8 command module alone into lunar orbit that would ultimately place the United States in a position to achieve President Kennedy's goal to land a man on the Moon and safely return him to Earth by the end of the decade.

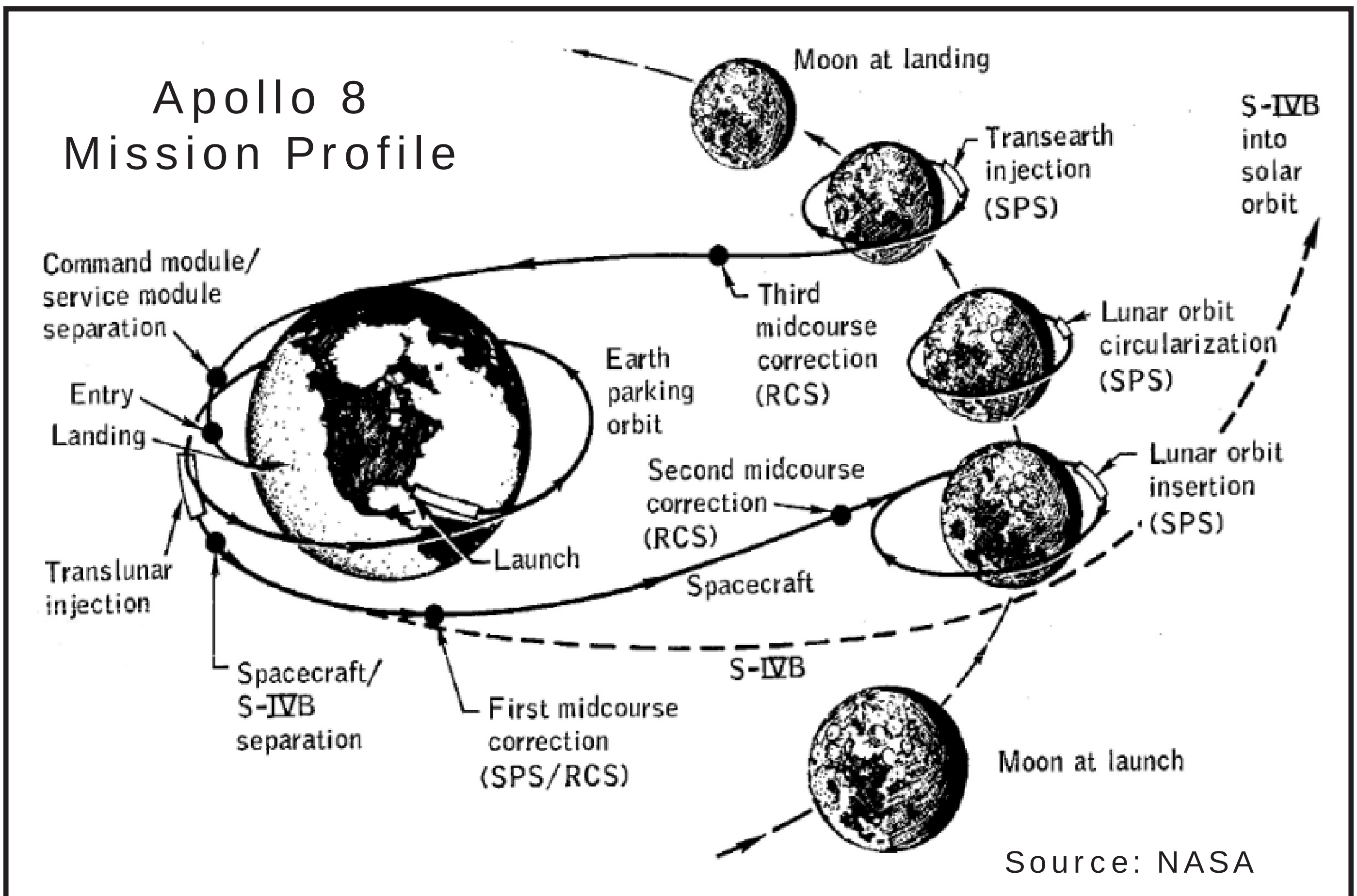
Apollo 8 was launched on December 21st under the command of Frank Borman with astronauts William Anders and Jim Lovell (Lovell replaced Michael Collins on the original team; Collins, who required back surgery, would go on to be the Command Module Pilot for Apollo 11). The launch was scheduled so that the crew would arrive at the Moon as the Sun was rising on the Sea of Tranquility. With the Sun low in the sky, the astronauts could photograph potential landing sites and resolve surface detail that would otherwise be washed out in the glare from a higher Sun.

The crew of Apollo 8 were the first to ride the three stage Saturn V rocket, with the explosive energy of an atomic bomb (the Saturn V had only been launched twice before – both unmanned). The night before the launch, the astronauts were visited by Charles Lindbergh. During the visit, it was discussed that the engines on the Saturn V would burn 10 times the amount of fuel every second that Lindbergh had used to fly nonstop from New York to Paris.

The Apollo 8 astronauts were also the first humans to leave Earth orbit and pass through the Van Allen radiation belts that extend up to 15,000 miles from Earth. To accomplish the mission, Apollo 8 had to cross the 240,000 mile void between the Earth and the Moon with sufficient precision so as to intercept the Moon (traveling at 2,300 miles an hour through space) just 69 miles above the lunar surface. By successfully doing so, the astronauts were the first humans to witness the rising of the Earth above the Moon's horizon (Earthrise). They would also be the first to return to Earth and reenter the atmosphere at a speed of 25,000 miles an hour.

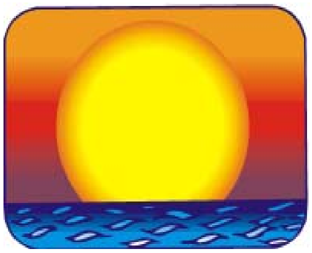
The highlight of the mission, to many, was the broadcast from the Apollo 8 command module during the ninth orbit of the Moon. After a brief introduction of the crew and their general impressions of the lunar landscape, William Anders said that the crew had a message for all those on Earth. The astronauts took turns reading from the book of Genesis, the story of creation. Frank Borman closed the broadcast with: "And from the crew of Apollo 8, we close with: Good night, Good luck, a Merry Christmas, and God bless all of you, all you on the good Earth." It is estimated that a quarter of Earth's population saw the Christmas Eve transmission.

In order to safely return to Earth, the main engine had to be restarted on the far side of the Moon (out of contact with the Earth). If successful, Apollo 8 would reappear from behind the Moon at a predetermined time. As predicted, the spacecraft reemerged on time, and when voice contact was regained, astronaut Jim Lovell would announce: "Please be informed, there is a Santa Claus." It was Christmas Day. Apollo 8 would return safely to the Earth two days later, splashing down in the Pacific Ocean shortly before sunrise. The astronauts and the capsule were recovered by the aircraft carrier USS Yorktown.



December Nights

Nights in December are not to be missed. While the often frigid and turbulent atmosphere can be frustrating for astronomers, the reflection of shimmering starlight (or moonlight) off a snow covered landscape can be truly magical. The bright stars of the winter sky glow with color from orange to yellow to brilliant blue-white. A star-filled sky in December is unsurpassed in grandeur.



Sunrise and Sunset (from New Milford, CT)

Sun	Sunrise	Sunset
December 1st (EDT)	07:01	16:24
December 15th (EST)	07:13	16:24
December 31st	07:20	16:34

Astronomical and Historical Events

- 1st Kuiper Belt Object 2006 QH181 at Opposition (82.823 AU)
- 1st History: launch of Soviet satellite Sputnik 6 and two dogs: Pchelka and Mushka (1960)
- 2nd Kuiper Belt Object 229762 (2007 UK126) at Opposition (41.558 AU)
- 2nd Apollo Asteroid 2008 WM61 near-Earth flyby (0.010 AU)
- 2nd Apollo Asteroid 2017 WP15 near-Earth flyby (0.083 AU)
- 2nd Amor Asteroid 2017 WL14 near-Earth flyby (0.085 AU)
- 2nd History: dedication of the John J. McCarthy Observatory in New Milford, CT (2000)
- 2nd History: launch of SOHO solar observatory (1995)
- 2nd History: launch of space shuttle Endeavour (STS-61), first servicing of the Hubble Space Telescope, including the installation of corrective optics and new solar panels (1993)
- 2nd History: Pioneer 11 spacecraft makes its closest approach to Jupiter; encounter redirects the spacecraft to Saturn and an escape trajectory out of the solar system (1974)
- 2nd History: touchdown of Soviet Mars 3 lander: communications were lost with the lander, the first spacecraft to touch down on the Red Planet, after 20 seconds possibly due to raging dust storm (1971)
- 3rd Full Moon (Cold Moon)
- 3rd Apollo Asteroid 2017 WH16 near-Earth flyby (0.045 AU)
- 3rd Amor Asteroid 2017 WL13 near-Earth flyby (0.061 AU)
- 3rd History: Pioneer 10 spacecraft makes its closest approach to Jupiter; first space probe to fly through the asteroid belt and to an outer planet (1973)
- 3rd History: discovery of Jupiter's moon *Himalia* by Charles Perrine (1904)
- 4th Moon at perigee (closest distance from Earth)
- 4th Atira Asteroid 164294 (2004 XZ130) closest approach to Earth (1.164 AU)
- 4th History: launch of space shuttle Endeavour (STS-88), first International Space Station construction flight, including the mating of the Unity and Zarya modules (1998)
- 4th History: launch of the Pathfinder spacecraft to Mars (1996)
- 4th History: Pioneer Venus 1 enters orbit, first of two orbiters (and probes) to conduct a comprehensive investigation of the atmosphere of Venus (1978)
- 4th History: launch of Gemini 7 with astronauts Frank Borman and Jim Lovell, spending almost 14 days in space (1965)
- 4th History: launch of Gemini Joe 2 rocket, test flight for the Mercury capsule and first U.S. animal flight with Sam, a Rhesus monkey (1959)
- 5th Aten Asteroid 2010 TK7 (Earth Trojan) closest approach to Earth (0.204 AU)
- 5th Amor Asteroid 1980 Tezcatlipoca closest approach to Earth (0.878 AU)
- 5th Apollo Asteroid 2017 WS13 near-Earth flyby (0.024 AU)

Astronomical and Historical Events (continued)

5th Kuiper Belt Object 145451 (2005 RM43) at Opposition (35.741 AU)
6th Amor Asteroid 2017 WA13 near-Earth flyby (0.076 AU)
6th History: Japanese spacecraft Akatsuki enters around Venus five years after unsuccessful first attempt and main engine failure (2015)
7th Apollo Asteroid 2017 WP1 near-Earth flyby (0.058 AU)
7th History: arrival of the Galileo space probe at Jupiter (1995)
7th History: launch of Apollo 17 with astronauts Ronald Evans, Harrison Schmitt (first scientist – geologist) and Eugene Cernan (last man on the Moon – so far) (1972)
8th Apollo Asteroid 4450 Pan closest approach to Earth (1.276 AU)
8th Centaur Object 8405 Asbolus at Opposition (20.229 AU)
8th Scheduled launch of a cargo-carrying SpaceX Dragon spacecraft from Cape Canaveral, Florida to the International Space Station
8th History: a Dragon spacecraft, launched by SpaceX into low-Earth orbit, is recovered in the Pacific Ocean: first time a spacecraft recovered by a commercial company (2010)
8th History: discovery of asteroid *5 Astraea* by Karl Hencke (1845)
9th Second Saturday Stars - Open House at the McCarthy Observatory (7:00 pm)
9th Apollo Asteroid 2017 WV12 near-Earth flyby (0.009 AU)
9th History: Pioneer Venus 2 enters orbit, second of two orbiters (and probes) to conduct a comprehensive investigation of the atmosphere of Venus (1978)
10th Last Quarter Moon
10th Apollo Asteroid 2017 WX near-Earth flyby (0.090 AU)
10th Apollo Asteroid 136617 (1994 CC) (2 Moons) closest approach to Earth (1.747 AU)
10th History: launch of the X-ray Multi-Mirror Mission (XMM-Newton), the largest scientific satellite built in Europe and one of the most powerful (1999)
10th History: launch of Helios 1 (also known as Helios A) into solar orbit; joint venture by Federal Republic of Germany and NASA to study the Sun (1974)
11th Kuiper Belt Object 2004 XR190 at Opposition (56.305 AU)
11th History: launch of the Boeing X-37B Orbital Test Vehicle 1 (unmanned space plane) from the Cape Canaveral Air Force Station (2012)
12th Amor Asteroid 2017 WE13 near-Earth flyby (0.042 AU)
12th Plutino 84922 (2003 VS2) at Opposition (35.664 AU)
12th Plutino 307463 (2002 VU130) at Opposition (39.187 AU)
12th History: discovery of Saturn moons *Fornjot*, *Farbauti*, *Aegir*, *Bebhionn*, *Hati* and *Bergeimi*r by Scott Sheppard, et al's (2004)
12th History: discovery of Saturn moons *Hyrrokkin* by Sheppard/Jewitt/Kleyna (2004)
12th History: launch of Uhuru, the first satellite designed specifically for X-ray astronomy (1970)
12th History: launch of Oscar, first amateur satellite (1961)
13th Geminids meteor shower peak
13th Aten Asteroid 2015 YA near-Earth flyby (0.060 AU)
13th Apollo Asteroid 2009 QL8 near-Earth flyby (0.088 AU)
13th Atira Asteroid 2010 XB11 closest approach to Earth (1.173 AU)
13th History: flyby of Asteroid 4179 Toutatis by the Chang'e 2 spacecraft, China's second lunar probe (2012)
13th History: discovery of Saturn's moons *Fenrir* and *Bestla* by Scott Sheppard, et al's (2004)
13th History: launch of Pioneer 8, third of four identical solar orbiting, spin-stabilized spacecraft (1967)
13th History: Mt. Wilson's 100-inch telescope used to measure the first stellar diameter (Betelgeuse); measured by Francis Pease and Albert Michelson (1920)
13th History: first light of Mt. Wilson's 60-inch telescope (1908)
14th Amor Asteroid 2017 WV14 near-Earth flyby (0.093 AU)

Astronomical and Historical Events (continued)

- 14th Aten Asteroid 2015 XX169 near-Earth flyby (0.025 AU)
- 14th Atira Asteroid 2015 ME131 closest approach to Earth (0.477 AU)
- 14th History: flyby of Venus by Mariner 2; first spacecraft to execute a successful encounter with another planet, finding cool cloud layers and an extremely hot surface (1962)
- 14th History: flyby of Mars by Japan's Nozomi spacecraft after an attempt to achieve orbit fails (2003)
- 14th History: creation of the Canadian Space Agency (1990)
- 14th History: Weston meteorite fall: first documented fall in the United States (1807); best coordinates for the fall are based upon investigative research by Monty Robson, Director of the McCarthy Observatory, published in 2009
- 14th History: birth of Tycho Brahe, Danish astronomer noted for his observational skills, the precision of his observations, and the instruments he developed; builder of the Uraniborg and Stjenborg observatories on the Swedish island of Ven (1546)
- 15th Aten Asteroid 2014 BA3 closest approach to Earth (1.745 AU)
- 15th Kuiper Belt Object 19521 Chaos at Opposition (40.358 AU)
- 15th History: launch of Soviet spacecraft, Vega 1 to Venus and then to Comet Halley (1984)
- 15th History: landing of Soviet spacecraft Venera 7 on the surface of Venus (1970)
- 15th History: discovery of Saturn's moon *Janus* by Audouin Dollfus (1966)
- 15th History: launch of Gemini 6 with astronauts Walter Schirra and Thomas Stafford (1965)
- 15th History: Gemini 6 and 7 execute the first manned spacecraft rendezvous (1965)
- 16th Apollo Asteroid 3200 Phaethon near-Earth flyby (0.069 AU)
- 16th History: launch of Pioneer 6, the first of four identical solar orbiting, spin-stabilized spacecraft (1965)
- 17th Scheduled launch of a Russian Soyuz spacecraft from the Baikonur Cosmodrome, Kazakhstan to the International Space Station with the next crew
- 17th Centaur Object 154783 (2004 PA44) at Opposition (19.718 AU)
- 17th Apollo Asteroid 2015 GF1 near-Earth flyby (0.074 AU)
- 17th History: Project Mercury publicly announced (1958)
- 17th History: Wright Brothers' first airplane flight, Kitty Hawk, North Carolina (1903)
- 18th Moon at apogee (furthest distance from Earth)
- 18th New Moon
- 18th Amor Asteroid 9950 ESA closest approach to Earth (1.207 AU)
- 18th History: discovery of Saturn's moon *Epimetheus* by Richard Walker (discovery shared with Stephen Larson and John Fountain) (1966)
- 19th Aten Asteroid 2011 YD29 near-Earth flyby (0.045 AU)
- 19th History: launch of the Gaia spacecraft from French Guiana to survey more than one billion stars in an effort to chart the chart the evolution of the Milky Way galaxy (2013)
- 19th History: launch of space shuttle Discovery (STS-103), third servicing of the Hubble space telescope including the installation of new gyroscopes and computer (1999)
- 19th History: launch of Mercury-Redstone 1A; first successful flight and qualification of the spacecraft and booster (1960)
- 20th Apollo Asteroid 2006 XY near-Earth flyby (0.017 AU)
- 20th History: Ames Research Center founded as the second National Advisory Committee for Aeronautics (NACA) laboratory at Moffett Federal Airfield in California (1939)
- 20th History: founding of the Mt. Wilson Observatory (1904)
- 20th History: launch of the Active Cavity Radiometer Irradiance Monitor satellite (ACRIMSAT); designed to measure Sun's total solar irradiance (1999)
- 21st Winter Solstice at 11:28 am EST (16:28 UT)
- 21st Apollo Asteroid 2017 RP2 near-Earth flyby (0.058 AU)
- 21st Plutino 55638 (2002 VE95) at Opposition (28.811 AU)

Astronomical and Historical Events (continued)

21st Apollo Asteroid 2017 WX12 near-Earth flyby (0.026 AU)
21st History: launch of the Soviet spacecraft Vega 2 to Venus, continued on to Comet Halley (1984)
21st History: landing of Soviet spacecraft Venera 12 on the surface of Venus, found evidence of thunder and lightning in the atmosphere (1978)
21st History: launch of Apollo 8 with astronauts Frank Borman, Jim Lovell and William Anders, first to circumnavigate the Moon (1968)
21st History: launch of Luna 13, Soviet moon lander (1966)
22nd Ursids Meteor Shower peak
22nd Apollo Asteroid 418849 (2008 WM64) near-Earth flyby (0.039 AU)
22nd Apollo Asteroid 2015 YQ1 near-Earth flyby (0.044 AU)
22nd Apollo Asteroid 2017 TS3 near-Earth flyby (0.047 AU)
22nd Apollo Asteroid 2015 HU9 near-Earth flyby (0.098 AU)
22nd Kuiper Belt Object 78799 (2002 XW93) at Opposition (44.607 AU)
22nd History: first asteroid (323 Brucia) discovered using photography (1891)
23rd Amor Asteroid 1580 Betulia closest approach to Earth (1.580 AU)
23rd History: discovery of Saturn's moon *Rhea* by Giovanni Cassini (1672)
24th Aten Asteroid 2017 WZ14 near-Earth flyby (0.019 AU)
24th Apollo Asteroid 2017 WD15 near-Earth flyby (0.069 AU)
24th History: inaugural of ESA's Ariane 1 rocket and first artificial satellite carried by an ESA rocket (1979)
24th History: Deep Space Network created (1963)
24th History: Jean-Louis Pons born into a poor family with only basic education, took post at observatory at Marseilles as concierge, went on to become most successful discover of comets (discovered or co-discovered 37 comets, 26 bear his name) (1761)
24th History: inaugural launch of the Arianne rocket, Europe's attempt to develop a cost-effective launcher to serve the commercial market (1979)
25th Aten Asteroid 2016 YA1 near-Earth flyby (0.080 AU)
25th Plutino 2002 XV93 at Opposition (37.786 AU)
25th History: European Space Agency's Mars Express spacecraft enters orbit around Mars (2003)
25th History: landing of Soviet spacecraft Venera 11 on Venus, second of two identical spacecraft (1978)
26th First Quarter Moon
26th Aten Asteroid 2007 AG near-Earth flyby (0.058 AU)
26th Apollo Asteroid 2015 AF45 near-Earth flyby (0.076 AU)
26th History: launch of Soviet space station Salyut 4 from Baikonur Cosmodrome; third Soviet space station and second space station devoted primarily to civilian objectives; deorbited in 1977 (1974)
27th Apollo Asteroid 2014 RJ11 near-Earth flyby (0.063 AU)
27th History: discovery of the ALH84001 Martian meteorite in the Allan Hills, Far Western Icefield, Antarctica, made famous by the announcement of the discovery of evidence for primitive Martian bacterial life (1984)
27th History: Johannes Kepler born, German mathematician and astronomer who postulated that the Earth and planets travel about the sun in elliptical orbits, developed three fundamental laws of planetary motion (1571)
29th Apollo Asteroid 2009 EO2 near-Earth flyby (0.090 AU)
29th Apollo Asteroid 140158 (2001 SX169) near-Earth flyby (0.090 AU)
30th Moon occults the star Aldebaran in the constellation Taurus (begins around 6:25 pm EST and ends around 7:15 pm EST)
30th Apollo Asteroid 2017 QL33 near-Earth flyby (0.034 AU)
30th Aten Asteroid 2015 SY near-Earth flyby (0.067 AU)
30th Amor Asteroid 4055 Magellan closest approach to Earth (2.157 AU)

Astronomical and Historical Events (continued)

30th History: Army Air Corp Captain Albert William Stevens takes first photo showing the Earth's curvature (1930)
30th History: flyby of Jupiter by Cassini spacecraft on mission to Saturn (2000)
30th History: discovery of Uranus' moon *Puck* by Stephen Synnott (1985)
31st Atira Asteroid 481817 (2008 UL90) closest approach to Earth (0.859 AU)
31st History: GRAIL-A, lunar gravity mapping spacecraft enters orbit (2011)

Commonly Used Terms

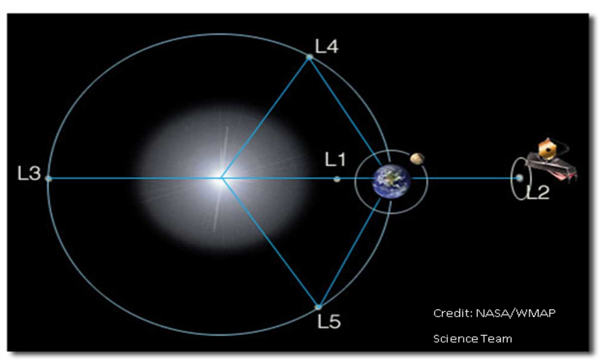
- **Apollo**: A group of near-Earth asteroids whose orbits also cross Earth's orbit; Apollo asteroids spend most of their time outside Earth orbit.
- **Aten**: A group of near-Earth asteroids whose orbits also cross Earth's orbit, but un like Apollos, Atens spend most of their time inside Earth orbit.
- **Atira**: A group of near-Earth asteroids whose orbits are entirely within Earth's orbit
- **Centaur**: Icy planetesimals with characteristics of both asteroids and comets
- **Kuiper Belt**: Region of the solar system beyond the orbit of Neptune (30 AUs to 50 AUs) with a vast population of small bodies orbiting the Sun
- **Opposition**: Celestial bodies on opposite sides of the sky, typically as viewed from Earth
- **Plutino:** An asteroid-sized body that orbits the Sun in a 2:3 resonance with Neptune
- **Trojan:** asteroids orbiting in the 4th and 5th Lagrange points (leading and trailing) of major planets in the Solar System

References on Distances

- The apparent width of the Moon (and Sun) is approximately one-half a degree (½°), less than the width of your little finger at arm's length which covers approximately one degree (1°); three fingers span approximately five degrees (5°)
- One astronomical unit (AU) is the distance from the Sun to the Earth or approximately 93 million miles

Lagrange Points

Five locations discovered by mathematician Joseph Lagrange where the gravitational forces of the Sun and Earth (or other large body) and the orbital motion of the spacecraft are balanced, allowing the spacecraft to hover or orbit around the point with minimal expenditure of energy. The L2 point (and future location of the James Webb telescope) is located 1.5 million kilometers beyond the Earth (as viewed from the Sun).



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Front page design and graphic calendar: Allan Ostergren

Second Saturday Stars poster: Marc Polansky

All other non-credited photos were taken by the author: Bill Cloutier

Solar Activity

For the latest on what's happening on the Sun and the current forecast for flares and aurora, check out *www.spaceweather.com.*

International Space Station and Iridium Satellites

Visit www.heavens-above.com for the times of visibility and detailed star charts for viewing the International Space Station and the bright flares from Iridium satellites.

Front Page

If the United Federation of Planets were to establish a network of recreational resources for its citizens, it would likely start with NGC 2264. Conveniently located in the constellation Monoceros (Unicorn), within the celestial equator, it would be an easy one-day excursion at warp speed 8.

Originally cited in John Herschell's *General Catalogue of Nebulae and Clusters of Stars*, and updated by John Louis Dreyer in 1888 and subsequent revisions, NGC 2264 is a celestial winter wonderland of heavenly objects.

Under the broad designation of *Christmas Tree Cluster*, for its triangular extension at the top of the image, NGC 2264 also includes a stellar nursery of newborn proto-stars at its center dubbed the Snowflake Cluster At left, in an extension of the cluster lies the Cone Nebula and the Fox Fur Nebula.

Of course, vacationers who made the trip would find themselves on the inside looking out, and would see only a panorama of distant stars and dust, without any theme or pattern. Perhaps they would then retire to the holodeck to choose among a universe of simulations to tease their imagination.

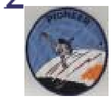
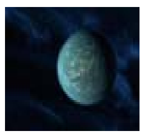
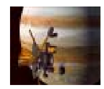
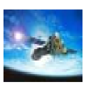
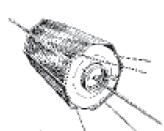
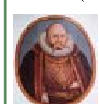
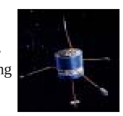
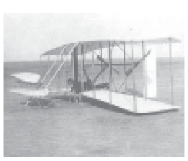
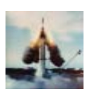
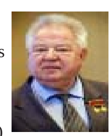
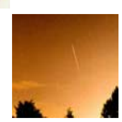
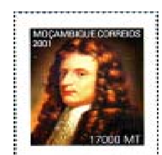
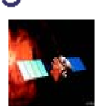
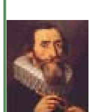
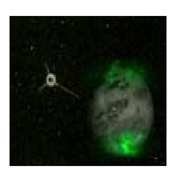
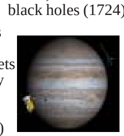
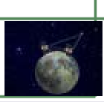
For further information and images, go to:

Fox Fur Nebula: https://apod.nasa.gov/apod/ap151230.html.
The Snowflake Cluster versus the Cone Nebula: *https://apod.nasa.gov/apod/ap070509*.html*;* *https://commons.wikimedia.org/wiki/File:Monoceros_constellation_map.png*
A Fox Fur, a Unicorn, and a Christmas Tree: *https://apod.nasa.gov/apod/ap100406.html*


Second Saturday Stars
FREE EVENT
Every Month at the
John J. McCarthy Observatory
Behind the New Milford High School
860.946.0312
www.mccarthyobservatory.org
December 9th
7:00 - 9:00 pm
Farewell to Saturn and the Cassini Spacecraft
Refreshments
Family Entertainment
Handicapped Accessible
ASL Interpretation Available with Prior Notice
Rain or Shine
Map
LARSON RD.
RT. 7
SULLIVAN RD.
New Milford High School
Observatory
CANDLEWOOD LAKE RD. S
RT. 7

December 2017

Celestial Calendar

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
Phases of the Moon  Dec 3 Dec 10 Dec 18 Dec 26					1  Launch of Soviet satellite Sputnik 6 with two dogs, Pchelak and Mushka (1960)	2 Flyby of Jupiter by Pioneer 11 spaccraft (1974)   Launch of SOHO solar observatory (1995) Space Shuttle Endeavour first Hubble servicing mission (1993) Dedication of John J. McCarthy Observatory in New Milford, CT (2000)
3 Orion test flight launch, Cape Canaveral  Pioneer 10 closest approach to Jupiter (1973)  Discovery of Jupiter moon Himalia by Charles Perrine (1904)	4 Moon at Perigee (closest to Earth) Gemini 7 launch - Borman/Lovell (1965) Launch of Pathfinder spacecraft to Mars (1996) Pioneer orbits Venus to study atmosphere (1978) Launch of Little Joe 2 rocket, test flight for the Mercury capsule with Sam, a Rhesus monkey (1959) 	Orion test flight Cape Canaveral 5  Discovery of Kepler-22b, by NASA's Kepler Space Telescope in the constellation of Cygnus - the first known transiting planet to orbit within the habitable zone of a Sun-like star (2011)	6  America's first attempt at putting a satellite into orbit failed as Vanguard TV3 rose only about four feet off a Cape Canaveral launch pad before crashing back down and exploding (1957)	Apollo 17 (Evans, Schmitt, Cernan) 1972 7 Gerard Kuiper born - proposed belt of minor planetary objects beyond Neptune (1905) Arrival of Galileo space probe at Jupiter (1995)  New Horizons spacecraft wakes up to prepare for its July 2015 encounter with the dwarf planet Pluto	8 Discovery of asteroid 5 Astraea by Karl Hencke (1845) Galileo spacecraft 1st Earth flyby (1990) SpaceX Dragon, launched into low-Earth orbit, is recovered in the Pacific Ocean: first by a commercial company (2010) 	9 Pioneer Venus 2 in orbit, 2nd to study planet's atmosphere (1978) Ausson meteorite fall, hits building in France (1858) Asteroid 2011 WU4 Near-Earth Flyby (0.084 AU) 2nd Saturday Stars New Milford High School 
10 Launch of XMM-Newton European X- Ray satellite (1999)  Launch of Helios 1 into solar orbit - joint project of NASA and Federal Republic of Germany (1974) St Louis meteorite, hits automobile (1950) Claxton, GA, hits mailbox (1984) Mihonoseki, Japan, hits house (1992)	11  Challenger, the Lunar Lander for Apollo 17, touched down on the Moon's surface with astronauts Harrison Schmitt and Eugene Cernan - last two men to walk on moon (1972)	12  Launch of Oscar, first amateur satellite (1961)	13  First light of Mt. Wilson's 60-inch telescope (1908)  Geminids meteor shower peak	14 Flyby of Venus by Mariner 2; first spacecraft to execute a successful encounter with another planet (1962) Weston, CT Meteorite, first documented U.S. strike (1807)  Tycho Brahe born, 1546 - Danish astronomer	15 Discovery of Saturn moon Janus by Audouin Dollfus (1966) Soviet Venus missions: landing of Venera 7 on the surface of Venus (1970); Vega 1 to Venus and Comet Halley (1984);  Gemini 6 launch (Schirra, Stafford) 1965	16 Launch of Pioneer 6, first of four solar orbiting spacecraft (1965)  Mars origin meteorite QUE 94201 discovered in Queen Alexandra range, Antarctica (1994) 
17  Wright Brothers first flight, Kitty Hawk, NC (1903)	18  NASA showed the first images from the $670 million Spitzer Space Telescope, launched 4 months earlier (2003)	19  Mercury 1, unmanned spacecraft (1960) Launch of Discovery STS-103, 3rd Hubble servicing mission (1999)  Benares meteorite, hits house in India (1798)	20 Founding of the Mt. Wilson Observatory (1904) Soviet cosmonaut Georgy Grechko makes the first spacewalk during the Salyut 6 EO-1 mission (1977)  Comet 21P Giacobini–Zinner discovered in the constellation Cygnus by Michel Giacobini from (Nice, France) (1900)	Winter Solstice at 21:23:03 UT (4:23 pm EST) 21 Launch of Soviet spacecraft Vega 2 to Venus and on to Comet Halley - (1984) Apollo 8 (Borman, Lovell, Anders), first to circumnavigate the Moon - 1968  Launch of Luna 13, Soviet moon lander (1966)	22  Discovery of LEW 88516 meteorite -Martian origin (1988) Ursids meteor shower peak 	23  Discovery of Saturn's moon Rhea by Giovanni Cassini (1672)
24 inaugural launch of the Ariane rocket (1979) Jean-Louis Pons born - discoveror of comets (1761)  Deep Space Network created (1963)	25 Mars Express spacecraft orbits Red planet (2003)  Launch of Soviet Salyut 4 space station (1974) Venera 11 on Venus, 4 days after sister lander Venera 12 (1978) 	26  Charles Babbage born - British mathematician, co-founder of Royal Astronomical Society and inventor of first mechanical computer (1791)	 27 Johannes Kepler born 1571 - established laws of planetary motion  ALH 84001 meteorite in Antarctica - cross section shows signs of possible Martian bacterial life (1984)	28  Galileo spacecraft explores auroras during eclipse of Jovian moon Ganymede (2000)	29  Nancy Jane Sherlock Currie born - an engineer, US Army officer and a NASA astronaut, designed hardware for space station and served on four shuttle missions (1956)	30 Discovery of Uranus' moon Puck by Stephen Synnott (1985) John Michel born, gravity scientist and first to predict existence of "dark stars", later called black holes (1724) Cassini meets Galileo at Jupiter and gets Jovian gravity boost, while en route to Saturn (2000) 
31  GRAIL-A spacecraft (Gravity Recovery And Interior Laboratory) enters lunar orbit, to be followed by GRAIL-B the following day. Duo will map the moon's gravity field (2011)						