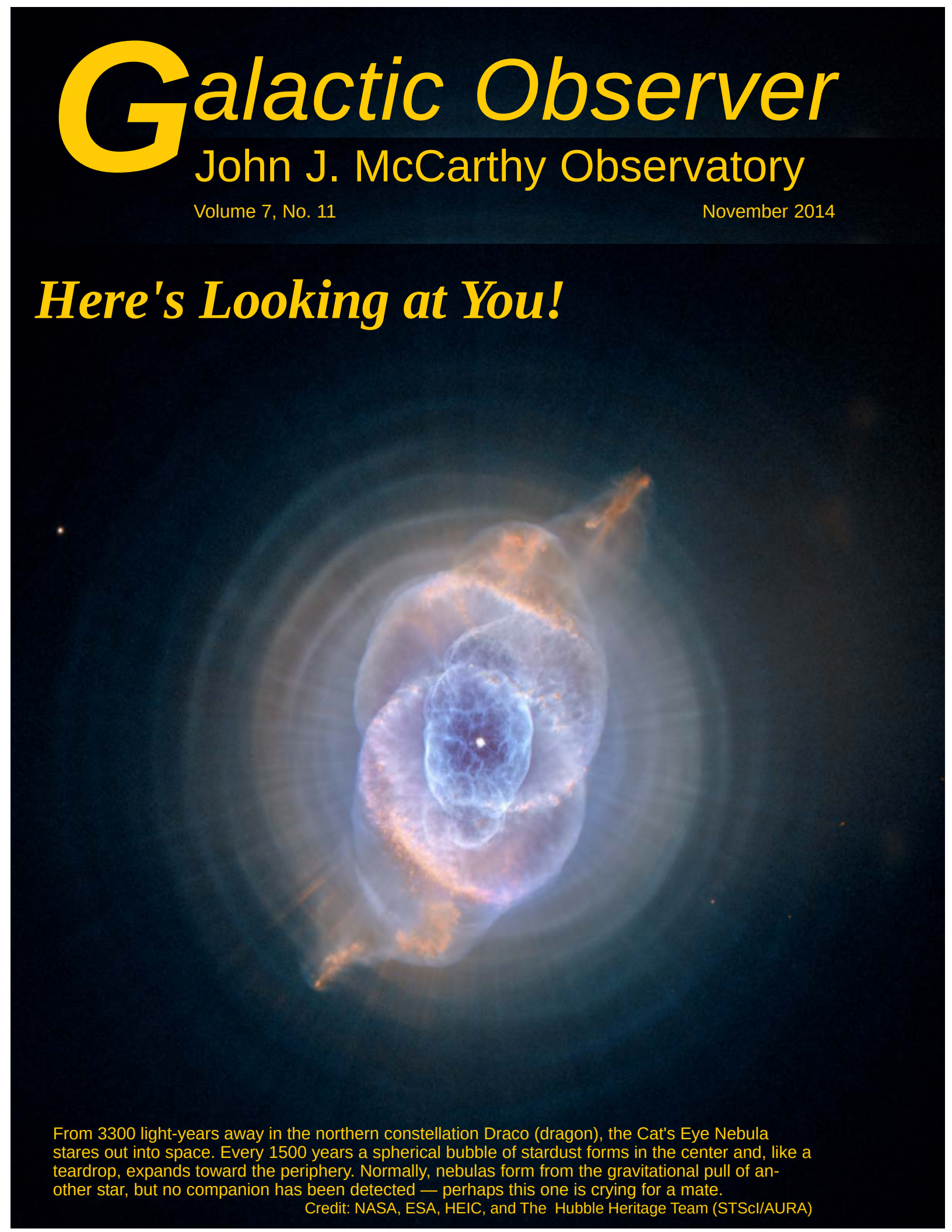
Galactic Observer

John J. McCarthy Observatory

Volume 7, No. 11 November 2014

Here's Looking at You!



From 3300 light-years away in the northern constellation Draco (dragon), the Cat's Eye Nebula stares out into space. Every 1500 years a spherical bubble of stardust forms in the center and, like a teardrop, expands toward the periphery. Normally, nebulas form from the gravitational pull of another star, but no companion has been detected — perhaps this one is crying for a mate.

Credit: NASA, ESA, HEIC, and The Hubble Heritage Team (STScI/AURA)

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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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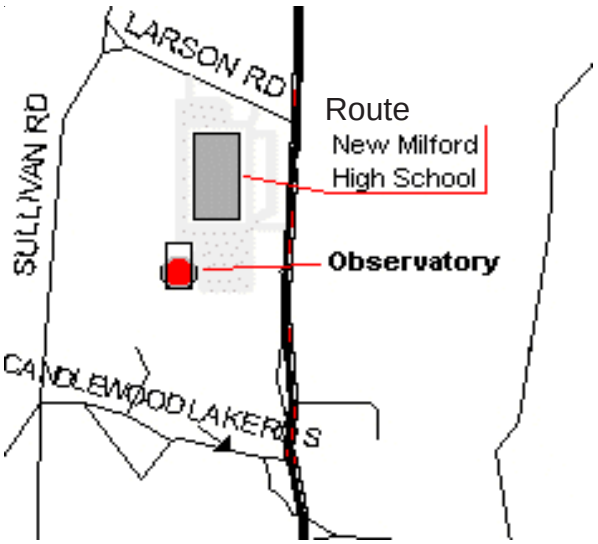
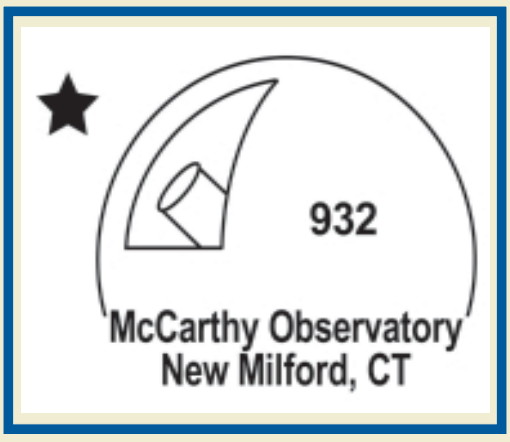


In This Issue



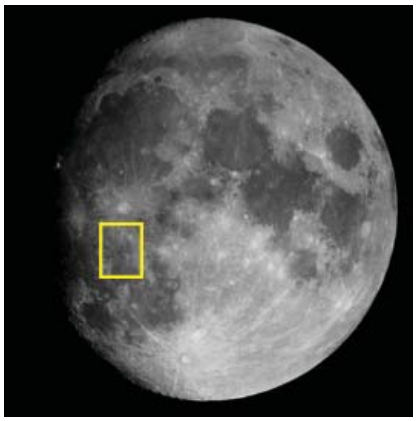
November AstronomyCalendar and Space Exploration Almanac

Damage to the space shuttle Endeavour's thermal protection system from its last mission.

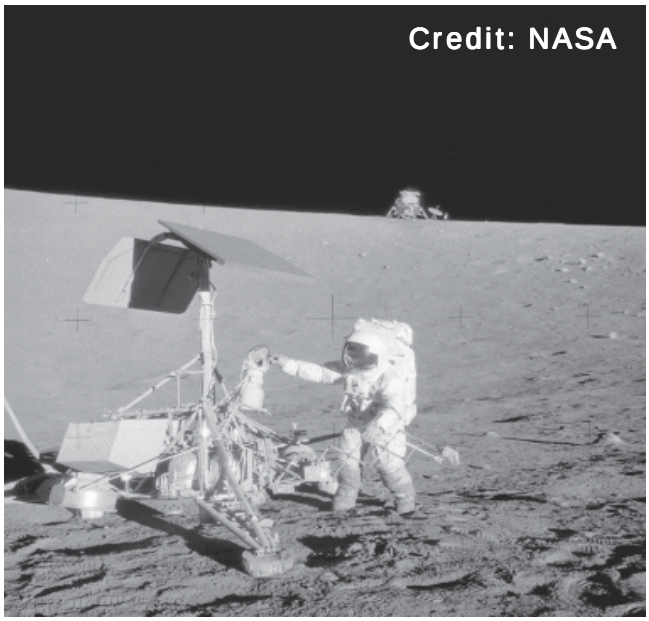
"Out the Window on Your Left"

IT'S BEEN OVER 40 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).

The landing site of Apollo 12 is visible in this month's image. The site for the second Moon landing was approximately 930 miles (1,500 km) west of the Apollo 11 site and, similar in that it offered a relatively smooth landing area. The Apollo 12 site was selected for its proximity to Copernicus crater, 190 miles (300 km) to the north and the ejecta (which was believed to have covered the site) from the crater's formation. The location was also home to Surveyor 3, an unmanned spacecraft that landed on the Moon in April of 1967.



The crew of the Apollo 12 Lunar Module (Pete Conrad and Al Bean) executed a pinpoint landing on November 19, 1969, setting down 535 feet from the Surveyor spacecraft (to minimize the potential of contaminating the Surveyor spacecraft by the descent engine exhaust or dust kicked up by the engine required that the landing be at least 500 feet away from Surveyor). The Sun was only 6° above the horizon at touchdown, casting long shadows across the volcanic plains and adding sharp relief to the features at the landing site.



Astronaut Alan Bean inspects Surveyor 3

Conrad and Bean spent 7 hours and 45 minutes on the surface, in two separate excursions, collecting 75 pounds (34 kg) of rock and soil samples and setting up experiments. The astronauts were also able to venture into the crater in which Surveyor had landed and remove pieces (including the TV camera and soil scoop) for further study back on Earth.

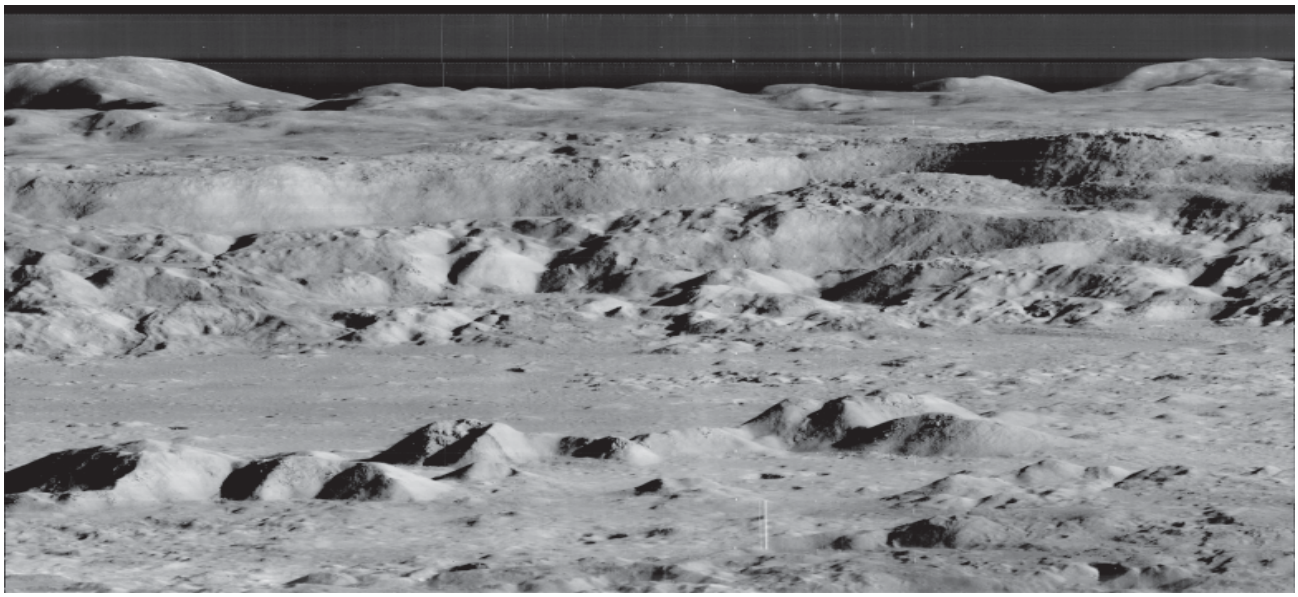
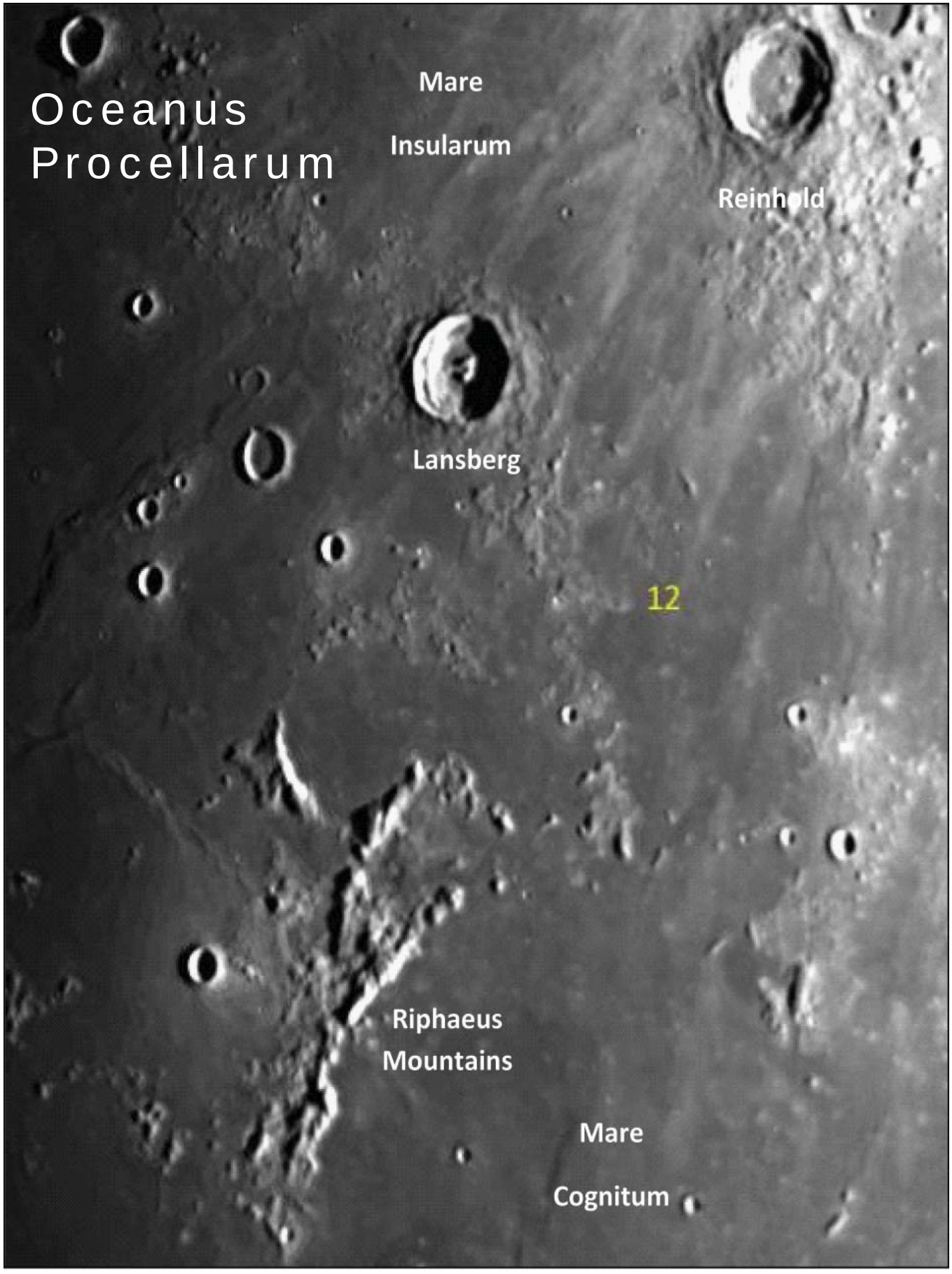


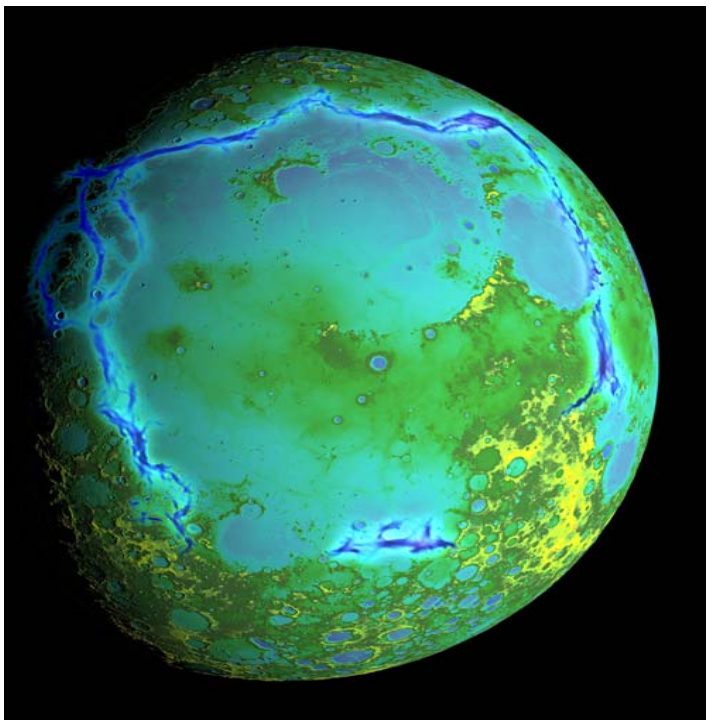
Image of Copernicus crater taken by the Lunar Orbiter 2 on November 24, 1966. Often called "the picture of the century" for the stark, unearthly landscape it revealed, it was taken from an altitude of 28.4 miles above the lunar surface and 150 miles due south of the crater. Source: NASA.


Oceanus Procellarum
Mare Insularum
Reinhold
Lansberg
12
Riphaeus Mountains
Mare Cognitum

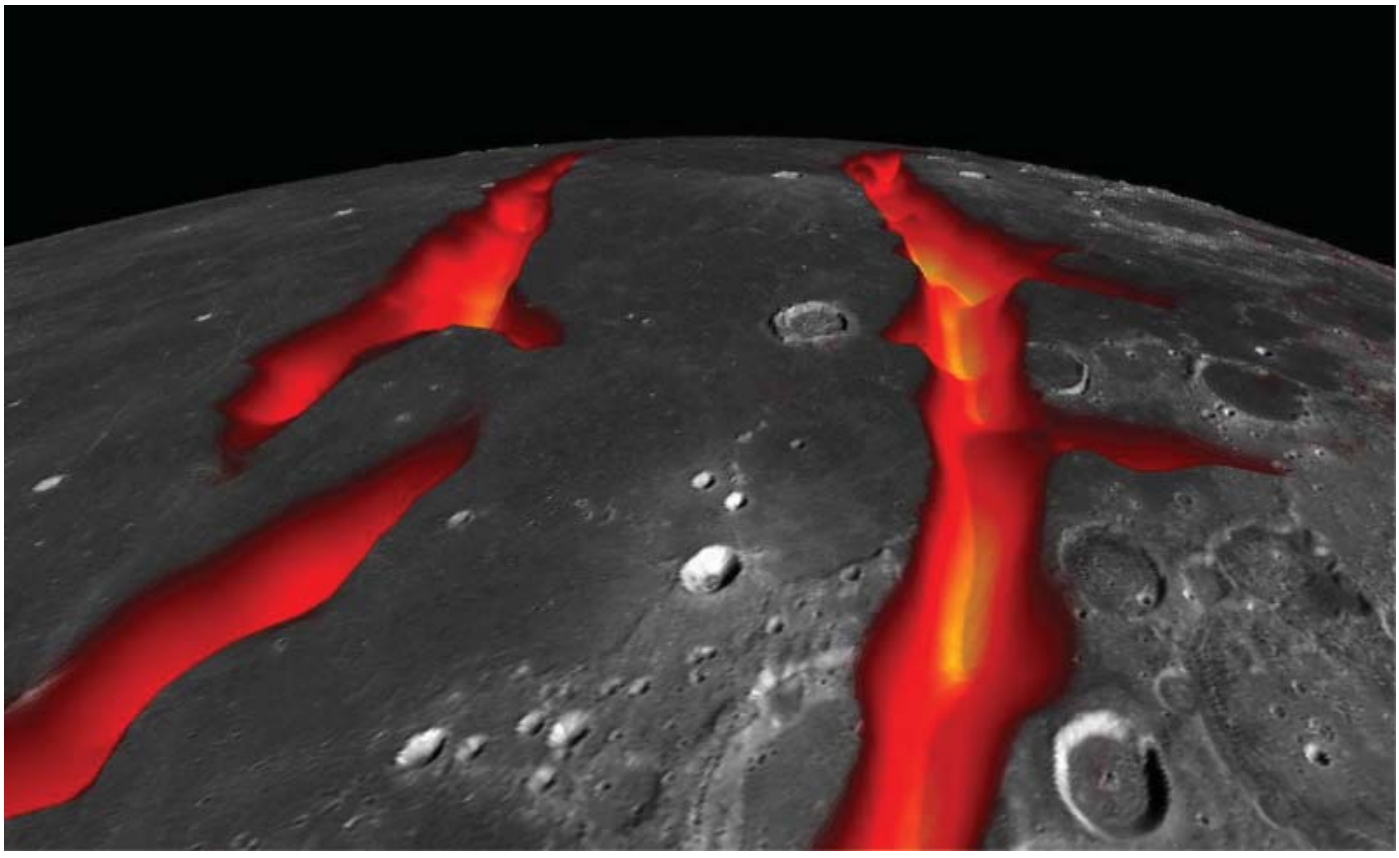
New Theory on the Formation of Oceanus Procellarum

Covering a large portion of the western half of the near side, Oceanus Procellarum (the Ocean of Storms), was once thought to have been created by a massive asteroid impact. Support for the impact theory has waned over the years as robotic spacecraft continue to explore the Moon and gather additional data. Recent observations from the Gravity Recovery and Interior Laboratory (GRAIL) have provided additional clues to the formation of this lunar feature.

GRAIL found evidence of ancient rift valleys bounding Oceanus Procellarum, forming a rectangular region approximately 1,600 miles (2,600 km) across. A rift valley is created when stress, for example from crustal cooling, creates fissures along the surface. The fissures, or valleys, provide pathways for the molten rock or magma located beneath the surface. As the activity subsided, the valleys are filled with solidified lava and subsequently buried by debris, for example, from impacts. The structure of the subsurface rift valleys, virtually indiscernible from the surface, is visible in the gravity data collected by GRAIL.



Topographic map created from data on gravity anomalies in the Procellarum border regions detected by the GRAIL spacecraft. Source: NASA.



Artist's concept of the rift valleys superimposed on images from the Lunar Reconnaissance Orbiter and topography data from LRO's Lunar Orbiter Laser Altimeter. Image credit: NASA/Colorado School of Mines/MIT/JPL/GSFC

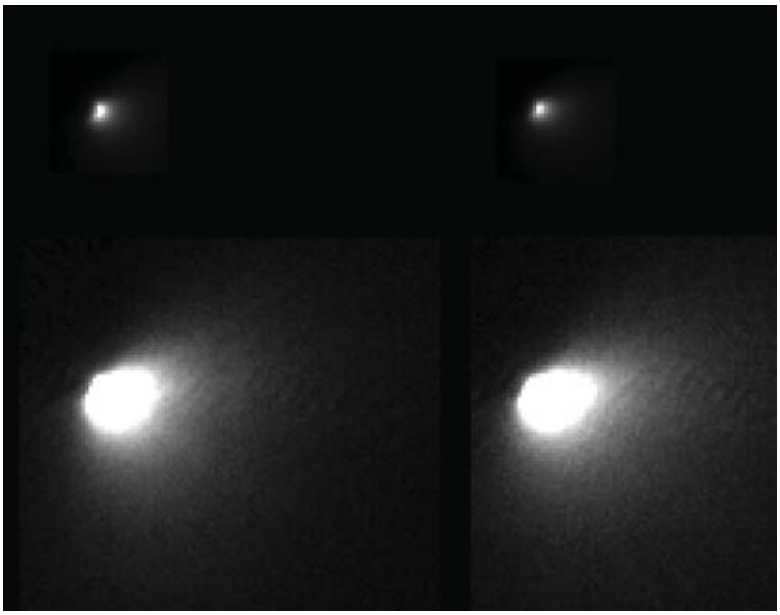
Comet Siding Spring's Encounter with Mars

NASA's three orbiters, the Mars Atmosphere and Volatile Evolution (MAVEN), the Mars Reconnaissance Orbiter (MRO), and the Mars Odyssey, were reported to be in good health following their encounter with comet Siding Spring. As a precaution, NASA had moved the three orbiters behind the planet during the comet's closest approach.

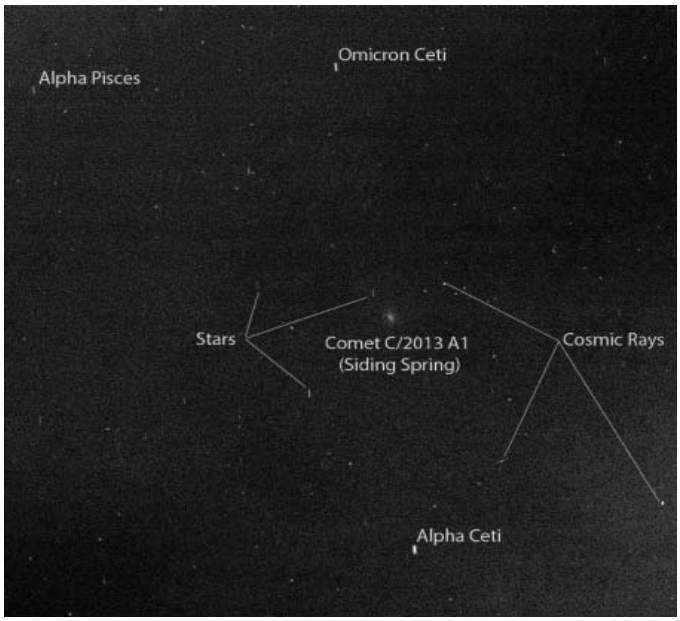
The images of the comet (below) were taken by MRO at a distance of 86,000 miles (138,000 kilometers). Based upon the scale of the images, the nucleus is estimated to be only a quarter mile across (one half a kilometer), smaller than originally estimated from telescopic observations. The images (left and right) were taken nine minutes apart.

NASA'a rovers (Opportunity and Curiosity) contributed observations of the comet. The image (right) was captured by the rover Opportunity. The image is from a 50 second exposure taken shortly before dawn.

NASA had readied Opportunity for its night time activity by limiting its daytime use (and recharging its batteries) prior to the encounter. Sky conditions were degraded by a dust storm to the west. However, Opportunity was able to capture the comet with its panoramic camera.



MRO Images of Comet Siding Spring. Credit: NASA/JPL-Caltech/University of Arizona



Comet Siding Spring from Mars Exploration Rover Opportunity. Image Credit: NASA/JPL-Caltech/ Cornell Univ./ASU/TAMU

Artist's concept of Siding Spring from surface of Mars. Source: NASA

X-37B space plane
Credit: Boeing

Secret Space Plane Lands

The U.S. Air Force's secret space plane landed at Vandenberg Air Force Base on Oct. 17, 2014 after nearly two years in orbit. This completes the third test flight of the winged spacecraft.

The 29-foot long, unmanned spacecraft, built by Boeing's Phantom Works, has a payload bay the size of a pickup truck and is equipped with a deployable solar array. The Air Force has not confirmed if a payload was on board or revealed what the space plane was doing for the past two years. The X-37B is designed to test reusable spacecraft and autonomous flight technologies. A fourth mission is scheduled for launch in February 2015. While the spacecraft has been launched from the Cape Canaveral Air Force Station, it has always landed at Vandenberg. The Air Force is now considering the shuttle landing facility at the Kennedy Space Center as a potential, alternative landing site.

Martian Panorama

Wdowiak Ridge
Image Credit: NASA/
JPL-Caltech/Cornell
Univ./Arizona State

NASA's Mars Exploration Rover "Opportunity" has been working its way along the western rim of Endeavour crater (14 miles or 22 km in diameter) as it heads south towards its winter home: "Marathon Valley." The valley (a notch in the crater wall) appears to be abundant in clay minerals, based upon observations and remote analysis from orbiting spacecraft.

Opportunity has been exploring a recent impact crater (Ulysses Crater) on Wdowiak Ridge. The impact excavated material from the rim and provided a plethora of interesting rock targets to analyze.

The photo (above) shows the view from Wdowiak Ridge and was acquired by Opportunity's panoramic camera on September 17, 2014. The ridge runs about 500 feet (150 meters) in length and reaches 40 feet (12 meters) above the surrounding crater rim.

Hayabusa 2

The Japan Aerospace Exploration Agency (JAXA) is planning to launch a second sample return mission on November 29th from its Tanegashima Space Center. Hayabusa 2 will rendezvous with asteroid 1999 JU3 in 2018. The spacecraft will study the asteroid for 18 months before returning to Earth in late 2020.

The ambitious mission includes deploying a lander and three small rovers, releasing an impactor to create a crater on the asteroid's surface, and collecting a sample for analysis back on Earth.

Hayabusa 2 is JAXA's second asteroid sample return mission – the first launched in 2003visited the near-Earth asteroid 25143 Itokawa. That mission had limited success, returning less than one-hundred microscopic particles.

Philae

The European Space Agency (ESA) is targeting November 12th as the date for releasing Rosetta's lander, "Philae," toward the surface of comet 67P/Churyumov-Gerasimenko. The landing site, currently designated as Site J, is located on the smaller of the comet's two lobes. Harpoons will be fired into the ice upon touchdown to prevent the lander from bouncing off.

The lander's battery has a life of 64 hours, which can be extended if its solar panels are able to recharge the battery (how long will depend upon the amount of sunlight at the landing site, the lander's orientation and the rate dust accumulates on the solar cells as the comet becomes more active). The lander is expected to acquire high resolution images of the surface and analyze surface and subsurface samples with its onboard laboratory.

Philae's landing site is shown in the photo below (Credits: ESA/Rosetta/MPS for OSIRIS Team MPS/UPD/LAM/IAA/SSO/INTA/UPM/DASP/IDA).

Did You Know?

• Philae weighed approximately 100 kg (220 pounds) on Earth. With the low mass of Comet 67P, the lander will weigh only 1 gram when it lands on the comet's icy surface. For comparison, a penny weighs 2.5 grams on Earth.

• Once the lander is released from Rosette, at a distance of 14 miles (22.5 km) from the center of the comet, it will fall toward the comet for approximately 7 hours before touching down. There are no attitude controls or engines on the lander – it just slowly falls towards the targeted landing site.

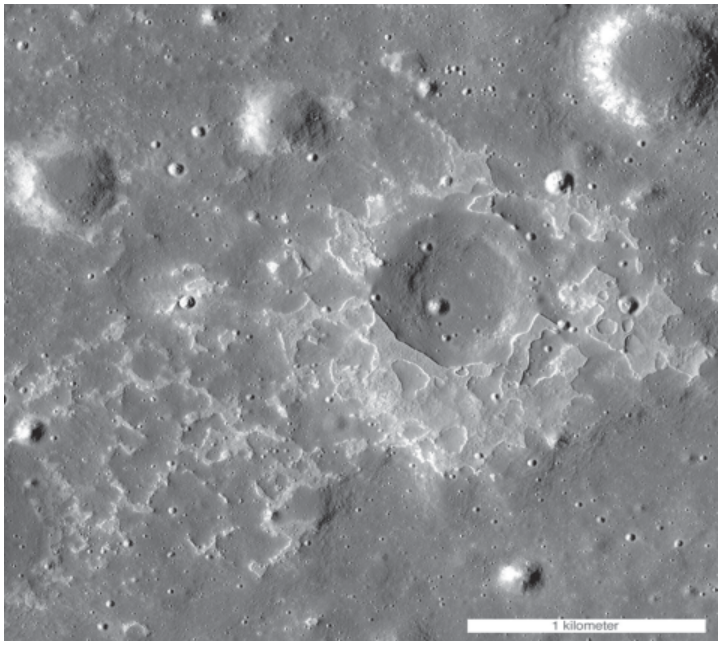
• As the comet nears the Sun, the Sun's gravity will exert a greater force upon the Rosetta spacecraft than the comet that it is orbiting.

Artist's impression of Philae descending to the surface of comet 67P

Credits: ESA/ATG medialab

Signs of a Recently Active Moon

Based upon the analysis of samples returned by the Apollo mission, the peak of lunar volcanic activity occurred between 3.9 and 3.1 billion years ago and ended 1.0 to 1.5 billion years ago. However, recent analysis of the high resolution images acquired by the Lunar Reconnaissance Orbiter's



Maskeylene IMP.
Credit: NASA/GSFC/Arizona State University

Narrow Angle Cameras has provided evidence of more "recent" volcanic deposits. The deposits (called Irregular Mare patches or IMPs) appear to have formed within the last 50 to 100 million years. IMPs, for example near the crater Maskelyne (shown in the photograph), have sharp, distinct features and are noticeably absent of large, overlying impact craters (used to date the deposits). The IMPs are comprised of rough material deposits that are well defined and smooth deposits that appear associated with the surrounding basalt.

More than 70 of the anomalies (IMPs) have been identified, in isolation and in clusters. Their young age would indicate the interior of the Moon was hotter for much longer than was thought.

The Apollo 15 and 17 missions did include heat flow experiments. The instrumentation recorded higher regolith temperatures than the models had predicted. At the time, the higher temperatures were explained as site-specific anomalies or instrument related. The new data on the suspected age of the IMPs suggests otherwise, and pockets of magma may still exist today below the surface.

Leonid Meteor Shower

Almost everyone has seen a 'shooting star;' but not everyone knows what they are, where they come from and how best to view them. For those of you that remember that chilly November night in 2001 when the stars fell like rain, a meteor shower or meteor storm is truly unforgettable. As with that night, all you need are a comfortable chair and a warm blanket to enjoy the show.

Meteor showers occur when the Earth passes through a cloud of debris left behind by a comet. As a comet nears the Sun, the volatile gases warm and erupt along with trapped particles of rock and dust. Pushed away from the comet by the solar wind, this material forms the comet's tail. Each time a comet crosses the Earth's orbit it leaves behind a small cloud of debris. When the Earth passes through these clouds, the debris quickly heats up in the atmosphere, creating streaks of light across the night sky. The point in the sky where the meteors appear to originate is called the radiant. Meteor showers are identified by the constellation in which the radiant appears. As such, if you trace the path of the meteors in the early morning of November 17, you will notice that most seem to originate from a point in the constellation Leo, hence the name Leonids.

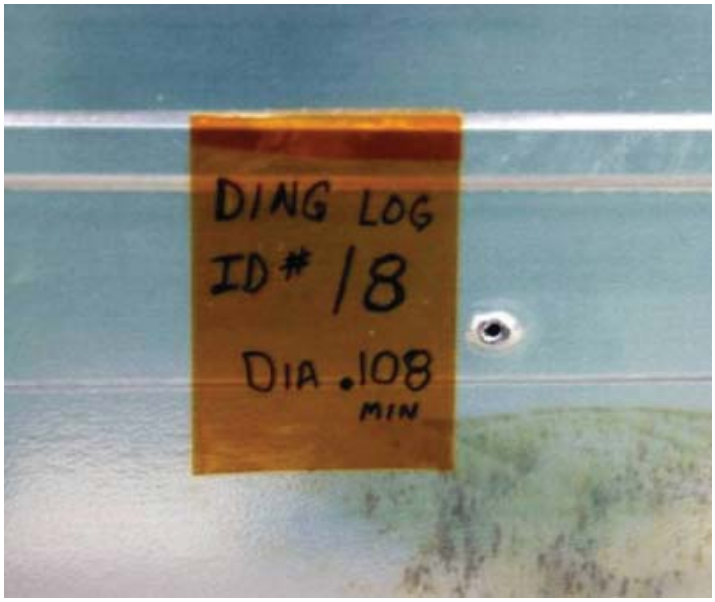
Why does the same meteor shower excite one year and disappoint the next? While comets are responsible for seeding Earth's orbit with the makings of a meteor shower, most comets are not frequent visitors to the inner solar system. Comet Tempel-Tuttle (the source of the Leonid meteors) crosses Earth's orbit once every 33 years. The resulting cloud is about 10 Earth diameters across and continues to drift along the comet's path. Most years the Earth misses these clouds altogether. In those years the meteor shower is sparse. Other years, as in 2001, the Earth can interact with several debris clouds from Comet Tempel-Tuttle. If the debris cloud is dense (containing a lot of rock and dust) the show can be spectacular. However, as debris clouds age they stretch out and become less dense. The resulting encounter produces fewer and fewer meteors.

What can we expect this year? With a waning crescent rising well after midnight, viewing conditions should be favorable. Expect to see an average of 15-20 meteors per hour during the peak period from a dark site (as long as the skies are clear).

Danger: Space Debris

More than a ton of meteoroids bombards the Earth and moon every day. Most disintegrate in the Earth's atmosphere. The moon is not so fortunate; the lunar surface is continually modified by the bombardment, as shown by the samples brought back from there by the Apollo astronauts. NASA is supporting projects that monitor the frequency of lunar impacts, anticipating that the information will be useful in designing more robust lunar structures and contingency plans for astronauts venturing out on the lunar surface.

NASA launched the Chandra X-ray Observatory in July 1999, placing it in an elliptical orbit that extends almost one-third the distance to the moon. In November 2003, the telescope's operators placed the telescope in a safe configuration during its passage through four meteor shower streams. Despite an extremely low probability (one in a million) that the telescope would be hit by a meteoroid, that's what apparently happened early on the morning of November 15th. Fortunately, there was no apparent damage to the more sensitive parts of the telescope.



In 2006, the right-hand payload bay door radiator of the space shuttle Atlantis was hit by space debris. The object blasted its way through the metal skin and aluminum honeycomb material inside before exiting the other side. The resulting hole missed the Freon coolant lines inside the panel and did not endanger the crew. (The radiators were only deployed once the shuttle is in space and were stored in the cargo bay during reentry.) However, the impact illustrates the danger presented by space debris to spacecraft and their human occupants.

The Hubble Space Telescope's Wide Field Planetary Camera 2 was returned to Earth as part of the telescope's servicing mission in 2009 (STS-125). Attached to the camera was a large radiator (2.2 m by 0.8 m). The radiator had been in space since the camera was installed in 1993, and its large flat surface provided an excellent measure for determining impact rates for orbital debris at the telescope's altitude (between 560 and 620 km). Initial analysis of the radiator found a total of 685 micrometeoroid and orbital debris impact features (larger than about 0.3 mm).

It is estimated that tens of millions of man-made objects also orbit the Earth, the vast majority smaller than 1 centimeter in size. The objects come from derelict spacecraft, exploding rocket boosters, discarded motors, deterioration of man-made structures including thermal blankets and solar panels, as well as from accidental and deliberate collisions. The objects orbit the Earth in many different directions, altitudes, and velocities, traveling up to 30,000 miles an hour or 20 times faster than a rifle bullet. At these speeds, it doesn't take a very large object to inflict considerable damage to another object, including the International Space Station. The space shuttle windows were hit by small pieces of debris 32 times during an average mission. Micrometeorites are involved in approximately one-third of the collisions. The grains of sand are generally less dense than man-made debris, and therefore, relatively harmless. The remaining two-thirds do have some penetrating power and are primarily bits of aluminum, followed by paint, steel, and copper.

NASA currently tracks almost 17,000 objects; most are larger than 10 centimeters (4 inches). This is double the number of objects tracked ten years ago. (There may be 500,000 debris fragments greater than one centimeter in size and over a 100 million fragments smaller than a centimeter). While the United States and Russia are the largest contributors to the swarm of man-made objects, newer space faring nations, in particular China, have added to the problem (particularly after China's intentional destruction of its Fengyun 1C weather satellite, the single largest debris producing event). While debris in low-Earth orbit will eventually fall back to the surface, objects higher than 800 kilometers (480 miles) can continue to circle the planet for decades and even centuries.

In mid-July, the International Space Station was repositioned to avoid debris from a Russian Breeze-M rocket upper stage that exploded in 2012. It was the third collision avoidance maneuver this year and 19th since 1999.

Until a solution can be found to cleaning up the debris (that is both technically feasible and economical), NASA has developed guidelines it hopes other nations will adopt to minimize the creation of even more debris. In the meantime, surveillance of the existing debris (only practical for the larger objects) will allow spacecraft that can maneuver to avoid future collisions, and more importantly, the loss of life. For additional information, NASA publishes the "Orbital Debris Quarterly News," complete with a "satellite box score." The newsletter (past and present) is available at http://www.orbitaldebris.jsc.nasa.gov/newsletter/newsletter.html.

November History: Apollo 12

The second manned mission to the lunar surface was launched on November 14, 1969. The mission was almost lost before it started. The Saturn V rocket booster was hit by lighting as it rose from the launch pad. Fortunately, a young flight controller in mission control (John Aaron) remembered seeing the same dizzying display of warning lights and alarms in a practice run and was able to provide the crew directions on re-establishing power and control to the spacecraft.

After leaving Earth orbit, the command module extracts the lunar excursion module from the third stage. The trajectory (or path) of the third stage is then modified, so as not to interfere with the lunar landing (either by placing it into orbit around the Sun or deliberately crashing it into the Moon). In what would become of interest 33 years later, the engine on the third stage burned 300 seconds too long, sending the rocket booster into a semi-stable orbit around the Earth. Two years later, it finally entered into an orbit around the Sun (by passing through a region of space controlled by the Earth and Sun).

The Ocean of Storms was the designated landing site for Apollo 12, southeast of the large crater Lansberg. Mission Commander Pete Conrad made a pinpoint landing 600 feet from the Surveyor 3 spacecraft which had landed two years earlier. The diminutive Conrad joked as he stepped out onto the lunar surface for the first time, "Whoopee! Man, that may have been one small one for Neil, but that's a long one for me."

In 2002, amateur astronomer Bill Yeung discovered a new object orbiting the Earth. Designated J002E3, the object was later determined to be artificial (from the analysis of reflected sunlight). After considerable study, it was concluded that J002E3 was most likely the third stage of Apollo 12. The object made six elongated orbits of the Earth before disappearing, presumably returning to its previous orbit around the Sun.

J002E3 was imaged from the McCarthy Observatory during three of its close approaches to Earth. Although the images are just snapshots, the tumbling motion of the booster is clearly seen as the sunlight alternately reflects off the white painted sides of the rocket and then the darkened ends.

November Nights

The late Harvard University astronomer Harlow Shapley was born in November 1885. One of his many accomplishments was accurately measuring the distance to globular star clusters and their position around the Milky Way Galaxy. While warm summer nights are usually reserved for hunting globulars, the autumnal sky contains several impressive clusters including M15 in Pegasus and M2 in Aquarius. M30 in Capricorn is also visible in the southwest sky in the evening.

On the eastern side of the Great Square of Pegasus is the constellation Andromeda. Within this constellation and visible to the unaided eye on a dark night is the Andromeda Galaxy (M31), a massive pinwheel of 500 billion suns. Larger than the Milky Way, the Andromeda Galaxy is currently rushing towards us at 75 miles per second. Fortunately, it is approximately 2½ million light years (14.7 million trillion miles) distant, so it will be some time before the two galaxies merge. Visible through a telescope are Andromeda's two companion galaxies, M32 and M110. While M32 can be mistaken for a bright star due to its close proximity to the core of the Andromeda Galaxy, M110 is a bit easier, being further away and larger than M32.

Located not far from M31 is the Triangulum or Pinwheel Galaxy (M33). Smaller and less massive than the Milky Way, this galaxy can be a challenge to see on less than ideal nights, due to its low surface brightness. However, through a large telescope on a dark, steady night, the view looking face-on at this giant pinwheel can be spectacular. The large spiral arms of M33 are filled with star-forming regions that almost appear to be gliding through space.

Sunrise and Sunset

Sun	Sunrise	Sunset
November 1st (EDT)	07:26	17:48
November 15th (EST)	06:43	16:34
November 30th	07:00	16:25

Astronomical and Historical Events

1st Mercury at its Greatest Western Elongation (apparent separation from the Sun in the morning sky) at 19°
1st History: launch of the Wind spacecraft, designed to monitor the solar wind (1994)
2nd End of Daylight Savings Time - set clocks back one hour at 2 a.m.
2nd Moon at perigee (closest approach to Earth)
2nd Kuiper Belt Object 55637 (2002 UX25) at Opposition (40.035 AU), rising with the setting Sun and visible all night
2nd History: flyby of Asteroid 5535 Annefrank by the Stardust spacecraft (2002)
2nd History: first light at the 100-inch telescope on Mount Wilson (1917)
3rd Taurids Meteor Shower peak
3rd Kuiper Belt Object 84522 (2002 TC302) at Opposition (44.347 AU), rising with the setting Sun and visible all night
3rd History: launch of Mariner 10 to Venus and Mercury; first mission to use the gravitational pull of one planet (Venus) to reach another (Mercury) (1973)
3rd History: launch of Sputnik 2 and a dog named Laika (1957)
4th History: Deep Impact's closest approach to the nucleus of Comet 103P/Hartley 2 (2010)
4th History: launch of the Soviet Venus lander Venera 14 (1981)
5th History: Chinese spacecraft Chang'e 1 enters orbit around Moon (2007)
6th Full Moon (Full Beaver or Full Frost Moon)
7th History: launch of Mars Global Surveyor (1996)
7th History: launch of Surveyor 6 moon lander (landed two days later). On November 17th, the lander's small vernier engines were fired for 2½ seconds, lifting the lander off the lunar surface 10 to 12 feet and almost 8 feet sideways. This lunar "hop" was the first powered takeoff from the lunar surface. It also provided NASA a view of the original landing site and a baseline for acquiring stereoscopic images of its surroundings. (1967)
7th History: launch of Lunar Orbiter 2, Apollo landing site survey mission (1966)
8th Second Saturday Stars - Open House at the McCarthy Observatory (7:00 pm)
8th History: launch of the ill-fated Phobos-Grunt spacecraft from the Baikonur Cosmodrome in Kazakhstan. Destined for the Martian moon Phobos, the spacecraft never left Earth orbit and eventually re-entered the atmosphere. (2011)
8th History: meteorite hits a house in Wethersfield, Connecticut (1982)
8th History: launch of Pioneer 9 into solar orbit (1968)
8th History: launch of Little Joe rocket, qualifying flight for the Mercury spacecraft (1960)
8th History: Edmund Halley born, English astronomer who calculated the orbit and predicted the return of the comet now called Comet Halley (1656)
9th History: launch of the Venus Express spacecraft; ESA Venus orbiter (2005)
9th History: launch of the first Saturn V rocket, Apollo 4 (1967)
10th History: launch of Luna 17, Soviet Moon rover mission (1970)
10th History: launch of USSR spacecraft Zond 6; Moon orbit and return (1968)
10th History: Waseda Meteorite Fall; hits house in Japan (1823)
11th History: launch of Gemini 12 with astronauts James Lovell and Edwin Aldrin (1966)
11th History: Tycho Brahe discovers a new star in the constellation Cassiopeia shining as bright as Jupiter; later determined to be a supernova - SN1572 (1572)
12th History: launch of STS-2, second flight of the Space Shuttle Columbia (1981)
12th History: flyby of Saturn by the Voyager 1 spacecraft (1980)
12th History: Seth Nicholson born, American astronomer who discovered four of Jupiter's moons, a Trojan asteroid, and computed orbits of several comets and of Pluto (1891)
13th Plutino 2003 UZ413 at Opposition (42.351 AU), rising with the setting Sun and visible all night

Astronomical and Historical Events (continued)

13th History: launch of HEAO-2, the second of NASA's three High Energy Astrophysical Observatories; renamed Einstein after launch, it was the first fully imaging X-ray space telescope (1978)
14th Last Quarter Moon
14th Moon at apogee (furthest distance from Earth)
14th History: dedication of the New Milford Solar System Scale Model (2009)
14th History: Mariner 9 arrives at Mars; first spacecraft to orbit another planet (1971)
14th History: launch of Apollo 12, with astronauts Pete Conrad, Richard Gordon and Alan Bean to the moon's Ocean of Storms and near the robotic explorer Surveyor 3 (1969)
15th History: ESA's spacecraft SMART-1 enters lunar orbit; first ESA Small Mission for Advanced Research in Technology; travelled to the Moon using solar-electric propulsion and carrying a battery of miniaturized instruments (2004)
15th History: the only orbital launch of the Russian space shuttle Buran; the unmanned shuttle orbited the Earth twice before landing (1988)
15th History: launch of Intasat, Spain's first satellite (1974)
16th Plutino 84719 (2002 VR128) at Opposition (37.765 AU), rising with the setting Sun and visible all night
16th History: launch of the third (and last) Skylab crew with astronauts Gerald Carr, William Pogue and Edward Gibson (1973)
16th History: launch of Venera 3, Soviet Venus lander (1965)
17th Leonids Meteor Shower peak
17th Asteroid 6 Hebe at Opposition (8.1 Magnitude)
17th Kuiper Belt Object 90377 Sedna at Opposition (85.154 AU)
17th History: Soviet lunar lander Luna 17 deploys first rover - Lunokhod 1 (built by the Kharkov state bicycle plant); operated for 11 months, photographing and mapping the lunar surface and analyzing the regolith (1970)
18th History: Leonids Meteor Storm (2001)
18th History: launch of the COBE spacecraft; observed diffuse cosmic background radiation (1989)
19th Comet 17P/Holmes Closest Approach to Earth (1.826 AU): comet erupted on October 24, 2007, when it brightened by a factor of nearly a million in less than 2 hours
20th History: launch of the Swift spacecraft; first-of-its-kind multi-wavelength observatory dedicated to the study of gamma-ray bursts (2004)
22nd New Moon
23rd Scheduled launch of a Russian Soyuz spacecraft from the Baikonur Cosmodrome, Kazakhstan to the International Space Station with the next Expedition crew
23rd History: launch of the European Space Agency's first satellite, Meteosat 1 (1977)
23rd History: launch of Tiros II weather satellite (1960)
24th Kuiper Belt Object 386723 (2009 YE7) at Opposition (49.831 AU), rising with the setting Sun and visible all night
25th Kuiper Belt Object 145453 (2005 RR43) at Opposition (38.254 AU), rising with the setting Sun and visible all night
26th History: launch of the Mars Science Laboratory (MSL) aboard an Atlas 5 rocket from the Cape Canaveral Air Force Station (2011)
26th History: discovery of Mars meteorites SAU 005 and SAU 008 (1999)
26th History: launch of France's first satellite, Asterix 1 (1965)
26th History: launch of Explorer 18; studied charged particles and magnetic fields in and around the Earth – Moon (1963)
27th Moon at perigee (closest approach to Earth)
27th History: Soviet spacecraft Mars 2 arrives at Mars; lander crashes, becoming first human artifact to impact the surface of Mars (1971)
28th Kuiper Belt Object 229762 (2007 UK126) at Opposition (42.542 AU), rising with the setting Sun and visible all night

Astronomical and Historical Events (continued)

28th History: launch of Algeria's first satellite, Alsat 1 (2002)
28th History: launch of Mariner 4; first spacecraft to obtain and transmit close range images of Mars (1964)
29th First Quarter Moon
29th Centaur Object 8405 Asbolus at Opposition (17.762 AU), rising with the setting Sun and visible all night
29th History: discovery of Y000593 Mars meteorite in Antarctica (2000)
29th History: launch of Australia's first satellite, Wresat 1 (1967)
29th History: launch of Mercury 5 with Enos the chimpanzee (1961)
30th Kuiper Belt Object 2006 QH181 at Opposition (82.288 AU), rising with the setting Sun and visible all night
30th History: Sylacauga Meteorite Fall; hits women (1954)

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

International Space Station/Space Shuttle/Iridium Satellites

Visit *www.heavens-above.com* for the times of visibility and detailed star charts for viewing the International Space Station, the Space Shuttle (when in orbit) and the bright flares from Iridium satellites.

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.*

Image Credits

Front page design and graphic calendar: Allan Ostergren
Second Saturday Stars poster: Sean Ross, Ross Designs

Page 3 Graphic: High temperature, black silica tiles that comprise the thermal protection system on the underside of the space shuttle Endeavour. The tile damage visible in the image occurred during Endeavour's final mission. The damage was analyzed on orbit and determined that it would not compromise the shuttle's safe return to Earth.Tile damage is evident on the underside of the space shuttler. The shuttle is currently on display at the California Science Center in Los Angles as it awaits the construction of a permanent venue. The shuttle will eventually be exhibited in a vertical (launch) configuration, complete with solid rocket boosters and an external tank. Photo by Bill Cloutier

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

Second Saturday Stars

FREE EVENT

Every Month at the

John J. McCarthy Observatory

Behind the New Milford High School

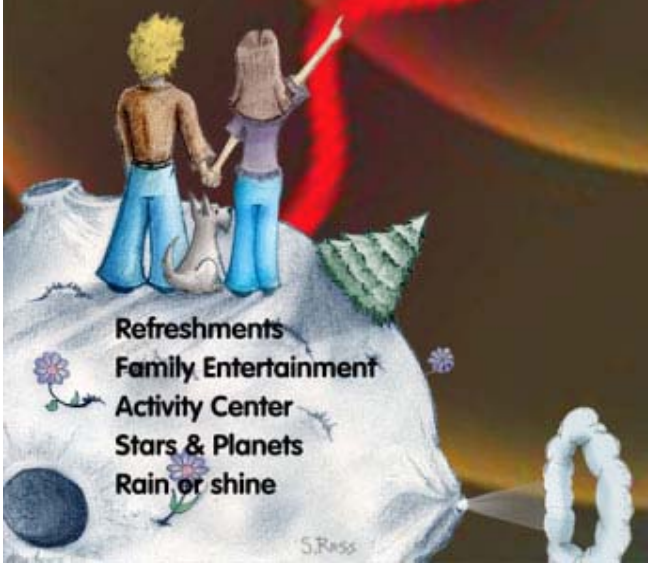
860.946.0312

www.mccarthyobservatory.org

November 8th

7:00 - 9:00 pm

MAPPING THE UNIVERSE



Refreshments
Family Entertainment
Activity Center
Stars & Planets
Rain or shine

Map

art & design · sean ross · rossgrafix13@yahoo.com

November 2014

Celestial Calendar

Phases of the Moon

Nov 6 — Nov 14 — Nov 22 — Nov 29

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
						1 Launch of Wind spacecraft to study solar wind (1994)
2 Moon at Perigee (closest to Earth); End of Daylight Savings Time; First light of Mt. Wilson 100-inch telescope - (1917); Harlow Shapley born, American astronomer, measured distances within our galaxy (1885)	**3** Taurids meteor showers peak; Launch of Mariner 10 to Venus and Mercury (1973); Launch of Sputnik 2, with dog Laika (1957)	**4** Chinese spacecraft Chang'e 1 enters orbit around Moon (2007); Deep Impact closest approach to the nucleus of Comet 103/P Hartley 2 (2010)	**5** Fred Lawrence Whipple born, American astronomer; first to theorize of comets as "dirty snowballs" (1906)	**6** Lunar Orbiter 2 launch (1966); Charles Owen Hobaugh, NASA astronaught born (1961)	**7** Launch of Mars Global Surveyor (1996); Launch of Surveyor 6 Moon Lander, dry-run for later manned mission (1967)	**8** Launch of Little Joe rocket (1960); Meteorite hits house in Wethersfield CT (1982); Edmund Halley born (1656); 2nd Saturday Stars Open House McCarthy Observatory
9 Launch of 1st Saturn V rocket - Apollo 4 (1967); Launch of Venus Express spacecraft; ESA Venus orbiter (2005)	**10** Launch of Soviet spacecraft Zond 6 to Moon (1968); Launch of Luna 17, Soviet Moon Rover mission (1970); Waseda meteor hits house in Japan (1823)	**11** Tycho Brahe discovers supernova SN1572 (bright as Jupiter) (1572); Launch of Gemini 12, with astronauts Lovell and Aldrin (1966)	**12** Seth Nicholson born, American astronomer (1891); Space Shuttle Columbia safe re-launch, with commander Joe Engle and pilot Richard Truly (1981)	**13** Launch of HEAO-2 (Einstein), 1st fully-imaging x-ray telescope in space - 1978; Dawn spacecraft enters Asteroid Belt on way to Vesta and Ceres (2009)	**14** Launch of Apollo 12 Conrad, Gordon, Bean, 1969; Mariner 9 arrives at Mars, 1st spacecraft to orbit another planet, 1971; The Great Comet of 1680, discovered by Gottfried Kirch over Rotterdam, and the first comet discovered by telescope; Dedication of the New Milford solar system scale model (2009)	**15** Moon at apogee (farthest from Earth); Astronomer William Herschel born (1738); ESA Smart-1 enters lunar orbit, using solar-electric propulsion 2004; Only orbital launch of Russian Buran space shuttle in unmanned mission (1988)
16 Launch of Venera 3, Soviet Venus lander (1965); Launch of 3rd and last Skylab crew - Carr, Pogue, Gibson (1973)	**17** Soviet lunar lander, Luna 17 with 1st rover, Lunakhod 1 (1970); Leonids meteor shower peak	**18** Leonids Meteor Storm (2001); Alan Shepard born, 1st American in space and 5th to walk on Moon - 1923; Launch of the COBE spacecraft; observed diffuse cosmic background radiation (1989)	**19** Apollo 12 astronauts Charles Conrad and Alan Bean made man's second landing on the moon (1969)	**20** Launch of the Swift spacecraft, multi-wavelength observatory to study gamma wave bursts (2004)	**21** India's space program begins with the launch of a Nike-Apache sounding rocket from coconut groves in Thumba, a small fishing village in Kerala state (1963)	**22** Dr. Guion Stewart "Guy" Bluford, Jr. born - an engineer, NASA astronaut, and the first African American in space (1942)
23 Launch of European Space Agency's 1st satellite, Meteosat (1977); launch of Tiros II weather satellite (1960)	**24** Space-walking astronauts from shuttle Columbia catch a 1 1/2 -ton satellite, and the cockpit crew used the shuttle's robot arm to return it to the cargo bay (1997)	**25** Radio signals exchanged between Viking 1 Mars Lander and Earth are slowed by sun's gravity, confirming Einstein's general theory of relativity (1976)	**26** Launch of France's first satellite, Asterix 1 (1965); Launch of Explorer 18; studied charged particles and magnetic fields in and around the Earth - Moon (1963); Discovery of Mars meteorites AU 005 and SAU 008 (1999)	**27** Moon at Perigee (closest to Earth); Soviet spacecraft Mars 2, first human artifact to impact Martian surface (1971)	**28** Launch of Algeria's 1st satellite, Alsat 1 (2002); Launch of Mariner 4, first spacecraft to send close range images of Mars (1964); Comet C/2012 S1 (ISON) Perihelion (0.012 AU)	**29** Launch of Australia's 1st satellite, Wresat 1 1967; Launch of Mercury 5, with Enos the chimp 1961; Discovery of Y000593 Mars meteorite in Antarctica (2000)
30 Sylicauga meteorite fall strikes Alabama woman (1954)						