Galactic Observer

John J. McCarthy Observatory

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Where Stars Are Born

About 60 million light years away in a barred spiral galaxy of the constellation Ursa Minor (*Little Bear*), a den mother nurses a litter of cubs. Although two-thirds of galaxies take the form of a spiral rotating around a bar-shaped core, NGC 6217 is also a star forming region, or "starburst" galaxy.The blue glow along the rim of the galaxy is an indicator of the intense heat generated by newly-formed star clusters.

NGC 6217 was the first image taken by the Hubble Space Telescope following NASA's fourth servicing mission to the satellite in 2009. For more information on the 25th anniversary of Hubble, see inside, page 6.

Source: NASA, ESA and the Hubble SM4 ERO Team

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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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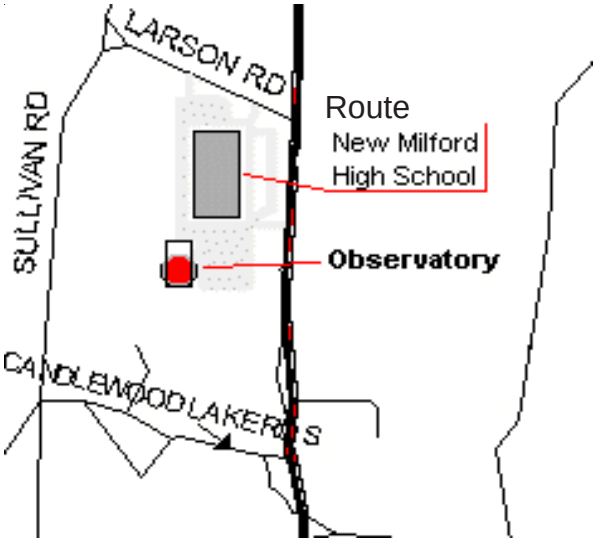
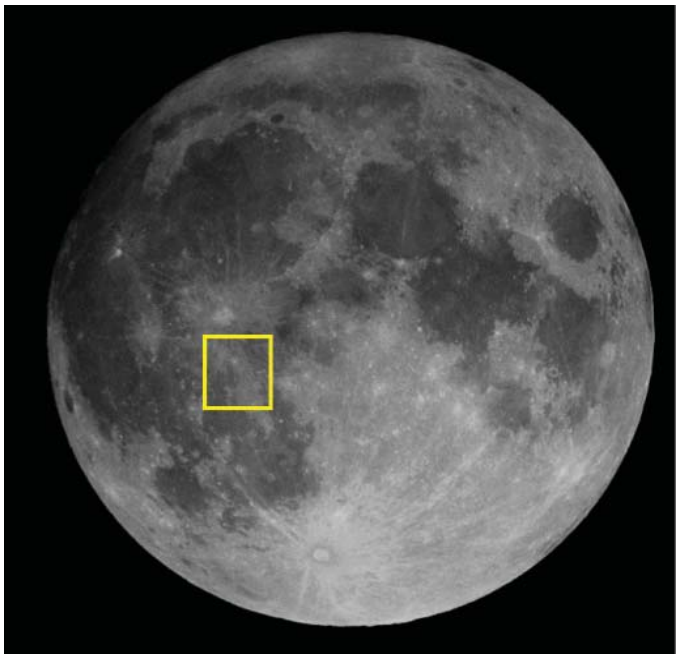


In This Issue

April Calendar and Space Exploration Almanac

"Out the Window on Your Left"

IT'S BEEN MORE THAN 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).

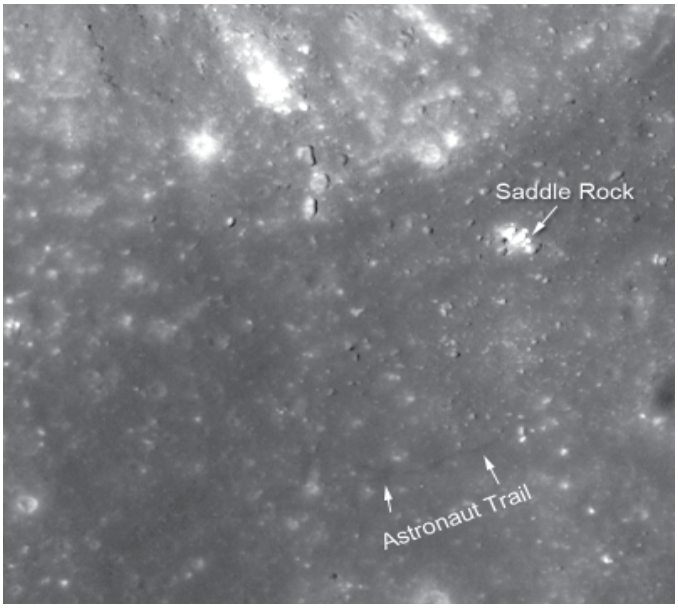


Lunar mare or "seas" are actually expansive low-lying plains formed by ancient lava flows

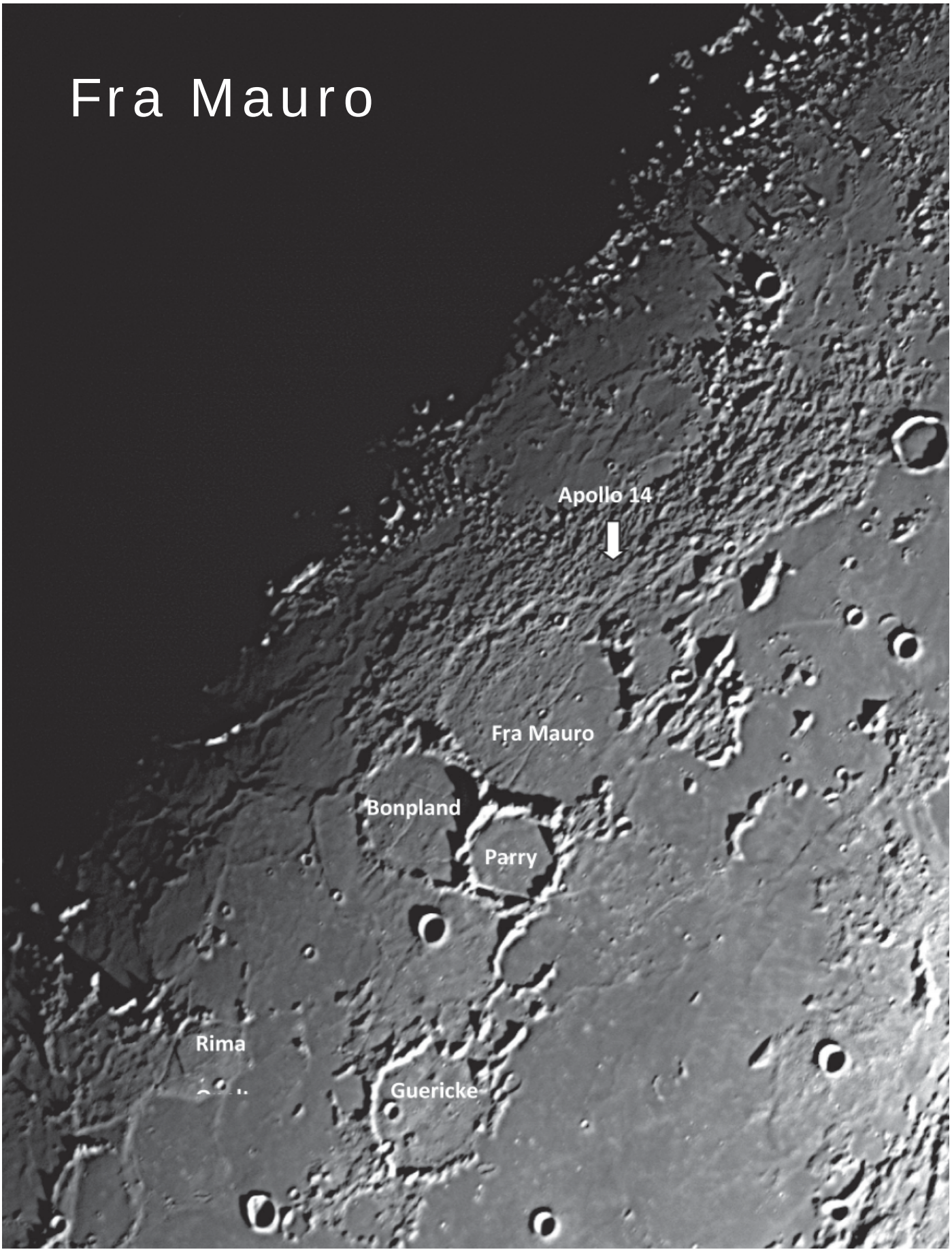
The Sun is rising on the Fra Mauro formation in this month's photo. The area, located 225 miles (360 km) south of Copernicus crater, was the intended landing site of Apollo 13. The Apollo 13 mission was cut short after only 56 hours when a cryogenic oxygen tank exploded, crippling the service module. After the safe recovery of the crew, NASA retargeted the Apollo 14 mission to Fra Mauro due to its scientific importance (Apollo 14 was to explore the Littrow region of Mare Serenitatis (Sea of Serenity) that was later visited by Apollo 17).

Fra Mauro was of particular interest to scientists in dating the impact that created the Imbrium basin (approximately 300 miles or 500 km to the north of the Fra Mauro formation). The largest impact basin on the near side, the area covered by Mare Imbrium (Sea of Showers) is approximately 700 miles (1,100 km) across. The underlying basin is believed to have been created by an impactor (for example, a large asteroid or small planetoid) 30 to 60 miles (50 to 100 km) across. The material ejected from the impact scoured the nearside, evidenced by ridges and furrows radial to the impact. Some of the debris may have come from a depth of 100 miles (161 km) or more beneath the lunar crust.

Early photographic surveys of the Fra Mauro formation indicated the presence of a potentially thick deposit of Imbrium debris that could aid in establishing the date of the impact and provide samples of much older material, predating the impact. However, since the original Imbrium impact, the Fra Mauro formation has been covered with a layer of regolith from smaller and more recent impacts. Without the means to excavate this overburden, NASA chose a landing site near a relatively young crater; Cone crater. Large blocks of material were visible around the 1,100 foot (340 m) diameter crater rim. Based upon the work done by Gene Shoemaker (with explosives and projectiles), the ejecta from impact craters can provide a vertical cross-section of the underlying material. Rock found on the crater's rim would be from the deepest depth (estimated at 110 feet or 34 m), well below the lower reaches of the overburden. This would be where the oldest rocks would be found. Material furthest from the rim would be from rock layers closest to the surface and, hence, much younger.



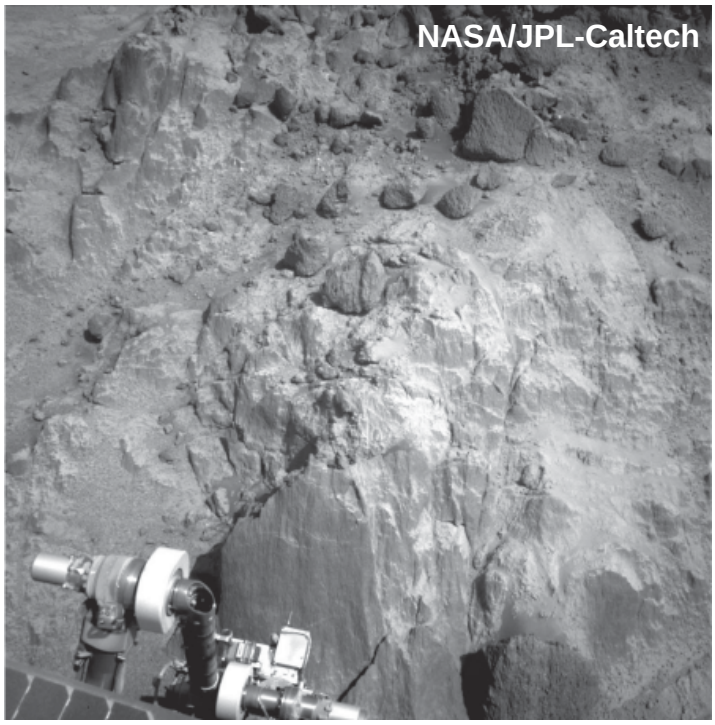
A low orbit image of the Cone crater taken by the Lunar Reconnaissance Orbiter (LROC) in 2011. In bulky suits and backpacks and dragging a cart, astronauts Al Shepard and Ed Mitchell set out for the crater to collect core samples. With no magnetic field to navigate by and few reference points, they turned around, exhausted, at Saddle Rock, only about thirty meters from the their destination. Source: NASA/GSFC/Arizona State University.


Fra Mauro
Apollo 14
Fra Mauro
Bonpland
Parry
Rima
Guericke

New Discoveries Even After Eleven Years of Exploration

The Mars Exploration Rover "Opportunity" has been working its way along the western rim of the Endeavour crater as it closes in on its winter destination: Marathon Valley. The valley is of particular interest to scientists since spectrometer observations from orbit indicate an abundance of clay minerals. Clays typically form in water with a neutral chemistry.

Just short of its destination, Opportunity came across large, gray blocks on the ridgeline. Analysis indicates that the rocks are high in aluminum and silicon, a composition not previously seen by Opportunity or its twin, Spirit, in previous sorties. After eleven years, Opportunity is still adding to our knowledge of Mars, past and present. Unfortunately, Congress may do what the harsh Martian environment has not; shut down the intrepid explorer. No money has been allocated for future operations in next year's budget.



Rocks on Endeavour's Ridgeline.

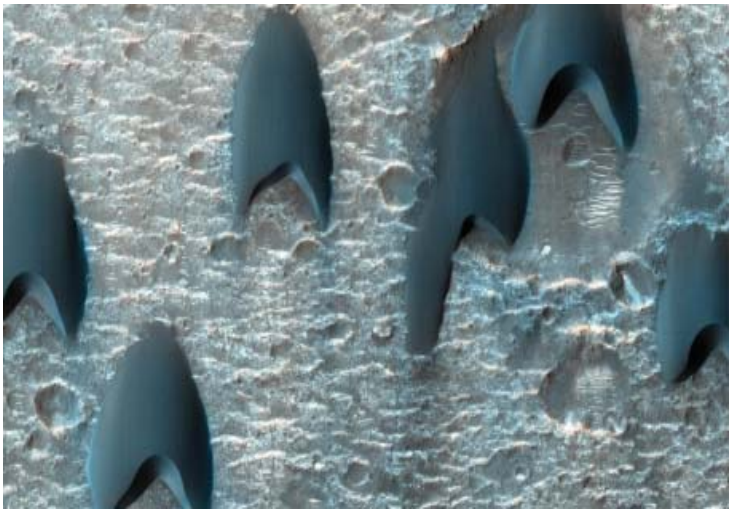
In Memory of Leonard Nimoy (1931 – 2015)

An image acquired by NASA's Mars Reconnaissance Orbiter's HiRISE camera shows wind-sculpted dunes in a large crater near Mawrth Vallis. The distinctive V-shape has been compared to the Star Fleet (Star Trek) insignia.

Mawrth Vallis was one of the landing sites considered for the Mars Science Laboratory (Curiosity). The valley is thought to have been created by an ancient water flow (based upon the presence of clay along its course). It meanders almost 400 miles (640 km) before draining into Acidalia Planitia, a large basin on the edge of Mars' northern lowlands.

Leonard Nimoy and William Shatner as Spock and Captain Kirk:

Farewell Mr. Spock.



Martian Dunes: NASA/JPL-Caltech/Univ. of Arizona

A Vulcan salute to Mister Spock by astronaut Terry W. Virts on the International Space Station while orbiting above Nimoy's home town of Boston.

Twenty-Five Years in Space

The Hubble Space Telescope is one of the four "Great Observatories" along with the Compton Gamma-Ray, Chandra X-Ray and Spitzer (infrared) telescopes. It is the only space telescope that can be serviced by astronauts. Over the past twenty-five years, five servicing missions have given the telescope a new lease on life, replacing and repairing many of the telescope's original components and extending its capabilities many times over. The Hubble Space Telescope in orbit today is a far superior instrument to the one originally launched.

The NASA photo (above) shows the telescope during its original deployment from the cargo bay of the space shuttle Discovery (STS-31) on April 29, 1990. This was followed by five servicing missions:

Servicing Mission 1 (December 1993) Space shuttle Endeavour (STS-61) delivered/ installed corrective optics, replaced/installed a new Wide-Field and Planetary Camera, solar arrays and gyroscopes

Servicing Mission 2 (February 1997) Replaced original spectrograph with the Near-Infrared Camera and Multi-Object Spectrometer (NICMOS), repaired insulation and upgraded instrumentation

Servicing Mission 3A (December 1999) Replaced/installed all six gyroscopes, a fine guidance system, main computer and thermal insulation blankets

Servicing Mission 3B (March 2002) Installed the Advanced Camera for Surveys, revived the dormant NICMOS and replaced the solar arrays

Servicing Mission 4 (May 2009) Replaced batteries, gyroscopes, a fine guidance system, installed a new Wide-Field and Planetary Camera, Cosmic Origins Spectrograph and repaired failed electronics in two instruments

When launched, it was thought that the telescope would be returned to Earth once it reached its end of life. Unfortunately, the telescope outlived the only vehicle (Space Shuttle) that could return the 12½ ton observatory to Earth. So, during the last service mission, a ring-shaped device was installed on the telescope's aft bulkhead. This device (a "soft capture mechanism") will be used in the future to allow a vehicle (to be determined) to dock with the telescope and guide it back to Earth (safely burning up in the atmosphere or falling over unpopulated areas).

The last servicing mission left the telescope in excellent health. Scientists expect the Hubble Space Telescope to operate to 2020 and beyond, barring a catastrophic system failure. If the James Webb Space Telescope launches in 2018, the two telescopes will be able to collaborate on certain observing targets, providing data over a larger range of the electromagnetic spectrum.

Astronauts John Grunsfeld (right) and Richard M. Linnehan on a spacewalk near the Hubble Space Telescope during Hubble Servicing Mission 3B.

A Different Kind of Galaxy

Edwin Hubble attempted to develop a classification of galaxies based upon the erroneous premise that galaxies would evolve from simple elliptical to complex spirals. His tuning fork diagram included a featureless elliptical as the origin. Today, astronomers believe that elliptical galaxies can form from the merger of spirals. Hubble's featureless elliptical prototype galaxy is now considered as a separate class of galaxies: Lenticular Galaxies.

The Hubble Space Telescope recently imaged the second brightest member of the Telescopium Group (a group of a dozen galaxies in the constellation Telescopium). The lenticular galaxy, NGC 6861, was discovered in 1826 by the Scottish astronomer James Dunlop. The prominent dust lanes, characteristic of a spiral galaxy, encircle the center of this armless galaxy. It is not known whether lenticulars are at the beginning or end of their evolutionary track, the result of multiple mergers or just ruined spirals.

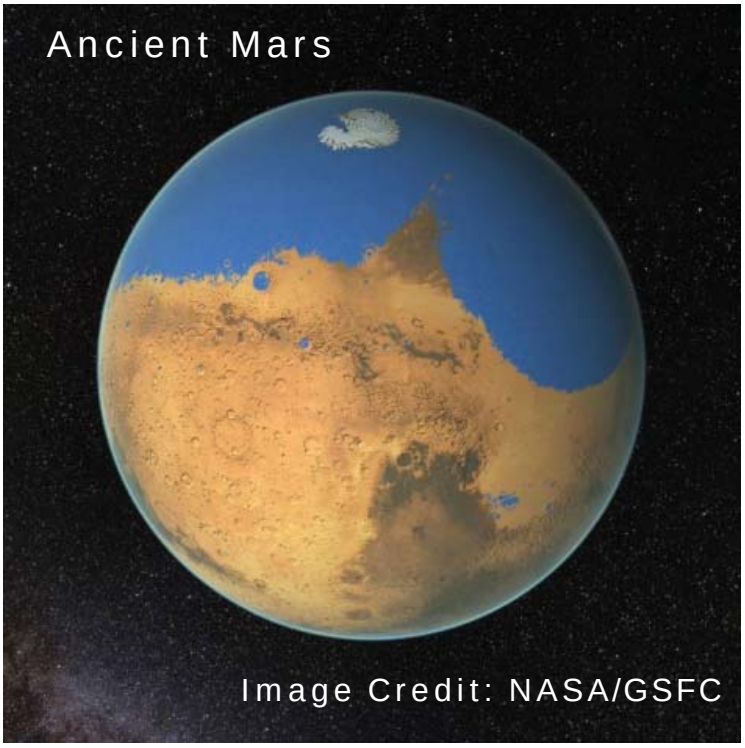
Image credit: ESA / Hubble / NASA / J. Barrington

A Wet Mars

The earliest geologic period on Mars is known as the Noachian. This period, similar to the Nectarian Period on the Moon, was dominated by cataclysmic impacts. It is also likely that the northern lowlands of Mars were created during this time. (The average elevation of the northern lowlands is more than a mile below the mean radius of the planet and the underlying crust is much thinner in the northern lowlands than in the southern highlands, suggesting an ancient impact basin.)

Unlike the Moon, Mars is believed to have been wetter and warmer during this early period with the possibility of regional rainfall and large areas covered by liquid water. Based upon Earth-based telescopic measurements of the amount of hydrogen and deuterium (an isotope of hydrogen with an added neutron) in the Martian atmosphere, compared with that found in ancient Martian meteorites, scientists have been able to measure the change in the atmosphere over time and estimate the volume of water lost.

The new research suggests that Mars lost 87% of its original water to space. If the water had collected in the northern lowlands, the resulting ocean would have covered almost half of the northern hemisphere. If the model is correct, liquid water was present on the surface of Mars for much longer than originally thought, proving an environment more welcoming for emergence of life.



Space Launch System News

NASA is building an advanced launch vehicle for deep space exploration. The Space Launch System, or SLS, is relying upon proven hardware from the space shuttle program and other successful launch vehicles, enhanced or upgraded for carrying larger payloads. The rocket's first stage will be powered by four reconfigured space shuttle engines. An upper stage from a United Launch Alliance Delta IV rocket will be used for initial testing (while design on a new, more powerful second stage is finalized). Augmenting the liquid-fueled first stage will be two, five-segment solid rockets built by Orbital ATK (similar to the boosters for the space shuttle which used a four segment design).

Rollout of the twelve foot diameter solid rocket booster for static firing. Image Credit: Orbital ATK

Orbital ATK fired its newly configured five-segment solid rocket in a static test on March 11th, using hardware recovered from 23 different space shuttle missions. The 177 foot long rocket fired for more than 2 minutes, sending a trail of flame across the Utah desert. The 5,000°F exhaust temperature turned the desert sand into glass. The test is one of two to qualify the new booster for an unmanned flight of SLS, along with the Orion spacecraft, in 2018.

The new solid rockets will provide 75% of the SLS's thrust during the first two minutes of flight. The initial SLS configuration (with the Delta upper stage) will be able to place 70 metric tons of payload into orbit. When equipped with the more powerful upper stage, the payload capacity will increase to 130 metric tons.

Static firing of the 5 segment solid rocket booster
Image Credit: Orbital ATK

Final Destination

In the early morning hours of March 6th, after a journey of 3.1 billion miles (4.9 billion km) and 7½ years, the Dawn spacecraft was captured by gravity of the dwarf planet Ceres. At the time, the spacecraft was approximately 38,000 (61,000 km) from the dwarf planet.

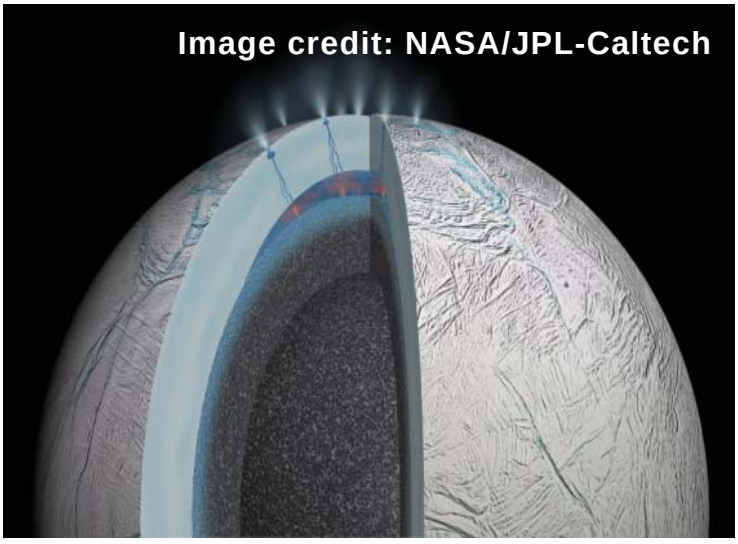
After spending more than a year exploring the asteroid Vesta, Dawn has spent the last 2½ years traveling out to the orbit of Ceres and preparing for its rendezvous. While a month away from entering its mapping orbit, Dawn has already imaged several bright spots on the surface that have raised the prospect finding active geological processes on the planet, for example, cryovolcanism.

Image Credit: NASA/JPL-Caltech/UCLA/MPS/DLR/IDA

Enceladus

Saturn's rings were first observed by Galileo Galilei in 1610, although it wasn't until 45 years later that Christiaan Huygens described the true nature of the rings as a disk surrounding the planet. The rings are comprised of billions of water ice particles, spanning a distance of 175,000 miles (282,000 km). There are seven named rings, named in the order of discovery with the letters A though G. The "D" ring is closest and the "E" ring, the furthest from the planet. The "A" and "B" rings are the brightest and easiest to see by Earth-bound observers. Saturn's "E" ring is the largest ring in the solar system. The diffuse ring extends from the orbit of Saturn's moon Mimas out to Titan.

Orbiting within the "E" ring is Saturn's moon Enceladus. The Cassini spacecraft's analysis of the "E" ring particles points to Enceladus as the likely source of ring material, either from micrometeoroid impacts or from the icy geysers at the moon's south pole. Now, microscopic grains of silica found in the "E" ring are suggesting hydrothermal activity on Enceladus.



Comparable sized silica grains are created in Earth's oceans when mineral laden, heated seawater rises from thermal vents on the ocean floor and pass through the colder water above. The minerals are initially extracted from Earth's rocky interior through an interaction of the hot seawater (at temperatures at least 194°F). Deep ocean hydrothermal vents, on Earth, support a multitude of species, for example, huge red-tipped tube worms, ghostly fish, and strange shrimp, that convert the chemicals from the vents into energy in a process called chemosynthesis.

Gravity measurements have suggested the presence of a vast ocean beneath Enceladus' icy crust. If the silica grains from the "E" ring have a similar origin (as on Earth), the hydrothermal vents could provide a food/energy source for deep ocean life on Enceladus.

Ganymede

Ganymede is the only moon in the solar system with a global magnetic field. The moon is also embedded with Jupiter's much stronger magnetic field. The aurora, seen dancing above the moon's poles, is affected by the interaction of the two magnetic fields, as well as the interior composition of the moon.

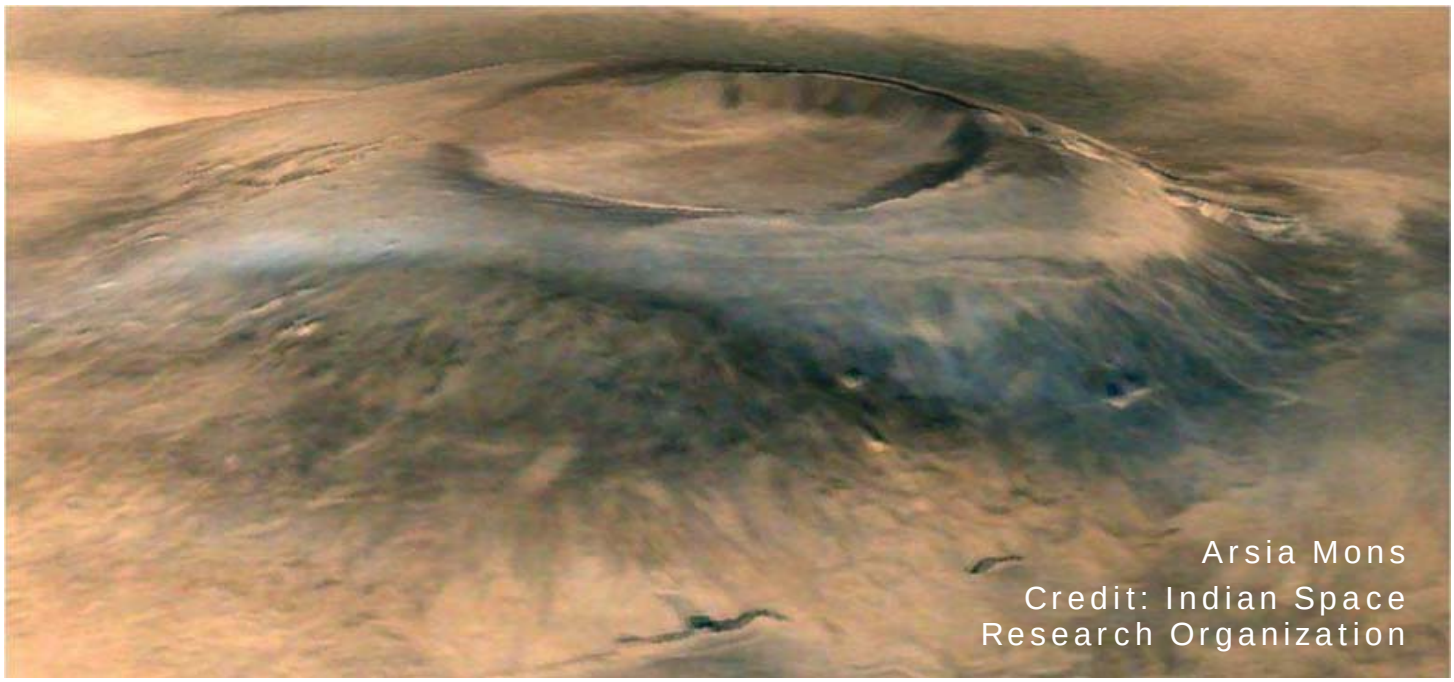
Observations of the aurora by the Hubble Space Telescope, and the shift with the rotation of the moon, suggest the presence of a large, saline ocean under Ganymede's icy crust.

Ganymede's ocean is thought to be 10 times deeper than Earth's oceans and contain more water than all of Earth's oceans. Unfortunately, Ganymede's oceans may be buried under almost 100 miles of ice, keeping their secrets safely locked away.

Ganymede: the largest moon in the solar system. Image Credit: NASA/ESA

MOM

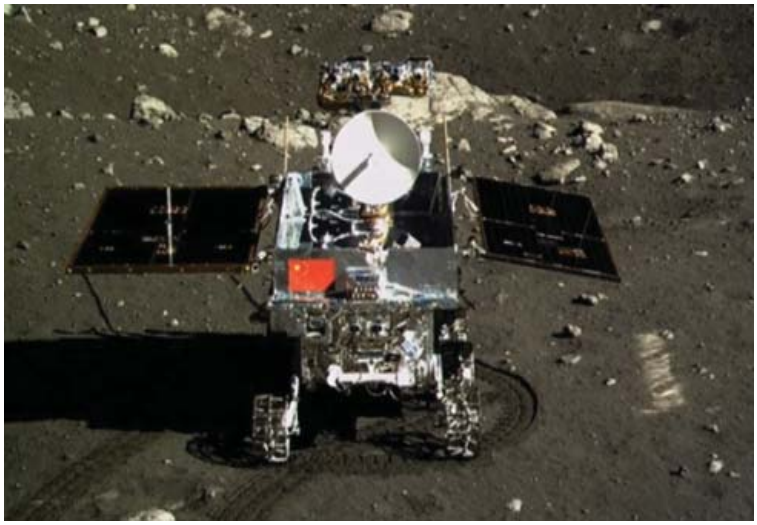
Since entering orbit in September 2014, Indian Space Research Organization's Mars Orbiter Mission (MOM) spacecraft has been scanning the Red Planet with its suite of instruments, gathering data on the rarified atmosphere, looking for methane, and mapping the planet from its highly elliptical orbit. The image of Arsia Mons is a rendering created from visual data taken by MOM's color camera combined with data from NASA's Mars Orbiter's altimeter.



Arsia Mons
Credit: Indian Space Research Organization

Yutu

The Chinese rover Yutu traveled 373 feet (114 meters) across the Moon's lava plains after its landing in December 2013. On board the rover were three instruments that included ground penetrating radar. The radar was able to distinguish several individual lava layers that suggest a complex history of multiple volcanic eruptions and flooding in Mare Imbrium.

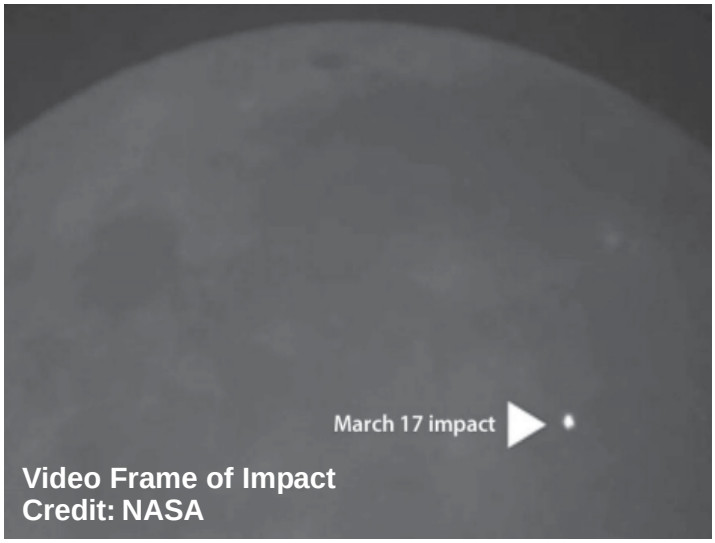


China's Yutu Lunar Rover (Credit: CNSA / CCTV Chinese National Space Administration/China Central Television)

Lunar Impacts

NASA's Meteoroid Environment t Office and the Marshall Space Flight Center's Space Environments Team have joined up to monitor the dark side of the Moon. Observations of the unlit portion of the waxing and waning crescents are analyzed for potential meteoroid strikes.

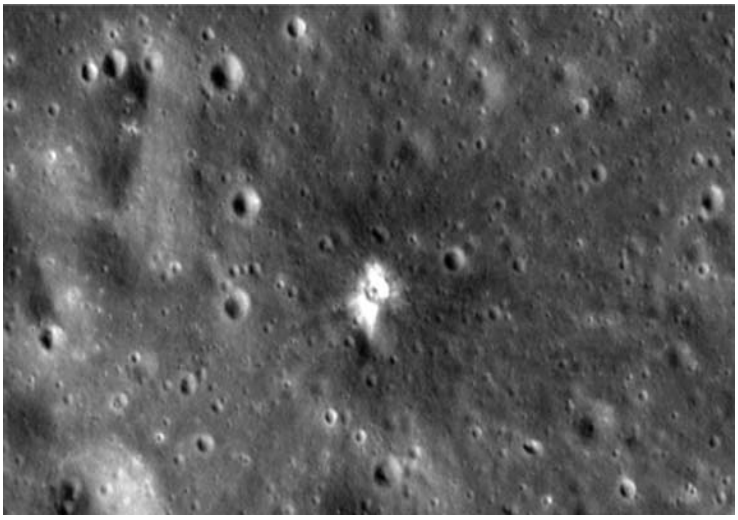
A small fraction of the heat generated from an impact is displayed as a flash of light at the impact site.



Video Frame of Impact
Credit: NASA

The impact flashes are recorded by ground-based telescopes using video recorders. The video is then analyzed to identify potential impact candidates (as opposed to cosmic rays, reflections off of satellites and space debris, meteors in Earth's atmosphere, or other noise that could also create a brief flash).

Two years ago on March 17th, a bright flash (brightest to date) was detected in the unlit portion of a crescent Moon. The impactor was estimated to be the size of a small boulder. Searches of images from the Lunar Reconnaissance Orbiter, before and after that date eventually located the new crater in Mare Imbrium. The crater measures 61.7 feet (18.8 meters) across. However, the debris excavated by the impact disturbed the lunar regolith up to 19 miles (30 km) away.



New Crater in Mare Imbrium (Credit: NASA/Goddard Space Flight Center/Arizona State Universitysion)

April History

Apollo 16 wasn't the only lunar mission launched in the month of April. Two years earlier, on April 11, 1970, Apollo 13 lifted off from Cape Canaveral in what was intended to be the third manned mission to the Moon. The crew of James Lovell, Fred Haise and Jack Swigert never got their chance.

Two days later and almost 200,000 miles from Earth, the No. 2 oxygen tank exploded, cracking the feed pipe to the No. 1 oxygen tank and crippling the fuel cells providing the electrical power to the Command Module. The next four days would become the greatest human drama in space history.

With failing power and a cloud of debris surrounding the space craft, the three astronauts shut down the Command Module and moved into the Lunar Module (LM). The LM was designed to support two astronauts for a maximum of 45 hours. The LM needed to support the three astronauts for 75 to 100 hours for a safe return to

Earth. To conserve supplies, almost all the spacecraft's systems were turned off. The temperature dropped to just above freezing, water condensed on all the internal surfaces and instruments and the level of carbon monoxide increased to life-threatening levels. Fluids and gases being expelled from the crippled Command Module acted like small rockets, continually pushing the spacecraft off course. The debris cloud prevented anything more than rudimentary navigation. The astronauts became dehydrated (fuel cells also provide water) and the conditions inside the spacecraft became increasingly unsanitary when the crew, through a misunderstanding, began to accumulate human waste inside the spacecraft (instead of discharging it).

Only through the ingenuity of the engineers back in mission control, the backup crew and hundreds of contractors involved in the assembly and operation of the spacecraft was the crew returned safely to Earth. The crew and the spacecraft reentered the Earth's atmosphere not knowing whether the heat shield had been damaged in the explosion or whether the parachutes would still deploy Apollo 13 splashed down right on target.

The cause of the accident was eventually traced to damage the oxygen tank had sustained during its removal from Apollo 10. Due to a defective drain, internal heaters were used to empty the tank. Unfortunately, the pad power supply was not compatible with the spacecraft's power systems. The higher voltage melted the insulation leaving bare metal exposed to the pure oxygen environment. When Jack Swigert turned on the tank fan, the contents exploded. The story of Apollo 13 is detailed in astronaut Jim Lovell's book "Lost Moon," former Flight Director Gene Kranz's book "Failure is Not an Option," and recreated in the Ron Howard/Tom Hanks film "Apollo 13."

April Showers

The Lyrid meteor shower is expected to peak just before dawn on April 22nd. The dust producing the shooting stars is from *Comet Thatcher*. Expect to see 10 to 20 meteors per hour if light from the crescent moon doesn't interfere. As with all meteor showers, the Lyrids are named for the constellation (Lyra) from which they appear to radiate.

Comet History

In the photo (right) *Comet Hale-Bopp* graces the evening sky on April 2, 1997, one day after perihelion (closest approach to the Sun). The comet was brighter than the brightest stars in the sky, with a dust tail that stretched almost 45 degrees across the sky. The photo shows the brighter, yellow dust tail and the dimmer, blue ion (gas) tail.

The orbital period of *Hale-Bopp* as it entered the inner solar system was 4,206 years. A close encounter with Jupiter in April of 1996 modified its orbit, shortening its orbital period to 2,380 years as it returned to the outer solar system.

Easter and the Full Moon

Although the Christian celebration of Easter is always on a Sunday, the date can vary by more than a month. Unlike many religious observances which are associated with a particular calendar date, Christian churches use a method developed by Pope Gregory XIII to establish the annual date of Easter. As a general rule, Easter falls on the first Sunday that follows the first Full Moon that occurs on or after the vernal equinox. It is important to note that the church has its own method of determining when the moon is full and the church has also fixed the date of the vernal equinox as March 21st. Consequently, the church's date of Easter may be different than if determined using more precise astronomical data.

This year (2015), the vernal equinox occurred on the evening of March 20th. The next Full Moon is on April 4th. Easter, therefore, falls on the following Sunday (5th). According to the Church's ecclesiastical rules for determining the date, Easter can occur no earlier than March 22nd or later than April 25th.

Sunrise and Sunset

Date	Sunrise	Sunset
April 1st (EDT)	06:37 am	7:19 pm
April 15th	06:14 am	7:34 pm
April 30th	05:52 am	7:50 pm

Astronomical and Historical Events

1st Moon at apogee (furthest distance from Earth)
1st History: launch of the first weather satellite, Tiros 1 (1960)
2nd History: launch of Zond 1, Soviet Venus flyby mission (1964)
2nd History: selection of the Mercury 7 astronauts (1959)
2nd History: French physicists Louis Fizeau and Leon Foucault take first photo of the Sun (1845)
3rd History: U.S. release of the movie "2001 A Space Odyssey" (1968)
3rd History: Soviet spacecraft Luna 10 becomes the first artificial satellite to orbit the Moon (1966)
4th Full Moon (Full Pink Moon)
4th Total Lunar Eclipse (visible in western portions of U.S. shortly before sunrise, totality lasts less than 5 minutes)
4th History: launch of Apollo 6, last test flight of the Saturn V rocket (1968)
5th Easter Sunday
5th History: launch of the Compton Gamma Ray Observatory (1991)
5th History: launch of the first Pegasus rocket (1990)
5th History: launch of Pioneer 11, Jupiter and Saturn flyby mission (1973)
6th History: launch of Intelsat 1, first commercial communications satellite (1965)
7th History: launch of Luna 14, Soviet Moon orbiter mission designed to test radio transmission stability, measure the lunar gravity field, solar wind and cosmic rays (1968)
8th History: discovery of Saturn moon's *Telesto* by the Voyager 1 spacecraft (1980)
8th History: launch of the unmanned Gemini 1 (1964)
8th History: Project Ozma, the search for extraterrestrial intelligence, begins as Frank D. Drake, an astronomer at the National Radio Astronomy Observatory in Green Bank, West Virginia, turns the 85-foot Howard Tatel telescope toward the star Tau Ceti (1960)
10th Scheduled launch of a Dragon cargo-carrying spacecraft aboard a SpaceX Falcon 9 rocket from the Cape Canaveral Air Force Station, Florida, to the International Space Station. The flight is being conducted under the Commercial Resupply Services contract with NASA
10th History: Japanese lunar probe Hiten impacts Moon; first non-U.S./ Soviet lunar probe, also first to visit the Lagrangian Points L4 and L5 during its three year mission (1993)
11th **Second Saturday Stars - Open House at McCarthy Observatory**
11th Last Quarter Moon
11th Distant flyby of Saturn's moon Titan, Tethys and Dione by the Cassini spacecraft
11th Kuiper Belt Object and Dwarf Planet 136108 *Haumea* at Opposition (49.831 AU)
11th History: ESA spacecraft Venus Express enters orbit around the planet Venus (2006)
11th History: launch of Apollo 13 with astronauts James Lovell, Fred Haise and Jack Swigert; mission aborted when oxygen tank explodes and cripples the Command Module (1970)
12th History: launch of the first space shuttle (Columbia) with astronauts John Young and Robert Crippen (1981)
12th History: launch of Vostok 1 with cosmonaut Yuri Gagarin, first person to orbit the Earth (1961)
12th History: Edward Maunder born; studied solar cycle and sunspots. Analyzed period between 1645 and 1715 when almost no sunspots where recorded - known as the "Maunder minimum" or "Little Ice Age" because of the severe winters (1851)
12th History: discovery of Asteroid 10 *Hygiea* by Annibale de Gasparis (1849)
13th History: launch of Transit 1B, first experimental navigation satellite (1960)
14th History: Christiaan Huygens born, Dutch scientist and discoverer of Saturn's rings and largest moon *Titan* (1629)
16th Moon at perigee (closest distance from Earth)
16th History: launch of Apollo 16 with astronauts John Young, Ken Mattingly and Charles Duke, the only mission to the lunar highlands (1972)
16th History: Leonardo Da Vinci born, first to correctly explain Earthshine (1452)
17th History: closest flyby of the Sun by a spacecraft, Helios 2 (1976)
17th History: launch of Surveyor 3, Moon lander, first to experience a lunar eclipse from the Moon's surface during which the temperature fell 250° F; Apollo 12 would later land near Surveyor 3 in 1969, retrieving pieces of the lander for return to Earth and analysis of the effects of the harsh lunar environment (1967)

Astronomical and Historical Events (continued)

18th New Moon
18th Northeast Astronomy Forum and Telescope Show (NEAF), Rockland Community College, Suffern, NY (18th and 19th)
19th History: launch of the last Soviet Salyut space station, Salyut 7 (1982)
19th History: launch of the first space station, Soviet Salyut space station, Salyut 1 (1971)
22nd Lyrids Meteor Shower peak
22nd History: launch of the Air Force's X-37B prototype space plane from Cape Canaveral, Florida; first orbital mission (2010)
24th History: launch of space shuttle Discovery (STS-31) and deployment of the Hubble Space Telescope (1990)
24th History: launch of Mao 1, first Chinese satellite (1970)
24th History: cosmonaut Vladimir Komarov dies during re-entry of a prototype Soviet lunar spacecraft (Soyuz 1) when parachute lines become entangled (1967)
25th First Quarter Moon
26th Trans-Neptunian Object 2010 EK139 at Opposition (36.477 AU)
26th History: flyby of Venus (gravitational assist) by the Cassini spacecraft (1998)
26th History: launch of Sputnik 14 (Cosmos 4), first successful Soviet reconnaissance satellite – designed to study upper layers of atmosphere and monitor U.S. nuclear tests (1962)
26th History: discovery of Asteroid 9 *Metis* by Andrew Graham (1848)
28th Moon at apogee (furthest distance from Earth)
28th Scheduled launch of a Russian cargo carrying Progress spacecraft from the Baikonur Cosmodrome, Kazakhstan to the International Space Station.
28th History: launch of the Cloudsat/Calipso cloud imaging and profiling satellites (2006)
29th Kuiper Belt Object 2014 FC69 at Opposition (82.996 AU)

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 calendars: Allan Ostergren

Page 3 Photo: A souvenir "flying disk" from the celebration marking the completion of the Hubble Space Telescope's main telescope mirror. The mirror was polished at Perkin Elmer's Danbury, Connecticut facility between 1979 and 1981. Photo by Bill Cloutier

Second Saturday Stars poster: Sean Ross, Ross Designs

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

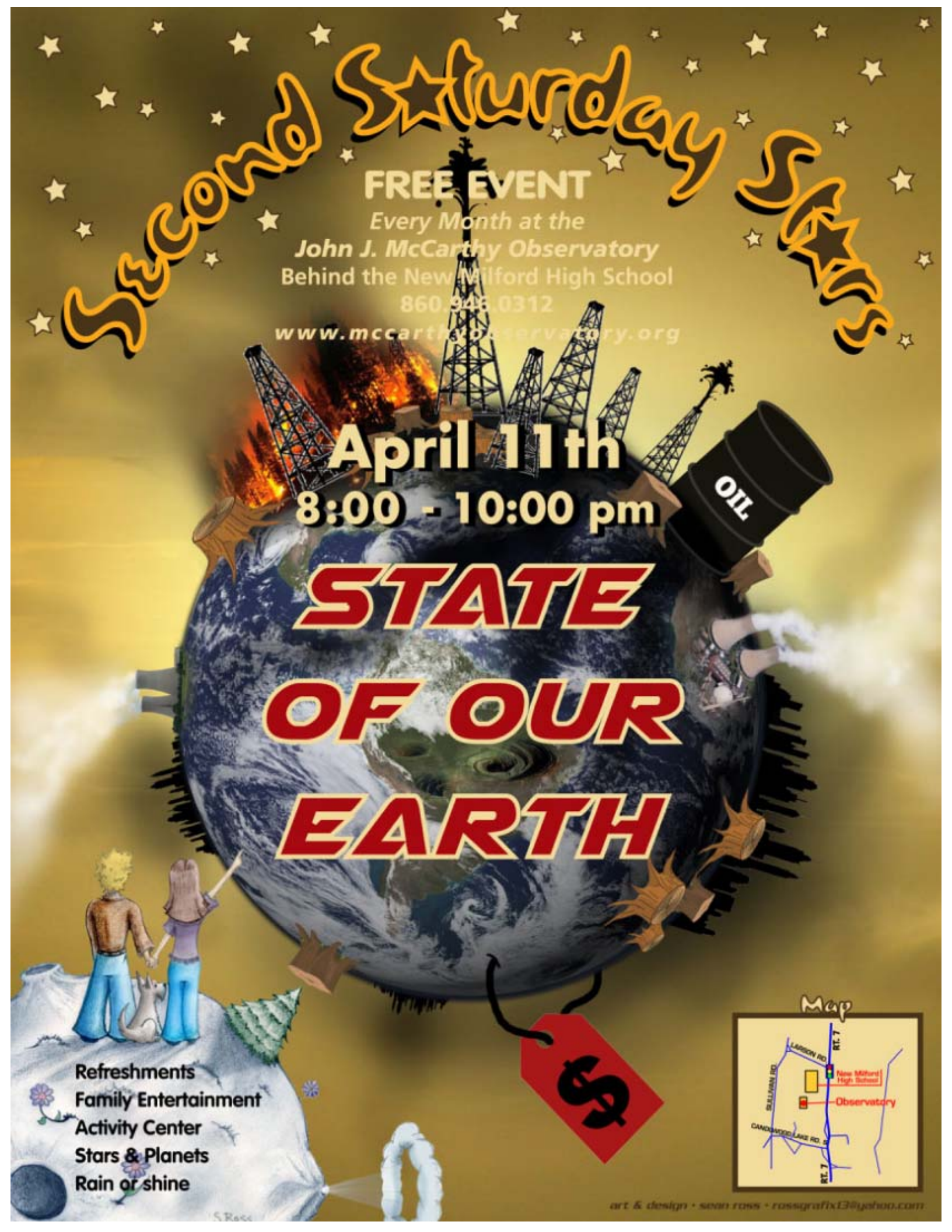
860.946.0312

www.mccarthyobservatory.org

April 11th

8:00 - 10:00 pm

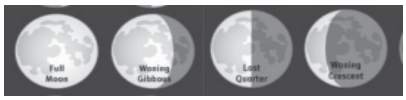
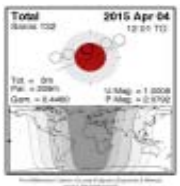
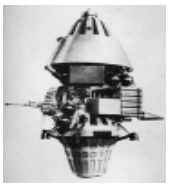
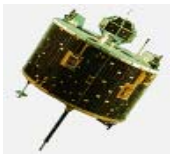
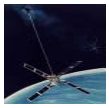
STATE OF OUR EARTH



- Refreshments
- Family Entertainment
- Activity Center
- Stars & Planets
- Rain or shine

April 2015

Celestial Calendar

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
Phases of the Moon  Apr 4 Apr 11  Apr 18 Apr 25			**1**  1960: First successful weather observation satellite, TIROS I (Television Infra-Red Observation Satellite), launched by NASA; operated for 78 days. (1960)	**2**  Launch of Zond 1, Soviet Venus flyby mission (1964)  Selection of the Mercury 7 astronauts (1959)	**3**  Soviet spacecraft Luna 10 first artificial satellite to orbit moon (1966)	**4** Launch of Apollo 6, last test flight of the Saturn V rocket (1968)   Total Lunar Eclipse, seen in U.S. West, before sunrise - less than 5 minutes
5  Launch of Pioneer 11, Jupiter and Saturn flyby mission (1973) Launch of Compton Gamma Ray Observatory (1991)   launch of the first Pegasus rocket (1990)	**6**  Launch of Intelsat 1, first commercial communica-tions satellite (1965)	**7**  Launch of Luna 14, Soviet Moon orbiter mission (1968)	**8** Launch of unmanned Gemini I (1964)   Project OZMA, search for extraterrestrial life (1960) Discovery of Saturn's moon Telesto by Voyager 1 (1980) 	**9**  NASA introduces Project Mercury astronauts: Scott Carpenter, L. Gordon Cooper Jr., John H. Glenn Jr., Virgil "Gus" Grissom, Walter Schirra Jr., Alan Shepard Jr., and Donald Slayton (1959)	**10**  Japanese lunar probe Hiten impacts Moon's surface (1993)	**11** ESA spacecraft Venus Express enters orbit around Venus (2006)   Apollo 13 launch on ill-fated moon mission (1970) 2nd Saturday Stars Open House McCarthy Observatory 
12  Edward Maunder born. studied solar cycle and sunspots. (1851) Shuttle, Columbia, with John Young and Robert Crippen (1981)   Yuri Gagarin first man in space on Vostok I (1961)	**13**  Launch of Transit 1B, first experimental navigation satellite (1960)	**14**  Christiaan Huygens, discoverer of Saturn's rings and moon Titan born (1629)	**15**  Leonhardt Euler, Swiss mathematician, precisely calculated the orbits of comets and other celestial bodies and contributed to the wave theory of light (1707)	**16** Moon at perigee (closest distance to Earth)   Apollo 16 launch to lunar highlands (1972) Leonardo da Vinci born (1452) 	**17**  Closest flyby of the Sun by a spacecraft, Helios 2 (1976) Launch of Surveyor 3 Moon lander (1967) 	**18**  Albert Einstein dies in Princeton, NJ (1955) 
19  Launch of Salyut 1 (1971) and Salyut 7 (1982), first and last Soviet space stations	**20**  Harold Graham performs 1.2-meter, 13- second free flight of a rocket pack, designed at Bell Aerosystems. (1961)	**21**  Apollo 16 on the Moon (Young, Mattingly and Duke) - fifth manned mission and first to land in the lunar highlands (1972)	**22**  Lyrids meteor shower peak launch of the Air Force's X-37B prototype space plane from Cape Canaveral, Florida; first orbital mission (2010) 	**23**  Ranger 4 Lunar probe launched - failed its mission, but became first U.S. craft to impact the Moon (1962)	**24** Launch of shuttle Discovery with Hubble space telescope (1990) Cosmonaut Valery Komarov dies on re-entry on lunar spacecraft Soyuz 1 (1967) Launch of 1st Chinese Mao 1 (*aka "the East is Red"*) satellite, (1970)	**25** The 20th Annual Great Moonbuggy Race, Huntsville, AL, at the U.S. Space & Rocket Center (April 25-27) Nikolai Semenovich Kardashev born, astrophysicist and deputy director of the Russian Space Research Institute, pioneered search for extraterrestrials (1932)
26 Cassini spacecraft gets gravitational assist from Venus on way to Saturn 1998	**27** Karl Jansky, a Bell Labs physicist and radio engineer, announces discovery of radio transmissions from Milky Way (1932)	**28** Moon at apogee (farthest from earth) Launch of the Air Force's X-37B prototype space plane from Cape Canaveral, first orbital mission (2010) Isaac Newton publishes *Principia*, describing gravitation and 3 laws of motion (1686)	**29** Cornelis de Jager, Dutch astronomer born; worked on predicting solar variation, to assess the Sun's impact on future climate (1921)	**30** Plinius' Eclipse, described by Pliny the Elder, Roman naturalist in Campagnia, Italy : "Then the sun was suddenly darkened and the fourteen districts of the city were struck by lightning" (59 AD)	