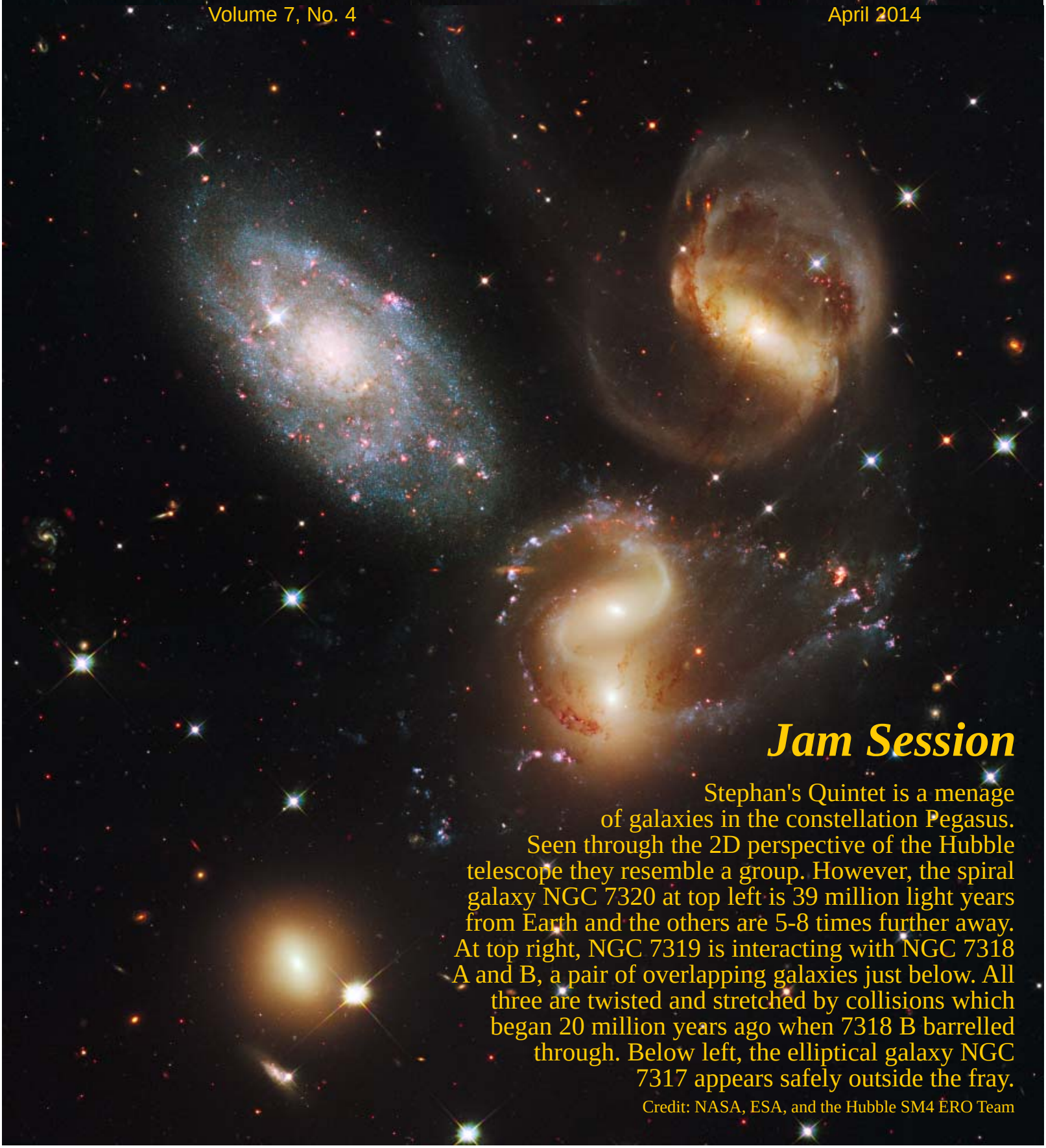
Galactic Observer

John J. McCarthy Observatory

Volume 7, No. 4 April 2014



Jam Session

Stephan's Quintet is a menage of galaxies in the constellation Pegasus. Seen through the 2D perspective of the Hubble telescope they resemble a group. However, the spiral galaxy NGC 7320 at top left is 39 million light years from Earth and the others are 5-8 times further away. At top right, NGC 7319 is interacting with NGC 7318 A and B, a pair of overlapping galaxies just below. All three are twisted and stretched by collisions which began 20 million years ago when 7318 B barrelled through. Below left, the elliptical galaxy NGC 7317 appears safely outside the fray.

Credit: 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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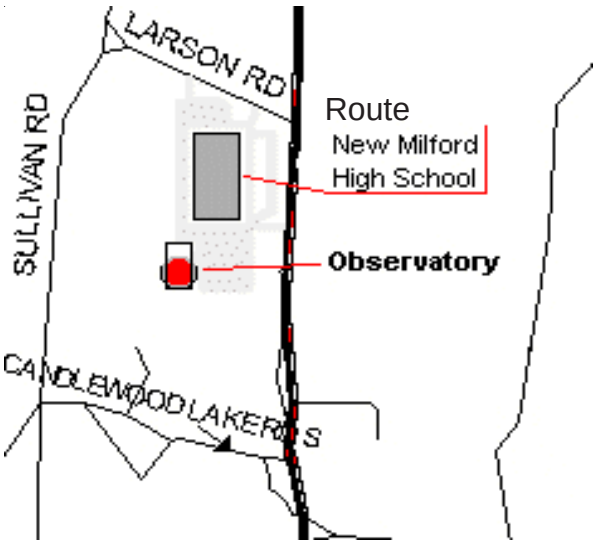
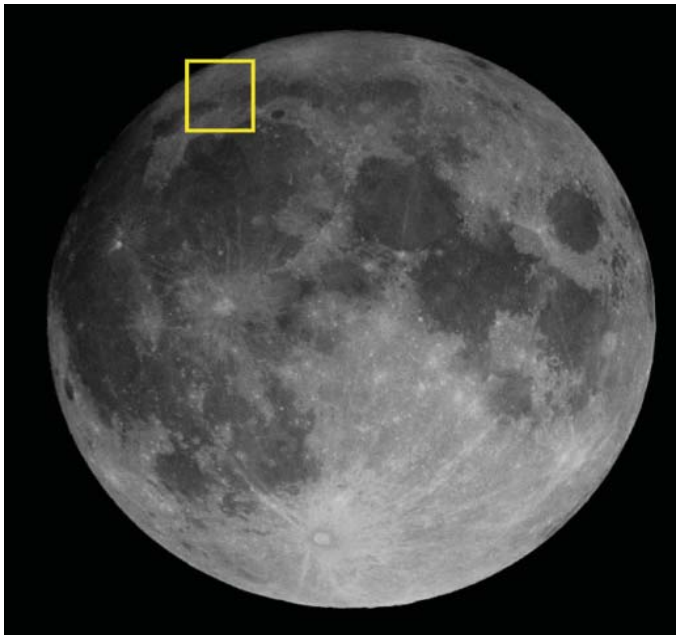


In This Issue

April AstronomyCalendar 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).

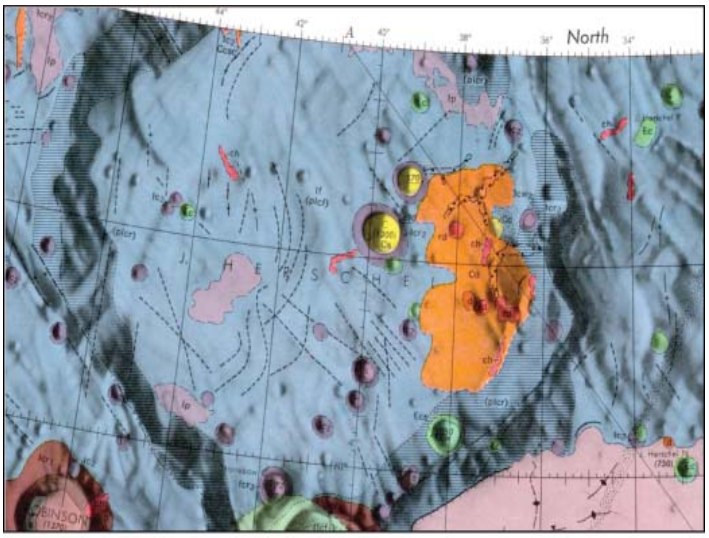


Lunar "seas" are actually expansive low-lying plains formed by ancient lava flows

The northern polar regions come into view this month and the irregular Mare Frigoris (the "Sea of Cold"). The sea of ancient lava covers 125,000 square miles (320,000 km^2), extends 1,000 miles (1,600 km) from east to west, but only 120 miles (200 km) across. The mare is located just north of Mare Imbrium, in a depression concentric to the larger impact basin to the south.

J. Herschel is the most prominent crater in the photo with a diameter of 100 miles (165 km). The floor of the crater has been covered by debris ejected by the impact that created the Imbrium basin. Under optimum lighting conditions, furrows give the ejecta the appearance of being raked by flying projectiles.

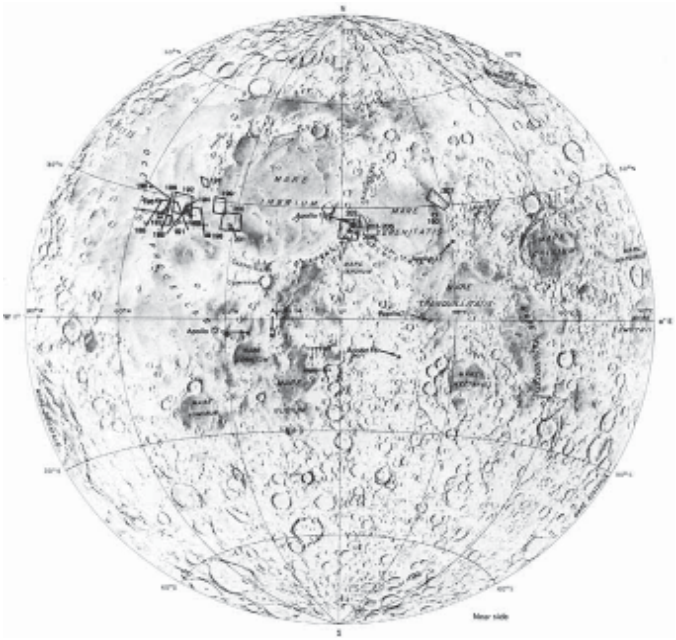
A patch of pyroclastic material can be seen on the east side of the crater, most likely from nearby volcanic vents. A short, sinuous rille (channel) cuts through the ejecta covering the crater floor, indicating that volcanism occurred after the ejecta producing event.



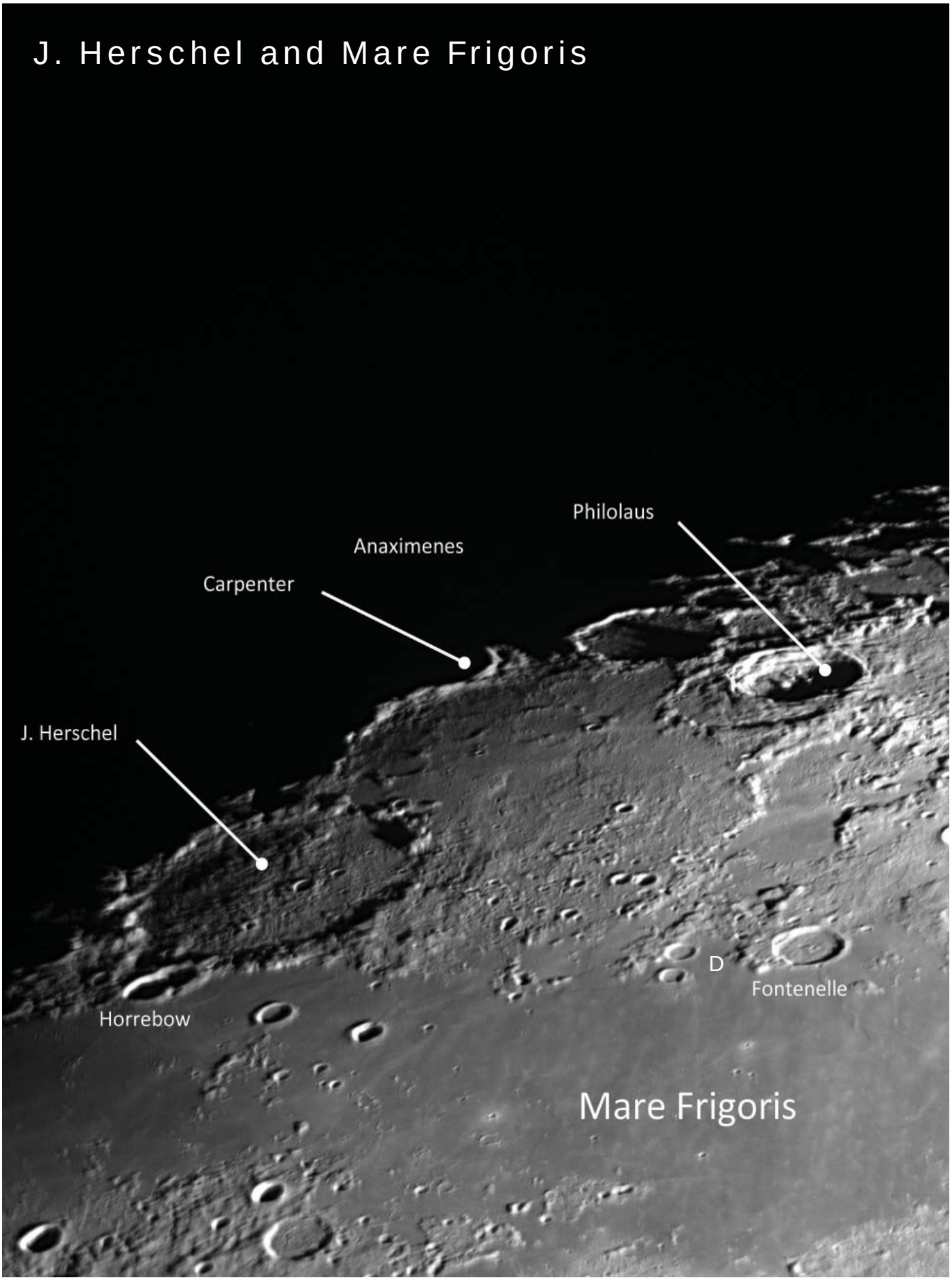
Pyroclastic Material (orange) in Crater Herschel
Credit: Geologic Map of the J. Herschel Quadrangle of the Moon by G.E. Ulrich, 1969

Philolaus is a bright crater approximately 46 miles (74 km) in diameter. The crater's walls rise 12,000 feet (3,660 m) above the floor. A curious feature, a segment of a circular ridge, can be seen just west of the crater.

Fontenelle D, located just to the west of the crater Fontenelle, is classified as a concentric crater, one of several small craters containing an inner ring, of unknown origin.



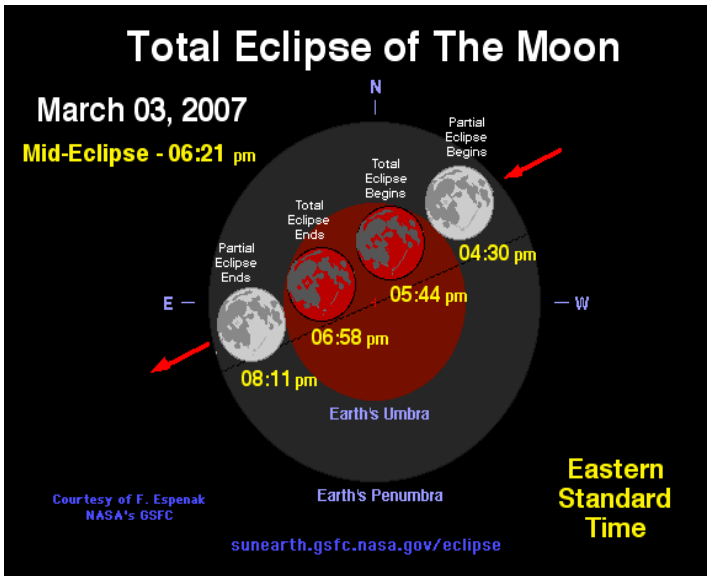
Sinuous rilles, or rimae are widely scattered on the lunar surface. Possibly formed from lava channels or collapsed lava tubes, many have been weathered and reshaped by subsequent lava formed from faults and debris erosion from the channel walls.
Source NASA; image courtesy of National Geographic

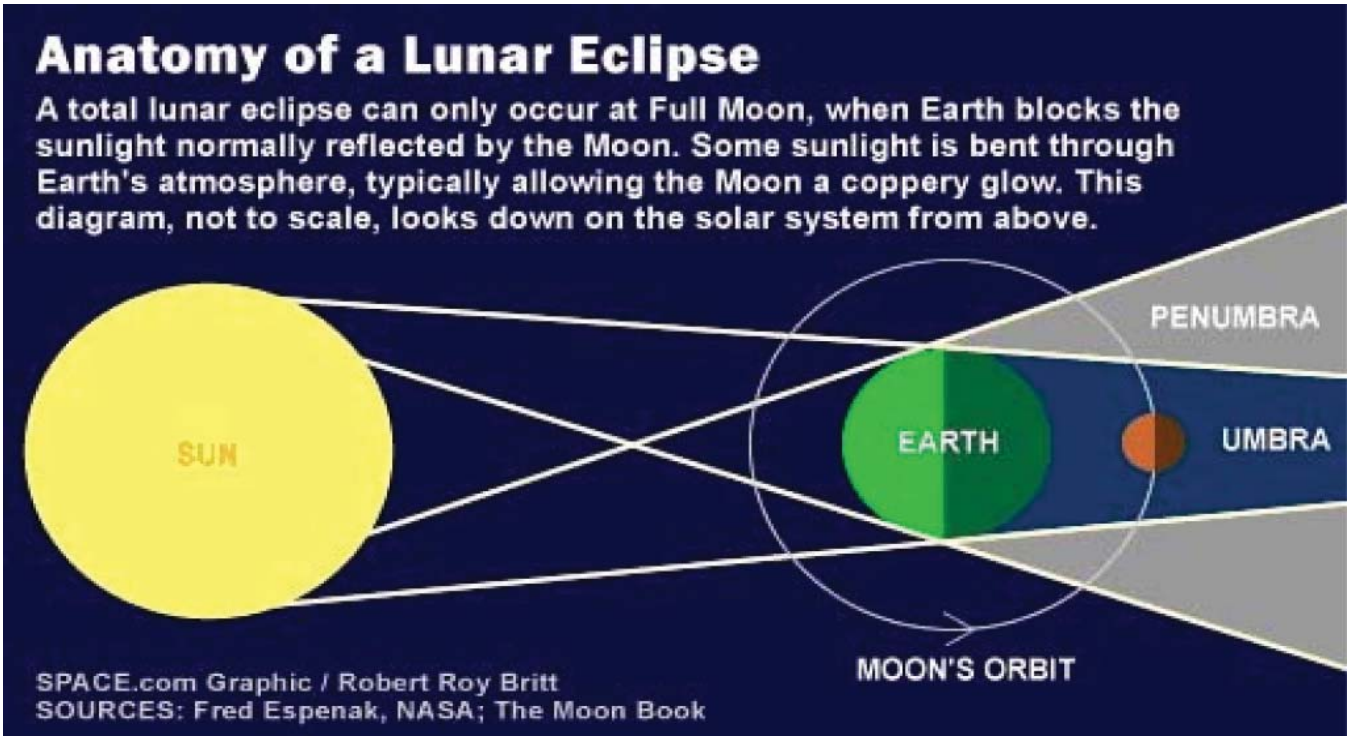

J. Herschel and Mare Frigoris
Philolaus
Anaximenes
Carpenter
J. Herschel
D
Fontenelle
Horrebow
Mare Frigoris

Lunar Eclipse

In the early morning of April 15th, the Full Moon will slip into the Earth's shadow. Once in the shadow, the Earth will block all direct sunlight from illuminating the lunar surface. This arrangement, with the Earth in line between the Sun and the Moon, produces a lunar eclipse.

The image below left was taken at the McCarthy Observatory on October 27, 2004. It shows the moon nearing the completion of its travel through the darkest part of the Earth's shadow (or umbra). The crimson glow is from sunlight scattered by the Earth's atmosphere that has filtered out most of the blue colored light. The northern limb of the moon is brighter as it is closest to the edge of the umbra. Below right is animage of a total eclipse in March, 2007 (one of two that year).On April 15th, the moon will travel through the southern half of umbra so that, unlike the photo, the northern limb of the moon will be the darkest. The entire eclipse will be visible (weather permitting) for observers in North America, with totality starting at 3:07 am EST and lasting approximately 78 minutes.





Total eclipse begins (moon completely within the umbra)	3:06:46 am EDT
Total eclipse ends (moon begins to exit umbra)	4:24:34 am EDT

Mars at Opposition

Once every 26 months, the orbits of the Earth and Mars bring the two planets to their closest approach. At that time, as viewed from above the solar system, Mars, Earth and the Sun align to form a straight line, with the Earth in between. From Earth, Mars will be opposite the Sun in the sky, rising when the Sun sets and setting when the Sun rises. This celestial alignment occurs on April 8th – the date when Mars is at "Opposition."

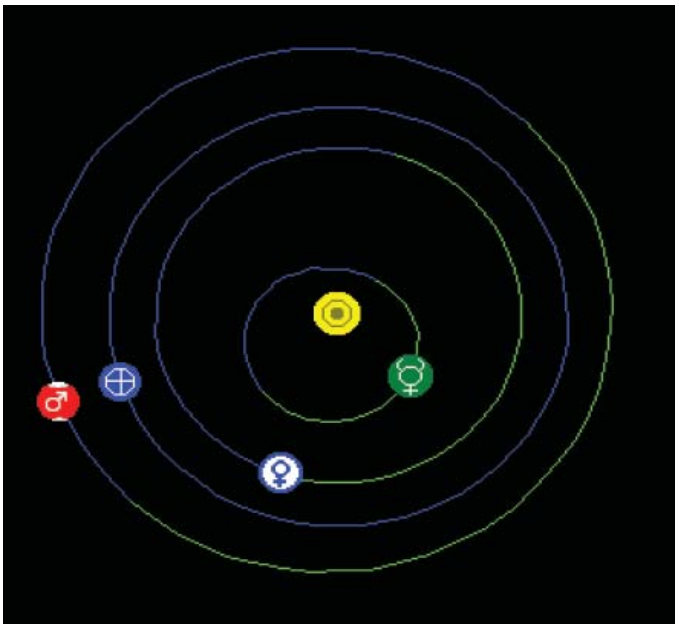


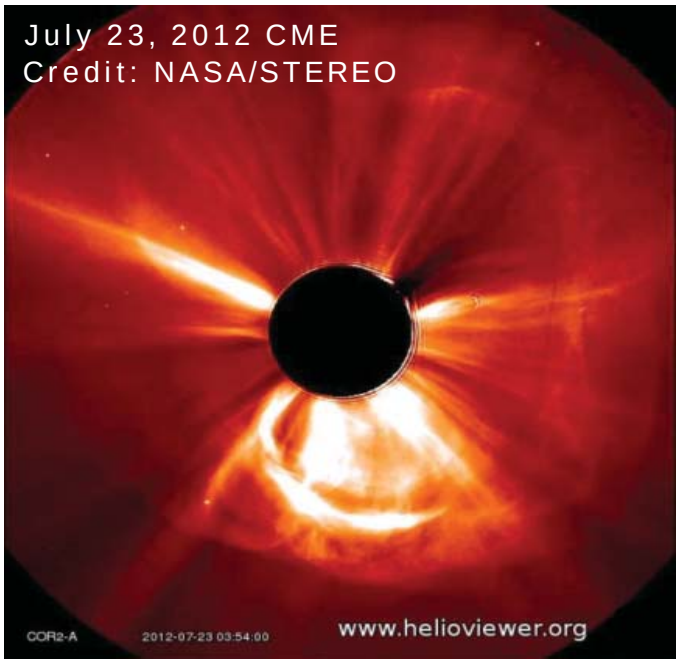
Figure: Solar System Live - John Walker

Planets are at their brightest at Opposition and appear the largest when viewed through a telescope. Due to Mars' highly elliptical orbit, not every Opposition is favorable for Earthlings, given Mars' relatively diminutive size (approximately one-third the diameter of Earth).

On April 8th, Mars will be 57.7 million miles from Earth, closer than it was at the 2012 Opposition when the distance was 62.7 million but far less favorable than the close approach in August of 2003 when only 34.7 million miles separated the two worlds. The next promising Opposition occurs in July 2018 when the distance will shrink to 35.9 million miles. Unfortunately, summer Oppositions occur when the planets are low in the sky, making viewing through Earth's turbulent atmosphere more challenging.

Near Miss

On July 23, 2012, spacecraft monitoring the Sun detected a massive eruption of plasma (a coronal mass ejection, or CME) from a sunspot on the far side. The



CME was noteworthy in that the cloud of material was traveling almost four times faster (between 1,800 and 2,200 miles per second) than a typical CME. Fortunately, the Earth was not in the direct path of the blast.

Researchers have recently concluded that if the eruption had been Earth-directed (happened just nine days earlier), the results would have been catastrophic for our high-tech society.

A similar eruption occurred in 1859 and was witnessed by the British astronomer Richard Carrington (known today as the "Carrington Event"). Carrington had been recording (drawing) sunspots on the morning of September 1, 1859 (as he routinely did on sunny days) when he saw two brilliant flashes emerge from the area. The light faded away within minutes but, unbeknownst to Carrington, a CME was racing towards Earth.

Before dawn on the following day, auroras were visible as far south as Hawaii. The red, green and purple auroras were said to be bright enough to read by. The only reported damage was to the telegraph network, as operators received electrical shocks and telegraph paper and some offices were set on fire. Today, a similar event (such as the one recorded in July 2012) could cripple a world economy so dependent upon satellites, power transmission grids, and telecommunication networks.

Martian Signposts

In late February, scientists at NASA's Johnson Space Center and the Jet Propulsion Laboratory announced that they had found evidence that water

Photograph of Yamato 000593 by the National Institute of Polar Research, Antarctic Meteorite Research Center

had altered the interior of a Martian meteorite. They also found two structures within the rock that have renewed the debate on whether Mars was recently active and whether that activity supported primitive life.

The meteorite, designated Yamato 000593 and classified as a Nakhlite, had been found on the Yamato Glacier in Antarctica by the Japanese Antarctic Research Expedition in 2000. The 30-pound (13.7 kg) rock was crystalized on Mars approximately 1.3 billion years ago (Martian meteorites are identified by the trace gases from the Martian atmosphere trapped within the rock). Twelve million years ago, an impact on Mars blasted the rock into space where it was eventually captured by Earth's gravity. It fell to Earth (Antarctica) about 50,000 years ago.

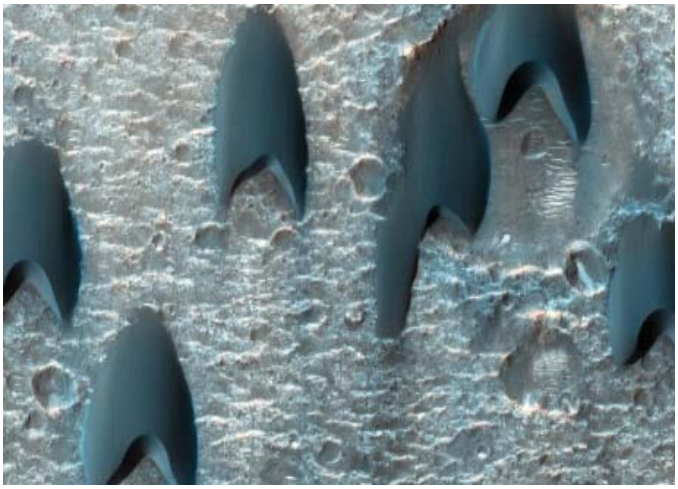
Inside the rock, scientists found microscopic tunnels. The tunnels are similar to those produced by bacteria in basaltic materials on Earth. They also found microscopic spheres embedded in the rock. The spheres were significantly higher in carbon content than the surrounding rock. These features are comparable to what was found within the Nakhla meteorite, recovered shortly after it fell in Egypt in 1911. The similarities in the interior features support the view that the Yamato features are Martian in origin, and not a result of Earthly contaminants. While these features could have been produced by abiotic means (non-living chemical and physical processes), it is also possible that the tunnels and spheres have a biological origin.

The analyses of Martian meteorites provide a tantalizing glimpse into the Red Planet's past. However, the question of life, past and/or present, may only be answered when samples from a variety of Martian terrain and geology can be collected and returned to Earth for detailed analysis.

To Boldly Go

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 possible 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 it course). It meanders almost 400 miles (640 km) before draining into Acidalia



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

Planitia, a large basin on the edge of Mars' northern lowlands.

Lunar Rabbit Update

Despite reports to the contrary, the Chinese rover Yutu (Jade Rabbit) is still functional after spending three lunar nights on the lava plains of Mare Imbrium. Unfortunately, the rover is no longer mobile due to a malfunction in one of its control circuits that has also hindered its hibernation routine (folding the solar panels over the electronics box to insulate it from the cold). Although stationary, the rover is still returning data from its ground penetrating radar on the surrounding regolith. Scientists expect to find that the basaltic lava is up to 150 feet thick at Yutu's location.

Lonely Mountain

The Mars Science Laboratory (Curiosity) recently imaged its ultimate destination – Aeolis Mons (commonly referred to as Mount Sharp). The mound of layered debris rises 3.4 miles (5.5 km) above the floor of Gale Crater. The crater is approximately 90 miles

(150 km) in diameter and was formed between 3.8 and 3.5 billion years ago. Mount Sharp covers approximately one-third of the crater's floor. The wind-blown sediments that form the mountain are thought to have been accumulated over a 2 billion year timeframe. The lowest levels may have been deposited on an ancient lakebed.

Lunar Impacts

On September 11, 2013, a boulder-sized meteoroid hit the Moon's Mare Nubium at an estimated speed of 37,900 mph (61,000 km/h). While the boulder was only several feet across, the high velocity impact created a crater with an estimated diameter of 131 feet (40 m).

The energy from the impact was equivalent to 15 tons of TNT and the flash from the vaporization of the rock would have been visible to observers on Earth that night. The energy released by the September impact was more than three times that of the largest previously observed impact.

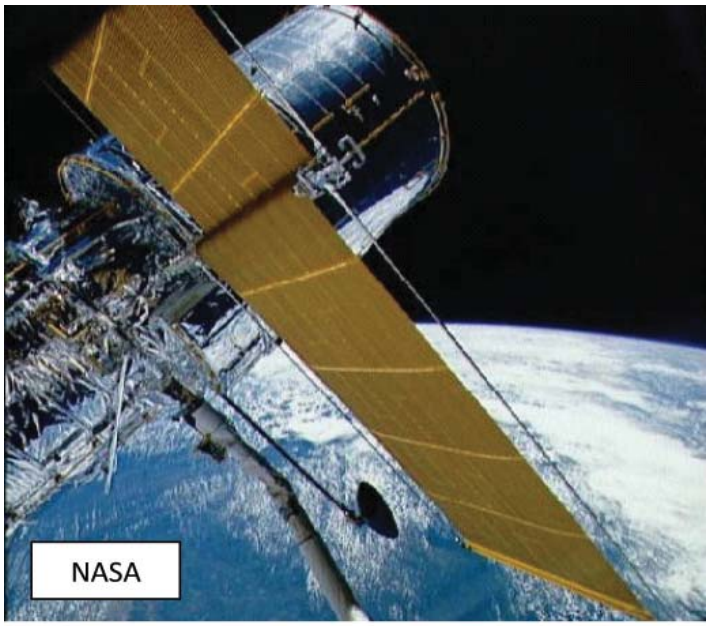
The impact was observed, and recorded, by scientists at an observatory in Spain. The observatory is a participant in the Moon Impacts Detection and Analysis System (MIDAS) that monitors the lunar surface. In a recently released video by Professor Jose Madiedo, who was operating the telescope at the time of the impact, an afterglow at the impact site was visible for almost eight seconds after the initial flash.

NASA's Marshall Space Flight Center is also involved in monitoring the lunar surface to better understand the rate and source of meteoroids, and evaluate their threat to spacecraft and astronauts operating in lunar space (http://www.nasa.gov/centers/marshall/news/lunar/). Since 2005, the program has detected more than 300 impacts.

Twenty-Four 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. However, it is the only space telescope that can be serviced by astronauts. Over the past twenty-four years, the 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 image (below) 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).

Hubble Trivia

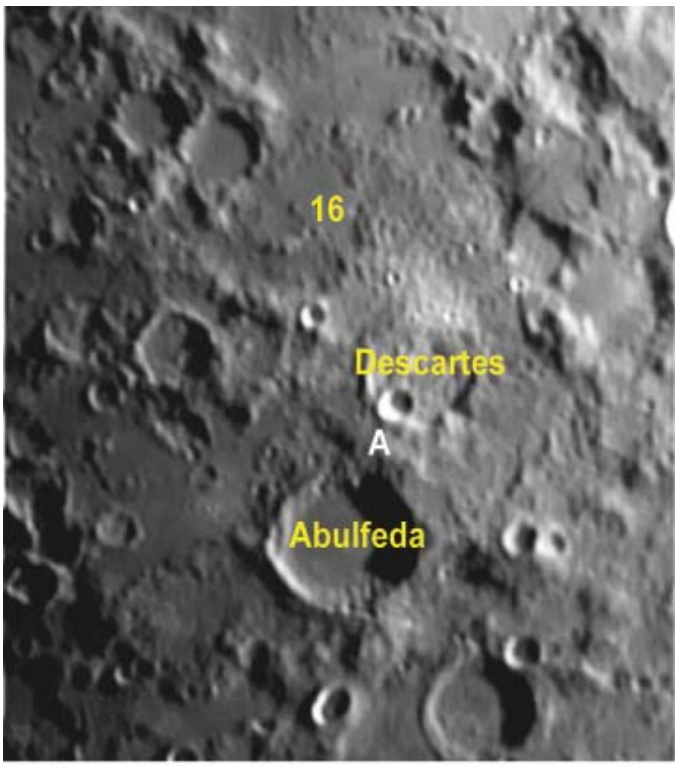
The pilot of the space shuttle Discovery (STS-31) that deployed the Hubble Space Telescope was Charles F. Bolden. In 2009, Mr. Bolden was appointed NASA's twelfth Administrator

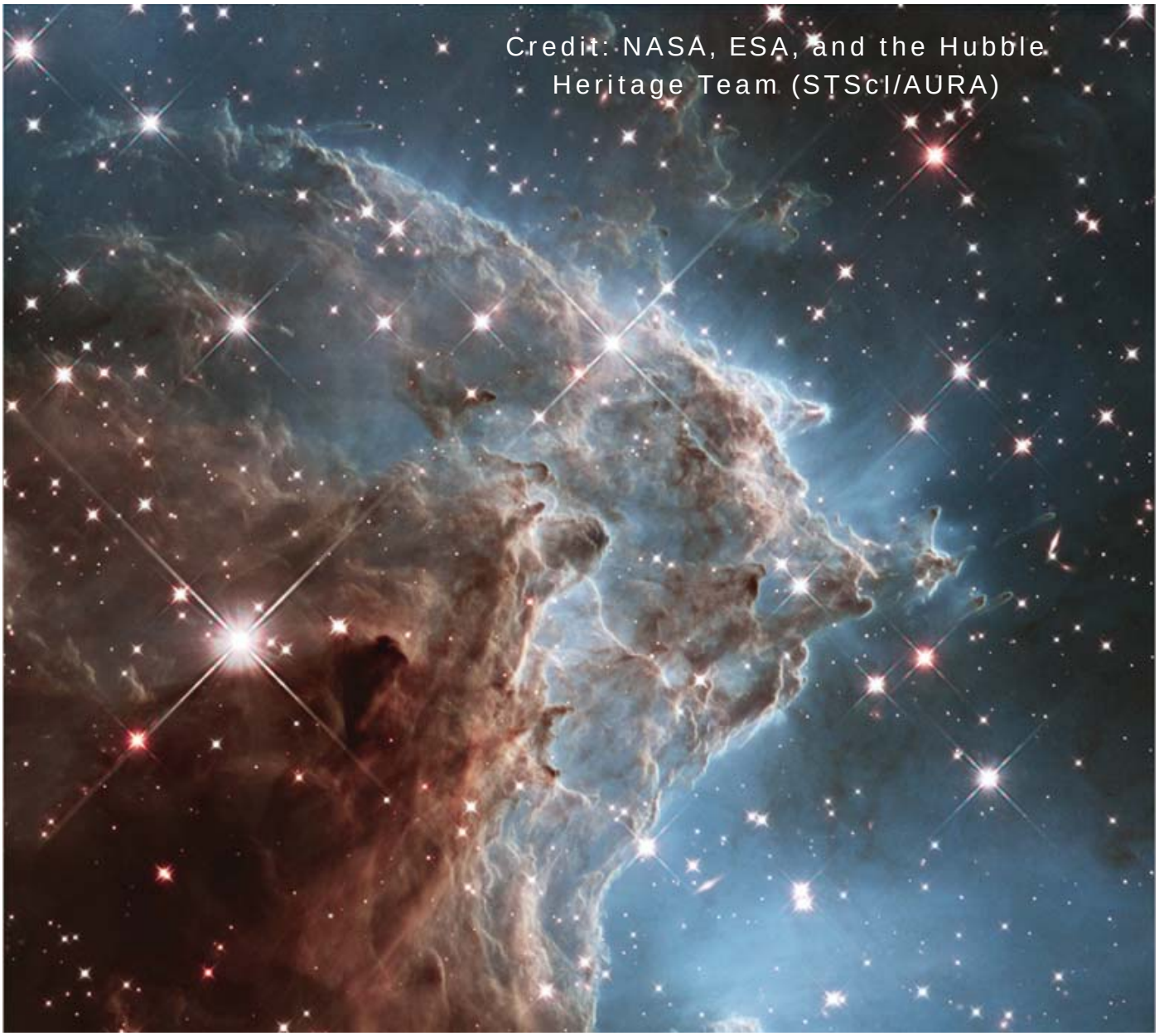
Anniversary Celebratory Photo

In anticipation of its 24th anniversary, the Hubble Space Telescope imaged this star-forming region within the Monkey Head Nebula. The image on the next page was taken by the telescope's Wide Field Planetary Camera 3 and shows the energized cloud of gas and dust through a set of infrared filters. The nebula (NGC-2174) is located near the Orion-Gemini constellation border and is similar in size and shape to the Orion Nebula, although much further away.

Our Mysterious Moon

The Earth's moon does not give up its secrets easily. After six manned missions, several sample return attempts and extensive surveys from orbiting satellites, there is still so much that we don't know about our mysterious neighbor. One of those mysteries involves the formation of the area around the crater *Descartes*. The early Apollo missions targeted the relatively smooth maria (lunar seas). The mare are remnants of spectacular impacts at the time when the Moon's crust was relatively thin and its interior molten. The impacts fractured the crust, allowing the molten magma to flood the impact sites. Although they cover less than 20 percent of the lunar surface, the maria offered more appealing (and safer) landing sites. However, for the Apollo 16 mission, geologists convinced NASA to visit the lunar highlands. Unlike on Earth, the lunar highlands did not form through some geologic process - for example, plate tectonics. The highlands represent the Moon's original crust, pushed upward by the tremendous energy from the impacts that created the maria. Scientists hoped that by ana-





lyzing samples of the original crust, answers might be found to many of the questions related to the Moon's origin and formation.

Descartes is a broken and battered crater. Its wall is breached to the north and topped by a small crater to the south. Spilling out of the crater is some rather unusual furrowed material, unlike any found elsewhere on the Moon. Scientists originally theorized that the material was from lunar volcanoes that had piled up around the vents rather than flowing away. To test their hypothesis, a landing site for Apollo 16 was selected just north of *Descartes* where a smooth plain met the furrowed or hilly material. The site was 7,400 feet higher than the Apollo 11 site just to the north. Unfortunately, the crew of Apollo 16 (John Young and Charles Duke) never got as far as *Descartes* in their travels, and all the samples brought back were of the lunar crust, not dark lavas which would be produced from volcanic activity. So, the mystery of the *Descartes* formation remains.

The best time to view the *Descartes* region is when it is near the terminator (the line that separates the sunlit portion of the Moon from the darkened portion). Sunrise occurs a day or two before First Quarter. Try looking for this area on the evening of April 6th. Sunset occurs a few days prior to Last Quarter, around the morning of April 19th. The *Descartes* region can best be found by starting at the three large craters (*Theophilus*, *Cyrillus* and *Catharina*) located on the western shore of the *Sea of Nectar*. West of *Cyrillus* is the crater *Abulfeda*. Look for a string of craterlets trailing from its southern rim. *Descartes* is

located just to the north of *Abulfeda*. The furrowed material breaches the north wall of the crater and *Descartes A* is the small crater on the southern rim.

The Apollo 16 landing site is near a bright spot on the edge of the smooth *Cayley Plains*, just to the north of *Descartes* and west of the *Sea of Nectar*. For scale, the craters *Abulfeda* and *Descartes A* are approximately 39 miles and 9 miles in diameter, respectively.

Swirls are bright features that resemble splashes on the dark lunar surface. They are typically associated with strong magnetic anomalies. *Reiner Gamma*, located near the western shore of the *Ocean of Storms*, is the most familiar swirl on the Moon. However, in a low pass over the *Descartes Mountains* in 1999, the Lunar Prospector spacecraft detected the strongest magnetic anomaly yet on the rim of the *Descartes* crater. The discovery raises even more questions on how these anomalies form (e.g., are they surface phenomena or do they extend deep into the lunar crust; did the rocks become magnetized by an impact or from a volcanic eruption; and why is the anomaly so localized). Hopefully, future missions to the Moon will provide some clues to the formation of these unusual features and whether these areas that divert the solar wind could someday be useful (e.g., as a refuge for colonists during a solar storm).

Life without the Moon

You might wonder why you should direct your gaze upon this desolate world when so many other celestial treasures await in the night sky. The Moon is more extraordinary than you might first think. No other planet (except for the dwarf planet Pluto) has a larger moon (compared to the size of the planet around which it revolves). Many believe that life on Earth would have been much different without the Moon.

The tidal forces of the Moon act as a brake to slow down the Earth's rotation. Without the Moon, the Earth would spin much faster. The faster rotation could lead to higher winds and stronger storms, similar to conditions on Jupiter. Gale force winds would have altered how life would eventually evolve. It might have created conditions under which some life forms could not have existed.

The Moon also stabilizes the Earth's axis of rotation. A stable axis is necessary for long-term climates to develop and ecologies to take hold. Most important, the Moon has shielded the Earth from swarms of cosmic debris. The battered lunar surface provides a visual record of the vast number of objects that could have impacted the Earth had the Moon not been present.

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 after four days of extreme cold. While Houston lost contact with the spacecraft for a minute longer than expected, 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 Last Quarter moon doesn't interfere. As with all meteor showers, the Lyrids are named for the constellation (Lyra) from which they appear to radiate.

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 (2014), the vernal equinox occurred on the afternoon of March 20th. The next Full Moon occurs on April 15th. Easter, therefore, falls on the following Sunday (20th).

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	7:51 pm

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.

Astronomical and Historical Events

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)
3rd History: Soviet spacecraft Luna 10 becomes the first artificial satellite to orbit the Moon (1966)
4th History: launch of Apollo 6, last test flight of the Saturn V rocket (1968)
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 First Quarter Moon
7th Flyby of Saturn's largest moon *Titan* by the Cassini spacecraft
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 Moon at apogee (furthest distance from Earth)
8th Mars at Opposition (rising with the setting Sun and visible all night)
8th History: discovery of Saturn moon's *Telesto* by the Voyager 1 spacecraft (1980)
8th History: launch of the unmanned Gemini 1 (1964)

Astronomical and Historical Events (continued)

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)
9th Scheduled launch of a Russian cargo carrying Progress spacecraft from the Baikonur Cosmodrome, Kazakhstan to the International Space Station.
10th Kuiper Belt Object and Dwarf Planet 136108 *Haumea* at Opposition (49.895 AU)
10th Asteroid 4179 Toutatis closest approach to Earth (2.848 AU); Toutatis is a potentially hazardous asteroid with a chaotic, four-year orbit that takes the 2.8 mile long asteroid just inside the Earth's orbit and back out beyond Mars to the main asteroid belt
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 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 **Second Saturday Stars - Open House at McCarthy Observatory**
12th Northeast Astronomy Forum and Telescope Show (NEAF), Rockland Community College, Suffern, NY (12th and 13th)
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 Asteroid *4 Vesta* at Opposition (5.8 Magnitude), a few degrees southwest and brighter than Asteroid *1 Ceres* in the constellation Virgo
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)
15th Full Moon (Full Pink Moon)
15th Total Lunar Eclipse (totality begins at 3:07 am EDT and lasts 78 minutes)
15th Asteroid *1 Ceres* at Opposition (7.0 Magnitude), in the constellation Virgo
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)
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)
20th Easter Sunday
22nd Last Quarter Moon
22nd Moon at perigee (closest distance from Earth)
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 Trans-Neptunian Object 2010 EK139 at Opposition (36.848 AU)
24th History: launch of space shuttle Discovery (STS-31) and deployment of the Hubble Space Telescope (1990)

Astronomical and Historical Events (continued)

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 History: Bovedy Meteorite Fall, hit store in Ireland (1969)
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 History: launch of the Cloudsat/Calipso cloud imaging and profiling satellites (2006)
29th New Moon

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
For more information on Stephan's Quintet, go to http://hubblesite.org/newscenter/archive/releases/2001/22/text/.

Page 3: Photo shows the eclipsed Moon during totality on October 27, 2004. It was the only time a lunar eclipse occurred during a World Series game. The image was taken from the McCarthy Observatory at 11:26 pm. shortly before the Moon would begin to move out from the Earth's shadow and less than 15 minutes before the final out of Game 4 in which the Red Sox defeated the St. Louis Cardinals, winning the World Series for the first time in 86 years.

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 12th
8:00 - 10:00 pm

Kid's Night

Sketching Jupiter and It's Moons

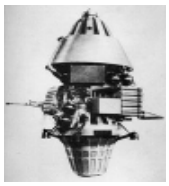
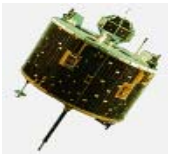
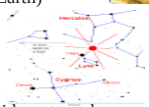
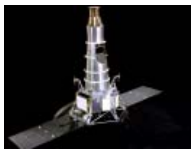
Refreshments
Family Entertainment
Activity Center
Stars & Planets
Rain or shine

Map

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

April 2014

Celestial Calendar

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
		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)	**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 communications satellite (1965)	**7**  Launch of Luna 14, Soviet Moon orbiter mission (1968)	**8**  Moon at apogee (farthest from earth) 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)	**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) 2nd Saturday Stars Open House McCarthy Observatory 
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**  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** Moon at perigee (closest distance to Earth)   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** Launch of the Air Force's X-37B prototype space plane from Cape Canaveral, Florida; 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)			

Phases of the Moon

Apr 7 Apr 15

Apr 22 Apr 29